

The Coastal Plain Chapter of the  
Society for Ecological Restoration  
*presents*



# **Restoration in the Southeast with a Focus on Military Lands**

**2009 Annual Symposium and  
Membership Meeting**

*School of Forestry & Wildlife Sciences -  
Auburn University, Auburn, AL*

**March 24 - 26**





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# Host Message

## Coastal Plain Chapter of the Society for Ecological Restoration

Welcome to the Society for Ecological Restoration Coastal Plain Chapter 2009 Annual Symposium and Membership Meeting! We are so excited to explore this year's theme of "Restoration in the Southeast with a Focus on Military Lands". Military lands provide a significant repository of natural resource value within a working landscape throughout the Southeast. Many of these lands have had ongoing management or restoration activities that pioneer or provide valuable insight into new restoration techniques that are then used on other non-military lands in the region. Although integration of military needs and natural resource value protection will continue to be an ongoing concern at the national and local levels, the natural resources that do occur within military or former military lands will continue to provide significant building blocks for conservation activities throughout the Southeast. The conference will provide an exciting opportunity to review projects and practitioners leading the way on these sorts of restoration projects as well as receive updates on new and exciting aspects of restoration in more traditional settings.

Thanks to the hard work of the Conference Committee we have a great schedule of speakers, as well as interesting restoration field trips lined up for the conference. I am looking forward to 3 days of highly motivating interaction and look forward to the development of exciting collaborations for the chapter's future. If you are not currently a member of SER, please consider joining during the conference. I would like to personally invite anyone that is interested in becoming more involved in our organization to please introduce yourself over the next couple of days and consider actively participating on one of the committees. Enjoy your time in Auburn!

Randy Mejeur - CPC President

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**2009 CONFERENCE COMMITTEE:** John McGuire, Sean McGary, John Kush, and Randy Mejeur

## Conference Agenda ~ Tuesday March 24

**8:00 – 10:00 A.M. Registration**

**8:30 A.M. Welcome**

**SFWS**

CPC President: Randy Mejeur and SFWS Representative

**8:45 – 10:00 A.M. Conference Kickoff**

**SFWS**

*Presenter: James Parker, Chief of Land Management, Fort Benning*

**Sustainable Forestry from the Land Manager's Perspective - Fort Benning Case Study**

This presentation will focus on a description of restoration and conservation activities within Fort Benning.

*Presenter: Wade Harrison*

**Conservation Buffers on Military Lands: Thinking Outside the Box;** Wade Harrison, Brant Slay, Michele Elmore;

Conservation buffers around military bases support military readiness and the sustainability of training lands for U.S. armed forces. Protected “bufferlands” limit encroaching land uses incompatible with both military training and natural resource management, effectively increasing the land area inside a military base. Bufferlands can also be used to restore habitat for imperiled species of concern to both military installation managers and conservationists. We will describe examples from the Army Compatible Use Buffer (ACUB) program at Fort Benning.

**10:00 – 10:15 Break**

**10:15 – 11:55 A.M. Technical Paper Session**

**SFWS**

**Session A** – Moderator: John McGuire

**10:15 – 10:30 Barrier island restoration on Eglin Air Force Base, Florida.** *M. Thetford and D. Miller.*

**10:30 – 10:50 Erosion Control and Sediment Reduction Program, Eglin AFB, FL.** *W. Pizzolato.*

**10:50 – 11:10 Influence of herbicide site preparation treatments on longleaf pine seedling growth, groundcover vegetation, and fuels composition: implications for longleaf pine restoration and long-term fire management on Fort Benning, GA.** *R. Addington, T. Greene, M. Elmore, C. Prior, and W. Harrison.*

**11:10 – 11:30\* Leptographium, its vectors, and longleaf pine decline: Implications for longleaf restoration at Fort Benning, GA.** *J. Zanzot and L. Eckhardt.*

**11:30 – 11:50 So many acres, so little time: Measuring landscape-level restoration success within longleaf pine communities on Eglin AFB.** *B. Williams.*

**11:55 A.M. – 1:30 P.M. Lunch Break**

**On Your Own**

**1:30 – 2:15 P.M. Keynote Address**

**SFWS**

*Presenter: Dean Gjerstad, Professor Emeritus, Auburn University*

This keynote address will focus on the history and current state of longleaf pine restoration in Alabama.

**2:15 – 2:30 P.M. Break**

**2:30 – 5:00 P.M. Technical Paper Session**

**SFWS**

**Session B** – Moderator: Sean McGary

**2:30 - 2:50\* Seedling recruitment of an endangered pitcher plant in a mesic restored and a wet unrestored Fall-Line Sandhill community.** *J. Chesser and S. Brewer.*

**2:50 – 3:10 The extent of invasive plant occupation of southern forests and preserves.** *J. Miller.*

**3:10 – 3:30\* Longleaf pine seedling growth in response to light and moisture under varying canopy densities.** *D. Dyson, E. Loewenstein, S. Jack, D. Brockway, and D. Gjerstad.*

**3:30 – 3:50 Restoration at the landscape scale in two mitigation banks in coastal northwest Florida, USA.** *J. Tobe, J. Moyers, S. Shea, and A. Davis.*

**3:50 – 4:00 BREAK**

**4:00 – 4:20\* Restoring little bluestem and broomsedge to upland forests in northern Mississippi.** *E. Maynard and S. Brewer.*

**4:20 – 4:40 Gopher tortoise mitigation bank management and restoration.** *J. McGuire and S. McGary.*

**4:40 – 5:00 Restoration considerations for the Sweetwater Mitigation Bank located in Bay County, USA.** *D. VanNostrand, J. Tobe, A. Davis, and A. Griffin.*

**5:00 – 6:30 P.M Social and Poster Presentation SFWS**

Developing a decision support framework for sandhill restoration on Eglin AFB. *D. Steen.*

Select soil physical properties associated with loblolly pine decline at Fort Benning Military Reserve, Georgia. *E. Carter, L. Eckhardt, R. Menard*

Ecological and molecular evidence suggests that *Leptographium serpens* is a recent introduction to southeastern forests. *J. Zanzot, Z.W. de Beer, M. Wingfield, and L. Eckhardt.*

Effects of oleoresins and terpenoids on fungal growth associated with pine decline in the southern United States. *L. Eckhardt, R. Menard, E. Gray*

The Pathogenicity and Virulence of Southeastern Blue-stain *Leptographium* species to Southern Pine Seedlings and Immature Longleaf Pine Trees. *G. Matusick and L. Eckhardt*

Longleaf pine nutrition and decline symptoms at Fort Benning Military Reserve—their application in responding to pine decline in the Southeast. *M.A. Sword Sayer, L. Eckhardt, and E. Carter*

**6:30 P.M. Dinner on your own**

## Conference Agenda ~ Wednesday March 25

**8:30 – 10:00 A.M. SER CPC Membership Meeting SFWS**

**10:00 – 10:15 A.M. Break**

**10:15 – 11:15 A.M. Plenary Presentations SFWS**

What the Escambia Experimental Forest Has and Can Provide for Restoration Efforts. *John S. Kush and Dale G. Brockway.*

A dual approach to longleaf restoration at Horseshoe Bend National Military Park. *Sharon M. Hermann, John S. Kush, and John Gilbert.*

**11:15 – 12:15 P.M. Technical Paper Session SFWS**

**Session C** – Moderator: John Kush

11:15 – 11:35 Restoration of longleaf forest of the Gulf Coastal Plain. *K. Outcalt and D. Brockway.*

11:35 – 11:55 Restoration of longleaf pine communities on the Mountain Longleaf National Wildlife Refuge. *L. Samuelson, T. Stokes, J. Kush, J. Gilbert, and M. Farris.*

11:55 – 12:15\* Longleaf pine establishment with non-traditional silviculture: early effects of harvesting treatments on ground layer vegetation at two military installations. *B. Knapp, J. Walker, H. Hu, and G. Wang.*

**12:15 – 1:30 P.M. Lunch Break On Your Own**

**1:30 – 3:10 P.M. Technical Paper Session SFWS**

**Session D** – Moderator: Randy Mejeur

1:30 – 1:50 Restoration of tidally-influenced sawgrass marsh on Bennett Bayou in the Pascagoula River system, Jackson County, MS. *J. Kelly.*

1:50 – 2:10 Development and Implementation of Freshwater Mollusk Recovery Efforts in Alabama. *M. Buntin, P. Johnson, and T. Fobian.*

2:10 – 2:30\* Damage associated with inoculation of mature longleaf and loblolly pine roots with four blue-stain *Leptographium* species. *G. Matusick and L. Eckhardt.*

2:30 – 2:45 BREAK

- 2:45 – 3:05 **Effect of planting treatments on first-year survival of American chestnut.** *J. Franklin.*
- 3:05 – 3:25 **Restoring the Kentucky lady's slipper orchid in the Kisatchie National Forest: a progress report.**  
*J. Barnett, S. Sharp, K. Allen, and A. Scott.*
- 3:25 – 3:45 **Loblolly pine restoration in cogongrass (*Imperata cylindrica*) infested areas.** *W. Faircloth, J. Miller,*  
*and M. Patterson.*

\* Denotes Student Presentation

**4:05 – 4:15 P.M. Closing Remarks**

**4:15 P.M. Dinner on your own**

## Conference Agenda ~ Thursday March 26

**7:30 – 8:00 A.M. Breakfast on your own**

**8:00 A.M – 5:00 P.M. Field Trip**

### Field Trip #1 – Fort Benning/TNC Bufferland

Covering approximately 180,000 acres, Fort Benning straddles the boundary between Georgia and Alabama in the Fall-line Sandhills physiographic region. In addition to the extensive longleaf pine habitats occurring within the base, wetland and floodplain systems associated with the Chattahoochee River, river bluffs, seepage bogs, and seasonal herbaceous ponds also occur. This field trip will review selected restoration projects within Fort Benning and/or adjacent lands acquired by the Nature Conservancy as part of the Army Compatible Use Program.

This field trip will require a minimum of 8 people and a maximum of 22 people.

Approximate length of field trip: day long

### Field Trip #2 – Horseshoe Bend National Military Park

The Horseshoe Bend National Military Park site preserves the location of a significant battle in the Creek War between an army led by General Andrew Jackson and Upper Creek warriors. The park is home to remnant mountain longleaf pine habitats, much of which has not experienced fire in many years. Restoration activities within the park have included the re-introduction of fire to existing longleaf pine stands.

This field trip will require a minimum of 8 people and a maximum of 22 people.

Approximate length of field trip: day long

**5:00 P.M. Depart**

## Oral Presentation Abstracts

### **INFLUENCE OF HERBICIDE SITE PREPARATION TREATMENTS ON LONGLEAF PINE SEEDLING GROWTH, GROUND COVER VEGETATION, AND FUELS COMPOSITION: IMPLICATIONS FOR LONGLEAF PINE RESTORATION AND LONG-TERM FIRE MANAGEMENT ON FORT BENNING, GA**

- Robert N. Addington, The Nature Conservancy, Fort Benning, GA. [raddington@tnc.org](mailto:raddington@tnc.org)
- Thomas A. Greene, The Nature Conservancy, Atlanta, GA.
- Michele L. Elmore, Catherine E. Prior, and Wade C. Harrison, The Nature Conservancy, Fort Benning, GA.

Site preparation treatments are common in longleaf pine restoration projects to promote initial establishment and growth of planted longleaf pine seedlings. Yet, site preparation should also be aimed at enhancing herbaceous vegetation and fine fuels to increase the likelihood that long-term management can be achieved with fire alone. We report results from a field study on Fort Benning, GA, initiated in 2002 to evaluate the response of seedlings, groundcover vegetation, and fine fuels to two herbicide site preparation treatments – imazapyr/glyphosate and hexazinone. Compared to an untreated control, treatment effects on seedling growth were apparent within two years – root collar diameter was an average 40% higher on treated plots while height growth was two-fold greater. Treatment effects on

woody stem density were variable, but by 2006 hexazinone treated plots had significantly fewer woody stems compared to imazapyr/glyphosate and control plots, and both herbicide treatments significantly reduced the density of hardwood tree species. No negative impact on perennial bunch grasses, an important fine fuel, was detected for either herbicide. Sites were burned in 2006 and 2009. Initial fire effects measurements indicated higher fire intensity on treated plots, likely necessary for continued control of woody competition. Overall, hexazinone plots appeared best poised for long-term fire management – release of woody shrubs and vines was lower on hexazinone plots and bluestem grasses also responded well. Our results suggest that herbicide site preparation treatments may decrease the need for future herbicide treatments by better enabling restoration sites to be managed with fire alone.

#### **RESTORING THE KENTUCKY LADY'S SLIPPER ORCHID IN THE KISATCHIE NATIONAL FOREST: A PROGRESS REPORT**

- James Barnett, Emeritus Scientist, USDA Forest Service, Southern Research Station and Newsletter Editor, Central Louisiana Orchid Society, Pineville, LA. [jbarnett@fs.fed.us](mailto:jbarnett@fs.fed.us)
- Shannan Sharp, Botanist, USDA Forest Service, Kistachie National Forest, Bentley, LA
- Kevin Allen, Science Teacher, Captain Shreve High School, Shreveport, LA and
- Andy Scott, Research Soil Scientist, USDA Forest Service, Southern Research Station, Pineville, LA 71360

The Kentucky lady's slipper orchid (*Cypripedium kentuckiense* C.F. Reed) is a tall, stately perennial plant with the largest flowers of any *Cypripedium* known. Its range includes much of the southeastern United States, though it is rare throughout its range due to specific edaphic and climatic habitat requirements. In Louisiana, a few plants are located on four sites within the 600 thousand-acre Kisatchie National Forest (KNF). This effort is to restore one of the most spectacular orchids native to the region. A high school student located a flowering orchid in the KNF, caused it to be pollinated, and later collected a fertile seed pod. A collaborative effort began between Spangle Creek Labs, KNF, Southern Research Station (SRS) and Central Louisiana Orchid Society (CLOS) to restore the

orchid on appropriate sites. Grants in 2006 from the Southwest Regional Orchid Grower's Association and in 2007 from the U.S. Forest Service allowed CLOS to purchase plantlets grown from the collected seed pod. A research study is now underway to develop propagation protocols and compare effects of seedling age, fungal inoculation, and depth and season of planting on establishment success. Three outplanting trials have been installed and information is being collected that will help develop guidelines for *Cypripedium* restoration.

#### **Development and Implementation of Freshwater Mollusk Recovery Efforts in Alabama**

- Paul D. Johnson, Michael L. Buntin and Todd Fobian, Alabama Department of Conservation and Natural Resources, Alabama Aquatic Biodiversity Center, Marion, Alabama.

In 2005 the Alabama Department of Conservation and Natural Resources (ADCNR) created the Alabama Aquatic Biodiversity Center (AABC) to address conservation needs of Alabama's rarest aquatic species. The first 3 years have focused on renovating and constructing new facilities to house the program. Once construction is complete in late 2009, operations will focus on propagation of freshwater mollusks, although initial recovery efforts have been underway for several years. Alabama is home to 80 federally listed or candidate aquatics, and contains the richest freshwater mollusk assemblage in the world. The AABC is also preparing to partner with several other federal, states, university, and private conservation groups to promote species conservation efforts in Alabama. The AABC's recovery efforts will be guided by several plans detailing the conservation related activities such as the controlled propagation, reintroduction and augmentation of freshwater mollusks. These plans represent the efforts of multiple federal and state natural resource agencies to coordinate and guide recovery efforts. To date plans have been drafted for the Mobile and Tennessee river basins and a plan for the eastern Gulf Drainages is under development.

### **SEEDLING RECRUITMENT OF AN ENDANGERED PITCHER PLANT IN A MESIC RESTORED AND A WET UNRESTORED FALL-LINE SANDHILLS COMMUNITY**

- Jason Chesser and Stephen Brewer, University of Mississippi, Oxford, MS. [jdchesse@olemiss.edu](mailto:jdchesse@olemiss.edu)

*Sarracenia rubra* ssp. *alabamensis* is an endangered pitcher plant endemic to central Alabama. Because of its unique life history and habitat requirements, it has been particularly hard-hit by fire suppression, altered hydrologic conditions, and possibly climate change throughout its range. Despite protection efforts, in all but the largest populations, seedling recruitment is not occurring. Even in the largest remaining population, seedling recruitment was extremely low (<<1% of viable seeds produced) and numbers of adults declined continuously between 2003 and 2007. We report the results of laboratory and field experiments investigating the factors that limited seedling recruitment and establishment in the two largest remaining populations which occurred at sites that differed in soil moisture and management. One population was located within a managed preserve along a periodically moist seepage slope subjected to restoration treatments (thinning and spring burning; mesic restored), and the other at an unrestored site within a continuously wet area at the base of a seepage slope (wet unrestored). Seedling recruitment was significantly higher at the wet unrestored site than at the mesic restored site due to a greater abundance of safe sites for germination (specifically, patches of sphagnum) and greater seedling survival as a result of higher soil moisture. Results suggest that soil moisture has a greater effect on seedling establishment than do restoration treatments and that thinning and burning will not compensate for the negative effects of low soil moisture on population declines at drier sites.

### **LONGLEAF PINE SEEDLING GROWTH IN RESPONSE TO LIGHT AND MOISTURE UNDER VARYING CANOPY DENSITIES**

- David S. Dyson, Edward F. Loewenstein, Steven B. Jack, and Dean H. Gjerstad, School of Forestry and Wildlife Sciences, Auburn, AL. [dsd0001@auburn.edu](mailto:dsd0001@auburn.edu)
- Dale G. Brockway, USDA Forest Service, Auburn, AL.

To determine the level of residual overstory that best promotes adequate longleaf pine seedling recruitment, six hundred containerized longleaf pine seedlings were planted on each of two sites—one subxeric and one mesic—in winter 2007-08. To differentiate overstory from understory influences, half of the seedlings at each site were randomly selected for understory removal (with herbicide). Canopy gap fraction was determined above each seedling using hemispherical photography, and average soil moisture was determined from four time domain reflectometer (TDR) measurements at each seedling from May to August, 2008. Seedling groundline diameter (GLD) was measured at time of planting and again in August, 2008. First year results show that mean soil moisture was significantly greater at the subxeric site for both herbicide and control seedlings ( $p < 0.0001$ ) and that understory removal resulted in higher soil moisture at both sites ( $p = 0.0002$ ;  $p = 0.005$ ). Both herbicide and control seedlings at the subxeric site showed significantly greater growth than at the mesic site ( $p < 0.0001$ ). Regression analyses indicate positive relationships between soil moisture and seedling growth for both herbicide and control seedlings. At the mesic site, gap fraction was a significant predictor for growth only within the control treatment ( $p = 0.015$ ). At the subxeric site, a significant relationship ( $\alpha = 0.05$ ) existed only within the herbicide treatment; gap fraction was not statistically significant in either the control or herbicide treatment.

### **LOBLOLLY PINE RESTORATION IN COGONGRASS (*IMPERATA CYLINDRICA*) INFESTED AREAS**

- Wilson H. Faircloth, USDA-ARS, Dawson, GA
- James H. Miller, USDA-Forest Service, Auburn, AL [jmiller01@fs.fed.us](mailto:jmiller01@fs.fed.us)
- Michael G. Patterson, Auburn University, Auburn, AL

Cogongrass is an invasive grass that is rapidly colonizing the Gulf coastal plain, with potential to spread well into the interior of the Southeastern U.S. It is particularly harmful to forested land and contributes to crown fires, displaces native plants and wildlife, and hinders forest regeneration. A study begun in 2001 investigates restoration options for loblolly pine (*Pinus taeda*) in cogongrass-infested areas and quantifies both pine productivity and species diversity impacts. The research site is near

Mobile, AL, close to the initial introduction point for cogongrass. Study treatments included combinations of herbicide site preparation (SP), mechanical SP, first year pine release with herbicides, and both non-treated and “complete” controls.

After 5 years, non-treated plots still had 92% cogongrass cover. The greatest suppression of cogongrass followed the combination of herbicide SP and first year release, resulting in only 55% cogongrass cover. In these plots, suppression of cogongrass was contingent on recruitment of woody understory species such as wax myrtle (*Myrica cerifera*) and yaupon (*Ilex vomitoria*) for additional shading. No other treatment combination gave suppression significantly less than the non-treated control. Loblolly pine was successfully established, even in the non-treated plots, with minimal mortality. Pine volume growth was greatest in the complete control (2X rates of herbicide SP + pine release). There was no defined relationship between pine volume and cogongrass suppression. In summary, loblolly pine was successfully re-established into a cogongrass infestation, while further research is needed on the establishment of a secondary shrub layer to further suppress or eliminate cogongrass.

#### **Effect of Planting Treatments on First-year Survival of American Chestnut**

- Jennifer Franklin, Department of Forestry, Wildlife and Fisheries, Knoxville, TN. [jafranklin@utk.edu](mailto:jafranklin@utk.edu)

Once a major component of eastern US forests, the American Chestnut was nearly eradicated by a blight in the early 1900’s. Blight-resistant individuals will soon be available from the American Chestnut Foundation, and there will be a need for recommended planting methods to maximize establishment. We compared the effectiveness of several planting methods on the establishment and growth of American Chestnut over one growing season. Four hundred seeds, with emerging radicals, were planted on two sites near Elk Valley, Tennessee in the spring of 2008, and monitored monthly until Aug., then bi-weekly to determine the date of budset. Seeds planted in March and April were planted in a factorial experiment with, or without, fertilizer, forest soil, and a water-holding gel. A second planting on the same sites in May used a different style of tree shelter. Survival over the

first growing season was approximately 30%. The use of fertilizer at the time of planting had a negative influence on early emergence and survival. The temperature inside solid plastic tree shelters was 4°C above ambient temperatures, which may have been detrimental to survival during the summer months. Predation rates on an oak and hickory companion planting were high, therefore, the use of well-ventilated tree shelters is recommended.

#### **CONSERVATION BUFFERS ON MILITARY LANDS: THINKING OUTSIDE THE BOX**

- Wade Harrison, Brant Slay, and Michele Elmore, The Nature Conservancy, Fort Benning, GA. [wharrison@tnc.org](mailto:wharrison@tnc.org)

Conservation buffers around military bases support military readiness and the sustainability of training lands for U.S. armed forces. Protected “bufferlands” limit encroaching land uses incompatible with both military training and natural resource management, effectively increasing the land area inside a military base. Bufferlands can also be used to restore habitat for imperiled species of concern to both military installation managers and conservationists. The Defense Department’s buffering authority allows a conservation agency or non-profit to acquire or encumber land around a military base, using military funding appropriated for that purpose. The buffer lands remain in private and/or conservation ownership, protected by a permanent conservation easement if not owned in fee by a conservation entity. We will describe examples from the Army Compatible Use Buffer (ACUB) program at Fort Benning, in which the Army and The Nature Conservancy’s Chattahoochee Fall Line Program have developed a wide range of protection models, including some that facilitate ecological restoration on private lands, and expansion of Fort Benning’s longleaf pine habitat outside its boundaries. Relevant tools include both donated and purchased conservation easements, conservation buyer transactions, private timber sales, carbon credits, species recovery credits, and conservation banking.

## **A DUAL APPROACH TO LONGLEAF RESTORATION AT HORSESHOE BEND NATIONAL MILITARY PARK**

- Sharon M. Hermann, Longleaf Pine Stand Dynamics Laboratory, Department of Biological Sciences, Auburn University [hermasm@auburn.edu](mailto:hermasm@auburn.edu)
- John S. Kush and John Gilbert, Longleaf Pine Stand Dynamics Laboratory, School of Forestry and Wildlife Sciences, Auburn University

Horseshoe Bend National Military Park (HOBE), a National Park Service (NPS) site in Tallapoosa County Alabama, has begun to restore longleaf pine forest. Although HOBE has not experienced fire in 50+ years, we documented almost 2,000 residual longleaf pine over 2,040 acres. Because of potential conservation value of residual trees, we proposed a dual approach to forest restoration for HOBE: 1) promote seedling establishment in vicinity of residual longleaf and 2) create appropriate conditions and plant in small gaps in the remainder of the area. We evaluated the distribution of residual longleaf and determined that more than 80% of the property is outside of seed dispersal distance of existing trees. This means that to restore longleaf, planting will eventually be required over much of the site. On the other hand, 20% of the landscape that supports residual trees is potentially decades closer to a functioning longleaf forest, if the residual trees can survive the re-introduction of fire. In 2006, after more than fifty years with no burns, the NPS re-introduced fire in montane longleaf pine stands at HOBE. Fire appears to be removing some but not all of the duff and off-site trees. Survivorship of residual second-growth trees is a special concern in part because of benefits they could provide a forest restoration plan. Retention of mature trees will provide opportunities for natural regeneration decades ahead of a restoration plan that relies solely on planting. The project is supported by NPS, National Fish and Wildlife Foundation, and the Southern Company.

## **RESTORATION OF TIDALLY-INFLUENCED SAWGRASS MARSH ON BENNETT BAYOU IN THE PASCAGOULA RIVER SYSTEM, JACKSON COUNTY, MS**

- Jim Kelly, Eco-Logic Restoration Services, LLC. [jkelly@ecologic-restoration.com](mailto:jkelly@ecologic-restoration.com)

Sawgrass (*Cladium jamaicense*) is a rhizomatous sedge in the *Cyperaceae* family. Sawgrass marshes supply important wildlife habitat and provide water quality functions like filtration, sediment capture, and erosion control. Following the hurricanes of 2005, Gulf Coast residents became acutely aware that these coastal marshes also play a critical role in floodwater attenuation and retention. Bennett Bayou is a tributary to the Pascagoula River. A large canal and boat basins were dredged through a sawgrass marsh in the headwaters of this bayou to provide direct river access for operation of a marina. Dredged material was side-cast onto the adjacent marsh and graded for use as a parking area. Riprap used for erosion control along the banks of the canal and basins further degraded ecological function. The Land Trust for the Mississippi Coastal Plain acquired the Bennett Bayou property in February 2006. Restoration of the 1.5 acre sawgrass marsh began in January 2007. Approximately 2,300 cubic yards of material was excavated to re-establish the site's historical elevation. Following a short consolidation period, more than 16,000 plants were installed. This is the first known restoration of tidally-influenced sawgrass marsh in Mississippi. It was made possible by funding and collaboration of numerous public and private entities. The Land Trust received a Bronze Plaque Recognition Award from the U.S. Environmental Protection Agency's Five Star Restoration Program for this project. Restoration techniques employed at Bennett Bayou and the site's current vegetative composition are presented. Funding mechanisms used and public-private partnerships formed for the project are also identified.

## **LONGLEAF PINE ESTABLISHMENT WITH NON-TRADITIONAL SILVICULTURE: EARLY EFFECTS OF HARVESTING TREATMENTS ON GROUND LAYER VEGETATION AT TWO MILITARY INSTALLATIONS**

- Benjamin O. Knapp and Joan L. Walker, Research Technician and Research Plant Ecologist, respectively, USDA Forest Service, Southern Research Station, Clemson, SC [bknapp@fs.fed.us](mailto:bknapp@fs.fed.us)
- Huifeng Hu and G. Geoff Wang, Graduate Student and Associate Professor in Silviculture/Ecology, respectively, Clemson University, Clemson, SC

Throughout the southeastern United States, land managers on military installations are interested in restoring longleaf pine forests to upland sites currently occupied by loblolly pine, especially those supporting populations of red-cockaded woodpeckers. However, ecological variation within the longleaf pine range suggests that similar management practices may not produce the same results at every site. We installed an experiment to test the effects of seven harvesting treatments (four with uniform thinning and three with patch cutting) on different aspects of longleaf pine ecosystem restoration at two ecologically distinct installations: Fort Benning, GA and Camp Lejeune, NC. Uniform treatments used single-tree selection to manipulate residual stand basal area (uncut control, residual basal area of 9 m<sup>2</sup>/ha, residual basal area of 4.5 m<sup>2</sup>/ha, and complete canopy removal), and patch cuts created gaps in the canopy of three different sizes (1257 m<sup>2</sup>, 2827 m<sup>2</sup>, and 5027 m<sup>2</sup>). The study treatments significantly affected the total cover of ground layer vegetation by the end of the first growing season after treatment (Fort Benning  $p < 0.0001$ , Camp Lejeune  $p = 0.0003$ ), with harvesting resulting in increased cover at each installation. However, composition differed between the installations: at Fort Benning, ground layer vegetation was dominated by herbaceous species, with a high component of forbs, while at Camp Lejeune we found greater cover of woody species and very little forb cover. Results suggest that management should be dependent on specific objectives and site conditions, as one set of management guidelines may not be suitable for all sites.

#### **WHAT THE ESCAMBIA EXPERIMENTAL FOREST HAS AND CAN PROVIDE FOR RESTORATION EFFORTS**

- John S. Kush, School of Forestry and Wildlife Sciences, Auburn University, Auburn, AL [kushjoh@auburn.edu](mailto:kushjoh@auburn.edu)
- Dale G. Brockway, Southern Research Station, USDA Forest Service, Auburn, AL

Longleaf pine was a research priority for the Forest Service from the 1920s through the 1960s. During that time, much incredible research was completed, most of which could not be replicated today. Research on longleaf pine was believed to be so important that the Forest Service established the Escambia Experimental Forest (EEF) on a 3,000-acre tract

of private land near Brewton, Alabama owned by the T.R. Miller Mill Company. Because of its interest in the higher prices commanded by longleaf pine timber, the company leased this property to the Forest Service in 1947 as an experimental laboratory. It was hoped that Forest Service scientists would find ways to restore longleaf pine, since its regeneration was largely ignored as the forests of the South were being systematically harvested. Thus, the EEF was established to focus on small landowner needs relative to the proper procedures for effectively managing longleaf pine forests.

Despite substantial early progress, a policy shift in the mid-1970s favoring more artificial regeneration caused a de-emphasis of research related to the natural regeneration of longleaf pine. Therefore, the need for the 3,000-acre forest was questioned and the Forest Service seriously considered giving up the lease for the EEF. However, two Forest Service scientists argued that long-term studies at the EEF could not simply be abandoned, because the research they were doing there on prescribed burning needed to continue. Their research was showing that regular, supervised fires were necessary for good forest management, despite many efforts to limit prescribed burning in the South.

In addition to the focus on regeneration and prescribed burning, there are several other areas in which the EEF has contributed to knowledge about longleaf pine. The "Farm 40," a 40-acre tract at the EEF, has been managed for 60 years to show a small landowner the wide variety of products that can be produced on a piece of land this size. There are numerous research plots examining tree growth and mortality. The EEF also has three demonstrations of uneven-aged management. And this year, the first series of hurricane-salvage replacement plantations was installed. The list goes on. Research at the EEF has produced more than 200 publications that have significantly influenced the sustainable management of longleaf pine forests. This presentation will provide an overview of 60 years of research.

**DAMAGE ASSOCIATED WITH INOCULATION OF MATURE LONGLEAF AND LOBLOLLY PINE ROOTS WITH FOUR BLUE-STAIN LEPTOGRAPHIUM SPECIES**

- George Matusick and Lori Eckhardt, Auburn University, School of Forestry and Wildlife Sciences, Forest Health Dynamics Laboratory. [matusge@auburn.edu](mailto:matusge@auburn.edu)

Premature pine mortality has been consistently observed in the southeast over the past few decades. Studies concerning potential causes of mortality have identified several biotic and abiotic factors positively associated with symptoms in mature trees. The presence and damage of root-inhabiting bark beetles and their associated blue-stain fungi have been commonly observed prior to the onset of decline symptoms in southern pines. Root damage associated with bark beetle and blue-stain fungal damage has led to examining the relationship between blue-stain fungal introductions and the associated host response. Five different southern pine stands were used to treat a total of 1080 pine roots with one of four commonly isolated root-inhabiting *Leptographium* species. The study was conducted in both the fall (2006) and spring (2007) seasons, then repeated in its entirety in five different pine stands from 2007-2008. Host response to fungal inoculation was measured on each treated pine root through a series of physical changes resulting from infection. A severe hypersensitive host response to infection was observed in both loblolly and longleaf pine roots in each of the treated stands. All blue-stain *Leptographium* species consistently caused a significantly larger response than controls. *Leptographium huntii* and *L. serpens* generally illicit the strongest host response, commonly damaging an estimated forty percent of root tissue surrounding inoculation points. Host response to infection was more intense during spring experiments. These data illustrate blue-stain *Leptographium* species are capable of causing a significant host response following introduction, often resulting in significant damage to root conducting tissues.

**RESTORING LITTLE BLUESTEM AND BROOMEDGE TO UPLAND FORESTS IN NORTHERN MISSISSIPPI.**

- Erynn Maynard and Stephen Brewer, Department of Biology, University of

Mississippi, Oxford, MS.  
[eemaynar@olemiss.edu](mailto:eemaynar@olemiss.edu)

In the early 1800s, upland plant communities of north-central Mississippi contained open, self-replacing stands of fire-tolerant oaks. Most areas protected from disturbance are now closed-canopy forests with a mixture of oaks and floodplain species. Although quantitative historical data are lacking, anecdotal evidence suggests that flammable warm-season grasses occurred in the understory of these forests. Restoring these grasses to the understory would be faithful to the original composition of these communities and could provide land managers with greater flexibility in the timing of effective prescribed burning. To elucidate the environmental conditions that favor *Schizachyrium scoparium* and *Andropogon virginicus* and natural regeneration of oaks, we utilized an existing restoration experiment initiated at Strawberry Plains Audubon Preserve in 2004. The experiment included prescribed burning and thinning of off-site trees paired with controls at two sites. Each site contained two or more 10 x 30 m plots, subdivided into 7 to 13 1.5 x 1.5 m sampling subplots. Discriminant analysis was used to contrast environmental conditions between samples that contained grasses and oak saplings from those that contained one or the other or neither. The presence of grasses and oak saplings declined with increasing canopy cover, silt/sand ratio, and distance to the nearest forest edge. Grass occurrence was also negatively associated with litter depth. Results suggest that the canopy structure that historically favored self-replacing stands of oaks likely favored flammable grasses. Maintaining open canopies and reduced leaf litter (through thinning and frequent fires) will likely facilitate restoration of flammable grasses.

Contact information:

**THE EXTENT OF INVASIVE PLANT OCCUPATION OF SOUTHERN FORESTS AND PRESERVES: WHAT IS OUR PATH FROM HERE FOR "RESTORATION".**

- James H. Miller, Ecologist, US Forest Service, Southern Research Station, Auburn, AL. [jmiller01@fs.fed.us](mailto:jmiller01@fs.fed.us)

Invasive plant surveys have been underway on all forestlands in the 13 southern states for the past 8 years. USDA Forest Service Research in partnership with State forestry agencies initiated a Southern Region survey of 33 invasive plant

taxa in 2001 on all forest ownerships. The Nonnative Invasive Plant Species (NNIPS) selected for survey were regionally recognized exotic pest plants known to invade interior forests and forest edges, gaps and stream-sides. The recently compiled maps and cover estimates by State and Counties reveal a level of occupation unrealized before. Overall, 9 percent of all forested lands in the region are occupied by one or more invasive species—18 million acres. Certain invasive plants are entering and spreading by sub-regions, which provides new insights for their management. These maps and occupation estimates provide a new reality that must be carefully considered when regional, state, and local management plans are formulated. They also give insights into the anticipated future composition of our forests in the South and how restoration will play perhaps a new and certainly pivotal role. Maps and estimates will be shared and implications for restoration in a landscape with “new” and aggressive plant participants will be postulated.

#### **RESTORATION OF LONGLEAF FOREST OF THE GULF COASTAL PLAIN**

- Kenneth W. Outcalt, USDA Forest Service, Athens, GA. [koutcalt@fs.fed.us](mailto:koutcalt@fs.fed.us)
- Dale G. Brockway, USDA Forest Service, Auburn, AL.

Historically longleaf pine (*Pinus palustris* Mill.) communities of the Gulf Coastal Plain burned every 2 to 4 years with low intensity fires, which maintained open stands with a herbaceous dominated understory. Reduced fire frequency allowed hardwoods to increase in the mid and overstory layers while woody shrubs gained understory dominance. A research study in cooperation with Auburn University was installed at the Solon Dixon Forestry and Education Center near Andalusia, Alabama. The objective was to compare treatments for restoration of this ecosystem. Treatments included an untreated control (no fire or other disturbance), prescribed burning only, thinning of selected trees, a combination thinning plus prescribed burning, and herbicide plus prescribed burning. After four prescribed burns applied biennially during the early growing season, there were positive changes in ecosystem composition. Thinning treatments reduced overstory hardwood component the most but burning also removed some hardwoods, especially when combined with other treatments. All treatments that included burning reduced midstory hardwoods and tall shrubs. Burning was also required to

keep woody understory in check and promote herbaceous growth. Herbicide application followed by burning was superior for reducing live woody understory, but this benefit must be weighed against the extra cost incurred.

#### **EROSION CONTROL AND SEDIMENT REDUCTION PROGRAM, EGLIN AFB, FL**

- William “Sandy” Pizzolato, Research Associate III, Colorado State University Center for Environmental Management of Military Lands for 96CEG/CEVSNF Eglin AFB Natural Resources Forestry Element. [pizzolat@eglin.af.mil](mailto:pizzolat@eglin.af.mil)

Eglin Air Force Base (AFB) is the largest forested military reservation in the United States containing a diverse species assemblage bordering Choctawhatchee Bay. The Endangered Species Act of 1973 is the primary legal requirement intended to conserve ecosystems and Eglin AFB manages two aquatic species: 1) Okaloosa darter (*Etheostoma okaloosae*), a small, freshwater fish whose entire global population is endemic to coastal Okaloosa and Walton Counties, FL, and 2) Gulf sturgeon (*Acipenser oxyrinchus desotoi*), a large fish whose critical habitat includes Choctawhatchee Bay and Yellow River. Significant soil loss resulting in habitat modification include: 1) test range vegetation control practices, 2) borrow pit runoff, and 3) unpaved stream crossings. Eglin AFB Natural Resources is responsible for maintaining a GIS database, prioritizing watershed site selection, reviewing design plans and budgets, and implementing a maintenance program. The Natural Resources Conservation Service Three Rivers Resource Conservation & Development Council assists Eglin AFB with technical assistance in design, construction, and contract administration. Rehabilitated sites include engineered plans using barrier controls, earthen diversions, sediment detention basins, drainage structures, and naturalized vegetation. These features result in a stabilized landscape, improved wildlife habitat, and longer runoff retention essential in these watersheds. Okaloosa darter populations have increased significantly since 1997 and will be down listed to threatened status in 2009. To date, Eglin AFB Natural Resources personnel rehabilitated 93 borrow pits and 433 nonpoint, pollution sediment sites totaling 763 acres resulting in soil loss reduction of more than 117,000 tons/acre/year.

## **RESTORATION OF LONGLEAF PINE COMMUNITIES ON THE MOUNTAIN LONGLEAF NATIONAL WILDLIFE REFUGE**

- Lisa J. Samuelson, Tom A. Stokes, John Kush, John Gilbert, and Marianne Farris, Center for Longleaf Pine Ecosystems, School of Forestry and Wildlife Sciences, Auburn University, AL [samuelj@auburn.edu](mailto:samuelj@auburn.edu)

Mountain longleaf pine (*Pinus palustris* Mill) forests are a diminishing component of the once vast longleaf pine forests of the Southeast maintained by fire. The Mountain Longleaf National Wildlife Refuge (MLNWR) on what was Fort McClellan holds significant acreages of mountain longleaf pine. Because of a lack of historical information, data are needed on forest structure and fuel loads to maintain and restore longleaf communities. Our objectives were to: (1) establish monitoring plots, (2) document herbaceous and woody vegetation, and (3) measure biodiversity, forest structure, and fuel loads in response to varying fire and management histories. Plots were categorized by burn year (2008, 2006, 2004, no burn) and by hardwood control (HC, no HC). Shannon Diversity Index ( $H'$ ), species richness, importance value ( $IV_{200}$ ), ground cover, and fuel loads were measured in the summer of 2008. We identified 23 and 22 different woody species in the overstory and understory, respectively. Longleaf basal area was highest in stands burned in 2006 and 2004 and with HC. The  $IV_{200}$  of longleaf in the understory was greatest in stands burned in 2006. Higher  $H'$  and species richness in the overstory was observed in the 2008 and in no burn stands, which indicated greater diversity and number of hardwood species, many of which are not typically found in fire maintained longleaf pine ecosystems. High humus and duff layers in all treatments indicated the lack of regular fire intervals. This study highlights the importance of fire and hardwood control in maintaining montane longleaf pine.

## **BARRIER ISLAND RESTORATION ON EGLIN AIR FORCE BASE, FLORIDA**

- Mack Thetford and Debbie Miller, University of Florida, West Florida Research and Education Center, Milton, FL 32583, [thetford@ufl.edu](mailto:thetford@ufl.edu)

Fragmentation of Barrier Island landscapes by frequent and severe storms and coastal development has renewed the need for focused

efforts on barrier island restoration. Santa Rosa Island, FL, a barrier island in the northern Gulf of Mexico, much of which is managed by Eglin Air Force Base, has experienced frequent and severe coastal storms over the past 15 years. Limited prior research and a need for restoration protocols to address the loss of dunes, plant communities, and wildlife habitat led to the development of our 14 year research program. This interdisciplinary program includes collaboration among a plant ecologist, horticulturist, wildlife behaviorist and a geomorphologist with the goal to develop and integrate information resulting in restoration procedures. Information about natural regeneration of vegetation, use of the landscape by beach mice (*Peromyscus polionotus*), and dynamics of sediment movement following storms have been integrated in restoration research. Examples of program success include recommendations for location and orientation of sand fence to promote sand accumulation and protocols for coastal plant propagation and production. Much focus has been on testing where, when and how to reestablish coastal vegetation for dune development, wildlife food and restoration of habitat. Specific recommendations include information on propagation of Florida rosemary (*Ceratiola ericoides*), beach elder (*Iva imbricata*), and maritime bluestem (*Schizachyrium maritimum*), recommendations for season of planting for Sea Oats (*Uniola paniculata*), bitter panicum (*Panicum amarum*) and maritime bluestem and influence of production container volume or depth on woody transplant success. The overall impacts of this collaborative program will be the continued development of procedures to guide restoration efforts on gulf coast barrier islands.

## **ESTORATION AT THE LANDSCAPE SCALE IN TWO MITIGATION BANKS IN COASTAL NORTHWEST FLORIDA, USA.**

- John D. Tobe and Alani Davis, Ecologic Restoration and Conservation, Ecological Resource Consultants, Inc., Tallahassee, Florida [jtobe@ecoresource.com](mailto:jtobe@ecoresource.com)
- Jim Moyers and Steve Shea, Wildlife Biologist, St. Joe Company, Ecological Services, Panama City, Florida.

Florida allows wetland mitigation bank permitting and as part of the regional general permit process in northern Florida, two mitigation banks, Breakfast Point (5,031 acres) and Devils

Swamp (3,049 acres) were set up in northwest Florida, USA. Their purpose is to offset impacts to wetlands in the bank service area and enhance and restore the ecological functions of wetlands on the mitigation banks. Our fundamental management goal is to restore the structure and function to appropriate native plant communities and restore the hydrology through road removal and low water crossings. The combined plant ecology of both mitigation bank landscapes includes all major upland and wetland plant communities associated with the near coastal environment. We have developed long and short-term management methods after five years of active ecological restoration of these formerly degraded landscapes. Restoration activities have focused on mechanical reduction of the industrial pine plantation canopy, restoration of the groundcover diversity, hydrologic sheet flow and re-introduction of prescribed burning into a fire suppressed landscape of 50 years. To measure our management, illustrate ecological trends in the landscape and provide direction regarding adaptive management, qualitative and quantitative transects and monitoring wells are measured annually. We have found that qualitative measure of plant life form and species richness are two of the most important metrics of plant community recovery. We have also observed unexpected hydrologic dynamics associated with saline/tidal storm overwash.

#### **RESTORATION CONSIDERATIONS FOR THE SWEETWATER MITIGATION BANK LOCATED IN BAY COUNTY, USA.**

- Dan VanNostrand, John Tobe, Alani Davis, and Ashley Griffin, Ecologic Restoration and Conservation, Ecological Resource Consultants, Inc., 631 East 6<sup>th</sup> Avenue, Tallahassee, Florida 32303, USA. [jtobe@ecoresource.com](mailto:jtobe@ecoresource.com)

To effectively set up a mitigation bank and write an appropriate mitigation bank instrument or permit for the Sweetwater site, the plant communities within the site must be correctly identified and delineated as georeferenced polygons. Each polygon is qualitatively measured using the Unified Mitigation Assessment Methodology (UMAM) in pre and post restoration landscape scenarios. The post UMAM measurements are dependent on many speculative future outcomes. To empirically predict what should be appropriate performance

standards, we have quantitatively measured representative plant community polygons and used experimental seed bank studies to sample areas that are currently without significant groundcover. Currently the landscape consists of fire suppressed wet prairie, bog and pine flatwoods. Basin swamps were included at the request of the regulatory agencies but are best described as representative of the wettest type of fire suppressed bog. During the permit writing process and negotiations, we have found that expectations from the regulatory community are sometimes at odds with the proposed management and ultimate “vision” of the restored landscape. To manage expectations, we quantitatively measured reference sites to better understand and describe the structure and function of representative landscapes within the mitigation bank. In this presentation, we examine the usefulness of our landscape studies, on-site and off-site reference sites, and seed banks studies to develop scientifically based success criteria and restoration targets.

#### **SO MANY ACRES, SO LITTLE TIME: MEASURING LANDSCAPE-LEVEL RESTORATION SUCCESS WITHIN LONGLEAF PINE COMMUNITIES ON EGLIN AFB**

- Brett Williams, Jackson Guard, Eglin AFB, Niceville, FL 32578. [Brett.williams@eglin.af.mil](mailto:Brett.williams@eglin.af.mil)

Ecosystem restoration at Eglin AFB is guided by an objective-based, adaptive management approach rooted in a formal conservation planning process as outlined in Eglin’s Integrated Natural Resources Management Plan (INRMP). Iterative conservation planning efforts focus on the identification of community and species-level targets, desired ecological conditions for these targets, and strategies for restoring targets to within their “natural” range of variation. Longleaf pine sandhills and flatwoods occupy approximately 80% of the Eglin reservation, and contemporary restoration of these communities has centered primarily on large-scale removal of Choctawhatchee sand pine, red-cockaded woodpecker habitat improvement, and the reintroduction of a frequent (1-5 year FRI), low-intensity fire regime. In order to measure landscape-level restoration success, as well as to track trends in ecological condition, a long-term vegetation monitoring program was developed at Eglin in 2001. The monitoring program relies on 200 - 1 ha

permanent vegetation plots, sampled based on the modular design of the North Carolina Vegetation Survey (NCVS), coupled with a spatially explicit, expert informed ecological condition model. The utility of this model-based approach lies in the ability of resource-limited managers to assess landscape-level change in ecological condition of these communities in response to restoration and management regimes through remote sensing techniques. Concurrently, the network of permanent plots allows managers to ground-truth spatial model results as well as to answer specific restoration effectiveness questions that can provide feedback to management.

#### **LEPTOGRAPHIUM, ITS VECTORS, AND LONGLEAF PINE DECLINE: IMPLICATIONS FOR LONGLEAF RESTORATION AT FORT BENNING, GA.**

- Zanzot, James W. and Lori G. Eckhardt. School of Forestry and Wildlife Sciences, Auburn University, AL. [zanzojw@auburn.edu](mailto:zanzojw@auburn.edu).

Southern pine decline has been of concern to foresters for years. Decline-like symptoms have also been observed in longleaf pine (*Pinus palustris*), which has affected efforts to restore this once dominant species. *Leptographium* spp. and their beetle vectors have been shown

to be important contributing factors in loblolly pine decline, and a risk model (LPDRM) was developed for predicting loblolly stands likely to exhibit decline. An objective of this study was to test the LPDRM's ability to predict longleaf pine decline at Fort Benning, GA. Plots were installed in high and low risk longleaf pine stands in 4 age classes. Roots were excavated and examined for damage and *Leptographium* infection. Crowns were assessed using a Forest Service protocol. Increment cores were taken, and standing resin reserves measured. Populations of root-feeding beetles were monitored for 2 Springs (2006, 2007) and one continuous year (August 2006-August 2007), and were rolled to determine infestation with *Leptographium* spp. Decline symptoms were rarely observed on any of the plots, and few of the predictions of the LPDRM were satisfied. *Leptographium* infection was observed on trees in both decline categories and in all age classes, although above ground symptoms were not apparent. Insect populations were lower than previous observations in loblolly pine at Fort Benning, and infested beetles were active during most of the year. While these data suggest poor predictive power of the LPDRM in longleaf stands, an empirical case-control study comparing actively declining stands and asymptomatic stands is recommended.

## Poster Presentation Abstracts

#### **SELECT SOIL PHYSICAL PROPERTIES ASSOCIATED WITH LOBLOLLY PINE DECLINE AT FORT BENNING MILITARY RESERVE, GEORGIA**

- Emily A. Carter, U.S. Forest Service, Southern Research Station, Auburn, AL
- Lori G. Eckhardt, School of Forestry and Wildlife Sciences, Auburn University, AL
- Roger D. Menard, U.S. Forest Service, Forest Health Protection, Pineville, LA

Loblolly pine (*Pinus taeda* L.) decline has been reported in the southeastern U.S. for several years, and recently a concern of land managers at Fort Benning, GA. A study was initiated in 2003 to examine soil and biological characteristics of sites identified as in decline or healthy according to Forest Service protocols and potentially link specific site conditions with tree status. Previous investigations have identified specific site conditions of poor internal drainage and insufficient soil nutrient content as casual factors of decline. Investigation of causal factors associated with loblolly decline at Fort

Benning consisted of installing thirty six 1/6 acre plots in sites segregated by status (healthy versus decline) and age (<10, 10 – 19, 20 – 40, and 40+). Three soil core samples were removed from each site, segregated into 4 inch segments, and analyzed for bulk density (BD), soil texture (TEX), soil strength (SS), and gravimetric water content (GMC). Bulk density values segregated by tree status indicated BD to be higher in healthy sites below the 4 inch depth and slightly elevated GMC in the upper 8 inches. Examination of BD and GMC data by status and age class indicated disparate differences in the < 10 and 10 – 19 age classes with BD levels substantially higher in decline sites at sites <10 years and the reverse for the age class 10 – 19 years. GMC levels were relatively similar in the <10 age class but more water was available in the decline site in the 10 – 19 age class suggesting higher root function in the healthy locations. Higher BD levels were noted in subsoil layers of healthy sites in the older age classes. Additional data related to SS and TEX will be presented as available. Subsequent analyses indicated the presence of *Leptographium* spp. were related to decline. Soil characteristics were then

examined by three conditions: 1) crown symptoms; 2) presence/absence of pathogenic fungi; and 3) physiographic region of sites. Soil samples were removed from sites initially identified as decline or healthy and analyzed for bulk density (BD), soil texture (TEX), exchangeable bases (EB), effective cation exchange capacity (ECEC), pH, aluminum (AL), manganese (MN) and sulfur (S) for three 10 cm depth increments. Logistic regression ( $\alpha = 0.15$ ) indicated BD at the 20 – 30 cm soil depth and ECEC of the soil surface layer to be significant for crown symptoms while soil potassium (K) AL, S, ECEC, BD, and sand content (%) at varying soil depths were significant by fungal status. Highly significant differences were detected when chemical and physical properties were examined by physiographic region.

#### **EFFECTS OF OLEORESINS AND TERPENOIDS ON FUNGAL GROWTH ASSOCIATED WITH PINE DECLINE IN THE SOUTHERN UNITED STATES**

- Lori G. Eckhardt, School of Forestry and Wildlife Sciences, Auburn University, AL
- Roger D. Menard, U.S. Forest Service, Forest Health Protection, Pineville, LA
- Erica Gray, Department of Plant Pathology and Crop Physiology, Louisiana Agricultural Experiment Station, Louisiana State University Agricultural Center, Baton Rouge, LA.

The three major root diseases in the southeastern U.S. are characterized by thin crowns, chlorotic foliage, reduced radial growth and premature mortality. Pine Decline and Littleleaf Disease are characterized by the deterioration of fine roots, however, only Pine Decline is associated with lateral root staining. Annosum Root Rot is characterized by lateral root infection and decay. The affect of host plant allelochemicals on the growth of root colonizing fungi associated with these diseases was examined. The root infecting fungi were grown in saturated atmospheres and in contact with pure monoterpenes and crude oleoresin collected from four southern pines (loblolly, shortleaf, longleaf, slash). Growth of the fungi differed significantly in their sensitivity when exposed to crude oleoresin and pure monoterpenes. Growth of *H. annosum* and *P. cinnamomi* were strongly inhibited by all the monoterpenes and most of the resins used. This was in sharp contrast to the Ophiostomatoid fungi which were less affected by the compounds tested. Growth of *L. huntii* and *L. serpens* was less inhibited than either *L. terebrantis* or *L. procerum* which was less inhibited than *H. annosum* and *P. cinnamomi*. The relationship among tree physiology and plant parasites has implications for the ecology and management of forest ecosystems. These fungal growth studies show that the kind and amount of allelochemicals produced by the host plant have a profound effect on tree pathogens.

Differences observed in the field may be explained by the ability of the fungus to tolerate these host defense mechanisms.

#### **THE PATHOGENICITY AND VIRULENCE OF SOUTHEASTERN BLUE-STAIN *LEPTOGRAPHIUM* SPECIES TO SOUTHERN PINE SEEDLINGS AND IMMATURE LONGLEAF PINE TREES**

- George Matusick and Lori Eckhardt, Auburn University, School of Forestry and Wildlife Sciences, Forest Health Dynamics Laboratory, [matusge@auburn.edu](mailto:matusge@auburn.edu)

In the southeastern U.S., blue-stain *Leptographium* species have been commonly observed invading pines following bark beetle feeding activities. Recently, *Leptographium* species along with several other biotic and abiotic factors were found associated with symptoms leading to premature mortality in loblolly pine. Similar observations have been made in longleaf pines experiencing high rates of premature mortality. Several inoculation tests have been performed to determine the pathogenicity and virulence of four common blue-stain *Leptographium* species to southern pines, with emphasis on longleaf pine. In pine seedling inoculations, longleaf pine appeared to be both more tolerant and more resistant to infection by *Leptographium* species when compared to slash and loblolly pines. However, in a separate longleaf pine seedling inoculation, *L. serpens* was capable of consistent infection and mortality under different environmental conditions. In inoculations of immature sapling-sized longleaf pines, *Leptographium* species were largely incapable of eliciting a significant host response and infection. The results suggest young longleaf pines appear to be more tolerant and potentially more resistant to *Leptographium* infection when compared to other southern pine species. *Leptographium* species appear to be incapable of eliciting a significant host response in young vigorously growing longleaf pine trees. However under some environmental conditions, *Leptographium serpens* was capable of contributing to mortality in longleaf pine seedlings.

#### **DEVELOPING A DECISION SUPPORT FRAMEWORK FOR SANDHILL RESTORATION ON EGLIN AFB.**

- David Steen, Auburn University. [davidasteen@gmail.com](mailto:davidasteen@gmail.com)

Restoring longleaf pine sandhills, while understanding its impact on red-cockaded woodpecker (RCW) recovery and facilitating the military mission, represents the most significant ecological challenge to military bases throughout the Southeast. Addressing that challenge has been constrained by lack of understanding of recovery processes in restoration. Eglin AFB offers an ideal opportunity to quantify dynamic reference conditions

(desired future trajectory), measure recovery rates of degraded sandhills in response to management, and build a Decision Support Framework to help managers meet restoration goals. We propose to: (1) Quantify annual and decadal dynamics of reference longleaf pine sandhills to create dynamic benchmarks for restoration; (2) Determine recovery rates of degraded sandhill ecosystems over a 10-15 year period in response to hardwood removal treatments; (3) Integrate 1 and 2 above into a dynamic forest modeling tool for management of the federally endangered RCW that incorporates population and forest structure feedbacks; (4) Integrate 1 and 2 above into a decision support framework that allows evaluation of landscape-scale ecosystem health through monitoring, while enhancing decision making. Reference dynamics and recovery rates of longleaf pine sandhills will be used to address major ecosystem management needs for military installations in the Southeast. Integrating recovery rates and dynamics of reference sites into RCW demography will directly improve management for recovery. By developing a decision support framework to provide automated analyses of ecological condition across the landscape, we address a critical shortcoming in ecological monitoring that limits use of data for adaptive management.

#### **LONGLEAF PINE NUTRITION AND DECLINE SYMPTOMS AT FORT BENNING MILITARY RESERVE—THEIR APPLICATION IN RESPONDING TO PINE DECLINE IN THE SOUTHEAST**

- Mary Anne Sword Sayer, U.S. Forest Service, Southern Research Station, Pineville, LA. [msword@fs.fed.us](mailto:m sword@fs.fed.us)
- Lori G. Eckhardt, School of Forestry and Wildlife Sciences, Auburn University, Auburn, AL
- Emily A. Carter, U.S. Forest Service, Southern Research Station, Auburn, AL

Pine decline in the southeastern U.S. is characterized by sparse and chlorotic crowns, low annual stemwood growth, and isolation of fungal pathogens from roots. At Fort Benning Military Reserve its occurrence has been reported for loblolly and shortleaf pine, and its symptoms have been seen in longleaf pine. We hypothesize that these occurrences are linked to the development of physiological conditions which interfere with root function and cause trees to lose their tolerance of natural soil resource limitations. The pine forest soils at Fort Benning are cation-deficient and of low water-holding capacity. During periods of water deficit, leaf area adjustment is one physiological condition that could compromise carbon allocation to roots and mycorrhizae, and uncouple cation-deficiency tolerance mechanisms. In July 2006, foliage and root samples were collected in longleaf pine stands to assess decline symptomology and nutrition at the time of peak nutrient demand. Distinct differences were found between the calcium,

magnesium, and manganese nutrition of symptomatic and asymptomatic trees. Results are being used to design future research to investigate the physiological status of declining pine at Fort Benning. In time, silvicultural alternatives may be needed that temper the downward adjustment of leaf area in response to water deficit. It may be possible, for example, to better conserve the forest floor and soil organic matter so that the water retention of Fort Benning's sandy soils is prolonged after rainfall events. Furthermore, less intense prescribed fire activity may be necessary where cation deficiencies prolong the re-growth of leaf area after scorch.

#### **ECOLOGICAL AND MOLECULAR EVIDENCE SUGGESTS THAT *LEPTOGRAPHIUM SERPENS* IS A RECENT INTRODUCTION TO SOUTHEASTERN FORESTS**

- James W. Zanzot and Lori G. Eckhardt, School of Forestry and Wildlife Sciences, Auburn University, AL 36849. [zanzojw@auburn.edu](mailto:zanzojw@auburn.edu).
- Z. Wilhelm de Beer and Michael J. Wingfield, Forestry and Agricultural Biotechnology Institute, University of Pretoria, South Africa.

*Leptographium* spp. (Ascomycota, Ophiostomatales) have been implicated as important factors in loblolly pine decline in the southeastern United States. Among the species most commonly recovered from roots and root-feeding beetles are *L. procerum*, *L. terebrantis*, and *L. serpens*. While the two former species are widespread and well documented in eastern US forests, *L. serpens* has only recently been reported from North America. Originally described from Italy, *L. serpens* has been reported from several European countries, as well as South Africa. In South Africa, pine hosts and bark beetle vectors are known to be introduced, suggesting that the fungus is introduced as well. While the sexual form, *Grosmannia serpens*, has been reported from several European nations, sexual structures have not been observed in South Africa nor the southeastern United States. Sequence data from three genes (internal transcribed spacer of the ribosomal RNA, beta-tubulin, and transcription elongation factor 1-alpha) also support the hypothesis of nativity to Europe and introduction to South Africa and the southeastern US. Potential exotic beetle vectors for *L. serpens* are discussed, and further molecular evidence, in the form of microsatellite markers, is also being pursued.

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