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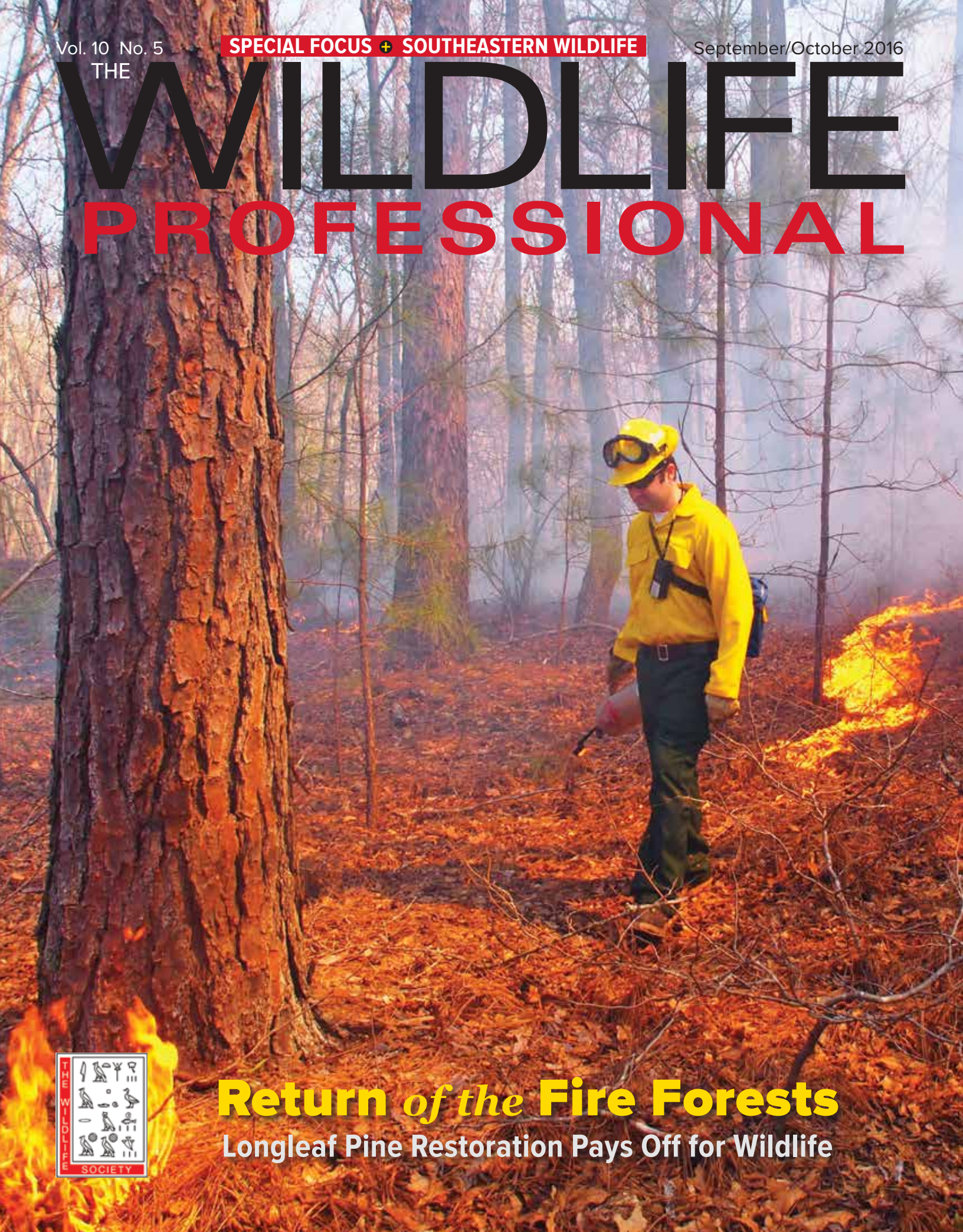

Return *of the* Fire Forests

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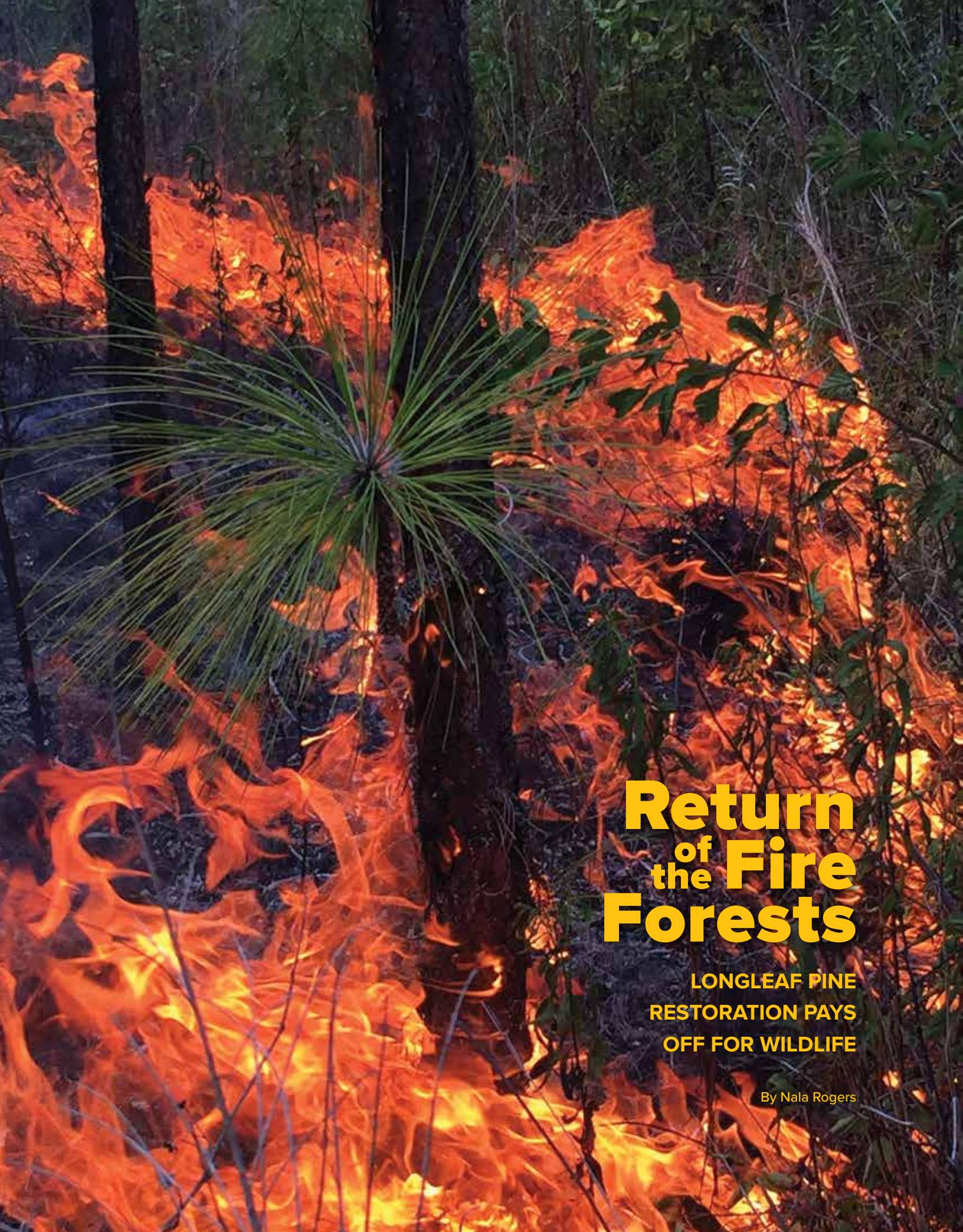


Return of the Fire Forests

LONGLEAF PINE RESTORATION PAYS OFF FOR WILDLIFE

By Nala Rogers

Reese Thompson's family has lived in longleaf country for six generations. Once, they bled the tall, stately longleaf pines (*Pinus palustris*) for turpentine. When that industry died in the mid-20th century, Thompson began selling the trees for pulp wood, replacing them with other species that were easier to grow. Still, some of the original longleaf forest remained and, in 2004, Thompson strolled through it with a visiting biologist from the National Wild Turkey Federation.

"She laid a yard-square aluminum frame randomly on the ground, and then she proceeded to identify 29 different species of plants that were in this yard-square area," said Thompson. "I thought to myself, 'I'm 50 years old, I've been walking on this all my life, and I didn't realize what was underneath my feet.'"

After the visit, Thompson learned all he could about longleaf pine ecosystems. He discovered that the forest on his land, with its century-old pines and intact understory, represented one of the most diverse ecosystems outside of the tropics. More importantly, he learned that such forests were vanishing, with less than four percent of the approximately 90 million original acres remaining. These revelations prompted Thompson to join a growing movement that is working to restore the ecosystem across its former range, which stretches from eastern Texas to southeastern Virginia.

"I realized what a unique treasure the longleaf ecosystem was, both for plants and animals," he said. "That's kind of what set me on my life's mission."

Today, Thompson is the sole private landowner on the 33-member Regional Longleaf Pine Partnership Council, which helps lead a massive collaboration between government agencies, industry, landowners and nonprofit organizations. Together, they are implementing a range-wide conservation plan, with the goal of restoring longleaf forests to 8 million acres by 2025.

A Fire-hungry System

At first glance, longleaf forests appear simple. They resemble parks, with widely spaced trees rising from rolling grasslands. But, on closer inspection, the landscape reveals dazzling complexity, with around 900 plant species and myriad species of birds, mammals, reptiles, amphibians and insects.

All of them rely on fire. In natural longleaf forests, flames kindled by lightning sweep through the understory every two to five years, clearing out brush and hardwoods and allowing light to reach the ground. Seeds from grasses, legumes and forbs germinate and thrive in the fire-replenished soil, feeding herbivores and pollinators. The flames rarely hurt longleaf pines, which are highly fire resistant during most of their life cycle.

When Europeans first settled in North America, such forests blanketed the Southeast. But by the mid-20th century, they had cut down nearly all of it, replacing the native ecosystem with buildings, farmland and plantations of faster-growing trees. Some second-growth longleaf stands regrew during the 20th century; but due to management practices that suppressed fire, most developed into badly degraded ecosystems.

In today's urbanized landscape, it's not safe to let wildfires burn unchecked. Instead, land managers must maintain longleaf forests through prescribed burning. Native Americans and European settlers burned the land for centuries; but the practice nearly died out in the era of fire suppression, says Robert Abernethy, president of the Longleaf Alliance, a nonprofit group that has spearheaded the longleaf restoration movement.

Abernethy points out that while school children learn about saving the world's rainforests, Americans scarcely noticed the destruction of their own iconic ecosystem.

"We lost our rainforest 100 years ago, and it wasn't a rainforest. It was a fire forest," he said. "We lost it before we even knew the value of it, and we're trying to get back a little piece."

◀ **Prescribed fire leaves young longleaf pines unharmed as it sweeps across Salem Saloom's land in Alabama. Fire is essential to the ecosystem, germinating seeds and clearing out brush so that light can reach the understory.**

Credit: Salem Saloom

Wildlife at Every Level

Twenty-six federally threatened or endangered species live in longleaf forests, says Abernethy. One of the most well-known is the gopher tortoise (*Gopherus polyphemus*), which helps the ecosystem by spreading seeds, digging burrows and inspiring conservationists.

"People love them," said TWS member Tracey Tuberville, a research scientist who studies gopher tortoises at the University of Georgia's Savannah River Ecology Laboratory in South Carolina. "They look old from the moment they hatch. And they outlive their researchers."

Credit: Kurt Buhlmann

▼ **Using a GPS unit, tortoise researcher Tracey Tuberville records the location of a juvenile gopher tortoise at a reintroduction site near Aiken, S.C. Gopher tortoise burrows provide shelter for many other species in the longleaf ecosystem.**

Credit: Jack Tuberville

▲ **A juvenile gopher tortoise with a radio transmitter on its carapace is ready to be released from a researcher's hand at St. Catherine's Island, Ga. The species is listed as threatened in the western part of its range.**

Gopher tortoises are candidates for protection under the U.S. Endangered Species Act; and, in the eastern portion of their range, they are already listed as threatened. They do best in classic longleaf habitats, with diverse groundcover plants to feed on and deep, sandy soil for burrows.

Hundreds of other animal species use gopher tortoise burrows; and some, such as the Florida mouse (*Podomys floridanus*), can live nowhere else. Because of their special role, gopher tortoises are sometimes called "ecosystem engineers."

Last year, a study published in *Biodiversity and Conservation* suggested just how much tortoise burrows contribute to biodiversity. In Florida's Wekiwa Springs State Park, researchers surveyed vertebrate species and mapped out key ecosystem variables, including the density of tortoise burrows, the distance to water, and the presence of fallen branches. Areas with tortoise burrows had far greater vertebrate diversity; and burrow density alone explained about 65 percent of the variation, more than any other factor.

One impressive burrow user is the federally threatened Eastern indigo snake (*Drymarchon couperi*). The glossy blue-black reptiles can reach lengths of more than 8.5 feet, making them the longest snakes native to the United States. They rely on tortoise burrows for shelter, especially during the breeding season from October to February, according to a 2013 study in the *Journal of Wildlife Management*.

If gopher tortoises are ground-level ecosystem engineers, red-cockaded woodpeckers (*Leuconotopicus borealis*) are engineers of the canopy. They spend months or years drilling into pine trees to create deep cavities, which they maintain and pass down through generations. Family groups arrange their cavities in clusters, and each bird returns to its own cavity to sleep — or tries to.

"There's literally a skirmish you can watch at some cavities, right as the sun sets, over who gets to go into that cavity at night," said Dylan Kesler, an avian ecologist at the Institute for Bird Populations.

Dozens of species compete over the cavities, from flying squirrels to wasps to wood ducks. The cavities are in high demand in part because they are hard to construct, carved from the tough, sticky wood of live trees. Red-cockaded woodpeckers are the only woodpeckers to excavate shelters in living wood. They can use several types of pines, but their favorites are old, massive longleafs with wood softened by fungus.

"They usually can't make their cavities in trees that are less than 100 years old. So if all of the old growth is cleared away, then they're pretty much doomed," said Jeff Walters, a behavioral ecologist and conservation biologist at Virginia Polytechnic Institute and State University, who has spent decades studying the species.

Many people thought the woodpeckers were doomed in the 70s and 80s, during the early years of recovery efforts for the federally endangered species, says Walters. In a landmark 1991 paper in the *Journal of Wildlife Management*, Walters revealed part of the solution: drilling artificial cavities to help woodpeckers settle in new areas. But while artificial cavities can help woodpeckers recolonize healthy longleaf forests, they can't restore degraded ones.

When longleaf forests are deprived of fire, hardwoods grow up and clog the midstory, blocking the sun and starving young longleafs and groundcover plants. In the past, researchers have found that woodpeckers spend more time in parts of the forest with fewer hardwoods, suggesting that hardwood density is a limiting factor for woodpeckers as well as understory wildlife.

But that could be changing as forests recover. A new study published in *Animal Conservation* found that while woodpeckers did seek out older pine trees, they made no effort to avoid hardwoods. The researchers attribute this change to their study site at Eglin Air Force Base in Florida, which is one of the largest and healthiest longleaf forests. At Eglin, it appears that prescribed burns have knocked the hardwoods back enough that they are no longer a problem for woodpeckers.

Credit: Will Randall

A red-cockaded woodpecker looks down from a branch in Florida's Three Lakes Wildlife Management Area. Longleaf forest restoration is helping the endangered woodpecker recover.

Credit: Kevin Stohlgren

A female eastern indigo snake glides over the sandy soil in Wheeler County, Ga. The snakes are one of many species that use gopher tortoise burrows for shelter.

"It really suggests that once those systems are recovered and the pine system itself is in a nice restored state, having some hardwoods in there isn't the end of the world," said Kesler, who conducted the study with Walters.

Now, says Walters, most red-cockaded woodpecker populations are increasing, and four have reached their recovery goals in the last 10 years. Red-cockaded woodpeckers are a classic umbrella species; so their success indicates that, for longleaf ecosystems, something is finally going right.

Tools of the Trade

Today's longleaf restoration relies on several practical advances. First of all, people have rediscovered how to burn forests, says Walters.

"It was pretty scary in the early years for people to try to bring back fire to landscapes that hadn't seen it in a long time. I mean, you're the one out there

Credit: Wayne Bell

▲ **Longleaf seedlings grow in a nursery in Moultrie, Ga. Some nurseries are working to breed hardier, faster-growing longleaf pines.**

Credit: Wayne Bell

▶ **Wayne Bell holds a 5-month-old longleaf seedling. By growing the seedlings in small containers, horticulturalists can keep the roots together so that they aren't damaged during transplanting.**

setting the match and responsible if it gets out of control," he said.

But people persevered, slowly learning how to prepare a site, choose a time and control the flame. Now, state agencies and conservation groups offer classes and guidance to share these skills with private landowners and professional burn teams.

While most prescribed burns are done in the winter, there is a recent movement to burn during the growing season, says Troy Ettel, director of Longleaf Pine Whole System for The Nature Conservancy. Winter burns are typically viewed as safer, but the forests evolved to burn in the spring and summer, when thunderstorms brought lightning to the landscape. Growing-season burns are best for destroying hardwoods and germinating the seeds of native understory plants. Wiregrass, a keystone species in many longleaf-dominated landscapes, typically won't even flower unless it is burned during or just before the growing season, according to the U.S. Fish and Wildlife Service.

Another major technical advance concerns how seedlings are grown. In the past, the only longleaf seedlings available were "bare root." Longleaf roots spread out more than roots of other species; and transplanting bare-root longleafs damages the roots, compromising the plants' ability to survive. A few decades ago, anyone planting longleaf could expect more than half of them to die, says Wayne Bell, chief operating officer of the International Forest Company, which produces about a quarter of all longleaf seedlings sold.

In 1983, Bell's company became the first to sell longleaf seedlings grown in little plastic cups that keep the roots in a bundle. Such "containerized" seedlings can be lifted from the soil with their roots intact; and, when planted, about 90 percent survive, says Bell. Production of containerized longleaf seedlings has shot up in recent years, lowering prices and enabling large areas to be replanted.

The quality of the seedlings may improve further, thanks to work by International Forest's sister company, International Forest Genetics and Seed Company. In the mid-20th century, nurseries were working to breed bigger, hardier longleaf trees that would be more profitable for timber companies; but they abandoned those efforts to focus on faster-growing species. In 2012, the company restarted them, buying up old seed plantations and studying the trees' genetics.

Uniting for Longleaf

The longleaf restoration movement comprises a vast network of wildlife biologists, foresters, policy makers, business people and landowners. One of the major drivers is the Longleaf Alliance, an organization founded in 1996 by researchers at Auburn University's School of Wildlife and Forestry. The Alliance helped bring attention to longleaf issues; and, in 2007, representatives from 22 government agencies and non-governmental organizations came together to develop America's Longleaf Restoration Initiative (ALRI). The Initiative's 43 current partners include state and federal agencies, university departments, and conservation nonprofits.

"I think the ALRI is almost unrivaled in terms of the number of public and private agencies that are engaged and involved around a common goal," said Troy Ettel, who chairs the initiative in addition to directing The Nature Conservancy's longleaf program.

In 2009, ALRI published what has become the guiding document for the movement: the Range-Wide Conservation Plan for Longleaf Pine. The plan set a goal of increasing longleaf forest coverage to 8 million acres by 2025. At the time,

about 3.4 million acres were dominated by longleaf pines; today, that number has swelled to about 4.7 million acres, an area larger than Hawaii. And the pace is accelerating, with on-the-ground improvements made to nearly 2 million acres in 2015. That's a 24 percent increase over 2014 efforts, and a 40 percent increase over those made in 2013, according to the initiative's 2015 Range-Wide Accomplishment Report.

The range-wide plan identified 16 "significant geographic areas" where restoration efforts should be focused. Each area includes a large piece of protected land, with adjoining areas that could some day be part of a single, contiguous habitat. Several of the most valuable areas have military bases at their core; and the U.S. Department of Defense has been a strong leader in restoring them, says Ettel.

For example, North Carolina's Fort Bragg, home to one of the largest populations of red-cockaded woodpeckers, has been restoring longleaf since before ALRI was founded. In the early 1990s, the USFWS restricted activities on the base in order to protect the endangered birds. After some initial resistance and negotiation, army officials embraced their role as ecosystem managers. They developed the very first Army Compatible Use Buffer Program, entering agreements with landowners to create a protected area around the base. By restoring habitat in the buffer zone and on the base itself, the army was able to offset any accidental harm from training activities, enabling soldiers and woodpeckers to share the land.

Army officials soon realized that the habitat they were creating for the woodpeckers was ideal for military training as well. Forests on the base had become dense and tangled, impeding soldiers' ability to move and see. In contrast, the restored forests were open and uncluttered.

"It makes it a much, much better place to train soldiers," said Mike Lynch, former director of plans, training, mobilization and security on the base.

Today, military bases across the region are following Fort Bragg's model, restoring longleaf habitat both on military land and in surrounding buffer zones.

"It's just a wonderful coincidence that the military's mission, which is primary, works so well with the mission of conservation," said Randy Tate, restoration partnership coordinator for the Fort Stewart/Altamaha Longleaf Partnership in Georgia, one of ALRI's significant geographic areas. Fort Stewart has its own buffer zone and longleaf restoration program, and officials at the base are managing the site for gopher tortoises and red-cockaded woodpeckers.

Restoring Private Land

So far, the bulk of longleaf restoration has happened on public land. There is still more progress to be made on state and federal lands; the U.S. Forest Service alone manages at least 600,000 acres of land suitable for restoration, which it is tackling at a rate of a few thousand acres per year, says Ettel.

The Value of Longleaf Sap

Longleaf pines are copious sap producers, and both wildlife and humans have taken advantage of the sticky bounty. Humans have used it to produce tar, pitch, turpentine and rosin, known collectively as "naval stores." Before the rise of petroleum, these products were essential for transportation, lubricating wagon axles and sealing the hulls of ships. In the 18th and 19th centuries, naval stores dominated the Southeast's economy.

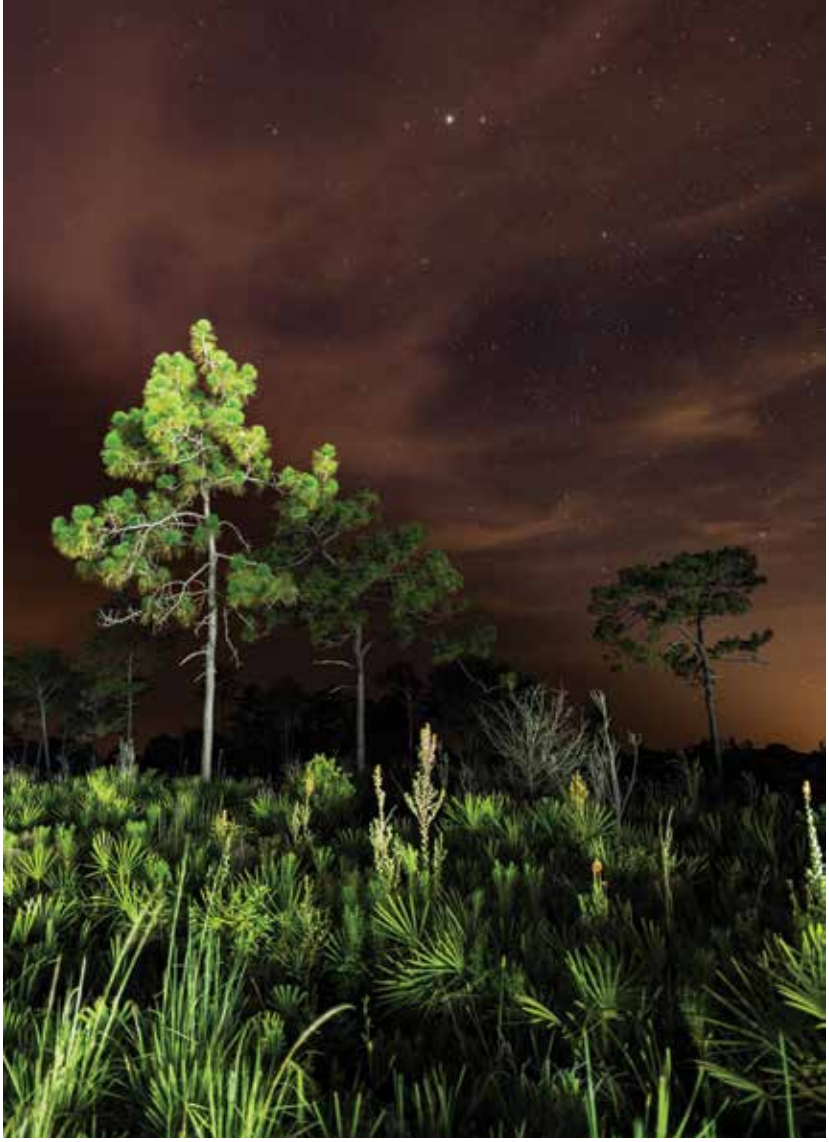
While humans have little use for pine sap these days, red-cockaded woodpeckers still need it. The birds excavate cavity shelters in live longleaf pines; and, afterward, they maintain small holes around the cavity entrance. Sap flows from these "resin wells" down the trunk of the tree, preventing snakes from entering.

The sap that keeps the shelters secure also makes them hard to excavate. Woodpeckers must work slowly, taking regular breaks while they wait for the wood to stop weeping.

"There's no way they can go and knock out a cavity in six weeks like other woodpeckers," said Jeff Walters, a behavioral ecologist and conservation biologist at Virginia Tech. "They'd end up trapped in the sap."

Credit: Kevin Rose

▲ **Sap flows from resin wells around a red-cockaded woodpecker cavity in Marine Corps Base Camp Lejeune, N.C. Woodpeckers keep the sap flowing as a defense against snakes entering the cavity.**



Credit: Will Randall

▲ **Longleaf pines reach toward a starry sky at Highlands Hammock State Park in Florida. Intensive restoration efforts are helping to conserve longleaf ecosystems.**

But nearly 90 percent of forestland in the South is privately owned, and if ALRI is to meet its 8-million-acre goal, landowners will need to participate.

The chief barrier for private landowners is money. Most private forest owners sell trees for lumber or wood pulp, and the most lucrative forests aren't the ones that are best for wildlife. To maximize timber revenue, people plant fast-growing pine species as close together as possible, sacrificing the understory and creating what Thompson refers to as a "green desert."

Federal and state lands don't have to earn a profit or pay property taxes, Thompson points out. "But the average guy that's raising a family, sending kids to college, got bills to pay — he has to squeeze a profit out of the land."

It's possible to manage loblolly pine (*Pinus taeda*) and other fast-growing species so that they resemble longleaf ecosystems; and some timber producers are doing so, says Darren Miller, science advisor and southern environmental research manager for Weyerhaeuser Company, who was recently elected Vice President of TWS. By burning the understory and keeping the trees sparse, landowners can create habitat for many longleaf-associated species, regardless of what type of pine they use. But even with fast-growing species, managing the ecosystem for wildlife comes with a financial cost.

The U.S. Department of Agriculture's Natural Resources Conservation Service offers a variety of cost-share programs — including the Conservation Stewardship Program and the Environmental Quality Incentive Program — that landowners can use to offset those costs. In 2016, such programs will fund $10.6 million worth of longleaf ecosystem restoration. Large industrial landowners aren't eligible, even though they have the most land to restore — a policy that ALRI would like to change, says Ettel. For smaller landowners, cost-share programs can make longleaf restoration feasible, allowing them to manage the land for other goals in addition to money. Many landowners enjoy hunting and spending time in their longleaf forests, valuing the ecosystem as part of their cultural heritage.

"That's important to people, especially in a region like the South where you have such a strong land ethic," said Ettel.

That land ethic is strong in Alabama landowner Salem Saloom, who is restoring his 2,200-acre property to longleaf with the help of several NRCS cost-share programs. He loves everything about his role as steward, from burning undergrowth to hunting turkeys to listening to wind in the needles — a sound he likens to the breath of God.

"It's an ethereal experience when you go out in the winter night," said Saloom. "You've got a black sky and no lights around, and you've got the stars and the moonlight, and you hear the breeze blowing through that longleaf. And the longleaf is singing." ■

Nala Rogers is a science writer at The Wildlife Society.