

15th Biennial Southern Silvicultural Research Conference

*Program
and
Abstracts*



November 17, 2008

Dear Participants;

Welcome to the 15th Biennial Southern Silviculture Research Conference! I'm excited to have the meeting here in Arkansas, the first time the meeting has been held in "The Natural State"—though a field tour from the 10th BSSRC in Shreveport did sneak across the border to the Crossett Experimental Forest (where I got the bus stuck in the mud).

Arkansas has a long and proud forestry tradition going back to the work by H.H. Chapman of Yale before 1920 on the feasibility of managing cutover stands of second growth in a profitable way. That upset the tradition of "cut out and get out" lumbering common up to that time, and ushered in a new professional philosophy of forest management in southern pines. Arkansas is home to two national forests and four federal experimental forests, and the state has long enjoyed a thriving forest industry and forest investment ownership sector. And yet, roughly 60 percent of the forest land in Arkansas is owned by the non-industrial private forest landowner, some of which is managed by an active network of forestry consulting firms. You'll have a chance to see two different dimensions of the forestry in Arkansas on the field tours scheduled on the last day of the meeting.

The 15th BSSRC would not have been possible without the very capable service of the Planning and Selection Committees. We'd like to thank these folks for support in program organization, and for selecting the abstracts for presentations and posters. The Planning Committee, and especially Don Bragg and Paula Hooks, are the folks to thank for all the things that you like about the meeting. See me for all the things you don't like, because in all likelihood I was the bonehead who made those decisions! Also, we are grateful to those that assisted with the other programmatic portions of this meeting, including student scholarship chair Gordon Holley, student presentation awards chair Brian Lockhart, moderator selection chair Brian Oswald, and all of the session moderators.

Thanks also to our many program sponsors, whose service primarily consists of support for the administrative side of the meeting. The Arkansas Division of the Ouachita Society of American Foresters and several Arkansas-based companies also provided some student support. Special thanks go to the Arkansas Forestry Association and the University of Arkansas at Monticello School of Forest Resources, who have worked together to take in receipts and pay the bills for the meeting. Larry Hedrick and the Ouachita National Forest and John Wainscott, Jim Sorenson, and Weyerhaeuser helped us immensely for assisting with our field trips. Finally, we would also like to thank the staff of the Hot Springs Convention Center and the Embassy Suites Hotel for all their help in registration, meeting logistics, and lodging.

So, enjoy the meeting and the venue here in the Hot Springs Convention Center, take advantage of the after-hours opportunities available in downtown Hot Springs, and enjoy yourself! Let me know if there's anything I or the Planning Committee can do to optimize your enjoyment of the meeting.

With best regards,

James M. Guldin, Ph.D.
Program Chair

15TH BSSRC COMMITTEES AND SUPPORT STAFF

Program Chair

James M. Guldin, USDA Forest Service, Southern Research Station

Program Co-Chair and Local Arrangements Chair

Don C. Bragg, USDA Forest Service, Southern Research Station

Local Arrangements and Logistics Staff

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Brian Lockhart, USDA Forest Service, Southern Research Station

Mike Messina, Department of Ecosystem Science and Management, Texas A&M University

Brian Oswald, Brian, Department of Forestry, Stephen F. Austin State University

Jamie Schuler, School of Forest Resources, University of Arkansas-Monticello

Callie Schweitzer, USDA Forest Service, Southern Research Station

Marty Spetich, USDA Forest Service, Southern Research Station

Susana Sung, USDA Forest Service, Southern Research Station

Rod Will, Department of Natural Resources Ecology and Management, Oklahoma State University

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James M. Guldin, USDA Forest Service, Southern Research Station

Larry Hedrick, USDA Forest Service, Ouachita National Forest

Student Scholarship Selection Chair

Gordon Holley, School of Forestry, Louisiana Tech University

Student Presentation Awards Chair

Brian Lockhart, USDA Forest Service, Southern Research Station

Session Moderator Chair

Brian Oswald, Brian, Department of Forestry, Stephen F. Austin State University

Administration, Program, Publication, and Web-IT Support

Paula Hooks, USDA Forest Service, Southern Research Station

Rose Moore, USDA Forest Service, Southern Research Station

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Carol Whitlock, USDA Forest Service, Southern Research Station

Nancy Koerth, USDA Forest Service, Southern Research Station

We would also like to thank Dr. Robert Weih and Dr. Richard Kluender of the University of Arkansas at Monticello for their help in procuring some of the technology (especially the notebooks) for this meeting.

15th Biennial Southern Silvicultural Research Conference

*November 17-20, 2008
Hot Springs, Arkansas*

GENERAL MEETING INFORMATION

Nestled in the shortleaf pine-covered Ouachita Mountains near the Ouachita National Forest and Hot Springs National Park in west-central Arkansas, the Hot Springs Convention Center will serve as the host of the 15th Biennial Southern Silvicultural Research Conference. The 15th Biennial Southern Silvicultural Research Conference consists of a plenary, four concurrent technical sessions, a poster session, and optional field trips.

On-site registration will begin the afternoon of Monday, November 17 at the Convention Center Grand Lobby. Following introductory comments at 8 a.m. and a plenary from 8:15 to 10:15 a.m., concurrent sessions will begin at 10:30 a.m. and end at 5:30 p.m. on Tuesday, November 18. The concurrent sessions will resume at 8:00 a.m. on Wednesday, November 19. There will also be a poster session with authors present from 6:00 to 8:00 p.m. on Tuesday evening (posters will be up during the rest of the meeting, but the authors may not be present). Heavy hors d'oeuvres will be available during the poster session for paid registrants. Refreshments will be available at scheduled breaks, and a full lunch will be served on-site both Tuesday and Wednesday.

Optional field tours are offered on Thursday, November 20. Transportation and lunch will be provided with the tour, and a separate registration fee will be charged to cover these expenses. November weather in Arkansas can range from warm, sunny days to cool, rainy weather, so dress appropriately for the tour!

MEETING SPONSORS

USDA Forest Service, Southern Research Station
USDA Forest Service, Ouachita and Ozark-St. Francis National Forests
University of Arkansas at Monticello's School of Forest Resources
Arkansas Forest Resources Center, University of Arkansas
Arkansas Forestry Association
Arkansas Forestry Commission
Arkansas Division of the Ouachita Society of American Foresters
Weyerhaeuser Company



ACCESSIBILITY

Both the Hot Springs Convention Center and the Embassy Suites Hotel are fully ADA compliant. Persons with disabilities who require alternative means for communication of program information (Braille, large print, audiotape, etc.) should contact USDA's TARGET Center at (202) 720-2600 (voice and TDD).

For special accessibility needs or accommodations during the conference, please contact Paula Hooks.

Any guests of the Embassy Suites Hotel in Hot Springs having special needs or accessibility issues with their rooms should inform the hotel about accommodations when making their reservations.

LODGING

The official lodging site for the 15th BSSRC will be the Embassy Suites Hotel in Hot Springs, Arkansas (<http://www.embassysuiteshotspings.com/home.aspx>). This hotel is located adjacent to the Hot Springs Convention Center, just a few minutes walk from the meeting. The Embassy Suites Hotel has many amenities including free parking, a free fitness center, an indoor pool and whirlpool, a restaurant, and laundry facilities.

For those that have reserved single occupancy rooms at the meeting group rate, the room goes for \$98. Plus, the **Embassy Suites will charge you \$8 for their breakfast buffet** and \$13 in taxes, for a total of \$119 per night. Multiple occupancy rooms are somewhat more than this, depending on how many people are in the room. This rate (\$119/night) gets you their full cook-to-order breakfast buffet, complimentary parking, free use of their fitness center, and an invitation to their "Manager's reception" every evening. For federal employees (and possibly others), you will need to subtract the breakfast cost from your daily per diem (as you will need to do for the provided lunches on Tuesday and Wednesday).

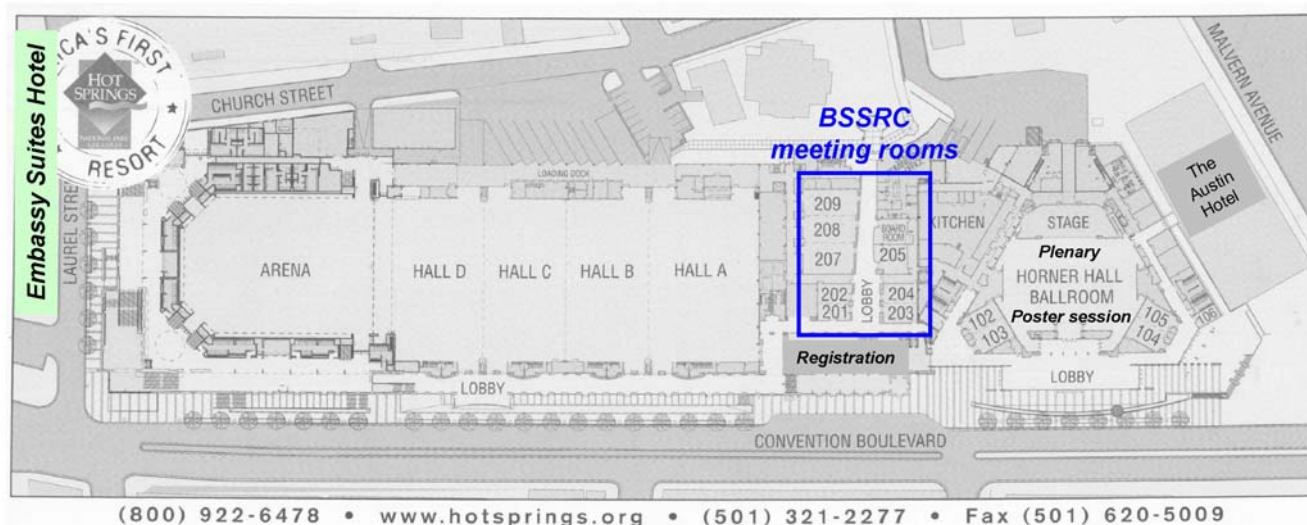
The Embassy Suites Hotel in Hot Springs is fully compliant with the Americans with Disabilities Act (ADA). Any guests having special needs or accessibility issues with their rooms should inquire with the hotel about accommodations when making their reservations.

If you did not get into the Embassy Suites, there are a number of other hotels in the area available, including most major chains. Check with the Hot Springs Convention and Visitor's Bureau for other suggestions on lodging: (http://www.hotspings.org/places_to_stay/)

CONVENTION CENTER FACILITIES

The Hot Springs Convention Center (HSCC) is a full-service facility, with fully accessible meeting rooms and convention space located just minutes from historic downtown Hot Springs. In addition to the offerings of the city, the convention space also doubles as an art gallery freely available to meeting participants. Plenty of free parking is located in the vicinity of the HSCC and Embassy Suites Hotel. For those interested, the HSCC is a wireless hotspot, with daily high-speed access available for a small fee.

Hot Springs Convention Center



STUDENT PRESENTATION COMPETITION

We will be having a student competition for best paper and best poster, with prizes awarded to the winners. Students interested in this competition must be presenting, have already identified themselves to competition coordinator Dr. Brian Lockhart (blockhart@fs.fed.us), and should not have won this prize in any previous year.

CONTINUING FORESTRY EDUCATION (CFE) CREDITS:

This program has been reviewed and is approved for professional CFE credits by the Society of American Foresters (SAF). These are Category 1-CF credits, and the total will depend on how many events the participant attends. There will be at least 5 credits for a full day on Tuesday, 6 credits for a full day on Wednesday, and each field trip is worth 3 CFE credits.

Each registration packet will contain a certificate for meeting attendees that they can use to record their participation. A CFE sign-up sheet will be available at the registration desk during both days of oral presentations—make sure you sign up so SAF has a record of your attendance. Sign-up sheets will be passed around for field trip attendees immediately prior to departure. We will submit the sign-up sheets to SAF after the meeting has ended, but note that individual participants are responsible for submitting their own applications for credit.

INSTRUCTIONS FOR PRESENTERS

Oral presentations are limited to 20 minutes, with 5 minutes for questions and 5 minutes to transition between sessions. Session chairs will be instructed to stay on schedule to reduce problems with the timing of the concurrent sessions. Presenters should use MS PowerPoint (version 2002, we cannot guarantee newer versions will work). Presenters are responsible for getting to their sessions early enough to have their talk loaded onto the provided computer. Talks can be uploaded using either a CD or USB-based memory device. To avoid time problems, do NOT attempt to present using your own computer (special arrangements may be possible under very limited circumstances by contacting the meeting organizers). **Please notify Dr. Don Bragg, Dr. Jim Guldin, or Ms. Paula Hooks regarding any special needs.**

Posters should be no more than 6 feet in width. They can be either landscape or portrait in their orientation. Posters will be attached to cloth-covered wall, and we will provide the necessary attachment devices (you cannot use any materials like glue that may damage the surface of the wall). Poster locations will be identified by a number assigned to them. Poster presenters should not bring any electronic audio/visual aids to their posters, as we cannot guarantee power access. However, presenters will be allowed to post handouts or other publications related to their poster in the space they are provided.

Posters can be set up starting after the plenary session on Tuesday morning, and all should be in place by the start of the 6 p.m. poster session. The room that the poster session will be held in, Horner Hall, will be kept open during the day to allow ample opportunity for placement of the posters. All poster presenters are expected to stand by their poster for the 2-hour session. Posters can be taken down any time after 8 p.m. Tuesday evening. Note that neither we nor the conference center will preserve paper copies of any posters left at the meeting—they will be discarded by 5 p.m. on Wednesday. Poster presenters will be given an opportunity to get their material incorporated in the final publication for this meeting (contact Dr. Jim Guldin for further details).

INSTRUCTIONS FOR AUTHORS

There will be a Forest Service General Technical Report published for the proceedings of this meeting. All those making oral presentations are required to submit a paper to the proceedings. Those offering posters may submit a full paper or just an abstract. **Manuscripts should be sent to Dr. James Guldin no later than January 30, 2009.** Additional instructions regarding formatting and reviews (both biometrics and technical) will be provided to all authors shortly, so please watch your emails and check the meeting website regularly.

All manuscripts must undergo a minimum of two peer reviews for clarity and content, and a biometrics review as appropriate, before submission to the Proceedings Editors. Forest Service scientists should use Southern Research Station forms and procedures for review of papers (we will post these forms on the meeting website soon after its conclusion). Authors will be responsible for the content and accuracy of their manuscripts. All papers will be subject to technical editing by the Station after submission to the proceedings compiler, and authors should prepare to make additional editorial changes as required.

In addition, please make sure you send your most up-to-date abstract (for both oral and poster presentations) to Paula Hooks, as these will also be compiled for the proceedings.

PLENARY SESSION DESCRIPTION

The theme of the Plenary Session will be "Forestry Research in the 21st Century, and the Role of Experimental Forests." Each of the three major sectors of ownership of the forestlands in the South have different perspectives and views on the role and value of forestry research in general, and opportunities available through Experimental Forests in particular. The idea for this Session originates with the 100th anniversary celebration of Experimental Forests in the USDA Forest Service in 2008 and 2009. In addition, the spring of 2009 represents the 75th anniversary for two of the better-known Forest Service Experimental Forests in the South—the Coweeta Hydrological Lab in North Carolina, and the Crossett Experimental Forest in Arkansas. Thus, it's appropriate to celebrate the past contributions and question the future value of the network of Experimental Forests in the Forest Service, as well as of university forests and the experimental forests of industry.

There are larger questions to ask about not only the future of the experimental forest concept, but also the concept of forestry research within the Forest Service, within universities, and especially within the changing landscape of private industry and ownership of industrial or investment forests. Three speakers will address these issues: Dr. Jim Reaves, Station Director for the Southern Research Station, will speak about the Station's network of Experimental Forests and Ranges. Dr. Eric Taylor, Associate Professor and Extension Specialist with the Department of Ecosystem Science and Management at Texas A&M, will speak to research opportunities in academia, extension for forestry research needs in the 21st century, and the role of university-based experimental forests in meeting those needs. Finally, Ms. Nadine Block with AF&PA in Washington, D.C., will speak to the future of forestry research in a changing landscape of private land ownership. These speakers will conclude the Plenary Session by taking questions from the conference attendees.

SESSION CHAIRS

Tuesday, November 18, 2008

Session #	Session name	Morning	Afternoon
1	Pine silviculture	Jimmie Yeiser	John Kushla
2	Hardwood intermediate treatment and stand development	Brian Lockhart	Jamie Schuler
3	Longleaf pine	Dave Haywood	Geoff Wang
4	Quantitative silviculture and economics	Gordon Holly	Tom Lynch

Wednesday, November 19, 2008

Session #	Session name	Morning	Afternoon
5	Pine silviculture	Brian Oswald	Andy Ezell
6	Hardwood regeneration	Hans Williams	Marty Spetich
7	Carbon, climate, and silviculture	Gary Kronrad	--
8	Fires and fuels management	--	Leda Kobziar
9	Soils and water	Callie Schweitzer	--
10	Forest health	--	Nancy Herbert

FOR MORE INFORMATION REGARDING ANY ASPECT OF THIS MEETING, PLEASE CONTACT:

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FINAL SCHEDULE, 15th BSSRC

Monday, November 17: Early registration in Grand Hall of Hot Springs Convention Center (4 PM - 9 PM)

Tuesday, November 18

All meeting rooms in Hot Springs Convention Center

<i>Start time</i>	Room 207	Room 203/204	Room 208	Room 209	Horner Hall	Grand Hall
7:00 AM						Registration
8:00 AM					Welcome/ Plenary	
8:15 AM						
10:15 AM						Break
10:30 AM	Session 1: Pine silviculture	Session 2: Hardwood intermediate treatment and stand development	Session 3: Longleaf pine	Session 4: Quantitative silviculture and economics		
11:00 AM						
11:30 AM						
Noon					Lunch	
1:30 PM						
2:00 PM						
2:30 PM						
3:00 PM						Break
3:30 PM						
4:00 PM						
4:30 PM						
5:00 PM						
5:30 PM	Transition to poster session					
6:00 PM					Poster session	
8:00 PM						

Wednesday, November 19

All meeting rooms in Hot Springs Convention Center

<i>Start time</i>	Room 207	Room 203/204	Room 208	Room 209	Horner Hall	Grand Hall
7:00 AM						Registration
8:00 AM	Session 5: Pine silviculture	Session 6: Hardwood regeneration (both natural and artificial)	Session 7: Carbon, climate, and silviculture	Session 9: Soils and water		
8:30 AM						
9:00 AM						
9:30 AM						Break
10:00 AM						
10:30 AM						
11:00 AM						
11:30 AM						
Noon					Lunch	
1:30 PM						
2:00 PM						
2:30 PM						
3:00 PM						Break
3:30 PM						
4:00 PM						
4:30 PM						
5:00 PM						

Thursday, November 20: Optional field trips (see page 14 in this program for details)

Introduction and meeting plenary, Horner Hall, Hot Springs Convention Center		
8:00 AM	Introduction and welcome	Dr. James M. Guldin, US Forest Service
8:15 AM	Plenary session	3 speakers, 2 hours
10:15 - 10:30 AM break (in lobby and Grand Hall)		
Session 1 (10:30 AM - 5:30 PM): Pine silviculture--Room 207, Hot Springs Convention Center		
Time	Presentation title	Author(s) and credentials (asterix indicates presenter)
10:30 AM	Before and after comparisons of tree height in successive loblolly pine plantations with intervening machine, whole-tree harvesting	Thomas J. Dean* , D. Andrew Scott , & Gordon Holley , respectively, Professor, School of Renewable Natural Resources, LSU Agricultural Center, Baton Rouge, LA; Research Soil Scientist, U.S. Forest Service, Southern Research Station, Pineville, LA; and Assistant Professor, School of Forestry, Louisiana Tech University, Ruston, LA
11:00 AM	Stand-level phosphorus status 25 years after exceptionally high fertilization rates: implications for the next rotation	C. M. Bliss* , D. A. Scott , & A. E. Tiarks , respectively, Soil Scientist, Research Soil Scientist, and Emeritus Scientist, U.S. Forest Service, Southern Research Station, Pineville, LA
11:30 AM	A comparison of slash and loblolly pine performance through age 12 across a range of densities, silvicultural regimes and soil types in the lower coastal plain of the southeastern United States	William M. Harrison* , Michael B. Kane , & Dehai Zhao , respectively, Research Professional, Professor, and Research Professional, Warnell School of Forestry and Natural Resources, University of Georgia, Athens, GA
Noon - 1:30 PM lunch (served in Horner Hall)		
1:30 PM	Comparison of three site preparation techniques on growth of planted loblolly pine after 6 years following a southern pine beetle epidemic	Wayne K. Clatterbuck* & Michael Carr , respectively, Professor and Research Assistant, Department of Forestry, Wildlife & Fisheries, University of Tennessee, Knoxville, TN
2:00 PM	First year survival and growth of fertilized slash pine in south Alabama	Rebecca J. Barlow* , Luben Dimov , Kris Connor , & Mark Smith , respectively, Assistant Professor/Extension Specialist, School of Forestry and Wildlife Sciences, Auburn University, Auburn, AL; Assistant Professor, Center for Forestry, Ecology, and Wildlife, Alabama A&M University, Normal, AL; Project Leader, U.S. Forest Service, Southern Research Station, Auburn, AL; and Assistant Professor/Extension Specialist, School of Forestry and Wildlife Sciences, Auburn University, Auburn, AL
2:30 PM	Plant community responses to soil disturbance and herbicide treatments over 10 years on a sandy soil in East Texas	D. Andrew Scott* & Richard H. Stagg , respectively, Research Soil Scientist and Forester, U.S. Forest Service, Southern Research Station, Pineville, LA
3:00 - 3:30 PM break (in lobby and Grand Hall)		
3:30 PM	Impacts of four decades of stand density management treatments on wood properties of loblolly pine	Michael A. Blazier* , Alexander Clark III , Michael Strub , Richard F. Daniels , & Laurie R. Schimleck , respectively, Assistant Professor, Louisiana State University AgCenter, Hill Farm Research Station, Homer, LA; Forest Products Technologist, U.S. Forest Service, Southern Research Station, Athens, GA; Forest Biometrician, Weyerhaeuser Company, Hot Springs, AR; Professor, University of Georgia, Warnell School of Forestry and Natural Resources, Athens, GA; and Associate Professor, University of Georgia, Warnell School of Forestry and Natural Resources, Athens, GA
4:00 PM	Immediate effect of burning and logging treatments on the avian community at Bankhead National Forest of northern Alabama	Jill M. Wick* , Yong Wang , & Callie J. Schweitzer , respectively, Graduate Student and Professor, Department of Natural Resources and Environmental Science, Alabama A&M University, Normal, AL; and Research Forester, U.S. Forest Service, Southern Research Station, Normal, AL
4:30 PM	Uneven-aged management of southern yellow pine for improved income and ecosystem services	Don M. Handley & Joshua C. Dickinson* , respectively, Forester, Handley Forest Services, Inc., Florence, SC; and Director, The Forest Management Trust, Gainesville, FL
5:00 PM	Comparisons of even- and uneven-aged silviculture in southern pines	James E. Henderson , Assistant Extension Professor, Department of Forestry, Mississippi State University

Introduction and meeting plenary, Horner Hall, Hot Springs Convention Center		
8:00 AM	Introduction and welcome	Dr. James M. Guldin, US Forest Service
8:15 AM	Plenary session	3 speakers, 2 hours
10:15 - 10:30 AM break (in lobby and Grand Hall)		
Session 2 (10:30 AM - 5:30 PM): Hardwood intermediate treatment & stand development--Room 203/204, Hot Springs Convention Center		
Time	Presentation title	Author(s) and credentials (asterix indicates presenter)
10:30 AM	Seven year growth responses of two young bottomland hardwood stands to various precommercial thinning treatments	Jamie L. Schuler* , Matthew W. Lowe , & Daniel J. Robison , respectively, Assistant Professor, School of Forest Resources, University of Arkansas, Monticello, AR; Business Innovation Manager, Temple-Inland Inc., Diboll, TX; and Associate Professor, Department of Forestry and Environmental Resources, North Carolina State University, Raleigh, NC
11:00 AM	Influences of tree, stand, and site characteristics on the production of epicormic branches in southern bottomland hardwood forests: preliminary analyses	James S. Meadows* , J.C.G. Goelz , & Daniel A. Skojac, Jr. , respectively, Principal Silviculturist, U.S. Forest Service, Southern Research Station, Stoneville, MS; Research Forester, U.S. Forest Service, Southern Research Station, Pineville, LA; and Forester, U.S. Forest Service, Ozark-St. Francis National Forest, Russellville, AR
11:30 AM	Overstory tree status following thinning and burning treatments in mixed pine-hardwoods stands on the William B. Bankhead National Forest, Alabama	Callie Jo Schweitzer* & Yong Wang , respectively, Research Forester, U.S. Forest Service, Southern Research Station, Huntsville, AL and Professor, School of Agricultural and Environmental Sciences, Alabama A&M University, Normal, AL
Noon - 1:30 PM lunch (served in Horner Hall)		
1:30 PM	Predicting amphibian communities using habitat variables in forested landscapes in the southern Cumberland Plateau	Timothy Baldwin* , Florence Chan , Yong Wang , & Callie Schwietzer , respectively, Graduate Student, Graduate Student, and Professor, Department of Natural Resources and Environmental Science, Alabama A&M University, Normal, AL; and Research Forester, U.S. Forest Service, Southern Research Station, Normal, AL
2:00 PM	Boxelder (<i>Acer negundo</i> L.) stand development – can it serve as a trainer species?	Brian Roy Lockhart* & Ray Souter , respectively, Research Foresters, U.S. Forest Service, Southern Research Station, Center for Bottomland Hardwoods Research, Stoneville, MS
2:30 PM	Crown closure, density and light in upland Ozark forests	Elizabeth M. Blizzard* , David R. Larsen , Daniel C. Dey , John M. Kabrick , Stephen G. Pallardy , & David P. Gwaze , respectively, Graduate Student and Chair, Department of Forestry, University of Missouri, Columbia, MO; Research Forester and Research Forester, U.S. Forest Service, Northern Research Station, Columbia, MO; Professor, Department of Forestry, University of Missouri, Columbia, MO; and Resource Scientist, Resource Science Division, Missouri Department of Conservation, Columbia, MO
3:00 - 3:30 PM break (in lobby and Grand Hall)		
3:30 PM	Assessing anthropogenic and natural disturbances: Vegetation response to similarly aged clearcut and tornado disturbances in an East Tennessee oak-hickory forest	Jonathan C. McGrath* & Wayne K. Clatterbuck , respectively, Graduate Research Assistant and Professor, Department of Forestry, Wildlife and Fisheries, University of Tennessee, Knoxville, TN
4:00 PM	Stand dynamics in a tupelo-baldcypress swamp following helicopter and skidder harvests: 21 year results	Dan Evans , John Peterson , & Mike Aust* , respectively, Research Specialist, Lab Specialist, and Professor, Forestry Department, Virginia Tech, Blacksburg, VA
4:30 PM	A preliminary test of estimating forest site quality using species composition in the southern Appalachians	W. Henry McNab* & David L. Loftis , Research Foresters, U.S. Forest Service, Southern Research Station, Asheville, NC
5:00 PM	Common persimmon (<i>Diospyros virginiana</i> L.) silviculture: limited information and research needs	Brian Roy Lockhart , Research Forester, U.S. Forest Service, Southern Research Station, Center for Bottomland Hardwoods Research, Stoneville, MS

Introduction and meeting plenary, Horner Hall, Hot Springs Convention Center		
8:00 AM	Introduction and welcome	Dr. James M. Guldin, US Forest Service
8:15 AM	Plenary session	3 speakers, 2 hours
10:15 - 10:30 AM break (in lobby and Grand Hall)		
Session 3 (10:30 AM - 5:30 PM): Longleaf pine--Room 208, Hot Springs Convention Center		
<i>Time</i>	<i>Presentation title</i>	<i>Author(s) and credentials (asterix indicates presenter)</i>
10:30 AM	Fire's impact in two old-growth montane longleaf pine stands	John S. Kush* & John C. Gilbert , respectively, Research Fellow and Research Associate, School of Forestry and Wildlife Sciences, Auburn University, Auburn, AL
11:00 AM	A decision tree approach using silvics to guide planning for restoration of an open-canopy forest: an example from fire-suppressed montane longleaf pine stands	S. M. Hermann*, J. S. Kush, & J. C. Gilbert , respectively, Visiting Assistant Professor, Department of Biological Sciences, Auburn University, Auburn, AL; and Research Fellow and Research Associate, School of Forestry and Wildlife Sciences, Auburn University, Auburn, AL
11:30 AM	Effects of prescribed burning on small mammal, reptile, and tick populations on the Talladega National Forest, Alabama	Robert Carter*, Jonathan Adams, Damien Willis, & Chris Edmondson , respectively, Assistant Professor and Graduate Students, Department of Biology, Jacksonville State University, Jacksonville, AL
Noon - 1:30 PM lunch (served in Horner Hall)		
1:30 PM	Site index model for naturally regenerated even-aged longleaf pine	Dwight K. Lauer* & John S. Kush , Research Analyst, Silvics Analytic, Ridgeway, VA and Research Fellow, School of Forestry and Wildlife Sciences, Auburn University, Auburn, AL
2:00 PM	Surface soil root distribution and possible interaction with site factors in a young longleaf pine stand	Mary Anne Sword Sayer , Plant Physiologist, U.S. Forest Service, Southern Research Station, Pineville, LA
2:30 PM	Longleaf pine regeneration following Hurricane Ivan utilizing the RLGS plots	John C. Gilbert* & John S. Kush , respectively, Research Associate and Research Fellow, School of Forestry and Wildlife Sciences, Auburn University, Auburn, AL
3:00 - 3:30 PM break (in lobby and Grand Hall)		
3:30 PM	Revisions of the interim guidelines for growing longleaf seedlings in containers	R. Kasten Dumroese, Mark Hains, James P. Barnett*, & Paul Jackson , respectively, Plant Physiologist, U.S. Forest Service, Southern Research Station, Moscow, ID; Research Coordinator, The Longleaf Alliance, Andalusia, AL; Emeritus Scientist, U.S. Forest Service, Southern Research Station, Pineville, LA; and Graduate Student, Auburn University, Auburn, AL
4:00 PM	Field performance and individual flush development of container-grown longleaf pine seedlings	Shi-Jean S. Sung*, Stanley J. Zarnoch, Daniel Leduc, James D. Haywood, & Mary A. Sword Sayer , respectively, Research Plant Physiologist, U.S. Forest Service, Southern Research Station, Pineville, LA; Mathematical Statistician, U.S. Forest Service, Southern Research Station, Asheville, NC; and Information Technology Specialist, Supervisory Research Forester, and Research Plant Physiologist, U.S. Forest Service, Southern Research Station, Pineville, LA
4:30 PM	Mortality and growth of first year longleaf pine seedlings under different treatments on Camp Lejeune, NC	Huifeng Hu*, G. Geoff Wang, Joan L. Walker, & Benjamin O. Knapp , respectively, Graduate Student, Department of Forestry and Natural Resources, Clemson University, Clemson, SC; Associate Professor, Department of Forestry and Natural Resources, Clemson University, Clemson, SC; Research Plant Ecologist, U.S. Forest Service, Southern Research Station, Clemson, SC; and Research Technician, U.S. Forest Service, Southern Research Station, Clemson, SC
5:00 PM	Sixty years of management on a small longleaf pine forest	Rebecca J. Barlow*, John S. Kush, & William D. Boyer , respectively, Assistant Professor/Extension Specialist and Research Fellow, School of Forestry and Wildlife Sciences, Auburn University, Auburn, AL; and U.S. Forest Service (retired), Auburn, AL

Introduction and meeting plenary, Horner Hall, Hot Springs Convention Center		
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8:15 AM	Plenary session	3 speakers, 2 hours
10:15 - 10:30 AM break (in lobby and Grand Hall)		
Session 4 (10:30 AM - 5:30 PM): Quantitative Silviculture and Economics--Room 209, Hot Springs Convention Center		
Time	Presentation title	Author(s) and credentials (asterix indicates presenter)
10:30 AM	The "Estate Owner's" approach to forest economics	David B. South* & David Laband , Professors, School of Forestry and Wildlife Sciences, Auburn University, Auburn, AL
11:00 AM	Cost effectiveness of three different release treatments of for table mountain pine (TMP) in an severely overstocked and pure stand	Amy L. Morgan* & Wayne K. Clatterbuck , respectively, Graduate Research Assistant and Professor, Department of Forestry, Wildlife & Fisheries, University of Tennessee, Knoxville, TN
11:30 AM	Impacts of silvicultural treatments on within-stand uniformity of loblolly pine (<i>Pinus taeda</i>) plantations	Stephen J. Purvis* & Michael B. Kane , respectively, Graduate Student and Professor, Warnell School of Forestry and Natural Resources, University of Georgia, Athens, GA
Noon - 1:30 PM lunch (served in Horner Hall)		
1:30 PM	Financial performance of loblolly and longleaf pine plantations	Steven D. Mills & Charles T. Stiff* , respectively, Forest Planning Analyst and Biometrician, FORSight Resources, LLC, North Charleston, SC
2:00 PM	Estimating annual growth losses from drought in loblolly pine plantations	Ralph L. Amateis* & Harold E. Burkhart , respectively, Research Associate and University Distinguished Professor, Department of Forestry, Virginia Tech, Blacksburg, VA
2:30 PM	Stand dynamics of intensively managed loblolly pine plantations: a 21-year real growth series from the Lower Coastal Plain and Piedmont of Georgia	Bruce E. Borders , Professor, Warnell School of Forestry and Natural Resources, University of Georgia, Athens, GA
3:00 - 3:30 PM break (in lobby and Grand Hall)		
3:30 PM	Modeling thinning in east Texas loblolly and slash pine plantations	Dean W. Coble , Associate Professor of Forest Biometrics, Arthur Temple College of Forestry and Agriculture, Stephen F. Austin State University, Nacogdoches, TX
4:00 PM	Comparing the practical application of two bark thickness conversion models: Does a non-linear mixed effects model out perform a fixed effects non-linear model?	Adam M. Saunders, David R. Larsen*, & Christopher K. Wikle , respectively, Graduate Student and Professors, University of Missouri-Columbia, Columbia, MO
4:30 PM	Predicting diameter at breast height from total height and crown length	Quang V. Cao* & Thomas J. Dean , respectively, Professor and Professor, School of Renewable Natural Resources, Louisiana State University, Baton Rouge, LA
5:00 PM	Estimating loblolly pine size-density trajectories across a range of planting densities	C. L. VanderSchaaf* & H. E. Burkhart , respectively, Arkansas Forest Resources Center, University of Arkansas at Monticello, Monticello, AR and Department of Forestry, Virginia Polytechnic Institute and State University, Blacksburg, VA

Meeting attendees are invited to participate in a evening social and poster presentation from 6 to 8 PM in the Hot Springs Convention Center's Horner Hall. Over 50 posters and displays will be available for review and discussion with their authors. A cash bar and "heavy" hors d'oeuvres will be provided.

Session 5 (8:00 AM - 5:00 PM): Pine silviculture--Room 207, Hot Springs Convention Center		
Time	Presentation title	Author(s) and credentials (asterix indicates presenter)
8:00 AM	Volume and branch characteristics of juvenile loblolly pine grown at various ratios of between row and within row spacings	John Britt* & Jason Reynolds , respectively, Consultant, John Britt & Associates, Fortson, GA; and Forest Resource Planner, Hancock Timber Resource Group, Charlotte, NC
8:30 AM	Effect of application timing on efficacy of site preparation treatments using Chopper GEN2	Andrew W. Ezell*, Jimmie L. Yeiser, Dwight K. Lauer, & Harold E. Quicke , respectively, Professor, Mississippi State University, Mississippi State, MS; Professor, Stephen F. Austin State University, Nacogdoches, TX; Research Analyst, Silvics Analytic, Richmond, VA; and Research Specialist, BASF Corporation, Auburn, AL
9:00 AM	Fifth-year pine growth response to woody release treatments in young loblolly plantations	Andrew W. Ezell*, Jimmie L. Yeiser, & Larry R. Nelson , respectively, Professor, Department of Forestry, Mississippi State University, Mississippi State, MS; Professor, College of Forestry, Stephen F. Austin State University, Nacogdoches, TX; and deceased
9:30 - 10:00 AM break (in lobby and Grand Hall)		
10:00 AM	Pine growth following a two-pass weed control system consisting of chemical site prep and post-plant herbaceous weed control compared to one-pass chemical site prep only	Dwight K. Lauer* & Harold E. Quicke , Research Analyst, Silvics Analytic, Ridgeway, VA and Research Specialist, BASF Corporation, Research Triangle Park, NC
10:30 AM	Control of Japanese climbing fern and effects to non-target vegetation using glyphosate, imazapyr, and metsulfuron herbicides in Florida's public forests	Kimberly K. Bohn* & Patrick J. Minogue , respectively, Assistant Professor, West Florida Research and Education Center, Milton, FL; and Assistant Professor, North Florida Research and Education Center, Quincy, FL
11:00 AM	Does site prep timing affect the optimal timing for post-plant herbaceous weed control in loblolly pine plantations?	Harold E. Quicke* & Dwight K. Lauer , respectively, Research Specialist, BASF Corporation, Research Triangle Park, NC and Research Analyst, Silvics Analytic, Ridgeway, VA
11:30 AM	Unwanted hardwood control with June-applied Chopper GEN2 and Chopper on four sites	Jimmie Yeiser*, Andrew Ezell, & Michael Blazier , respectively, Professor, Arthur Temple College of Forestry and Agriculture, Stephen F. Austin State University, Nacogdoches, TX; Professor, Department of Forest Resources, Mississippi State University, Mississippi State, MS; and Assistant Professor, Louisiana State University AgCenter, Hill Farm Research Station, Homer, LA
Noon - 1:30 PM lunch (served in Horner Hall)		
1:30 PM	Habitat use and spatial ecology of <i>Agkistrodon contortrix</i> in silviculture disturbed pine-hardwood forests of northern Alabama	William B. Sutton* & Yong Wang , respectively, Graduate Student and Professor, Department of Natural Resources and Environmental Science, Alabama A&M University, Normal, AL
2:00 PM	Establishment results of a coastal plain oak-pine-soybean agroforestry trial	Hayley Stevenson, Daniel Robison*, Fred Cabbage, Paul Mueller, & Mike Burton , respectively, Graduate Research Assistant and Professors, North Carolina State University, Raleigh, NC
2:30 PM	Effects of site preparation practices and sustained competing vegetation control on loblolly pine growth in the Piedmont/Upper Coastal Plain of the southeastern United States	Dehai Zhao*, Michael Kane, Bruce E. Borders, Mike Harrison, & John Rheney , respectively, Research Professional, Professor, Professor, Research Professional, and Research Professional, Warnell School of Forestry and Natural Resources, University of Georgia, Athens, GA
3:00 - 3:30 PM break (in lobby and Grand Hall)		
3:30 PM	Assessing potential genetic gains from varietal planting stock in loblolly pine plantations	Scott D. Roberts* & Randall J. Rousseau , Associate Professors, Department of Forestry and Forest and Wildlife Research Center, Mississippi State University, Mississippi State, MS
4:00 PM	Regenerating shortleaf pine in clearcuts in the Missouri Ozark Highlands	David Gwaze* & Mark Johanson , respectively, Resource Scientist, Missouri Department of Conservation, Columbia, MO and Private Lands Conservationist, Missouri Department of Conservation, Sullivan, MO
4:30 PM	Impacts of genetically improved planting stock and complete competing vegetation control on loblolly pine plantation performance through age 21 in the Coastal Plain and Piedmont	Michael B. Kane*, William M. Harrison, Dehai, & Bruce E. Borders , respectively, Professor, Research Professional, Research Professional, and Professor, Warnell School of Forestry and Natural Resources, University of Georgia, Athens, GA.

Session 6A (8:00 AM - 12:00 PM): Hardwood regeneration (natural)--Room 203/204, Hot Springs Convention Center		
Time	Presentation title	Author(s) and credentials (asterix indicates presenter)
8:00 AM	Regeneration dynamics during oak decline in Arkansas' Boston Mountains	Martin A. Spetich , Research Forester, U.S. Forest Service, Southern Research Station, Hot Springs, AR
8:30 AM	Regeneration in bottomland forest canopy gaps six years after prescribed wildlife habitat improvement treatments	Daniel J. Twedt* & Scott G Somershoe , respectively, Research Wildlife Biologist and Avian Ecologist, USGS Patuxent Wildlife Research Center, Vicksburg, MS
9:00 AM	Red maple (<i>Acer rubrum</i>) response to prescribed burning on the William B. Bankhead National Forest, Alabama	Stacy L. Clark* & Callie J. Schweitzer , Research Foresters, U.S. Forest Service, Southern Research Station, Huntsville, AL
9:30 - 10:00 AM break (in lobby and Grand Hall)		
10:00 AM	Regeneration of Appalachian hardwoods: adapting the REGEN model for the Ridge and Valley and Cumberland Plateau Physiographic Provinces	Lance A. Vickers* , Thomas R. Fox , & David L. Loftis , respectively, M.S. Candidate and Associate Professor, College of Natural Resources, Virginia Polytechnic Institute & State University, Blacksburg, VA; and Research Forester, Bent Creek Experimental Forest, Asheville, NC
10:30 AM	The use of midstory injection for increased light availability in two Arkansas greentree reservoirs	Rory O. Thornton* , Andrew W. Ezell , John D. Hodges , & Andrew J. Londo , respectively, Graduate Student, Professor, Professor Emeritus, and Associate Professor, School of Forest Resources, Department of Forestry, Mississippi State University, Mississippi State, MS
11:00 AM	Herpetofaunal community and silviculture: lessons from the Cumberland Plateau of northern Alabama	Zach Felix* , Yong Wang , & Callie Schweitzer , respectively, Research Associate and Professor, Department of Natural Resources and Environmental Science, Alabama A&M University, Normal, AL; and Research Forester, U.S. Forest Service, Southern Research Station, Normal, AL
11:30 AM	Modeling the long-term effects of oak regeneration treatments on species diversity, oak resilience, and carbon stocks in southern Appalachian forests of North Carolina	Tara L. Keyser* & Chad E. Keyser , respectively, Research Forester, U.S. Forest Service, Southern Research Station, Bent Creek Experimental Forest, NC; and Forester, U.S. Forest Service, Forest Management Service Center, Fort Collins, CO
Noon - 1:30 PM lunch (served in Horner Hall)		
Session 6B (1:30 PM - 5:00 PM): Hardwood regeneration (artificial)--Room 203/204, Hot Springs Convention Center		
Time	Presentation title	Author(s) and credentials (asterix indicates presenter)
1:30 PM	A comparison of canopy structure measures for predicting height growth of underplanted seedlings	John M. Lhotka* & Edward F. Loewenstein , respectively, Assistant Professor of Silviculture, Department of Forestry, University of Kentucky, Lexington, KY and Associate Professor of Silviculture, School of Forestry and Wildlife Sciences, Auburn University, Auburn, AL
2:00 PM	Effect of directed-spray glyphosate applications on survival and growth of planted oaks after three growing seasons	Andrew B. Self* , Andrew W. Ezell , & Josh L. Moree , respectively, Graduate Student and Professor, School of Forest Resources, Department of Forestry, Mississippi State University, Mississippi State, MS; and Wildlife Biologist, Mississippi Department of Wildlife Fisheries and Parks, Columbia, MS
2:30 PM	Nine-year performance of a variety of <i>Populus</i> taxons on an upland site in western Kentucky	Randall J. Rousseau* , Joshua P. Adams , & David W. Wilkinson , respectively, Associate Extension/Research Professor and Graduate Students, Department of Forestry and Forest and Wildlife Research Center, Mississippi State University, Mississippi State, MS
3:00 - 3:30 PM break (in lobby and Grand Hall)		
3:30 PM	Restoration of Nuttall oak using Root Prune Method (RPM) and bareroot in the Felsenthal National Wildlife Refuge Greentree Reservoir	John W. McCoy* & Bobby D. Keeland , respectively, General Biologist and Research Ecologist, USGS National Wetlands Research Center, Lafayette, LA
4:00 PM	Influence of planting stock, planting method, fertilization, and competition control on the survival of planted oak seedlings; second and third year results	Joshua L. Moree , Andrew W. Ezell* , John D. Hodges , & Andrew J. Londo , respectively, Area Biologist, Mississippi Department Wildlife, Fisheries, and Parks, Columbia, MS; Professor, Professor Emeritus, and Associate Professor, Department of Forestry, Mississippi State University, Mississippi State, MS
4:30 PM	A comparison of tree shelters installed on green ash (<i>Fraxinus pennsylvanica</i> Marsh.) and cherrybark oak (<i>Quercus pagoda</i> Raf.) seedlings in Arkansas	H. Christoph Stuhlinger , University System Forest Manager, University of Arkansas Division of Agriculture, Arkansas Forest Resources Center, Monticello, AR

Session 7 (8:00 AM - 12:00 PM): Carbon, climate, and silviculture--Room 208, Hot Springs Convention Center		
Time	Presentation title	Author(s) and credentials (asterix indicates presenter)
8:00 AM	A tree biomass and carbon estimation system	Emily B. Schultz* , Thomas G. Matney , & Donald L. Grebner , respectively, Associate Professor, Professor, and Associate Professor, Forest and Wildlife Research Center, Mississippi State University, Mississippi State, MS
8:30 AM	Initial estimates of belowground coarse woody debris in a fire-maintained forest: the good and the not-so-good attributes	Steven B. Jack* , Noah A. Jansen , & J. Kevin Hiers , respectively, Conservation Ecologist, Research Technician and Assistant Scientist, J.W. Jones Ecological Research Center, Newton, GA
9:00 AM	Results of a long-term thinning study in some natural, even-aged pine stands of the Midsouth	Don C. Bragg , Research Forester, U.S. Forest Service, Southern Research Station, Monticello, AR
9:30 - 10:00 AM break (in lobby and Grand Hall)		
10:00 AM	Simulation of pine plantation carbon dynamics under contrasting silvicultural scenarios	Timothy A. Martin* & Wendell P. Cropper, Jr. , respectively, Associate Professor of Tree Physiology and Assistant Professor of Biological Process Modeling, School of Forest Resources and Conservation, University of Florida, Gainesville, FL
10:30 AM	Growth and carbon allocation patterns of clonal <i>Pinus taeda</i> following fertilization in the Virginia piedmont	J.P. Stovall* , C.A. Carlson , J.R. Seiler , & T.R. Fox , respectively, Graduate Assistant, Research Associate, Shelton H. Short Professor of Forestry, and Associate Professor, Department of Forestry, Virginia Tech, Blacksburg, VA
11:00 AM	Effects of nutrient availability and genetics on aboveground productivity and its influence on belowground soil CO ₂ efflux in a young loblolly pine clonal plantation	Michael C. Tyree , John R. Seiler* , & Chris A. Maier , respectively, Graduate Research Assistant and Shelton H. Short Professor of Forestry, Department of Forestry, Virginia Tech, Blacksburg, VA; and Research Biological Scientist, U.S. Forest Service, Southern Research Station, Research Triangle Park, NC
11:30 AM	One stand at a time-a silvicultural strategy for stand-level response to climate change in Southern forests	James M. Guldin and Rob Doudrick* , respectively, Supervisory Ecologist and Project Leader, USDA Forest Service, Southern Research Station, Hot Springs, AR, and Ecosystem Services Coordinator, Office of the Chief, USDA Forest Service, Washington, DC.
Noon - 1:30 PM lunch (served in Horner Hall)		
Session 8 (1:30 PM - 5:00 PM): Fires and fuel management--Room 208, Hot Springs Convention Center		
Time	Presentation title	Author(s) and credentials (asterix indicates presenter)
1:30 PM	Fuel variation in the Carolina Sandhills National Wildlife Refuge: effects on fire and vegetation	Evelyn S. Wenk* , G. Geoff Wang , & Joan L. Walker , respectively, Graduate Student and Associate Professor, Department of Forestry and Natural Resources, Clemson University, Clemson, SC; and Research Plant Ecologist, U.S. Forest Service, Southern Research Station, Clemson, SC
2:00 PM	Comparing soil ectomycorrhizal and vesicular-arbuscular mycorrhizal inoculum potential after fuel reduction treatments in beetle-killed stands	Aaron D. Stottlemeyer* , G. Geoff Wang , Thomas A. Waldrop , Christina E. Wells , & Mac A. Callaham , respectively, Graduate Student and Associate Professor, Department of Forestry and Natural Resources, Clemson University, Clemson, SC; Research Forester, U.S. Forest Service, Southern Research Station, Clemson, SC; Associate Professor, Department of Horticulture, Clemson University, Clemson, SC; and Research Ecologist, U.S. Forest Service, Southern Research Station, Athens, GA
2:30 PM	Fuel dynamics across southern Appalachian landscapes	Horace E. Gambrell* , Thomas A. Waldrop , & Geoff G. Wang , respectively, Graduate Student, Department of Forestry and Natural Resources, Clemson University, Clemson, SC; Research Forester, U.S. Forest Service, Southern Research Station; and Professor, Department of Forestry and Natural Resources, Clemson University, Clemson, SC
3:00 - 3:30 PM break (in lobby and Grand Hall)		
3:30 PM	Restoration treatments in eastern hardwoods: impacts and interactions of multiple ecosystem components	Thomas A. Waldrop* , Ralph E. J. Boerner , & Daniel A. Yaussy , respectively, Supervisory Research Forester, U.S. Forest Service, Southern Research Station, Clemson, SC; Professor of Ecology, Ohio State University, Columbus, OH; and Supervisory Research Forester, U.S. Forest Service, Northern Research Station, Delaware, OH
4:00 PM	Interest group opinions about fuel reduction in southern Appalachia	Carin Vadala , Robert D. Bixler* , & Thomas Waldrop , respectively, Doctoral Student and Associate Professor, Clemson University, Clemson, SC; and Team Leader and Research Forester, U.S. Forest Service, Southern Research Station, Clemson, SC
4:30 PM	Estimating and managing live fuels for Atlantic Coastal Plain forest communities	Bernard R. Parresol , Mathematical Statistician, U.S. Forest Service, Southern Research Station, Asheville, NC

Session 9 (8:00 AM - 12:00 PM): Soil and water--Room 209, Hot Springs Convention Center		
Time	Presentation title	Author(s) and credentials (asterix indicates presenter)
8:00 AM	The impact of intensive management practices on erosional characteristics of a loblolly pine plantation in the Piedmont Region of Alabama, USA	Emily A. Carter , Research Soil Scientist, U.S. Forest Service, Southern Research Station, Auburn, AL
8:30 AM	Evaluation of road approaches to four different types of stream crossings in the Virginia Piedmont	Matthew B. Carroll* , W. Michael Aust , C. Andrew Dolloff , & Robert M. Shaffer , respectively, Graduate Student and Professor, Virginia Tech, Blacksburg, VA; Team Leader, U.S. Forest Service, Southern Research Station, Blacksburg, VA; and Charles Nettleton Professor of Forestry, Virginia Tech, Blacksburg, VA
9:00 AM	Influence of forest roads standards and networks on water yield as predicted by the Distributed Hydrology-Soil-Vegetation Model	S. F. Dymond* , W. M. Aust , M. H. Eisenbies , & J. M. Vose , respectively, Graduate Student and Professor of Forestry, Virginia Tech, Blacksburg, VA; Hydrologist, U.S. Forest Service, Starkville, MS; and Project Leader, U.S. Forest Service, Southern Research Station, Coweeta Hydrologic Laboratory, Otto, NC
9:30 - 10:00 AM break (in lobby and Grand Hall)		
10:00 AM	Effectiveness of forested streamside management zones for minimizing nutrient fluxes from forest fertilization in Piedmont streams	Joseph M. Secoges , John R. Seiler* , & Wallace M. Aust , respectively, Graduate Research Assistant, Shelton H. Short Professor of Forestry, and Professor of Forestry, Department of Forestry, Virginia Tech, Blacksburg, VA
10:30 AM	Determination of field effective soil properties in the Tidewater Region of North Carolina	J. McFero Grace III* & R. W. Skaggs , respectively, Research Engineer, U.S. Forest Service, Southern Research Station, Auburn, AL; and W.N.R. and Distinguished University Professor, Biological and Agricultural Engineering Department, North Carolina State University, Raleigh, NC
11:00 AM	Louisiana Forestry Best Management Practice effectiveness for reducing nonpoint source pollution in intermittent streams	William B. Patterson* , Dan S. Taylor , & Mark D. Gibson , respectively, Assistant Professor, Research Associate, and Professor, School of Forestry, Louisiana Tech University, Ruston, LA
11:30 AM	Implications of diurnal dissolved oxygen patterns in low-gradient forested headwater streams for silvicultural Best Management Practices	Y. Jun Xu* , John Beebe , & George Ice , respectively, Associate Professor, School of Renewable Natural Resources, Louisiana State University, Baton Rouge, LA; Senior Research Scientist, National Council for Air & Stream Improvement (NCASI), Western Michigan University (Parkview Campus), Kalamazoo, MI; and Principal Scientist, NCASI, Corvallis, OR
Noon - 1:30 PM lunch (served in Horner Hall)		
Session 10 (1:30 PM - 5:00 PM): Forest health--Room 209, Hot Springs Convention Center		
Time	Presentation title	Author(s) and credentials (asterix indicates presenter)
1:30 PM	A cost-benefit analysis of the North Carolina Southern Pine Beetle Prevention Program	Rafael Estevez* , Dennis Hazel , Erin Sills , Robert Bardon , & Arnie Oltmans , respectively, Graduate Student, Assistant Professor, Associate Professor, Associate Professor, and Undergraduate Coordinator, North Carolina State University, Raleigh, NC
2:00 PM	Using the GIS-based spot growth model to simulate the effect of silvicultural treatments on the southern pine beetle infestation stands	Chiao-Ying Chou* , Roy L. Hedden , Bo Song , & Thomas Williams , respectively, Graduate Student, Professor, Associate Professor and Professor, Department of Forestry and Natural Resources, Clemson University, Clemson, SC
2:30 PM	Flooding effects on stand development in cypress-tupelo	Richard F. Keim* , Thomas J. Dean , & Jim L. Chambers , respectively, Assistant Professor, Professor, and Professor, School of Renewable Natural Resources, Louisiana State University, Baton Rouge, LA
3:00 - 3:30 PM break (in lobby and Grand Hall)		
3:30 PM	Prescribed fire and brush removal affect vegetation, fuel loads, and abundance of selected beetle populations in pine stands	James D. Haywood* , Tessa A. Bauman , Richard A. Goyer , & Gerald J. Lenhard , respectively, Supervisory Research Forester and Biological Science Tech, U.S. Forest Service, Southern Research Station, Pineville, LA; School of Renewable Natural Resources (retired) and Department of Entomology (retired), LSU Agricultural Center, Baton Rouge, LA
4:00 PM	Restoring the Kentucky lady's slipper orchid on the Kisatchie National Forest: seedling production and outplanting trials	James Barnett* , Shannan Sharp , Andy Scott , & Byron McGraw , respectively, Emeritus Scientist, U.S. Forest Service, Southern Research Station, Pineville, LA; Botanist, U.S. Forest Service, Kistachie National Forest, Pineville, LA; Research Soil Scientist, U.S. Forest Service, Southern Research Station, Pineville, LA; and Central Louisiana Orchid Society, Pineville, LA
4:30 PM	Thinning to improve growth, bole quality, and forest health in an Inonotus hispidus-infected red oak-sweetgum stand in the Mississippi Delta: 10-year results	James S. Meadows* , Theodor D. Leininger , David Montwé , T. Evan Nebeker , respectively, Principal Silviculturist and Principal Plant Pathologist, U.S. Forest Service, Southern Research Station, Stoneville, MS; Undergraduate Student, Hochschule für Forstwirtschaft (University of Applied Forest Sciences), Rottenburg, Germany; and Professor Emeritus, Department of Entomology and Plant Pathology, Mississippi State University, Mississippi State, MS

AGENDA, HIGH-YIELD FORESTRY FIELD TOUR
Mountain Pine Tree Farm, Weyerhaeuser Company
Tour guides: John Wainscott, Jim Sorenson

The objective of this tour is to illustrate the practices used to grow high-quality southern yellow pine sawlogs under the principles of high yield forestry developed through research and practical application by Weyerhaeuser Company in the Ouachita Mountains of west-central Arkansas. Personal protective equipment (PPE) will be required for this tour. The tour date (November 20) is in the second week of the modern gun deer season in Arkansas, and the tour will be conducted with attention to participant safety. Weyerhaeuser Company and the BSSRC will provide any PPE required for the tour. Transportation will be supplied by the BSSRC.

0800 Depart Embassy Suites Hotel for Stop 1
0830 Stop 1 Plantation establishment
0915 Depart for Stop 2
0930 Stop 2 First thinning (commercial)
1015 Depart for Stop 3
1030 Stop 3 Pruning
1115 Depart for stop 4
1130 Stop 4 Late-rotation stand nearing final harvest
1215 Lunch
1300 Depart for Hot Springs
1330 Return to Embassy Suites Hotel

AGENDA, SHORTLEAF PINE-BLUESTEM ECOSYSTEM RESTORATION FIELD TOUR
Poteau RD, Ouachita NF
Tour guides: Larry Hedrick, Jim Guldin

The objective of this tour is to illustrate the silvicultural practices used to restore shortleaf pine-bluestem ecosystems on the Ouachita NF in the western Ouachita Mountains. Restored stands reflect conditions that were widespread prior to the harvest of the virgin forest in the early 1900s, but that are underrepresented on the landscape today. Pine-bluestem stands support a variety of flora and fauna, such as red-cockaded woodpeckers and coneflowers, not typically found in mature second-growth unburned shortleaf pine stands in the Ouachitas. The restoration work represents an unusually productive interrelationship of operational pine sawlog timber sales, proceeds from which are used to conduct the follow-up treatments that enable the restoration to occur. Any personal protective equipment (PPE) required on the tour will be provided, and transportation will be supplied by the BSSRC.

0700 Depart Embassy Suites Hotel for Stop 1
0900 Stop 1 Unrestored mature second-growth shortleaf pine stand
0930 Depart for Stop 2
0940 Stop 2 Fully-restored stand featuring a properly-thinned overstory, effective midstory removal, and the results of a series of cyclic prescribed fires
1010 Depart for Stop 3
1020 Stop 3 Summer burning, featuring a detailed discussion of the prescribed burning program used on the area, the lack of specific need for summer burning, and a quick summary of research results about the effects of restoration on vegetation, wildlife, soil and foliar nutrients, growth and yield, and economics
1040 Depart for stop 4
1050 Stop 4, Marking demonstration used to illustrate how field crews conduct marking in the pine and hardwood component for the initial overstory thinning prescription
1120 Depart for Stop 5
1130 Stop 5, Effects of prescribed burning in young planted and naturally-regenerated stands. Discussion will focus on stand establishment and sapling development, precommercial thinning, and the strategy and tactics that underlie the re-introduction of prescribed burning in young stands and on landscapes containing young stands.
1150 Depart for lunch stop
1200 Lunch
1230 Depart for Stop 6
1240 Stop 6, Shelterwood reproduction cutting in the management area. Discussion will focus on the need for reproduction cutting in the management area, and the silvicultural prescription used to generate the two-aged stand in the management area
1330 Depart for Hot Springs
1600 Return to Embassy Suites Hotel

Oral Presentation Abstracts

NOTES:

ESTIMATING ANNUAL GROWTH LOSSES FROM DROUGHT IN LOBLOLLY PINE PLANTATIONS

Ralph L. Amateis* & Harold E. Burkhart, respectively, Research Associate and University Distinguished Professor, Department of Forestry, Virginia Tech, Blacksburg, VA

Growth data over the past 10 years from loblolly pine (*Pinus taeda* L.) plantations established across the natural range of the species were linked with annual rainfall data over the same period to evaluate the impact of drought on stand growth. Regression procedures were used to determine (a) whether dominant height growth or basal area growth or perhaps both were correlated with local rainfall, (b) whether annual rainfall was a significant predictor of annual growth in the presence of other stand and site variables, and, (c) whether prediction equations could be developed that would provide reasonable estimates of growth loss during periods of drought. Results show that basal area growth but not dominant height growth is correlated with rainfall. A prediction equation was developed that can be used to estimate the effect of rainfall on annual basal area growth. The equation should be useful for forest managers needing to estimate basal area and volume growth losses due to drought conditions in loblolly pine plantations.

PREDICTING AMPHIBIAN COMMUNITIES USING HABITAT VARIABLES IN FORESTED LANDSCAPES IN THE SOUTHERN CUMBERLAND PLATEAU

Timothy Baldwin*, Florence Chan, Yong Wang, & Callie Schwietzer, respectively, Graduate Student, Graduate Student, and Professor, Department of Natural Resources and Environmental Science, Alabama A&M University, Normal, AL; and Research Forester, U.S. Forest Service, Southern Research Station, Normal, AL

We investigated the relationship between landscape and habitat features and herpetofaunal species richness and abundance at the James D. Martin Skyline Wildlife Management Area, the Walls of Jericho, and Forever Wild Land Trust in the Cumberland Plateau of northern Alabama between 2005 and 2006. The study area was stratified based on landform and solar exposure. A total of 176 points were randomly selected. Line transect surveys, drift fences with pit-fall traps, pond surveys, and targeted and opportunistic searches were used to quantify the herpetofaunal community. Habitat variables were collected by the collaborators from Auburn University and the Land Division of Alabama Department of Conservation and Natural Resources. Landscape variables at each survey point were generated using remote sensing images, digital elevation models, Alabama Gap Analysis Project, and other spatial reference databases. A total of 2,307 animals were detected during the line transect surveys, including 26 amphibians and 21 reptiles species. The detection probability on the transect line was the highest for stream salamanders (30%) and the lowest for terrestrial and spring amphibians (both 20%). The amount of forest canopy cover, soil condition, amount of disturbance, and distance to the stream were the significant predictors of herpetofaunal species richness abundance. The land type composition analysis suggested that with the increase in deciduous forests, the herpetofaunal species richness and abundance increased, while developed space and agricultural land had a negative impact on herpetofaunal community. Recommendations for the herpetofaunal monitoring program and conservation at the study site and adjacent areas were provided.

FOREST EDGE HABITAT AS THE STOPOVER SITE OF LANDBIRD MIGRANTS DURING FALL MIGRATION AT WALLS OF JERICHO MANAGEMENT AREA OF NORTHEASTERN ALABAMA

Lisa Gardner Barillas* & Yong Wang, respectively, Graduate Student and Professor, Department of Natural Resources and Environmental Science, Alabama A&M University, Normal, AL

Songbird species show different habitat associations during the breeding season compared to the migratory periods. Migratory songbirds are sensitive to food availability at stopover sites when they need to gain energy stores to continue migration. We examined the use of forest edge habitat by stopover songbird migrants and compared it with a wetland site in the area during the fall of 2006 and 2007. Migrants showed different habitat associations spatially and temporally during migration stopover in the fall. A total of 1,776 individuals at the wetland site, and 1517 individuals at the forested site were captured. The wetland had higher species richness than the forest. Omnivorous species such as American Goldfinch and Indigo Bunting were concentrated at the wetland, and species including Wood Thrush, Gray Catbird, and Swainson's Thrush showed stronger associations with the forest site. Some warbler species were distributed relatively evenly across both sites. Neotropical migrants used the sites earlier than Temperate migrants. Some habitat use patterns are consistent with breeding habitat associations, and may be related to food availability and habitat structure. However, some species showed more flexibility in habitat use, which may be related to the need to gain energy stores quickly to continue migration. These patterns have important implications for the management of forests and conservation of these migratory species, as competition increases with more species using similar habitats.

FIRST YEAR SURVIVAL AND GROWTH OF FERTILIZED SLASH PINE IN SOUTH ALABAMA

Rebecca J. Barlow*, **Luben Dimov**, **Kris Connor**, & **Mark Smith**, respectively, Assistant Professor/Extension Specialist, School of Forestry and Wildlife Sciences, Auburn University, Auburn, AL; Assistant Professor, Center for Forestry, Ecology, and Wildlife, Alabama A&M University, Normal, AL; Project Leader, U.S. Forest Service, Southern Research Station, Auburn, AL; and Assistant Professor/Extension Specialist, School of Forestry and Wildlife Sciences, Auburn University, Auburn, AL

Early survival and growth rates are critical to the successful establishment of pine stands. Landowners need options to improve first year growth on pine stands that will help them meet their land management objectives. One way to improve early stand survival and growth is through fertilization. In January 2008, approximately five acres of slash pine (*Pinus elliotii*) were planted on an old field site in south Alabama. Slash pine seedlings were treated with Accele-Gro™, a patent pending fertilizer supplement, to determine if there were any growth differences as a result of foliar, root dip, or a combination of both foliar and root dip application and compared to a control group. Comparisons between initial seedling height and root collar diameter measurements that were taken shortly after planting and first year growth measurements will determine if there were any first year growth differences among treatments and the control.

SIXTY YEARS OF MANAGEMENT ON A SMALL LONGLEAF PINE FOREST

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A management demonstration in a 40-acre tract of second growth longleaf pine (*Pinus palustris* Mill.) has its 60th anniversary in 2008. The demonstration was initiated by the U.S. Forest Service in 1948 on the Escambia Experimental Forest in south Alabama. At the time, the management goal for this "Farm Forty" was to produce high-quality poles and logs on a 60-year rotation. The goal was to be accomplished entirely through management of the existing natural forest with little to no capital investment other than the cost for prescribed burning, marking trees for cut, and limited control of cull hardwoods. Boyer and Farrar reported on the first thirty years of the demonstration in a 1981 Southern Journal of Applied Forestry article. Since that time, management has continued making the stand an excellent demonstration of small-scale longleaf pine management. Frequent harvests and small capital outlay make this type of management strategy especially appealing to landowners with limited resources. This presentation celebrates the 60th anniversary of the "Escambia Farm Forty" with discussions of the diameter class distribution of pines per average acre, standing volume of merchantable pine timber at selected inventories, plus volumes harvested between inventories.

RESTORING THE KENTUCKY LADY'S SLIPPER ORCHID ON THE KISATCHIE NATIONAL FOREST: SEEDLING PRODUCTION AND OUTPLANTING TRIALS

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The Kentucky Lady's slipper orchid (*Cypripedium kentuckiense* C.F. Reed) is a tall, stately perennial plant with the largest flowers of any *Cypripedium* known. Its range includes much of the southeastern United States, though it is rare throughout its range due to specific edaphic and climatic habitat requirements. In Louisiana, a few plants are located on three sites within the 600 thousand-acre Kisatchie National Forest (KNF). This effort, to restore one of the most spectacular orchids native to the region, began with the initiative of a high school student. The amateur botanist, Kevin Allen, located a flowering orchid in the KNF and later collected a fertile seed pod. The KNF recognized an opportunity to restore the orchid and sought help from the Central Louisiana Orchid Society (CLOS) to produce seedlings. CLOS obtained a research grant in 2006 from the Southwest Regional Orchid Grower's Association which enabled the society to purchase 200 plantlets grown from the seed pod's seeds. Additional grants in 2007 from the U.S. Forest Service allowed CLOS to purchase an additional 700 plantlets. The 2006 crop allowed CLOS to develop propagation protocols that were applied to the 2007 crop. A research study is now underway to compare effects of seedling age, season of outplanting, and field fertilization on success of establishment. An additional effort is underway to determine, based on data collected from the known native Lady's slipper sites, where seedlings of this rare species should be reintroduced into the KNF.

IMPACTS OF FOUR DECADES OF STAND DENSITY MANAGEMENT TREATMENTS ON WOOD PROPERTIES OF LOBLOLLY PINE

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In 1958, a loblolly pine plantation density management study was established at the LSU AgCenter Hill Farm Research Station in north central Louisiana. When the plantation was age 3, five density treatments (1000, 600, 300, 200, and 100 trees per acre) were implemented. At age 21, five thinning regimes were superimposed on the original density treatments to sequentially thin all original density treatments to 25 trees per acre using declines in dbh growth rates within biennial measurement periods as a thinning need indicator. By 2000, all treatments had reached the target density of 25 trees per acre. In 2007, the LSU AgCenter and University of Georgia Wood Quality Consortium conducted a collaborative study to ascertain the effects of the diverse density management regimes of this study on key wood properties. In August and September 2007, a stratified destructive sampling of trees in all plots was conducted in which wood subsamples were collected at 16.5-ft. intervals along each stem. Wood strength, stiffness, and specific gravity were quantified on the wood subsamples. Results of these analyses will be presented.

STAND-LEVEL PHOSPHORUS STATUS 25 YEARS AFTER EXCEPTIONALLY HIGH FERTILIZATION RATES: IMPLICATIONS FOR THE NEXT ROTATION

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A study to determine the optimal phosphorus (P) fertilizer rate for loblolly pine seedlings using sorption curves was established in 1982. Triple superphosphate was applied at 0, 81, 162, 324 kg P ha⁻¹. While only 60 kg P ha⁻¹ was needed for optimal rotation-age growth, the additional P added by the higher rates may reduce P fertilizer needs in the second rotation. This study will document P content in the aboveground biomass to be harvested and in the soil fractions. This data will provide preliminary results for the continuation of the study into a second rotation and determine if adding high rates of P would affect future fertilizer need.

CROWN CLOSURE, DENSITY AND LIGHT IN UPLAND OZARK FORESTS

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Foresters, wildlife biologists and naturalists manipulate forest composition and structure for numerous reasons including forest regeneration, timber production, wildlife habitat, conservation of native biodiversity, and ecosystem restoration. Light conditions in the understory of forests and woodlands are often key in meeting their objectives. Stand density descriptors are used to relate these light conditions - including trees per acre, basal area per acre, percent stocking and percent crown closure. Relationships between percent crown closure and density are not well defined, nor are the relationships between each measure and light conditions near the forest floor, although general trends are accepted. We intend to address: (1) the relationship of percent crown closure to trees per acre, basal area per acre, and percent stocking and (2) the relationship between specific structure and light in the forest understory.

CONTROL OF JAPANESE CLIMBING FERN AND EFFECTS TO NON-TARGET VEGETATION USING GLYPHOSATE, IMAZAPYR, AND METSULFURON HERBICIDES IN FLORIDA'S PUBLIC FORESTS

Kimberly K. Bohn* & **Patrick J. Minogue**, respectively, Assistant Professor, West Florida Research and Education Center, Milton, FL; and Assistant Professor, North Florida Research and Education Center, Quincy, FL

Japanese climbing fern (*Lygodium japonicum*) is a non-native, invasive vine whose spread into forest ecosystems has detrimental implications for a variety of forest products and ecosystem services. It first invades as scattered individuals, but can then form thick, tangled mats covering ground vegetation and can overtop shrubs and trees. Because the fern often intermingles with desired vegetation, effective control measures using herbicides must consider the surrounding vegetation. We tested the effects of glyphosate, imazapyr, and metsulfuron methyl at three

rates and in combination in two bottomland hardwood forests and two recently disturbed pine stands in northwest Florida. Several herbicide treatments resulted in 80% or greater crown reduction of Japanese climbing fern, including the high rates of glyphosate alone, glyphosate in combination with imazapyr at low rates or in combination with metsulfuron methyl at high rates, and three way combinations. The extent of injury to non-target woody seedlings varied by forest type, selectivity of the herbicide, and percent cover of fern over seedlings. Small woody seedlings draped in fern were injured significantly more when sprayed with glyphosate and or imazapyr. Pine seedlings showed a lower phytotoxicity response than hardwoods to imazapyr. Percent cover of herbaceous vegetation was reduced by 30-80% with glyphosate and imazapyr treatments, though the long-term recovery of those non-target species has yet to be evaluated. Several options are available for effectively treating Japanese climbing fern, and selection of which herbicide treatment to use will depend on the associated non-target species and the thickness or abundance of the fern.

ROW SAMPLING FOR IMPROVED TIMBER INVENTORY ESTIMATES IN PLANTED STANDS

Bruce E. Borders, Professor, Warnell School of Forestry and Natural Resources, University of Georgia, Athens, GA

A new individual stand sampling design is presented and discussed. All estimators are presented and field procedures are described. Example applications in planted pine stands are demonstrated. Precision and accuracy of this sampling method are compared/contrasted with traditional plot and point sampling methods.

STAND DYNAMICS OF INTENSIVELY MANAGED LOBLOLLY PINE PLANTATIONS: A 21-YEAR REAL GROWTH SERIES FROM THE LOWER COASTAL PLAIN AND PIEDMONT OF GEORGIA

Bruce E. Borders, Professor, Warnell School of Forestry and Natural Resources, University of Georgia, Athens, GA

The Consortium for Accelerated Pine Plantation Studies (CAPPS) contain some of the most intensively managed and measured loblolly pine research plots anywhere in the world. The oldest plots in this large effort are now 21 years old with replicates in both space and time. All pertinent stand dynamics will be described and discussed for this very unique set of research trials.

RESULTS OF A LONG-TERM THINNING STUDY IN SOME NATURAL, EVEN-AGED PINE STANDS OF THE MIDSOUTH

Don C. Bragg, Research Forester, U.S. Forest Service, Southern Research Station, Monticello, AR

This paper reports on a long-term thinning study in stands of naturally-seeded loblolly (*Pinus taeda*) and shortleaf (*Pinus echinata*) pine in southern Arkansas and northern Louisiana. Plots were established between 1949 and 1954, stratified into medium ($SI_{50} = 75$ to 85 ft) or good sites ($SI_{50} = >85$ ft), thinned roughly every 5 years after age 20 until 1990, and then monitored until 1995 when the study was discontinued. Both site quality and thinning intensity influenced average tree size at stand rotation, with lower density stands having bigger trees than dense stands, and better sites produced larger trees. When harvesting and mortality losses are included, total periodic increments on better quality sites averaged 10 to 25% higher than medium sites. The long-term maintenance of low stand densities had less impact on total yield. For instance, over the course of the study, the highest thinning thresholds (115 and 130 ft^2/ac) produced an average cumulative yield of about 34 MBF (International $\frac{1}{4}$ " scale) per acre on a good site, compared to just under 26 MBF/ac on sites of the same quality when the stands were thinned to 55 ft^2/ac . Given that most treatments produced between 28 and 33 MBF/ac regardless of thinning strategy or site quality, the biggest impact of thinning relates primarily to the speed in which trees achieve sawtimber size—on average, low density natural stands reached 10 inches d.b.h. 5 to 10 years earlier than denser stands. However, the openness required to boost individual tree diameter growth eventually limited stand-level cumulative yields.

VOLUME AND BRANCH CHARACTERISTICS OF JUVENILE LOBLOLLY PINE GROWN AT VARIOUS RATIOS OF BETWEEN ROW AND WITHIN ROW SPACINGS

John Britt* & Jason Reynolds, respectively, Consultant, John Britt & Associates, Fortson, GA; and Forest Resource Planner, Hancock Timber Resource Group, Charlotte, NC

Many of the activities in plantation silviculture are row oriented. When rows are treated individually, planting trees in wider rows may result in lower silvicultural treatment cost through reduced equipment time and reduced material needs. Increased row widths may allow for pure selection thinnings if rows are wide enough for machines to operate between. Planting trees in wider rows can also delay crown closure, increasing the period that early successional vegetation cover is present in a stand. All three scenarios could provide benefit to landowners, yet few studies have

considered the effects of asymmetrical rectangular spacing on tree growth, stand yield, or wood quality. This study examines these tree and stand attributes for loblolly pine grown at five different rectangular spacings and a common tree density. The treatments include spacings of 9 ft by 8 ft, 12 ft by 6 ft, 15 ft by 4.8 ft, 18 ft by 4 ft, and 24 ft by 3 ft.; these planting arrangements represent between row to within row spacing ratios of 1:1, 2:1, 3:1, 4:1, and 8:1, respectively. Tree and stand volumes and branching characteristic after the ninth growing season are discussed.

PREDICTING DIAMETER AT BREAST HEIGHT FROM TOTAL HEIGHT AND CROWN LENGTH

Quang V. Cao* & Thomas J. Dean, respectively, Professor and Professor, School of Renewable Natural Resources, Louisiana State University, Baton Rouge, LA

Tree diameter at breast height (DBH) is often predicted from either total height (model 1a) or both total height and number of trees per acre (model 1b). These approaches are useful when LiDAR data are available. LiDAR height data, either for individual trees or plot averages, can be employed to predict DBH, and consequently volume per acre can be obtained for the tract. In this paper, we will examine alternative methods of predicting DBH from total height and crown length (model 2a), or from total height, crown length, and number of trees per acre (model 2b), based on the uniform stress theory. The uniform stress theory hypothesizes that stems behave like tapered cantilever beams to equalize bending stress across their length. The four models will be evaluated based on the mean difference between observed and predicted diameters, mean absolute difference, and fit index. Results should reveal the most appropriate method for predicting DBH, which is needed to compute tract volume using LiDAR data.

EVALUATION OF ROAD APPROACHES TO FOUR DIFFERENT TYPES OF STREAM CROSSINGS IN THE VIRGINIA PIEDMONT

Matthew B. Carroll*, W. Michael Aust, C. Andrew Dolloff, & Robert M. Shaffer, respectively, Graduate Student and Professor, Virginia Tech, Blacksburg, VA; Team Leader, U.S. Forest Service, Southern Research Station, Blacksburg, VA; and Charles Nettleton Professor of Forestry, Virginia Tech, Blacksburg, VA

Stream crossings, an integral component of forest harvesting operations, have the potential to contribute significant quantities of sediment to streams. A major contributor of sediment can be the approaches leading to crossings. The objectives of this study were to evaluate the erosion potential associated with four different types of stream crossings (steel bridges, standard culverts, pole bridges, and re-enforced fords). Prior to operational timber harvests, we identified six crossings of each type and collected data prior to stream crossing installation, after stream crossing installation, during the harvest operation, and after road closure. Potential erosion rates from approaches to crossings were estimated by collecting the road/site information (slope, soil, cover, slope length, slope width) necessary to estimate erosion with the Water Erosion Prediction Project for forest roads (WEPP) and the forest version of the Universal Soil Loss Equation (USLE). Results to date indicate that any of the stream crossings may be appropriate depending upon site conditions. Also, we found that the stream crossing approach may be more important in determining water quality effects than the type of crossing installed. Both WEPP and USLE estimates show that culverts and their associated road approaches had the highest erosion potential during the harvest phase. Our data indicate that approach slopes, water control, and cover best management practices should be emphasized to protect water quality.

THE IMPACT OF INTENSIVE MANAGEMENT PRACTICES ON EROSIONAL CHARACTERISTICS OF A LOBLOLLY PINE PLANTATION IN THE PIEDMONT REGION OF ALABAMA, USA

Emily A. Carter, Research Soil Scientist, U.S. Forest Service, Southern Research Station, Auburn, AL

Forest management practices often accelerate soil erosion processes due to changes in soil compaction status, reductions in water infiltration, and loss of ground cover. A study was initiated in the Fall 1998 and monitored through Spring 2002 to investigate the erosion potential and productivity loss in a harvested loblolly pine (*Pinus taeda* L.) in the Piedmont region of Alabama. Steel framed plots approximately 5.5 x 2 m in size were established on 10 % slopes and runoff and sediment routed to 210 liter containers for collection. Plots were established in two locations during 1998 to monitor post-harvest erosion potential as well as a control area in proximity to the harvested plantation. Subsequent to site preparation and tree planting, plots were established in three locations of the harvest tract to examine the influence of bed orientation on erosion potential. Runoff and sediment loss from post-harvest areas averaged approximately 6.5 mm and 7.7 kg/ha, respectively, over a ten month period in 1998. Site preparation influenced runoff resulting in 3.1, 10.3, and 4.7 mm of runoff from areas with beds oriented across the slope (ATS), down the slope (DTS), and no bedding (flat-planted) (FPO), respectively, during the first year after site preparation. Runoff quality did not appear to be adversely affected during the post-harvest phase, but declined in the post site preparation phase. Sediment losses of 3.9, 788.0, and 46.0 kg/ha reflected the influence of bed orientation, respectively.

EFFECTS OF PRESCRIBED BURNING ON SMALL MAMMAL, REPTILE, AND TICK POPULATIONS ON THE TALLADEGA NATIONAL FOREST, ALABAMA

Robert Carter*, **Jonathan Adams**, **Damien Willis**, & **Chris Edmondson**, respectively, Assistant Professor and Graduate Students, Department of Biology, Jacksonville State University, Jacksonville, AL

Prescribed burning is widely used as a silvicultural tool to control competition and plant species composition. Prescribed fires have been shown to influence the populations of small mammals, reptiles, and ticks portions of the United States, but such research has not been conducted in mountain longleaf pine forests. Fire was shown to have little long-term effect on mammal and reptile populations. The animals quickly returned to burned areas. Ticks returned to the preburn population in two to three years. Small mammals and reptiles are reservoirs for tick-borne diseases such as Lyme disease. Although fires did not have a great impact on small mammal and reptile populations, they did temporarily reduce tick populations. Prescribed fire may be a useful tool for reducing the incidence and spread of tick-borne diseases.

FORESTED COMMUNITIES OF THE PINE MOUNTAIN REGION, GEORGIA

Robert Carter* & **Robert Floyd**, respectively, Assistant Professor and Graduate Student, Department of Biology, Jacksonville State University, Jacksonville, AL

The Pine Mountain Range in the Piedmont of West Central Georgia, USA has remnant longleaf pine ecosystems that occupy steep slopes with shallow soils. It also has ecosystems containing species with Coastal Plain (*Quercus margaretta*) and Appalachian (*Vaccinium pallidum*) affinities. Within the Pine Mountain Range, seven landscape scale ecosystems were identified on public and private land using vegetation, soil, and landform variables. 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, chestnut oak-sand hickory-Christmas fern type on steep slopes bordering ephemeral streams, oak-heath type on steep moist slopes above streams, longleaf pine-heath type on steep rocky slopes above the Flint River, and sweetgum-switchcane type on stream borders and mountain valleys. . The diagnostic environmental variables included elevation, landform index, percent A-horizon sand, and B-horizon Ca. Communities with longleaf pine as the dominant overstory species have been strongly influenced by fire and contain species with Coastal Plain affinities. Moist slopes and valleys support *Rhododendron minus* and *Kalmia latifolia* with a more Appalachian affinity. This research provides baseline data for the conservation and management of these unusual forests.

USING THE GIS-BASED SPOT GROWTH MODEL TO SIMULATE THE EFFECT OF SILVICULTURAL TREATMENTS ON THE SOUTHERN PINE BEETLE INFESTATION STANDS

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There are many models for estimating southern pine beetle (SPB) stand susceptibility, including the probability of infestation and spot growth. These models can predict sufficiently well to enable management on a least cost basis. However, all of them are limited to regression or mechanistic models which predict the number of trees killed in a forest stand. We developed a program to simulate SPB spot growth in a GIS-based model, based on a regression model of SPB spot growth, using the ArcGIS™. The spot spread for natural loblolly pine stands were mapped with different SPB management alternatives. Moreover, GIS maps of possible infestations were used as the basis of 3-D visualizations to provide stereo viewshed and full motion animations of selected scenarios, using the VNS™ (Visual Natural Studio™) software package. The simulation results showed that under various silvicultural treatments of SPB management, including thinning, different species mixtures, and different ages of stands, there are significant differences between the before and after treatments. Although silvicultural treatments can reduce the number of trees killed, this does not necessarily result in a reduction of the infested area in the stand. In the future, the spot initiation and growth data will be combined with ArcGIS™ and VNS™ to develop an integrated program to visualize the SPB damage under various sites and stand conditions.

RED MAPLE (*ACER RUBRUM*) RESPONSE TO PRESCRIBED BURNING ON THE WILLIAM B. BANKHEAD NATIONAL FOREST, ALABAMA

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Prescribed burning is part of Land and Resource Management Plans on National Forest System lands throughout the

southeastern United States, and is sometimes implemented to achieve a desired future condition of oak-dominated forest or woodland habitat. However, effects of burning on oak competitors, such as red maple (*Acer rubrum* L.) are not well understood. In this study, we documented red maple seedling and sapling response to prescribed burns at both large (stand level) and small (0.01 acre plot level) scales, and we examined relationships between fire behavior and red maple response. The study was implemented in 2005 within a larger replicated silvicultural study on the William B. Bankhead National Forest in Lawrence County, AL. At the stand-level scale, prescribed burning had no effect on red maple sapling mortality, sprouting or diameter growth in the largest size class [1.5-5.4 inch dbh]. Burned stands showed a significant increase in red maple seedlings (< 4.6 ft height) and a significant decrease in small saplings (> 4.5 ft height, < 1.5 inch dbh) compared to unburned stands. At the plot-level scale, neither maximum recorded temperature or heat index (duration of temperature > 90° F) of the fire could significantly explain the variation in sapling density changes, sapling sprouting occurrence, sapling diameter growth, or changes in seedling density. Results indicate that one dormant-season prescribed burn was not effective at decreasing oak competition of red maple in the midstory, but did increase red maple competitors in the understory.

COMPARISON OF THREE SITE PREPARATION TECHNIQUES ON GROWTH OF PLANTED LOBLOLLY PINE AFTER 6 YEARS FOLLOWING A SOUTHERN PINE BEETLE EPIDEMIC

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Three site preparation treatments (complete removal of woody debris – raked and windrowed, drum chopping leaving woody debris, and no site preparation – planting among standing dead trees) were compared by evaluating the growth and survival of planted loblolly pine (*Pinus taeda* L.) after 6 growing seasons following a southern pine epidemic. Each treatment was replicated 3 times at one location on the Cumberland Plateau in Tennessee. Each treatment had the same number of planted seedlings (681) per acre, and was sprayed with herbicide to control hardwood residuals before planting and to release seedlings one growing season after planting. Preliminary results indicate that growth of seedlings was not significantly different between the treatments. However survival was only slightly, but significantly different, for the no mechanical site preparation (standing dead) treatment which may be a reflection of difficult planting conditions. A cost analysis of the different site preparation treatments is also presented.

MODELING THINNING IN EAST TEXAS LOBLOLLY AND SLASH PINE PLANTATIONS

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Nearly 12 million acres of forestland exist in east Texas, with approximately 2.5 million acres in pine plantations. Estimation of the productivity of these plantations is vitally important to forecasting future wood fiber yields. Currently, growth and yield models for east Texas do not accommodate thinning as a silvicultural option. In this study, we will incorporate a Pienaar-type thinning sub-model into a whole-stand growth and yield model recently developed for east Texas loblolly and slash pine plantations as part of the East Texas Pine Plantation Research Project (ETPPRP). We will compare this new model to the thinning model of Burrows (2001). The intent is to produce a whole-stand growth and yield model for thinned and unthinned loblolly and slash plantations in east Texas that is based wholly on data from the ETPPRP.

BEFORE AND AFTER COMPARISONS OF TREE HEIGHT IN SUCCESSIVE LOBLOLLY PINE PLANTATIONS WITH INTERVENING MACHINE, WHOLE-TREE HARVESTING

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In 1993, several forest industries, the U.S. Forest Service, Southern Research Station, Louisiana Tech University, and the School of Renewable Natural Resources in the LSU Agricultural Center formed a cooperative that came to be called Cooperative Research in Sustainable Silviculture and Soil Productivity (CRiSSSP). One of the objectives of the cooperative was to determine whether typical, high-production harvesting was detrimental to the growth of newly established plantations. Prior to harvesting, dominant and codominant trees were severed and discs cut from the stems at 0.5-m intervals up to 10 m in height. Annual heights of the trees were determined through stem analysis. Height comparisons were made between trees from the previous plantation with those of the current plantations at age 10. Results show inconsistent responses on height with changes in bulk density caused by the mechanized harvesting methods.

REVISIONS OF THE INTERIM GUIDELINES FOR GROWING LONGLEAF SEEDLINGS IN CONTAINERS

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The production of longleaf pine planting stock has shifted during the last 20 years from bareroot to container production. The move to container stock has resulted from the significant improvement in field performance of container seedlings over those from bareroot nurseries. Not only has survival markedly improved, but the improvements have been so significant that they have resulted in the increased use of longleaf pine in the South's reforestation and restoration programs. In an attempt to facilitate production of quality container stock, *Interim Guidelines for Growing Longleaf Seedlings in Containers* were developed and published in 2002 by the U.S. Forest Service, Southern Research Station as General Technical Report SRS-60. These guidelines were developed largely by surveying growers and trying to develop recommendations by consensus. It was recognized that refinements would be required as more performance data were obtained. A number of studies have been conducted and published that relate seedling specifications to field survival and growth. This paper will be the first attempt to upgrade, revise, and improve these guidelines for longleaf pine seedling production.

INFLUENCE OF FOREST ROADS STANDARDS AND NETWORKS ON WATER YIELD AS PREDICTED BY THE DISTRIBUTED HYDROLOGY-SOIL-VEGETATION MODEL

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Throughout the country, foresters are continually looking at the effects of logging and forest roads on stream discharge and overall stream health. In the Pacific Northwest, a distributed hydrology-soil-vegetation model (DHSVM) has been used to predict the effects of logging on peak discharge in mountainous regions. DHSVM uses elevation, meteorological, vegetation, and soil data to model the hydrology of the catchment explicitly on a grid cell by grid cell scale. The model is unique in its ability to consider the impacts of road networks on catchment hydrology due to the addition of a road and channel network algorithm. This is of critical importance because it has long been recognized that forest roads can have very large impacts on water yields and water quality. The primary objectives of this study are to determine whether or not DHSVM can be applied to the gentler slopes of the Appalachian Mountains and, if so, determine which types of roads and road networks have the smallest effect on stream discharge. Calibration of the model will be done using historical data collected from the Coweeta Long Term Ecological Research Station in the Blue Ridge Mountains of North Carolina. Forest road parameters that will be considered in the study include road density and road standards. This type of information will be useful to watershed managers and watershed planners for minimizing the impacts of forest roads.

A COST-BENEFIT ANALYSIS OF THE NORTH CAROLINA SOUTHERN PINE BEETLE PREVENTION PROGRAM

Rafael Estevez*, Dennis Hazel, Erin Sills, Robert Bardon, & Arnie Oltmans, respectively, Graduate Student, Assistant Professor, Associate Professor, Associate Professor, and Undergraduate Coordinator, North Carolina State University, Raleigh, NC

Publicly-funded forestry cost-share programs usually have the following common objectives: (1) provide incentives for private landowners to implement better management practices on their forests, and (2) provide ecosystem service benefits for the public at large through improved management. In implementing these programs, state and federal government agencies have the challenge of documenting benefits to legislative bodies for long-term funding. The North Carolina Division of Forest Resources (DFR) Southern Pine Beetle Prevention Program (SPBPP) was authorized and funded by the USDA Forest Service Forest Health Protection program in 2004. The objective of this program is to encourage eligible forest landowners in North Carolina to improve forest health and reduce the threat and severity of Southern Pine Beetle (SPB) attack through technical assistance and cost-sharing of precommercial thinning (PCT) of pine stands. This study documents the costs and benefits of this cost-share program from both the landowner and the State of North Carolina perspective. Factors considered included risk reduction for SPB for landowners, SPB suppression cost savings, changes in volumes and values of future harvested products due to PCT, PCT direct costs (both landowner and agency), and program administration costs. Although not evaluated metrically, interest in the program across the state with its diverse stand types and conditions and demographics were examined. This study aided NCDFR program administrators with periodic evaluations and recommendations regarding more effective program administration and results are briefly discussed.

STAND DYNAMICS IN A TUPELO-BALDCYPRESS SWAMP FOLLOWING HELICOPTER AND SKIDDER HARVESTS: 21 YEAR RESULTS

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Society, agencies, and land managers have concerns regarding regeneration and stand development following harvest operations in forested wetlands. In 1986 a research project was begun within the Mobile-Tensaw River Delta to evaluate the effects of clearcutting operations following conventional ground based harvesting versus helicopter timber extractions. Treatments consisted of clearcutting with rubber-tired skidding versus clearcutting with helicopter removal with nine replication of each treatment. Initially we believed that the helicopter harvest would have greater productivity following treatment due to the severity of the skidding operations and associated changes in soil physical and chemical characteristics. However, subsequent measurements have not supported this hypothesis and the skidder treatment actually has greater biomass than the helicopter treatment. From stand age 7- 16 the stand compositions have remained relatively uniform with the helicopter treatment being dominated by water tupelo, baldcypress, black willow, and pumpkin and Carolina ashes, while the skidder treatment has is dominated by tupelo and black willow. Remeasurements at stand age 21 indicate that the stands are currently undergoing major shifts in overstory species, particularly with regard to the decline of black willow. The changes in stand dynamics and implications will be discussed.

FIFTH-YEAR PINE GROWTH RESPONSE TO WOODY RELEASE TREATMENTS IN YOUNG LOBLOLLY PLANTATIONS

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Pine plantation establishment procedures include some form of competition control. While the majority of this work is completed as chemical site preparation, there is appreciable interest in using herbicides to release the pine seedlings from hardwood competition after planting. These release applications are usually completed at the end of the first or second growing seasons. In this study, six herbicide treatments were applied in Texas and South Carolina, and eight were applied in Mississippi to loblolly plantations on forest industry land. All applications were completed at the end of the second growing season. Sulfometuron methyl was added to part of the treatments to evaluate the effect of residual herbaceous competition control on pine growth responses. Total height and dbh were measured two, three, and five years after treatment. Specific results varied by state due to differences in the weed complex present at each site. Statistical analyses revealed that all treatments provided a significant growth response in both height and diameter. In addition, the treatments with either the highest rate of Arsenal AC or those with sulfometuron added had the greatest total height or dbh five years after treatment. Results from the two, three, and five year measurements will be presented.

HERPETOFAUNAL COMMUNITY AND SILVICULTURE: LESSONS FROM THE CUMBERLAND PLATEAU OF NORTHERN ALABAMA

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Since 2002 we have been monitoring the response of a community of reptiles and amphibians to three levels of overstory tree removal, including clearcuts, stands with 25-50% of trees retained, and closed-canopy stands. Tree harvest created a gradient of conditions from warm and dry daytime conditions on clearcuts to cool, more humid conditions on controls. Microhabitat features also responded to treatments forming a gradient of open canopies with plentiful vegetation, bare ground and abundant slash and coarse woody debris on clearcuts to more closed canopy stands dominated by leaf litter. Many parameters of both micro- climate and habitat approximated control conditions by the 5th year post-treatment. Herp communities were characterized using drift fences, coverboards, and artificial pools. The most species-rich units were consistently those with intermediate levels of tree retention (25 and 50% of original basal area). Lizards responded favorably to removal of >25% of trees, while American toads were most abundant in closed-canopy stands. Oviposition rates of 4 amphibian species which bred in artificial pools were affected by treatments. Cope's gray treefrogs responded favorably to tree removal, while mountain chorus frogs and spotted salamanders responded negatively. Radiotelemetry of eastern box turtles revealed that, while movement patterns were not affected, use of macro- and microhabitat levels was. Our results suggest that herpetofaunal response was complex and occurred at several levels. I will discuss management implications of these common tree regeneration prescriptions as well as other economic factors that will likely affect management of biodiverse forest stands on the Cumberland Plateau in the future.

COMPARISON OF HPLC AND ELISA METHODS FOR ANALYSIS OF IMIDACLOPRID IN VEGETATION EXTRACTS

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We have compared reversed-phase HPLC with monoclonal and polyclonal ELISA techniques for analysis and quantification of the insecticide imidacloprid in vegetation extracts. Species tested included Hawaiian wiliwili (*Erythrina sandwichensis* O. Deg), Hawaiian koa (*Acacia koa*), and Louisiana loblolly pine (*Pinus taeda*). Extracts of each species were analyzed by each of the above methods as paired blanks and spikes. The blank extracts were tested for matrix interferences, and known amounts of imidacloprid were spiked into these blank extracts and analyzed for comparison. Limits of detection and limits of quantitation were determined for imidacloprid in each matrix using each analysis method.

FUEL DYNAMICS ACROSS SOUTHERN APPALACHIAN LANDSCAPES

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There have been many individual studies measuring hardwood fuels, which yielded useful information about fuel loads and their response to different variables over a limited geographic area. Although the information from these studies is beneficial, there is an urgent need to know how hardwood fuels are distributed across the landscape for fire management planning. Our study quantified the input (production and accumulation) and losses due to decay of leaf litter and fine woody fuels at different slope and topographic positions. Preliminary analyses indicate no significant differences in the accumulation of leaf litter and fine woody fuels across slope and topographical positions, which supports previous research. Inputs and decomposition may vary across these topographic variables and that portion of the study will be completed by June. Results will allow fire planners to better understand the complex distribution of fuels across the southern Appalachian landscape.

LONGLEAF PINE REGENERATION FOLLOWING HURRICANE IVAN UTILIZING THE RLGS PLOTS

John C. Gilbert* & **John S. Kush**, respectively, Research Associate and Research Fellow, School of Forestry and Wildlife Sciences, Auburn University, Auburn, AL

On September 16, 2004, Hurricane Ivan hit the Alabama coast and severely impacted numerous plots in the USDA Forest Service's Regional Longleaf Growth Study (RLGS). The Escambia Experimental Forest in Brewton AL, operated by the US Forest Service in cooperation with the T.R. Miller Mill Company, which has 201 of the 325 RLGS plots, took a major hit. Nearly one-third of the Escambia Experimental Forest was impacted. Nine plots were entirely lost which had pole-size trees, greater than 40-years old. Another 54 plots had some type of damage. Following the hurricane, a salvage logging operation was conducted to recover any damaged merchantable timber. The damage done by Hurricane Ivan and the disturbance from the salvage logging operation allowed for an opportunity to examine longleaf pine (*Pinus palustris* Mill.) regeneration and its development as a result of the openings created by the hurricane. The RLGS database contains a history of burn frequency, plot density, and the location of each tree on a plot. Several regeneration monitoring plots have been installed on the RLGS plots, and an initial inventory of the regeneration has been documented. The location of the monitoring plot, seedling density, and measurements of seedling size have been documented. With this information, longleaf pine regeneration and its development on plots impacted by Hurricane Ivan can be followed.

INFLUENCE OF FOREST ROAD BUFFER ZONES ON SEDIMENT TRANSPORT IN THE SOUTHERN APPALACHIAN REGION

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Research on forest road sediment movement has recommended the forest floor (forest buffers or strips) for filtering forest road stormwater. Based on these recommendations, minimum streamside management zone (SMZ) or filter strip width criteria have been incorporated into forest road Best Management Practices (BMPs). However, a gap exists in the understanding of the effectiveness of these practices in controlling sediment movement and minimizing risks of sediment delivery to forest streams. The fundamental question that has yet been answered is, "Does current management practices disconnect forest road sediment and water?" The objective of this paper is to report the findings of investigations to assess sediment travel distances downslope of forest roads in the Appalachian region,

relate sediment travel distances to BMP recommendations, and describe the deposition patterns within buffer zones in the Appalachian region. Forest road sections were randomly selected for this investigation from National Forest roads in the Southern Appalachian region. Sediment deposition areas were measured downslope of the road lead-off ditch structures for each selected site. The mean distance sediment was tracked across the forest floor was 30 meters. Sediment transport distances were less than 30 m for 38 and 88 percent of sites evaluated in National Forests in Alabama and Georgia, respectively. This paper will also present special issues related to the connectivity and the role of the forest buffer in minimizing the connection of forest roads and streams in this sensitive region.

DETERMINATION OF FIELD EFFECTIVE SOIL PROPERTIES IN THE TIDEWATER REGION OF NORTH CAROLINA

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Soils vary spatially in texture, structure, depth of horizons, and macropores, which can lead to a large variation in soil physical properties. In particular, saturated hydraulic conductivity and drainable porosity are critical properties required to model field hydrology in poorly drained lands. These soil property values can be determined from several methods; however, field effective values are needed in developing, calibrating, and validating models, such as DRAINMOD. In this investigation, "field-effective" soil property values were determined from water table and outflow measurements from a 3-year field experiment on poorly drained loblolly pine (*Pinus taeda L.*) plantation watersheds in eastern North Carolina. Field values were compared to values measured using the auger-hole method and values determined from soil cores by the constant head method. The "field effective" saturated hydraulic conductivity of the surface layer was estimated at 840 cm/hr and 500 cm/hr for the unthinned and thinned condition, respectively. These values are much greater than values obtained from soil cores and the auger-hole method which had mean conductivities of 100 and 80 cm/hr for unthinned condition, respectively. The thinned condition had saturated hydraulic conductivities of 32 and 17 cm/hr based on soil cores and the auger-hole method, respectively. The differences between the field-based values and the constant head method and auger-hole method may be a result of heterogeneity of soils or overestimations in the field effective results.

REGENERATING SHORTLEAF PINE IN CLEARCUTS IN THE MISSOURI OZARK HIGHLANDS

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A shortleaf pine (*Pinus echinata* Mill.) regeneration study was established by the Missouri Department of Conservation in 1986 at the Current River Conservation Area. The objective of the study was to compare two site preparation methods (prescribed burning and dozing) and two regeneration methods (natural and planting) on establishment and growth of shortleaf pine. Eighteen years after establishment, control treatment (natural regeneration) had only 94 stems/ha, burn treatment had 727 stems/ha and the doze treatment had 1680 stems/ha. Mean volume growth per tree was greatest in the doze treatment (53.7 dm³) followed by the burn treatment (34.1 dm³) with the control having the least volume growth (22.3 dm³). Harwood competition was greatest in the control treatment (3132 stems/ha) followed by the burn treatment (2470 stems/ha) and least in the doze treatment (1210 stems/ha). The results suggest that 1) survival and growth of shortleaf pine increases with increase in site preparation intensity, 2) natural regeneration without follow-up release may not achieve stocking goals and adequate growth, and 3) prescribed burning is a viable site preparation method.

UNEVEN-AGED MANAGEMENT OF SOUTHERN YELLOW PINE FOR IMPROVED INCOME AND ECOSYSTEM SERVICES

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Uneven-aged management offers family forest owners in the coastal plain of the Southeast an attractive economic alternative to the two most common approaches to forestry in the region. Over two thirds of the owners practice no management at all, but rather rely on a logger or procurement forester who offers a seemingly large sum for a cut of all merchantable timber. Similarly, owners following the industry plantation model can expect sales of thinnings but with only one major saw timber cut in a lifetime, followed by significant investment in site preparation and replanting. The return from either of these once-in-a-lifetime events is generally significantly less than what could be earned over time under uneven-aged management. Experience in lowland North and South Carolina has shown that forest owners who convert both unmanaged forests and plantations to uneven-aged management have historically earned over \$100 per acre per year while maintaining full stocking of their forest. Minimal soil and ground cover

disturbance associated with reentry to stands for a selective cut every five to seven years followed by natural regeneration contrasts sharply with disturbance associated with high grading or plantation reestablishment. Comparative data on returns from alternative approaches to management are provided.

A COMPARISON OF SLASH AND LOBLOLLY PINE PERFORMANCE THROUGH AGE 12 ACROSS A RANGE OF DENSITIES, SILVICULTURAL REGIMES AND SOIL TYPES IN THE LOWER COASTAL PLAIN OF THE SOUTHEASTERN UNITED STATES

William M. Harrison*, **Michael B. Kane**, & **Dehai Zhao**, respectively, Research Professional, Professor, and Research Professional, Warnell School of Forestry and Natural Resources, University of Georgia, Athens, GA

The coastal plain Intensive Culture / Density study was established in 1995/96 to examine the effects of intensive silviculture and current operational practices on the growth and yield of slash and loblolly pine across a wide range of densities. The study was installed across a range of CRIFF soil types so soil type interactions could be tested. Although species comparison was not an explicit objective of the study, the data can be used for such a comparison. For example, under a regime including complete competition control and repeated fertilization, loblolly pine (*Pinus taeda* L.) outgrew slash pine (*Pinus elliottii* Engelm.) across all density classes and soil groups. Under an intensive operational regime, slash pine outperformed loblolly pine on spodosol sites with no underlying argillic horizon. Results from this analysis can be used to help foresters make better, site-specific prescriptions with regards to species, planting density and subsequent management of southern pine plantations.

PRESCRIBED FIRE AND BRUSH REMOVAL AFFECT VEGETATION, FUEL LOADS, AND ABUNDANCE OF SELECTED BEETLE POPULATIONS IN PINE STANDS

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Three upland forest sites were selected in Louisiana in early 2001. On each site (block), three treatments were applied in a randomized complete block design: Check--no further management, PF--prescribed fire was applied in May 2001 and June 2003, and PF-WPC--in July 2002, between the two prescribed fires, the midstory and understory woody vegetation was felled within 5 cm of the ground using a machine-mounted horizontal-shaft drum shredder (Woodgator®) as a woody plant control (WPC) treatment. Management did not change overstory composition, and basal area per hectare increased on all treatments through February 2005. Percentage of understory arborescent cover also increased on all treatments, although less so on the PF and PF-WPC treatments. Herbaceous plant cover decreased on all treatments through August 2004, and increased shading and crowding were the likely reasons. Both PF and PF-WPC reduced 10-hr time-lag dead fuels, but did not significantly affect 1-hr or 100-hr fuels. The PF-WPC treatment also did not significantly reduce basal area of understory woody vegetation compared to the PF treatment. The abundance of pine bark beetles, *Dendroctonus terebrans*, *Hylastes salebrosus*, *H. tenuis*, and *Ips* spp., and root-feeding weevils, *Hylobius pales* and *Pachylobius picivorus*, increased after each prescribed fire but not after WPC. Apparently, WPC in addition to burning had little influence on fuel loads, understory vegetation, or beetle populations. Therefore, hand-felling of midstory trees would probably have been as effective as the mechanical WPC treatment.

COMPARISONS OF EVEN- AND UNEVEN-AGED SILVICULTURE IN SOUTHERN PINES

James E. Henderson, Assistant Extension Professor, Department of Forestry, Mississippi State Mississippi

Much of the past research on comparative economics of even- and uneven-aged silviculture would suggest that even-aged silviculture is economically superior; however, uneven-aged silviculture becomes competitive with even-aged when non-timber benefits are considered. The silvicultural techniques of even- and uneven-aged management of southern pines are reviewed including both fiber production and economic comparisons. The comparisons also include consideration of advantages and disadvantages of both approaches to southern pine silviculture and management.

A DECISION TREE APPROACH USING SILVICS TO GUIDE PLANNING FOR RESTORATION OF AN OPEN-CANOPY FOREST: AN EXAMPLE FROM FIRE-SUPPRESSED MONTANE LONGLEAF PINE STANDS

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Sciences, Auburn University, Auburn, AL; and Research Fellow and Research Associate, School of Forestry and Wildlife Sciences, Auburn University, Auburn, AL

A simple decision tree based on silvics can aid in guiding forest restoration. Of special significance is knowledge of appropriate soils, seed production, seed dispersal distance, and regeneration requirements. We created a decision tree based on silvics of longleaf pine and regional historical descriptions to develop approaches for restoration management at Horseshoe Bend National Military Park, a National Park Service site in central Alabama. A NPS goal is to promote structure and composition of a forest that likely surrounded the 1814 battlefield. The region was logged in the early 1900s and has suffered from fire exclusion. We considered options for 1) stands currently supporting second-growth montane longleaf, 2) isolated trees, and 3) areas beyond the dispersal range of longleaf. Locations of residual trees coupled with silvics aided in identifying conditions where it is most appropriate to pursue rehabilitation of fire-suppressed longleaf. We estimate that >50% of the 2,000 ac property is appropriate for longleaf but that <20% of appropriate area is within the dispersal range of existing seed trees. There are three major areas with current tree densities sufficient to be classified as longleaf stands; in these high-priority stands, fuel reduction burns are being applied in an effort to maintain adult trees and create appropriate seed beds. Decision tree criteria applied to isolated trees categorize them as medium-priority. Areas beyond seed dispersal range of residual longleaf are low-priority and will require planting. We will discuss how this method may be useful in restoration of uneven-aged stands in other forest types.

MORTALITY AND GROWTH OF FIRST YEAR LONGLEAF PINE SEEDLINGS UNDER DIFFERENT TREATMENTS ON CAMP LEJEUNE, NC

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In order to determine an optimal silvicultural system for restoring longleaf pine (*Pinus palustris* Mill., LLP) while retaining existent mature loblolly pine (*P. taeda* L., LBP) trees, we used randomized complete block design to test seven overstory LBP silvicultural treatments of 1 ha in size (four uniform treatments: Control, BA9 (m²/ha), BA4.5, and clearcut; three gap treatments of 1256, 2826, and 5024 m² in size) on Marine Corps Base, Camp Lejeune, NC. In each plot, we also randomly assigned four culture treatments (Control, Grassing, Weeding, and Weeding & Fertilizing) into each 20 m x 20 m subplots. Containerized LLP seedlings were planted by 6 ft x 10 ft in our treatment blocks in November 2007. The LLP seedling mortality will be monitored before and after applying cultural treatments in May and October, 2008, respectively. Root collar diameter (RCD) and the height will be measured in October, 2008. The effects of overstory (plot level) and cultural (subplot level) treatments on LLP seedling survival and growth will be assessed using analysis of variance. Nitrogen (NO₃ and NH₄) availability and top 6 cm-depth soil moisture within 1-m profile will also be taken monthly during the growing season. LLP seedling survival and growth in relation to soil nitrogen and soil moisture will be quantified using regression analysis.

INITIAL ESTIMATES OF BELOWGROUND COARSE WOODY DEBRIS IN A FIRE-MAINTAINED FOREST: THE GOOD AND THE NOT-SO-GOOD ATTRIBUTES

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Forests are beginning to be consciously managed for increased carbon sequestration to address environmental concerns. Interest in prescribed fire in some forest types has also increased, but prescribed fire is becoming more regulated in regard to smoke management and air quality concerns. While the role of coarse woody debris (CWD) in both carbon sequestration and as a source of smoke has been studied, CWD assessments typically include only aboveground components. Little is known about the biomass in stumps, taproots and large coarse roots, whether from natural mortality or harvest, even though they may represent substantial pools of sequestered carbon and are potential producers of smoke from burning. A March 2007 windstorm with significant blowdown provided an opportunity to determine the amount of belowground coarse woody biomass (BCWB) for 2 species frequently managed using prescribed fire, longleaf (*Pinus palustris* Miller) and slash pine (*P. elliottii* Englemann). We measured DBH on 787 mapped overstory trees damaged in the windstorm, and for a subsample of 26 stumps (9 slash and 17 longleaf pines) we measured taproot length and BCWB. Taproot length was not significantly different between species and was not correlated with DBH. However, BCWB was positively correlated with DBH, and regression parameters did not differ between species. From these relationships we estimated that 238 tons of BCWB was input to the study area in addition to aboveground CWD. The results indicate that BCWB needs more attention in both the estimation of fuel for prescribed fires and as pools of sequestered carbon.

IMPACTS OF GENETICALLY IMPROVED PLANTING STOCK AND COMPLETE COMPETING VEGETATION CONTROL ON LOBLOLLY PINE PLANTATION PERFORMANCE THROUGH AGE 21 IN THE COASTAL PLAIN AND PIEDMONT

Michael B. Kane*, **William M. Harrison**, **Dehai Zhao**, & **Bruce E. Borders**, respectively, Professor, Research Professional, Research Professional, and Professor, Warnell School of Forestry and Natural Resources, University of Georgia, Athens, GA.

The Plantation Management Research Cooperative (PMRC) established a designed experimental study at 16 locations in the Coastal Plain region of Georgia and northern Florida and at 15 locations in the Piedmont region of South Carolina, Georgia and Alabama during 1987 with the objective of evaluating the impacts of first generation genetic improvement, complete vegetation control and of the genetic improvement and vegetation control combination on loblolly pine plantation performance. This study is of particular significance as it allows evaluation of improved genetic stock, with and without competition control, in block plots of either mixtures of improved families or of single families. Results of main effects of genetic improvement and complete vegetation control and their combination are reported through age 21. Significant temporal trends in periodic growth patterns are highlighted. Implications for silvicultural regimes and genetic testing and deployment are discussed.

FLOODING EFFECTS ON STAND DEVELOPMENT IN CYPRESS-TUPELO

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The effects of inundation on growth of cypress and tupelo trees have been extensively researched, but conclusions are often complicated by attendant effects on stand development. Flooding affects development of cypress-tupelo stands in three main ways. First, seedling germination and survival are limited by flooding in the growing season, so that regeneration reflects hydrologic conditions at the time of stand initiation or minor disturbances. Second, flooding truncates species richness proportionally to flooding stress. Third, data from sites in south Louisiana indicate flood stress may reduce site quality and slow growth and self-thinning, but mortality of cypress and tupelo mainly occur only in the case of large, rapid increases of duration or depth. Persistence of the cypress-tupelo type therefore depends on flood stress sufficient to prevent establishment of other species and either sufficient stability of hydrologic regime to prevent mortality or, in the case of altered hydrology, a new regime favorable for establishment of cypress and tupelo rather than other species.

MODELING THE LONG-TERM EFFECTS OF OAK REGENERATION TREATMENTS ON SPECIES DIVERSITY, OAK RESILIENCE, AND CARBON STOCKS IN SOUTHERN APPALACHIAN FORESTS OF NORTH CAROLINA

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In January 2008, the Upland Hardwoods Ecology and Management research work unit (RWU-4157) of the Southern Research Station, Forest Service, United States Department of Agriculture, began a long-term cooperative study to describe forest ecosystem response to four oak regeneration treatments in the Central Hardwoods Region of the United States. Pre-treatment inventory data from 20 mature, mixed-oak forest stands on North Carolina State Wildlife Resources Commission game lands was input into the Forest Vegetation Simulator (FVS) to analyze the long term forest ecosystem response to the following regeneration treatments: (1) Shelterwood followed by prescribed fire and overstory removal; (2) Shelterwood via herbicide followed by overstory removal; (3) Repeated prescribed fire (three fires with a fire return interval of four years) followed by overstory removal; and (4) Control. FVS is a simulation system capable of modeling stand dynamics for the purpose of analyzing relative differences in timber outputs, fire and fuels effects, carbon stocks, and wildlife habitat based on alternative management scenarios. In this study, FVS simulations were used to analyze oak regeneration treatment effects on species diversity, oak resiliency, and carbon stocks over the next 50 years.

FIRE'S IMPACT IN TWO OLD-GROWTH MONTANE LONGLEAF PINE STANDS

John S. Kush* & **John C. Gilbert**, respectively, Research Fellow and Research Associate, School of Forestry and Wildlife Sciences, Auburn University, Auburn, AL

The structure of longleaf pine (*Pinus palustris* Mill.) forests of the southeastern United States coastal plains has been the focus of numerous studies. By comparison, the longleaf pine forests in the mountains of Alabama and Georgia are

not well-understood. Much of what little work conducted in these areas occurred prior to the mid 20th-century. It is estimated that less than 0.004% of the remaining longleaf pine stands are considered to be old-growth, trees greater than 100-120 years old. Of this total, less than 1% of the old-growth stands are found in the montane portion of longleaf pine's range. Several of these old-growth longleaf pine stands occur on the Mountain Longleaf National Wildlife Refuge located in northeastern Alabama, USA. A 1998 study documented the conditions in two old-growth longleaf pine stands on the Refuge. The purpose of that study was to describe the age and stand structure and shed light on the past disturbance and replacement patterns of two remnant old-growth longleaf pine stands. In 2006, these two stands were re-measured to document what changes had occurred in the following years. One stand was subjected to a relatively intense prescribed fire in the interim while the second stand was not. Both stands suffered a decline in tree density, but only the stand which had been burned experienced a loss in basal area. This presentation will discuss the changes in these two stands and the impact of fire.

SITE INDEX MODEL FOR NATURALLY REGENERATED EVEN-AGED LONGLEAF PINE

Dwight K. Lauer* & **John S. Kush**, Research Analyst, Silvics Analytic, Ridgeway, VA and Research Fellow, School of Forestry and Wildlife Sciences, Auburn University, Auburn, AL

Data from the Regional Longleaf Growth Study (339 permanent sample plots) was used to develop a site index model for naturally regenerated, even-aged longleaf pine (*Pinus palustris* Mill.). The site index equation was derived using the generalized algebraic difference approach (GADA) and is base-age invariant. Using height as a measure of site productivity in naturally regenerated longleaf pine is confounded by the variability in the number of years an individual tree remains in the grass stage. Age, for this model, was defined as the years since emergence instead of ring count plus 7 years. The model was fitted using the base-age invariant dummy variable method to account for the longitudinal data structure and variability in length of the grass stage. The resulting model describes height growth from the time of emergence from the grass stage.

PINE GROWTH FOLLOWING A TWO-PASS WEED CONTROL SYSTEM CONSISTING OF CHEMICAL SITE PREP AND POST-PLANT HERBACEOUS WEED CONTROL COMPARED TO ONE-PASS CHEMICAL SITE PREP ONLY

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The objective was to compare loblolly pine (*Pinus taeda* L.) growth following a traditional two-pass weed control system to a one-pass system. In the two-pass system, woody competitors were targeted with a Chopper® GEN2™ site prep treatment and herbaceous weeds were targeted with an Arsenal® AC + Oust® treatment applied after the pines were planted. In the one-pass system, a site prep tank mix of Chopper GEN2 + Oust was used to target woody competitors and to provide residual herbaceous weed control into the year following pine planting. These treatments were examined in replicated studies installed at four locations covering Piedmont, Hilly Coastal Plain, and Middle Coastal Plain physiographic regions of the southern U.S. Treatments are compared in terms of year 1 vegetation control and year 2 pine response.

A COMPARISON OF CANOPY STRUCTURE MEASURES FOR PREDICTING HEIGHT GROWTH OF UNDERPLANTED SEEDLINGS

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The study compares the relationship between twelve measures of canopy structure and height growth of underplanted yellow-poplar (*Liriodendron tulipifera* L.) seedlings. In August 2003, fifty 0.05 ha experimental units were established within a mixed-hardwood riparian forest located in western Georgia. Investigators used four midstory removal intensities to create a structural gradient across the fifty units; removals resulted in a range of canopy cover between 51 to 96% (approximately 3% to 21% full sun). Twelve, one-year-old containerized yellow-poplar seedlings were planted within each 0.05 ha area and height growth was monitored through two growing seasons (2004 to 2005). Canopy structure was quantified using measures of stand density and vertical structure, visual and photographic estimates of canopy openness, and linear ceptometer readings. Investigators used regression analysis ($n = 50$) to compare the ability of the structural metrics to predict two-year height growth. Height-to-canopy ($R^2 = 0.69$), canopy cover estimated using crown width models (coverCW) ($R^2 = 0.59$), and spherical densiometer readings ($R^2 = 0.44$) were the strongest individual predictors of height growth. The best-fit multiple regression model included height-to-canopy and coverCW ($R^2 = 0.78$). Because height-to-canopy and coverCW can be derived from tree inventory data, a seedling growth model incorporating these variables could potentially be linked with a stand

development model (e.g., Forest Vegetation Simulator) to evaluate how residual structure affects seedling response. Results emphasize the potential importance of quantifying vertical and horizontal canopy characteristics when evaluating the relationship between forest structure and growth of underplanted seedlings.

COMMON PERSIMMON (*DIOSPYROS VIRGINIANA* L.) SILVICULTURE: LIMITED INFORMATION AND RESEARCH NEEDS

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Common persimmon (*Diospyros virginiana* L.) is a shade-tolerant species commonly found in the Lower Mississippi Alluvial Valley. It is a highly desired wildlife habitat species due to its relatively large fruit used by many wildlife species. Therefore, common persimmon is often planted as a minor component in afforestation of former agricultural fields. While it has been observed as a large component in natural reproduction, common persimmon is rarely found as an overstory species in maturing bottomland hardwood stands. Unfortunately, we have little information regarding common persimmon ecology and silviculture to develop management prescriptions to increase its density and development. I plan to use reproduction information from a variety of studies, ranging from reproduction studies to old-growth forest studies, plus information from two stem reconstructions and associated plot-level data, to elucidate clues about common persimmon reproduction and stand development ecology. This information, along with information from the literature, will be used to development silviculture options for common persimmon management. I will also point out areas where we need additional research to better understand common persimmon ecology and silviculture.

BOXELDER (*ACER NEGUNDO* L.) STAND DEVELOPMENT – CAN IT SERVE AS A TRAINER SPECIES?

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Boxelder (*Acer negundo* L.) is a shade-tolerant species commonly found in West Gulf Coastal Plain floodplains. It is a desirable species for wildlife habitat, but has long been considered a “weed” for timber management, especially when regenerating forests to more desirable species. Recent observations indicate that boxelder may be beneficial in forest management for timber production objectives, primarily as a trainer species for the development of more desired species. We have stem reconstruction data for 50 boxelder trees and associated plot-level data. We will examine height development of boxelder and associated species to determine if it has a similar pattern of height growth as sweetgum in mixed bottomland hardwood stands. We will then discuss the role of boxelder in reforestation efforts, and how boxelder may be useful in bottomland afforestation efforts.

SIMULATION OF PINE PLANTATION CARBON DYNAMICS UNDER CONTRASTING SILVICULTURAL SCENARIOS

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In the southeastern U.S., forests occupy 60% of the land area, with a large fraction dominated by pine forests originating from natural regeneration or from planting of nursery seedlings (plantations). Because of the large area they occupy and their high productivity, southern forests are a significant portion of the U.S. carbon (C) budget. Overall, southern forests contain 12 Pg of C, 36% of the sequestered forest C in the conterminous United States. For this reason, it is important to understand how silvicultural options will impact pine plantation forest C balance. The objective of this project was to quantify how different silvicultural scenarios affect the C balance of plantation pine forest in northern Florida, a region representative of much of the SE U.S. coastal plain. We simulated patterns of C sequestration using a phenomenological model parameterized with data collected with eddy covariance techniques over a range of pine plantation forests. Simulations included C costs of silvicultural activities and the half-life of different harvested wood products. Simulation scenarios were chosen to include representative silvicultural options for the SE Coastal Plain. The scenarios for private and industrial pine forestland management included 20- and 30-year pulpwood regimes, and a 45-year rotation with a commercial thinning. In addition, we simulated different silvicultural options for tract-level C balance, including large-scale even-aged management, as well as classic “even flow” harvesting and regeneration patterns. Results will be discussed within the context of the SE U.S. regional C balance.

PLANTING OF NUTTALL OAK USING ROOT PRODUCTION METHOD (RPM) AND BAREROOT STOCK IN THE FELSENTHAL NATIONAL WILDLIFE REFUGE GREENTREE RESERVOIR

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Plantings of Nuttall's oak (*Quercus texana* Buckley) in three different flood regimes in a greentree reservoir (GTR) within Felsenthal National Wildlife Refuge (FNWR) were done March 2007. The plantings were done in an attempt to develop a method to sustain regeneration of the primary species of trees in this GTR, using the Nuttall's oak as the model species. Primary tree species present within the GTR include Nuttall's oak, overcup oak (*Q. lyrata* Walter), willow oak (*Q. phellos* L.), water hickory (*Carya aquatica* [Michx. f.] Nutt.), and sweetgum (*Liquidambar styraciflua* L.). Currently about 6 (1" to 2") oaks per acre are regenerating naturally in a 5-year period in the FNWR GTR. This rate of regeneration is not sufficient to maintain the forest where mortality of oaks is 3 per cent per year. Two types of seedlings were planted; root production method (RPM) and bareroot seedlings. RPM trees are about 3-5 feet tall, flood tolerant, and are 1-year-old trees that are grown in 3-gallon buckets. Plantings of these are difficult and expensive. Planting of 122 RPM seedlings was accomplished with a portable auger. Bareroot seedlings (335) were planted by dibble bar as a control for the RPM seedlings and also to check for success of bareroot stock when planted in potentially deeply flooded conditions. Tree protectors were placed around some RPM seedlings but not bareroot stock. Preliminary results indicate high mortality with both methods. Monitoring will continue periodically to assess the viability of these planting methods in a GTR.

ASSESSING ANTHROPOGENIC AND NATURAL DISTURBANCES: VEGETATION RESPONSE TO SIMILARLY AGED CLEARCUT AND TORNADO DISTURBANCES IN AN EAST TENNESSEE OAK-HICKORY FOREST

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In February of 1993, an F-3 tornado caused a large-scale disturbance in an East Tennessee oak-hickory forest. Vegetation response to anthropogenic and natural disturbances was compared by examining two tornado-disturbed areas and five adjacent, 1-acre silvicultural clearcut areas unaffected by the tornado disturbance. Nested overstory, midstory, and understory plots (0.1, 0.02, and 0.001-acre plots respectively) were measured to determine species composition, species diversity, stocking, and structure, as well as coarse woody debris (CWD) volume, CWD density and CWD percent cover. Preliminary results, 14 years post-disturbance, indicate that diversity (Shannon Diversity Index) is similar between the clearcut and tornado areas, though differences in stocking do exist. Structural differences also occur between the two disturbance types. The presence of residual overstory and midstory trees in the tornado-disturbed blocks caused the diameter distribution in said blocks to have a reverse-J distribution compared to the typical even-aged distribution of the clearcut. CWD volume, density, and percent cover were significantly higher in the tornado-disturbed blocks.

A PRELIMINARY TEST OF ESTIMATING FOREST SITE QUALITY USING SPECIES COMPOSITION IN THE SOUTHERN APPALACHIANS

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Site index estimation is problematic in most mixed hardwood stands in the southern Appalachians because many of the underlying assumptions are not met. Availability of soil moisture during the growing season is an important environmental factor affecting site productivity within areas of uniform temperature and fertility. The association of certain species with a moisture regime has long been used by foresters to infer site quality (e.g., scarlet oak (*Quercus coccinea*) = xeric = low quality) but a workable system of assessment based on species composition has not been proposed and tested. We devised a system by weighting each forest tree species according to its perceived position of modal occurrence along a xeric to mesic moisture gradient; the site moisture regime index (MRI) is calculated as the mean weight for all species present. We evaluated the relationship of MRI with oak site index on 118 permanent plots in Bent Creek Experimental Forest dominated by even-aged stands of either mixed oaks (*Quercus* spp.) or yellow-poplar (*Liriodendron tulipifera*), where oak site index averaged 69 feet and ranged from 37 to 96. Regression analysis indicated MRI was significantly ($P < 0.001$) associated with oak site index and accounted for 62 percent of its variation. When the model was tested with an independent data set ($n = 30$), predicted site index was significantly ($P < 0.001$) correlated with measured site index ($r = 0.73$). Results of this exploratory study suggest that estimation of site quality based on species composition shows promise for application in mixed hardwood stands of the southern Appalachians.

INFLUENCES OF TREE, STAND, AND SITE CHARACTERISTICS ON THE PRODUCTION OF EPICORMIC BRANCHES IN SOUTHERN BOTTOMLAND HARDWOOD FORESTS: PRELIMINARY ANALYSES

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Epicormic branches are adventitious twigs that develop from dormant buds found along the main bole of hardwood trees. These buds may be released at any time during the life of the tree in response to various types of stimuli. Epicormic branches cause defects in the underlying wood and may significantly reduce both log grade and subsequent lumber value. The presence of epicormic branches often becomes a serious problem in the management of hardwood forests for high-quality sawtimber production. Species, stress, and sunlight have been proposed as the three major factors affecting the production of epicormic branches in hardwoods, but no definitive research has been conducted to evaluate this hypothesis. This paper combines data from seven different studies across the South in an attempt to quantitatively describe the influences of several tree, stand, and site characteristics on the production of epicormic branches in both unthinned and thinned stands of southern bottomland hardwoods. Tree characteristics evaluated include species, diameter class, crown class, and hardwood tree class. Stand density and site index were also evaluated. Each of these characteristics was examined individually and in combination with other characteristics to determine the level of influence exerted on the formation of epicormic branches. Individual species were classified based on their susceptibility to the production of epicormic branches in both unthinned and thinned stands.

THINNING TO IMPROVE GROWTH, BOLE QUALITY, AND FOREST HEALTH IN AN *INONOTUS HISPIDUS*-INFECTED RED OAK-SWEETGUM STAND IN THE MISSISSIPPI DELTA: 10-YEAR RESULTS

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A 55-year-old red oak-sweetgum (*Quercus* spp.-*Liquidambar styraciflua* L.) stand on the Delta National Forest was thinned in 1997. Special emphasis was placed on removing all red oaks infected with *Inonotus hispidus* (Bull.) P. Karst, a canker decay fungus that causes severe degrade and cull. Thinning significantly increased diameter growth of residual trees, especially among red oaks, 10 years after treatment. Thinning had little influence on the production of new epicormic branches on the butt logs of residual red oaks, but it greatly increased the number of epicormic branches on the butt logs of residual sweetgum trees. The thinning operation successfully reduced the incidence of *Inonotus hispidus* in the residual stand. Only one new canker was found in the stand 10 years after thinning. Thinning did not influence the presence of insect borers in the stand. We found no significant difference in the numbers of insects between the thinned and unthinned plots. The thinning operation also resulted in numerous logging wounds on the lower boles of residual trees. By the end of the 10th year after thinning, most of the larger wounds were not closed and were infected with rot. However, about 75 percent of the wounds smaller than 80 square inches had closed completely.

FINANCIAL PERFORMANCE OF LOBLOLLY AND LONGLEAF PINE PLANTATIONS

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The past decade has seen significant shifts in timberland ownership, particularly in the southern United States. Integrated forest product companies have sold many of their land assets, which have subsequently been acquired by institutional investors. Along with shifts in forest ownership, the past decade has also seen increased interest in longleaf pine management. In recent years, various organizations have begun encouraging longleaf plantation establishment with much of their effort directed at private landowners whose objectives include factors such as wildlife habitat and aesthetics in addition to economics. Little work has been done examining the economic viability of longleaf pine management on investment properties. Much of the literature about longleaf pine focuses on a diversity of management objectives, including wildlife and endangered species. This analysis differs in that the focus is solely on the economics of plantation management. While longleaf pine forests may provide additional wildlife or aesthetic benefits, this analysis ignores such amenity values.

The financial performance of selected management regimes for loblolly and longleaf pine plantations were compared for four cases, each with low and high site productivity levels and each evaluated using 5% and 7% real discount rates.

In all cases, longleaf pine was considered both with and without pine straw harvesting as part of the management regime. Results indicate that longleaf pine regimes that do not incorporate pine straw raking yield financial results that are inferior to those from intensive loblolly management. However, with the addition of pine straw revenues, longleaf management can yield returns that are comparable to typical loblolly pine regimes (-16% to +3%, depending on site quality and discount rate). With little to no direct return on reforestation investments before 20-25 years longleaf pine may be a more attractive alternative, due to lower establishment costs up front and favorable LEV comparisons.

INFLUENCE OF PLANTING STOCK, PLANTING METHOD, FERTILIZATION, AND COMPETITION CONTROL ON THE SURVIVAL OF PLANTED OAK SEEDLINGS; SECOND AND THIRD YEAR RESULTS

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Oaks (*Quercus spp*) are a very important component in southern bottomland forests for a variety of reasons. For decades, these forests were cleared for agriculture, but the current trend is to replant retired agricultural areas with trees. It is estimated that 34 million acres of retired agricultural land will be afforested in the South by 2040. A total of 6, 480 oak seedlings were planted to evaluate the influence of nursery stock, planting method, fertilization and competition control on seedling survival one, two, and three years post planting. Results from the two planting sites demonstrate that good "nursery run" seedlings will survive as well or better than seedlings produced under a special nursery protocol ("enhanced" seedlings). Fertilization has no impact on survival. Hand planting in subsoil trenches is considered the optimal method as it results in survival equal to auger planting and greater than "flat" planting, and the hand planting costs less than augering. Competition control is considered essential on these planting sites, but a single preemergent application was sufficient for excellent survival in most evaluations. Repeated applications of glyphosate during the growing season may result in damage to the seedling or mortality.

COST EFFECTIVENESS OF THREE DIFFERENT RELEASE TREATMENTS OF FOR TABLE MOUNTAIN PINE (TMP) IN A SEVERELY OVERSTOCKED AND PURE STAND

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In the fall of 2007, the University of Tennessee Forest Stand Dynamics Research Lab initiated a research project on the Nolichucky District of the Cherokee National Forest in Tennessee to evaluate various release treatments in a pure table mountain pine (*Pinus pungens*) stand. The acreage of TMP in the Southern Appalachians is decreasing because of fire suppression and southern pine beetle epidemics that have led to encroachment of hardwoods and the eventual change of species composition to hardwoods. The studied TMP stand is overstocked (6,500 stems per acre with average diameters of 1.6 inches), 26 years of age, and in the stem exclusion stage of stand development but is in a stagnant condition. The research objective was to reduce stocking in order to overcome the stagnant state by increasing growth and potential seed production for this endemic species. Treatments on the site included a prescribed burn, crop tree release, strip thin and control. An economic analysis is presented to determine the costs and benefits of each of the release treatments. Variables in the economic analysis include labor, equipment use, preparation time and time involved in installing the treatments.

ESTIMATING AND MANAGING LIVE FUELS FOR ATLANTIC COASTAL PLAIN FOREST COMMUNITIES

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There is currently little information available for live fuel estimates for shrubs and herbs in the eastern pine and pine-broadleaf forests. Many Coastal Plain forests can contain a significant amount of live fuels that pose a serious fire hazard. Managers need a means to assess live fuel loading to aid in fire management. Vegetation profile data was collected based on Forest Inventory and Analysis (FIA) procedures from their 1985 field guide. A complete assessment was done of live fuel components on 629 plots located on the Savannah River Site, a National Environmental Research Park located in the upper coastal plain of South Carolina. The vegetative layer was categorized into 5 components: 1) tree seedlings, 2) shrubs, 3) vines, 4) grasses and grass-like plants, and 5) forbs. Total live fuel loading across the landscape ranged from a low of 0.013 to a high of 1.18 tons per acre with a mean of 0.35 tons per acre. The relationships among stand variables, fire frequency and live fuel component loadings were examined through use of analysis of variance and regression. For the major forest types (loblolly, longleaf, slash, pine-hardwood) stand variables generally explained the larger fraction of the variability in total fuel loading. The spatial

pattern of fuel loading across the landscape reflects both stand management and fire management. The Site is increasing fire frequency in ecologically critical longleaf savannah habitat and reducing frequency in smoke-sensitive zones. Mechanical, chemical and other silvicultural techniques are being applied to reduce fuels in smoke-sensitive zones.

LOUISIANA FORESTRY BEST MANAGEMENT PRACTICE EFFECTIVENESS FOR REDUCING NONPOINT SOURCE POLLUTION IN INTERMITTENT STREAMS

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Silvicultural activities have been identified as a contributor to nonpoint source pollution in Louisiana. Although the implementation rate of the recommended forestry Best Management Practices (BMPs) in Louisiana has dramatically increased, little quantitative information exists about the effectiveness of the BMPs in maintaining water quality. The objective of this project was to evaluate the effectiveness of BMPs from the Louisiana manual, "Recommended Forestry Best Management Practices for Louisiana" for reducing nonpoint source pollution from storms for intermittent streams in north-central Louisiana. The study, on Weyerhaeuser Company and Plum Creek Timber Company land, monitored water quality of intermittent streams passing through tracts with one of three treatments: Control (No Harvest), Harvest with Full BMP implementation, and Harvest with no BMP implementation. Each of the nine tracts within the Ouachita Basin were assigned to one of the treatments, and water quality was sampled or measured immediately upstream and downstream of the treatment. Turbidity, Total Suspended Solids (TSS), Total Phosphorus (TP), Nitrate-Nitrite (NN), and Total Kjeldahl Nitrogen (TKN) were analyzed for composited storm samples. The Harvest without BMP treatment had significantly higher downstream Turbidity than that of the Control and Harvest with BMP treatments. Non significant trends between treatments were found for TSS, TP, NN, TKN, and Total Nitrogen. Great variation in parameters were found for different sites, and storms within the treatments.

IMPACTS OF SILVICULTURAL TREATMENTS ON WITHIN-STAND UNIFORMITY OF LOBLOLLY PINE (*PINUS TAEDA*) PLANTATIONS

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Although substantial research has examined loblolly pine productivity and yield responses to different silvicultural treatments, comparably little research has specifically assessed how silvicultural treatments affect within-stand uniformity. Treatment impacts on uniformity of tree dbh, height, and quality attributes may affect product distribution, stand value and stand development patterns. Knowledge of these impacts can be used to refine silvicultural regimes and guide development of improved growth and yield and inventory approaches. Results are reported from over 50 field experiments located in Alabama, Florida, and Georgia established by the Plantation Management Research Cooperative (PMRC). Data were used to determine how varying levels of site preparation, planting density, competing vegetation control, and intensive culture affect within-stand uniformity in tree dbh, height, and quality attributes over time. The significance of the results for silvicultural regimes and growth and yield systems is discussed.

DOES SITE PREP TIMING AFFECT THE OPTIMAL TIMING FOR POST-PLANT HERBACEOUS WEED CONTROL IN LOBLOLLY PINE PLANTATIONS?

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Five-year loblolly pine growth is presented for three study sites in the Upper Coastal Plain of the southeastern US. At each site, Chopper® herbicide site prep treatments were applied at two different timings. Pines were planted in winter following the site prep treatments. Post-plant herbaceous weed control treatments were applied at different timings over the first two pine years. Results provide insight into the effect of site prep timing on pine growth, the interaction between site prep timing and herbaceous weed control timing, and growth response to two consecutive years of herbaceous weed control. All studies are fully replicated at each site.

ASSESSING POTENTIAL GENETIC GAINS FROM VARIETAL PLANTING STOCK IN LOBLOLLY PINE PLANTATIONS

Scott D. Roberts* & **Randall J. Rousseau**, Associate Professors, Department of Forestry and Forest and Wildlife Research Center, Mississippi State University, Mississippi State, MS

Forest landowners have increasingly more options when it comes to planting stock for loblolly pine plantations. For the last several years, the majority of plantations have been established with seedlings produced from 2nd-generation open-pollinated seed. Increasingly, however, foresters have recognized the increased gains obtainable from full-sib families produced using mass-controlled pollination (MCP) techniques. The next step in genetic improvement is varietal (clonal) forestry. Forest biotechnology firms have begun producing loblolly pine varietal planting stock for deployment in the southeastern US. Continued testing of this material will determine individual genotypes best suited for specific sites or desired products. Currently, however, the cost of varietal planting stock is considerably higher than that of standard open-pollinated seedlings, or even MCP seedlings. It is unclear if the increased gains from the improved genetic material will be great enough to offset increased plantation establishment costs. In 2007, a Loblolly Pine Genetic Level Study was installed in northern Mississippi to examine differences in growth and form among of open-pollinated second-generation seedlings, MCP seedlings, and loblolly pine varieties derived from somatic embryogenesis. First-year measurements showed no difference in heights between the different stock types. Results from second-year height measurements will be presented.

NINE-YEAR PERFORMANCE OF A VARIETY OF *POPULUS* TAXONS ON AN UPLAND SITE IN WESTERN KENTUCKY

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A variety of hybrid poplars have been planted on upland sites throughout the mid-west and mid-south regions of the United States. Very few of these clones have proven to be worthwhile due to susceptibility to a variety of diseases. A variety of *Populus* taxons were planted on an upland site in western Kentucky as a means of assessing resistance to local diseases, especially *Septoria musiva*. These taxons included combinations of *P. trichocarpa* crossed with *P. deltoides*, *P. maximowiczii*, and *P. nigra* as well as backcrosses to *P. deltoides* and *P. maximowiczii*. Nine-year data including height, diameter and incidence of disease will be reported and compared to a known *Septoria* resistant clone.

SURFACE SOIL ROOT DISTRIBUTION AND POSSIBLE INTERACTION WITH SITE FACTORS IN A YOUNG LONGLEAF PINE STAND

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The acquisition of soil resources is essential to the sustainability of southern pines. After planting, an inverse relationship between root biomass and soil depth typically develops. Because water and mineral nutrients are more abundant in the surface soil compared to the subsoil, this pattern of root distribution affords resource sufficiency. If root growth in the surface soil is restricted, soil resource uptake could be compromised. In a 14-year-old stand of sapling longleaf pine (*Pinus palustris* P. Mill.) on the Kisatchie National Forest, Rapides Parish, Louisiana, an investigation is underway to evaluate the distribution of roots in the upper 20 cm of soil. The soil at this location is Beauregard silt loam which is representative of many pine forest soils in the West Gulf region. The study contains three replications and four treatments (i.e., three seasons of prescribed fire and no prescribed fire). Four subplots were established within each of the 12 treatment plots. From each subplot, 24 soil cores were extracted and partitioned into six sections (0-2.5, 2.5-5.0, 5.0-7.5, 7.5-10.0, 10.0-15.0, 15.0-20.0 cm) for evaluation of root biomass. Preliminary results suggest that there are distinct rooting patterns near the surface of the soil. Linkages between these patterns, soil characteristics, and forest management activities will be discussed.

SEVEN YEAR GROWTH RESPONSES OF TWO YOUNG BOTTOMLAND HARDWOOD STANDS TO VARIOUS PRECOMMERCIAL THINNING TREATMENTS

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Overstocking is a major factor limiting the growth of individual stems in naturally regenerated bottomland hardwood stands. Young stands are especially problematic due to the difficulties and expense of treating extremely dense stands with small diameter stems. We employed three density reduction treatments to evaluate their potential to improve stem growth in two young bottomland hardwood stands (ages 4 and 8 yr old) in East Texas. The treatments were (1) a traditional individual tree release (ITR), (2) strip thinning, and (3) a combination of strip thinning and ITR. ITR treatments reduced stem densities down to 500 and 1000 stems/ac on the 8 and 4 yr old sites, respectively. Strip

thinning used a mulching apparatus attached to a front end loader to create alternating 10 ft wide leave and kill strips. We will present the changes in stem diameter and height seven years after treatment. Apart from stem size, stem quality is extremely important since hardwood stumpage value is closely regulated by tree grade. We will also discuss treatment impacts on stem quality using height to the lowest live branch as a metric for tree quality for each ash (*Fraxinus pennsylvanica*) and oak (*Quercus* spp.) stem.

A TREE BIOMASS AND CARBON ESTIMATION SYSTEM

Emily B. Schultz*, **Thomas G. Matney**, & **Donald L. Grebner**, respectively, Associate Professor, Professor, and Associate Professor, Forest and Wildlife Research Center, Mississippi State University, Mississippi State, MS

Appropriate forest management decisions for the newly developing woody biofuel and carbon credit markets require inventory and growth and yield systems reporting component tree dry weight biomass estimates. We have developed an integrated growth and yield and biomass/carbon calculator. The objective was to provide Mississippi's state inventory system with bioenergy economic development tools and small landowners trying to qualify for carbon credit programs with carbon estimates. Biomass equations were collected from many sources in the literature and organized into a uniform software system that provides estimates of volume/biomass/carbon of branches, foliage, and bole. Users may select biomass components for 347 species/region combinations and obtain information on 1) tree profiles, 2) biomass/carbon tables, and 3) model forms and coefficients. Bole biomass and volume can be obtained to any top diameter limit. Pine plantation and hardwood stand case studies demonstrate biomass and carbon estimation and pine projections. Alternative financial analyses generated by the growth and yield system provide information upon which forest landowners may base management decisions for the biofuel and carbon markets.

OVERSTORY TREE STATUS FOLLOWING THINNING AND BURNING TREATMENTS IN MIXED PINE-HARDWOODS STANDS ON THE WILLIAM B. BANKHEAD NATIONAL FOREST, ALABAMA

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Prescribed burning and thinning are intermediate stand treatments whose consequences when applied in mixed pine-hardwood stands are unknown. The William B. Bankhead National Forest in north-central Alabama has undertaken these two options to move unmanaged, 30- to 50-year-old loblolly pine (*Pinus taeda* L.) plantations towards upland hardwood-dominated stands. Our study of their management employs a randomized complete block design with a 3 by 3 factorial treatment arrangement and three replications of each treatment. Treatments are three residual basal area treatments (50 ft²a⁻¹, 75 ft²a⁻¹, and an untreated control) with three burn frequencies (frequent burns once every 3-5 years, infrequent burns once every 8-10 years, and an unburned control). To date, only one burn cycle has been completed (all burn units burned once). Stands were thinned from May through October, and prescribed burned in January-February. We measured the overstory response to these treatments 1 year after implementation. Pretreatment basal area ranged between 112.0 and 136.9 ft²a⁻¹; harvesting reduced basal areas to 48.9 ft²a⁻¹ and 64.4 ft²a⁻¹ in the 50 and 75 retention treatments. The percentage of total basal area that was loblolly pine remained relatively unchanged post-treatment (47.4% pretreatment and 46.5 % post-treatment). Oak basal area (*Quercus* spp.) increased slightly post-treatment, from 6% of total stand basal area to 10%. Harvested stands had a 30% reduction in percent canopy cover, and light penetration through the canopies ranged from 5-25% pretreatment to 29-60% post-treatment. The cool, slow moving burns had no discernable effect on the overstory trees.

PLANT COMMUNITY RESPONSES TO SOIL DISTURBANCE AND HERBICIDE TREATMENTS OVER 10 YEARS ON A SANDY SOIL IN EAST TEXAS

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Forest management operations create soil disturbances that change nutrient cycling, soil water relations, and rooting potential. Because each species has its own physiological requirements and tolerances for soil conditions, plant communities change in response to disturbances. In 1997, a study was installed that compared three levels of harvest intensity and organic matter removal intensity (stem-only harvest, whole-tree harvest, and whole-tree harvest plus litter removal) and three levels of soil compaction (none, moderate, and severe) on a sandy soil in East Texas. In addition, glyphosate was applied on half of each plot multiple times over the first five years of growth. The site was initially a natural mixed southern pine stand with a yaupon-dominated understory, and was planted with loblolly pine after treatment. We measured planted pine survival and growth and understory biomass and composition through 10 seasons. Organic matter removal intensity, compaction, and herbicide treatments altered the understory biomass and

community composition in varying ways. Pine survival and growth was reduced by intensive organic matter removal, but was not reduced by soil compaction.

EFFECTIVENESS OF FORESTED STREAMSIDE MANAGEMENT ZONES FOR MINIMIZING NUTRIENT FLUXES FROM FOREST FERTILIZATION IN PIEDMONT STREAMS

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Many state Best Management Practices (BMP) programs established Streamside Management Zone (SMZ) widths based on limited or inadequate data with regard to nutrient fluxes from silvicultural activities. Previous studies have shown slight post-harvest increases of several nutrients in streams and increased nitrogen (N) and phosphorous (P) levels in streams located in agricultural settings. However, little is known about the effectiveness of recommended SMZ widths in regards to controlling nutrient fluxes following an industrial fertilizer application. Our hypothesis is that N and P levels will decrease on the soil surface, forest floor, and soil subsurface in a forested SMZ setting as distance from the harvest boundary to the creek increases. Furthermore, we hypothesize that wider, unthinned SMZs will do a better job at preventing nutrients from reaching the creek than narrower and/or thinned SMZs. Diammonium Phosphate (DAP) and UREA were applied to subwatersheds of 2- to 3-yr-old loblolly pine (*Pinus taeda*) upslope from SMZ study areas throughout Buckingham Co., VA. Three replications of four SMZ treatments (30.5 m, 15.2 m unthinned, 15.2 m thinned, and 7.6 m) were studied using surfacewater collectors, cation/anion exchange membranes, lysimeters, and stream grab-samples. Measurement tools were spaced symmetrically across the SMZ from the uphill SMZ edge to creek edge with grab samples being collected approximately one chain upstream and one chain downstream of the fertilized area. Preliminary results show that stream water quality is unaffected by fertilization at all SMZ width treatments. Overland and subsurface nutrient movements through the various SMZ widths will be discussed.

COUPLING OF CARBON FIXATION AND SOIL CO₂ EFFLUX IN 2 CLONES OF LOBLOLLY PINE

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An accurate estimate of soil CO₂ efflux (F_s) in loblolly pine stands is critical for modeling C sequestration in these managed ecosystems. Past studies, which have modeled F_s in the field, typically only explain about 50 percent of the variance. Our hypothesis is that variation in recently fixed C due to the changes in the environment (e.g., light, vapor pressure deficit) may explain a significant amount of the variance observed in F_s. The objective of this research is to determine the relationship between recent C fixation and patterns in F_s. Five replications of two clones of loblolly pine were grown in large, walk in growth rooms which allowed us to control precisely the temperature, humidity, and light levels. Soil CO₂ efflux was monitored continuously in two locations in each pot using an open automated gas exchange system. Light levels were manipulated over three day periods giving ranges that simulated full sunlight (1000 PPFD) to heavily overcast days (150 PPFD). Vapor pressure deficit (VPD) was also manipulated in a separate experiment to explore the relationship between VPD, carbon fixation and F_s. Photosynthetic rates and root carbohydrate levels were measured at the various light and VPD levels. Preliminary results show a strong relationship between F_s rates and light levels, and strong clonal differences. Relationships between F_s rates and rates of C fixed will be discussed in the context of understanding patterns observed in the field.

EFFECT OF DIRECTED-SPRAY GLYPHOSATE APPLICATIONS ON SURVIVAL AND GROWTH OF PLANTED OAKS AFTER THREE GROWING SEASONS

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Thousands of acres of oak plantations are established across the South annually. Survival and growth of these plantings has been less than desirable. Several techniques have been utilized in attempts to achieve improved success in these areas. One such technique is the application of directed-spray herbicide treatments. Typically, an application of a glyphosate product is sprayed on competing vegetation around the seedling. The seedling is either shielded, or herbicide is carefully applied immediately adjacent to the seedling without the use of shielding. In both cases, extreme caution is taken avoid wind drift or vegetative drip of the herbicide onto the seedling. In this study, 3,240 bare-root Nuttall oak (*Quercus texana*) and white oak (*Quercus alba*) seedlings were planted in February 2005 on Malmaison Wildlife Management Area near Carrollton, Mississippi. One third of the seedlings were subjected to a pre-emergent Oust XP® application in March 2005. One third of the seedlings were treated with a pre-emergent Oust XP®

application in March 2005 and directed-spray glyphosate applications throughout the 2005 growing season. One third of the seedlings were subjected to pre-emergent Oust XP® applications in March of 2005, 2006, and 2007, and received directed-spray glyphosate applications once a month during the growing season each year. The effect of repeated directed-spray applications was evaluated and substantial differences were noted. Multiple examples of adverse seedling conditions were observed in the three-year directed-spray plots. Seedling survival and total height were appreciably lower in three-year directed-spray areas compared to non directed-spray or one-year directed spray areas.

THE “ESTATE OWNER’S” APPROACH TO FOREST ECONOMICS

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It has been almost 160 years since Martin Faustmann published a paper on the "Calculation of the Value which Forest Land and Immature Stands Possess for Forestry". Most economists employed by forest industry evaluate forestry investments by using Faustmann's formula to calculate a "Soil Expectation Value" (SEV). There is another approach to forest economics that is occasionally used by "Estate Owners" like kings, governments and land barons. Their approach assumes that each year, a pro rata share of the forested estate is harvested and an equivalent area is planted. For example, if the rotation age is 50 years, then 1/50th of the forest is harvested during the year, and an equal amount of land is replanted. When calculating a return on investment, all past investments are treated as "sunk" and all future investments are ignored. Only costs and incomes realized during the current year are considered. This relatively simplistic approach is referred to as the "Estate Owner's" method. Although more popular 200 years ago, we believe this method is still used by some large landowners as well as by some government foresters. This paper compares and contrasts the SEV approach with the Estate Owner's approach to forest economics. The PTAEDA3 growth and yield program is used to evaluate both economic approaches.

REGENERATION DYNAMICS DURING OAK DECLINE IN ARKANSAS' BOSTON MOUNTAINS

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Northern red oak (*Quercus rubra* L.) seedlings were inventoried in 2000 and again in 2005 to better understand survival of advance regeneration during oak decline. In 2000 ground stem diameter of 861 seedlings that were less than 5 cm dbh were individually tagged, measured and subsequently monitored. By mid-2001, this stand began to exhibit symptoms of severe oak decline. In 2004 a prescribed fire was applied to one third of the study area. Based on logistic regression analysis, survival probability of northern red oak increased with increasing initial ground stem diameter and decreasing site index. In unburned areas greatest mortality occurred on seedlings with ground stem diameters less than 7mm. However, in burned areas seedlings less than 12mm exhibited the greatest mortality. This information can aid managers in developing prescriptions that help mitigate the impacts of oak decline.

ESTABLISHMENT RESULTS OF A COASTAL PLAIN OAK-PINE-SOYBEAN AGROFORESTRY TRIAL

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Agroforestry systems in the Southeast may prove useful in a variety of land use systems to provide alternative/multiple products and income streams. The opportunity produce annual and long term harvests from the same parcel of land may be appealing in a variety of situations to landowners. Annual crops might include traditional field crops (perhaps including those that would benefit from partial shade and/or windbreak) or annual/perennial fiber, bioenergy and forage crops. Tree crops might yield intermediate thinnings of modest size and value, and long term production of high quality and value logs. In the current study triple row single-species strips of loblolly pine, longleaf pine or cherrybark oak were planted separated by 12 or 24 m wide areas of soybean. On a subsample of trees on-farm wastes were used as mulch. These mulches were a hay-manure combination, old hay, and black plastic. The impact of mulch and tree species was evaluated on soil condition, and tree survival, condition and growth the first and second year after planting.

COMPARING SOIL ECTOMYCORRHIZAL AND VESICULAR-ARBUSCULAR MYCORRHIZAL INOCULUM POTENTIAL AFTER FUEL REDUCTION TREATMENTS IN BEETLE-KILLED STANDS

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Heavy fuel loads were created by southern pine beetle (*Dendroctonus frontalis* Ehrh.) outbreak throughout the southeastern Piedmont during the early 2000's. Prescribed burning and mechanical mulching (mastication) are used to reduce fuel loading, but many ecological impacts are unknown. Successful forest regeneration can depend on ecto- (ECM) or vesicular arbuscular mycorrhizal (VAM) fungi which form important symbiotic relationships with most forest plants. Fuel reduction treatments may impact mycorrhizal propagule abundance and/or vigor through propagule consumption, changes in soil chemistry, and/or effects on host vegetation. The objectives of this study were to (1) determine whether there were differences in inoculum potential among burning and mulching treatments and no-treatment (control) and (2) determine whether inoculum potential was related to fire behavior and/or pretreatment vegetation in treated areas. ECM inoculum potential observed from soil bioassays was not significantly different among treatments. However, ECM inoculum potential was positively related to fire intensity and residence time. VAM inoculum potential was significantly lower in burned plots than in mulched or control plots and was negatively related to fire intensity and residence time. The importance of pretreatment vegetation as refugia for mycorrhizal fungi is currently being investigated. Results of this study will assist forest managers in evaluating treatment options for different silvicultural objectives in beetle-killed stands.

GROWTH AND CARBON ALLOCATION PATTERNS OF CLONAL *PINUS TAEDA* FOLLOWING FERTILIZATION IN THE VIRGINIA PIEDMONT

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Clonal forestry offers the opportunity to increase yields, enhance uniformity and improve wood characteristics. Intensive silvicultural practices, including fertilization, will be required to capture the full growth potential of clonal plantations. However, variation in nutrient use efficiency that exists among clones could affect growth responses. Our research objective was to determine the range of growth response and biomass partitioning due to fertilization in clones of *Pinus taeda*. A split plot experimental design was used, with the whole plots being two levels of fertilization (with or without) and the split plot factor being 25 clones. Whole plot treatments were blocked and replicated four times. Trees were planted in May 2003, with fertilizer (224 kg ha⁻¹ DAP and 184 kg ha⁻¹ ammonium nitrate) applied in May 2004 and May 2006. Four years after planting, a repeated measures analysis showed fertilizer by time and clone by time interactions significantly affected volume. Although there were no fertilizer by clone interactions in this trial across all 25 clones, the response to fertilizer varied, with 40 % of the clones showing a volume improvement at 3.5 years of < 3 % while 20 % showed improvement > 15 %. Our results suggest that a screening technique for clonal response to silvicultural treatments such as fertilization may be necessary given the wide range of fertilizer responses found among clones in this field trial and the large numbers of clones being developed by forest industry.

A COMPARISON OF TREE SHELTERS INSTALLED ON GREEN ASH (*FRAXINUS PENNSYLVANICA* MARSH.) AND CHERRYBARK OAK (*QUERCUS PAGODA* RAF.) SEEDLINGS IN ARKANSAS

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Tree shelters can aid hardwood seedling establishment by improving early seedling survival and growth. This study was established in February 2004 at two sites in Arkansas to compare three types of tree shelters installed on green ash (*Fraxinus pennsylvanica* Marsh.) and cherrybark oak (*Quercus pagoda* Raf.) seedlings. Seedlings planted in 4-foot tall BLUE-X®, Protex® or Tubex® tree shelters were observed monthly during the growing seasons and compared to unsheltered controls with respect to survival, browse damage, and emergence (recorded when each seedling reached the top of its shelter or 3.9 ft). Groundline diameter and height of each seedling were measured at the end of each growing season. A comparison of the initial purchase and establishment costs of the three shelter types shows that Tubex® shelters cost about twice as much as the BLUE-X® shelters, with the Protex® cost in between. Early results show that tree shelters did not affect survival. Diameter growth varied by site and shelter treatment. Height growth and emergence rates were greater for sheltered seedlings than unsheltered seedlings, but shelter type made little difference. Overall growth differed between sites, but sheltered cherrybark oaks grew slightly taller than sheltered green ash seedlings at both sites. Less costly shelters may provide the same growth benefits as more expensive shelters. Final results of this 5-year study will be presented.

FIELD PERFORMANCE AND INDIVIDUAL FLUSH DEVELOPMENT OF CONTAINER-GROWN LONGLEAF PINE SEEDLINGS

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Longleaf pine (*Pinus palustris* P. Mill.) seedlings, grown in containers of small (S), medium (M), and large (L) cavity with either copper (Cu) cavity coating or none (N), were outplanted in central Louisiana in November, 2004. All treatments had over 90% survival after 3 years. About 90% of the Cu-L, N-L, and Cu-M seedlings came out of the grass stage in year 3; whereas about 20% of the N-M, Cu-S, and N-S seedlings did not. The Cu seedlings were greater in height and diameter than the R seedlings in year 3. Seedling height and diameter increased with cavity size. Three seedlings in each plot were tagged for periodic measurements of flush development and photosynthesis in 2007. Additionally, 4 seedlings were excavated from each plot in November, 2007. The length of the first flush formed in 2007 was significantly correlated with heights and diameters measured in 2006 and 2007 with *r* values ranged from 0.61 to 0.95. Seasons, but not container treatments, affected photosynthetic rates. However, with more needles in the L and M seedlings, total potential photosynthesis per seedling was greater for the L and M seedlings than for the S seedlings. Compared to the L and M seedlings, not only did the S seedlings had less total biomass, they also allocated less biomass to stem or lateral roots and more to needles. Benefits of growing longleaf pine seedlings in Cu containers in terms of sapling toppling in strong winds will be discussed.

HABITAT USE AND SPATIAL ECOLOGY OF *AGKISTRODON CONTORTRIX* IN SILVICULTURE DISTURBED PINE-HARDWOOD FORESTS OF NORTHERN ALABAMA

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Little information exists regarding snake habitat use and spatial ecology in managed forests of the Southeast. We studied habitat use and spatial patterns of copperheads (*Agkistrodon contortrix*) of pre- and post-silviculture treatments. Twenty-one snakes (16 males and 5 females) were monitored for various periods during the 2006-2007 field seasons in experimental forest stands in the William B. Bankhead National Forest, Alabama, USA. Experimental design for this for this project consisted of a before-after control-impact, randomized complete-block design. Disturbance factors consisted of control, prescribed burn, thin, and thin-burn. Each experimental plot was approximately nine hectares in size and was replicated three times across the landscape. Snakes were initially captured in drift-fence trapping arrays and each snake was surgically implanted with a model SI-2 radio-transmitter (Holohil Systems Ltd.). As each snake was located, a detailed micro-habitat survey including five climatic variables and 18 habitat variables was completed at the snake location (used site) and a random location (unused site) 1-50 m from the used site. Multivariate paired logistic regression was used to determine habitat differences between used and random locations. Akaike's information criterion was used to select the most parsimonious model that best explained the differences between used and not used locations. Home ranges were estimated with kernel density and minimum convex polygon techniques. Both male and female snakes were found to prefer sites with greater abundance of coarse woody debris and greater litter depth when compared to random sites. Males were found to have larger total home ranges and core area home ranges than females. Our results indicate that evaluation of habitat features and spatial ecology is necessary to determine how forest management affects snake habitat use and spatial movements in disturbed forests of the Southeast.

THE USE OF MIDSTORY INJECTION FOR INCREASED LIGHT AVAILABILITY IN TWO ARKANSAS GREENTREE RESERVOIRS

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Light availability is a major factor limiting growth and survival of oak seedlings in mature bottomland hardwood stands. The presence of a dense midstory and understory occupied by shade-tolerant species may prevent the development of oak advance regeneration. To evaluate the use of midstory control as a means of providing sufficient light for seedling development, 24 plots were established across two greentree reservoirs near Stuttgart, Arkansas. Total area in each plot was two acres. Half of the plots received midstory control while half received no treatment. Eight permanent light sampling points were established in each plot. A hemispherical fisheye lens and a Nikon 990 digital camera attached to a self-leveling mount were used to provide a photograph of the canopy from 4.5 feet above the forest floor. The pre-treatment photographs were taken in July of 2007 during the first two hours after sunrise and the last two hours before sunset to avoid any distortion from direct sunlight on the lens or reflections on the underside of leaves. The images were analyzed using the HemiView computer program. Three solar radiation site factors (direct site factor, indirect site factor, and global site factor) were calculated to estimate the amount of light reaching the forest floor. Wide-spacing injection of imazapyr was used to control all undesirable midstory and

understory trees in fall 2007. The light sampling procedure was repeated in July of 2008 and analyzed to evaluate the efficacy of midstory control in promoting a light environment conducive to advance oak regeneration.

REGENERATION IN BOTTOMLAND FOREST CANOPY GAPS SIX YEARS AFTER PRESCRIBED WILDLIFE HABITAT IMPROVEMENT TREATMENTS

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Forestry and wildlife professionals in the Mississippi Alluvial Valley have developed management recommendations for enhancing wildlife habitat on bottomland forests. These recommendations espouse 'Desired Forest Conditions' in terms of primary factors, which can generally be attained via direct management actions (e.g., canopy cover), and secondary factors, which are expected to be attained indirectly as a result of prescribed management. One desired secondary attribute is ensuring succession of shade-intolerant trees to the forest canopy via providing sufficient advance regeneration of these species. Prescribed silvicultural treatments, often variable-retention harvests (a.k.a. wildlife forestry), have been advocated as a means to achieve Desired Forest Conditions. We assessed regeneration within 41 canopy gaps and four patch cuts in four bottomland stands on Tensas River National Wildlife Refuge, Louisiana six years after application of variable-retention, habitat improvement treatments. We contrasted our findings with regeneration within 21 canopy gaps in two adjacent stands that were not subjected to silvicultural treatment (i.e., controls). Gap area on treated stands (disregarding patch-cuts of 0.5 – 1.8 ha) averaged nearly three times that of control stands. Sweetgum (*Liquidambar styraciflua*) was the most common definitive gap filling species within silviculturally created gaps but was not among the four most common species filling naturally created gaps. Green ash (*Fraxinus pennsylvanica*), sugarberry (*Celtis laevigata*) and water oak (*Quercus nigra*) were also common gap fillers on treated sites. When considering all definitive gap fillers, regardless of species, average age (15 years) on treated stands was half that on control stands.

EFFECTS OF NUTRIENT AVAILABILITY AND GENETICS ON ABOVEGROUND PRODUCTIVITY AND ITS INFLUENCE ON BELOWGROUND SOIL CO₂ EFFLUX IN A YOUNG LOBLOLLY PINE CLONAL PLANTATION

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Improved genotypes and increased understanding of the role of intensive silviculture have made southeastern pine plantations some of the most productive forests in the world. Additionally, these stands have the potential to act as C sinks mainly by fixing atmospheric C into woody biomass and/or increasing soil C, which in the future may provide an additional source of income to landowners. The objectives of this research were to determine how two superior loblolly pine genotypes, which represent two distinct ideotypes, respond to manipulations of nutrient availability. Secondly, based on estimates of C capture and loss predict how treatment effects may influence net ecosystem productivity. A combination of N and P fertilization and the incorporation of high C:N logging residue (LR) provided a range of nutrient availability to test the following hypotheses. The two genotypes would both respond to increased N and P, but to different extents. Additionally, the incorporation of LR would decrease growth in both clones, but effect crop ideotype to a lesser extent. And finally, the decrease in aboveground growth and differences in C allocation between clones will have a significant impact of the rate of C evolution from these soils. We found both clones increased aboveground growth in response to fertilization, but to different degrees. Additionally, there were large differences in response to LR incorporation between clones. Finally, there were significant clonal differences in soil CO₂ efflux, heterotrophic respiration, and microbial biomass C indicating that there may be strong differences in NEP between genotype and nutrient availability.

INTEREST GROUP OPINIONS ABOUT FUEL REDUCTION IN SOUTHERN APPALACHIA

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Opinions of interested publics and interest groups (N=640) about fuel reduction (FR) in the southern Appalachians were investigated through social survey using both pictorial and regular questions. The study identified three discrete groups based on knowledge of forest history in the southern Appalachians, attitudes toward social and ecological changes due to FR, credibility of public land management agencies as managers of forests, aesthetics of FR areas, and recreation activity participation. Results identified three groups of concerned publics labeled as Conservation Oriented, Naïve Perceptual and Preservation Oriented. The conservation oriented group was accepting of FR but for

selective reasons, the naïve perceptual group disliked even minor charred views and stumps, the preservation group was skeptical of FR and characterized by wanting nature to be left alone. Detail rich results provide guidance in constructing different educational and persuasive messages specific to each of these three groups about forest management through fuel reduction in southern Appalachia.

ESTIMATING LOBLOLLY PINE SIZE-DENSITY TRAJECTORIES ACROSS A RANGE OF PLANTING DENSITIES

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Size-density trajectories on the logarithmic (ln) scale are generally thought to consist of two major stages. The first major stage is often referred to as the density-independent mortality stage where the probability of mortality is independent of stand density; in the second stage, often referred to as the density-dependent mortality or self-thinning stage, the probability of mortality is related to stand density. Within the self-thinning stage, segments of a size-density trajectory consisting of a non-linear approach to a linear portion, a linear portion (Maximum Size-Density Relationship (MSDR) dynamic thinning line), and a divergence from the linear portion are generally assumed. VanderSchaaf and Burkhart (2008) used a loblolly pine (*Pinus taeda* L.) planting density study to demonstrate the use of segmented regression models for estimating stages and phases of stand development. In this current paper, estimates of the logarithm of quadratic mean diameter (lnDq) and logarithm of trees per acre (lnN) where the two stages of stand development and the three phases of self-thinning begin and end were obtained from the segmented regression analyses and used as response variables predicted as a function of planting density. Predicted values of the lnDqs and lnNs allow for size-density trajectories comprised of stages and phases of stand development to be estimated for any planting density.

REGENERATION OF APPALACHIAN HARDWOODS: ADAPTING THE REGEN MODEL FOR THE CUMBERLAND PLATEAU PHYSIOGRAPHIC PROVINCE

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The difficulty of achieving reliable oak regeneration is well documented. Applicability of silvicultural techniques to facilitate regeneration largely depends on current regeneration potential. A computer model to predict future stand composition following harvest based on existing stand composition and advanced regeneration in Appalachian hardwoods was developed by David Loftis at the USFS Bent Creek Experimental Forest. REGEN is a competition based, expert system which predicts future species composition following heavy disturbance. Species composition at the initiation of the stem exclusion phase is predicted using data collected from regeneration surveys in existing mature stands. A knowledge base which contains competitive rankings for each species likely to be encountered in a management unit is used to develop predictions of future stand composition. The stochastic nature of the model combined with multiple simulation runs per stand allows for summary statistics to be reported with predictions. REGEN was initially developed for hardwood forests in the Blue Ridge physiographic province of the southern Appalachians. We have developed REGEN knowledge bases for hardwood forests in the Cumberland Plateau physiographic province. These knowledge bases are currently being tested by comparing REGEN predictions from existing mature stands to species composition of younger nearby stands in the stem exclusion phase. Test results, assessments of accuracy, and applicability of the knowledge bases are discussed along with possible future refinements.

RESTORATION TREATMENTS IN EASTERN HARDWOODS: IMPACTS AND INTERACTIONS OF MULTIPLE ECOSYSTEM COMPONENTS

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Land managers for hardwood forests of the eastern US are challenged by new demands for fuel reduction and ecosystem restoration but with little information on fire effects. Mechanical fuel treatments and prescribed fire are powerful tools for restoration and for reducing wildfire potential but the ecological consequences of their use is unknown. The National Fire and Fire Surrogate Study (NFFS) examines the effects of alternative fuel reduction techniques involving fire and mechanical “surrogate” treatments on numerous environmental variables. Previous

papers have presented results of these treatments on individual variables at the NFFS sites in the Ohio Hill Country and the Southern Appalachian Mountains. In this paper, we will show how fire and mechanical fuel treatments impacted vegetation, soils, small mammals, birds, herpetofauna, tree diseases, and fuels. We will also show how interactions among these variables contributed to changes in both ecosystem structure and function.

FUEL VARIATION IN THE CAROLINA SANDHILLS NATIONAL WILDLIFE REFUGE: EFFECTS ON FIRE AND VEGETATION

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Upland forest in the Carolina Sandhills National Wildlife Refuge (McBee, SC) is characterized by a longleaf pine (*Pinus palustris*) canopy with a patchy understory of turkey oak (*Quercus laevis*), and a ground layer of wiregrass (*Aristida stricta*) and mixed forbs. The system was historically maintained by fire, and has been managed with prescribed fire in recent decades. A refuge goal is to restore forest structure by reducing the turkey oak stem density in the understory. The heterogeneity of this forest type creates heterogeneity of fuel complexes on a relatively small within-stand scale. Understanding the properties of each fuel complex is necessary to develop a better understanding of how fire functions to meet management objectives, including the reduction of oaks and increase of grasses. We measured chemical content (energy and ash) of five common species, and used prescribed burns on three fuel treatments (longleaf needle litter, wiregrass and turkey oak) to compare fire temperature and intensity associated with each fuel type. Longleaf litter contained the highest energy content (21725 J/g) and little bluestem (*Schizachyrium scoparium*) the lowest (19142 J/g). Intensity and fire behavior will be reported for each fuel type. Ongoing work examines if post-fire conditions of the fuel treatments affect wiregrass seedling survival and growth, and the role of below-ground competition on wiregrass seedling establishment.

IMMEDIATE EFFECT OF BURNING AND LOGGING TREATMENTS ON THE AVIAN COMMUNITY AT BANKHEAD NATIONAL FOREST OF NORTHERN ALABAMA

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We evaluated the changes in the bird community in relation to six silviculture treatments in the Bankhead National Forest, AL. The study design is randomized complete block with a factorial arrangement of three thinning levels (no thin, 11 m² ha⁻¹ residual basal area [BA], and 17 m² ha⁻¹ residual BA) and two burn treatments (burn and no burn), with three replications. Data were collected from pre- and post-treatment avian line-transect and microhabitat surveys. Canonical correspondence analysis (CCA) was used to evaluate relationships between bird community and microhabitat characteristics. Multivariate analysis of variance was used to test effects of treatment and change over time. Abundance of bird species and nesting guilds of birds were associated with ground cover and canopy cover. Abundance of tree and cavity nesting birds increased in burned plots and decreased in control and thinned plots. Abundance of foliage foraging birds and interior/edge habitat dwelling birds decreased in plots that were thinned and burned. Abundance of edge/open habitat dwelling birds increased in thinned plots. Abundance of Prairie warblers (*Dendroica discolor*), a species of high concern in Alabama, increased in number of detections on treated plots. In this study, tree thinning had more impact on the bird community than prescribed burning. This type of thinning can be used as a management tool to increase densities of birds associated with open habitat.

IMPLICATIONS OF DIURNAL DISSOLVED OXYGEN PATTERNS IN LOW-GRADIENT FORESTED HEADWATER STREAMS FOR SILVICULTURAL BEST MANAGEMENT PRACTICES

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During the summer season, many low-gradient forested streams in the Gulf coastal plain of the U.S. are characterized by low discharge, high organic content, and high temperatures. These streams are often oxygen depleted and entire watersheds can reflect these conditions. Concerns about low dissolved oxygen (DO) concentrations are especially significant in Louisiana, where a large number of the state's low-gradient watersheds have been defined as impaired by U.S. Environmental Protection Agency due to low DO levels in streams. This raises questions for both agencies and the forest community about how silvicultural practices, such as timber harvesting and site preparation, can be conducted to maintain and/or improve the stream oxygen conditions. In this study, we monitored daily DO

fluctuation upstream and downstream along a 2nd order low-gradient stream draining through a watershed with mature loblolly pine in central Louisiana. Timber harvesting on both sides of the stream was implemented in summer 2007 under the current forestry Best Management Practice (BMP) guidelines for Louisiana. DO data collected in four seasons prior to harvest (summer and fall 2006, winter 2006/07, and spring 2007) will be used to determine whether two characteristics of stream diurnal DO profiles, daily amplitude and maximum value of the DO saturation deficit, are affected by timber harvesting activities. Changes in these indicators could be indicative of modifications to stream metabolism but must also be interpreted while considering fluctuation in weather and hydrology. Such information is critical to both developing silvicultural BMPs and defining attainable stream DO standards for low-gradient forested watersheds.

UNWANTED HARDWOOD CONTROL WITH JUNE-APPLIED CHOPPER GEN2 AND CHOPPER ON FOUR SITES

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Chopper is commonly used for herbicidal preparation of pine sites for planting. Chopper GEN2 is an improved formulation of Chopper, offering enhanced early product performance. Both products contain the active ingredient, imazapyr. Managers of southern timberlands routinely apply Chopper from July through October. Unfavorable weather between July and October, increases the difficulty in completing timely applications. A wider application window allows managers more time to complete the applications needed for effective weed control. Opportunity exists to expand the application window into June. Four sites, one each in Louisiana, Mississippi, Virginia and South Carolina were selected for testing. The objective was to compare the unwanted hardwood control of Chopper (32oz prod per acre) and Chopper GEN2 (32oz prod per acre) mixed with 0, 2.5%, 7.5%, and 12.5% MSO when preparing pine sites for planting. At each site, treatments were replicated three times in a randomized complete block design. Treatments were foliar applied in a total volume of 10 GPA. All sites were treated between June 2-14, 2005. Red maple, blackgum, sweetgum, red oak, white oak and yellow-poplar were the major hardwoods tested. After two growing seasons, there were two findings of operational significance. First, percent control of Chopper GEN2+2.5% MSO was better than Chopper+2.5% MSO and equivalent to Chopper+12.5% MSO. This allows early (pre-June 15) application at reduced MSO volumes and cost without reduced control. Second, the overall control for the best treatment in this study was 87%, indicating higher rates could provide even higher control.

EFFECTS OF SITE PREPARATION PRACTICES AND SUSTAINED COMPETING VEGETATION CONTROL ON LOBLOLLY PINE GROWTH IN THE PIEDMONT/UPPER COASTAL PLAIN OF THE SOUTHEASTERN UNITED STATES

Dehai Zhao*, **Michael Kane**, **Bruce E. Borders**, **Mike Harrison**, & **John Rheney**, respectively, Research Professional, Professor, Professor, Research Professional, and Research Professional, Warnell School of Forestry and Natural Resources, University of Georgia, Athens, GA

A study was initiated in 1986 to evaluate the impact of different site preparation treatments on the growth and yield of loblolly pine (*Pinus taeda* L.) plantations in the Piedmont and Upper Coastal Plain of the southern United States. Site preparation treatments included: (1) burn only, (2) chop and burn, (3) shear, pile and disk, (4) chop, herbicide and burn, (5) herbicide and burn, and (6) herbicide, burn and herbicide. The herbicide, burn and herbicide treatment consistently and significantly increased total volume per acre compared to all other treatments. There were no significant differences among the shear, pile and disk treatment, the chop, herbicide and burn treatment, and the herbicide and burn treatment. The burn only treatment consistently ranked worst compared to all other treatments, and the second worst one was the chop and burning treatment. Chopping six to eight weeks prior to chemical site preparation and burning was not effective as the simple chemical site preparation and burning. Burning alone did not effectively control the larger hardwoods. Average 21-yr-old mean annual total volume increments (ft³/ac/yr) across all locations by treatment were: herbicide, burn and herbicide (249.3), shear, pile and disk (227.9), herbicide and burn (227.6), chop, herbicide and burn (223.5), chop and burn (209.4), and burn only (154.7). The temporal patterns of response to site preparation and vegetation control have implications regarding timing of treatments such as thinning and fertilization as well as financial return.

Poster Presentation Abstracts

NOTES:

TREE ROOT EXTENT AND BEHAVIOR ALONG AND IN LEVEES AND FLOODWALLS IN SOUTH LOUISIANA

Christopher B. Allen*, **Thomas J. Dean**, **Jim L. Chambers**, & **Melinda S. Hughes**, respectively, Research Associate, Professor, Professor, and Senior Research Associate, School of Renewable Natural Resources, LSU Agricultural Center, Baton Rouge, LA

The damage due to storm surge from the 2005 hurricanes in coastal Louisiana raised concerns for potential future levee and floodwall weaknesses. This study was initiated to gather data on tree root extent and behavior for vegetation management decisions and guidelines to be adopted by the US Army Corps of Engineers for levees and floodwalls in south Louisiana. We selected 79 trees representing a mix of diameter classes and species most represented along the levees in the New Orleans district for sampling. Species included live oak, water oak, sycamore, baldcypress, sugarberry, Chinese tallow, pecan, and slash/loblolly pine. For each tree, we installed trenches (3 feet deep x 10 feet wide) for mapping root profiles into the levee walls. The distance to the first trench from the tree varied with tree distance from the levee toe and subsequent trenches were placed at 6 foot intervals until no roots greater than 0.5 inches were found. Roots were classified as: 0.5 to 0.99 inch, 1 to 1.49 inches, 1.5 to 1.99 inches, and above 2 inches. We also estimated soil strength and texture within the profile and measured several tree attributes for correlation with root length. Root frequency decreased with distance from the tree for all species. Pecan, live oak, and sycamore had the greatest radial root extent while Chinese tallow, sugarberry, and water oak had the lowest. Total height, D²H, and crown diameter were the best predictors of maximum root extent. Root sampling and probabilities of root distribution will be portrayed.

DELAYS IN SAMPLE PROCESSING MAY AFFECT ESTIMATES OF MINERAL NITROGEN IN LOW NITROGEN SOILS

Christopher B. Allen*, **Thomas J. Dean**, & **D. Andrew Scott**, respectively, Research Associate and Professor, School of Renewable Natural Resources, LSU Agricultural Center, Baton Rouge, LA; and Research Soil Scientist, U.S. Forest Service, Southern Research Station, Pineville, LA

The delay in processing soil samples has been shown to influence estimates of extractable N in soils with inherently high rates of nitrogen mineralization and nitrification. In Louisiana, mineralization and (particularly) nitrification rates are often relatively low. This study was conducted to test the effects of delayed sample processing (our standard method) vs. the extraction of mineral nitrogen in the field. Eight plots in young loblolly pine stands (4 with high growth rates, 4 with low growth rates) were chosen for this 2-year study. Samples were taken to 20 cm periodically at 5 locations within each plot. At each sampling, two subsamples per plot were extracted with 100 ml of 2M KCl in the field. A separate sample was returned to the lab, where 2 subsamples were homogenized and likewise extracted with 100 ml of 2M KCl. The aliquots were analyzed for NH₄ and NO₃. Field extraction showed lower extractable NH₄ and total mineral N than delayed laboratory extraction on 3 of the 6 sampling dates and on 4 of the 6 sampling dates for NO₃. On one sampling date, laboratory extraction resulted in higher extractable NH₄, and total mineral N than field extraction. These results indicate that samples should be processed in the field whenever possible, even under low nitrogen conditions.

NITROGEN FERTILIZER RESPONSE CURVES IN INTENSIVELY MANAGED HARDWOOD FORESTS

Doug P. Aubrey*, **Mark D. Coleman**, & **David R. Coyle**, respectively, Technician and Research Biologist, U.S. Forest Service, New Ellenton, SC; and Graduate Student, University of Wisconsin, Madison, WI

Forest production can be optimized through nitrogen (N) amendments. However, N fertilization beyond an optimal level is wasteful and may contaminate ground water through leaching. We estimated biomass of common southeastern hardwoods grown with or without irrigation across a range of fertilization (8 levels) to determine optimal fertilization regimes for each species. Fertilizer was applied weekly via drip irrigation over the 26 week growing season. Fertilizer levels were adjusted for the demand expected during early establishment. We harvested stems, branches and stumps from 3 random trees per treatment (stratified by dbh) during the dormant season following 8 years of growth. Power functions were used to estimate biomass as a function of dbh. We determined the response surface for each species using regression techniques and fit quadratic equations to the data. We included the response surface value in our quadratic equations and determined the expected biomass production at optimal fertilizer levels. Based on total tree biomass, cottonwoods (162 – 231 kg N ha⁻¹) had the highest optimal fertilization level, followed by sycamore (140 kg N ha⁻¹) and sweetgum (101 kg N ha⁻¹). However, total biomass under optimal fertilization levels was highest in sycamore (80 Mg ha⁻¹) and lowest in one of the cottonwoods (52 Mg ha⁻¹). Based on optimal N levels and expected biomass accumulation, sweetgum is most efficient in utilizing applied N for biomass production, sycamore is intermediate, and cottonwoods are the least efficient.

AGROFORESTRY PLANTING DESIGN AFFECTS LOBLOLLY PINE GROWTH

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The effect of plantation design on resource utilization has not been adequately investigated in agroforestry plantations. An experiment was conducted near Booneville, AR on a silt loam soil with a fragipan. Loblolly pine trees were planted in 1994 in an east-west row orientation in three designs: two-rows (1.2 x 2.4 m) with a 7.3 m alley, four rows (1.2 x 2.4 m) with a 12.2 m alley, and a rectangular 1.2 x 2.4 m configuration. Each 0.4 ha design was replicated three times, and had 1540 tph (two- and four-row designs), and 3,340 tph (rectangular design) at planting. An estimated 75 to 90% of trees survived to 2007. Height and dbh were measured for six years (2002-2007) in 0.047 ha plots. Tree height increased annually from 7.30 m (2002) to 13.27 m (2007), but designs did not differ in height within years. There was a year x design interaction effect for dbh. For any given year, dbh was greatest in the two-row design; the four-row design had greater dbh than the rectangular design in 2004-2007. Row location (north, south, or middle rows depending on the design) did not have an effect on dbh in two-row and rectangular designs, but exterior rows in the four-row design had greater dbh than interior rows. Overstocking constrained dbh growth in the rectangular design, but this design could have value for pine straw production. The two- and four-row designs could be used for silvopasture.

ANNUAL AND SEASONAL VARIATION OF SEEDFALL, SEED VIABILITY, GERMINATION AND SURVIVAL OF SEEDLINGS BELOW CANOPY IN SLASH PINE STANDS

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Typical slash pine (*Pinus elliottii* Engelm. var. *elliottii*) is one of the most important cultivated species in Argentina. In this country, the forest landowners have interest to management the natural regeneration (stimulating or controlling). Several factors may play a key role in successful regeneration. One of these factors is the viable seeds in the soil at moment to remove the canopy. The objective of this study was to evaluate the annual and seasonal variation of the factors that controlling the potential use of natural regeneration after clear cutting, in Concordia (31° 22' Lat. S, 58° 07' Long. W) Entre Ríos Province, Argentina. We monitored seedfall, seed viability, germination, and survival of seedling in three slash pine stands during six years. The radiation environment below canopy was characterized using hemispherical photographs. We detected a cyclical pattern with a seedfall peak every three years. Seedfall values of 130 - 500 seeds m⁻² year⁻¹ were registered. We found that 84 to 89% of seedfall occurs during April and May (autumn). The germination occurred during a short period after seedfall. The recruitment was registered during winter and spring. After few months the viable seed represented only 3% of the seed total in the soil. Mortality had more impact during spring and summer. So, survival of seedlings below canopy was very low. In this condition, the relative radiation was 15 - 39%. The results permitted to planning a calendar of harvest to facilitate or to control the natural regeneration.

CONVERSION OF AN OAK SEED ORCHARD TO OAK SILVOPASTURE

Kristina Connor*, **Rebecca J. Barlow**, **Luben Dimov**, **Mark Smith**, & **Eddie Kirkland**, respectively, Project Leader, U.S. Forest Service, Southern Research Station, Auburn, AL; Assistant Professor/Extension Specialist, School of Forestry and Wildlife Sciences, Auburn University, AL; Assistant Professor, Center for Forestry, Ecology, and Wildlife, Alabama A&M University, Huntsville, AL; Assistant Professor/Extension Specialist, School of Forestry and Wildlife Sciences, Auburn University, AL; and State Lands Forester, Alabama Forestry Commission, Auburn, AL

Silvopasture offers the opportunity to provide the multiple benefits of high value timber products and livestock or agricultural crop production. In 1995-1998, the Alabama Forestry Commission established 63 acres of hardwood seed orchards at the Stauffer Nursery on a 30 foot x 30 foot spacing. The planted species are valuable oaks, namely cherrybark, white, Shumard, Nuttall, swamp chestnut, and willow. It is our intent to convert the now-decommissioned orchard to a hardwood silvopasture. While much silvopasture research has been done with a number of hardwood species in Europe, research in the United States has focused primarily on loblolly and slash pine, although there has been some work with black walnut and pecan. Very little research is available with hardwood performance in silvopasture settings and none with the oak species planted on the Stauffer Nursery site. In the spring/summer of 2008, we are initiating our study by measuring length of live crown, dry weight understory biomass under the different oak species, and epicormic branches and where they occur on the trunk. This baseline data will ultimately lead to studies on relative growth, vigor, and value of the different oak species, the effect of pruning on log quality, log value of trees grown at wide spacing, periodicity of acorn bumper crops, influence of cattle on discoloration of sapwood, creation of wildlife habitat in oak systems, and the economic benefits and costs of hardwood silvopasture or silvoarable systems.

ADDITIONAL ANALYSIS ON THE EFFECTS OF ORGANIC MATTER REMOVAL AND SOIL COMPACTION ON AN LTSP SITE IN NORTH CAROLINA

Robert Eaton* & Felipe Sanchez, respectively, Biologist and Chemist, U.S. Forest Service, Southern Research Station, Research Triangle Park, NC

The Long Term Soil Productivity (LTSP) experiment is a U.S. Forest Service-led effort to test the effects that organic matter removal, soil compaction, and competition control have on forest soil productivity, as measured by tree growth. A replicated experiment was installed on the Croatan National Forest, North Carolina, USA, in winter 1991, and loblolly pine (*Pinus taeda* L.) seedlings were planted there in early spring 1992. Experimental treatments included three levels of organic matter removal: stem-only; whole tree; and whole tree plus all forest floor, in combination with three levels of compaction: none; moderate; and severe. Plots were split for competition control treatments. Previous analyses, using all live trees in the measurements plots, indicated that competition control was the sole significant treatment effect on tree height for the first 10 years of this study. Further analysis indicates separation of the competition control effects may yield main treatment effects on height growth and diameter, suggesting that site preparation may affect merchantable timber production.

QUANTITATIVE AND QUALITATIVE MEASURES OF DECOMPOSITION: IS THERE A LINK?

Robert Eaton* & Felipe Sanchez, respectively, Biologist and Chemist, U.S. Forest Service, Southern Research Station, Research Triangle Park, NC

Decomposition rates of loblolly pine coarse woody debris (CWD) were determined (by mass loss estimates and changes in wood density) for trees that differed in source of mortality (natural, standing, and felling). No significant difference was detected between the rates of decomposition for CWD on the different treatment plots indicating that source of the tree mortality did not influence rates of decomposition once the tree fell. These experimental measures of decomposition were compared to two decay classification systems (a three unit and a five unit classification) to determine any linkages. Changes in wood density did not correlate to any decay classification whereas mass loss had a weak correlation with decay class. While mass loss was related to decay classification, there was a large degree of variation which limits the utility of these systems in estimating mass loss.

INTENSIVE STRAW HARVESTING, FERTILIZATION, AND FERTILIZER SOURCE AFFECT NITROGEN MINERALIZATION AND SOIL LABILE OF A LOBLOLLY PINE PLANTATION

Keith Ellum, Hal O. Liechty, & Michael A. Blazier*, respectively, Graduate Student and Professor, University of Arkansas Monticello, School of Forest Resources, Monticello, AR; and Assistant Professor, Louisiana State University AgCenter, Hill Farm Research Station, Homer, LA

Straw harvesting can supplement traditional revenues generated by loblolly pine plantation management. However repeated raking may alter soil properties and nutrition. A previous study documental altered bulk densities and microbial populations related to straw harvesting and different fertilizer applications. Another study at this same site was initiated to evaluate the long-term effects of intensive straw raking and fertilizer source (inorganic or organic) on nitrogen cycling and soil carbon quality. Monthly in situ soil nitrogen mineralization and end-of-season soil labile C concentrations were measured in response to: (1) annual straw raking for four years, (2) annual straw raking and fertilization with inorganic fertilizer for four years, and (3) annual straw raking and fertilization with broiler poultry litter application for four years. Results of these analyses will be presented and related to the potential sustainability of these differing treatments

EFFECTS OF LIGHT REGIMES ON 2-YEAR-OLD SWEETGUM AND WATER OAK SEEDLINGS

Robert L. Ficklin* & Michael G. Shelton, respectively, Assistant Professor, School of Forest Resources, University of Arkansas-Monticello, Monticello, AR and Research Forester, U.S. Forest Service, Southern Research Station, Monticello, AR

Modified shadehouses were used to test the effects exposure to direct sunlight on the growth of sweetgum (*Liquidambar styraciflua* L.) and water oak (*Quercus nigra* L.) seedlings. Simulating light conditions within forest openings, the five light regimes represented the time of exposure to direct sunlight: none, noon, morning, afternoon, and full. Greenhouse-started sweetgum and water oak seedlings were randomly field planted in the treatment plots at a 0.3 x 0.3 m spacing. Height, groundline diameter, biomass, stem density, and leaf characteristics were determined at the end of the second growing season. Growth for both species generally increased with the amount of direct sunlight received. For treatments receiving some direct sunlight, water oak seedlings were taller than sweetgum; however, sweetgum was 42% taller than water oak in the fully shaded treatment. Groundline diameter of sweetgum

exceeded that of water oak by an average of 33%. Only minor differences for biomass occurred either between species or among treatments when some direct sunlight occurred. However, biomass of sweetgum was four times greater than water oak in the fully shaded treatment. Stem density did not vary across treatments for water oak, but sweetgum stem density increased with increased exposure to direct sunlight. In full shade, sweetgum leaves had a specific leaf area of 225 cm² g⁻¹ compared to 150 cm² g⁻¹ for water oak. Results suggest that sweetgum seedlings are more physiologically plastic with respect to low light levels than water oak seedlings during the first 2 years of development.

INFLUENCE OF FOREST MANAGEMENT PRACTICES ON FLORIDA SCRUB-JAY (*APHELOCOMA COERULESCENS*) NEST DAILY SURVIVAL ON THE OCALA NATIONAL FOREST, FLORIDA

Kathleen E. Franzreb, Research Wildlife Biologist, U.S. Forest Service, Southern Research Station, Knoxville, TN

One of the main populations of the Florida scrub jay (*ApheLOcoma coeruleScens*), a federally threatened species, occurs on the Ocala National Forest, Florida. I undertook a study to examine how the scrub-jay responds to different sand pine regeneration methods that are used on the Ocala National Forest and to determine if these methods are conducive to maintaining a viable population of scrub-jays. I assessed the nest daily survival rate (Mayfield method) in response to treatment of stands after timber harvesting or wildfire occurrence. Stand treatments included site preparation (post-harvest burning, chopping, and chopping with burning) and re-seeding (artificial versus natural). I detected little difference in nest daily survival probability in relation to the type of treatment after harvesting. Although nest survival was not apparently significantly higher in burned areas, none the less, the proportion of Florida Scrub-Jay nests was significantly higher in burned habitat than what would be expected based on availability. To increase the population size of Florida Scrub-Jays on the Ocala National Forest, it is recommended that burning activities be emphasized.

ENRICHMENT PLANTINGS TO ESTABLISH WHITE OAK SEEDLING IN RIPARIAN BUFFER STRIPS

Benton Gann* & Jamie L. Schuler, respectively, graduate student and Assistant Professor, School of Forest Resources, University of Arkansas at Monticello, Monticello, AR

Small creek bottoms are very common in southern Arkansas. These sites tend to be productive, supporting a variety of oak species, and provide habitat for many species of wildlife. State BMP guidelines suggest leaving 35 to 80 ft wide buffer strips and a minimum of 50 ft²/ac. In many cases, the high value oak species have been removed from these areas, leaving behind shade tolerant species with low commercial value (e.g., elms, hophornbeam and red maple). Most past attempts to supplement natural regeneration with planted seedlings have failed due to compounded pressures from competing vegetation and herbivory. We will report the two-year results of a technique used to artificially establish oak in riparian buffer strips.

FAMILY AND IRRIGATION EFFECTS ON WOOD QUALITY AND WATER RELATIONS OF LOBLOLLY PINE

Carlos A. Gonzalez* & Tim A. Martin, respectively, Graduate Student and Associate Professor, School of Forest Resources and Conservation, University of Florida, Gainesville, FL

Secondary xylem fundamental functions are mechanical support and transport of water and nutrients. Because wood structure and morphology are directly related to water transport, genetic selection for “better” wood quality could potentially impact or influence water relations characteristics. Similarly, environmental factors which influence tree water relations can potentially impact wood quality traits, such as wood specific gravity or latewood:earlywood ratios. This study was carried out to determine to what extent water availability, tree water relations, and wood quality traits are related in loblolly pine, and to determine whether provenance impacts these relationships. This study was conducted on a 10-year-old loblolly pine irrigation x genetic trial, located in Southlands Forest, Bainbridge, GA. The trial consists of 4 treatments: 2 genetics entries + 2 water availability (irrigation or no irrigation) entries. For 2 growing seasons we measured sapflow, basal area growth, soil moisture, foliar and xylem carbon isotope discrimination, wood properties (specific gravity and latewood:earlywood ratio), foliar water potential, whole tree hydraulic conductance and climate. Irrigation had significant effects on most measured variables, including wood quality traits; in some cases these responses varied by provenance. We will discuss the results within the context of environmental and genetic control of wood quality traits.

EFFECT OF FUEL REDUCTION TREATMENTS ON GROUND-DWELLING MACROARTHROPOD COMMUNITIES IN A SOUTHERN APPALACHIAN UPLAND HARDWOOD FOREST

Cathryn H. Greenberg*, T.G. Forrest, & Thomas A. Waldrop, respectively, Project Leader and Research

Ecologist, U.S. Forest Service, Southern Research Station, Asheville, NC; Professor, Department of Biology, University of North Carolina at Asheville, Asheville, NC; and Team Leader and Research Forester, U.S. Forest Service, Southern Research Station, Clemson, SC

As part of the multidisciplinary National Fire and Fire Surrogate Study we compared the effects of 3 fuel reduction techniques and a control on ground-dwelling macroarthropod communities. Four experimental units, each > 14-ha were contained within each of 3 replicate blocks at the Green River Game Land, Polk County, North Carolina. Treatments were (1) prescribed burning (B); (2) mechanical felling of shrubs and small trees (M); (3) mechanical felling + burning (MB), and; (4) controls (C). Treatments were implemented incrementally, but were complete by spring 2003. We collected macroarthropods using drift fences with pitfall traps that were open continuously and concurrently during spring and late summer (mid-May through June and August – September) 2003. After treatments (2003) leaf litter depth decreased in B and MB, and snag density and light levels were highest in MB. We captured a total of 460g (dry biomass) of 6,776 individual macroarthropods within 22 identified orders, and 59 identified families. Total relative abundance, dry biomass, and richness of macroarthropod orders and families were similar among the treatments and control. Our data indicate that fuel reduction treatments, including prescribed burning, had little effect on macroarthropod communities, at least in the short-term.

UNDERSTANDING LANDOWNERS' ATTITUDES TOWARD SHORTLEAF PINE RESTORATION IN MISSOURI

David Gwaze*, Heather Scroggins, Michele Baumer, Ron Reitz, & Tom Treiman, respectively, Resource Scientist, Resource Scientist, Resource Assistant, Resource Scientist, Resource Scientist, Missouri Department of Conservation, Columbia, MO

Public land managers have identified restoring shortleaf pine as a top priority in Missouri. Given that 85% of commercial forests in the state are under private landownership, restoration efforts are not possible without the participation of private landowners. Our objective was to assess the attitudes of private landowners toward shortleaf pine restoration. In 2007 and early 2008 nine focus groups were conducted in the traditional shortleaf pine range of Missouri. The reasons why private landowners restore shortleaf pine included aesthetic, recreational, economic, wildlife and legacy values. Funding was not viewed as a challenge, but receiving seedlings on time, availability of seeds for direct seeding, access to education material and access to markets were. It appeared that challenges to restoring shortleaf pine were not insurmountable. Findings from the focus groups will be used to better target educational efforts related to shortleaf pine restoration and to develop new ways to assist landowners as well as to aid in the development of a large scale mail survey.

DEVELOPING EQUATIONS FOR ESTIMATING TREE COMPONENT BIOMASS FOR NATURALLY REGENERATED SHORTLEAF PINE IN SOUTHEAST OKLAHOMA

Nabin Gywali, Thomas B. Lynch*, & Rodney E. Will, respectively, Graduate Research Assistant, Professor, and Associate Professor, Department of Natural Resource Ecology and Management, Oklahoma State University, Stillwater, OK

Tree component (branch, foliage and tree bole) biomass equations were developed based on destructive measurement of 48 shortleaf pine (*Pinus echinata* Mill.) trees, ranging from 2 to 13 inches in dbh. Measurements were taken from a thinning study established in an even-aged, natural stand of shortleaf pine and consisting of 12 permanent plots established during 1988-1989. Thinning treatments included unthinned control plots and plots thinned to 70%, 50% and 30% full stocking. Equations for prediction of shortleaf pine branch-level biomass were fitted first by nonlinear regression based on ordinary least squares (OLS) Branch basal diameter, height of the branch and the ratio of total height to dbh were significant in predicting both branch wood and foliage biomass. Branch-level mixed-effect models were also developed by used random parameters at the tree level to account for correlations among samples obtained from the same tree. For the mixed-effects model, the random tree variance was significant at 0.05 alpha level and AIC (Akaike Information Criterion) was highly improved compared to the OLS model. The developed branch-level equations were used to predict the biomass of branches that were not sampled on each biomass sample tree. Using these data, relationships were developed to predict shortleaf pine biomass components at the individual tree level using nonlinear seemingly unrelated regression methods.

EFFECTS OF PLANTING DENSITY AND GENOTYPE ON CANOPY SIZE, CANOPY STRUCTURE, AND GROWTH OF 25-YEAR-OLD LOBLOLLY PINE STANDS IN SOUTHEASTERN OKLAHOMA

Thomas C. Hennessey*, Rodney E. Will, Thomas B. Lynch, Robert Heinemann, Keith Anderson, Dennis Wilson, Randal Holeman, & Gregory Campbell, respectively, Professor, Associate Professor, and Professor, Department of Natural Resource Ecology and Management, Oklahoma State University, Stillwater, OK and

Station Superintendent and Staff, Kiamichi Forestry Research Center, Oklahoma State University, Idabel, OK

Leaf biomass and its display within the canopy are important driving variables of stand growth because they reflect a tree or stand's capacity to intercept radiation, reduce carbon dioxide, and transpire water. We determined the effects of planting density (4 x 4, 6 x 6, 8 x 8, and 10 x 10 foot spacing) on annual needle-fall biomass, stand-level basal area, intercepted radiation, canopy openness, and current annual increment for 25-year-old stands planted with two loblolly pine seed sources: North Carolina Coastal (NCC 8-01) and Oklahoma/Arkansas (O/A mix 4213). The study site is located on an excessively drained, mountain site in southeastern Oklahoma. Litter was measured using randomly located traps and summed for a phenological year (1 April to 31 March). Intercepted radiation and canopy openness were measured using hemispherical photographs and the WinScanopy Canopy Analysis Software. Basal area at the beginning of the 2008 growing season was positively correlated to litterfall that represented the previous-year's cohort ($p < 0.01$, $r^2 = 0.37$). This relationship was not affected by genotype or spacing. During the 2008 growing season, we will measure current annual increment, intercepted radiation, litterfall, and canopy openness to evaluate the effects of spacing and genotype on growth efficiency, radiation use efficiency, and canopy structure.

TEMPORAL EFFECTS OF MIDROTATION FERTILIZATION AND COMPETITION CONTROL COMBINED WITH AGGRESSIVE THINNING

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A cooperative study of the feasibility of production of large loblolly pine sawtimber trees through application of mid-rotation management practices was established in eastern Texas in 1994. The study was designed to evaluate the effects of heavy thinning, fertilization, and competition control on future growth and yield. Three different levels of thinning treatments were applied on randomly selected plots at two separate sites to reduced residual density to 70, 120, and 170, as measured by Stand Density Index (approximately 36, 60, and 84 square feet of basal area or 100, 200, and 300 stems, respectively) per acre. Treatments also included two levels of fertilization (fertilized and not fertilized) and two levels of competition control (herbicide and no herbicide). Plots were remeasured at two-year intervals for 8 years following treatment application. Data was analyzed using mixed model repeated measures ANOVA techniques. Results showed temporal effects of select treatments that relate to silvicultural response types.

LONG-TERM (1991-2006) PATTERNS OF OAK MORTALITY IN A SOUTHERN APPALACHIAN FOREST

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Between 1991 and 2006, 332 oak trees within Bent Creek Experimental Forest (BCEF), were monitored for mast production. Sample trees represented a variety of species, size, and age classes with the majority of trees in dominant and co-dominant canopy positions. Over 15 years, a total of ~14% of oaks died. Patterns of oak mortality related to disturbance events and background mortality rates within BCEF were observed. The majority of tree death was attributed to one of two mortality agents: (1) storm-related mortality or (2) decline (e.g. background mortality). Storm-related mortality resulted from wind-throw during three distinct storm events: Hurricane Opal (August, 1995) and Hurricanes Frances and Ivan (September 2004). During these storms a combined 6% of trees were uprooted and killed. A disproportionate number of scarlet oak were uprooted relative to black, chestnut, northern red, and white oak (15% compared to an average of 3%). Unlike storm-related mortality which produced distinct pulses of mortality, no single year was punctuated by decline-related mortality. A similar proportion of trees (7%) died from decline as were killed via storm damage. Scarlet oak was most susceptible to decline (13%) followed by black (8%) and northern red oak (7%). Surprisingly, older trees were no more susceptible to decline than younger trees. From these data, we conclude that oak decline produces background mortality rates of 0.5% of trees per year in BCEF. Background rates were quickly exceeded during storm events which killed an additional 3.6% and 2.1% of trees in 1995 and 2004, respectively.

USING EXISTING GROWTH MODELS TO PREDICT RCW HABITAT DEVELOPMENT FOLLOWING SITE PREPARATION: PITFALLS OF THE PROCESS AND POTENTIAL GROWTH RESPONSE

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Land managers throughout the southeast are interested in restoring the longleaf pine (*Pinus palustris* Mill.) ecosystem, due in part to its value as habitat for the endangered red-cockaded woodpecker (*Picooides borealis*). In 2003, we established a study in Camp Lejeune, NC to determine the effects of common site preparation treatments (mounding, bedding, herbicide, chopping) on longleaf pine restoration on wet sites. We monitored mortality and measured root collar diameter and height throughout three growing seasons. Although we found early increases in seedling growth in response to site preparation, it is unclear if these differences will persist through stand development. We attempted to use existing growth models to project stand development over time for each treatment and found that few models exist for growth projections from young ages. Using the models available, we determined that stand structure for suitable foraging habitat could potentially be reached around 25 years earlier on the treatment with the most early growth (chopping/herbicide/bedding) when compared to the untreated check. However, liberal application of the models generates considerable uncertainty regarding interpretation of the results; we discuss the sources of error and suggest areas for needed research.

LANDSCAPE-LEVEL FOREST COMPOSITION AND SOUTHERN FLYING SQUIRREL USE OF RED-COCKADED WOODPECKER CLUSTERS

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Habitat management for the endangered red-cockaded woodpecker (RCW) requires removal of the hardwood midstory and reduction of overstory hardwoods within cavity clusters. Reduction of hardwoods increases RCW foraging habitat quality and may help to reduce cavity kleptoparasitism, particularly by southern flying squirrels (SFS). However, a recent study found that SFS use of RCW clusters was not related to the amount of hardwoods within the cluster. Because SFS are capable of relatively long movements, we tested whether SFS use of RCW clusters was related to the composition of the surrounding landscape, particularly the amount of hardwoods. We measured SFS use of RCW cavities on the Carolina Sandhills National Wildlife Refuge during 1998 and 1999. A GIS database was used to determine the total amount of each forest type and total length of streams and roads within 100 m, 400 m, and 800 m of each cluster, and the distance to the nearest stream, road, hardwood stand, and cluster. SFS use of RCW clusters was not related to the amount of hardwood or pine-hardwood forest at any of the landscape scales, or the distance to the nearest hardwood or pine-hardwood stand. However, total length of streams within 400 m and 800 m, and the distance to the closest stream were significantly related to the presence of SFS in RCW clusters. Our results suggest that access to riparian areas, particularly abundant green vegetation and soft mast, may be more important in determining SFS use of RCW clusters than hard mast during the summer.

DEVELOPMENT OF VOLUME EQUATIONS USING DATA OBTAINED BY UPPER-STEM DENDROMETRY WITH MONTE CARLO INTEGRATION: PRELIMINARY RESULTS FOR EASTERN REDCEDAR

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Preliminary results are given for development of an eastern redcedar (*Juniperus virginiana*) cubic volume equation based on measurements of redcedar sample tree stem volume using dendrometry with Monte Carlo integration. Monte Carlo integration techniques can be used to provide unbiased estimates of stem cubic foot volume based on upper-stem diameter measurements obtained at randomly selected stem heights. Monte Carlo integration with importance sampling and antithetic variates were used to obtain sample tree volume estimates in this study. Importance sampling is a variance reduction technique that uses a proxy taper function (in this case a paraboloid) to randomly select the most influential upper-stem sample diameters. Antithetic variates use negatively correlated upper-stem measurements to further reduce the variance of stem volume estimates. The estimator was revised to use tree dbh rather than stump diameter. Since volume estimates from these techniques are unbiased, they can be used as dependent variables to estimate the parameters in a standard volume equation for eastern redcedar. Data were obtained from more than 30 sample trees using a Wheeler pentaprism to obtain two upper-stem diameter measurements for each sample tree. Sample tree total height and dbh were also measured. Preliminary results indicate an R^2 (approximately 0.8) somewhat higher than that usually obtained in studies where trees are felled and measured deterministically. However, since the Monte Carlo integration estimates are unbiased the mean regression line is probably well-located even though the variance about the line may be somewhat greater than would be the case for felled tree data.

REGENERATING OAK DOMINATED FORESTS USING IRREGULAR, GAP-BASED SILVICULTURAL SYSTEMS

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Throughout the eastern United States, practitioners have primarily focused on using uniformly applied even-aged approaches to regenerate oak species. Irregular, gap-based silvicultural systems offer an alternative that retains continuous canopy cover, creates heterogeneous forest structure, and provides multiple income flows over a rotation. Although commonly used in Europe, there are few documented applications of these systems in oak forests of North America. Our objective is to establish a region-wide trial of two variants of an irregular group shelterwood system that successively expand gaps outward until the entire stand has been regenerated. Both variants will use cutting cycles that are 10% of the rotation length and harvest approximately 20% of the area at each entry. Initial gap size for both variants will be 2.0-2.2 times the dominant canopy height and the overstory will be removed in either one or two stages. In addition, the midstory canopy will be removed from areas of the surrounding forest matrix scheduled for harvest in the next cycle for both variants. Soil scarification, competition control, and/or underplanting may be used in areas lacking sufficient advanced reproduction. These treatments will create a light gradient extending from the gap center into the surrounding matrix that should allow intolerant species, like yellow-poplar, to prevail in areas high in direct beam radiation and oaks to dominate in the diffuse light conditions created on the gap margins and within the surrounding matrix. Successive expansions will release the developing oak reproduction and will result in a stand with a diverse mixture of commercial species.

DIAMETER-HEIGHT AND CROWN RELATIONSHIPS FOR LOBLOLLY PINE FROM NORTH CAROLINA AND OKLAHOMA-ARKANSAS SEED SOURCES NEAR THE WESTERN EDGE OF THE NATURAL RANGE

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Individual loblolly pine sample trees planted in 1983 as part of a seed-source and density study on Carter Mountain near Broken Bow, Oklahoma were used to investigate the effects of seed source and density on the relationship between dbh, height, and crown length. The study site is a rocky, mountain soil near but outside the western boundary of the loblolly pine natural range in Oklahoma. North Carolina and Oklahoma - Arkansas seed sources were planted at 4'x4', 6'x6', 8'x8', 10'x10' spacings. Diameter at breast height (dbh) of sample trees ranged from 4 to 13 inches, with heights ranging from approximately 30 to 70 feet. Regression relationships between individual tree dbh and height indicated a significant difference due to seed-source, with the North Carolina source being approximately 2 feet taller across the dbh range in these data. This indicates that the North Carolina seed source is out-performing the Oklahoma-Arkansas seed source in height growth even at the extreme western edge of the loblolly natural range. The average dbh-height relationship also was significantly affected by density, but the North Carolina seed-source was taller on average per given dbh for all densities. In addition to being taller for a given dbh, the North Carolina had a longer live crown than the Oklahoma Seed source (21.4 vs. 18.8 feet).

STREAM CARBON DYNAMICS IN LOW-GRADIENT HEADWATERS OF A FORESTED WATERSHED

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Headwater streams drain more than 70% of the total watershed area in the U.S. Understanding of carbon dynamics in the headwater systems is of particular relevance for developing best silvicultural practices to reduce carbon export. This study was conducted in a low gradient, predominantly forested watershed located in the Gulf Coastal Plain region, to (1) investigate spatiotemporal dynamics of carbon concentrations in the headwaters, (2) assess the relationships among stream carbon and nutrient conditions, and (3) quantify carbon export from the entire watershed. Fifteen sites were selected along four 1st – 3rd order streams. Monthly and storm event water samples were collected from December 2005 to September 2007. The samples were analyzed for total and dissolved organic and inorganic carbon, nitrate/nitrite nitrogen, and total and dissolved phosphorus. In addition, in-stream water quality parameters (DO, temperature, pH) were measured monthly at each site to gather information on stream environmental conditions. The study found a seasonal variation of stream carbon concentration ranging from 9.6 mg L⁻¹ to 30.0 mg L⁻¹ with the lowest concentrations in January and February. There was a clear increasing trend of dissolved inorganic carbon from the winter to summer months, indicating a critical metabolic role of carbon supply and transport. Over the entire 22 months, the watershed exported a total of 1,054,350 kg carbon, in a decreasing

trend of fluxes from 5.2 kg ha⁻¹ month⁻¹ to 1.3 kg ha⁻¹ month⁻¹ with the increasing drainage area. This information can be useful for designing silvicultural practices that will conserve and maintain ecosystem carbon.

THE HOPE FARM WOODLAND MANAGEMENT STUDY: 60 YEARS OF PRODUCTION FROM AN UNEVEN-AGED LOBLOLLY PINE STAND

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Beginning in 1948, 28 acres was placed under intensive study to evaluate the long-term growth and yield a loblolly-shortleaf pine stand under uneven-aged management. The earliest operations removed less desirable trees and increased the proportion of pine sawtimber. Subsequent stand entries removed excess growth while maintaining adequate stocking for a multi-aged mixed pine stand. We present the long-term volume yielded from this stand over the last 60 years.

FELSENTHAL NATIONAL WILDLIFE REFUGE GREENTREE RESERVOIR MONITORING PROJECT AND OVERVIEW 1985 – 2006

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Felsenthal National Wildlife Refuge (FNWR) is located in south central Arkansas at the confluence of the Ouachita and Saline rivers. The greentree reservoir (GTR) contains approximately 40,000 acres of bottomland hardwood forest that can be affected by flooding from the lock and dam, operating since 1985, at FNWR's southern end. This current lock and dam maintains water in the Felsenthal pool at 65' mean sea level (MSL) but can flood to 70' MSL, although flooding frequently exceeds 70' MSL when river flows are high. Primary species within the GTR include Nuttall's oak (*Quercus texana* Buckley), overcup oak (*Q. lyrata* Walter), willow oak (*Q. phellos* L.), water hickory (*Carya aquatica* [Michx. f.] Nutt.), and sweetgum (*Liquidambar styraciflua* L.). Since 1985 there has been substantial mortality, up to 50 percent of willow oaks in the GTR monitoring project area. Most of the mortality of the primary tree species has been in the smaller size classes (< 11") and very little recruitment (about 1 stem per acre per year of oaks) is occurring. There has been a shift in forest composition to more water tolerant species. The GTR does not seem to be stabilized at this time. It is hoped that the monitoring project will help redirect depth, duration, and timing of flood events that have been implicated for at least some of the tree mortality and recruitment problems in the FNWR GTR.

AN ECONOMIC MODEL FOR MULTIPLE-VALUE MANAGEMENT OF LONGLEAF PINE

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There is growing interest in multiple-value forest management, particularly among private landowners. To balance multiple objectives, a low intensity silvicultural system featuring selection harvest and natural regeneration may be most appropriate. However, little information exists about the economic aspects of these integrated management goals. An interactive spreadsheet model was developed with initial data based on a standard 10% timber inventory of a moderately stocked tract at the Joseph W. Jones Ecological Research Center. Three harvest intensity scenarios were modeled over 50 years. The following values are presented from lower to higher levels of harvest intensity, with figures in real values adjusted for inflation. Average present value ranged from \$1,428,903 to \$1,721,283, with 20 year internal rates of return from 3.58% to 3.86%. Accumulated cash flow ranged from \$2,309,050 to \$5,499,282, with ending values from \$4,907,850 to \$3,118,557. Initial stocking was 4,672 mbf, with ending stocking ranging from 6,008 mbf to 2,956 mbf. This model is in the early stages of development and is intended as a heuristic rather than a predictive tool. The assumptions incorporated in the model represent our best current information but can benefit from further refinement and validation. This modeling approach has also pointed out information gaps and areas of needed research, such as growth and yield for multiage natural longleaf pine stands, regeneration dynamics, and ingrowth rates. Further refinement and development of models such as this can help landowners understand trade-offs and make informed decisions when balancing multiple land management objectives.

RESPONSE TO PRESCRIBED BURNING OF FIVE-YEAR-OLD HARDWOOD REGENERATION ON A MESIC SITE IN THE SOUTHERN APPALACHIAN MOUNTAINS

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Five years after a mesic Southern Appalachian cove was regenerated the sapling stand averaged $11,780 \pm 12,286$ stems per acre and consisted primarily of yellow-poplar (*Liriodendron tulipifera*). The stand was prescribed burned during the late spring of 2001 to improve the habitat for wildlife by reducing density of hardwood saplings to stimulate greater production of grasses and herbs. The prescribed fire, which was fueled primarily by logging slash, completely killed about 54 percent of the saplings; the others were top-killed and produced basal sprouts that reclaimed much of the canopy growing space after one growing season. Regression analysis indicated that probability of sapling mortality was associated primarily with fire intensity, sapling size, and species. Yellow-poplar seedlings were more likely to be killed by the prescribed fire in comparison with other species. Oak (*Quercus* spp) regeneration was sparse and small (<2 feet in height), but experienced low (7%) mortality. A prediction model was developed that offers managers a means of prescribing fires of specified intensity to achieve a desired level of hardwood sapling mortality. Results of this study suggest that one or more additional prescribed burns will be necessary to reduce yellow poplar stem density and achieve wildlife habitat objectives.

LOADING OF HEAVY FUELS IN BEETLE-KILLED AREAS: A PROBLEM OF PREDICTING FIRE BEHAVIOR

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A prolonged drought in the southeastern United States increased the severity of an attack of southern pine beetles (*Dendroctonus frontalis*) throughout the region. Since 2001, South Carolina alone has detected over 92,000 beetle-killed spots and the death of approximately 25.5 million trees. After these attacks and as dead trees fall, a particular concern is heavy fuel loading and how to predict when large fuels will ignite. Fire behavior models typically do not account for these fuels but, when ignited, logs can increase fire intensity and/or duration and become a problem for smoke management (Haywood and others 2003). Variables such as rainfall amount and duration greatly impact the ignition probability of large woody fuels but these relationships have not been measured. We conducted a study of log moisture content after simulated rainfall events ranging from 1 inch during one week to 4 inches in one day using both pine and hardwood logs. Log moisture content was measured daily for 1 week after each simulated rainfall event to determine when each log would be sufficiently dry to ignite. Results will help managers to understand when beetle-killed areas can be safely burned without the danger of high-intensity fires.

HOW MECHANICAL MANIPULATION AND HERBICIDE TREATMENTS MEASURE UP TO THE EFFECTS OF PRESCRIBED FIRE ON AN ESTABLISHED LONGLEAF PINE (*PINUS PALUSTRIS*) ECOSYSTEM

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In August 2007, the South Carolina Department of Natural Resources, Clemson University, and NaturChem, LLC initiated a cooperative project on Aiken Gopher Tortoise Heritage Preserve located in Aiken County, South Carolina. The study compares the effects of prescribed burning, mechanical manipulation, and herbicide treatment on the understory species diversity, soil properties, and natural regeneration of longleaf pine in an established mature longleaf pine (*Pinus palustris*) ecosystem. The entire study area has been subjected to prescribed burning since early 2000, with the last burn conducted in May 2005, consequently resulting in a relatively uniform understory. Each of the three proposed treatments (F = fire will be applied during the growing season; M = mechanical manipulation will consist of the use of a BobCat with a forestry cutter head and hand tools; H = herbicide (Velpar® ULW) will be applied at the manufacturer's suggested rate) will be randomly assigned to six 1-acre experimental units. Velpar® ULW herbicide was selected to minimize impact on groundcover plants and diversity. Each treatment has been scheduled between March and May 2008. Evaluation on these units includes an initial (September 2007), 1-, 2-, and 3-year measurements of the canopy openness, basal area, understory vegetation, soil properties, and longleaf pine regeneration. Pretreatment measurements will be included in the analyses to determine if there are any correlations between the pretreatment and post-treatment measurements. This poster reports the results from the initial and 1-year measurements.

HARDWOOD TREE GROWTH AND REMOVALS IN THE APPALACHIAN HARDWOOD REGION OF THE EASTERN UNITED STATES

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The hardwood forests of the Appalachian region play a dominant role in both the ecology and economy of the area.

Because of the importance of the hardwood resource in the Appalachians, it is essential to understand the current status of the resource and trends of both change and resource use. Data from the USDA Forest Service Forest Inventory and Analysis (FIA) program from 1984 to 2005 were used to 1) describe the current hardwood resource, 2) quantify recent trends in volume of hardwood growth and 3) quantify the utilization of the hardwood resource according to recent trends in the removal of hardwood tree volume within the Appalachian Hardwood Region (AHR). The AHR is a 344 county area stretching from northern Georgia to southern New York State. According to the most recent data, there are 65.42 million acres of timberland in the AHR, which is a small increase from an estimated 65.13 million acres in the late 1980's and early 1990's. Current mean annual growth of hardwood species across the AHR is an estimated 2.7 billion cubic feet per year. Current mean annual removals of hardwood species across the AHR is estimated at 1.28 billion cubic feet annually. The current growth to removals ratio for each group of AHR counties in each state, with the exception of Maryland (0.98), are greater than 1. This study shows that overharvesting of hardwoods in the AHR, as defined here, is not occurring at the landscape or region-wide scale.

MEASURED IMPACTS OF HURRICANE KATRINA ON MISSISSIPPI FORESTS

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Hurricane Katrina triggered public interest and concern for forests in Mississippi that required rapid responses from the scientific community. A uniform systematic sample of 3,590 ground plots were established and measured in 687 days immediately following the impact of Hurricane Katrina on the gulf coast. The hurricane damaged an estimated 521 million trees >2.5cm DBH and killed approximately 54 million trees, statewide. Sixty-nine percent of tree mortality occurred in 17 counties in southeastern Mississippi, and forty-five percent of trees killed were loblolly pine trees. Total tree mortality was less than 1 percent of the statewide population. Hurricane Katrina had a dramatic impact on coastal Mississippi, Louisiana, and Alabama. In Mississippi, forestland in the southern-most tier of counties experienced the majority of storm-related damage, though not all damage was severe. Though many trees died immediately following Katrina, these results indicate that total mortality is less than one percent of the statewide population. In addition, a portion of that damage, particularly in the Delta and northern tier of counties where data collection occurred last, may have also included damage from Hurricane Rita.

THE LONGEST ACTIVE THINNED AND PRUNED LOBLOLLY PINE PERMANENT PLOTS: THE LAST MEASUREMENT

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The longest active study of the effects of thinning and pruning on growth of loblolly pine (*Pinus taeda* L.) was established by Dr. James D. Burton in 1970 in a typical 12-year-old loblolly pine stand planted by then the Georgia-Pacific Corp. in the south-eastern corner of Arkansas. Basal area has been maintained at 30, 50, 70 and 90 square feet per acre by periodic thinnings. Within each level of basal area plots were pruned in two stages at 12 and 15 years, finally clearing the bole to heights of 33, 26, and 22 feet and reducing crown lengths to 25, 40, and 50% of the total tree height, respectively. Each thinning-pruning combination has three replications within a randomized complete block design and one replication was also established where each of the four thinning treatments remained unpruned (a total of 40 plots). Five control plots (without thinning or pruning) were installed on the adjacent untreated part of the plantation at age 27. Recently the plots were re-measured on their golden anniversary (50 years) in the fall of 2007. This paper presents data and analysis of plot stand dynamics by thinning and pruning levels. The 50-year re-measurement will be the last since the current owner has decided to clearcut the study.

PINE SNAGS AND FOREST THINNING PROVIDE ROOSTING HABITAT FOR BIG BROWN BATS (*EPTESICUS FUSCUS*) OF THE OUACHITA NATIONAL FOREST

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No information exists on tree-roosting by big brown bats (*Eptesicus fuscus* Beauvois, 1796) in forests the southeastern United States and effects of various silvicultural practices on roost availability and use are unknown. We characterized types of trees used by male big brown bats and determined relationships between forest structure and roost selection. We quantified 25 male roosts located via radiotelemetry, and describe an additional 9 maternity roosts for females. All roosts were in shortleaf pine (*Pinus echinata* P. Mill.) snags, and 82% of roost snags were 15–25 cm diameter at breast height (dbh). Most (94%) roosts were under loose bark. A logistic regression model differentiating male roost sites from random locations indicated males were more likely to roost in recently thinned, open-forest conditions (less canopy cover, more cut stumps, fewer understory woody stems) that contained abundant

overstory pines ≥ 25 cm dbh and abundant snags. Males roosted primarily (84%) in stands that had recently undergone partial harvesting and midstory removal. Maintaining a supply of pine snags 15–25 cm dbh in relatively open forests, such as areas undergoing partial harvest or thinning, would likely provide suitable roosting habitat for male big brown bats in the Ouachita Mountains. However, sustainability of adequate densities of pine snags in thinned or partially harvested areas with reduced overstory pine BA is equivocal.

FUEL LOADING AFTER FUEL REDUCTION TREATMENTS AND IMPACTS FROM NATURAL DISTURBANCES

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A long-term study of fuel reduction treatments was begun in 2000 and 2001 for sites located in the Piedmont and Appalachian Mountains, respectively. During this time multiple natural disturbances (southern pine beetle infestation and ice storms) occurred that allowed us to observe effects these treatments had on the impact of natural disturbances on these stands. Immediately following treatment burning slightly reduced fine woody fuels at both study sites; whereas, mechanical treatment (alone and in combination with burning) showed significant increases in fine woody fuel loading. In the Piedmont, Southern pine beetle infestations occurring in 2001 affected stands with higher basal area (burn-only, thin-only, and control treatments) causing impacts on large woody fuel loadings. In 2004, ice storm damage was greatest in stands that burned, but did not suffer beetle infestation, and control stands. For the Mountain site, an ice storm event in 2006 resulted in increased fine fuel loading for every treatment except for the mechanical + burn. However, large woody fuels significantly increased for all treatments. Implications on fire behavior will be discussed.

OCCURRENCE AND SPREAD OF NON-NATIVE INVASIVE PLANTS IN STANDS TREATED WITH FIRE AND/OR THINNING IN THE PIEDMONT OF SOUTH CAROLINA

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Increasing numbers of invasive non-native plant species and the expansion of existing non-native plant populations provide challenges for land managers trying to achieve commercial and restoration goals while controlling for exotic species. Some methods used to achieve these goals (e.g., prescribed fire and mechanical thinning) may result in disturbances that promote the establishment and spread of the non-native species land managers are trying to keep in check. Natural disturbances (i.e., insect infestations, wind and ice storms, etc.) can also provide opportunities for non-native plants expansion. Effects of fuel reduction treatments on the occurrence and distribution of non-native invasive plant species for intact loblolly stands and areas affected by southern pine beetle will be discussed. These results are expected to help direct land managers' decisions on treatment implementation and invasive plant control while contributing to the knowledge base of invasive plant biology.

EFFECT OF PINE STRAW HARVESTING ON LOBLOLLY PINE GROWTH AND MORTALITY RATES

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Pine needles that accumulate on the forest floor form a straw layer that provides soil nutrients and organic matter while helping control erosion, water loss, temperature extremes, and weed growth. Because pine needles tend to interlock, pine straw is not easily dislodged by high winds or water flows, but retains a loose structure that allows air, water, and nutrients to easily infiltrate to the soil surface. These qualities have made pine straw a valuable landscaping mulch, and a multi-million dollar business in several southeastern states. However, some forest managers are concerned that loss of those mulching benefits from forests may hinder timber productivity in areas where pine straw has been harvested. Previous research indicated that pine straw harvesting can increase water stress on loblolly pine during summer drought in the first year after the harvest, but did not show that the effect would last long enough to have a significant impact on tree growth and survival. Therefore, an experiment was conducted to determine whether pine straw harvesting affected tree mortality and growth rates in an established loblolly (*Pinus taeda* L.) plantation (3.0 x 1.5 m tree spacing). Four pine straw management practices were compared in the presence and absence of fertilizer additions, using 24 plots (0.044 ha each) to provide three replications of each treatment combination. Results showed that pine straw harvesting effects on tree growth and mortality over seven years were not significant, regardless of fertilizer applications.

NOT ALL BASAL AREA IS CREATED EQUAL: CONSIDERATIONS FOR REGULATING CANOPY COVER TO ACHIEVE RESTORATION OBJECTIVES IN PLANTED UPLAND PINE FORESTS

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Restoring natural fire regimes and native ground cover to planted upland pine forests typically requires a substantial reduction in stocking at the initial entry. While maintaining full canopy cover (CC) is consistent with maximizing fiber production, this approach does not allow sufficient light to reach the forest floor to accomplish these broader objectives. The relationship between stand basal area (BA) and CC has been used successfully to regulate the overwood in shelterwood seed cuttings and is worth exploring for other purposes. Two factors potentially complicating the use of BA as a proxy for CC in plantation conversions include: (1) the dynamic relationship between stem diameter and crown size, and (2) species level differences. Published crown-width models were used to estimate the relative influence of both factors among four commonly planted southern pines (*Pinus taeda*, *P. elliottii*, *P. echinata*, *P. palustris*). Relative to a stated objective of achieving 30% CC, notable differences were indicated in the amount of BA to be retained in stands at different average diameters (5 to 14 in dbh, PITA 60-51 ft²/ac; PIEL 52-44; PIEC 81-63; PIPA 85-62). The differences attributable to species were more dramatic, where the BA corresponding to 30% CC for PIEL (44 ft²/ac) was 36% lower than for PIEC and PIPA (69 ft²/ac) averaged across all diameters; PITA was intermediate at 54 ft²/ac. Species composition and stage of stand development may be worth considering where BA is used to control CC.

EFFECTS OF OVERSTORY OPENINGS ON THE DYNAMICS OF YOUNG POPULATIONS OF SLASH PINE NATURAL REGENERATION

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Typical slash pine (*Pinus elliottii* Engelm. var. *elliottii*) has been introduced into Argentina and is one of the most cultivated forests. Slash pine reproduce naturally in small openings, although competition from overstory and understory vegetation reduces growth and causes much mortality. We evaluated the dynamics of slash pine natural regeneration following different overstory openings, in the northeast of Argentina. The following conditions were evaluated: after total clearcutting (CC), after strip clearcutting (two orientations: E-W and N-S, and three widths: 12, 18 and 24 m). Density, recruitment, mortality, diameter and height of seedlings were monitored during five years, every three-month. The light environment inside of the strips was characterized using hemispherical photographs. Results indicated that the density of seedlings was enough to begin a productive cycle (2.7 - 15 plants m⁻²). The only critical condition was generated in the narrowest strip with N-S orientation, which had a very low density. In general, the recruitment was registered during winter and spring. Seedlings mortality had more impact during spring and summer, resulting higher in strips than in CC. The strips of 18 or 24 m not present problems to establishment of plants, whatever their orientation. The best growth was found in strip of 24 m with E-W orientation. This result coincides with an entrance of relative radiation higher than 65%. The seedlings growth in the strips was 32% to 68% with respect to CC. The results showed that slash pine natural regeneration is an alternative establishment system in the study area.

A PRELIMINARY ASSESSMENT OF THE HEALTH OF LOBLOLLY PINE STANDS AT FORT BENNING, GA

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Loblolly pine (*Pinus taeda* L.) is an important species in the southeastern United States, both economically for timber and ecologically as habitat for wildlife including the endangered red-cockaded woodpecker (RCW; *Picoides borealis*). However, recent reports of loblolly pine decline suggest a management need to restore longleaf pine (*Pinus palustris* Mill.) to loblolly pine stands currently used as RCW habitat. Conversion to longleaf pine is critical at Fort Benning, Georgia, where 70% of the active RCW cavities are located in mature loblolly pine stands that may be susceptible to declining health. To focus restoration efforts where they are most needed, it is necessary to identify loblolly pine stands that are most likely to decline. We set up 89 plots in Fort Benning to evaluate the influence of slope, aspect, ground vegetation, soil compaction, competition (e.g., stem density and basal area), burning frequency, and harvesting history on stand health. Health of loblolly pine stands was assessed using crown vigor class (vigor class 3 defined as declining). We found that 2.8 ± 6.2% and 8.0 ± 8.4% of loblolly pine trees were classified as declining and dead, respectively, and the stand in the poorest health had 33.3% of loblolly pine trees in vigor class 3 or dead. Further evaluation is needed to conclude that loblolly pine decline is a problem at Fort Benning and to identify any causal factors.

HYDROLOGIC INFLUENCE ON SEDIMENT TRANSPORT OF LOW-GRADIENT, FORESTED HEADWATER STREAMS IN CENTRAL LOUISIANA

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Despite extensive research on headwater streams in topographically variable areas, fewer studies have examined low-gradient headwater stream systems, such as those existing on much of the southeastern coastal plain. This study aimed to investigate spatial and temporal variation of headwater stream hydrology in a low-gradient forested watershed, and determine their effect on the transport of suspended and dissolved solids. Stream discharge and sediments were monitored over the period from December 2005 to April 2007 throughout a 3rd order watershed with stream channel slopes less than 1%, located in central Louisiana. The study showed that headwater streamflow in this low-gradient forested watershed was highly variable, from intermittent/no flow conditions in the late summer, to high volume overbank conditions in the winter season. Transitioning from the headwater streams to the watershed outlet, stream hydrologic response and streamflow variability decreased. Suspended and dissolved solid concentrations during baseflow showed little seasonal variation, and loading was mainly controlled by discharge levels. Sediment yield from the watershed was low due to the drier than normal period of study and subsequently low storm runoff. As most of the land use in the watershed is commercial pine plantation, the low runoff decreases erosion susceptibility from harvesting activities. However, caution must also be taken as harvest sites can become quickly saturated following precipitation events, creating the potential for excess runoff and sediment delivery to streams.

MECHANISMS CONTROLLING MAXIMUM CARRYING CAPACITY IN LOBLOLLY PINE

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The southern United States produces 60% of the Nation's timber products and more timber than any other country in the world. The role of the southern United States as the woodbasket of the world is due, in part, to increasing productivity of pine plantations, in particular loblolly pine, as a result of improved genetic stock and use of more intensive management practices such as repeated fertilization and competition control. Despite great gains in productivity of loblolly pine in response to more intensive silviculture, rapid growth rates in Hawaii, Brazil and South Africa indicate that biological expression of growth potential in loblolly pine's native range has not been fully realized. A better understanding of growth constraints would improve management practices needed to meet future demand for wood, fiber, and bioenergy in the United States. The goal of this research is to determine what factors influence mortality and carrying capacity of an existing loblolly pine density study in Hawaii. The Hawaii Olinda plantation is located in Maui and is now at age 46. The Olinda study is the only complete, replicated, long-term, experimental spacing study of loblolly pine in an exotic location in the world making this a rare opportunity to (1) re-define biological growth potential of loblolly pine, and (2) identify critical factors controlling mortality, carrying capacity and growth potential. Preliminary results will be presented.

MEASURING FINE ROOT PRODUCTION IN RECENTLY ESTABLISHED BIOMASS PLANTATIONS

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The establishment of short rotation woody crops (SRWC) for woody biomass and fiber production is expected to increase to over 2 million acres in the U.S. by 2050. Much emphasis has been placed on their potential for high aboveground biomass production. There have been comparatively fewer studies on belowground biomass and nutrient cycling of these crops largely because measurement of root biomass is difficult. Information on production of fine roots is important for forest soil nutrient and water management. This study was carried out to compare fine root production of three species-- loblolly pine (*Pinus taeda*), cottonwood (*Populus deltoides*) and silver maple (*Acer saccharinum*) in a newly established biomass plantation. Monthly fine root production will be compared to see if there are any significant changes on the fine root production among the species.

LAND CLASSIFICATION OF THE STANDING STONE STATE FOREST AND PARK ON THE EASTERN HIGHLAND RIM IN TENNESSEE: THE INTERACTION OF GEOLOGY, TOPOGRAPHY, AND SOILS

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The Tennessee Division of Forestry has adopted a land classification system developed by the senior author as the basic theme of information for the management of its 15 state forests (166,231 acres). This paper summarizes the application of that system to the Standing Stone State Forest and Park on the Eastern Highland Rim. Landtypes are the most detailed level in the hierarchical system and represent distinct units of the landscape (mapped at a scale of 1:24,000) as defined by climate, geology, soils, topography, and vegetation. The area is highly dissected with local relief of about 1,000 feet. Mississippian and Ordovician strata are level-bedded and defining elevations were assigned. Suites of soils are common to the nine strata and a group of landtypes was defined for each geologic strata/soils combination. Each of the nineteen landtypes is described in terms of nine elements. Additional information includes species suitable, site productivity, and operability for management activities. The maps aid the delineation of stands, streamside management zones, and "conservation" and other special use areas; the location of potential threatened and endangered species; the design of harvests; and the modeling of future forest conditions. The landtypes are an integral element in modeling wildlife habitat and planning wildlife management activities. The maps are excellent training devices and extremely useful in explaining management plans to legislators and the public.

GROWTH RING RESPONSE IN SHORLEAF PINE FOLLOWING GLAZE ICING CONDITIONS IN WESTERN ARKANSAS AND EASTERN OKLAHOMA

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Width reduction in growth rings in shortleaf pine (*Pinus echinata* Mill.) following glaze ice conditions produces a characteristic pattern dependent on live crown ratio and extent of crown loss. Ring widths of 133 trees for three years preceding and seven years following the December 2000 ice storm in western Arkansas and eastern Oklahoma were cross-dated to detect missing rings, then measured under a 32X microscope. Data from undamaged trees was detrended using a logarithmic decay function to identify the climate signal, which was then incorporated into the model. Ring width was affected by live crown ratio, proportion of crown lost, presence of branch damage and tree basal area. Stand basal area, tree height and diameter were not significant. Three trees produced no growth ring in 2001; no tree survived loss of more than 83% of its crown. Ring widths of undamaged trees declined slightly from an average of 0.064 inches in 2001 to an average of 0.058 inches in 2007. Branch-damaged trees had ring widths inversely proportional to live crown ratio and averaged 0.055 inches throughout the seven years following the storm. Stem-damaged trees responded along two opposing curves, a decreasing logarithm and an increasing logistic, producing a logistic curve with a "cup" at the lower end. The shape of the logistic was affected by both live crown ratio and crown loss, while the shape of the logarithmic curve was affected only by crown loss.

RESIDUAL EFFECTS ON THE ANT COMMUNITY OF 2 HARVESTING TREATMENTS APPLIED 12-YEARS-EARLIER IN A PINE FOREST IN SOUTHEASTERN ARKANSAS

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Objectives were to assess the residual effects on the ant community of 2 harvesting treatments done 12-years-earlier in a pine forest in southeastern Arkansas. Ants were collected weekly using pitfall traps, from July through October in 1994, 1996, 1998, and 2000 in Drew County. The experiment received three replicated harvesting treatments in 1981, including: 1) selection treatments where about 50% of trees were removed, leaving the remaining pines to grow, 2) clearcut treatments where all trees were harvested, with felled noncommercial trees and tops windrowed and burned, and 3) uncut controls (checks). Disturbed stands were regenerated naturally. A total of 7 subfamilies, 30 genera, 51 species, and 39,000 individuals were collected. Two-way cluster analysis classified treatment effects by ant species occurrence and presence/absence. This faunal analysis showed 18 species were almost ubiquitous, and these species dominated the site, comprising 95% of the community abundance. Treatment effects on common species were analyzed with Indicator Species Analysis, revealing their faithfulness to specific treatments. Most common species did equally well in all treatments, but 1 species each showed preferences for selection harvests (*Aphaenogaster fulva*) and another for clearcuts (*A. treatae*), and 3 species showed preferences for undisturbed checks (*Camponotus castaneus*, *C. pennsylvanicus*, and *Crematogaster ashmeadi*). In summary, 3 members of the ant community remained sensitive to the 12-year-old harvesting disturbance.

INFLUENCE OF FOREST STRUCTURE ON SOIL RESPIRATION IN LONGLEAF PINE

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Global climate change and the accumulation of the greenhouse gas carbon dioxide (CO₂) in the atmosphere can be mitigated by the proper management of soils and forests through carbon sequestration. Particularly, longleaf pine (*Pinus palustris* Mill.) forests and soils are able to sequester large quantities of carbon through long rotations of timber and temperate climatic conditions. Soils compose the largest carbon sinks on earth and thus have potential to be the largest contributors of CO₂ to total ecosystem respiration. The objective of this study is to examine how different densities and forest structures influence the rate of soil CO₂ efflux to contribute knowledge of forest management effects on carbon pools. If management objectives are formulated so that soils act as a sink for carbon instead of a source, the results may be coupled with the long term carbon storage of solid wood products to benefit landowners if credibility becomes profitable. However, more knowledge on the effects of stand structure relative to soil respiration rates is needed to understand how soils affect the carbon cycle. When the economics of carbon credits and high value products are combined through management of longleaf forests, landowners will be able to gain multiple sources of revenue. Soil respiration will be examined in response to basal area, aboveground and belowground biomass in woody and herbaceous plants, and environmental conditions. Various basal areas will be tested so as to cover the range of management plans and silvicultural operations for natural longleaf stands. Preliminary data will be presented.

EFFECTS OF PLANTING DENSITY AND GENOTYPE ON LOBLOLLY PINE STANDS GROWING IN THE MOUNTAINS OF SOUTHEASTERN OKLAHOMA

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We determined the effects of planting density (4 x 4, 6 x 6, 8 x 8, and 10 x 10 foot spacing) on stand-level height, diameter at breast height, stem volume, basal area, and periodic annual increment for two loblolly pine seed sources. Seed sources for the 25-year-old stands were a North Carolina seed source (NCC 8-01) and a regionally-local Oklahoma/Arkansas seed source (O/A mix 4213). The research site was a droughty, mountain soil in southeastern Oklahoma outside the native range of loblolly pine. Except for subsoiling at planting, no other stand-level treatments were applied. The experimental design was a split-plot with whole plot factor planting density (n=2) and the split-plot factor genotype (n = 8). While similar between genotypes, stand density increased basal area (188 to 241 ft² ac⁻¹), increased stand volume (4230 to 5030 ft³ ac⁻¹) and decreased average tree diameter (10.1 to 6.3 inches). Average tree heights decreased with stand density (61 to 55 ft) and the North Carolina genotype was taller than the Oklahoma/Arkansas genotype (60 vs. 56 ft). Between ages 22-25, periodic annual increment decreased with stand density and density-dependent mortality was occurring in the two highest planting densities. These results indicate that over 25 years, the North Carolina genotypes performed as well or better than the regional seed source. In addition, sites outside the native range of loblolly pine can support relatively high basal areas and can successfully grow commercial loblolly pine stands with little outside inputs.

REINEKE'S STAND-DENSITY INDEX: A QUANTITATIVE AND NON-UNITLESS MEASURE OF STAND DENSITY

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Reineke's stand-density index (SDI) is used to determine site occupancy, degree of competition, and levels of stocking. There are often misconceptions about whether this measure is unitless most likely because many foresters believe SDI is exclusively a relative measure. When used as a measure of stocking, SDI can be made unitless by relating the current SDI to an optimum stand density thought to best meet management objectives. When used as a quantitative measure of stand density though, SDI is not unitless. Reineke's SDI relates the current stand density to an equivalent number of trees per unit area in a stand with a quadratic mean diameter (D_q) of either 10 in. (English units) or 25.4 cm (metric units). Thus, when used as a quantitative measure, SDI is in fact unit dependent on two levels, one is whether English or metric units are used, and the second is whether the unit area is one acre (hectare) or two, three, etc. Foresters should express SDI as either number of trees per acre or number of trees per hectare to clearly indicate the unit being used. Since Reineke's SDI is often exclusively considered to be a relative measure, past analyses have estimated the slope between the logarithms of trees per unit area and D_q for observations thought to be the maximum trees per unit area for a given D_q across all stands of a species. When viewing Reineke's SDI as a quantitative measure, it is legitimate to estimate the slope of an individual stand.