Proceedings of the Second Montane Longleaf Conference Workshop

November 18-19, 2005
Berry College
Mount Berry, Georgia

We are deeply indebted to the following organizations for their support in making this conference possible:

Berry College
The Longleaf Alliance
Georgia Forestry Commission
USDA Forest Service
US Army Corps of Engineers
Park Marina
South Winds Sailing Club

Thank you for your support

Longleaf Alliance Report No. 9
January 2006

Citation: Cipollini, Martin L., comp. 2006. Proceedings of the Second Montane Longleaf Pine Conference Workshop; 2005 November 18-19; Berry College, Mount Berry, Georgia. Longleaf Alliance Report No. 9

Cover Photograph by Martin L. Cipollini. This is a photo taken during a prescribed burn conducted by Martin in April 2004. The location is in the Berry College Longleaf Pine Project's Core Management Area (Stand E).

Table of Contents

Oral Presentations

Other Contributed Papers

Roundtable Discussion

In the morning of the first day's sessions, a brief roundtable discussion was held, focusing on the list of topics/key issues raised at the 1st Mountain Longleaf Conference (Jacksonville State University). The list of key issues is as follows.

1) Linking areas under management for Mt. LL Pine
2) Need for more seed sources for Mt. LL Pine
3) Outreach
4) Understory vegetation
5) Delineating long-term and short-term goals
6) Concerns of T & E species and private landowners
7) Harvest/use of non-timber forest products
8) Increasing restrictions on fire needs reversal
9) Delineating research priorities
10) Initiating dialog with those concerned w/ preventing Mt LL Pine restoration/management
11) Coordination of grant writing
12) Coordination of management efforts across agencies and private landowners
13) Understanding the decisions made by private w/ M LLP & educating & incenting them to manage for the ecosystem.

While some of the discussion focused on prioritizing this list (e.g., moving items #11 and 12 up in priority), a decision was made to create a Mountain Longleaf Pine Working Group charged with addressing these issues. All persons interested in joining this group should contact Martin Cipollini at 706-290-2149 or mcipollini@berry.edu.

Most active discussion focused on the question of how to more precisely define "mountain longleaf" (species vs. variety?, habitat type?, region?, etc.), with no set consensus being reached. Most seemed to agree with the general community definition of "habitats above the fall line in NW GA and NE AL that were historically dominated by longleaf pine". The question of whether or not to include Piedmont areas (which could include areas in NC and SC) under the same umbrella was considered. Answers to such questions are paramount to initiating solid, well-coordinated efforts to conserve and manage these habitats.

Finally, it was agreed that there is support for a future Mountain Longleaf Conference/Workshop. Callaway Gardens was proffered as a possible meeting site, and Robert Kindrick agreed to look into this possibility. According to Bill Garland, future meetings and coordination of conservation/management efforts may be possible through a planned resource center at the Mountain Longleaf National Refuge in Fort McClellan, AL.

Mountain Longleaf National Wildlife Refuge Longleaf Restoration Program

Bill Garland: Biologist, U.S. Fish and Wildlife Service, Mountain Longleaf National Wildlife Refuge, Fort McClellan, Alabama; Bill_garland@fws.gov

Mountain longleaf pine forests historically occurred throughout northeastern Alabama and northwestern Georgia. Lightning caused fires along with fires set by Native Americans and early settlers were responsible for maintaining this vast forest. With increased wildfire suppression and public education programs on the evils of "woods burning", fire had disappeared from much of the landscape by the early 20th Century. Forests evolutionarily dependent on fire began to successionally evolve into more hardwood dominated forest types. With establishment of the Fort McClellan in 1917, military training related wildfires continued to maintain forests in this one corner of the mountain region. The closure of Fort McClellan in 1998 and the elimination of military wildfires, however, eventually placed these forests back on a successional track. In an attempt to save this vanishing forest, Mountain Longleaf National Wildlife Refuge was legislatively created on May 29, 2003. The primary purpose for establishing the 9,000 acre refuge was to "enhance, manage and protect the unique mountain longleaf pine ecosystem on the property". Biological Integrity Policy for national wildlife refuges provides further direction to restore and maintain, where possible, the historic landscape that existed during the pre-settlement period.

The Fish and Wildlife Service has prepared a Habitat Management Plan that will guide restoration and management efforts on the refuge for the next fifteen years (U.S Fish and Wildlife Service, 2005). The Vision Statement within the plan is that "Mountain Longleaf NWR will be managed to maintain and restore a naturally regenerating mountain longleaf pine ecosystem, along with providing educators, research scientists, and the public with a broad range of opportunities to appreciate and enjoy a rare and disappearing southern forest type."

Historic use of refuge lands and observations by early scientists were used to construct probable descriptions of pre-settlement forests. Both Mohr (1901) and Harper (1905) characterize mountain slope forests as containing more stunted and crooked trees than normally occur on the Coastal Plain. Mountain forests are further described as open longleaf pine stands with a sparse cover of primarily black jack oak (*Quercus marilandica*) (Smith, 1883; Mohr, 1901; Harper, 1928). Above an elevation of 1900 to 2000 feet longleaf forests disappeared and a hardwood community of chestnut oak (*Q. montana*), American chestnut (*Castanea dentata*) and pignut hickory (*Carya glabra*) is described along higher ridge-tops (Mohr 1901; Harper 1928). Using historic descriptions, the refuge can be characterized as "originally containing open forests of somewhat stunted and branched longleaf pine on exposed west, south and east slopes to about a 1900 foot elevation with a sparse understory of primarily blackjack oak and a continuous ground cover of herbaceous species".

Refuge management occurs in two distinct phases; restoration and maintenance. Currently, no refuge forests meet criteria for maintenance prescriptions. The restoration phase can be classified into one of three categories; prescribed burning (1000 acres), prescribed burning and hardwood encroachment (3000 acres), and inadequate stocking (500 acres). Some forest stands may actually require prescriptions for both hardwood encroachment and inadequate stocking. A fire management plan has been prepared for the refuge and prescribed burning was initiated in 2003. Growing season prescribed burning is considered critical to reestablishing conditions for maintenance phases.

Approximately 1000 acres of the refuge has experienced recurring wildfires from previous military training activities. While these lands contain a relatively open herbaceous/shrub understory and a scattered overstory of longleaf pine, hardwood sprouting represents a continuing encroachment problem within the forest. Historic wildfires appear to have been variable in frequency, depending on site location. In some situations, extremely hot wildfires within stands containing high fuel loads appear to have killed, stressed or scarred overstory trees. A primary objective of restoration within these areas is to initiate growing season burns to control hardwood sprouting and establish light consistent fuel loads throughout burn units.

Approximately 3000 acres on the refuge contain longleaf pine forests that have successionally evolved to a more hardwood dominated forest community. The overstory of this forest contains a relict canopy of at least a 30 percent longleaf pine. Fire dependent or resistant oaks and hickories with thicker barks and sprouting ability tend to comprise the larger hardwoods in the forest. Chestnut oak is particularly abundant, possibly moving down mountain slopes in the absence of frequent fire. An understory of more fire sensitive species characterizes the understory, reflecting a continuing shift to more mesic conditions. Typical understory trees include black cherry (*Prunus serotina, P. alabamensis*), red maple (*Acer rubrum*), tulip-poplar (*Lirodendron tulipefera*), blackgum (*Nyssa sylvatica*), sourwood (*Oxydendrum arboretum*), and flowering dogwood (*Cornus florida*). Management objectives include opening the ground layer to sunlight and reintroducing fire into the forest. Hardwoods are currently injected with Arsenal AC to open the forest canopy. Dormant season prescribed burns are scheduled for 2006 to slowly reduce fuel loads. Preventing damage to feeder roots and allowing pines to adjust to more xeric soil conditions is considered critical to successfully restoring second and old-growth forests.

Approximately 500 acres of the refuge contain sites suitable for longleaf pine, but currently lack adequate stocking to ensure a future overstory. Some of these areas are hot burnouts along steep slopes, while others have experienced recurring wildfires but lack a nearby seed source. These areas will be monitored through the prescribed burning program, and may be replanted in the future or, possibly, be managed as openings within the overall longleaf pine forest.

Literature Cited:

Harper, R.M. 1905. Some Noteworthy Stations for *Pinus palustris*. Torreya 5:55-60

Harper, R.M. 1928. Economic Botany of Alabama – Part 2: Catalog of the Trees, Shrubs and Vines of Alabama, With Their Economic Properties and Local Distribution. Monograph 9. Geologic Survey of Alabama. Tuscaloosa. 228 pp.

Mohr. C.T. 1901. Plant Life in Alabama, an Account of the Distribution, Modes of Association, and Adaptions of the Flora of Alabama, Together with a Systematic Catalogue of the Plants Growing in the State. Reprint of Vol. VI, Contributions from the U.S. National Herbarium, July 31, 1901, U.S. Department of Agriculture; Washington, D.C. Alabama Edition, Alabama Geological Survey. Tuscaloosa. 921 pp.

Smith, E.A. 1883. Geological Survey of Alabama-Agricultural Features of the State. W.D. Brown & Co. Montgomery. 615 pp.
U.S. Fish and Wildlife Service. 2005. Mountain Longleaf National Wildlife Refuge Habitat Management Plan. USFWS, P.O. Box 5087, Fort McClellan, AL 36205. 142 pp.

A Progress Report on the Longleaf Ecosystem Restoration Project – Talladega National Forest – Oakmulgee District.

Cindy Ragland: Oakmulgee Ranger District, Talladega National Forest; cragland@fs.fed.us

The lands currently managed as the Talladega National Forest - Oakmulgee District (District) are part of what was once the South's most prevalent forest – the longleaf ecosystem. Today, only an estimated 3.5% of Alabama's historic longleaf remains. Throughout its historic range, longleaf has declined from an estimated 91 million acres to an estimated 3 million acres. For a variety of reasons, many historic longleaf sites within the District were converted to loblolly and shortleaf pines, and in some areas, hardwoods within these sites exist at levels that classify those sites as mixed pine-hardwood. It is currently estimated that one-third (31,000 acres) of the District's native longleaf sites (estimated at 86,400 acres to 92,000 acres) are dominated by loblolly, shortleaf, and mixed pine and hardwood. While historic evidence indicates that loblolly and shortleaf pines were a component of the native longleaf ecosystem, these pine types were never *dominant* on the upland landforms. This un-natural condition is the underlying source of several forest health problems and the focus of the Longleaf Ecosystem Restoration Project FEIS and Record of Decision signed February 2, 2005. Less than one year into the implementation of this Project the District struggles with limited funding, southern pine beetle epidemics, and diversion of resources to support natural disaster recovery. Key issues are reversing declining RCW population trends, managing root disturbances to *Liptographium* stressed loblolly, and reestablishing understory conditions endemic to native longleaf ecosystems.

Montane longleaf pine forest management on the Shoal Creek Ranger District, Talladega National Forest, Alabama.

G. Ryan Shurette: Talladega National Forest gshurette@fs.fed.us; J. Gardner

At present, approximately 25,000 acres of forestland on the Shoal Creek District are classified under the montane longleaf forest type. Pure longleaf forest generally occurs along ridges and down to mid-slope, grading into pine/hardwood and hardwood/pine forest types further down the slope. In the past, the dry shallow soils of these uplands were often planted by the Forest Service with loblolly pine. Here, due to several biotic and abiotic factors, loblolly pine forests have suffered a number of problems including beetle infestation, stunted growth, and premature die-off. To address this issue (and others) the District completed an Environmental Impact Statement (EIS; Record of Decision signed March 5, 2004) to restore longleaf pine stands to areas where they are believed to have originally occurred. This decision also authorized thinning of overstocked longleaf stands to increase habitats for the endangered red-cockaded woodpecker. Timber sales under this EIS are presently being laid out and will begin in fiscal year 2006. Another problem similar to mature longleaf forest elsewhere exists in that many stands on the

District have been denied fire over the past decades and have developed dense hardwood midstories of fire-sensitive species. To restore an open forest structure and promote the growth of herbaceous vegetation, the District has been involved in active longleaf forest management including such practices as midstory removal and aggressive growing season prescribed burning. As a result of these treatments over the past few years, a growing percentage of the Shoal Creek District's upland longleaf forest has been restored to a system with an open, longleaf-dominated canopy and a diverse bluestem/forb herbaceous understory.

The Preserve at Callaway's Longleaf Management Plan: A Forest Legacy Site on Pine Mountain Ridge and Longleaf Pine (*Pinus palustris)* Restoration Plans for the Site

Rob Kindrick: Ida Cason Callaway Foundation, rkindrick@callawaygardens.org

In the winter of 2005 a conservation easement was placed on 2,507 acres of forest including a section of the Pine Mountain Ridge under the Forest Legacy program. The site is located southwest of the town of Pine Mountain, GA. and consists of broad, steeply sloping ridges. Currently, the site is in a mature, fire suppressed condition. There is a considerable representation of remnant Longleaf Pine and a primary goal for the site is to restore in appropriate locations Longleaf Pine and the plant community that historically accompanied these trees. To work toward this goal a number of methods will be used including the reintroduction of prescribed fire, the use of herbicides, and/or mechanical manipulation to remove hardwoods and allow release of Longleaf seedlings and the planting of ecotype seedlings grown from stock collected on the site. Loblolly pine (*Pinus taeda*) may be harvested in select areas to allow for the reintroduction and release of Longleaf. Understory manipulation of grasses and forbs will be a component of the restoration process as well. Returning prescribed fire to the restoration sites has already begun with one burn executed in the winter of 2005 and two more planned for the winter of 2006. The first consideration during the reintroduction of prescribed fire is to reduce the fuel load, which is very high across the entire site. Initial burn plans require conservative weather parameters due to these heavy fuel loads, topography, the desire to use natural firebreaks, and to minimize the risk of mortality in the remnant seed trees. Details of future management plans are written in the Forest Stewardship Plan required by the Forest Legacy Program.

Research and restoration of the montane longleaf pine forests of Oak Mountain State Park, Alabama.

R. Scot Duncan: Birmingham Southern College, sduncan@bsc.edu; Corrina B. Anderson, Chris B. Clayton, Heather N. Sellers, and Rich Q Williams

We are studying the montane longleaf communities within Oak Mountain State Park (OMSP), near Pelham, AL. OMSP encompasses part of Double-oak Mountain and an adjacent valley. Longleaf stands are found on the mountain's ridges and south-facing slopes, and the upper slopes of hills in the valley. Most stands were logged during the first half of the last century and have been fire-suppressed for many decades. A few stands have had wildfires or been burned through a new prescribed burning program in the park. Our project has three primary goals: a) to describe the current condition of longleaf stands in the park, b) understand the role of fire and logging history on the longleaf forests, and c) aid managers in the maintenance of the park's longleaf forests. To describe the ecological variation among stands in the park, we have established and surveyed 26 20x50-m permanent plots within the park, half of these are in the foothills and half are on the mountain. Within these plots we have inventoried tree and shrub communities, exposed bedrock, and fuel levels (foothills only). In addition, to monitor the effects of wildfire and prescribed fire, we have established and surveyed fourteen permanent transects in stands exposed to fire and adjacent unburned stands. Comparisons of the mountain and foothill forests show clear differences in the current structure and 'health' of these longleaf stands. Preliminary analyses of the transect data suggest prescribed fire is having a limited effect on the tree density and composition in the foothills. Details on these findings will be presented.

The Berry College Longleaf Pine Project: Progress Over the First Three Years.

Martin L. Cipollini: Berry College, Department of Biology, mcipollini@berry.edu

Since the fall of 2002, Berry College has undertaken a combination restoration, research, and education project called the Berry College Longleaf Pine Project. The project had its roots in Birkhead and McGuire's (1998) dendrochronology work on the Lavendar Mountain area of the campus (Mount Berry, Georgia), which suggested the presence of longleaf pines over 200 years old. Starting in 1999, the Plant Ecology class began a long-term census project in five permanent study stands and initiated efforts to quantify fuel loads and to characterize the composition of the tree and shrub communities. Results of those studies showed a declining longleaf population, significant hardwood encroachment, extremely high fuel loads, and little evidence of burning in the last 50+ years (Cipollini, 2005). Remant longleaf stands were found to occur almost exclusively on south- and southwest-facing slopes. In response to logging on the campus in 2000-2001, Berry's Students Against Violating Earth (SAVE) club sought and was granted permission to plant 2000 containerized longleaf seedlings into an area logged to control a Southern Pine Beetle (SPB) outbreak. By early 2002, it became clear that a written management plan would be needed to coordinate research, education, and management efforts. The rationale for developing the management plan was as follows:

1) The longleaf forests of the campus represent an ecologically significant landscape type with a paucity of knowledge about it. Most information on longleaf forests comes from rolling hills or coastal plain landscape types, i.e., wiregrass country.
2) The campus has a number of very old trees; these trees are significant for ecological, historical, and social reasons. There are very few tracts of old longleaf pines left in the south, and almost none left within mountainous areas.
3) Much of the steep hillsides have never been plowed and thus (through seed banking) have the potential of recovering groundcover species considered characteristic of fire maintained mountain longleaf sites (e.g., the Mountain Longleaf National Wildlife Refuge, Fort McClellan, Alabama). Two prior plant surveys (Andrews, 1917; Jones, 1940) serve as sources for determining potential or "target" plant communities of the restored mountain longleaf system.
4) By establishing a model management plan that includes the research on the use of controlled burning, information generated by the project will have important implications for fire re-introduction programs in other mountain longleaf sites within the south.

5) As the management plan would be administered within an educational context, the project has extremely high potential to serve as an outdoor classroom for Berry students, for local school children, and for regional land managers.
6) The plan has the potential of generating funding from various agencies interested in conserving biodiversity and in determining how best to manage private forests for multiple uses.

The plan was presented to the Berry College administration via our Educational Land Management program and was accepted in July of 2002. The management plan currently applies to a 160-acre area designated as the Core Berry Longleaf Management Area and to three western out-parcels (60 acres total) that had been subjected to SPB salvage logging in 2002.

In addition to research and education objectives, the key management plan components include:
1) Planting containerized seedlings in SPB cuts
2) Slowly restoring a burning regime on 4-5 year frequency
3) Controlling hardwoods via direct removal and herbicides
4) Establishing a local seed source via cone collection and a grafted seed orchard

The plan calls for Berry College's Biology Department, Forestry and Land Resources Department, and locally recruited volunteers to help with various management tasks. The project is guided partly by an external group of experts (The Berry Longleaf Network) and initial prescribed burning trials were conducted with the help of an interagency burn team (Georgia Forestry Commission, U.S. Forest Service, Georgia Department of Natural Resources, U.S. Fish and Wildlife Service, The Nature Conservancy).

Since 2001, the following management tasks have been undertaken:

1) Planting containerized seedlings (150-300 per acre)

a) 2001 "SAVE 2001" selective-cut plot: 18 acres with no site preparation. Trees within this site showed a 60% survivorship rate by 2005; most in open areas had grown out of the grass stage by 2003. Areas with substantial hardwood cover had higher mortality, and many of those seedlings were still in the grass stage in 2005. Trees were not planted uniformly throughout the site, so dense thickets and thin areas abound.

b) 2003 clear- and selective-cut plots: 50+ acres with spotty site preparation burn. Survivorship across the first two years was highly variable; trees in open, low-lying, wetter areas had high mortality rates (10-25% survivorship), presumably due to herbaceous competition. Trees on higher, dryer slopes had nearly 100% survivorship. As in the SAVE 2001 site, mortality was higher and growth suppression greater in areas with substantial hardwood over-story.

c) 2004 core management area: 2 acres with a site preparation burn. In this site, survivorship across the first year was nearly 100%.

d) 2005 selective-cut plot: 10 acres with cut-stump herbicide (Garlon 4) site preparation, coupled with follow-up hardwood control (Garlon 3A). Residual mature longleaf trees (about 25) were left on the site as a potential seed source. If necessary and possible, this site will be burned. Re-planted in the fall of 2006 will be done to bring the seedling density to 300 per acre.

2) Restoration burning

a) In April 2003 a trial restoration burn was carried out on 8 acres. Only one adult longleaf was killed, with major reductions in leaf litter and other fuel components (Belk, et al., 2004).

b) In response to the successful trial burn, and larger (80 acre) burn was conducted in April 2004. This burn killed some adult longleaf, necessitating a 10-acre salvage/restoration selective cut in October 2005 (see above). Major reductions were observed in leaf letter, duff, and other fuel components (Gaskill, et al., 2005).

c) Burning in areas planted with longleaf pine seedlings will begin with a burn in the SAVE 2001 plot and the 2003 clear- and selective-cut plots in early 2006.

3) Hardwood control in core management area

In the winters of 2003-2004 and 2004-2005, hardwoods in about 20 acres within and around the five study stands (A-E) were herbicided using wide-space Arsenal AC hack-and-squirt methods. In each season, we sought to herbicide all soft mast trees and 50% of all hard mast trees. Herbicide methods were evaluated after the first year, with results showing effects upon most injected trees (Cipollini, et al., 2005). Follow-up observations suggest that nearly all injected trees died after two years. Herbiciding will continue in an expanding area around these stands in 2005-2008, expanding to cover all south- and southwest-facing slopes within the core management area. Herbiciding will also be expanded to include the SAVE 2001 and the selective cuts done in 2003 and 2005.

4) Post-planting herbiciding in 2003 clear- and selective-cut plots

In response to low survivorship and growth suppression of longleaf seedlings in minimally prepared sites, we used Garlon 3A directed foliar sprays in the summers of 2004 and 2005 to control blackberry and hardwood competition (Cipollini, et al., 2005). In the summer of 2006, we will use site preparation rate Arsenal in spots to prepare these areas for re-planting in the fall of 2006.

5) Seed collection and growth of Berry seedlings

Because of the lack of northwestern Georgia seed sources, we have decided to grow our own seedlings for use within our core management area. We collected cones from trees in October 2003 and 2004, generating 250 seedlings in 2004 and 2000 seedlings in 2005. Beginning in 2006, we will expand our pilot program to generate 4000 seedlings per year for our restoration efforts. While not cost-effective, these efforts help us to preserve and expand the Berry College genetic stock, which may be unique in terms of frost and ice storm tolerance (being derived from the northern interior limit of the natural range of longleaf pine).

6) Seed orchard and grafting

Because seed collection in the field has proven to be so difficult and costly, in collaboration with Kirk Hinson (Southern Seed Company), we began a project to establish a seed orchard on the campus. We planted 200 North Carolina Piedmont containerized seedlings into a 2.5 acre fenced area in spring 2003. With the help of John Hendrickson (Temple-Inland), we initiated grafting experiments in winter 2005 using field grown longleaf rootstocks and scions from mature trees. Graft success rate was about 90% (Worrell, et al., 2005), with several scions growing over two feet during the subsequent growing season. The methods employed will be used to graft scions from 20-50 mature trees onto the rootstocks in the seed orchard starting in February 2006. We expect our first cone harvests to occur in 2010-2015.

Management tasks are partly supported by student workers. Because prescribed burning is difficult and risky, student workers must be properly trained to assist. As a result, our on-going training program has been ramped up to meet minimal U.S. Forest Service guidelines. This includes having all potential participants take the S130/S190 Fire Behavior and Safety short course and pass the "arduous-level" pack test. A grant from the National Fish and Wildlife Foundation-Southern Company grant will provide full safety equipment for the six-person student burn team (see next point).

Support for the project through 2005 was primarily through internal Berry College grants, with some support through a National Science Foundation-Research for Undergraduates Site Grant. During the 2005-2008 period, management efforts will be supported by a National Fish and Wildlife Foundation-Southern Company Longleaf Legacy grant. This grant will support site-preparation and re-planting in 60 acres to bring densities of seedlings to 200 per acre, and will establish a 220-acre carbon reserve and procedures for annually reporting carbon stocks.

Student/faculty research is a fundamental aspect of the project. Since 1999, the following research projects have been conducted in stands undergoing restoration:

1) Plant/Forest Ecology classes: 1999-present. Population and tree community dynamics (Cipollini, 2005).

2) Various student workers: 2002-present. Fuel load analysis (Belk, et al, 2004; Cipollini, et al., 2005).

3) Brianna Bennett, West Georgia College: 2003-2005. Effects of restoration burning on fine root regeneration and soil nutrient dynamics (Bennett, 2005).

4) NSF-REU Program, 2004: Amy Gaskell and Chris Worrell, Use of herbicides and prescribed burning for hardwood control (Cipollini, et al, 2005).

5) NSF-REU Program, 2004: Troy Knight and Chris Worrell. Dendrochronology of relict longleaf pines (Knight, et al, 2006).

6) NSF-REU Program, 2005: Amy Huber, Chris Worrell, and Larry Rogers. Estimation of total carbon reserves (Huber, et al., 2006).

7) NSF-REU Program, 2005: Kate Currie, John Kush, J. Morgan Varner, Chris Worrell, and Larry Rogers. Herbaceous plant survey (Currie, et al., 2006).

Finally, public education is an extremely important aspect of the project if information concerning longleaf pine and fire ecology is to spread regionally. To that end, we have created a public friendly website, have sponsored numerous volunteer and learning experiences for grade-school, middle-school, and college students, and have given several radio and newspaper interviews to local media. As project director, I have also participated in a number of formal classes and symposia in environmental biology and have communicated the rationale, objectives, and methods used in the project to our campus community. These efforts suggest that the message is getting through, as feedback concerning the project has been overwhelmingly positive.

Literature Cited:

Andrews, F. F. 1917. Agency of fire in propagation of longleaf pines. Botanical Gazette 64: 497-508.

Bennett, B. and J.J. Hendricks. 2005. Reintroduction of fire in a long-unburned Mountain Longleaf Pine forest -- impacts on fine root and mycorrhizal dynamics.

Birkhead, R. and J.P. McGuire. 1998. Lavender Mountain – the forgotten longleaf pine of Georgia. Poster presentation at 1st Longleaf Alliance Conference. Charleston, SC 1998.

Cipollini, M. L. 2005. The Berry College Longleaf Management Plan. http://fsweb.berry.edu/Academic/MANS/mcipollini/management/The%20Berry%20College%20Longleaf%20Management%20Plan.htm

Cipollini, M. L., A. Gaskell, and C. Worrell, 2005. Use of herbicides and prescribed burning to control hardwoods in the regeneration and restoration of Mountain Longleaf Pine habitats. Proceedings of the Fifth Longleaf Alliance Regional Conference, Harriesburgh, Mississippi, October 12, 2004. Longleaf Alliance Report 8: 9-13.

Knight, T., M. L. Cipollini and C. Worrell. 2006. Dendrochronological investigations of longleaf pine on Lavendar Mountain. Proceedings of the 2nd Mountain Longleaf Conference, Mount Berry, GA. November 18-19, 2005. Longleaf Alliance Report No. 9 (in press)

Currie, K., J. M. Varner, J. Kush, and M. L. Cipollini. 2006. A Survey of the Herbaceous Vegetation Found in the Berry Longleaf Pine Management Area. Proceedings of the 2nd Mountain Longleaf Conference, Mount Berry, GA. November 18-19, 2005. Longleaf Alliance Report No. 9 (in press)

Huber, A., A. Gaskell, C. Worrell and M. L. Cipollini. 2006. Estimation of Carbon Storage in a Mountain Longleaf Ecosystem of Northwestern Georgia. Proceedings of the 2nd Mountain Longleaf Conference, Mount Berry, GA. November 18-19, 2005. Longleaf Alliance Report No. 9 (in press)

Jones, H. C. 1940. Plant ecology of the Berry Schools property, Floyd County, Georgia. PhD. Dissertation, George Peobody College, Nashville, Tennessee.

Worrell, C., J. Oliver, and M. L. Cipollini. 2005. Determination of average longleaf pine seed viability and grafting success rate. Abstracts - Berry College Symposium on Student Scholarship, Berry College, Mount Berry, GA, April, 2005.

Historic fire regimes and species composition of two Georgia mountain longleaf communities

Nathan Klaus: Georgia Department of Natural Resources, naklaus@mindspring.com

Though mountain longleaf pine is undoubtedly a pyric system it remains unclear how frequently this system requires fire. Because fire frequency results in substantial differences in tree species composition, wildlife habitat, and groundcover diversity it is critical that the natural fire regime be an eventual part of restoration activities. Two lines of investigation were used to clarify the historic frequency of fire. First cross sections of lighter stumps were taken from the Pigeon Creek tract of Sprewell Bluff Natural Area. Fire scars in these stumps were dated between 2005 and 1818 using standard denchronological techniques. Three periods of differing fire frequency were apparent: pre 1840 (avg. fire return interval 2.6 years), 1840-1912 (avg. fire return interval 1.2 years), and 1912 to present (avg. fire return interval 11.4 years). A second method of investigation used tree species surveys from Georgia's historic land lottery maps circa 1820. A subjective value of fire tolerance (-2 to +2) was assigned to all species that when summed by region revealed differences in the average fire tolerance of forests across Georgia. The Pine Mountain area had very high fire tolerance values for north and south facing slopes that were comparable to coastal plain longleaf/wiregrass ecosystems. Modern forests on Pine Mountain were resurveyed in 2005 and revealed much lower fire tolerance scores.

A GIS model to target restoration hotspots by determining probabilities of existing longleaf pine stands found by remote sensing.

Kevin Kleiner: Al GaP analysis project, Auburn University; kleinkj@auburn.edu

The restoration of longleaf pine at the regional scale has been hindered, in part, by the lack of a fine scale distribution map of existing longleaf pine stands. Currently, we know the historic range of longleaf pine and its present distribution on many public lands is well documented. However, even on national forests, stand inventories are far from complete and our knowledge of what exists on private lands is even more limited. We used remote sensing and extensive field sampling to create region wide, fine scale probability distribution maps of longleaf ecosystems (coastal plain and mountain). These maps cover the state extents of Alabama and Mississippi, and portions of Tennessee, Georgia, Louisiana, and Florida. They have a grain size of 30 meters and depict the probability that a longleaf ecosystem exists at each pixel. We show how these maps can be used to determine restoration hotspots by incorporating three important factors into a GIS: distance to urban areas, distance to public lands, and a minimum longleaf ecosystem probability and patch size. The resulting output is a fine grain but large extent restoration hotspot map which can be used to prioritize future longleaf restoration efforts.

Loblolly Pine Decline, *Leptographium* spp. and Root -Feeding Insects.

Lori Eckhardt: Auburn University, eckhalg@auburn.edu; R. Menard; N. Hess; E. Carter

Loblolly pine decline, characterized by an expanding area of declining and dead trees, is becoming increasingly prevalent in central Alabama. A three year study was conducted to determine the fungal, insect, and/or soil parameters associated with this syndrome. *Hylastes salebrosus, Hylastes tenuis*, *Pachylobius picivorus* and *Hylobius pales* were significantly more abundant in declining plots than in healthy *Pinus taeda* L. plots. These root and lower stem-infesting insects consistently carried *Leptographium terebrantis, L. procerum, L. serpens,* and *L. lundbergii.* Root sampling revealed high levels of root damage and mortality, staining and infestation with *Leptographium* species. This below-ground mortality precedes the above-ground symptoms of short chlorotic needles, sparse crowns, and reduced radial growth followed by mortality. A sequence of interactions among this complex of organisms and abiotic factors is proposed as the cause of loblolly pine decline. The data from this research also strongly suggests that loblolly pine decline, as a disease syndrome, is distinct from littleleaf disease.

Burn slowly and carry a water bag: Lessons learned from 10 years of restoration burning

John S. Kush: Auburn University, kushjoh@auburn.edu; J. Morgan Varner

The Flomaton Natural Area is an old-growth longleaf pine stand in south Alabama that underwent 45 years of fire exclusion. The absence of fire allowed deep forest floor accumulation, encouraging colonization by small pine roots. The re-introduction of fire posed a problem because fuel accumulations increased the possibility high severity fire that is lethal even to the larger trees that are normally very fire resistant. Large, old longleaf pines are frequently killed when re-introducing fire into long-unburned stands. Despite the best intentions, temperatures sufficient to girdle trees and kill roots in the duff and mineral soil can be created even in low intensity or “cool” fires. Often this mortality of trees can be delayed for 2 or more years. Accumulated results from 10 years of restoration burning at the Flomaton Natural Area are: removal of large fuels that can smolder or re-ignite hours or even days after the burn. To minimize near-tree duff smoldering, consider raking litter and duff from around old trees. Burn when duff is moist, within 2 days of approximately 1-inch rains. Avoid backing fires that move too slow, use strip head fires or spot-ignition that discourage duff ignition and residual combustion. Immediately following burning, check the bases of all old trees for subsurface smoldering and extinguish thoroughly. These results are applicable to long-unburned stands throughout the mountain longleaf pine region.

Introduction

Chapman (1932) wrote: “In the longleaf pine type of the south (and nowhere else in North America to the writer's knowledge) fire at frequent but not necessarily annual intervals is as dependable a factor of site as is climate or soil.” Longleaf pine evolved with fire, developing traits that make it the most fire-tolerant of the southern pines. While longleaf pine is tolerant to fire, fire can kill longleaf, especially in stands with a history of fire exclusion.

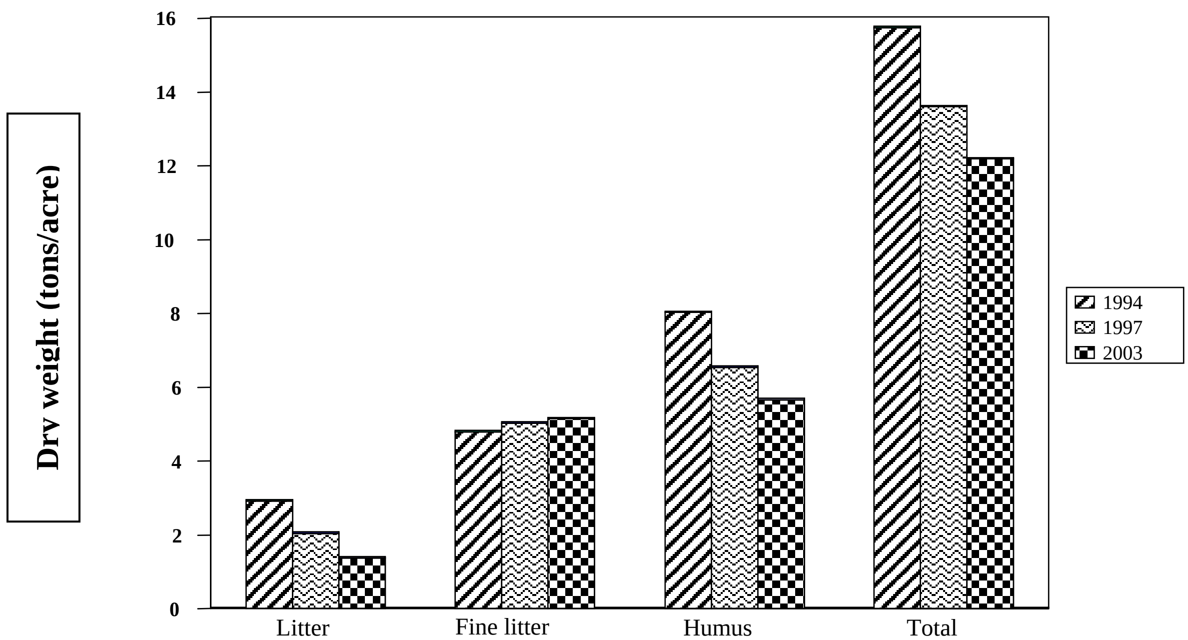
There are numerous examples across the Southeast where longleaf pines have been killed by restoration burning (Kush and Meldahl 2006, Varner et al. 2005). The Flomaton Natural Area (FNA) in southern Alabama is a prime example of mortality in older tress related to restoration burning. Prior to restoration efforts beginning in 1993 (Kush and Meldahl 2000), the FNA was fire excluded for 45 years. The objectives of this paper are to highlight observations and results from nearly 10 years of restoration work at the FNA. These results are pertinent to restoration efforts throughout the mountain longleaf pine region, where fires have been excluded for decades (Varner et al. 2000).

Problems with restoring fire

In frequently burned longleaf pine stands, fuel accumulation is often minor, composed primarily of needle litter (1-3 tons ac-1) and small woody fuels that accumulate between fires. When fires are suppressed, litter accumulates at the base of trees and gradually decomposes into defined organic soil horizons: first litter, fine litter (fermentation horizons), and eventually humus (duff comprising the latter two). Actively uptaking fine roots colonize this wet and potentially nutrient-rich area. Given this high local loading, heating caused by smoldering duff can girdle and kill the tree or damage underlying roots.

When restoration began at the FNA in 1994, fuel loads averaged 16 tons ac-1 (Figure 1). In the 5 fires conducted over the past 10 years at the FNA, the fine litter and humus have only been decreased by 2.2 tons ac-1 (14%). Based on this pace of removing 0.44 tons ac-1 of fine litter and humus per fire, it will require 27 more prescribed burns using our current prescriptions to reach pre-settlement litter and duff loadings.

Figure 1. Forest floor fuel loading following five restoration fires at the Flomaton Natural Area, AL



How successful has restoration burning been? Pre-restoration, there were 7 vine species, 1 herbaceous species, and no grasses present. Ten years later, there are over 38 herbaceous species, including 7 grasses. Additionally, there was no longleaf pine regeneration and no longleaf < 3” DBH. Following the large 1996 and 1998 seed crops, many seeds germinated. Currently the FNA has 3,100 seedlings ac-1; in the more open areas, several have emerged from the grass stage. Due to our efforts, there has been minimal mortality (10.2 %) of the older longleaf pine.

The following recommendations for restoring fire to fire-suppressed stands are based on efforts at the FNA, a coastal plain site with little change in topography. These recommendations would apply to montane stands as well only there needs to be more planning and care because of the effects of slope and aspect will have on fire behavior.

Recommendations

1. Burn when duff is moist: Duff ignition and burning is a function of moisture content (Frandsen 1987). Fires at the FNA have been ignited 2-3 days following substantial (1 inch or greater) rainfall. Long-term droughts likely require additional rainfall to prevent duff ignition.

2. Mop-up is CRITICAL: Even when fires are ignited under moist conditions, small areas can ignite and smolder for days following ignition. As a result, our average “post-burn crew” at the 60 ac FNA has consisted of 8 people, 6 carrying water bags and 2 riding on tractors/ATVs with water tanks. On average, we have spent 48 man hours on each burn walking around the stand extinguishing smoldering “hot spots” and re-ignited flaming fuels. Our goal has been to extinguish every hot-spot before leaving the stand. In the 1997 spring burn, for example, we had to return the next day and spend 8-10 hours extinguishing fires that smoldered in the dry conditions.

3. Avoid backing fires: Since fuel ignition is greatest following pre-heating, we suggest avoiding backing fires. Backing fires have longer residence time and tend to facilitate underlying duff ignition. While flame lengths will be low, backing allows for a tremendous build-up of heat in the duff. Head fires, in contrast, burn across the surface quickly, removing the past years’ needle cast and initiating subsurface combustion. We suggest strip head fires or spot fires with short distances (30 ft) between strips.

4. Protect older pines: In restoration fires, efforts typically focus on minimizing overstory pine mortality. For those trees of high value, pre-fire raking may be appropriate. If you have some trees you want to protect and you cannot be out there to mop-up then you may need to do something to prepare them and/or the stand. Raking the litter and duff away from old trees has been suggested but there is no hard science that indicated this is effective. It would certainly be quite an undertaking to do that if the stand had 100’s of trees. As far as the stand is concerned, you need to think about what is on the ground and standing snags that can present problems even days later if they start to smolder or burn.

5. Use winter burns: Throughout the region, fuel moisture is often at its highest during the winter. Dormant season burns usually generate lower flame lengths, facilitating wider distances between strips. Additionally, weather during winter is more amenable to planning and executing prescribed fires. After the first 2 restoration burns at the FNA we tried to use growing season burns; for the next two consecutive years there were only 2 days within prescription. On both of these occasions, we were without resources needed to mop-up. Once fuel loads are reduced, a system integrating growing season fires may be appropriate.

Conclusions

Restoring fire-excluded longleaf pine ecosystems cannot happen over night, restoration requires substantial time and financial resources. The FNA underwent 45 years of fire suppression; it may require 45 years of prescribed restoration burning to restore. So take it slow, burn under cool conditions and carry a water bag, we have to make what longleaf we have left last.

Literature Cited:

Chapman, H. H. (1932). Is the longleaf type a climax? Ecology 13:328-334

Frandsen, W.H. (1987). The influence of moisture and mineral soil on the combustion limits of smoldering forest duff. Canadian Journal of Forest Research 17:1540-1544.

Kush, J.S. and R.S. Meldahl. (2000). Composition of a virgin longleaf pine stand in south Alabama. Castanea 65:56-63.

Kush, J.S., and R.S. Meldahl. (2006). Stand dynamics of a longleaf pine restoration project. In: Proceedings of Thirteenth Biennial Southern Silvicultural Conference, February 28-March 4, 2005, Memphis, TN. USDA Forest Service GTR-SRS (In press).

Varner, J.M., J.S. Kush, and R.S. Meldahl. (2000). Ecological restoration of an old-growth longleaf pine stand utilizing prescribed fire. Tall Timbers Fire Ecology Conference 21:216-219.

Varner, J.M., D.R. Gordon, F.E. Putz, and J.K. Hiers. (2005). Novel fire effects in southeastern pine forests: smoldering fire and overstory pine mortality. Restoration Ecology 13:539-544.

Dendrochronological Investigations of Longleaf Pine on Lavendar Mountain

Troy Knight: University of Arizona; takjinsco@earthlink.net; Martin Cipollini; Chris Worrell

Introduction

The montane longleaf pine (*Pinus palustris*) populations occupying northeast Alabama and northwest Georgia have received little attention in the scientific literature compared to the more southerly coastal plain populations (Varner 1999). Though once extensive, these montane longleaf forests have been reduced to a fraction of their former extent due to logging, land conversion, and especially fire suppression (Harper 1901, Andrews 1917). The longleaf pines on Lavender Mountain on the campus of Berry College in northwestern Georgia represent one of a few remnant populations (Cipollini 2002). As restoration efforts continue apace at Berry and in other montane stands, study of the few remaining pre-Euro-settlement stands grows more important as researchers strive to gain further knowledge of the ecological processes that once dominated these forests. Dendrochronology is especially suited to elucidating past patterns and processes in forested areas. This paper describes dendrochronological research conducted on the Lavender Mountain longleaf stands in the summer of 2004.

Three questions will be addressed in this paper. First, how old are the longleaf pine stands on Lavender Mountain? Previous work by former Berry student Roger Birkhead brought to attention the presettlement ages of many of these trees but until this study, they have yet to be crossdated (Cipollini 2002). Related to tree age is analysis of recruitment, though the sample size in the present study is too small to draw definitive conclusions, we can show the general differences between stands in terms of the oldest surviving cohort.

Second, how does longleaf pine radial growth relate to climate? Climate/growth relationships allow one to identify those conditions favorable and unfavorable to tree growth thus allowing the building of predictive models of forest health and change under different climatic conditions (Grissino-Mayer and Butler 1993). Both of which may become increasingly important in light of predicted future global climate changes which may affect the range of many plant species in yet unforeseen ways. This work also shows the potential for longleaf pine in tree based reconstructions of past climate variability.

Third, what role do disturbance events play in radial growth patterns? Whereas some disturbances leave scars such as fire scars or frost rings, others leave distinctive ring width patterns such as insect infestations or damaging wind, ice or snow storms. For instance, storms causing mortality to some trees create less competition for survivors often leading to growth releases. Conversely, growth suppressions may be encountered where the dominant effect is loss of limbs and needles or leaves. Depending on the amount and nature of damage incurred, complex mixtures of these two aspects, both within individual trees and in different trees within the same forest, can occur (Lafon and Speer 2002).

Study Area

Longleaf on Lavender Mountain are generally found on southwestern facing slopes. The principal concentrations of longleaf lie in six geographically distinct stands in near proximity but separated by stretches of hardwood dominated forest. The longleaf restoration team at Berry College have designated these stands A-F (Cipollini 2002). All but two stands are characterized by scattered older individual pies in a matrix of hardwoods and other pine species with no regeneration apparent. Stand C is different in being rather open and dominated by younger longleaf of generally similar age. Stand D has some active reproduction (Cipollini 2002).

Methods

Field and Lab

During the summer of 2004 core samples were collected from 40 living longleaf pines, 1 stump, and 1 standing snag including trees from all designated stands. Two core samples were extracted from each tree using increment borers at a height of approximately 50cm above ground surface. In the lab cores were prepared according to standard dendrochronological procedures (Stokes and Smiley 1968). Cores were then visually crossdated by close attention to narrow marker years with the aid of a compound microscope. Precise width (0.01mm) of each annual ring, including full ring width and early and latewood portions, was measured using a Velmex calibrated sliding table, compound microscope, and computer using Measure J2X software. The computer program COFECHA was used to confirm accuracy of crossdating and identify any potential errors which were then corrected by changing assigned dates or excluding of problematic individual series (Holmes 1999). Finally, the computer program ARSTAN was used to detrend the ring width series of age related growth trend, and to standardize the tree ring chronologies creating dimensionless indices both for individual tree chronologies and a site master chronology (Cook and Holmes 1999).

Age structure

Inner dates were assigned where pith was captured in sampling. For the remainder of samples, pith was estimated using ring estimator transparencies based on size and degree of curvature of the innermost rings of each sample. Estimations were considered accurate up to 15 rings. Because trees were cored at a uniform height of 50cm, we believe we were capturing, or coming very close to capturing, the year in which the tree would have emerged from its grass stage. After obtaining tree ages, they were separated into age classes by decade beginning with 1790 and displayed graphically by stand and age class.

Climate Growth Analysis

Climate data was acquired from the United States Historical Climate Network (USHCN) on the National Climate Data Center (NCDC) website for the Rome weather station. Rome is unusual in having consistently recorded daily weather data dating back to 1878 for precipitation and temperature.

In order to determine climatic variables that most influence radial growth, we conducted correlation analysis using SPSS between the detrended site chronology and monthly and seasonal combinations of average temperature and total precipitation values for the current growing season and the prior year. We then conducted multiple stepwise regression with tree-ring indices as the dependent variable and the same climatic variables as potential predictors. After several attempts, we decided on an equation that maximized the variance explained, while not violating the statistical assumptions for regression.

Disturbance Analysis

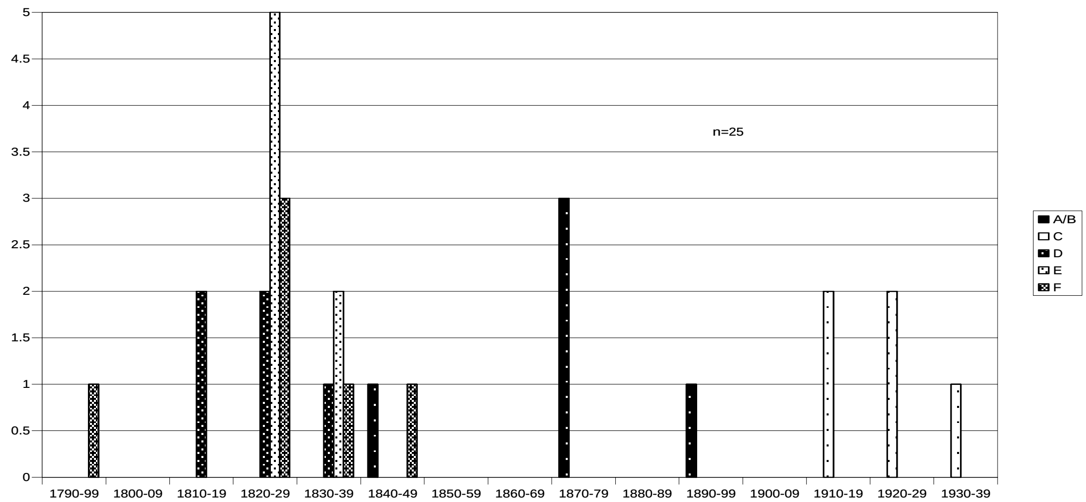
Analysis of disturbance proceeded in three steps. First, individual growth curves of trees were visually examined for any incidences of sudden changes in growth trend that typically characterize disturbances. Secondly, the residuals from the climate/growth model previously developed were plotted and compared with known recorded disturbance events in the Rome area, including ice storms, heavy snow storms, and high wind events (Knight 2003). Finally, in order to identify and quantify medium term changes in growth regime, we subtracted from each individual tree ring series the predicted growth series calculated from the climate/growth model (Lafon and Speer 2002). This created residual series for each tree. The residual chronologies for each tree were then screened for abrupt and prolonged changes in growth regime by comparing consecutive 5 year means for the entire length of each tree-ring series (Nowacki and Abrams 1997). Trees were tallied that met predetermined growth change thresholds. The thresholds were based on previous research that has captured growth changes in mature over-story trees (Nowacki and Abrams 1997, Lafon and Speer 2002). The tallies were then compared with known events that may have caused forest disturbances.

Results and Discussion

Age Structure

Recruitment dates were acquired for 25 of the 43 trees sampled (Figure 1). Because of the small sample size and targeted sampling strategy (oldest trees), the age structure data must be viewed as preliminary. However, by targeting older appearing trees we may have captured maximum ages of trees in each stand. Stand C is of interest as the most recently established and the most uniform in age. The data suggest the stand was cleared by an unknown event, natural or human, in the 1910s and subsequently regenerated. The grouping of older trees established in the 1820s and 1830s in stands D, E, and F could also the result of a recruitment episode occurring after a disturbance event such as a stand clearing fire or wind event (Turner 1935, Parker et al. 2001).

Figure 1. Ages of sampled trees by decade and by stand.

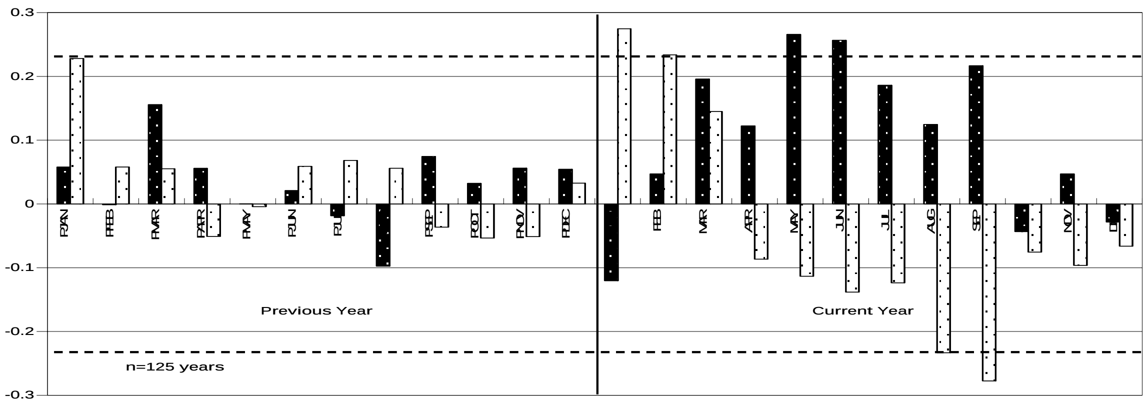


Climate growth relationships

Correlation analysis revealed several significant relationships between ring width and monthly temperature and precipitation values (Figure 2). The significant correlations generally lie within the months preceding and during the growing season. Warmer Januarys and Februarys correlate with increased growth suggesting preparation for earlywood formation under favorable conditions. Cool and wet summers also appear favorable for longleaf pine as these conditions decrease rates of evapotranspiration thus increasing the amount of water available. Correlations with the early and latewood ring widths accentuate these findings where earlywood relates to winter and spring climatic conditions and latewood to summer and early fall (not shown). These results are quite similar to findings of climate/growth relationships for longleaf pine stands further south on the piedmont and coastal plain for both full ring width and the early and latewood portions of the ring (Meldahl et al. 1999, Knight 2004).

Multiple regression produced a climate growth model that included current year May-September precipitation, January-March temperature, September temperature and previous year March-April precipitation and January temperature as predictor variables. The model did not violate any of the assumptions of linear regression and had an R^2 value of 0.394 with a standard error of 0.14718.

Figure 2. Correlations between radial growth and temperature and precipitation. Red line indicates significance at the 0.01 level.



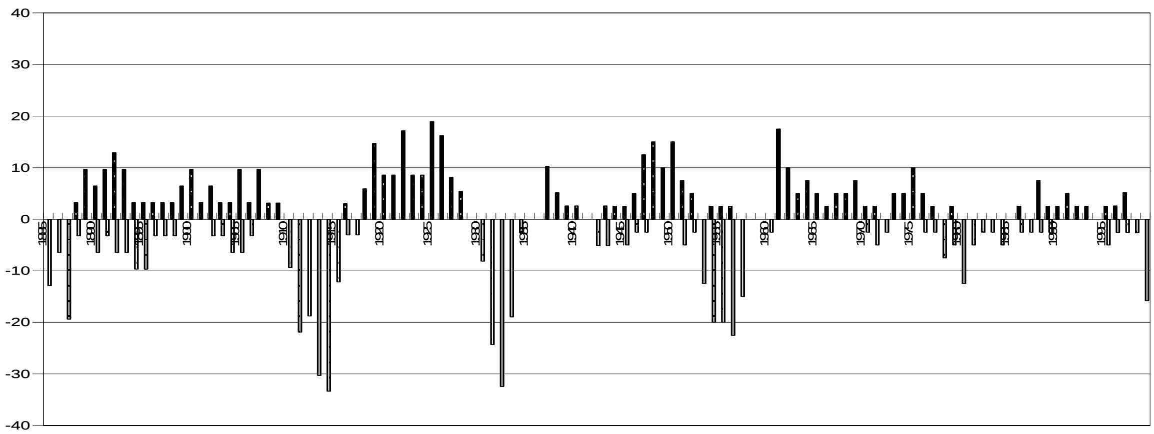
Disturbance analysis

Visual analysis of radial growth patterns of individual trees revealed several consistencies among trees and between stands (not shown). Many trees experienced significant decreases in growth during 1960, most likely attributable to the intense late season ice storm. Trees in stand C, which are considerably younger than those other stands, tended to recover more quickly to previous growth rates, and in some cases even experienced increased growth rates in the years after 1960. Several trees in other stands appeared to retain suppressed growth rates for several years following 1960. The contrast between stand C and the others may reflect a number of factors, for instance, age related ability to recover from damage may be responsible, or possibly higher mortality of neighboring trees in stand C allowing survivors more access to resources following the storm. Also of note is the reduction in growth for many trees during the mid-50s beginning around 1954. Many of these trees in both stands may have been weakened by drought during the period preceding the ice storm damage of 1960.

Analysis of residuals revealed no clear pattern, although during 1960 and 1886, the winter of 1885-1886 saw Rome’s most significant snowfall event, the two largest negative residual occurred. Other known storm events showed more ambiguous results suggesting that this method captures only the most severe events both in terms of intensity and timing (the storm of 1960 occurred in March).

Comparison of five year means was even more ambiguous than single year residual analysis, suggesting that effects of these storm events, while not ruling out significant longer term effects on forest ecology, are rather too subtle to capture in ring-width patterns alone using the methods employed in this study (Figure 3). In this case, 1960 registers as a growth change year for only a very few trees. Instead, many trees began somewhat suppressed growth in the 1950s and a few, especially those in stand C, rebounded after 1960-61 to register as growth releases. The suppressed growth in some trees in the early 1930s may be attributable to ice storms in 1933 and 1935, but the graph is not conclusive. In regards to the ice storm of 1960 these results lie in contrast to similar analysis conducted in the Marshall Forest located seven miles south of Lavender Mountain. In the Marshall Forest old growth shortleaf pine (*Pinus echinata*) experienced prolonged and often severe reductions in radial growth following the 1960 event (Knight 2003). Explanations could include differences in species ability to recover from canopy damage to limbs and needles, or the spatially variable nature of ice storm damage. Such variability has been witnessed in many studies conducted soon after the occurrence of a storm where subtle differences in slope, aspect, and forest structure create significant differences in ice accumulation, longevity of ice coating, and exposure to wind (Mou and Warillow 2000, Lafon et al. 1999.).

Figure 3. Percent of trees experiencing either 60% increases or 45% decreases in radial growth when comparing consecutive five year means.



Conclusion

The data and analysis provided in this paper should help form a baseline from which further studies may be extended as the opportunity arises. Future work could include larger and systematic sampling in order to identify recruitment dynamics over time and across space for the stands on Lavender Mountain. Shortleaf Pine, which mingles with longleaf in several of the stands, could also be sampled to study the relationship between these two pine species. Finally, work on other longleaf stands within the montane distribution is needed to develop a fuller picture of dendrochronological aspects of this tree across space.

Literature Cited:

Andrews, E.F. Agency of fire in propagation of longleaf pines. *Botanical Gazette*, 1917, 64:497-508.

Cipollini, M. et al. The Berry College Longleaf Management Plan: A proposal fro the study and management of mountain longleaf pine on Lavender Mountain. 2002. Unpublished, but available online at http://fsweb.berry.edu/academic/mans/mcipollini/manage.pdf

Cook, E.R. and Holmes, R.L. (1999) Users Manual for the Program ARSTAN. Laboratory of Tree-Ring Research, University of Arizona, Tucson.

Grissino-Mayer H.D. and D.R. Butler. Effects of climate on the growth of shortleaf pine in northern Georgia: a dendroclimatic study. *Southeastern Geographer*, 1993, 23(1):65-81.

Holmes, R.L. Users Manual for Program COFECHA. Laboratory of Tree-Ring Research, 1999 University of Arizona, Tucson.

Knight, T.A. Ice Storm Reconstruction using Tree Ring Data in Northwest Georgia. MA. Thesis, Georgia State University, 2003.

Knight, T.A. Reconstruction of Flint River streamflow using tree rings. Georgia Water Policy and Planning Center, Water Policy Working Paper #2004-005, 2004. Available online at http://epp.gsu.edu/waterPDF/W2004005.pdf

Lafon, C.W., D.Y. Graybeal and K.H. Orvis. Patterns of ice accumulation and forest disturbance during two ice storms in southwestern Virginia. *Physical Geography*, 1999, 20(2):97-115.
Lafon, C.H. and J.H. Speer. Using dendrochronology to identify major ice storm events in oak forests of southwestern Virginia. *Climate Research*, 2002, 20:41-54.
Meldahl, R.S., N. Pederson, J.S. Kush, and J.M. Varner III. Dendrochronological investigations of climate and competitive effects on longleaf pine growth. Tree-Ring Analysis: Biological, Methodological, and Environmental Aspects. Wimmer, R. and R.E. Vetter, eds. Cabi Publishing: Oxon, UK, 1999, 265-285.
Mou, P. and M.P. Warillow. Ice storm damage to a mixed hardwood forest and its impacts on forest regeneration in the ridge and valley region of southwestern Virginia. *Journal of the Torrey Botanical Society*, 2000, 127(1):66-82.
Nowacki, G.J. and M.D. Abrams. Radial growth averaging criteria for reconstructing disturbance histories from presettlement-origin oaks. *Ecological Monographs*, 1997, 67(2):225-249
Parker, A.J., K.C. Parker and D.H. McCay. Disturbance-mediated variation in stand structure between varieties of *Pinus clausa* (sand pine). *Annals of the Association of American Geographers*, 2001, 91(1):28-47.
Stokes, M.A. and Smiley, T.L. (1968) An Introduction to Tree-ring Dating. University of Chicago Press: Chicago.
Turner, L.M. Catastrophes and pure stands of southern shortleaf pine. *Ecology*, 1935, 16:213-215.
Varner, J.M. Longleaf pine forests…in the mountains? Alabama's Treasured Forests, Fall 1999:30-31

Connecting the Longleaf Pinelands of Northeast Alabama and Northwest Georgia: Our Last Chance for Corridors to Protect the Special Things

Johnny Stowe: South Carolina Department of Natural Resources, stowej@dnr.sc.gov

What's So Special About Mountain Longleaf ?

Intact longleaf pine forests, woodlands and savannas once covered about 90 million acres in the Southeastern U.S., but only about 3 million acres remain. Longleaf ecosystems are well-known for their unique attributes, including resilience to fire, insects, disease and wind damage; valuable timber and other forest products; delightful aesthetics; and plant and animal biodiversity seldom equaled in the temperate zone.

The longleaf-wiregrass (*Aristida stricta* & *beyrichiana*) communities of the Sandhills and Coastal Plain are probably the best known -- in fact, the terms "longleaf" and "longleaf-wiregrass" are often used synonymously. But there are other longleaf ecotypes in which, to quote the Longleaf Alliance's John McGuire,"nary a sprig of wiregrass is to be found." John refers to the longleaf that grows mutualistically with a variety of other "bunchgrasses," such as bluestems. These longleaf-bluestem systems are well-represented in the flatwoods of the Coastal Plain, where the soils are less xeric than those of the Sandhills.

But as special as these Sandhills and Coastal Plain longleaf communities are, they are not as unique and threatened as the longleaf ecosystems of the rough and rocky ridges, "mountains," and gravelly flatwoods of Northwest Georgia and Northeast Alabama, where longleaf grows at elevations up to 1,900 feet > MSL. Here, longleaf was once a keystone species of a globally-unique natural and cultural convergence zone. Here -- near the 34^{th} parallel of latitude -- where the Cumberland Plateau, Ridge and Valley, Blue Ridge, and Piedmont physiographic regions meet, where the Creek and Cherokee Indian Nations met, and later and today the Deep South and Scots-Irish Appalachian cultures merge with African influences, this area where plant assemblages found nowhere else on earth grow, with some plant species reaching their extreme northern, and others the extreme southern, tips of their ranges -- here is where we should develop a network of protected lands, a functionally connected network of lands that will restore and maintain the unrivaled ecological and cultural integrity of this special place. The mountain longleaf pinelands have been described in several papers, which can be obtained from the authors or the Longleaf Alliance. These documents include work done here at Berry College, and at Jacksonville State University and Auburn University, as well as publications of the U.S. Forest Service and U.S. Fish and Wildlife Service. For detailed descriptions of the unique natural and cultural attributes of mountain longleaf pinelands, see, e.g., Varner (1999), Maceina et al. (2000), Stowe et al. (2002) and Stowe (2004).

As the world becomes increasingly homogenized, what stands out, of course -- are the "special things," the unique and pleasingly-different places, biota, artifacts, and customs that so often are taken for granted, sometimes not fully-appreciated by the folks who are immersed in them daily. As these special things disappear, many folks don't notice and many don't care, and often by the time the full value of these special things becomes salient in the public consciousness, they are either gone or too far gone to save. Sometimes they remain only vestigially and out-of-context; sad remnants of what once was but no longer is part of a cohesive and significant piece of the Earth.

Why Now?

We are fortunate that we still have time to act. It's not too late to establish a natural and cultural nexus that will serve many purposes. But it will soon be either too late or extremely difficult and expensive to develop a system of linked protected lands in the adjoining parts of northern Georgia and Alabama, since so-called "development" pressures are increasingly intensifying. The metastatic growth of Atlanta poses the greatest risk to the area. Atlanta's unbridled growth vis-à-vis land protection can be usefully examined through the lens of economic growth and private property rights. Let's take a look.

Many folks in the rural areas being disintegrated by Atlanta's spread seem to confuse economic *growth* with economic *well-being* and increased quality of life. I think the insidious trap we have fallen into is plain. During much of human history, these concepts have usually been positively correlated. But today in much of the South, and especially in this area, we have reached a level of land "development" such that many capital projects -- projects that yield *short*-term economic *growth* -- actually lower our short-term and especially our *long*-term economic *well-being* and cause our quality of life to deteriorate. Ed Abbey alluded to this phenomenon when he wrote, "Growth for the sake of growth is the ideology of the cancer cell." What progressive thinkers like Abbey and Aldo Leopold had in mind was that if we wish to protect the land we all depend on we must rethink concepts such as “progress” and “development.” The philosopher John Dewey coined the term “reflective morality” to describe the process of periodically reevaluating our mores and values, and when necessary, making changes. Basic values like the Decalogue and the Golden Rule tend to be timeless, but other aspects of society tend to change over time. Slavery and opposition to women’s suffrage are relatively-recent examples of things that seem outrageous to us today, but were the status quo not long ago. And justice was achieved in neither instance without violent opposition. My point is this -- whereas in the past the idea of “more and bigger” has generally been associated with “better” when it comes to roads, residential and commercial areas, businesses, budgets, sales, and other economic indicators, today that relationship is less clear, and in some cases, the correlations have switched diametrically, from positive to negative.

As for private property rights, we Southerners tend to be rather adamant in our belief that “a man [sic] can do what he wants to on his own land.” But even the most hard-core property rights advocate would not likely defend his or her right to do something that harms the land of a neighbor, say for instance, dumping toxic waste in a creek. Like many such things, property rights are a matter of degree, not total sacrosanctity. Private property rights can be viewed as sticks in a bundle, and those sticks include exclusivity, specificity, transferability, and enforcability. These rights are already being undermined by Atlanta’s sprawl. For instance, air pollution in the metro-Atlanta area has already taken away the right of landowners in dozens of surrounding counties, all the way over to the Alabama line, to conduct growing season burns.

Zoning is another property rights issue we need to address. Few of us like being told what we can and cannot do on land we own and pay taxes on. But given that zoning by whatever name is ubiquitously-associated with “development,” which seems at least to a large degree both incessant and inexorable, would we not be better off to initiate, develop and implement land-use planning that would protect land values before we are forced to do so by interests that are now outside the area?

Ensuring and enhancing the quality of life of the common region along the shared north Georgia and Alabama boundary area should be an issue most conservationists and community-minded folks can agree on as a societal goal.

The good news is that the fast-disappearing attributes -- like the mountain longleaf pinelands -- that make this area so special ecologically and culturally can also be used to maintain both our quality of life as well as short- and long-term economic well-being. Eco-tourism, hunting leases, and sustainable forestry practices all are compatible with protection of our unique longleaf forests. And of course intact native ecosystems provide less noticeable, but priceless and essential services such as carbon sequestration (e.g. The Southern Company’s longleaf pine project), pollination, enhanced water quality and stabilized streamflow (mitigating both droughts and floods) and erosion control.

For an outstanding overview of how land protection provides the vital base for a vibrant economy, see The Trust for Public Land’s excellent publication *The Economic Benefits of Parks and Open Space* (http://www.tpl.org/), or the work of Donella Meadows (http://www.sustainer.org/dhm_archive/search.php).

So What Next?
We are lucky to have many thousands of acres of the most ecologically significant lands protected to some degree already. The most notable of these tracts include Berry College, the Talladega National Forest, and the Mountain Longleaf National Wildlife Refuge. A very few conservation groups, such as the Georgia Land Trust headed by Katherine Eddins, are playing a paramount role in protecting unique mountain longleaf tracts. The state of Alabama is doing its part, too. Recently, through its Forever Wild Land Trust, it acquired several hundred acres on the south slope of Indian Mountain in Cherokee County that has remnant old-growth longleaf pine. These trees can be seen from the Pinhoti, which traverses the tract.

I see these lands as the keystone tracts of a keystone ecosystem. They are the jewels. Recent recreational linkages such as the Pinhoti Trail and the Silver Comet Trail now tie some of these jewels together. We now have before us, but not for long, the chance to protect more jewels, and moreover, to connect them with a corridor that would provide a one-of-a-kind centerpiece for our landscape. And the scope of what I propose need not be limited to northern Alabama and Georgia; the Pinhoti could be connected northward to the Benton MacKaye Trail and the Appalachian Trail, and southward to other public lands and trails so that Maine could be linked with the Gulf of Mexico! To paraphrase Doug Rayner, if we protect only the scattered special places we may well find that we have protected the crown jewels, but lost the crown. The crown consists of connecting the jewels.

As desirable as corridors are, they are not panaceas. They must be carefully designed and implemented so as to avoid creating ecological traps or sinks, or pathways for invasive species, and ideally, to facilitate ecological processes (functional connectivity). But the tools and expertise to do it right are available. Kevin Kleiner's presentation today on the Alabama GAP project is a wonderful example of how modern technology can be used in land protection. Reed Noss (see, e.g. 2004-2005) has designed corridors for several decades, both as an academic, and on-the-ground as a conservation biologist and planner. Many of his publications, such as *Saving Nature's Legacy* (Noss and Cooperrider 1994), provide a "how to" approach to connecting wildlands. The Wildlands Project (www.wildlandsproject.org) joins partners interested in creating interconnected systems of North American wildlands.

With careful planning and implementation, we could develop an ecologically-functional corridor that would tie the mountain longleaf pinelands together in a fashion that would yield synergistic natural and cultural benefits. Such a corridor would protect ecosystem integrity, that precious blend of native species composition, structure and processes that conservation biologists use to define and gauge land health and resilience. Such a corridor would tie us to our past, give deeper meaning to and make us more secure in the present, and help ensure a healthy, land-centered, economically-viable future for those who come after us.

I don't fear that our mountain longleaf pinelands will not be recognized for their spectacular uniqueness and beauty. *But I do fear that they may not be fully appreciated until they are gone.* The old story of taking care of the goose that lays the golden eggs comes to mind. When chambers of commerce and other civic cheerleaders and marketing folks set out to draw folks into an area, they tend to focus on things that set the place apart, things like the heritage and traditions, and the unique elements and special character of an area. One day the appeal of this area will be evident to all, and what we are now either unaware of or take-for-granted could one day be the economic backbone of our future. Let's not let anyone in the future look back at and bemoan what was once here, but that we let disappear in the name of "progress."

I leave you with this passage from Aldo Leopold's (1933) seminal text *Game Managemen*t, as I implore you to work together to protect the mountain longleaf pinelands.

We of the industrial age boast of our control over nature. Plant or animal, star or atom, wind or river – there is no force in earth or sky which we will not shortly harness to build "the good life" for ourselves.

But what is the good life? Is all this glut of power to be used for only bread-and-butter ends? Man cannot live by bread, or Fords, alone. Are we too poor in purse or spirit to apply some of it to keep the land pleasant to see, and good to live in?

Literature Cited:

Leopold, A. 1933. Game Management. Charles Scribner's Sons. 481 pp.

Maceina, E.C., J.S. Kush, and R.S. Meldahl. 2000. Vegetational survey of a Montane Longleaf pine community at Fort McClellan, Alabama. Castanea. 65:2. 147-154.

Noss, R.F., and A.Y. Cooperrider. 1994. Saving Nature's Legacy. Island Press. 416 pp.

Noss, R.F. 2004-2005. What have we learned about connectivity? Wild Earth. The Wildlands Project. 14. 3-4. 12-15.

Stowe, J., J.M. Varner III, and J. McGuire. 2002. Montane longleaf pinelands … Little-known and Disappearing Treasures. Tipularia. 17. 8-15.

Stowe, J. 2004. Wildlife and other aspects of the mountain longleaf pine forests and other ecosystems of northeast Alabama and northwest Georgia. Pages 1-27 in J.S.

Kush, compiler. Proceedings of the First Montane Longleaf Pine Conference. 15-17 October 2003. Jacksonville State University. Longleaf Alliance Report No. 7.

Varner, M. 1999. Longleaf pine forests … in the mountains? Alabama's Treasured Forests. Fall. 30-31.

Conservation Easements

Katherine Eddins: Georgia-Alabama Land Trust; katherine@chattowah.org

Many landowners want to protect their land, while continuing to use the land for their individual benefit and enjoyment. A conservation easement is a tool used by landowners to achieve this objective. For example, ten years ago the McIntosh family purchased a large forested property in rural northwest Georgia to "get away" from the city and to teach their children about natural resources, forestry and wildlife. They manage the property primarily for wildlife and timber production, and are restoring the ecology of the forest by converting a portion from loblolly pine plantation to mountain longleaf. Last year, they placed a conservation easement on the property with the land trust, which allowed them to protect the property's conservation values. Conservation values include the protection of a large longleaf pine forest that serves as habitat for deer, turkey, bobwhite quail and numerous migratory bird species. In the conservation easement, the family reserved the right to manage wildlife, produce timber and build a home for Mr. and Mrs. McIntosh and their three children. As a result of donating the conservation easement to the land trust, the family received significant income tax savings and modest property tax savings. It also helped reduce their estate tax liability. For more information on conservation easements, including sample conservation easements and tax savings, please visit our website at www.galandtrust.org.

Conservation Provisions of the 2002 Farm Bill

Keith Wooster: Natural Resource Conservation Service, keith.wooster@ga.usda.gov

The 2002 Farm Bill represents the single most significant commitment of money for conservation on private lands in our nation's history. Programs are directed toward erosion control, water conservation, wetland protection and restoration, wildlife habitat and farmland protection. This presentation will discuss 5 conservation programs in Alabama and Georgia. EQIP, Environmental Quality Incentives Program, is a voluntary program that provides cost share assistance for protection of ground water and surface waters, erosion control, air qualify, wildlife habitat and plant health. In Georgia and Alabama, a special EQIP program to address wildlife and forest health has been developed. Cost share is available for commercial and pre-commercial thinning, tree planting, release, and prescribe burning. The WHIP program (Wildlife Habitat Incentives Program) provides cost share for conservation practices that address priority habitats. These include; early successional habitat, longleaf pine ecosystem and hardwood ecosystems. The WRP program (Wetlands Reserve Program) restores degraded wetlands by purchasing 30 year or perpetual easements on qualified lands. The new CSP (Conservation Reserve Program) recognizes and rewards farmers and ranchers for high levels of environmental stewardship. CSP helps producers maintain and further their conservation commitment. Four watersheds in Georgia and Alabama were chosen for 2006. The CRP program (Conservation Reserve Program) provides technical assistance, rental payments and cost share funding to address specific natural resource concerns including; protection of ground and surface waters, soil erosion and wildlife habitat. Longleaf pine planting is available on the historic range. Also developing early successional habitat by creating wildlife field borders is also available in certain counties. Two non-farm bill programs are also available that create early successional habitat on power line easements. The WILDPOWER program is available in Alabama and WINGS is available in Georgia. For additional information on farm bill programs contact your local Farm Service Center or log on to: www.al.nrcs.usda.gov for Alabama or www.ga.nrcs.usda.gov for Georgia.

Southern Pine Beetle Cost Share Program

James Johnson: Georgia Forestry Commission, jjohnson@gfc.state.ga.us

Without question, the southern pine beetle (SPB) is the most destructive forest pest in the southeastern U.S. Beginning in 2003 through U.S.D.A. Forest Service funding, a new opportunity arose for forest landowners throughout Georgia to implement practices that can minimize damage that Southern Pine Beetles cause on their pine stands or restore areas already impacted by them. It is an accepted fact among the forestry community that healthy, vigorous stands of pine tend to have less damage caused by these destructive insects if they attack. Traditionally, stands that have too many trees or too much hardwood competition suffer the greatest damage. Furthermore, Longleaf and Slash Pine have a natural resistance against SPB attacks and these species are encouraged and promoted where practical.

Practices available include: noncommercial thinning (which should be done by hand to reduce the number of stems per acre to an optimum level), release treatments (which remove unwanted species from the stand and lower the number of stems per acre), prescribed burning, creation of permanent buffer strips, replanting Longleaf, Loblolly or Slash Pine (depending upon the region of the state and site characteristics) or hardwoods. All practices are offered statewide.

These practices not only result in healthier stands of timber that will increase in value but also have wildlife benefits for many species including deer, turkey and quail. Interested landowners should contact their local Georgia Forestry Commission office for more information. Applications are made through the GFC forester that oversees the County where the property is located. Landowners can apply next spring and the money will be allocated on a first come, first serve basis. If you don't know who your forester is, contact 1-800-GATREES or log on to: http://www.gatrees.org/ContactUs.cfm

The Longleaf Challenge on Industrial Land

R. Larry Ford**:** Gulf States Paper Corporation, lford@gulf-states.com

Gulf States Paper Corporation is a 121 year old, privately owned corporation headquartered in Tuscaloosa, AL. Approximately 400M acres in west central Alabama are owned and leased by the corporation and have been certified by the Sustainable Forestry Initiative®. The corporation has 2 sawmills and a pole mill on the same site. Longleaf reforestation was begun in the 1970's with bare root seedlings, and a container nursery was established in 1982. Acquisition of proven genetic seed source for the mountain region has been a problem in the past. Along with this is the high cost of the seed. The economics of managing longleaf pine, on industrial land, on a longer rotation than fertilized loblolly pine is a major challenge. On GSPC lands, individual compartments and blocks of land have been selected for future longleaf management using the Longleaf Decision Tree where soils mapping is the basis. The Decision Tree also incorporates wildfire, diversity, aesthetics, forest health, and the Wildland/Urban Interface. Site preparation is primarily aerial chemical application with a subsequent burn. Various mechanical site preparation treatments have not proven acceptable for several reasons: Primarily poor response to the tillage, and the subsequent seedling suppression from blackberry invasion due to the herbicide used for early pine release. Other challenges in stand establishment include overtopping by natural loblolly pine seedlings. Thinning longleaf plantations is dependent upon site and stocking factors bringing the trees to be cut to merchantable size. The rotation length is planned at 35-40 years.

All GSPC lands have been reviewed and are in a Land Classification System. In this System, the species to plant and management intensity are set. Harvested tracts that are classified for longleaf based on the Longleaf Decision Tree are put into the reforestation plan and only that number of acres each year is reforested in longleaf. The Decision Tree screens for 1. Soils mapping recommendation 2. Ability to prescribe burn and aerial spray as needed (Wildland/Urban Interface) 3. High wildfire frequency 4. Aesthetics 5. Forest Health 6. Forest Diversity

Site preparation is planned for an aerial herbicide application in June with a following site preparation burn. GSPC grown containerized seedlings are planted in the fall @622 trees/acre. An aerial application of herbaceous weed control is then planned for the next April.

Use of mechanical site preparation is limited due to poor response.

Prescribed burning begins at age 2 on most tracts and is planned on a 4-5 year rotation.

The seeding in of natural loblolly pine seedlings on reforested stands has been a problem for a number of years. A prescribed burn in the spring is effective on removing the loblolly if the trees have not reached a height of approximately 6 feet. Beyond that, they are hard to kill. This is also the stage at which the longleaf are the most susceptible to injury from fire and care must be taken to not injure too many of them. If a burn is not accomplished, precommercial thinning is an option to remove the loblolly mechanically with saws and thereby releasing the longleaf.

Commercial thinning of longleaf stands has just begun with stands 21 years old. The thinning prescription is for a leave basal area of 70 square feet. Rotation length is planned for 35-40 years.

Allatoona Lake Longleaf Pine Ecosystem Restoration Project

Terrell Stoves: US Army Corps of Engineers, Terrell.S.Stoves@sam.usace.army.mil

In the year 2000, Foresters at Allatoona Lake discovered a scattered population of longleaf pine within the primarily loblolly forests located in the Allatoona Wildlife Management Area on the northern shores of Allatoona Lake. Many of these trees were over 75 years old and were dominant trees on their sites. Research showed the general area had once been settled by Native Americans on the banks of the Etowah River. It was part of the Native American culture to burn the forest frequently to open the area up and facilitate browse growth and to improve hunting. This burn regime would have created perfect conditions for longleaf to dominate the landscape. After many decades, possibly centuries, of annual or biannual burns the area was settled by farmers and most of the site was cleared for farming communities. This eliminated most of the longleaf presence in the vicinity. Around the 1940s, the US Army Corps of Engineers began acquiring lands for the creation of Allatoona Dam and Lake including the farms on the northern banks of the Etowah River. This pushed farmers off the lands once dominated by longleaf pine which, without the historical fire regime, no longer ruled the forest. Over the next 60 years loblolly pine trees would emerge as the dominate species. Allatoona Foresters have worked for approximately four years to develop and implement a plan on Corps lands at this historic site to recover the lost longleaf pine community. Allatoona’s focus remains on attempting to recover an entire ecosystem, not just the pines. Through selective herbicide use and a prescribed fire regime we intend to maintain a healthy biodiversity in our forest understory on the 400 acre project. Partners on this project include GA Department of Natural Resources, The National Wild Turkey

Federation, Southern Company, and National Fish and Wildlife Foundation. We also consulted with the GA Native Plant Society, Dr. Martin Cipollini (Berry College), The Nature Conservancy, GA Forestry Commission, GA Bobwhite Quail Initiative, John Kush (Auburn University), and others.

Additional Abstracts

Landscape scale ecosystem classification in the Pine Mountains of Georgia and Talladega Mountains of Alabama

Robert Carter: Jacksonville State University, rcarter@jsucc.jsu.edu

Landscape scale ecosystems in mountainous regions of the Piedmont of Georgia and Appalachian region of Alabama were identified through multivariate techniques using vegetation, soil, and landform variables. In the Talladega Mountains of northeast Alabama, five communities were identified including chestnut oak-oak leaf-hydrangea-wild yam, loblolly pine-American hornbeam-hayscented fern, longleaf pine-partridge pea-legume-, longleaf pine-dwarf huckleberry-Elliott's blustem, and longleaf pine-shortleaf pine-muscadine grape. The diagnostic environmental variables included landform index, A-horizon depth, A-horizon Mg, B-horizon Ca, B-horizon Mg, B-horizon P, and slope. Within the Pine Mountain Range of West Central Georgia four landscape scale ecosystems were identified. The communities included a longleaf pine-turkey oak-goat's rue type on steep rocky upper slopes, a longleaf pine-post oak-blackseed needle grass type on mountain tops and side slopes, a mockernut hickory-post oak-yellow passion flower type on mountaintops and moist slopes, and chestnut oak-sand hickory-Christmas fern type on steep slopes bordering ephemeral streams. The diagnostic environmental variables included elevation, landform index, percent A-horizon sand, B-horizon C, B-horizon P, and B-horizon Ca.

Alabama National Forest Partnership

David Borland: The Nature Conservancy, dborland@tnc.org

The establishment of the ***Alabama National Forests Partnership*** formalizes a unique collaboration between the *U.S. Forest Service (USFS)* in Alabama and *The Nature Conservancy (TNC)*. This partnership expands the relationship of The Nature Conservancy in public land policy and management practice, as well as allows the continuation of an important history of public collaboration on projects within Alabama that champions continued land acquisition, rare species protection and appropriate ecological restoration.

The ***GOALS*** of the ***Alabama National Forests Partnership*** are:

- To work directly with USFS leadership, its staff and other partners of five Forest Districts in Alabama and thereby influence the vision and decisions made at Forest District levels,

- To guide strategic management and ecological restoration initiatives related to the many conservation issues critical for these landscapes,

- To provide the technical input and critical oversight for the appropriate planning, management and the promotion of well-conceived and applied public stewardship strategies, and

- To continue efforts to promote and secure federal appropriations for land acquisition within the National Forests in Alabama and assist in negotiations to conserve these important public natural and cultural resources.

The ***OBJECTIVES*** of the ***Alabama National Forests Partnership*** include:

- Assessing the USFS technical approach in directing ecological restoration of natural communities and providing specific definitions of the attributes for restored targeted ecosystems

- Expanding through direct discourse the understanding and utility of prescribed fire to achieve ecological restoration goals and long-term natural community sustainability

- Establishing and facilitating measures to evaluate performance criteria for the ecological restoration treatments planned for the Forest Districts in Alabama

- Increasing public support, through presentations and public outreach, for: conservation forestry methods, rare species protections, prescribed use of fire in the landscape, new or unique stewardship applications and related practices applied on the National Forests to achieve appropriate ecological restoration goals.

The National Forests of Alabama

<u>*Alabama's National Forests harbor some of the richest biological diversity in the state.*</u>

- The National Forests of Alabama represent 3% of the Total Lands in Alabama

- 50 % of all Threatened and Endangered Species occur on National Forests

- 45 % of the Threatened and Endangered Species tracked by the Alabama Natural Heritage Program occur on or near the National Forests of Alabama

- The National Forests of Alabama are obvious bioreserves, serving as refugia for multiple species, ecosystems and conservation target-elements, and containing some of the largest, intact landscapes in the US

The Alabama National Forests Partnership works to assure adequate protection of these and other resources on public lands in three primary ways:

First, through successful influence and regular, direct communication in Washington D.C., TNC Senior Staff engages to secure federal appropriations for land acquisition within the National Forests in Alabama and to assist in policy negotiations to conserve these important public natural and cultural resources.

Second, to help the U.S. Forest Service acquire thousands of acres within the National Forests in Alabama, TNC works directly with the USFS Acquisition Staff in Montgomery to accomplish formal public ownership of in-holdings within the Proclamation Boundaries established for each National Forest. TNC Protection Staff provides assessment, negotiation and acquisition expertise, as well as technical support and logistical facilitation to accomplish final land transactions for these critical parcels.

Third, through the responsibilities of a *Partnership Ecologist*, The Nature Conservancy brings scientific input to conservation management and ecological restoration programs directly to the leadership of the ***Bankhead National Forest, Tuskegee National Forest*** and the three Ranger Districts of the ***Talladega National Forest: the Oakmulgee Ranger District, Shoal Creek Ranger District*** **and** ***the Talladega Ranger District***.

The Nature Conservancy ecologist serves as a working member on the USFS Leadership Team in Alabama and provides important influence and opinion for conservation strategies and ecological restoration planning employed on the National Forests.

The Alabama National Forests Partnership provides expertise to the USFS in order to define appropriate ecological goals, develop ecological restoration strategies and plans and to provide advice on fire ecology for the National Forests in Alabama. The ***Partnership*** E***cologist*** facilitates the establishment of goals and measures of success used to evaluate the effects of management and restoration treatments through additional collaborations with research interests from area universities in monitoring and analysis agreements serving the Districts.

The ***Alabama National Forests Partnership***:

- Expands the use and understanding of prescribed fire to restore ecosystem health, integrity and function for fire dependent natural communities on public lands

- Addresses invasive, non-native species and the importance of reestablishing native species after extirpation

And

- Increases public support for conservation and ecological restoration of the health, integrity and function of the many ecosystems represented on the public lands of Alabama

Through this ***Partnership***, TNC brings the most current ecological science and practice to the management of National Forests and facilitates research to determine how to best monitor and manage these exceptional places and to protect their biological richness.

In this way, TNC forwards it Mission to protect and restore landscapes and waters necessary to support and preserve the natural communities, plants and animals that represent significant biodiversity in Alabama.

A Survey of the Herbaceous Vegetation Found in the Berry Longleaf Pine Management Area.

Kate Currie: University of Tennessee, kcurrie3@utk.edu; J. Morgan Varner; John Kush; Martin Cipollini

Introduction

The Berry Longleaf Pine Project is an attempt to restore the fire-suppressed Berry College mountain longleaf ecosystem (Lavendar Mountain, Georgia; Cipollini, 2006). The target reference community for restoration efforts is represented by frequently burned longleaf stands at the Mountain Longleaf National Refuge (MLNWR), Alabama (ca. 100 mi from Berry College) that were surveyed previously (Varner et al. 2000, 2003). To begin monitoring the progress of the Berry project, a survey of the herbaceous vegetation was conducted in the summer of 2005 in six longleaf pine stands (2.5 to 3 ac each, varying in recent history and management) within the 160 ac Berry College Longleaf Management Area. In addition, an area selectively harvested following a Southern Pine Beetle outbreak in 2000 was surveyed.

Management efforts in the Berry Longleaf Pine Project began in 1999, following decades of fire exclusion. Stands A and B are dominated by hardwood and other pine species (oaks, hickories, black gum, sourwood, loblolly pine and shortleaf pine), but contain several dozen 100-150 year old longleaf pines. Stand B contained a sizable mature longleaf pine stand until a wildfire swept this and an adjacent area (Stand C) in 1999, killing many of the larger trees (probably due to duff combustion; Varner et al. 2005). Stand C contains a substantial number of younger adult trees, dating to the early 1900's. Wildfire damage in Stand C was less severe than in Stand B; the major result has been the death of most competing hardwoods. As a result, Stand C is considered the best example of a mountain longleaf community on campus, as its canopy is rather open and a widespread herbaceous and woody understory has established. Stand D contains areas of successful regeneration as well, but a thick hardwood overstory and a deep forest floor was present prior to restoration efforts. Currently, all growth stages from seedling to reproductive adult can be found in this plot. Stands E and F are home to some of the oldest longleaf pines on campus, dating to the mid to late 1700's, and were otherwise similar to Stand D prior to management efforts.

Prior to this study, Stands A through E were treated with herbicide twice using hack-and-squirt Arsenal (50% of hardwoods targeted in early spring 2003 and again in early spring 2004). Stands A and B were burned by prescription in April 2003, and Stands A-E were burned in April 2004. Stand F has not been treated in any way and therefore served as a no-burn control stand. The SAVE 2001 plot was representative of our most extreme management condition, having been selectively cut and re-planted with containerized longleaf seedlings in 2001. Prior to this study, however, this plot had not been burned.

Methods and Materials

Following North Carolina Vegetation Survey protocol (Peet et al., 1998), we established a permanent 50 m x 20 m plot within each of the study areas. Each plot was subdivided into 10 m x 10 m modules. Four modules were selected as intensive modules, while the remaining six were designated as residual modules. In 2 corners of each intensive module, a 1 m x 1 m box was marked out. Within the corner of each 1 x 1 m box, a 32 cm x 32 cm box was designated, followed finally by a 10 cm x 10 cm box nested inside the previous box. This system of nested boxes will allow for analysis of vegetation on different spatial scales. The Fort McClellan surveys (Varner et al., 2003) were conducted using 1.1 x 1.1 m quadrats, so our nested 1 x 1 m boxes served as the basis of comparison in subsequent analyses.

Within each 1 x 1 m box, we determined cover for each species present. In the field, we used the Peet et al. (1998) system, where 0 = no specimens, 1 = a trace of cover, 2 = 0-1% cover, 3 = 1-2%, 4 = 2-4%, etc., with each cover class roughly doubling thereafter. We used cover and frequency values to calculate an overall importance value for each species in each study area.

The raw data from our 1 x 1 m nested boxes were combined with data from two of the most frequently burned stands (Red-Tail Ridge and Caffey Hill) at the MLNWR and then subjected to a principal component analysis (PCA). This PCA allows us to determine how closely the Berry College vegetation approaches reference conditions and also helps identify sources of key differences

Results and Discussion

Of the top eleven species ranked by importance value in our stands, seven species were mountain longleaf indicator species according to Varner et al. 2000 (Table 1). In our more general survey (including residual plots) 15 of 21 mountain longleaf indicator species were found within the Berry College stands (Table 2).

Table 1. List of the 15 most important herbaceous species, characterized by overall importance values on a 1 x 1 m scale (RC = relative cover, RF = relative frequency, IV = importance value [RC + RF]).

Species	RC	RF	IV
Smilax glauca	0.10	0.06	0.16
Andropogon scoparium	0.09	0.06	0.15
Vitis rotundifolia	0.08	0.06	0.14
Epilobium angustifolium	0.09	0.04	0.13
Panicum dichotomiflorum	0.06	0.06	0.12
Solidago odora	0.05	0.04	0.09
Rubus alleghениensis	0.04	0.03	0.08
Chimaphila maculata	0.03	0.04	0.07
Parthenocissus quinquefolia	0.04	0.03	0.07
Pteridium aquilinum	0.04	0.03	0.07
Panicum boscii	0.03	0.04	0.07
Horseweed entire	0.03	0.03	0.06
Eupatorium capillifolium	0.02	0.03	0.05

Coreopsis major	0.02	0.02	0.04
Lespedeza repens	0.02	0.02	0.04
Scleria reticulate	0.02	0.02	0.04
Solanum carolinense	0.02	0.02	0.04

Table 2. Presence/absence of mountain longleaf indicator species in the Berry College survey.

Andropogon spp (+), Asclepias spp. (-), Aster spp. (-), Chrysopsis graminifolia (+), Clitoria mariana (+), Coreopsis major (+), Helianthus spp. (+), Hypericum spp. (+), Hypoxis hirsute (+), Krigia biflora (+), Kuhnia eupatoriodes(-), Lespedeza spp. (+), Panicum spp. (+), Pteridium aquilinum (+), Rhyncosia tomentosa (-), Salvia urticifolia (-), Cassia marilandica (-), Sisyrinchium angustifolium (+), Smilax glauca (+), Solidago spp. (+), Tephrosia virginiana (+)

In our PCA, variance was high; thirty eigenvectors were greater than 1 (and were thus significant), and the first principal component axis accounted for only 12.86% of the variance. Nevertheless, the first principal component cleanly split MLNWR stands from Berry College stands, whereas the second two principal components cleanly split the two MLNWR stands (Figure 1). Major sources of variation included presence of fire-adapted species (e.g. A. ternarius, H. microcephalus) in the MLNWR stands and non-fire adapted species (e.g. Rubus spp, Vitis spp.) in the Berry College stands. The SAVE 2001 modules appear to be closest to the MLNWR stands, while Stands A and B are the most distant. The Berry stands are very tightly clustered, indicating relatively little variance among the modules. The four species loading most positively or negatively onto each axis (and thus most responsible for variation among study plots) are listed in Table 3.

Figure 1. Graph of all study plots in principal components space (first three principal components = PC1, PC2 and PC3). A-F, SAVE = plots within Berry College stands A-F and the SAVE 2001 area. CH and RTR = plots within MLNWR Caffey Hill and Red Tail Ridge areas.

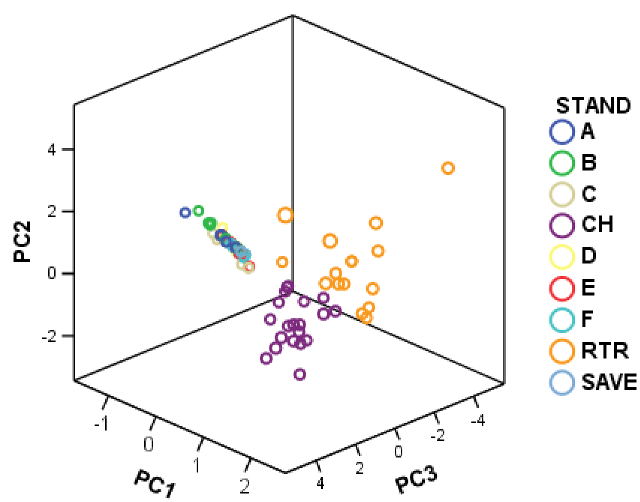


Table 3. Species most associated with extremes of PC axes 1-3.

Most positive factor loadings

PCA 1		PCA 2		PCA 3	
Species	Value	Species	Value	Species	Value
A. ternarius	0.874	*P. amoena*	0.715	*H. gentianoides*	0.564
H. microcephalus	0.842	*V. palmate*	0.505	*A. purpurea*	0.52
E. corollata	0.760	*S. avenacia*	0.485	*V. pedata*	0.52
P. commutatum	0.729	*A. purpurea*	0.477	*V. palmata*	0.504

Most negative factor loadings

PCA 1		PCA 2		PCA 3	
Species	Value	Species	Value	Species	Value
E. angustifolium	-0.46	*S. erecta*	-0.559	*S. terebenthinaceum*	-0.559
Vitis spp.	-0.448	*C. major*	-0.557	*A. amplexicaulis*	-0.497
P. dichotomiflorum	-0.434	*A. pedicularia*	-0.443	*O. violacea*	-0.442
A. scoparium	-0.395	*S. odora*	-0.398	*P. annua*	-0.442

Overall, the survey revealed an ecosystem still suffering from fire exclusion and hardwood encroachment, but showing signs of recovery. Many species considered typical of well-maintained mountain longleaf pine communities are present, albeit at low densities. Overall, the area with the most open canopy (the SAVE 2001 area) appears most similar to the MLNWR reference community, suggesting that hardwood canopy removal is a key to restoration success. Future surveys within these stands will allow for the monitoring of the progress and success of the Berry College Longleaf Pine project. As hardwood control and prescribed burning continue over the next decade, we expect to find even greater convergence toward the reference community. The endpoint of management efforts will occur when the Berry College stands and the reference stands are indistinguishable based upon PCA analysis.

Literature Cited:

Cipollini, M. L. (2006) The Berry College Longleaf Pine Project: Progress over the first three years. Proceedings of the 2nd Mountain Longleaf Conference, Mount Berry, GA. November 18-19, 2005. Longleaf Alliance Report 9: 9-13.

Peet, R. K., Wentworth, T. R., and White, P. S. (1998) A flexible, multipurpose method for recording vegetation composition and structure. Castanea 63(3), 262-274.

Varner, J. M., Kush, J. S., and Meldahl, R. S. (2000) The mountain longleaf pine resources of Fort McClellan, Alabama: Final report on their status, ecology, and management needs. Auburn University School of Forestry and Wildlife Sciences.

Varner, J. M., Kush, J. S., and Meldahl, R. S. (2003) Vegetation of frequently burned old-growth longleaf pine (Pinus palustris Mill.) savannas on Choccolocco Mountain, Alabama, USA. Natural Areas Journal 23(1), 43-52.

Varner, J.M., D.R. Gordon, F.E. Putz, and J.K. Hiers. 2005. Novel fire effects in southeastern pine forests: smoldering fire and overstory pine mortality. Restoration Ecology 13:536-544 .

Assessment of restoration potential of residual stands of mountain (piedmont) longleaf pine at Horseshoe Bend National Military Park

S.M. Hermann: Auburn University, hermasm@auburn.edu; J.S. Kush

Introduction

There is strong interest in re-introducing longleaf pine (*Pinus palustris*) to sites where is has been extirpated. The process of ecological restoration is a continuum. One extreme involves extensive site preparation and re-introduction of all species to an area. However when species of interest remain on site, another approach to restoration includes enhancing populations of significant species in an effort to recreate original habitat structure and function. Making use of residual resources is gaining attention for regional restoration efforts (Kush et al. 2004, Varner et al. 2005). Throughout much of the late nineteenth and twentieth centuries many sites in the northern (montane or piedmont) range of longleaf pine suffered extensive cutting and prolonged periods of fire suppression that resulted in alteration of habitat structure and species composition. Today, old-growth stands of montane longleaf are dominant on ridges and most faces of extreme rocky slopes in some areas (Varner et al. 2003) but in areas with more moderate slopes, longleaf originally were predominately found on south and west faces (Reed 1905). A recent search of uplands in Horseshoe Bend National Military Park (HOBE) uncovered stands of suppressed longleaf pine. HOBE is a site with generally moderate slopes in Tallapoosa County, AL. Preliminary observations indicated that there is a substantial number of medium sized longleaf present and so the site warranted further examination to determine if it was reasonable to consider restoration utilizing residual natural resources, including the remaining longleaf.

Methods

In 2005, we assessed three 5 acre plots on south and west facing slopes that currently support longleaf pine. These areas were designated as Plot I (northeast region of HOBE with slopes averaging 7%), Plot II (northwest region of HOBE with slopes averaging 25%) and Plot III (southwest region of HOBE with slopes averaging 20%). Sites were selected for evaluation, in part, because they were deemed to be relatively accessible for possible future restoration activities. On each 5 acre plot, a stand inventory was done and stem map created for all longleaf stems plus all other woody stems ≥ 4 inches in diameter at breast height (DBH). We compared this information to a century-old regional timber evaluation reported by Reed (1905). In addition, we measured the fine fuel accumulation on each plot and collected samples of tree cores for a sub-set of sizes of longleaf plus some of the larger hardwood trees.

Preliminary Results and Discussion

A 100% cruise and stem maps of longleaf pine on three 5 acre plots at HOBE revealed that residual trees were common over much of the sampled areas. The number of longleaf tallied was: 283 on Plot I, 184 on Plot II and 273 on Plot III. Figure 1 illustrates the observed longleaf size distribution estimated on a per acre basis. Almost all of these individuals were of medium size (5-20 inches DBH). There were only three longleaf with diameters less than 4 inches DBH and only 7 trees with diameters greater than 21 inches DBH. Tree cores from a sub-sample of the trees indicated that the oldest extant longleaf on the HOBE plots were approximately 75 yeas and ranged in size from 8 – 18 inches DBH. The youngest were 45-50 years old and ranged in size from 5-7 inches DBH. Many individuals > 5 inches DBH were observed to have produced cones the previous season.

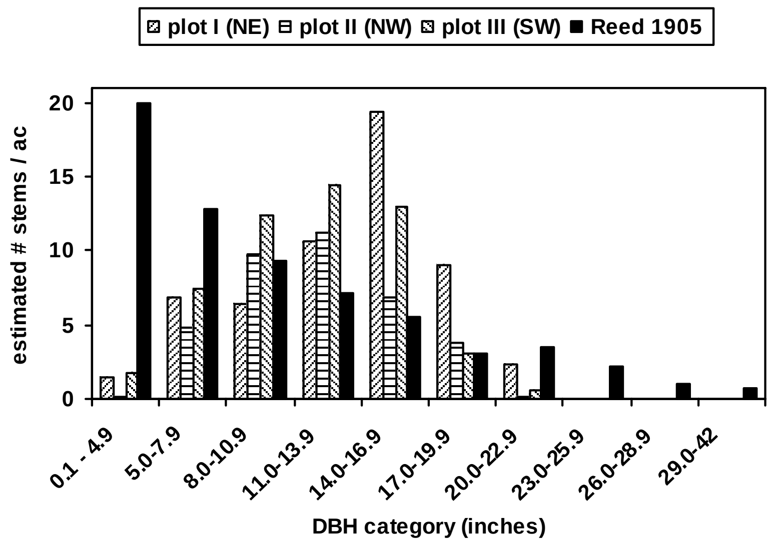


Figure 1: Estimated number per acre of longleaf pine, by size class, for three plots on HOBE and for old-growth longleaf on south and west facing slopes a century earlier in a nearbycounty (Reed 1905).

Figure 1 also compares observed size distribution of longleaf on HOBE to data reported by Reed (1905) for old-growth longleaf forest on larger tracts of land in nearby Coosa County, AL. A striking feature of the comparison is the lack of longleaf recruits in the modern landscape of HOBE. Visual comparison of larger size classes presents a less obvious pattern, however the total number of longleaf stems ≥ 5 inches DBH in1905 was 45.1/acre and this is within the range of the number of medium sized longleaf on HOBE in 2005 (36.6 – 61.0/acre). Because HOBE lacks recent longleaf recruits, it is not surprising that current density is also below the 120 stems/ac reported for an old-growth longleaf forest located northwest of HOBE (Varner et al. 2003).

The number of woody stems ≥ 4 inches DBH for all species on each 5 acre plot is illustrated in Figure 2. It is expected that many of these individuals invaded south and west slopes as the result of lack of fire. Many of these species were not recorded by Reed (1905) to be associated with south or west facing longleaf stands. It is likely that there was expansion of species commonly associated with infrequently burned habitats such as *Liquidambar* (sweetgum), *Cornus* (Florida dogwood), *Oxydendron* (sourwood), and *Liriodendron* (yellow poplar). However some individuals of other species may have been components of old-growth longleaf forest on the slopes of HOBE. Tree cores of larger hardwood individuals revealed that some *Quercus stellata* (post oak) and *Q. falcata* (southern red oak) are older than residual longleaf trees. Cores of some of the larger oak stems indicated ages of 125 – 175 years. A century ago Reed (1905) noted that post and southern red oak intermingled with longleaf pine on west and south facing slopes and so the old oaks at HOBE are relicts of the original old-growth forest.

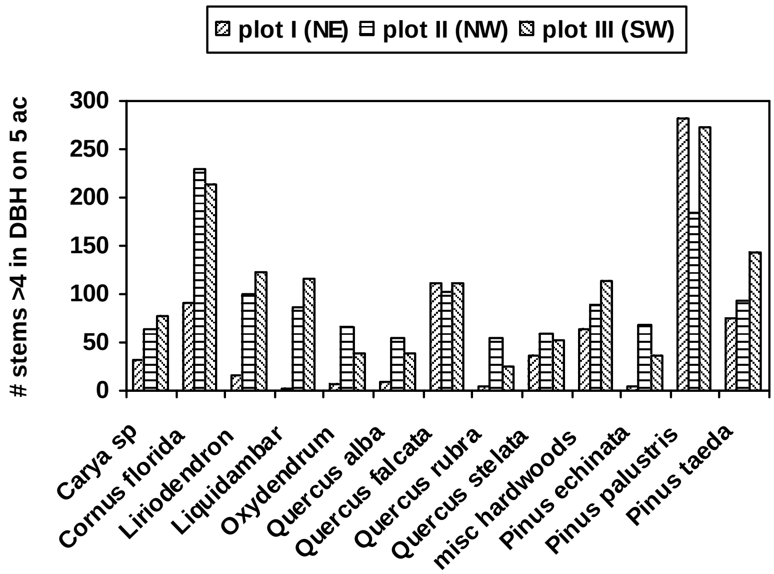


Figure 2: Number of woody stems ≥ 4 inches DBH on three 5 acre plots at HOBE. The taxa are species with more than 50 stems on at least one plot. Species of *Carya* (hickory) were lumped. All other woody species are in the category of "misc hardwoods".

No fire has been reported on HOBE since the site became federal property in 1959. Currently, there is an excessive accumulation of fine fuel. Average litter depth across all three plots is 6-8 inches. At the base of some longleaf, litter depth is as great as 10-14 inches. The lowest layers of pine needles are in an advance state of decomposition and many trees, including longleaf, have roots growing in this duff layer. Excessive duff creates a challenge for the reintroduction of fire (Kush et al. 1998). Trees, including longleaf, are often stressed and/or killed due to destruction of roots. Duff at the base of longleaf may smolder, unnoticed, and eventually burn down to mineral soil (Kush et al. 1998); this prolonged exposure to high temperature usually damages the cambium and kills the tree.

Restoration and Management Recommendations

The residual longleaf trees and the older oaks on the south and west facing slopes at HOBE are valuable resources for future habitat restoration efforts. Although all plots have been invaded by off-site tree species, intrusion of these stems is not the most immediate management challenge to restoring native forest structure and species composition. The most significant task is to develop ways to reduce and eventually eliminate excessive fine fuel that has accumulated over decades of fire suppression and, at the same time, maintain many extant, cone-producing longleaf and the old-growth oak trees. Because longleaf requires mineral soil for successful establishment, reintroduction of fire is necessary but the process will be difficult. Kush et al. (1998) recommended burning to remove excess fuel in small amounts over a series of low-severity head fires under cool and relatively moist conditions. Even with great care, some longleaf are likely to be killed in the process. Although mechanical and/or chemical treatment of off-site trees and shrubs may eventually be necessary, we suggest that these actions wait until much of the litter accumulation has been removed. Some and perhaps many off-site stems are likely to be killed by fire and, in the worst case where longleaf mortality is high, residual woody stems, regardless of species, may be important to serve as cover on a short-term basis.

Because small longleaf are absent at HOBE, it may be useful to focus attention on ways to establish new recruits as soon as possible. In addition to eventually creating bare mineral soil with the tempered re-introduction of fire, it may be productive to establish trial plots of planted, container longleaf juveniles. This effort could include creation of patches for planting using manual and/or mechanical removal of litter coupled with local removal of nearby off-site woody stems. Such activity may be one way to shorten the time required to restore a natural stand structure.

Acknowledgements
Much of the data was collected as part of a senior project in Auburn University School of Forestry and Wildlife Sciences (SFWS). We appreciate the many efforts of the students (J. Angel, J. McBrayer, R. Musick, and P. Turner). We thank the SFWS for accepting HOBE as a site for a senior project and D. Laband for his thoughtful comments on the work. Additional field assistance was provided by R. Estes, J. Gilbert, V. Johnson, V. Lee, R. Moore, B. Rumsey, R. Sampson, G. Sorrell, P. Turner and J. Waite. Staff at HOBE, especially J. Cahill, was helpful and supportive; we appreciate their interest. Portions of the work were funded by SFWS and the National Park Service. C. Nobel and L. McInnis facilitated our efforts. The Auburn Environmental Institute administered the National Park Service funds and we appreciate the assistance of D. Block.

Literature Cited:
Kush, J.S., R. S. Meldahl, and C. Avery. 2004. A restoration success: longleaf pine seedlings established in a fire-suppressed, old-growth stand. Ecological Restoration 22(1):6-10.
Kush, J.S., J.M. Varner, and R.S. Meldahl. 1998. Slow down, don't burn too fast…Got to make that old-growth last. Proceedings of the 2nd Longleaf Alliance Conference. Pages 109-111 in Longleaf Alliance Report No. 4. Auburn University, AL.
Reed, F.W. 1905. A working plan for the forest lands in the central Alabama. USDA Forest Service, Bulletin 68, Washington, D.C.
Varner, J.M, D.R. Gordon, F.E. Putz, and J.K. Hiers. 2005. Restoring fire to long-unburned Pinus palustris ecosystems: novel fire effects and consequences for long-unburned ecosystems. Restoration Ecology 13(3):536-544.
Varner, J.M., J.S. Kush, and R.S. Meldahl. 2003. Structural characteristics of frequently-burned old-growth longleaf pine stands in the mountains of Alabama. Castanea 68(3):211-221.

Restoration of Loblolly Decline Sites to Longleaf Pine Management for RCW Habitat Improvement

Nolan Hess: USDA Forest Service, Pineville, LA; William Otrosina: Southern Research Station, Athens, GA; Lori Eckhardt: School of Forestry and Wildlife Sciences, Auburn AL; Roger Menard: USDA Forest Service, Pineville, LA; and Emily Carter: Southern Research Station, Auburn, AL

Forest Health Monitoring plots, established in the mid-1990's, reported declining loblolly pine stands in three southern states with predominance of sites in central and southern Alabama. Additional studies in central Alabama defined loblolly decline as a complex of interactions of biotic and abiotic stressors. Symptoms of this decline include sparse tree crowns with short chlorotic needles, and reduced radial growth of the stems. These symptoms occur primarily in trees above 40 years of age (though trees younger than this may also be affected). Mortality can occur within as little as two to three years after the first expression of symptoms. Although loblolly pine decline symptoms are similar to those of littleleaf disease, site conditions associated with this decline are different. On upland sites on federal lands in the South, loblolly pine is the major forest type since it is easily regenerated and was planted on a significant number of acres for watershed restoration of these sites. Many of these sites are now managed for red-cockaded woodpecker (RCW) habitat and this decline may be impacting the long-term habitat needs of this endangered bird.

Traditionally, risk rating for root diseases in the southern forest is accomplished by identifying soil characteristics generally associated with specific root diseases. For example, deep, well drained soils are associated with annosum root disease and poorly drained heavy clay soil with littleleaf disease. However, in loblolly pine decline, landform (topography) and *Leptographium sp.* incidence in roots and soils, were significantly correlated with the occurrence of the decline (Eckhardt 2003). Slope and aspect are the two topographic variables with the most influence on risk. Soils on these decline sites are predominantly sandy loam, loam, or sandy clay loam, and are moderately well drained to well drained. Soil chemical characteristics related to nutrient status were indicative of differences between decline and healthy sites more than soil physical characteristics. Current investigations are focused on the prior disturbance history of these sites which also appears to have significant effect on the expression of decline (Carter 2005).

Species of the fungal genus *Leptographium* are most commonly associated as causes of blue-stains in sapwood of pine, spruce, and other conifers. These stain fungi rarely kill healthy trees, but they do degrade the value of timber and may be associated with mortality in stressed trees. The level of pathogenicity and the role of the three *Leptographium* species (*L. procerum*, *L. terebrantis*, *L. serpens*) that are associated with decline of southern yellow pines are still being debated and research is continuing. *Leptographium* species are associated with various species of root feeding bark beetles, which may serve as vectors and/or as wounding agents that allow the introduction of these fungi into tree roots.

National Forest Districts in central Alabama are implementing restoration of longleaf pine management on some of the loblolly pine decline sites. The current Forest Service policies are directed towards ecosystem management and native species restoration. Research since the

1980's has greatly improved the survival of artificially regenerated longleaf seedlings, both bare-rooted and containerized. The areas of concern for sustaining restored longleaf ecosystems are site quality and the ability to manage for specific site conditions. Most of the decline sites being restored to longleaf are altered sites and are considered exotic ecosystems (Otrosina 2005). An exotic ecosystem is defined as a pathologically unstable ecosystem arising from edaphic and environmental changes brought about by past land use or current management practices. This type of ecosystem can be more susceptible to root-feeding bark beetles and root pathogenic fungi after silviculture treatments, fire regimes, and other disturbances. Altered fire regimes, wind events, drought, silvicultural treatments (including possible misuse of herbicides) and a variety of other stress factors likely play major roles in decline complexes. Effects may be direct (physical injury, stress) or indirect including increase attraction of, and/or susceptibility to secondary insects such as the *Hylastes* species. However, the exact roles of disturbances, stain fungi and associated insects in loblolly pine decline remains unclear, and are still being researched.

In recent years we have seen a renewed emphasis on the restoration of longleaf pine ecosystems using semi-intensive to intensive management. Longleaf pine is preferred management species for RCW habitat recovery and restoration to longleaf pine is currently being recommended for upland sites affected by loblolly pine decline. The degree to which pine declines are due to site history (including fire and other disturbances), management practices, and insects and fungi, remains to be determined. It is likely, that management and site factors will be the key determinants of the success of longleaf pine restoration and sustainability.

Literature Cited:

Carter, E.A., N.J. Hess, A.J. Goddard, L.G. Eckhardt, and J.P Jones. 2005. Soil characteristics of loblolly pine decline sites in central Alabama. 2005 Southwide Forest Disease Workshop, 10-13 January 2005, Baton Rouge, LA.

Eckhardt, L.G. 2003. Biology and ecology of *Leptographium* species and their vectors as components of loblolly pine decline. Ph. D. diss. Baton Rouge, LA: Louisiana State University.

Otrosina, W.J. 2005. Exotic Ecosystems: When Root Disease is Not a Beneficial Component of Temperature Conifer Forests. p. 121-126. In: Lundquist, J.E. and Hamelin, R.C. ed. Forest Pathology From Genes to Landscapes. American Phytopathological Society. St. Paul, MN.

Estimation of Carbon Storage in a Mountain Longleaf Ecosystem of Northwestern Georgia.

Amy Huber (Miami University, huberan@muohio.edu), Amy Gaskell, Chris Worrell, Melanie Belk, Carly Donahue and Martin Cipollini

Introduction

Due to its relatively dense wood, long life, and ability to sequester large amounts of carbon, much interest has gathered recently in the preservation and restoration of longleaf pine (*Pinus palustris*) forests as a means of addressing the global rise in CO_2 (Kush et al., 2004). The goal of this research was to provide an estimate of total carbon reserves in five mountain longleaf stands on Lavendar Mountain, Floyd County, GA (Berry College). Because methods of estimating carbon storage have not been established specifically for mountain longleaf forests, it was necessary to derive methods to reflect local conditions. The methods used in this research are modified from the Brown and Kerr (1982) method (hereafter the "Brown Method") for estimating fuel loads coupled with a point-centered quarter method for estimating biomass of trees >10 ft tall.

The Berry College Longleaf Management Area contains most of the mature mountain longleaf trees on the college campus. Within this area are located several permanent study stands, all having a long history of fire suppression. The stands are undergoing initial management efforts, including prescribed burning and herbicide injection of hardwoods. For a description of these stands and their recent history, see Currie et al. (2006) in this volume and Cipollini (2005). Management efforts are being supported by a Southern Company-National Fish and Wildlife Foundation Longleaf Legacy grant which calls for the establishment of a carbon reserve and accurate methods for estimating carbon storage.

To quantify the carbon present in any ecosystem, total biomass needs first to be estimated. Biomass is total mass of duff, litter, downed woody material, herbaceous material, shrubs, and trees. Because plants are about 50% carbon by dry mass, carbon storage can be estimated by dividing biomass in half (Fearnside et al., 1993). In a 2004 fuel load census in five of our study stands, the Brown Method was used. This procedure combines several techniques at single sample points to calculate the total biomass. Duff biomass is estimated by multiplying duff depth by an independently derived duff bulk density value. Litter and herbaceous material biomass is obtained by weighing material collected from subplots. Biomass of downed woody material (DWM) is estimated using biomass equations based upon counts or measurements of material crossing through a planar intersect. Biomass of shrubs and trees <10 ft. tall is estimated from stem counts in various size classes and the application of biomass equations to those values.

Though the Brown Method is widely used, the biomass equations for downed woody materials, shrubs and trees <10 ft. tall are intended for forests in the interior west. Based upon the 2004 data set, biomass values for shrubs and small trees were negligible. DWM, on the other hand, constituted the third heaviest fuel category (after litter and duff). It was necessary therefore to assess whether Brown method derived values for biomass of DWM are accurate for Mountain Longleaf forests. Moreover, the biomass of trees >10 ft. is not covered in the Brown Method. For our study, biomass of trees taller than 10 ft was estimated using the point centered quarter method and the application of published allometric equations for the tree species encountered.

Methods and Materials

DWM samples were taken randomly from ten study stands (10 points per stand) in the summer of 2005. At each point, a 50 ft. long x 10 ft. tall planar transect was oriented in a random direction. The numbers of individual DWM units crossing the transect were tallied along a 6.8 ft section for the 0 - 0.25" and 0.25 - 1" diameter classes, along a 13.6 ft section for the 1 - 3" diameter class, and along the full 50 ft transect for the >3" diameter class. The diameters of DWM units larger than 3" were measured and recorded as sound or rotten. Biomass equations from the Brown Method were used to estimate dry mass of these components at each sample point. The same transect was converted to a 50 ft. by 1'7" (975 ft^2) fixed plot for DWM collection. Using the same diameter classes and transect distances, DWM was collected within the fixed plot. This material was sorted into the four diameter classes, dried to constant mass at 60^oC, and weighed. Volumes of extremely large DWM samples were measured in the field and a representative cookie was collected, dried, and weighed. The volume of the cookie was measured with a water displacement instrument in the laboratory, and used to calculate density and thereby the mass of the original sample. Finally, regression analysis was used to determine the relationship between biomass estimated using the Brown Method and biomass estimated using fixed plots, thereby establishing a correction factor for each fuel class that will allow the Brown Method to be used with greater accuracy in the future

For trees >10 ft tall, the point centered quarter method was used along with allometric equations to determine biomass. In summer of 2004 a point centered quarter technique (Barbour 1999) was used to obtain an estimate of the basal area of all tree species within five of the longleaf stands. Data were collected at 20-25 uniformly spaced grid points within each stand. At each sample point a line was established perpendicular to the main transect, marking off four quadrants at each point. Within each quadrant, the distance to the nearest individual was determined, its species identity was recorded, and its circumference at 1.3 m (CBH) was measured. Diameter at 1.3 m (D) for each individual was calculated from the CBH. Allometric equations (Zianis and Mencuccini, 2004) were then used to estimate aboveground dry biomass from D. The equations followed the format $M = aD^b$,where M is the total aboveground tree dry biomass, a and b are scaling coefficients. Belowground biomass was estimated as 15% of the aboveground biomass (Cacho et al., 2004) and the total biomass was found by combining aboveground and belowground biomass.

These results were combined to estimate the total biomass for the study areas based upon fuel load and point-centered quarter data collected in 2004.

Results and Discussion

All regressions of fuel loads as determined by the Brown Method on values determined using fixed plots were significant (relationships and corrections factors can be seen in Figure 1). Insufficient >3” rotten material was collected to allow comparisons, most likely due to a prescribed burn that occurred in April 2004, just prior to this study.

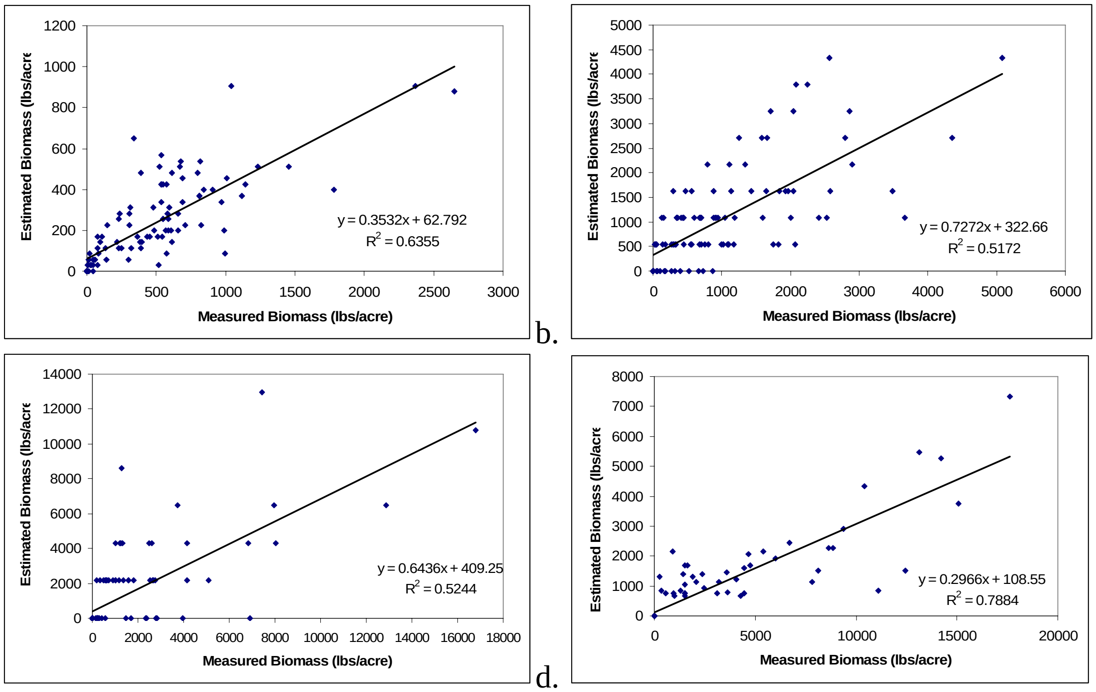


Figure 1. Regressions of estimated biomass using Brown Method vs. fixed plots for fuel classes: a) 1 0”-1/4”, b) 1/4”-1”, c) 1”-3”, and d) > 3” sound.

Total biomass, which was dominated by trees > 10 ft tall, litter, and duff categories ranged from 72 tons/acre (in stand B, which was burned twice since 1999) to 176 tons/acre (in Stand E with no record of recent fire (Stand E).

Table 1. Total dry biomass for various fuel classes in five longleaf pine stands on Lavendar Mountain, Floyd County, GA in summer 2004. Values are tons/acre with standard errors in parentheses.

Fuel Class	**Stand A**		**Stand B**		**Stand C**		**Stand D**		**Stand E**	
0-1/4"	0.27	(0.04)	0.27	(0.06)	0.16	(0.07)	0.13	(0.04)	0.16	(0.04)
1/4" - 1"	0.50	(0.27)	0.39	(0.27)	0.62	(0.30)	0.46	(0.26)	0.59	(0.28)
1" - 3"	1.13	(0.34)	0.99	(0.47)	2.11	(0.37)	1.14	(0.42)	0.49	(0.23)
>3"sound	0.59	(0.43)	3.40	(2.79)	2.38	(1.78)	0.67	(0.28)	0.28	(0.16)
>3" rotten	2.05	(1.04)	16.18	(7.67)	3.44	(2.26)	0.07	(0.07)	0.44	(0.38)
Litter	3.69	(0.58)	3.23	(1.03)	1.99	(0.26)	3.30	(0.36)	3.41	(0.39)
Herbs	0.01	(0.00)	0.02	(0.02)	0.00	(0.00)	0.00	(0.00)	0.01	(0.01)
Duff	13.92	(2.07)	9.35	(2.24)	10.06	(2.33)	18.27	(4.06)	24.25	(2.95)
Live shrubs	0.03	(0.01)	0.05	(0.02)	0.18	(0.08)	0.01	(0.00)	0.16	(0.05)
Dead shrubs	0.00	(0.00)	0.00	(0.00)	0.04	(0.03)	0.00	(0.00)	0.02	(0.02)
Trees < 10 ft.	0.03	(0.00)	0.04	(0.01)	0.03	(0.01)	0.22	(0.12)	0.12	(0.06)
Trees > 10 ft.	97.55	(20.1)	71.16	(1.03)	71.85	(13.6)	100.59	(44.3)	146.32	(37.0)
Total	119.76		105.07		92.86		124.87		176.24	

Literature cited:

Barbour, M.G., and J. H. Burk. 1999 Terrestrial Plant Biology 3rd Edition. Bedford St. Martin's.

Brown, J.K., and J. Kerr. 1982. Handbook for inventorying surface fuels and biomass in the interior West. U.S. Dept. of Agriculture, Forest Service.

Cacho, O.J., R. M. Wise, and K. G. MacDicken. 2004. Carbon monitoring costs and their effect on incentives to sequester carbon through forestry. Mitigation and Adaptation Strategies for Global Change 154:273-293.

Cipollini, M.L., 2005. The Berry College Longleaf Management Plan. http://fsweb.berry.edu/Academic/MANS/mcipollini/management/The%20Berry%20College%20Longleaf%20Management%20Plan.htm

Currie, K., J. M. Varner, J. Kush, and M. Cipollini. 2006. A survey of the herbaceous vegetation found in the Berry Longleaf Pine Management Area. Proceedings of the 2nd Mountain Longleaf Conference, Mount Berry, GA. November 18-19, 2005. Longleaf Alliance Report 9 (in press).

Kush, J.S., R. S. Meldahl, C. K. McMahon, and W. D. Boyer. 2004. Longleaf pine: A sustainable approach for increasing terrestrial carbon in the southern United States. Environmental Management 33:S139-S147.

Fearnside, P.M., N. Leal, and F. M. Fernandes. 1993. Rainforest burning and the global carbon budget: Biomass, combustion efficiency, and charcoal formation in the Brazilian Amazon. Journal of Geophysical Research. 98:16733-16744.

Zianis, D. and M Mencuccini. 2004. On simplifying allometric analyses of forest biomass. Forest Ecology and Management 187:311-332.

Native Legumes, Wildflowers, and Bunch-Grasses Available for First Time Ever from Alabama Seed Sources (Primarily Covington and Escambia County Seed)

Mark Hainds: Longleaf Alliance, hainds@alaweb.com

This year, for the first time ever, several species of herbaceous plants native to the longleaf forest ecosystem will be commercially available. Most of these herbs are native legumes and warm season grasses. For instance, butterfly pea (*Centrosema virginianum*), several native lespedezas (*Lespedeza capitata*, *L. hirta*, & *L. virginica*) and other native species are available. These herbaceous species are well documented as good quality quail foods and they are perennials. Some of these species may live for decades after establishment.

Several nurseries on the *Longleaf Nursery List* will be growing and selling native herbs from the same containers that longleaf seedlings are produced in. These plugs may be easily planted by hand or machine and should sell for roughly the same price as container-grown longleaf pine seedlings.

Unlike many commercially available food plot species (thunberg, bicolor, and sericea lespedezas), our native legumes are not invasive weeds. For decades, most perennials herbs and shrubs recommended for food plot establishment came from Asia. Unfortunately, these plants often prove highly mobile and aggressive, displacing the native herbaceous layer as they spread through the forest. Today, and in the near future, some of our greatest management challenges will be controlling invasive weeds that we purposely planted in misguided attempts at improving wildlife habitat.   When I talk to landowners about these Asian species I tell them, “Today it will cost you $1.00 to plant it. Tomorrow, it will cost you $10.00 to control it.”

Whenever possible, consider using native species as your first alternative. Autumn olive and bicolor lespedeza are not better for quail because they were brought all the way from Asia; or because your local nursery recommends them. Quail were present in large numbers when most of the Southeast was covered with native herbaceous species and there were many small farms scattered through the rural landscape. Planting invasive weeds is not improving our situation!

In addition to native legumes, several nurseries will have warm season bunch grasses like Indian Grass (*Sorghastrum nutans*) and switchgrass (*Panicum virgatum*). These are tall, attractive, bunch grasses that are native to the longleaf pine understory community. They also look great in flower gardens! The Missouri Botanical Garden has fliers describing the attributes of Indian Grass and switchgass in native plant gardens.

Some native species make very attractive wildflowers. Several nurseries on the *Longleaf Nursery List* have been provided with *Baptia albescens* (white flowers), *Baptisia lanceolata* (yellow flowers), and native blazing stars (purple flowers.) The previously mentioned butterfly pea (*Centrosema virginianum*) is a climbing vine with very attractive blue flowers.

For a full listing of nurseries and the species they are growing, please contact The Longleaf Alliance (attn: Mark) at the Solon Dixon Center. Or, you can call the nurseries directly. Some of the nurseries producing native species this year are: Simmons Tree Farm, Meeks Tree Farm, Blanton & Sons, Clary & Sons, Honey Hole Nursery, International Paper, International Forest Company, PH Longleaf Seedling Co., Deep South Growers, Pine Tree Nursery and Oak Grove Farm.