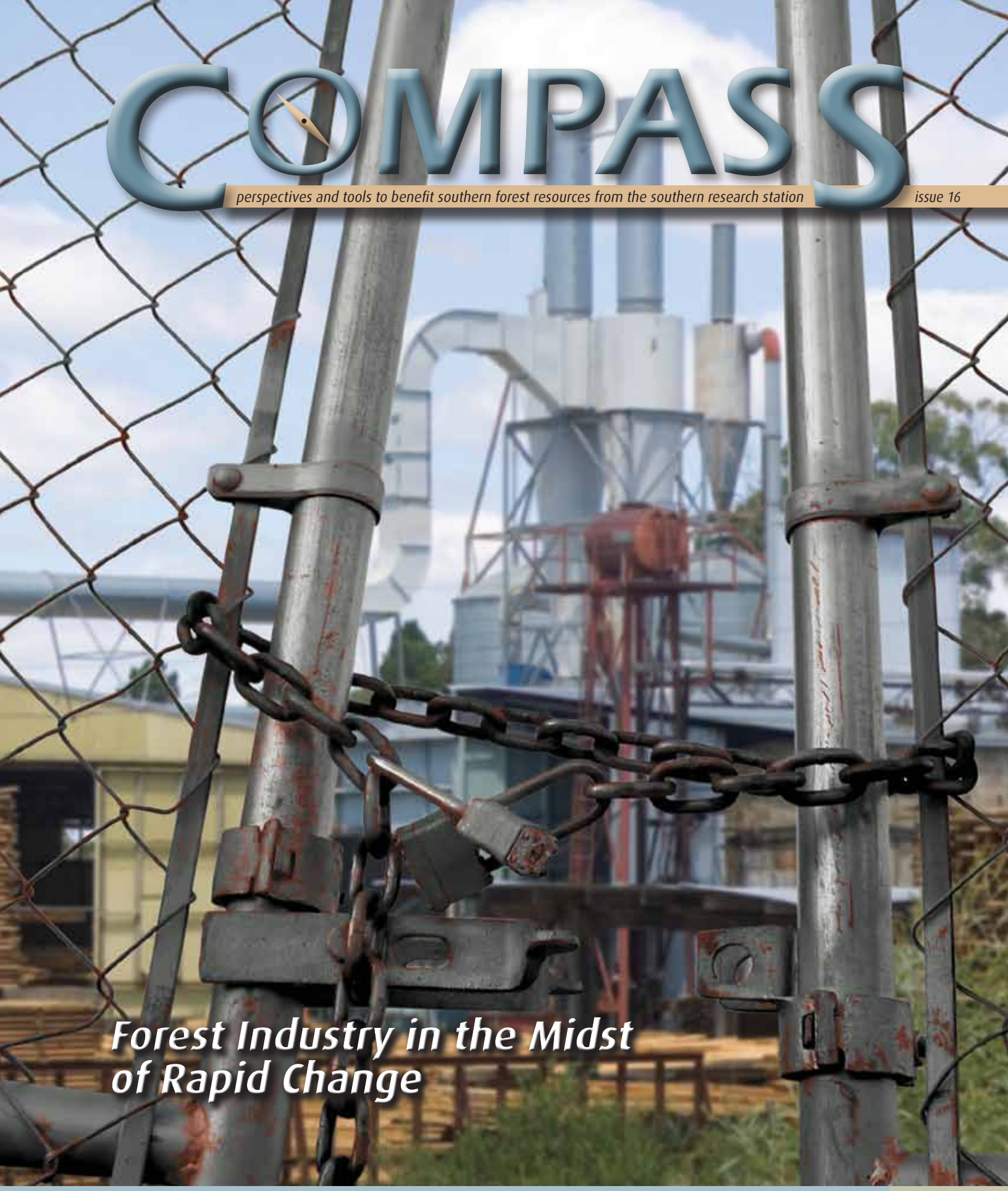
COMPASS

perspectives and tools to benefit southern forest resources from the southern research station

issue 16



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COMPASS

Science You Can Use!

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perspectives and tools to benefit southern forest resources

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Cove hardwood forest in North Carolina. (photo by Bill Lea)

An Industry Always in Transition

by Carol Whitlock

America has always had a love-hate relationship with its forest industries. We prefer wood over other materials for building and furnishing our homes. We ask for paper instead of plastic at the grocery store, and we respond to sentiments like "hearth and home" even though only a few of us can claim proficiency at splitting logs or building fires.

Although we value the benefits from our forests, we often react with aversion to the remains of a clearcut, the pungent odor from an upwind paper mill, or the use of pesticides, whether to combat nonnative infestations and invasions or to improve stands by eliminating undesirable competitors.

The Early Days

The relationship between the American public and forest industry got a rocky start in the 1890s, when timber barons responded to the needs of a growing Nation by cutting down much of its virgin forests. They provided the timber to build America's new towns and cities, and to power its railways deep into the West. But they left behind cutover landscapes, eroded soils, and sediment-filled streams. Unsustainable farming added to the problem; the Nation's streams and lakes were so polluted that drinking water supplies got compromised.

"The South's forest industry certainly looks a lot different than it did 50 to 60 years ago, and will continue to change and evolve over the coming decades. The social and environmental impacts of these changes could be profound." -Tony Johnson

When the Forest Service was established in 1905, with forester **Gifford Pinchot** as its first chief, one of its first mandates was to restore the protection that forested watersheds provide for water. A few years later, the Forest Service started setting up a network of experimental ranges and forests across the Nation to research the best practices for managing forests sustainably. One of the first of these was the **Bent Creek Experimental Forest** located in Asheville, NC, near the Biltmore Estate, where, in the late 1800s, **Carl Schenck** and others started the first forestry school in the United States based on scientific management practices.

Loading hardwood logs in Arkansas in the 1940s. (photo courtesy of the U.S. Forest Service)

Thanks to educational pioneers like Schenck and Pinchot, later generations of U.S. forest industry were run by forestry professionals, men who shared classrooms with future State Foresters, Forest Service rangers, academics, and researchers. These early forest managers were apt to switch from public to private employment several times during their careers. They shared a love of the outdoors; a determination to restore and sustainably manage forested landscapes; and a common language—some would say jargon—that bred both a culture of cooperation and an insularity that sometimes alienated those who were unversed in terms like d.b.h., BMPs, and even-aged management.

Wood Basket for the World

Today the South produces more timber than any other single country in the world, and is projected to remain the dominant producing region for many decades to come. In the early 1900s, southern pine forests, mostly

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It was during the 1990s that the South became the "wood basket of the world," producing more timber than any single country in the world. (photo by U.S. Forest Service)

In Transition

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loblolly pine, were established across the South with significant help from SRS research on seeds, seedlings, and management. The market for southern pine products boomed, with the South's role in production growing steadily since the 1960s.

But becoming the world's wood basket has not come without controversy.

By the end of the 20th century, the share of timber harvests from industrial public lands in the Rocky Mountain and Pacific states had dropped to less than 1 percent. As the wood business steadily increased in the South, some of the environmental struggles to save Pacific Northwest forests and emblematic species such as the spotted owl shifted south.

As environmental groups focused on the South, the federally listed red-cockaded woodpecker of the southern flatwoods started to replace the spotted owl as the flashpoint for a new round of debates over timber harvesting. Paper mill demand for pulpwood gave rise to portable chipmills in places where there had been none, causing concerns for environmental quality. Also of concern was an increase in conversions to single-species plantations from the patchwork of natural stands and farmland that had come to characterize the South.

Amid these controversies, 1997 was somewhat of a landmark year for forest industry in the South. The economy was booming, creating demands for construction materials and paper, especially in the South where population growth outstripped that of every other part of the country. Saw-log production continued to gradually increase. Pulpwood production, which had been rising sharply for several decades, peaked at an all-time high of 201 million green tons. The long-held fear of looming timber shortages was put to rest by evidence that decades of growing inventories would continue into the future. Forest industry companies began a decade of mergers and acquisitions.

It was during this period that the South began to produce more timber than any other region of the United States—and any single country in the world—and became widely known as the "wood basket of the world."

Caught in the Crunch

The reversals came quickly and with little warning. The effects of growing populations meant more development and higher property taxes for an industry that had invested in vast holdings of timberland. That and the need to service debt from recent mergers and acquisitions left companies ill prepared for the recessions that continue to plague the new century. And demand for paper declined, partly because of the recession, but also in response to recycling and the boom in digital information formats.

Faced with these and other regulatory challenges, southern companies stopped building new mills. Their vast timberlands, once viewed as a hedge against timber shortages that had not materialized, now became capital investments they could no longer afford to maintain.

Industry began pulling back, unloading vast tracts of forest land in the South or converting ownership into timberland investment management organizations (TIMOs), which hold land for investors in anticipation of selling it in smaller parcels and at higher prices; and real estate investment trusts (REITs), which enjoy a favorable tax treatment as long as 90 percent of earnings are passed along to shareholders.

Over the past decade, many acres of forest land were sold to TIMOs; many others were sold or converted to REITs. And some companies took the steps necessary to become REITs, essentially moving from a focus on product manufacturing to one of maximizing shareholder returns by finding the highest prices for the land and its resources.

Near Future Forecasts

SRS tracks forest industry trends through its **Forest Inventory and Analysis** (FIA) unit in Knoxville, TN, and its **Forest Economics Research** unit in Research Triangle Park, NC. Researchers from both units report that the days of vertically integrated forest products companies—traditional industries that control or own both

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Just What Are *TIMOs and REITs?*

In recent years, the forest products sector started feeling the pressure to show more profits at what might seem just the wrong time. The price of raw materials was rising, often inefficient industry operations became even more capital intensive, and capital tied up in timberland was relatively inaccessible.

As a way to keep raw materials accessible while freeing capital assets, large forest products companies have transferred millions of acres of forest land, either by selling or by restructuring, to legally separate the ownership and control of their timber holdings from that of their manufacturing facilities.

If companies sell, it's often to **timberland investment management organizations (TIMOs)** that buy, manage, and sell forest land on behalf of various institutional investors such as insurance companies, pension funds, endowments, and foundations. It should be noted that TIMOs do not own land; they buy land, manage it and sell it for their clients. They have teams experienced in both forest management and portfolio management. For this advice and service, they charge a fee.

If companies restructure, it's usually into **real estate investment trusts (REITs)**—entities that buy, manage, and sell real estate or real estate related assets such as mortgages on behalf of various private investors. REITs do own the timberland. The primary business of REITs is to manage groups of properties that produce income; they are required to distribute most of their profits as dividends. The performance of REITS is affected by the same trends that affect the real estate market in general, including population and job growth trends, changes in interest rates, and market conditions.

Total assets managed by TIMOs and REITs have risen steadily over the last 20 years. TIMOs manage an estimated 25 million acres of U.S. forest land worth more than $30 billion. REITs own about 17 million acres worth about $28 billion. Studies in the South have shown that TIMOs tend to manage their lands like forest industry, with a focus on planted pine and management for high yield.

Recommended reading:

Fernholz, K.; Bowyer, J.; Howe, J. 2007. **TIMOs and REITs: what, why and how they might impact sustainable forestry.** Minneapolis: Dovetail Partners, Inc. 13 p.

Hickman, Cliff. 2007. **TIMOs and REITs. The timberland blog.** http://thetimberlandblog.blogspot.com/2007/05/timos-and-reits.html. [Accessed July 7, 2010].

In Transition

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their upstream suppliers and their downstream buyers—are fading.

Tony Johnson, SRS FIA resource-use analyst in Knoxville, says that the changes in the South's forest industry are more profound and far reaching than they have been since the 1950s. Thousands of mom-and-pop sawmills have been displaced by larger mills with greater capacity that can pay more for raw materials and labor.

"The South's forest industry certainly looks a lot different than it did 50 to 60 years ago, and will continue to change and evolve over the coming decades," he says. "Primary producers like pulpmills and sawmills are closing regularly in the South, while new state-of-the-art mills are coming online in countries like China and Brazil."

Products that were once considered secondary products—like shavings, mulch, and pellets—are now considered primary products," he continues. "At the same time, the role of independent loggers is becoming more important and their equipment is becoming more sophisticated and expensive, enabling them to increase the amount of fiber from logging operations. This increases their profits while allowing them to leave a site that is more aesthetically pleasing and easier to replant."

The social and environmental impacts of a changing forest products industry could be profound. In the South, forest industry has owned some of the largest contiguous blocks of forest land for many years. These tracts, which provided conservation anchors and recreational venues, are increasingly falling into the hands of multiple owners. Fragmentation and road building by new landowners affect sensitive wildlife. At the same time, fighting fire, once the purview of the large holders of industrial timberland, now falls to state and local governments, putting new burdens on already strapped budgets.

And every mill closure—like the two pulpmills and the many sawmills that shut their doors in 2009—eliminates more of the best paying jobs in the rural South. Some of these jobs are being replaced by European companies, which are building industrial grade pellet plants in the South to support a European Union commitment to substituting 20 percent of its greenhouse-gas producing energy sources with renewable sources by 2020.

Johnson says that old definitions of growing and nongrowing stock and even the commonly accepted standards for merchantability are losing relevance. "Today, the terms that define our southern forest industry are solid wood products and fiber. And . . . oh yeah, energy."

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or tjohnson09@fs.fed.us

Recommended reading:

Wear, D.N.; Greis, J.G. 2002. **Southern forest resource assessment.** Gen. Tech. Rep. SRS–53. Asheville, NC: U.S. Department of Agriculture Forest Service, Southern Research Station. 635 p.

Carol Whitlock is a freelance writer and publisher based in Asheville, NC.

Equipment for logging has become more sophisticated as interest in energy from wood fiber grows. (photo by Trice Megginson)

Is Wood-Based Energy the Key to the Future?

by Carol Whitlock

Data from the U.S. Department of Energy show that when it comes to sources for renewable energy, the South lacks the solar, wind, or geothermal resources that other regions enjoy. What it does have is plenty of wood-based fuels due to its warm climates, long growing seasons, and the predicted stability of its forest inventories. With the added benefit of coal-fired power plants that could easily be converted for cofiring wood fiber, one might think that the biofuels business would be booming in the South.

But beyond pellet production for European markets and the long-standing practice of mills producing their own power from byproducts of the pulping process, not much progress has taken place. Several municipalities have committed to alternate energy projects, but few of these commitments have become realities due to a tight credit market, wildly fluctuating transportation costs, technical issues with the chemistry of wood, and uncertainties about the ultimate sustainability of such projects.

David Wear, research forest economist and project leader of the **SRS Forest Economics and Policy** unit based in Research Triangle Park, NC, leads a multiagency analysis of forest futures that is scheduled for completion this year. His findings suggest that the government—not financial markets—will most likely provide the stimulus needed to awaken the South's potential as a provider of renewable energy.

One such government stimulus, the Biomass Crop Assistance Program (BCAP) is a Federal effort led by USDA to increase the use of renewable energy by offering 2-year subsidies for collecting, harvesting, storing, and transporting woody biomass and agricultural residues. BCAP sets strict requirements both for eligible materials and for the biomass conversion facilities (such as power plants) that receive and process the materials.

Wear predicts that government interventions on behalf of renewable energy, if successful, would likely result in more competition and higher prices for feedstocks. In such an environment, it would be difficult to see a way forward for companies with diminishing timber and land assets that depend on aging and increasingly inefficient pulpmills.

The picture becomes brighter for other segments of forest industry. Small innovative companies should continue to benefit from government programs and subsidies that promote renewable energy. For large companies, options to restructure into tax advantageous real estate investment trusts (REITs) or S corporations have provided the flexibility that will be sorely needed to thrive in a rapidly changing marketplace. For REITs especially, this flexibility provides a diversification of product lines—from parcels of land to pulpwood, saw logs, or biofuels—that maximizes income from currently high-performing products while allowing management to withhold others in anticipation of future price increases.

And Wear cautions against predictions of gloom-and-doom for traditional forest industry in the South. "One of the scenarios that could play out internationally would be a substantial diversion of wood fiber into bioenergy," he says. "If that happens, the South's paper industry might experience a resurgence."

Carol Whitlock is a freelance writer and publisher based in Asheville, NC.

The Southern Forest Futures Project

How will the profound changes taking place in forest industry affect southern landscapes? This question and others are being addressed in the **Southern Forest Futures Project**, a comprehensive analysis of forest responses to various social, biological, and physical scenarios that **David Wear**, project leader of the **SRS Forest Economics and Policy** unit, leads with **John Greis**, a resource specialist at the Forest Service regional office in Atlanta.

A major goal of the forest futures project is to develop practical tools for making and implementing sound decisions and adjusting protocols in response to new threats and opportunities. Wear says that input by the broadest spectrum of natural resource users, managers, and advocacy groups has been a key ingredient to the project; and that the results will shape how the Southern Research Station prepares to serve the new set of customers.

Southern Forest Futures Project: www.srs.fs.usda.gov/futures/

Putting Land Ownership Changes in Perspective:

An interview with David Tenny

by Zoë Hoyle

In May 2008, **David Tenny** was named president and chief executive officer of the newly formed **National Alliance of Forest Owners** (NAFO), whose mission is to protect and enhance the economic and environmental values of privately owned forests through targeted advocacy at the national level. Together NAFO members represent 75 million acres of private U.S. forest land; 45 million acres are managed by member companies, and the balance represented by member associations made up of individuals owning a few hundred to thousands of acres.

Before assuming leadership of NAFO, Tenny was vice president of forestry and wood products for the **American Forest and Paper Association**. Before that he served as **USDA Deputy Under Secretary for Natural Resources and Environment** and on staff for the **Committee on Agriculture in the U.S. House of Representatives**, where he served as counsel and policy advisor on natural resources and related issues.

I recently asked Tenny to share his perspectives on how shifts in land ownership have affected southern forests.

ZH: What's happening with land ownership in the South?

DT: There's a big difference between land ownership today and a decade ago, but the core business of all ownerships is forestry, and all owners are subject to the same economic pressures and potentials.

"There's a big difference between land ownership today and a decade ago, but the core business of all ownerships is forestry, and all owners are subject to the same economic pressures and potentials."

Forest land is a resource base which has a variety of potential uses, from traditional timber to emerging markets for bioenergy and carbon. This diversity of uses will probably be good for keeping forests on southern lands regardless of ownership.

TIMOs include a greater diversity of owners—private, institutional, endowments, even retirement funds. The common thread among these owners is their recognition of forestry as a long-term, solid investment, one that has always performed well in relation to others, and stabilizes portfolios. Investors like the idea of forest resource investment as providing a sustainable return for the long term.

ZH: How have changes in land ownership affected southern forests at the landscape level?

DT: Ownership type—private nonindustrial, industrial, TIMO, or REIT—doesn't have as much impact on landscape-level issues such as fragmentation as economics does. It doesn't matter who owns forest land when they're competing with development and other such interests. Because of the way they're structured, TIMOs and REITs have the benefit of being able to look at the longer term and at a larger range of income possibilities. Individual landowners sometimes have a much shorter time horizon for making decisions. For instance, they may have to consider selling their land because of a catastrophic illness, the inability to pay taxes, or other situations.

There are lots of different voices involved in the conversation about what should happen to forest landscapes over time. Some of the most important voices belong to the people who are managing the land. The general public is aware that it's important to maintain the continuity of our forests at the landscape level, but many people are not aware that the forests they see across the South are a result of the management actions of different types of owners over time. Most people do not understand how the market and forestry work together and that much of the forest they see in the South resulted from that interaction.

ZH: What are the major land management concerns of NAFO members?

DT: If you look at what's on the immediate horizon, the housing market looms as the most prominent trajectory we're watching. Forestry and housing have always been connected. The housing market has been tough for a while, but it will

David Tenny, chief executive of the National Alliance of Forest Owners (NAFO) (photo courtesy of NAFO)

come back, probably with some major changes. Other markets such as pulp and paper are also changing and may even bottom out over time. One major market is not doing well, while another is declining.

Landowners are looking at ways to hedge their bets and diversify their income streams from forest land. That's where bioenergy and environmental markets come into play. In the South, access to high-quality water will be an important part of environmental markets, which also include energy, carbon, habitat, and aesthetics. Recreation will be very important; owners are looking at how to allow multiple-use access that's responsible, sustainable, and informed.

ZH: What are the effects of ownership changes on forest-related research?

DT: Some research capabilities have been lost as industry has evolved. Ten years ago, industry research focused on production; today's focus is on potential markets. Most of the new ownerships have smaller staffs than traditional industry and no in-house research staff, so research partnerships among landowners, the Forest Service, universities, and private entities are more important than ever before. The old model for research has become unsettled; we need to build a new model based on what we all need to do to keep forests on the land. There's a great need to understand how forest business responds to economic pressures, and how ecosystem and carbon markets will play out over time. We also need to look at how energy markets will work out over time and how landowners will respond to increases in demand for renewable energy.

There are three main areas that research must focus on. First, we need more data on the relationship between forest management and carbon, how different uses of forest land affect the carbon cycle. The second area is adaptation: how will climate change affect our forests and how can we adapt to keep them healthy? Third, we need to keep refining the basics of good forestry. What tools can we use to provide the best array of economic benefits to forest landowners while balancing public benefits?

In all of this, discussions with the landowner community are vital to providing robust outcomes. NAFO is a good plug-in point to start these discussions, an easy way to contact and connect with a broad group of landowners.

For more information:

NAFO: www.nafoalliance.org

Research and the Bottom Line

Industry shifts and long-term research

by Bridget O'Hara

Findings from long-term research by the SRS, universities, and forest industry provide the foundation for much of what we know so far about southern forests. With the majority of forest land in the South privately owned, forest industry companies have traditionally been strong forest research partners with SRS and state university cooperators.

In recent years, private industrial landowners such as **International Paper** and **MeadWestvaco** have sold vast acres of southern forest land. Once sold by forest industry, these lands can pass through many other hands. Some are broken up for development; many are now owned by the relatively new timberland investment management organizations (TIMOs) and real estate investment trusts (REITs), whose objectives are primarily financial.

As land ownership changes, the future of research studies established with industry partners or on industry land comes into question, and the continuity of data from long-term studies sometimes threatened.

Tree improvement programs provided the seedlings for restoring longleaf pine forests across the South. (photo courtesy of U.S. Forest Service)

Why Improve on Trees?

Without decades of cooperation between state agencies, industry, and SRS research, the tree improvement programs and coop nurseries that supply seeds and seedlings for planting and restoring forests on public and private lands throughout the Southeastern United States would never have come into being.

Tree improvement programs were started to produce trees that mature faster and provide better quality wood than the seedlings that sprout naturally after logging. Tree improvement programs founded in the 1960s now include a range of members. The **Western Gulf Tree Improvement Program**, for example, includes 13 full-member organizations that are responsible for breeding and testing seedlings. Five of the full members are states—Arkansas, Louisiana, Mississippi, Oklahoma, and Texas—and five are TIMOs and REITs. Collectively they're responsible for planting over 300 million seedlings a year in the western gulf region.

Seeds and seedlings from tree improvement programs are vital to reestablishing key species such as longleaf pine. Longleaf pine forests now occupy only 3 percent of the 92 million acres they once dominated. There is growing interest in not only restoring the tree, but the unique ecosystem it supports. Since the 1940s, SRS research has played a pivotal role in not only developing the guidelines for the natural regeneration of this important

The Flomaton Natural Area in Alabama included one of the last remaining virgin stands of longleaf pine (left), until it was sold and clearcut in 2008 (middle). (photos by John Kush)

species, but in perfecting methods for growing successful seedlings.

The Flomaton: A Cautionary Tale

Sometimes changes in land ownership result in minor setbacks while researchers establish relationships with the new owners. However, this was not the case with the **Flomaton Natural Area** (Flomaton) in southern Alabama, which up until 2008 included one of the last remaining virgin (unlogged) stands of longleaf pine.

The 60-acre tract was originally set aside in the early 1900s by the **Alger-Sullivan Lumber Company**, and was kept through multiple ownerships in recognition of its significance. In 1963, the Society of American Foresters designated the Flomaton as the E.A. Hauss Old Growth Natural Area. **Champion International** bought the site in the 1950s; from that time until the 1990s, the stands were not burned. In 1993, a nearly catastrophic fire prompted Champion to enter into an agreement with **Auburn University, The Nature Conservancy**, and SRS for research, restoration, and management on the tract. A program of controlled burning and understory thinning began in the mid-1990s.

"This type of agreement allows research to be established on private lands relatively quickly, but the down side is that there is no guarantee that it will last forever," says Auburn University researcher **John Kush**, who, with other researchers, spent 15 years at the Flomaton documenting the effects of prescribed fire on longleaf pine stands.

Although the intent of the original Flomaton Natural Area agreement was to allow continued research and collaboration, the forest fell through the cracks as ownership changed. In the late 1990s, International Paper bought out Champion, keeping the stand in a special program and working with Kush and others to keep the prescribed burning program going. During 2006 and 2007, International Paper itself was sold to multiple entities. Though the new owner of the Flomaton tried to find an agency or nonprofit to buy the stand, no one came forward. In January 2008, the stand was commercially clearcut and all the stumps removed, the site cleared for future development.

"This should never have happened to the Flomaton," says Kush. "We in the longleaf community lost an asset and a resource. The work we did at Flomaton provided some of the first published information about reintroducing fire to fire-excluded old-growth longleaf pine stands."

Adaptation by Education

No matter who owns the land, it's important that researchers take the time to foster relationships with landowners. **Callie Schweitzer**, research forester with the **SRS Upland Hardwood Ecology and Management** unit, currently has studies on national forest, industry, state, private, and Federal lands. In the Cumberland Plateau area where Schweitzer works, rapid changes in land ownership are the rule rather than the exception, and collaboration is essential. The ownership of two Jackson County, AL, sites where

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The Bottom Line

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Schweitzer conducts experiments changed hands five times in 2 years.

To maintain access to her research plots, Schweitzer, who is based in Huntsville, AL, developed a strong partnership with forest industry.

"My oldest study was originally designed to help **Mead Corporation** with management questions, and in support of certification under Sustainable Forestry Initiative guidelines," says Schweitzer. "Mead was a tremendous supporter and partner."

Since the study started, Mead has gone through several iterations of ownership—from Mead to **MeadWestvaco**, to **Smurfit Stone**, to **Coastal Lumber**, which is managed by **Stevenson Land Company**. Part of the original study is now on Stevenson Land Company property; the other part is now managed by the state of Alabama.

"Over the course of these changes, I spent considerable time soliciting continued support from each new owner by convincing them that the research was relevant to them," says Schweitzer, whose concern for her study plots has transformed into a proactive strategy for educating new landowners. Over the last decade, she's built partnerships with industry that last across shifts in ownership. For example, **Greg Janzen**, now with Stevenson Land Company and formerly with MeadWestvaco, has helped facilitate field tours so Schweitzer can educate representatives from the new owners about why research matters.

Schweitzer provides tours on the northern Alabama sites where she studies oak regeneration and the effects of different silviculture treatments on wildlife habitat. On state land in Jackson County, AL, she's created a set of roadside demonstrations of different levels of silviculture treatments. When landowners drive by the site, they can readily see the difference between the treatments, and understand that there are as many science-based alternatives to managing forest land as there are reasons to own it.

"There are a variety of options for managing the hardwood forests on these lands," says Schweitzer. "We're trying to show them that they can use timber management to get additional desired effects such as forest health, wildlife habitat, even aesthetics. Sometimes it's just a good chance for a new owner to find out about their land, form a connection."

SRS research forester Callie Schweitzer developed strong partnerships with industry that last across land ownership changes. (photo by Rodney Kindlund)

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or kushjoh@auburn.edu

Recommended reading:

Hoyle, Zoë. 2007. **The forest for the trees: connecting silviculture and wildlife.** Compass. Asheville, NC: U.S. Department of Agriculture Forest Service, Southern Research Station; (9): 12–16.

Kush, J.S.; Meldahl, R.S.; Avery, C. 2004. **A regeneration success: longleaf pine seedlings established in a fire suppressed old-growth stand.** Ecological Restoration. 22: 6–10.

Kush, John. 2009. **Obituary for Flomaton: one less virgin longleaf stand (Alabama). Ecological Restoration.** 27(3): 247–8.

LeQuire, Elise. 2009. **Restoring fire to the longleaf pine forest.** Fire Science Brief. 30: 1–6.

Bridget O'Hara is a science communications specialist at the University of North Carolina's National Environmental Modeling and Analysis Center.

The Good News

by Zoë Hoyle

Research doesn't have to be adversely affected by changes in land ownership. Take, for example, the long-term experiments SRS research wildlife biologist **Paul Hamel** has established on forest industry land to look at whether silviculture can be used to improve habitat for cerulean warblers.

The cerulean warbler, so named for the male's vivid sky-blue plumage, is a neotropical migratory songbird. The small bird breeds in the upper canopies of forests in the Eastern United States, flying south every August to winter on the slopes of the Andes in South America. Since 1966, numbers of cerulean warblers have declined an estimated 70 percent due to loss of habitat in both the species' breeding and winter ranges.

Hamel, based at the **SRS Center for Bottomland Hardwoods** in Stoneville, MS, has studied cerulean warblers for well over two decades. In the early 1990s, he began scoping out sites along the Mississippi River known to harbor the species. He wanted to understand why the bird had declined so much in this part of its traditional breeding range.

"I had heard that there were cerulean warblers on a site in Desha County, AR, owned by the **Anderson-Tully Company**," says Hamel. "In the beginning, all I wanted was access to the area. Over time, interactions with the company's staff—especially **Mike Staten**, their wildlife manager—led to a unique experiment on providing habitat by silviculture."

Staten and **Bob Ford**, then working with the University of Memphis, found cerulean warblers on the site in Desha County in the early 1990s, when there was growing interest in the decline in neotropical migratory bird species. Ford served as the first contact for cerulean warbler research with Anderson-Tully.

From left to right: Paul Hamel, volunteer Doc Weaver, and Mike Staten surveying for cerulean warblers on Anderson-Tully land. (photo by Wilks Wood)

In 1992, SRS researcher **Winston Smith**, University of Georgia's **Bob Cooper** (then at the University of Memphis), and Ford (these days with U.S. Fish and Wildlife Service in Memphis) established plots to study the status of neotropical migratory birds on three sites in the Mississippi River floodplain, one on the site in Desha County owned by Anderson-Tully, a second on state-owned land in Tennessee, and a third on a national wildlife refuge. Hamel, then employed by the State of Tennessee, served as an advisor and cooperator on the project; he became more central to the project when he was hired to work for SRS in 1993.

Researchers still go back to the plots every year to monitor not only the territories of cerulean warblers, but also American redstarts, northern parulas, yellow-throated warblers, and other neotropical migratory songbirds.

Cutting for Ceruleans

Of the three plots, the timber industry site is the only one where experiments have been done on managing forests specifically for

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Cerulean warbler (Dendroica cerulea). *(photo by Callie Schweitzer)*

The Bottom Line

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cerulean warblers. At the beginning of the experiment, the researchers worked with Anderson-Tully to reserve the 135-acre plot from any forest management for 10 years. In 1994, when an ice storm hit the forest in Desha County, Anderson-Tully held back salvage operations until researchers could get their decade of data from the plot.

"It was at that point that the company became interested in managing to promote habitat for cerulean warblers and other neotropical migratory songbirds," says Hamel. "I trained their staff, who put in the silvicultural prescriptions and became active participants in gathering and publishing the data that came from the work."

The experimental plot was divided in half. The timber company did their usual cut on one-half of the plot, basically reducing the overstory and taking out most of the midstory. On the other half, they left more of the midstory as habitat for cerulean warblers. Hamel and fellow researchers have observed that the cerulean warblers use the side of the plot treated for them but not the other side, which was treated to increase production by improving species composition and spacing.

Hamel stresses that this particular experiment has not been replicated. However, results from a larger project conducted by university researchers on multiple sites across cerulean warbler breeding range align with what Hamel's seen on his Desha County plot. The good news is that cerulean warblers show some flexibility in habitat, and will move into areas disturbed by silviculture.

"The question now is whether we keep applying standard cuts and measuring the response of cerulean warblers, or do we come up with a specific cerulean warbler prescription," says Hamel. "The work with Anderson-Tully, their willingness to try managing their forest to provide habitat specifically for the cerulean warbler, allows research the latitude to try to answer this question."

Painless Transition

In 2005, Anderson-Tully merged with **The Forestland Group, LLC**, an independent timberland management investment organization (TIMO) headquartered in Chapel Hill, NC. The Forestland Group manages approximately 3.4 million acres in 20 U.S. states as well as Belize, Canada, and Costa Rica; emphasizes naturally regenerating hardwood forests; and manages its portfolios as a Certified Resource Manager under the Forest Stewardship Council guidelines.

"There've been no changes in cooperation since the merger," says Hamel. "It's really about people like Mike Staten who continue to work in the same capacity, and the relationship between Anderson-Tully and The Forestland Group. In my opinion, the cooperation we've had with Anderson-Tully and Mike Staten is exemplary."

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"Six Planks" to Expanding South Carolina's Forest Industry

by Stevin Westcott

Gene Kodama, South Carolina State Forester. (photo courtesy of South Carolina Forestry Commission)

"Research and development" is one of six important elements that can help South Carolina's forest industry rebound from the recession and expand in the future.

That's according to a team of industry representatives, economists, and other experts that gathered during a day-long conference last fall in Columbia, SC.

"The goal of the session was to develop a list of key factors that can help the state expand the forest industry's annual economic impact in South Carolina from $17 billion to $20 billion by 2015," said State Forester **Gene Kodama**. "The recommendations, or 'six planks' as I call them, are the focal point of the "20x15" campaign being implemented by the **South Carolina Forestry Commission** in cooperation with the **South Carolina Forestry Association**."

To kick off the campaign a "first-of-its kind" forestry economic development conference was held in October 2009 that attracted nearly 50 natural resource professionals, economic and government leaders, and others from across the state.

Kodama cited the other five "planks" as: retaining and growing current businesses and recruiting new ones, fully utilizing available timber volumes, marketing and branding, improving infrastructure, and protecting the resource.

"We're in the process of creating a steering committee and task groups to work on each plank," Kodama said. "We're also receiving advice from experts outside the state who can help us achieve the 20x15 goal."

Kodama says that when combined the six planks form a bridge that leads South Carolina's forest industry out of recession and into a more vibrant economy in the coming years. He says the economic downturn in the state's forest industry over the past 2 years has been deeper and longer than expected, creating a critical need for a project like 20x15 to help move the industry out of its trough as quickly as possible.

The forest industry is vitally important to the economic health of South Carolina. It's the number one manufacturing segment in the

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The forestry industry is of vital importance to the economic health of South Carolina. (photo courtesy of South Carolina Forestry Commission)

Six Planks

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Palmetto State when it comes to the total number of jobs (84,000) and total wages paid ($2.4 billion).

Kodama believes there are untapped opportunities that can increase those economic figures.

"In the near term, with the trees that are in the ground today as documented by the **SRS Forest Inventory and Analysis** (FIA), we know there is excess biomass that can be used for bioenergy, and the large amount of sawtimber coming available can supply significantly more solid wood and residue reliant businesses. Increasing the state's exports offers especially exciting opportunities, for example China's rising demand for wood and Europe's hunger for renewable energy sources. In the mid- to longer-term, the productivity of the state's forests can be greatly improved by increasing tons and value generated per acre via reforestation with genetically improved growing stock and by applying known silvicultural practices to increase timber production. There are also significant opportunities to create new forest products and increase the use of wood products throughout society. South Carolina is well-positioned to take advantage of some of these markets, and we can do better."

If doing better translates into achieving the 20x15 goal, it would raise the economic impact of South Carolina's forest industry by 15 percent. Experts at the conference noted that just a 10-percent expansion over the period would create 8,400 more well-paying jobs and $1.7 billion more in overall economic impact in South Carolina.

"The 20x15 goal is important, but what is even more important than the exact numbers or dates is that the state's forest industry recovers as quickly as possible from the recession and moves in a positive direction," said Kodama. "If we do nothing, the state's high unemployment rate will continue longer, timber-based opportunities will go to other states or countries and grow their economies rather than ours, individual landowners' forest investments will languish, and forest businesses will have more difficulty recovering from the recession and growing when the economy improves."

The Six Planks

According to the group of experts, the following six factors need attention to recover and expand the forest industry in South Carolina:

1. Economic impact. Forest industry is already a driving force in the state's economy. The industry should leverage this advantage by keeping current businesses healthy to recruit more forestry investment to South Carolina.

2. Abundant wood supply. There is more timber growing now in South Carolina than has ever been recorded. The group cited this oncoming "wall of wood" and a positive growth-to-harvest ratio as beneficial to sustaining and expanding forestry-based businesses and employment. Value-added solid wood products are growth areas in particular.

3. Marketing and branding. Forest industry and the forestry commission must aggressively market and brand South Carolina timber-related businesses. Participants in the conference identified modern marketing techniques as being critical to achieving greater public understanding of forestry's role in the economy, maintaining current forestry businesses, and attracting new business investment.

4. Research and development (R&D). Forestry R&D capacity has been greatly reduced and is entirely inadequate to enhance current products and create new ones. Forest management research is also at an all time low, and must increase to capture the timber production opportunities that exist.

5. Infrastructure. The state's highways, railroads, and ports are well located and support industry investment geographically and logistically, but need upgrades in many locations. Ports need to expand their capacity to load a range of cargo forms. Statewide, rural roads and bridges need upgrading for all types of commercial transportation.

6. Resource protection. Recent major cuts to the forestry commission's state funding has greatly reduced its capacity for emergency response to wildfires and its ability to protect lives, property, and the forest resource. Budgetary emphasis will have to be placed on the forestry commission's role as a protector of the public and the forest resource to attract capital investment and job growth.

Source: South Carolina Forestry Commission news release dated October 30, 2009

Helping Industrial Landowners Offset Carbon

by Ted Leininger

The forest protocol developed by SRS scientists involves sheltering young hardwoods with fast-growing cottonwoods to promote the growth of straight stems in the slower growing hardwoods. Here, cottonwoods have been removed from the area in the right, leaving oak saplings to continue their growth. (photo by U.S. Forest Service)

SRS research developed the planting technology that's being used in a unique partnership to reforest the lower Mississippi Alluvial Valley (LMAV). **Duke Energy**, one of the largest utility companies in the South, is partnering with **GreenTrees®** in a reforestation program designed to offset carbon dioxide emitted from the utility's daily operations by planting trees on 1,700 acres in the LMAV, which includes flood plains in parts of Arkansas, Illinois, Kentucky, Louisiana, Mississippi, Missouri, and Tennessee.

GreenTrees® is a privately managed forest restoration and carbon sequestration program created for landowners within the seven states of the LMAV. The program, created by **C21, LLC**, seeks to restore open and marginal farmland in the Nation's largest watershed to hardwood forest ecosystems capable of sustainably sequestering large amounts of carbon dioxide, providing habitat for wildlife, and benefiting landowners committed to the long-term restoration of their properties.

"SRS scientists **Emile Gardiner** and **John Stanturf**—along with partners from forest industry, universities, and state and Federal agencies—pioneered the protocol used by GreenTrees®, which shelters young hardwoods with fast-growing cottonwoods," says **Ted Leininger**, project leader for the **SRS Center for Bottomland Hardwoods Research** based in Stoneville, MS.

Research to support the practice was conducted over the past 15 years, primarily at the **Sharkey Restoration Research and Demonstration Site** in Sharkey County, MS. Stanturf currently leads the **SRS Center for Forest Disturbance Science** in Athens, GA, and Gardiner is a research forester at the Center for Bottomland Hardwoods Research.

Gardiner, Stanturf, and their collaborators used a variety of silvicultural practices on the Sharkey site plots to establish tree species native to the LMAV, which, before European settlement, supported 25

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Offset Carbon

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million acres of bottomland forest. Factors such as soil fertility, flooding duration, and competing vegetation contributed to determining what type of stands would grow well.

The method adopted by GreenTrees® involves using cottonwoods to serve as nurse trees for the hardwood seedlings. Once established, the cottonwoods provide an environment that promotes the growth of straight stems in the slower growing hardwoods, thus providing the potential for quality timber for landowners desiring this environmental benefit. The cottonwoods develop forest structure very quickly, providing habitat for many bird species found in neighboring bottomland hardwood forests.

Having seen and valued the carbon sequestration, wildlife, and timber benefits of the cottonwood-hardwood planting mix, GreenTrees® consulted with Gardiner and Leininger recently to adapt the initial silvicultural techniques to include planting 302 hardwoods and 302 cottonwoods per acre as a launching pad for their carbon offsets program in the LMAV. The long-term plan for the program builds on increments of 70-year leases with participating landowners. These leases add longevity to forest restoration, increase wildlife habitat and populations, and allow carbon to be sequestered for longer periods of time.

Plantation canopy, with eastern cottonwood in highest position. (photo by Emile Gardiner)

Duke Energy's chief policy, strategy, and regulatory officer called this approach "the most innovative afforestation and carbon offset project in the United States."

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Cottonwood-Nuttall oak grove, with a row of eastern cottonwood on the right, and Nuttall oak on the right. (photo by Emile Gardiner)

science

You Can Use!

... For the Forest Health Protection Professional

Now Available on the Web: Elution Rate Test Results for Semiochemical Products

Semiochemical products are widely used by forest health protection professionals to deter or attract and trap insects. Semiochemicals are substances that organisms, especially insects, produce that cause a behavioral response in another individual. Attractive pheromones, a common class of semiochemicals, are used to lure various insect species to detection traps. Each year hundreds of thousands of dollars are spent in the United States on semiochemicals for insect management.

A wide range of devices have been designed to release chemicals to lure specific insects. A device to release the chemical is usually paired with a trap to collect the insects, which are then identified and counted. Forest health protection professionals use data from trapping to detect the presence of invasive insect species, predict damage from infestations, or provide information on insect populations.

Not all lure devices are created equal. Insect responses are controlled by both the type of the lure chemical (its chemical identity) and the amount being released. To be used successfully, the semiochemicals must elute—evaporate or release—from the device in a reliable and predictable way. Ideally, a lure device will hold the chemical, be inexpensive and robust in field operation, and elute at a predictable rate over time. However, these requirements, combined with the technical challenges posed by the lure chemicals themselves and the environments in which they are used, can make elution inexact.

A collaborative effort among the USDA Forest Service Southern Research Station, Forest Health Technology Enterprise Team, Missoula Technology and Development Center and Region 5 Forest Health Protection, has brought together independently generated field data for semiochemical products commonly used in forestry applications.

One result, the **Elution Rate Test Results** Web site www.fs.fed.us/foresthealth/technology/elutionrate is designed to help pest management professionals more effectively use lure chemicals for insect management and research in forestry applications.

The Elution Rate Test Results Web site provides summary sheets that depict the performance and longevity of each lure device, along with raw data for users who desire additional evaluations. Users can search by specific lure chemicals to find evaluations of the devices used to release them. Another purpose of the Web site is to provide a forum for sharing similar data gathered by others, and to increase the usefulness of elution data by promoting the standardization of measurement protocols.

Pouch developed by Synergy Semiochemicals Corporation to release Beetleblock™ Verbenone, an anti-aggregation pheromone that signals pine beetles that the tree they're on is "full." (photo courtesy of U.S. Forest Service)

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If you've conducted elution rate testing and would like to post the results, please contact Brian Strom at brianstrom@fs.fed.us.

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

Popular Guide to Nonnative Invasive Plants of Southern Forests Updated

In July 2010, SRS published *A Field Guide for the Identification of Invasive Plants in Southern Forests,* which updates the immensely popular *Nonnative Invasive Plants of Southern Forests: A Field Guide for Identification and Control* published in 2003, with over 160,000 copies distributed free to a wide range of audiences.

Lead author, **Jim Miller**, SRS research ecologist based in Auburn, AL, coauthored the new field guide with SRS research technician **Erwin Chambliss** and Auburn University research fellow and extension specialist **Nancy Loewenstein**.

The updated guide offers a more comprehensive identification guide to nonnative trees, shrubs, vines, grasses, ferns, and forbs invading the region's forests and other natural areas. The authors added 23 plant species, over 300 photos and images, and a new section of plant "look-alikes."

The guide's appendix includes the most complete list of nonnative invasive plants in the 13 Southern states, providing common and scientific names for 300 other invading species including, for the first time, aquatic plant invaders.

The guide differs from Miller's first book in that the update focuses solely on the identification of exotic plants and does not include control methods. Miller and coauthors **Steven Manning,** president of Invasive Plant Control, Inc., and **Stephen Enloe,** weed management extension specialist at Auburn University, cover methods for controlling invasive plants in *A Management Guide for Nonnative Invasive Plants of Southern Forests,* available August 2010.

To request copies of *A Field Guide for the Identification of Invasive Plants in Southern Forests*, send your name and complete mailing address, along with book title, author, and publication number GTR-SRS-119 to: pubrequest@fs.fed.us.

You can also access the guide in PDF format at the SRS Web site at http://www.srs.fs.usda.gov/pubs/35292.

The book is also available in HTML format at wiki.bugwood.org/Archive:IPSF. Images from the book can be downloaded from www.forestryimages.org.

Southern Research Station headquarters in spring 2007. (photo by Rodney Kindlund)

NEW PRODUCTS
from the Southern Research Station...

Note: Articles published in 2010 will appear in the next issue of Compass or another advertising venue.

Natural Resources Inventory and Monitoring

1 Bentley, James W.; Johnson, Tony G. 2009. **Virginia harvest and utilization study, 2007.** Resour. Bull. SRS–163. Asheville, NC: U.S. Department of Agriculture Forest Service, Southern Research Station. 27 p.

In 2007, a harvest and utilization study was conducted on 81 operations throughout Virginia. There were 2,016 total trees measured; 1,086 or 54 percent were softwood, while 930 or 46 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-nine percent of the total hardwood volume measured was utilized for a product, while 21 percent was left as logging residue.

2 Brandeis, Thomas J. 2009. **Diameter growth of subtropical trees in Puerto Rico.** Res. Pap. SRS–47. Asheville, NC: U.S. Department of Agriculture Forest Service, Southern Research Station. 39 p.

Puerto Rico's forests consist of young, secondary stands still recovering from a long history of island-wide deforestation that largely abated in the mid-20th century. Limited knowledge about growth rates of subtropical tree species in these forests makes it difficult to accurately predict forest yield, biomass accumulation, and carbon sequestration. This study presents mean annual increases in tree diameter at breast height among trees measured by the forest inventories of Puerto Rico; this information is given for each forested life zone, by species, then by species and crown class, and by crown position class.

3 Brandeis, Thomas; Helmer, Eileen; Marcano-Vega, Humfredo; Ariel, Lugo. 2009. **Climate shapes the novel plant communities that form after deforestation in Puerto Rico and the U.S. Virgin Islands.** Forest Ecology and Management. 258(7): 1704–1718.

Environmental and past land use controls on tree species assemblages on the Commonwealth of Puerto Rico and the U.S. Virgin Islands were characterized to determine whether biophysical factors or land use history has been more important in determining the species composition of secondary tropical forests after large-scale forest clearing for agriculture, widespread species introduction, and landscape-scale forest fragmentation. We conclude that environmental factors have an overarching effect on species composition across the broader range of climatic, geologic, and topographic conditions while land use history influences species assemblages with a specific climatic zone or set of relatively narrow environmental conditions.

4 Brandeis, Thomas; Randolph, KaDonna; Strub, Mike. 2009. **Modeling Caribbean tree stem diameters from tree height and crown width measurements.** International Journal of Mathematical and Computational Forestry & Natural Resource Sciences. 1(2): 78–85.

Regression models to predict diameter at breast height (d.b.h.) as a function of tree height and maximum crown radius were developed for Caribbean forests. The model predicting d.b.h. from tree height fit reasonably well while the model predicting d.b.h. from crown radius fit the data poorly. Models that use tree height have some potential for predicting d.b.h. for use in Caribbean forest biomass and carbon estimation models, but the potential for error propagation by using d.b.h. predicted from crown radius is too great to earn our recommendation for such applications.

5 Conner, Roger C.; Adams, Tim O.; Johnson, Tony G. 2009. **Assessing the potential for biomass energy development in South Carolina.** Res. Pap. SRS–46. Asheville, NC: U.S. Department of Agriculture Forest Service, Southern Research Station. 19 p.

An assessment of the potential for developing a sustainable biomass energy industry in South Carolina was conducted. Biomass as defined by Forest Inventory and Analysis is the aboveground dry weight of wood in the bole and limbs of live trees ≥ 1 inch d.b.h., and excludes tree foliage, seedlings, and understory vegetation. Several possible sources of biomass were analyzed: unutilized logging residue and standing residual inventory trees on acres with tree harvesting, commercial thinning, precommercial thinning on overstocked natural sapling-seedling stands, mill residue, and urban wood waste. A range of prices from $20 to $30 per ton was established by surveys sent to South Carolina's timber producers. Prices reflect 2008 market conditions. The estimates of potential biomass distributed across these price points rose from 4.8 million tons to a total of 16.5 million tons annually. Nearly 7.7 million tons are currently being utilized. New facilities that use wood to produce energy could capitalize on the 8.8 million annual tons of unutilized biomass and operate without overly impacting existing forest industries or increasing harvest levels above 2006 estimates.

6 Johnson, Tony G.; Adams, Tim O. 2009. **South Carolina's timber industry—an assessment of timber product output and use, 2007.** Resour. Bull. SRS–150. Asheville, NC: U.S. Department of Agriculture Forest Service, Southern Research Station. 28 p.

In 2007, industrial roundwood output from South Carolina's forests totaled 613 million cubic feet, 5 percent less than in 2005. Mill byproducts generated from primary manufacturers decreased 6 percent to 176 million cubic feet. Almost all plant residues were used primarily for fuel and fiber products. Pulpwood was the leading roundwood product at 304 million cubic feet; saw logs ranked second at 226 million cubic feet; composite panels were third at 39 million cubic feet. The number of primary processing plants remained at 75 in 2007. Total receipts declined 2 percent to 569 million cubic feet.

7 Johnson, Tony G.; Bentley, James W.; Howell, Mike. 2009. **The South's timber industry—an assessment of timber product output and use, 2007.** Resour. Bull. SRS–164. Asheville, NC: U.S. Department of Agriculture Forest Service, Southern Research Station. 52 p.

In 2007, industrial roundwood output from the South's forests totaled 8.22 billion cubic feet, 5 percent less than in 2005. Mill byproducts generated from primary manufacturers declined 8 percent to 2.95 billion cubic feet. Almost all plant residues produced were used for another product. Fuel and fiber products accounted for 82 percent of utilized plant byproducts. Pulpwood was the leading roundwood product at 3.55 billion cubic feet; saw logs ranked second at 3.45 billion cubic feet; veneer logs were third at 721 million cubic feet. The number of primary processing plants declined from 2,028 in 2005 to 1,882 in 2007. Total receipts declined 5 percent to 8.26 billion cubic feet.

8 Mathison, Rhonda M.; Nevins, Christopher G. 2009. **Kentucky's timber industry—an assessment of timber product output and use, 2007.** Resour. Bull. SRS–154. Asheville, NC: U.S. Department of Agriculture Forest Service, Southern Research Station. 31 p.

In 2007, roundwood output from Kentucky's forests totaled 186 million cubic feet, 3 percent less than in 2005. Mill byproducts generated from primary manufacturers decreased 5 percent to 90 million cubic feet. Seventy-seven percent of plant residues were used, primarily for fuel, miscellaneous, and fiber products. Saw logs were the leading roundwood product at 144 million cubic feet; pulpwood ranked a distant second at 25 million cubic feet; composite panels were third at 9 million cubic feet. The number of primary processing plants declined from 292 in 2005 to 253 in 2007. Total receipts declined 7 percent to 200 million cubic feet.

9 Rose, Anita K.; Coulston, John W. 2009. **Ozone injury across the Southern United States, 2002–06.** Gen. Tech. Rep. SRS–118. Asheville, NC: U.S. Department of Agriculture Forest Service, Southern Research Station. 25 p.

As part of the Forest Inventory and Analysis (FIA) Program, ozone-induced foliar injury is evaluated in the South

between late July and mid-August on about 350 ozone biosites. This study suggests that, despite reported declines in ambient ozone concentrations over the past 10 years, some forest areas in the South were classified in the low- and no-risk categories due to the moisture deficit conditions that existed during the 2002–06 time period. The correlation between ozone injury and moisture conditions, as well as the consistent low-to-moderate levels of injury, occurring year after year in some parts of the South, warrant continued monitoring and close scrutiny for potential forest health impacts. FIA conducts the only annual nationwide systematic survey for ozone-induced foliar injury. This information is extremely valuable to research on trends in ozone exposure and injury and the impacts to vegetation across the United States.

10 Rose, Anita K.; Nicholas, N.S. 2008. **Coarse woody debris in a Southern Appalachian spruce-fir forest of the Great Smoky Mountains National Park.** Natural Areas Journal. 28(4): 342–355.

As part of a biogeochemical study in the spruce-fir forest of the Great Smoky Mountains National Park, coarse woody debris (CWD) was sampled to determine volume, biomass, change in density, and change in carbon and nitrogen over the decomposition process. At the watershed level, CWD biomass and carbon averaged about 73.2 Mg ha^{-1} and 34.9 Mg ha^{-1}, respectively. Across decay classes, wood density decreased, carbon concentrations remained relatively constant, and nitrogen concentrations increased sharply. The magnitude of CWD in this system is among the highest reported in the literature for the Eastern United States, emphasizing the high degree of disturbance that has taken place in this ecosystem.

Forest Ecosystem Restoration and Management

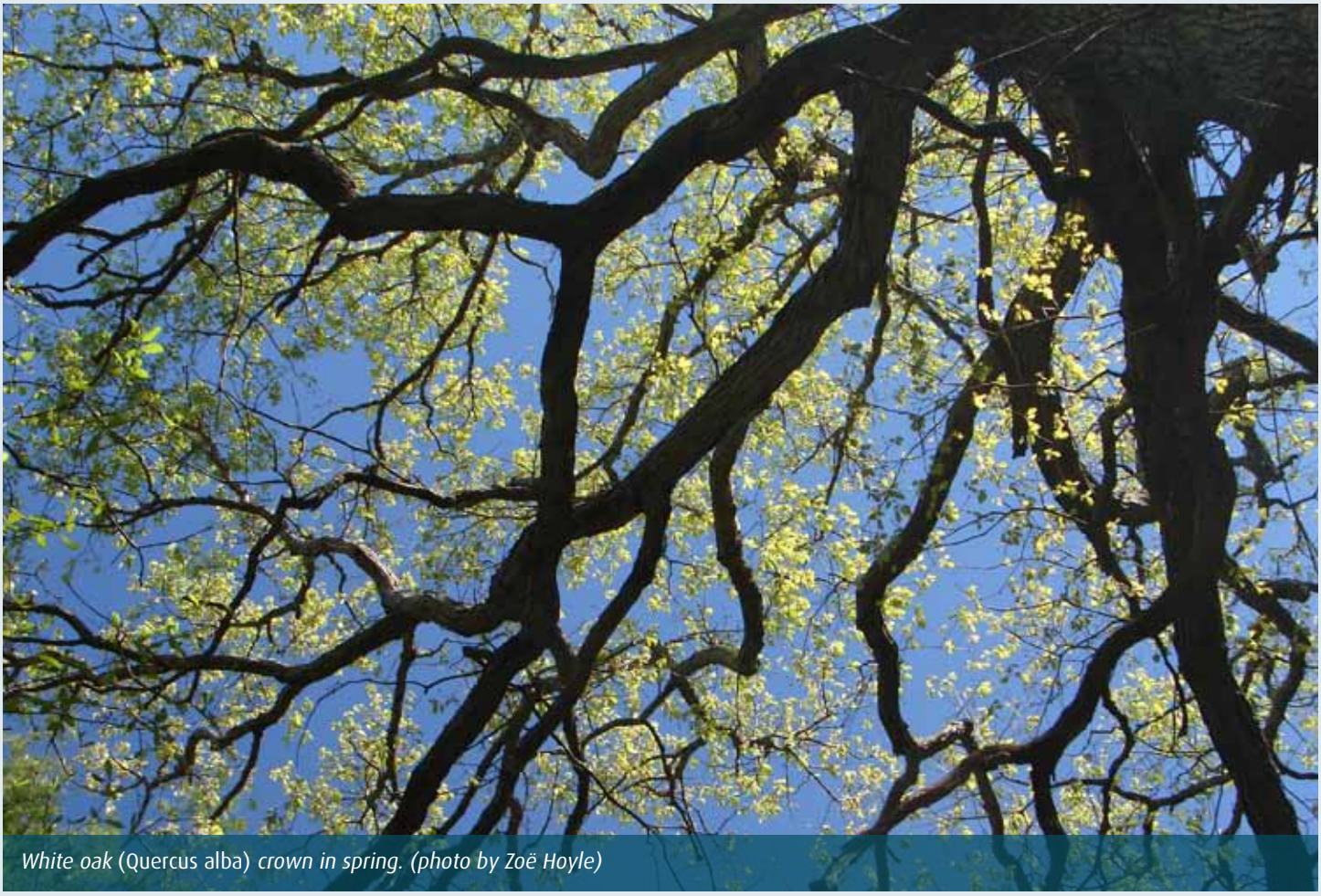
11 Anderson, Peter H.; Johnsen, Kurt H. 2009. **Fertilizer responses of volunteer longleaf pine trees within a loblolly pine plantation: separating direct effects from competition effects.** Res. Pap. SRS–48. Asheville, NC: U.S. Department of Agriculture Forest Service, Southern Research Station. 6 p.

White oak (Quercus alba). *(photo by Zoë Hoyle)*

Evidence is mixed on how well longleaf pine (*Pinus palustris* Mill.) responds to increased soil nitrogen via fertilization. We examined growth and physiological responses of volunteer longleaf pine trees within an intensive loblolly pine (*P. taeda L.*) fertilization experiment. Fertilizer was applied annually following thinning at age 8 years (late 1992) at rates tailored to maintain a high needle nitrogen concentration. We measured the annual growth of 20 volunteer longleaf pine trees per treatment. We took bimonthly gas exchange measures on 12 longleaf pine trees per treatment from June 1999 through June 2000, after which we estimated carbon isotope discrimination and foliar nitrogen concentration on foliage. The impact of fertilization in both growth and gas exchange was dependent on competition for light with neighboring loblolly pine trees. When fertilized longleaf pine trees were separated into categories with respect to being dominant or suppressed (relative to the loblolly pine trees), dominant-fertilized trees had the lowest carbon isotope discrimination increased photosynthesis, and decreased stomatal conductance, indicating greater water use efficiency in these trees. Compared to loblolly pine, longleaf pine growth is restricted less by poor soil nutrition. However, early rotation longleaf pine appears to have the potential to increase growth rate via fertilization to almost the same extent as loblolly pine.

12 Gazal, Rico M.; Kubiske, Mark E.; Connor, Kristina F. 2009. **Leaf gas exchange of mature bottomland oak trees.** Res. Pap. SRS–45. Asheville, NC: U.S. Department of Agriculture Forest Service, Southern Research Station. 8 p.

We determined how changes in environmental moisture affected leaf gas exchange in Nuttall (*Quercus texana Buckley*), overcup (*Q. lyrata Walt.*), and dominant and codominant swamp chestnut (*Q. michauxii Nutt.*) oak trees in Mississippi and Louisiana. We used canopy access towers to measure leaf level gas exchange rates, e.g., photosynthesis, transpiration, stomatal conductance, on the upper crowns. Leaf gas exchange rates of the dominant swamp chestnut oak tree increased in response to summer precipitation. Nuttall and overcup oak trees exhibited constant gas exchange rates throughout the measurement periods. Dominant swamp chestnut oak also maintained high water use efficiency during periods of low soil moisture. These responses and access to water sources during soil drying may buffer extreme fluctuations in leaf gas exchange rates in mature canopy oak trees. Seasonal fluxes in water use and transpiration among individual oak trees of various sizes and other bottomland hardwood species need to be determined to assess their physiological and ecological contributions on the water balance of southeastern bottomland hardwood forests.



White oak (Quercus alba) *crown in spring. (photo by Zoë Hoyle)*

13 Tyree, Michael C.; Seiler, John R.; Maier, Chris A. 2009. **Short-term impacts of nutrient manipulations on leaf gas exchange and biomass partitioning in contrasting 2-year-old Pinus taeda clones during seedling establishment.** Forest Ecology and Management. 257(8): 1847–1858.

We conducted a 1-year greenhouse experiment to assess the impact of nutrient manipulations on seedling growth, biomass partitioning, and leaf gas exchange between two fast growing *Pinus taeda* clones that differed in growth efficiency. After 1 year we observed significant treatment and treatment by clone effects on growth, biomass partitioning, and gas exchange parameters. Fertilization increased total seedling biomass 18 percent, primarily through an increase in foliage and coarse roots. Clones did not differ in total seedling biomass; however, clone 85 produced more stem than clone 93, leading to 37 percent greater stem:leaf, while clone 93 maintained more branch biomass. The logging residue treatment increased stem:leaf by 30 percent, but had no effect on total biomass or partitioning. Differences in leaf morphology resulted in significantly greater canopy leaf area in clone 93 than clone 85. Increased foliar N concentration from fertilization had only minor effects on specific photosynthesis under saturating light (AS_{at}), but lowered stomatal conductance (g_s), transpiration (E), and internal to external CO_2 concentration ratio (C_i/C_a) as well as improved water use efficiency independently of genotype. When gas exchange data was scaled to the canopy level, both genotypes achieved similar canopy level CO2 assimilation rates, but our data suggests they did this by different means. Although we did see a small effect of nutrient limitations in total canopy photosynthesis under saturating light (A_{Canopy}), AS^{at}, and total leaf area, our foliar N concentration (N) indicated that our level of logging residue incorporation did not cause N to decrease below sufficiency limits. From a practical standpoint, a better understanding of strategies for capturing and partitioning C may lead to better selection of clonal material, thereby optimizing productivity.

Forest Values, Uses, and Policies

14 Ginn, Allison L.; Green, Gary T.; Nibbelink, Nathan P.; Cordell, H. Ken. 2009. **The spatial relationship between exurban development and designated wilderness lands in the contiguous United States.** In: Klenosky, David B.; Fisher, Cherie LeBlanc, eds. Proceedings of the 2008 Northeastern Recreation Research Symposium. Gen.Tech.Rep. NRS-P-42. Newtown Square, PA: U.S. Department of Agriculture, Forest Service, Northern Research Station: 35-42.

Public lands provide recreational opportunities and preserve historical and ecological values. Increases in low-density residential development in the contiguous United States pose a threat not only along the boundaries of national parks and forests, but also around uniquely valuable wilderness areas. Development within and around protected lands can affect land management and landscape ecology by fragmenting forest and wildlife habitat, diminishing air and water quality, and limiting recreational opportunities and access. Exurban and rural sprawl particularly affects wilderness areas because land development is inconsistent with the nature of wilderness and its associated values. This research uses U.S. Census and land ownership data to identify National Wilderness Preservation System units with exurban or urban housing densities and large amounts of surrounding private land.

15 Poudyal, Neelam C.; Hodges, Donald G.; Cordell, H. Ken. 2008. **The role of natural resource amenities in attracting retirees: implications for economic growth policy.** Ecological Economics. 68(1-2): 240–248.

Increasing criticism of resource-extractive and polluting heavy duty industries in urban areas, as well as continuing declines in timbering, farming, and mining in rural areas, have created challenges for planners and policymakers seeking sustainable rural economies. Earlier studies have concluded that a retiree economy is a viable approach for rural economic sustainability. Using specific measures of natural amenities that vary over time, this study examined the role that natural amenity resources have played in attracting retirees. Results reveal that the rural and biologically rich counties with substantial land use diversity, water amenities, and other man-modified natural and recreational attractions have great potential for attracting retirees. The findings from this study can be useful for local and regional agencies to identity their latent potential to promote a retiree economy, and also to predict future amenity demands. In addition, we draw other policy implications regarding regional economic growth and ecological concern in rural America.

Threats to Forest Health

16 Hanula, James L.; Horn, Scott; Taylor, John W. 2009. **Chinese privet (*Ligustrum sinense*) removal and its effect on native plant communities of riparian forests.** Invasive Plant Science and Management. 2(4): 292–300.

Chinese privet, an invasive shrub, was removed from heavily infested forests by hand felling or grinding it with a Gyrotrac® mulching machine. Both treatments resulted in complete removal of the privet shrubs without damaging nonprivet shrubs. However, neither method reduced the privet in the herbaceous plant layer, so an herbicide application was needed the following winter. The treatments increased plant diversity compared to privet-infested sites, but the plant communities were very different from forests never infested by privet. Eliminating privet made the forests usable for recreation, such as hiking or birding, but much more time will be needed for typical mature forest plant communities to develop.

17 Miller, Daniel R.; Crowe, Christopher M. 2009. **Length of multiple-funnel traps affects catches of some bark and wood boring beetles in a slash pine stand in northern Florida.** Florida Entomologist. 92: 506–507.

In 2001 we compared catches of some common species of bark and wood beetles in 8- and 16-unit multiple-funnel traps (baited with ethanol and (–)-α-pinene) in a slash pine stand on the Osceola National Forest in northern Florida. More *Arhopalus rusticus nubilus*

(Cerambycidae) and *Xyleborus* species (Scolytidae) were caught in 16-unit traps than in 8-unit ones, whereas catches of *Hylobius pales* (Curculionidae) were lower in 16-unit traps than in 8-unit ones. Trap length had no effect on catches of *Xylotrechus s. sagittatus* (Cerambycidae), *Dendroctonus terebrans*, *Ips grandicollis*, *Xyleborinus saxesenii* (Scolytidae), and *Pachylobius picivorus* (Curculionidae).

18 Strom, B.L.; Roton, L.M. 2009. **A small-bolt method for screening tree protectants against bark beetles (Coleoptera: Curculionidae).** Journal of Entomological Science. 44(4): 297-307.

A simple, small-bolt method was developed and refined for evaluating and screening treatments against bark beetles. Four insecticide products (three active ingredients) were evaluated against southern pine beetle during a period spanning 1 day to 9 months post-application. Permethrin (Astro) showed the best residual effectiveness, followed by bifenthrin (Onyx) and carbaryl (Ferti-Lome and Sevin XLR Plus). Bifenthrin has been reported as effective in field tests with southern pine beetle and carbaryl as ineffective, lending credence to the small-bolt method. Results with permethrin suggest that a more extensive evaluation is warranted. As described, the method provides a useful and efficient tool for identifying ineffective treatments. Its use for screening products can limit expensive and time-consuming field evaluations to treatments that show significant promise. With additional refinement, the small-bolt method may provide most of the benefits of more costly testing methods while offering the flexibility needed to compare prophylactic treatments that rely on different modes of action.

19 Yates, Harry O., III; Smith, David R. 2009. **History, distribution, damage, and life cycle of a pine shoot gall sawfly, *Xyela gallicaulis* (Hymenoptera: Xyelidae)**. Journal of Entomological Science. 44(3): 276–283.

Larvae of *Xyela gallicaulis* Smith cause shoot stem galls in young pines. Loblolly pine (*Pinus taeda L.*) is the most seriously damaged, but galls have been observed on slash pine (*P. elliottii* var. *elliottii Engelm.*) and shortleaf pine (*P. echinata* Mill.). Studies in Virginia and Georgia confirm a 2-year life cycle. Larval development takes 4 to 6 weeks. After feeding, larvae bore out of the galls and drop to the ground where they form a papery cocoon in the soil to pupate, and where they remain for 22 to 25 months. Adults emerge from cells constructed in the soil from early December to mid-January of the second year. Eggs are inserted into the vegetative buds during odd-numbered years. Insect associates found feeding in or on gall tissues are the Nantucket pine tip moth [*Rhyacionia frustrana* (Comstock) (Tortricidae)] and the weevil [*Conotrachelus carolinensis* Schoof (Curculionidae)].

Forest Watershed Science

20 Hawkins, Tracy S.; Schiff, Nathan M.; Leininger, Theodor D. [and others]. 2009. **Growth and intraspecific competitive abilities of the dioecious *Lindera melissifolia* (Lauraceae) in varied flooding regimes.** Journal of the Torrey Botanical Society. 136(1): 91–101. [Editor's note: Southern Research Station scientists Emile S. Gardiner, Margaret S. Devall, Paul B. Hamel, A. Dan Wilson, and Kristina F. Connor coauthored this publication.]

The contribution of sexual dimorphism to male-biased colony ratios observed in field populations of the federally endangered *Lindera melissifolia* was investigated. Growth characteristics and intraspecific relative competitive abilities were determined for first-year male and female *L. melissifolia* plants grown at varied densities and receiving three flooding treatments. In the no-flooding and 30-day-flooding treatments, stem height, stem diameter, and total leaf area for male plants were significantly greater than that of higher density male plantings and of female plants without respect to density. In both male and female plants, stem growth ceased, and leaves were abscised in response to flooding. Although density effects in combination with hydrologic regime influenced intersexual competition, male bias from competitive exclusion was not indicated. Growth characteristics for male plants grown alone suggest potential for greater interspecific competitive abilities than that of female plants. Therefore, male plants may be better adapted for colonizing suitable habitat, thus contributing to male-biased colony ratios observed in naturally occurring populations.

21 Horton, Jonathan L.; Clinton, Barton D.; Walker, John F. [and others]. 2009. **Variation in soil and forest floor characteristics along gradients of ericaceous, evergreen shrub cover in the Southern Appalachians.** Castanea. 74 (4): 340–352.

The importance of evergreen shrubs in Southern Appalachian ecosystems, primarily *Rhododendron maximum* and mountain laurel, has long been appreciated. Two of the more important influences of these species are their effects on nutrient cycling and tree species establishment. This study, a component of a larger project that examined mechanisms associated with these effects, was designed to examine how nutrient availability varies across the landscape due to the presence of these two species. The study showed that where evergreen shrubs are present, the quality of organic matter diminishes, which translates into lower nutrient availability for establishment and growth of other species.

22 Lockhart, Brian Roy; Gardiner, Emile; Leininger, Theodor; Stanturf, John. 2008. **A stand-development approach to oak afforestation in the Lower Mississippi Alluvial Valley.** Southern Journal of Applied Forestry. 32(3): 120–129.

Oak afforestation in the Lower Mississippi Alluvial Valley has involved planting 1-year-old bare-root seedlings on a relatively wide spacing in single-species stands or planting light-seeded species with oaks to form mixed-species stands. In the former case, the developing single-species stands have limited future management options because they do not provide structures that favor quality wildlife habitat or quality sawtimber production. In the latter case, species mixtures are being planted with little knowledge of subsequent stand development, leading to an inability to predict future stand composition for management purposes. In this article, we present a system to determine bottomland tree planting mixtures that will create single-cohort, mixed-species stands with the potential for high-quality bottomland oak.

23 Swank, Wayne T.; Vose, James M. 2009. **Long-term forest ecosystem**

Climbing aster (Aster carolinianus) *native to western North Carolina. (photo by Zoë Hoyle)*

research: a programmatic view. Journal of Forestry. 107(7): 335–336.

Swank and Vose discuss the historical roots and importance of long-term research at Coweeta Hydrologic Laboratory and other sites in the network of the Forest Service's Experimental Forests and Ranges, in collaboration with universities, Federal and State agencies, and other institutions. In the 1980s, Forest Service scientists provided strong leadership in the formation, establishment, and subsequent development of the Long-Term Ecological Research (LTER) network funded by the National Science Foundation. Coweeta is one of the original six sites established, in partnership with the University of Georgia. Research from this and other LTER sites is providing the scientific community, policymakers, and society with the knowledge and the predictive understanding necessary to conserve, protect, and manage the Nation's ecosystems and the services they provide. Additionally, long-term research sites have long played a role in educating and training future ecosystem scientists, policymakers, and educators.

24 Vukovich, Mark; Kilgo, John C. 2009. **Effects of radio transmitters on the behavior of red-headed woodpeckers.** Journal of Field Ornithology. 80(3): 308–313.

Radio transmitters can affect the behavior of study animals and may, therefore, bias research results. Our objective was to evaluate effects of transmitters on the behavior of red-headed woodpeckers (*Melanerpes erythrocephalus*). We observed both radio-tagged and nonradio-tagged woodpeckers to quantify the proportion of time allocated to various standardized behaviors. We found no difference between the two groups in the time engaged in each activity. We also quantified incidence of cavity use by radio-tagged woodpeckers and found that their ability to use cavities was not affected. We concluded that backpack transmitters weighing >3.6 percent of body weight did not impact the behavior of red-headed woodpeckers.

Yellow trumpets (Sarracenia alata). *(photo by Jeff McMillian @ USDA-NRCS PLANTS Database)*

Research Work Units

Location and project leader	Name and Web site	Phone
Athens, GA Ken Cordell	Pioneering Forestry Research on Emerging Societal Changes	706-559-4263
Forest Ecosystem Restoration and Management		
Asheville, NC Cathryn Greenberg	Upland Hardwood Ecology and Management www.srs.fs.usda.gov/bentcreek	828-667-5261
Auburn, AL Kris Connor	Restoring and Managing Longleaf Pine Ecosystems www.srs.fs.usda.gov/4111	334-826-8700
Monticello, AR James Guldin	Southern Pine Ecology and Management www.srs.fs.usda.gov/4106	870-367-3464
Saucier, MS Kurt Johnsen, acting	Forest Genetics and Ecosystems Biology www.srs.fs.usda.gov/organization/unit/mississippi.htm#SRS-4153	228-832-2747
Forest Values, Uses, and Policies		
Gainesville, FL Vacant	Integrating Human and Natural Systems www.srs.fs.usda.gov/trends	352-376-3213
Auburn, AL Bob Rummer	Forest Operations www.srs.fs.usda.gov/forestops/	334-826-8700
Pineville, LA Les Groom	Utilization of Southern Forest Resources www.srs.fs.usda.gov/4701	318-473-7268
Research Triangle Park, NC David Wear	Forest Economics and Policy www.srs.fs.usda.gov/econ	919-549-4093
Threats to Forest Health		
Asheville, NC Danny Lee	Eastern Forest Environmental Threat Assessment Center www. forestthreats.org	828-257-4854
Athens, GA John Stanturf	Center for Forest Disturbance Science www.srs.fs.usda.gov/disturbance	706-559-4316
Pineville, LA Doug Streett	Insects, Diseases, and Invasive Plants of Southern Forests www.srs.fs.usda.gov/4501	318-473-7232
Forest Watershed Science		
Franklin, NC Jim Vose	Center for Forest Watershed Research www.srs.fs.usda.gov/coweeta	828-524-2128
Lincoln, NE Michele Schoeneberger	National Agroforestry Center - Research www.nac.gov	402-437-5178
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Natural Resources Inventory and Monitoring		
Knoxville, TN Bill Burkman	Forest Inventory and Analysis www.srsfia2.fs.fed.us	865-862-2000

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