Carbon Sequestration in Longleaf Pine Ecosystems: Current State of Knowledge and Information Needs

February 16-17, 2010
School of Forestry and Wildlife Sciences
Auburn University
Auburn, AL

Hosted By:

THE CENTER FOR LONGLEAF PINE ECOSYSTEMS

East Gulf Coastal Plain JOINT VENTURE
Sponsors

The Center for Longleaf Pine Ecosystems

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Purpose:

Forest may mitigate changes in climate by sequestering atmospheric CO₂. Longleaf pine ecosystems in the southeastern United States offer new opportunities for sequestering carbon and reducing U.S. CO₂ emissions because of the focus on restoration and protection of longleaf pine for a variety of products and ecosystem services. There is increasing interest at state, regional and national levels in the development of forest carbon inventory and monitoring programs. A better understanding of the biology and economics of carbon sequestration in longleaf pine forests is needed.

Objectives:

The objectives of this meeting are to: 1) review the current status of knowledge on climate change and carbon sequestration in longleaf pine ecosystems, 2) review the economic and policy issues associated with carbon sequestration, 3) discuss how longleaf forests might fit with proposed Waxman-Markey bill or similar cap and trade legislation, 4) examine how different wildlife and forest management objectives influence carbon sequestration potential in longleaf pine forests, 5) enhance communication among federal and state agencies, universities, and nonprofit groups involved in longleaf research and management to improve knowledge of carbon sequestration in longleaf pine ecosystems, 6) identify knowledge gaps and research needed to develop a standardized accounting system, and 7) discuss how to best engage land managers including family forest owners, to enhance carbon sequestration in conjunction with other ecosystem services.

Hosts:

The Center for Longleaf Pine Ecosystems at Auburn University, the U.S. Fish and Wildlife Service, and the East Gulf Coastal Plain Joint Venture.

Planning Committee:

**Chairs** – Lisa Samuelson (Center for Longleaf Pine Ecosystems), Catherine Rideout (East Gulf Coastal Plain Joint Venture)

**Members** – Ray Aycock, Cynthia Bohn (U.S. Fish and Wildlife Service), Kris Conner (USDA Forest Service), John Dondero (USDA Forest Service), Todd Gartner (American Forest Foundation), Lark Hayes (Southern Environmental Law Center), Kurt Johnsen (USDA Forest Service), Roel Lopez (Texas A&M Institute of Renewable Natural Resources), Tim Martin (University of Florida), Bob Mitchell (Joseph W. Jones Ecological Research Center).
Lisa Samuelson

Professor and Director of the Center for Longleaf Pine Ecosystems
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Phone: (334) 844-1040, Fax: (334) 844-1084
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Dr. Lisa Samuelson is a Professor of Tree Physiology in the School of Forestry and Wildlife Sciences at Auburn University and Director of the newly formed Center for Longleaf Pine Ecosystems. She received her B.S. and M.S. in Forestry from the School of Forest Resources at the University of Georgia, and her Ph.D. in Forestry in 1992 from Virginia Tech. Dr. Samuelson joined the Auburn University faculty in 1994 following a position with the Tennessee Valley Authority. Her general research interests focus on tree physiological responses to environmental and silvicultural influences. Her current research projects are examining climate change response and carbon sequestration in longleaf pine ecosystems. Dr. Samuelson has authored over 50 peer-reviewed publications on tree physiology, three dendrology texts and a popular Trees of Alabama web site. She has served on editorial boards for Forest Science, New Phytologist and Tree Physiology and on review panels for the National Academies Advisors to the Nation on Science, Engineering and Medicine; the National Science Foundation; the Environmental Protection Agency; the United Nations Economic Commission for Europe and Convention on Long-Range Transboundary Air Pollution; and the Swedish Environmental Research Institute and Nordic Council of Ministers. Her teaching responsibilities include courses in dendrology and tree physiology. She was awarded the School of Forestry and Wildlife Sciences Harold E. Christian Award for service to teaching in 2005.
Catherine Rideout

Coordinator
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Catherine Rideout serves as the coordinator for the East Gulf Coastal Plain Joint Venture, a voluntary public-private partnership that seeks to protect and restore bird populations in the East Gulf Coastal Plain through a strategic approach to conservation of longleaf pine and other priority habitats. Working collaboratively, the joint venture partners conduct activities to support bird conservation including biological planning, conservation design, project implementation, monitoring, and research.

Prior to this position, Catherine worked for the Arkansas Game and Fish Commission where she served as the state ornithologist for six years. During this time, she worked extensively with habitat Joint Ventures, served as a co-chair of the regional bird initiative Southeast Partners in Flight, and developed and implemented habitat projects and monitoring programs. Catherine received a BS degree in Biology from Davidson College in 1994 and an MS degree in Biology from Boise State University in 2001.
Poster Social and Dinner

There will be a social/dinner along with poster presentations at the Moore’s Mill Country Club on Tuesday evening from 6:00-9:00 pm.

Directions from Auburn University’s parking lot:

- Turn right out of parking lot onto S. Donahue Drive.
- At 2nd traffic light turn right onto Samford Ave. (0.4 miles)
- At 4th traffic light take a right onto Moore’s Mill Road. (0.9 miles)
- Continue until you see Regions Bank on the right. (2.2 miles)
- Take the second right after the Bank onto Rock Fence Road.
- Take second right onto Fairway Dr. (0.2 miles)
- Turn right into Moore’s Mill Golf Club. (<0.1 miles)
- Address is 1957 Fairway Drive, Auburn, AL 36830. (4.3 total miles)
- Reception is in the Pavilion next to the parking lot.
Lunch Suggestions:

The new student union offers a variety of places to grab lunch on campus (although these could be crowded). Lunch options at the Student Union include:

* Coyote Jacks – burgers with a southwestern flair
* Chef Yan Can Cook – oriental cuisine
* Mamma Leone’s – pasta and pizza
* Chick-fil-a – chicken
* Chef’s Table – changing daily menu
* Outtakes – grab and go selections
* Au Bon Pain – sandwiches/soups/salad

To get to the Student Union:

- Turn left out of the front doors and walk up Duncan Drive.
- Duncan Drive will come to an end with a parking deck to your left.
- There will be a large grassy field in front of you.
- The Student Union is directly across the grassy field and has a bus station located on the left side.
Off Campus Lunch Suggestions within Walking Distance:

Amsterdam Café
410 S. Gay Street (0.7 miles)

Price’s Barbeque House
345 S. College Street (0.6 miles)

China Palace
335 S. College Street (0.7 miles)

Ariccia Italian Trattoria & Bar (inside the Auburn University Hotel & Conference Center)
241 S. College Street (0.8 miles)

Downtown Auburn (S. College Street) - offers additional places to eat within a mile of meeting

Additional Restaurants: travel south down S. College Street (Not Within Walking Distance)
Carbon Sequestration in Longleaf Pine Ecosystems: Current Status of Knowledge and Information Needs

To be held at: School of Forestry & Wildlife Sciences Conference Hall
Auburn University
Auburn, AL

AGENDA

February 16, 2010

8:00-8:30 Coffee and Pastries, Registration Packet Pick-up

8:30-8:45 Welcome, Introductions and Conference Objectives
Lisa Samuelson, Catherine Rideout, Dean Richard Brinker

8:45-9:30 Keynote Speaker: Climate Change Trends and Projections for the Southeast: Implications for Forest Ecosystems
Virginia Burkett, U.S. Geological Survey

9:30-10:15 Keynote Speaker: Taking Longleaf Pine Restoration and Management to the Carbon Market: An Overview of Forest Carbon Standards and Experiences in Project Level Carbon Accounting
David Shoch, TerraCarbon

10:15-10:30 Break

David Ganz, The Nature Conservancy

11:15-11:35 Longleaf Pine: The Tree that Built and Shaped the South
Rhett Johnson, Longleaf Alliance Inc.

Matthew Hurteau, Northern Arizona University

12:00-1:30 Lunch

1:30-1:50 Expected Effects of Climate Change on Longleaf Pine Growth and Productivity
Bob Teskey, University of Georgia
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| 1:50-2:10    | Wildlife Conservation and Climate Change: How Tomorrow’s Landscape Should Influence Today’s Decisions  
Barry Grand, Alabama Cooperative, Fisheries and Wildlife Research Unit |
| 2:10-2:30    | Carbon Sequestration Partnerships – A Model for Restoring Ecosystem Functions and Values  
Pete Jerome, US Fish and Wildlife Service |
| 2:30-2:50    | Coordinating Longleaf Pine and Climate Change Research via the Southeast Regional Partnership for Planning and Sustainability (SERPPAS)  
Roel Lopez, Texas A&M Institute for Renewable Natural Resources |
| 2:50-3:10    | Longleaf Pine and Global Warming: The Dual Role of Restoration and Potential Carbon Incentives  
Amadou Diop and Eric Palola, National Wildlife Federation |
| 3:10-3:30    | Break                                                                        |
| 3:30-3:50    | A Multi-State Longleaf Carbon Modeling Project  
Tim Martin, University of Florida |
| 3:50-4:10    | Modeling Longleaf Pine Ecosystems at Multiple Scales: Needs for Regional Carbon Sequestration Evaluation  
Wendell Cropper, University of Florida |
| 4:10-4:30    | A Preliminary Examination of Prescribed Fire’s Role in Longleaf Pine Carbon Dynamics  
Gregory Starr, University of Alabama |
| 4:30-4:50    | Coarse Root Biomass of Longleaf and Loblolly Pine in a 50-year-old Silviculture Experiment in Mississippi  
Kurt Johnsen, USDA Forest Service |
| 6:00-9:00    | Poster Social & Dinner– Moore’s Mill Country Club |

February 17, 2010

8:00-8:30 Coffee and Pastries

8:30-8:50 What We Know and Don’t Know About Carbon Stocks in Different Longleaf Pine Ecosystems  
John Kush, Auburn University
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| 8:50-9:10| **Comparing Carbon Storage in Longleaf Pine Among Various Stand Structures**<br>
|          | *Ed Loewenstein, Auburn University*                                                            |
| 9:10-9:30| **Comparative Economics of Carbon Sequestration**<br>
|          | *Evan Mercer, USDA Forest Service*                                                             |
| 9:30-9:50| **Economics of Carbon Sequestration in Longleaf Pine**<br>
|          | *Kurt Krueger, Larson & McGowin*                                                              |
| 9:50-10:10| **Potential of Stacking Other Ecosystem Services with Carbon Offsets in Longleaf Pine**        |
|          | *Andrew Stainback, University of Kentucky*                                                     |
| 10:10-10:30| **Income Tax Treatment of Forest Carbon Credit Payments to Landowners**                        |
|          | *Linda Wang, USDA Forest Service*                                                              |
| 10:30-10:50| **Break**                                                                                      |
| 10:50-12:00| **Panel Discussion/Question & Answer**                                                         |
| 12:00    | **Adjourn**                                                                                    |
NOTES
Keynote Speakers
Climate Change Trends and Projections for the Southeast: Implications for Forest Ecosystems

Virginia Burkett, U.S. Geological Survey, Reston, VA.

Abstract: The southeastern United States spans a broad range of physiographic settings and has exceptionally high levels of forest productivity and biodiversity. Many forest ecosystems and associated wildlife species in the region are under threat due to human development activities and the effects of anthropogenic climate change. The climate of the southeast has changed significantly over the past century; all current general circulation models (GCMs) indicate that warming will intensify across the region during the next 20 years regardless of emission control policies.

Since 1970 the annual average temperature of the southeastern states has risen about 2°F, with the greatest seasonal increase in temperature occurring during the winter months. The decline in freezing days (four to seven days per year for most of the region) since the mid-1970s has had important effects on the distribution and phenology of plants and animals -- both native and invasive species. Climate model projections portend even milder winters across the entire region during the coming decades. Average annual precipitation in the Southeast has declined by approximately 4% since 1970. There has been an increase in heavy downpours in many parts of the southeast, while the percentage of the region experiencing moderate to severe drought increased over the past three decades. The area of moderate to severe spring and summer drought has increased by 12 percent and 14 percent, respectively, since the mid-1970s. Even in the fall months, when precipitation tended to increase in most of the region, the extent of drought increased by 9 percent. Because higher temperatures lead to more evaporation of moisture from soils and water loss from plants, the frequency, duration, and intensity of droughts are projected to increase. The warming is also likely to increase the propensity for wildfires and the distribution of native and non-native species.

Understanding the historical trends and projected changes in climate will enable forest resource managers to anticipate responses in forest ecosystems and develop adaptation strategies that can help minimize adverse impacts and increase any benefits that may be gained from climate change and atmospheric CO₂ enrichment. The effectiveness of adaptation by resource managers will depend, in part, on the predictive skill of ecological response models that can be coupled with climate model scenarios at the scale of a forest management unit, watershed, or biome.
Virginia Burkett is the Chief Scientist for Global Change Research at the U.S. Geological Survey. She was formerly Chief of the Forest Ecology Branch at the USGS National Wetlands Research Center in Lafayette, Louisiana. Burkett has served as Secretary/Director of the Louisiana Department of Wildlife and Fisheries, Director of the Louisiana Coastal Zone Management Program, and Assistant Director of the Louisiana Geological Survey. She has published extensively on the topics of global change and low-lying coastal zones. She was a Lead Author of the United Nation's Intergovernmental Panel on Climate Change (IPCC) Third and Fourth Assessment Reports (2001 and 2007) and the IPCC Technical Paper on Water (2008). She is an author of the 2009 national assessment of climate change impacts produced by the U.S. Global Change Research Program. She has co-authored reports for The Wildlife Society (2004), the United Nations Convention on Biodiversity (2005), the Everglades Task Force (2007), and the U.S. Department of Transportation (2008) that address climate change impacts and potential adaptation strategies. Burkett has been appointed to over 40 Commissions, Committees, Science Panels and Boards during her career and was among the four generations of IPCC authors who shared in the 2007 Nobel Peace Prize. She is an editor of the international journal Ethics in Science and Environmental Policy. Burkett received her doctoral degree in forestry from Stephen F. Austin State University in Nacogdoches, Texas in 1996.
The Nature Conservancy’s Approach to Forest Restoration and Carbon: Scientific Foundations for Linking Forest Resilience Projects to Carbon Policy

David Ganz, The Nature Conservancy, Berkeley, CA.

Abstract: The Nature Conservancy (TNC) is committed to restoring and conserving a broad array of habitats around the globe, including fire-adapted forests like those long-leaf pine ecosystems of the South East. In the United States, significant changes to fire-adapted forests have accrued through decades of fire suppression, logging and grazing, making them susceptible to uncharacteristically severe fire, insect and disease events. Climate change is an additional stress. Forest management practices that reduce fuels, including mechanical thinning, prescribed fire and wildland fire use, are acknowledged as key to restoration. Additional possible benefits of fuels treatment involve carbon. Interest in carbon markets is stimulating treatment proposals that seek carbon offset payments for changing forest management to store additional carbon. One aspect of this forest management and carbon relationship is the need to better understand the carbon trade-offs from fuel reduction treatments, designed to reduce the risk of catastrophic fires and improve degraded forest conditions. TNC focuses its efforts on projects whose primary objectives are to increase the resilience of forests. Resilience is defined as “the capacity of an ecosystem to tolerate disturbance without collapsing into a qualitatively different state that is controlled by a different set of processes.” TNC’s climate change mitigation and adaptation strategies are consistent with this objective, thus advancing the science and practice of allowing restored ecosystems to abate the threat of climate change.

The purpose of this presentation is to introduce the key topics that need to be considered when linking forest management to the science of carbon and climate change. There is open and constructive debate in the field of forest carbon, both scientifically and politically. This presentation addresses the following topics:

- The relationships among forest treatments, carbon budgets and emissions; and
- The kinds of treatments and analyses TNC should be considering to ensure projects achieve resilience while abating climate change threats.
**David Ganz** is a senior scientist with The Nature Conservancy’s Climate Change Team. David is an expert in forest science, policy and management who also has experience integrating forest and fire science with some of conservation’s most important new opportunities and emerging issues: sustainable livelihoods, climate change adaptation, ecosystem services, avoided deforestation and degradation, and community forestry.

David has worked for United Nations’ Food and Agricultural Organization (FAO) positioned at the Regional Community Forestry Center in Bangkok, Thailand. In his role with FAO, David managed a variety of projects focused on Southwestern China and Southeast Asia. More recently, he was a senior scientist in charge of forestry and fire science projects for TSS Consultants and vice president of international operations for the Renewable Energy Institute. Recent projects have included organizing and facilitating both the China E5 Biofuels Assessment and the Pinchot Institute’s independent science review of the Quincy Library Group pilot project.

Dr. Ganz’s doctoral research in the Sierra Nevada looked at forest health and management implications of various prescribed burning and thinning treatments. More recently he has focused on facilitating processes in which local communities have substantial involvement in deciding the objectives and practices involved in preventing, controlling or utilizing fires. He has published more than 40 papers in technical journals with a primary focus in the fields of forest carbon science and management, fire science, ecosystem services, forest health, silviculture and community forestry.
Taking Longleaf Pine Restoration and Management to the Carbon Market: An Overview of Forest Carbon Standards and Experiences in Project Level Carbon Accounting

David Shoch, TerraCarbon LLC, Charlottesville, VA.

Abstract: Voluntary markets for forest carbon offsets hold potential to make important contributions to financing longleaf pine restoration and management. The presentation will review the standards that govern most of the near-term forest carbon market in the US (including Voluntary Carbon Standard, Climate Action Registry, and the Chicago Climate Exchange), followed by an overview of how eligibility requirements and accounting methodologies are applied to inform proper project planning and monitoring.

David Shoch is the Director of Forestry and Technical Services for TerraCarbon LLC, advising clients on the design and management of forest carbon offset projects. Prior to joining TerraCarbon, David worked for The Nature Conservancy’s Climate Science Group, and with Winrock International where he managed the implementation of carbon measurement and monitoring efforts for a wide range of clients. Mr. Shoch has more than 10 years of experience in forest biomass carbon measurement and monitoring and forest growth and yield modeling, and has served as a contributing author on the International Panel on Climate Change and the Voluntary Carbon Standard.

Mr. Shoch received his Masters degree in Forestry from the Duke University Nicholas School of the Environment and a bachelor’s degree in Biology from the University of Richmond. He is a member of the Society of American Foresters.
Invited Speakers
Modeling Longleaf Pine Ecosystems at Multiple Scales: Needs for Regional Carbon Sequestration Evaluation

Wendell P. Cropper Jr., University of Florida, Gainesville, FL.

Abstract: Forest carbon markets are often thought of as mechanisms to facilitate exchanges at the level of individual forest stands. Forest carbon models, coupled with remote sensing and some field verification could be valuable tools for establishing and operating these markets. Design of stand-level C accounting systems can be complicated by temporal and spatial scale issues. What is the fate of the C after the contract period is completed? Must C payments be returned following a fire or windstorm that reduces standing biomass? These problems result from a failure to understand the forest as a dynamic system, even at equilibrium. An effective strategy to store C in forests should be focused at the regional- and not the stand-level. The annual rate of C sequestration in a stand is not an important consideration relative to the sustainable standing crop of C in the region. Fire and windstorms should be considered inevitable and used to inform decisions on the area of land allocated to carbon sequestration. Given a political consensus on the importance of C sequestration, wood product production, and biodiversity protection, sophisticated optimization models could be used at the regional-scale to manage forest C purchases.

Wendell Cropper received a B.A. in biology from Cornell College and M.S. and Ph.D. degrees in ecology from Emory University. He is currently an Associate Professor of Biological Process Modeling at the School of Forest Resources and Conservation at the University of Florida. He has taught Environmental Science, Forest Ecology, Forests for the Future, and graduate courses in simulation modeling, fire modeling and ecology, and forest ecology. His research interests include development, testing, and application of computer simulation models for pine forests in the Southeast.
Longleaf Pine and Global Warming: The Dual Role of Restoration and Potential Carbon Incentives

_Amadou Diop_ and _Eric Palola, National Wildlife Federation, Atlanta, GA._

**Abstract:** Longleaf pine (*Pinus palustris*) forests are one of America’s natural treasures, yet past exploitation has left them hanging by a thread, now covering just 3 percent of their pre-settlement range. Because other pine species in the Southeast may be more susceptible to global warming, longleaf pine forests have an opportunity to reclaim some of their former glory. Indeed, re-establishing longleaf pine ecosystems will benefit all Americans by improving climate resilience, economic opportunity, and ecosystem vitality.

NWF just released a science-based report that examines the intersection between longleaf pine restoration and actions needed to address global warming. The report address how:

- **Global warming puts Southeast forests at risk.** Increasing temperature shifts in precipitation, more severe storms, sea-level rise, and other climate changes are stressing natural ecosystems and forcing communities and governments to rethink how we manage our forests, water supply, and other natural resources.

- **Longleaf pine ecosystems are naturally resilient to climate extremes.** Compared to other pine species, longleaf pine grows in very dry and very wet conditions, is tolerant of and even dependent on wildfires, is better able to weather severe storms, and is more resistant to beetle infestations likely to be exacerbated by warmer and drier conditions.

- **Longleaf pine ecosystems represent one of the best global warming adaptation strategies for Southeast forests.** Restoring and expanding healthy longleaf pine forests can ensure reliable economic returns for landowners, provide crucial wildlife habitat, enhance natural retention of fresh water on the landscape, and help protect communities from natural disasters.

- **Longleaf pine ecosystems should be a centerpiece of land-based carbon sequestration efforts in the Southeast.** Longleaf pine ecosystems are well suited to long-term storage of carbon because they outlive other southern pine species, have a low mortality rate, are effective at storing carbon below ground and in its wiregrass understory, and produce wood likely to be used in long-lived structures.

- **Longleaf pine restoration can help alleviate poverty among African American landowners in the Southeast.** Community-based forestry programs to educate and empower landowners about longleaf pine conservation and stewardship can help them take better advantage of the rich natural resources of the region, and thereby access new short-term income opportunities, build wealth, and enhance the resiliency of communities.
In this presentation we will discuss how global warming will affect forests in the Southeastern United States and how longleaf pine is expected to be resilient to many of these changes. Our presentation will also make a case for why longleaf pine ecosystem restoration should be the centerpiece of forest-based climate adaptation and carbon sequestration efforts in the region.

**Amadou Diop** is Director of NWF’s Southern Forest Restoration Program. He is responsible for leading the National Wildlife Federation’s longleaf and forest restoration program in the Southeast. Amadou previously served as the Forestry Program Director at the Federation of Southern Cooperatives where he was responsible for outreach and technical assistance programs to small and underserved private forest landowners across a five state region. As a leader in the national community forestry movement, Amadou has also managed multi-year projects with the Ford Foundation. He holds an M.S. in Agricultural and Resource Economics from Tuskegee University. Amadou currently serves in the Professional Agricultural Workers Conference’s advisory board and the National Network of Forest Practitioners’ Board of Directors.

**Eric S. Palola** is Senior Director of the Forests for Wildlife program at the National Wildlife Federation. His work focuses on national and international forest climate policy, forest restoration, and market incentives. He currently serves as Vice Chair of the international Board of Directors of the Forest Stewardship Council based in Germany, and on the Steering Committee for the national Forest Climate Working Group involving over thirty U.S. forest industry and conservation groups. He is a past Chair of the Northern Forest Alliance and previous Board member of the National Network of Forest Practitioners. He has served in numerous consultancies and task forces for the US Forest Service, the Pinchot Institute, the states of Maine and Vermont, and formal Keystone dialogues on forest taxation and ecosystem management. Eric previously directed NWF’s northeast regional office covering programs in water quality, forest restoration, wildlife conservation, and environmental education. He also worked as Project Manager for a private biomass energy firm, as a policy analyst at US EPA, and as Associate Director for the Vermont Natural Resources Council. Eric has degrees in natural resource economics and public policy from the University of Vermont and Harvard University. He lives on a small farm in Huntington, VT.
Wildlife Conservation and Climate Change: How Tomorrow’s Landscape Should Influence Today’s Decisions


Abstract: Natural resource managers in the southeastern United States face unprecedented pressure to develop effective and efficient conservation strategies. Climate change and anthropogenic pressures further complicate the challenges associated with maintaining populations of trust species and the habitats they require. The great uncertainty associated with predicting future climates and landscapes, as well as wildlife responses to them present enormous difficulties for decision makers. In addition, opportunistic, reactive conservation strategies frequently have not been effective for stabilizing or bolstering already declining populations of many species of terrestrial and aquatic wildlife. If the benefits to wildlife populations are considered in the application of large-scale conservation policies, such as carbon sequestration, such policies could be much more effective at simultaneously accomplishing programmatic objectives as well as contributing to wildlife conservation. This may be possible by applying the principles of conservation biology and reserve network design for the strategic placement of focal areas, and making use of the growing body of literature on vulnerability and adaptation of wildlife populations to environmental change. Smart conservation decisions should appropriately be based on measurable conservation objectives and rigorous analyses that incorporate the values of stakeholders, consider numerous alternatives, and objectively evaluate the consequences of each alternative. Analyses must pay close attention to the uncertainties associated with predicting the environmental conditions and the outcomes of conservation alternatives and linked decisions. If competing models are used to predict system response to management actions, these constitute the basic elements of adaptive management, which is an ideal tool for decision making when uncertainty is great and there is opportunity to learn by monitoring the consequences of management actions. This process will be illustrated using a model for longleaf pine bird conservation that incorporates land use change due to climate and urban growth.

Dr. James (Barry) Grand is a Professor of Wildlife Sciences at Auburn University and has been the Leader of the Alabama Cooperative Wildlife Research Unit since 1998. His research interests lie mainly in the area of avian ecology and population dynamics. Dr. Grand received his undergraduate degree in Forestry and Wildlife from Louisiana State University. He completed his Masters of Science degree at Auburn in 1984 while conducting research on Mourning Doves under the supervision of Dr. Ralph Mirarchi. He completed his Ph.D., also in
Wildlife Science, at Texas A&M University under the supervision of world renowned waterfowl and wetlands ecologist Dr. Milton W. Weller.

Dr. Grand was the principal investigator for the Alabama Gap Analysis Project, and a co-investigator in the Southeast Regional Gap Analysis Project. His current research includes developing inventory and monitoring programs, and management recommendations for species of greatest conservation need on state-owned lands in Alabama. He works with the East Gulf Coastal Plain Joint Venture to plan for strategic conservation of open pine ecosystems, and is currently engaged in developing similar tools for the Atlantic Coast Joint Venture that incorporate urban growth and climate change projections. These products will be used in the USGS southeast regional assessment of climate change impacts.
Managing Fire Risk and Carbon Emissions in Dry Temperate Forests

Matthew Hurteau, Northern Arizona University, Flagstaff, AZ.

Abstract: Dry forests of the western U.S. are experiencing an increased frequency of large, severe fires as a result of past fire suppression and on-going climate change. The risk of large, high-severity fire can be mitigated through the use of mechanical thinning and prescribed fire. Both fuels treatments and wildfire impact forest carbon stocks. Using a field study in a Sierran mixed-conifer forest, we tracked pre- and post-treatment carbon stocks and emissions for three levels of thinning and two levels of prescribed burning. We then modeled the effects of two levels of thinning and the reconstructed 1865 forest structure, coupled with two levels of prescribed burning on long-term carbon stocks under high-severity wildfire conditions. In the field study we found that post-treatment live tree carbon stocks ranged from 65.8 Mg C ha$^{-1}$ in the overstory thin/burn treatment to 249.8 Mg C ha$^{-1}$ in the control. Treatments had little impact on soil carbon stocks. Total emissions including prescribed fire, milling waste, and equipment emissions ranged from 14.8 to 67.8 Mg C ha$^{-1}$. Seven years post-treatment the burn only and understory thin treatment carbon stocks had recovered the quantity of carbon emitted and removed during treatment implementation. In the modeling study we found that in the absence of wildfire, the control had the highest C stocks after 100 years of growth (476 Mg C ha$^{-1}$). However with a mid-century wildfire, the burn-only and 1865 reconstruction had the largest C stocks after 100 years. Wildfire emissions were highest for the control (40.8 Mg C ha$^{-1}$) and lowest for the 1865 forest structure coupled with prescribed burning. These results suggest that thinning smaller trees and retaining large-diameter, fire-tolerant pines provides the most favorable outcome for long-term carbon stocks that are resistant to high-severity wildfire.

Matthew Hurteau is a research associate with the Western Regional Center of the National Institute for Climatic Change Research at Northern Arizona University. His research focus is on climate mitigation and adaptation in forested systems. He received his Ph.D. from the University of California, Davis in 2007 where he conducted research on the impacts of predicted changes in precipitation, nitrogen deposition, and fire on forest understory productivity and diversity. His current research focus is on the potential climate mitigation benefit of fire-prone forests and modeling the growth response of trees to changes in climate.
Carbon Sequestration Partnerships – A Model for Restoring Ecosystem Functions and Values

Pete Jerome, U.S. Fish and Wildlife Service, Atlanta, GA.

Abstract:

Pete Jerome coordinates the biological carbon sequestration for the Fish and Wildlife Service and co-chairs the biological carbon sequestration working group for the Department of the Interior. Pete was the supervisor for refuges in the lower Mississippi River Valley. It was during his tenure in the lower Miss that the Service developed a carbon sequestration program directed toward restoring bottomland hardwood forest ecosystems. This effort has resulted in 80,000 acres of land being restored and 40,000 acres permanently protected as part of the National Wildlife Refuge system. Currently Pete supervises refuges in the South Atlantic and the Caribbean where he is working with partners to develop carbon sequestration protocols for peatlands and tidal wetlands. Pete has been the lead for the Service in working with USGS on carbon sequestration stock assessment methodologies under the Energy Independence and Security Act. He is currently working with the Climate Action Reserve to support carbon offset project eligibility on refuge lands.

Pete is a career service employee with 31 years in federal service. He has worked on refuges in Alaska, California and on the program staff in Washington, DC. He has master’s degree in regional planning from the Samuel Trask Dana School of Natural Resources at the University of Michigan.
Coarse Root Biomass of Longleaf and Loblolly Pine in a 50-year-old Silviculture Experiment in Mississippi

John R. Butnor\textsuperscript{1}, Kurt H. Johnsen\textsuperscript{1}, and C. Dana Nelson\textsuperscript{2}, \textsuperscript{1}USDA Forest Service, Southern Research Station, Research Triangle Park, NC., \textsuperscript{2}USDA Forest Service, Southern Institute of Forest Genetics, Saucier, MS.

Abstract: It is frequently stated that longleaf pine trees have exceptionally large root systems. However, this “fact” is largely based on observations; very little quantitative data have been published. In order to quantify and predict total carbon sequestration of longleaf pine forests, equations describing below-ground C allocation are needed. We are in the process of quantifying biomass C in a 50-year-old silviculture experiment located on the US Forest Service Harrison Experimental Forest in Saucier, MS which was established to assess the impacts of early fertilization on the growth of longleaf, loblolly and slash pine. Coarse roots (all roots > 5mm) contained within pits within a 1 \times 1 m area (to the depth of each root system) surrounding trees up to 40 cm in DBH are being excavated via backhoe (designated “below stump root biomass”). Lateral coarse root (> 0.5 cm) biomass between trees was estimated using ground-penetrating radar (GPR). GPR performed reliably on this well-drained upland, fine sandy loam site, estimates of lateral root mass closely matched actual root mass collected with soil cores (R\textsuperscript{2} = 0.79). In agreement with conventional wisdom, results thus far indicate that longleaf does allocate more biomass to roots than loblolly pine, although below stump root biomass varied more with tree size for longleaf compared to loblolly pine. At a basal area of 20 m\textsuperscript{2} ha\textsuperscript{-1}, longleaf pine has 40\% greater below stump root biomass than loblolly pine.

Kurt Johnsen received his B.S. in forestry from the University of Vermont in 1985, his M.S. in forest biology from Virginia Tech in 1987 and his Ph.D. in tree physiology and forest genetics from The University of Georgia in 1990. He worked for the Canadian Forest Service in Ontario and New Brunswick from 1990-1997 and has worked for the USFS Southern Research Station based out of RTP, NC since 1997.
Longleaf Pine: The Tree that Built and Shaped the South

Rhett Johnson, Longleaf Alliance Inc., Andalusia, AL.

Abstract: Longleaf pine and longleaf ecosystems have played an integral role in the development of the South and the nation. Although longleaf is justifiably appreciated for its ecological and economic values, the role that forest resource has played in the shaping of the region’s culture and social structure is no less remarkable. From the pre-settlement culture of the first Americans to today’s “green” society, longleaf forests have been important components in the everyday life of the region’s inhabitants. It has been suggested that taking fire out of the longleaf forest is akin to taking the rain out of the rain forest. Fire is the driver that makes longleaf truly unique among forest systems. The roles that fire and longleaf may play in carbon budgets is yet to be determined, but must be addressed in policy and practice.

Rhett Johnson is a co-founder and Co-Director of The Longleaf Alliance and currently serves as the President of The Longleaf Alliance, Inc., a non-profit 501(c)(3) corporation, formed to advocate for retention and restoration of longleaf ecosystems across their range. Rhett earned wildlife biology and forest management degrees at North Carolina State and Clemson and worked in both fields before accepting the position as the first Director of the Solon Dixon Forestry Education Center, Auburn’s teaching and research forest in south Alabama, in 1979. He retired from the University in 2006 and continues to work with the Longleaf Alliance.
Economics of Carbon Sequestration in Longleaf Pine

Kurt Krueger, Larson & McGowin, Inc., Merryville, LA.

Abstract: Current political environment and outlook for the Chicago Climate Exchange. Real world example of costs and income potential from carbon offset sales under various registries and trading platforms.

Kurt R. Krueger was born in St. Louis, Missouri in 1972. Received Bachelor of Science in Forestry from the University of Missouri-Columbia – 1994. Continuing education includes courses at the University of Georgia, the Association of Farm Manager and Rural Appraisers on appraisal theory and rural property appraisal. Kurt is a District Manager for Larson & McGowin, Inc. and oversees the management of approximately 70,000 acres of timberland in Louisiana and Texas. Kurt is responsible for the development of annual budgets, administration & negotiation of timber sales and supervision of contracted silvicultural services. He is a Registered Forester in Georgia and affiliated with the American Society of Farm Managers and Rural Appraisers (ASFMRA), the Association of Consulting Foresters, the Society of American Foresters, and the Texas Forestry Association.
What We Know and Don’t Know About Carbon Stocks in Different Longleaf Pine Ecosystems

John Kush, Auburn University, Auburn, AL.

Abstract: Carbon sequestration associated with longleaf pine has potential to be significant at two levels: the tree species and the forest ecosystem. Longleaf pine may have an advantage over other southern pines to sequester large amounts of carbon for a longer time period. This may be achieved through not only standing timber managed on rotations of 60 years or longer, but also through carbon that continues to be held in solid wood products such as power poles and high quality lumber produced from these forests. However, little is known about how much carbon is actually stored through time by longleaf pine-dominated ecosystems. Factors that might influence carbon in these systems include the effects of frequent fire, geographic location, soil type, and species composition of the diverse ground layer. Although we lack specific knowledge on how to accurately account for these stocks, there are several ongoing projects that can assist in filling in these gaps. The Regional Longleaf Growth Study is an example of a unique long-term study that provides a comprehensive data set of longleaf growth and mortality across the region. There is the potential to also use information from this study to examine fire effects on the ecosystem. Additionally, an ongoing region-wide mapping project is helping to identify where longleaf pine currently exist across its natural range. Although less “glamorous” than the ability to produce carbon sequestration rates themselves, information provided by projects such as these are critical to the success of future attempts to accurately account for carbon in longleaf pine ecosystems. The continuation of these projects is critical to provide needed information to both the public and private sector. Without this information, values produced are of little practical application, and the inaccuracy may have long term impacts on policy and the environment that are yet to be calculated.

John S. Kush is a Senior Research Fellow for the Auburn University School of Forestry and Wildlife Sciences and serves as Director of the Longleaf Pine Stand Dynamics Laboratory. For over 25 years he has been responsible for numerous research projects dealing with longleaf pine. These projects include: the 30-year, 35-year, and 40-year inventories of the Regional Longleaf pine Growth Study plots and factors affecting the growth, yield, and carbon sequestration of longleaf pine ecosystems. In addition, he has examined re-introduction of fire into fire suppressed longleaf pine ecosystems; longleaf pine restoration and state and condition of montane longleaf ecosystems with emphasis on old-growth longleaf pine stands at the US Fish and Wildlife Service Mountain Longleaf National Wildlife Refuge. He has authored or co-authored more than 90 papers on longleaf pine.
Comparing Carbon Storage in Longleaf Pine Among Various Stand Structures

Ed Loewenstein\textsuperscript{1}, Dale G. Brockway\textsuperscript{2}, and Lisa Samuelson\textsuperscript{3}, \textsuperscript{1}Auburn University, Auburn, AL, \textsuperscript{2}USDA Forest Service, Southern Research Station, Auburn, AL, \textsuperscript{3}Auburn University’s Center for Longleaf Pine Ecosystems, Auburn, AL.

Abstract: “All models are wrong, but some are useful.” This oft quoted statement attributed to the statistician, Dr. George E. P. Box certainly applies to carbon accounting, but also to all aspects of the silviculture and ecology of longleaf pine ecosystems. How then is it possible to address carbon storage in a system where the only defensible answer is: it depends? Our attempt to answer part of this question (that associated with the general management approach and the resulting unique stand structures) requires a suspension of disbelief. Or, as scientists often suggest, all other things being equal… We examine only three possible structures along a continuum: 1) intensive plantation management, 2) selection silviculture (continuous cover forestry) based on the Proportional-B method, and 3) a no management scenario (old growth). These structures are based (where possible) on inventories from stands with a known management history. Where necessary, stand projections are made and mortality estimated using the Forest Vegetation Simulator, growth and yield model. In our analysis we assume no difference and account for no effect among external disturbance regimes (natural or applied), do not address below ground dynamics, and do not account for the carbon requirements of management.

Dr. Edward F. Loewenstein earned a BS in Forest Resources Management from Southern Illinois University, a MS in Forest Biology from Auburn University, and a Ph.D. in Silviculture from the University of Missouri. He returned to Auburn in 2002 after six years as a Research Forester with the US Forest Service, North Central Research Station in Columbia, MO. His research interests include: uneven-aged silvicultural systems, hardwood silviculture, canopy dynamics, and the temporal effects of thinning on light in the understory.
Coordinating Longleaf Pine and Climate Change Research via the Southeast Regional Partnership for Planning and Sustainability (SERPPAS)

Roel Lopez, Texas A&M Institute of Renewable Natural Resources, College Station, TX.

Abstract: The Southeastern Regional Partnership for Planning and Sustainability (SERPPAS) is a coalition of state environmental and natural resource agencies (FL, AL, GA, NC, SC), Department of Defense and military services, and other federal agencies (EPA, NOAA, USFS, USFWS) that promotes collaboration in land-use decisions. The range-wide conservation of longleaf pine is within the mission of SERPPAS to promote improved regional and local coordination to sustain natural resources as well as national defense. Members of SERPPAS identified 7 key actions in support of the Range-wide Longleaf Pine Conservation Plan. One action included the need to coordinate climate change research related to longleaf pine. As a result, a one-day workshop was held with key climate change experts with the goals of (1) identify key research gaps and priorities, and (2) outline key implementation strategies to further coordinate longleaf pine and climate change research. Presentation will review key workshop findings.

Roel R. Lopez is an Associate Professor in the Department of Wildlife and Fisheries Sciences and Associate Director of the Texas A&M Institute of Renewable Natural Resources. His previous research focused on endangered and/or fragmented wildlife populations and nuisance populations in urban settings. Prior to his return to Texas A&M, Roel was on assignment (2-year IPA) serving as a Special Assistant for Range Sustainment and Regional Partnerships in the Office of the Deputy Under Secretary of Defense (Installations and Environment) in Arlington, Virginia. His professional interests includes land conservation practices on military lands and strategies that promote sustainable ranges.
A Multi-State Longleaf Carbon Modeling Project

Timothy Martin¹, Lisa Samuelson², Kurt Johnsen³, Carlos Gonzalez-Benecke¹, Wendell Cropper¹, and John Butnor³, ¹University of Florida, Gainesville, FL., ²Auburn University’s Center for Longleaf Pine Ecosystems, Auburn, AL., ³USDA Forest Service, Southern Research Station, Research Triangle Park, NC.

Abstract: Forests can offset greenhouse gas emissions by sequestering CO₂ in tree biomass, understory vegetation, forest floor litter, dead wood, soil organic matter and ultimately in wood products. Sustainable forest management activities have the potential to increase forest sequestration rates. Approximately 12-16% of CO₂ emissions in the U.S. are offset by U.S. forests and forests in the southeast and south-central U.S. could offset up to 23% of regional emissions. Longleaf pine ecosystems offer opportunities to sequester carbon and reduce CO₂ emissions, because longleaf pine is a long-lived tree species and because of the focus on restoration and protection of longleaf pine ecosystems as habitat for threatened and endangered species. However, we do not know how restoration and management practices, in particular prescribed fire, impact carbon stocks and we lack information at the ecosystem level, which includes carbon in above and belowground biomass of trees, shrubs, and herbaceous plants, and in soils. This talk will summarize planned efforts to develop a longleaf pine carbon balance modeling system capable of simulating carbon stored on-site and in forest products, and which incorporates site- and stand-level factors, management activities including thinning and prescribed fire, as well as the life-cycle carbon costs of management and post-harvest processing.

Tim Martin is an Associate Professor of Tree Physiology in the School of Forest Resources and Conservation at the University of Florida. He holds a B.S. degree in Forest Management from Oklahoma State University, an M.S. in Tree Physiology from the University of Georgia, and a Ph.D. in Tree Physiology from the University of Washington. His research program focuses on the physiological mechanisms controlling productivity and carbon and water flux in trees and forests. He is the Director of the UF Carbon Resources Science Center, a multidisciplinary initiative designed to facilitate collaboration in agricultural and natural resources carbon dynamics research, and to serve as a source of carbon science information for stakeholders. He is also Co-Director of the Forest Biology Research Cooperative, which fosters collaborative research on the mechanisms controlling sustainability and productivity of managed southern pine ecosystems.
Comparative Economics of Carbon Sequestration

Evan Mercer, USDA Forest Service, Southern Research Station, Research Triangle Park, NC.

Abstract: This paper assesses the viability of forest project offsets, relative to other carbon offset options in order to examine how competitive non-industrial private forest (NIPF) lands are with alternative methods for offsetting greenhouse gas (GHG) emissions. Alternative methods for GHG offset projects include: agriculture, clean transportation, carbon capture and sequestration, nuclear and advanced technologies, increasing energy efficiency, renewable energy, and emissions reductions from public transportation vehicles. First, factors affecting forest offset costs are discussed including: species and site characteristics, management practices, opportunity costs of land, and price effects on forest and agricultural products. Then, the competitiveness of forest based offsets with alternatives sources is evaluated by comparing the costs of reducing GHG in terms of CO₂ equivalent (CO₂e) for the various alternatives. We conclude by examining the current policy environment focusing on the cap and trade bills before the Congress, emphasizing how different eligibility criteria may impact forestry offset projects and potential strategies for increasing the competitiveness of NIPF offset projects.

Evan Mercer is a Research Economist with the USDA Forest Service Southern Research Station Economics and Policy Research Unit in Research Triangle Park, NC. He also is an Adjunct Professor at Duke University and North Carolina State University. He holds B.S. degrees in Biology and Zoology from the University of Texas at Austin, an M.S in Forest Ecology from the University of Michigan and a Ph.D. in Resource Economics from Duke University. Prior to joining the Forest Service in 1992, he served as a Post-Doctoral Research Associate for a World Bank project evaluating the economic impacts of a new national park in Madagascar, worked for the Research Triangle Institute as an economist on natural resource damage assessments, and served a two year internship with the East West Center in Honolulu studying forest policy problems in the Pacific Rim. In addition to Madagascar, international experience includes projects in Mexico, Costa Rica, Jamaica, Indonesia, the Philippines, and Lesotho. Mercer’s current research focuses on analyzing the effects of government policies, market factors, and societal values on the production of multiple benefits from public and private forest resources.
A Preliminary Examination of Prescribed Fire’s Role in Longleaf Pine Carbon Dynamics

Gregory Starr\(^1\), Robert Mitchell\(^2\), Jason McGee\(^2\), Mathew William\(^3\), Jennifer Wright\(^3\), Joseph J. O’Brien\(^4\), and A. Whelan\(^1\), \(^1\)University of Alabama, Tuscaloosa, AL., \(^2\)Joseph W. Jones Ecological Research Center, Newton, GA, \(^3\)University of Edinburgh, Edinburgh, Scotland, UK, \(^4\)USDA Forest Service, Center for Forest Disturbance Science, Athens, GA.

Abstract: Climate change has presented a number of challenges to ecologist and their understanding of the complex feedbacks between variables that control ecosystems processes. The interaction of fire and moisture is one that has gained considerable recognition in the scientific community over the last few years. Predictions suggest that climate change will result in longer and more intense the fire seasons in several parts of the world because of prolonged drought. Under these scenarios it is estimated that the average area that will burn in some forests may double by 2041-2050. This doubling, however, is associated with wildfires, mostly in catastrophic burning regimes, and largely in the boreal region. The increase burning is likely to release significant stores of carbon and provide a feedback to climate changes associated with increased CO\(_2\). However, other ecosystems and their corresponding fire regimes may be viewed fundamentally differently than above. For instance, frequent fire regimes have been suggested to play a mitigating role in global carbon budgets, particularly in tropical and subtropical savannas. Several reports suggest that increasing the fire return interval may result in increased C sequestration capacity. Evaluating how effective this strategy is requires a much deeper fundamental understanding of fire and hydrologic controls on C dynamics of these systems.

To increase our understanding of fire, water, and carbon dynamics we established a study along a natural soil moisture gradient in longleaf systems at the Joseph W. Jones Ecological Center in the spring of 2008. Preliminary data shows that the fire had a short-lived effect on the system and the ecosystems recovered within 3 months of the fire. This trend was seen in both the net ecosystem exchange (NEE) and individual components that comprise NEE such as soil respiration (R\(_{\text{soil}}\)). Along the moisture gradient the xeric site had 50% NEE and R\(_{\text{soil}}\) than did the mesic site. Both systems were shown to be small carbon sinks during this first year of study. Although preliminary evidence shows that this high fire frequency system has the potential to sequester carbon, additional work is needed to quantify how long-term carbon pools are affected by fire and how climate change in the southeastern region may alter this ecosystems ability to sequester carbon.
Dr. Gregory Starr

Education
Ph.D. 2000 Biological Sciences, Florida International University
M.S. 1998 Biological Sciences, Florida International University
B.S. 1994 Biological Sciences, University of Nevada Las Vegas

Academic Appointments
01-08-present Assistant Professor of Plant Eco-physiology, Department of Biological Sciences, University of Alabama.
01-08-present Adjunct Research Scientist, The Joseph W. Jones Ecological Research Center.
10/03-12/07 Assistant Research Scientist, PI, CO-PI, Graduate Faculty (voted by faculty) – School of Forest Resources and Conservation (SFRC) University of Florida (non-tenure).
08/00-10/03 Post Doctoral Research Associate and CO-PI – School of Forest Resources and Conservation (SFRC) University of Florida.
01/95 – 7/00 Field Director – Florida International University. Manage National Science Foundation – Office of Polar Programs (OPP) grant:

Research Interests

My research focuses on understanding the controls over carbon, water, and energy fluxes through terrestrial ecosystems. This includes the interaction between abiotic and biotic processes and the feedbacks to global biogeochemical cycles and climate change. I am particularly interested in understanding these processes across multiple scales (e.g. internal plant signals to continental level carbon dynamics) using plant physiological ecology as a foundation for my research. My research makes use of the latest environmental instrumentation to understand the relationships among climate, biogeochemistry, and plant physiology.

Over the past decade I have been involved with research in a multitude of ecosystems around the world, these include but are not limited to: Arctic Tundra, Everglades, Southern Pine, and Lowland Neo-Tropical Rain Forest Ecosystems.
Potential of Stacking Other Ecosystems Services with Carbon Offsets in Longleaf Pine

G. Andrew Stainback, University of Kentucky, Lexington, KY.

Abstract: Longleaf Pine forests provide a multitude of ecosystem services, including among others, carbon sequestration, habitat for biodiversity and water quality enhancement. Because longleaf pine can provide multiple ecosystem services there is the potential for landowners to be compensated for other ecosystem services in addition to carbon sequestration. Such compensation schemes are commonly referred to as stacking. Stacking can potentially increase the incentive landowners have to establish and manage longleaf pine forests. However stacking can make issues in ecosystem services markets, such as additionality, more complicated.

G. Andrew Stainback is currently an assistant professor of Forest and Natural Resource Policy at the University of Kentucky. His interests are in the economics and policy of ecosystem services, natural resource and environmental law and sustainable development. He has conducted research on the economic and policy implications of carbon offsets and other ecosystem services in managed slash and longleaf pine ecosystems. He has a Ph.D. in Forest Resources and Conservation from the University of Florida and a J.D. from Florida State University.
Expected Effects of Climate Change on Longleaf Pine Growth and Productivity

Robert Teskey, University of Georgia, Athens, GA.

Abstract: Carbon dioxide has increased in the atmosphere from less than 280 ppm in the 1880’s to over 380 ppm at the present time due to the burning of fossil fuels. Its concentration is expected to increase steadily over the 21st century, and may exceed 700 ppm by the end of the century. Carbon dioxide is the substrate for photosynthesis and its increased availability has potentially significant consequences for longleaf pine growth and productivity. In most tree species, increased rates of net photosynthesis caused by elevated levels of carbon dioxide are substantially tempered by a lack of soil nutrients and water stress. Studies conducted on longleaf pine show that its growth also responds positively to elevated levels of carbon dioxide, however, soil nutrient availability appears to have little overall effect on longleaf pine’s growth response to carbon dioxide. This suggests that the high nutrient use efficiency of longleaf pine may be the key factor for understanding how the species will respond to climate change. Climate change is also expected to increase air temperatures 2 to 4°C in the region. This will result in a longer growth season, further increasing the productivity and carbon sequestration potential of longleaf pine ecosystems. Taken together, the changes in the climate expected in the 21st century are likely to have generally positive, although relatively small, effects on longleaf pine productivity.

Dr. Teskey is a Distinguished Research Professor of Forest Biology at the University of Georgia. He has authored or co-authored over 85 refereed publications, and has given over 40 invited presentations at scientific meetings, universities and research institutes in ten countries. He has been a member of the Editorial Review Board of Tree Physiology for 21 years, and has also served as an Associate Editor for the Canadian Journal of Forest Research. Dr. Teskey was the Coordinator of Physiology Working Groups in the International Union of Forestry Research Organizations from 2001-2005. Honors he has received include the Society of American Foresters Southeastern Society Research Award, the McMaster Research Fellowship from CSIRO Australia, a Japanese Science Development Program Fellowship, and an Honorary Faculty Appointment from the Northeast Forestry University, Harbin China. He has served as major professor for 12 PhD and 15 MS students.
Tax Treatment of Forest Carbon Credit Payments to Landowners

Linda Wang, USDA Forest Service, State and Private Forestry, Washington D.C.

Abstract: Voluntary markets such as the Chicago Climate Exchange are trading more credits every year and forest landowners have participated in these markets. However, tax laws currently provide no specific guidance on the issue of income from carbon credits. This presentation describes some of the options that may apply to carbon credit income from forest property.

Dr. Linda Wang serves as a national timber tax specialist with USDA Forest Service, State and Private Forestry, Cooperative Forestry unit in Washington, D.C. She provides education and training on income and estate tax to private family forestland owners through tax workshops, daily phone calls, emails and technical publications. She conducts tax legislative analysis and tax policy assessment that helps to ensure the long-term health of the non-industrial family forests in the nation.

She works extensively with private landowners and possesses expert knowledge of the tax issues associated with the management of private forest lands. She serves as nationally-recognized expert instructor in forest income and estate tax seminars. She co-authored 2006-2008 issues of Tax Tips for Forest Landowners and is revising the 3rd edition of the Federal Income Tax on Timber: A Key to Your Frequently Asked Questions. She has written the training manual on the woody biomass energy tax incentives for the southern region. She coordinates timber tax issues with the IRS.

As leading expert in the timber tax field, Dr. Wang has presented at the Congressional timber tax seminar on the Capital Hill in 2009. She has testified, as a timber tax expert, before the Texas House committee on timberland property tax policy in 2004, along with the officials of the Texas Forest Service while employed in that agency from 2000-2006.

She received her Certified Public Accountant (CPA) certificate from Washington State in 1997. She has gained professional tax field experience from working in a public accounting firm Ingram & Wallis Professional Corporation in 1999-2000. She has volunteered to prepare tax returns for low-income and seniors under the IRS VITA Program in 2007.

She has planned and participated as an instructor in over 60 training sessions and workshops for private landowners, with thousands of participants providing hundreds of hours of contact, including the 2008 national forest tax webinar.
Poster Abstracts
Carbon Sequestration in Longleaf Pine Ecosystems: Current State of Knowledge and Information Needs
Carbon Dynamics in Slash Pine (*Pinus elliottii* var *elliottii* Englm.) Plantations in Florida

**Rosvel Bracho**¹, **Timothy A. Martin**¹, **Wendell P. Cropper, Jr.**¹, **Henry L. Gholz**² and **Gregory Starr**³, ¹University of Florida, Gainesville, Fl., ²Division of Environmental Biology, NSF, Arlington, VA., ³University of Alabama, Tuscaloosa, AL.

**Abstract:** We used eddy covariance and biometric approaches to measure carbon dynamics in slash pine plantations (*Pinus elliottii* var *elliottii* Englm), consisting of a newly planted and mid rotation stands in north Florida for ten years. The climatic variability during the research period included two severe droughts and three continuous years with average precipitation. Both eddy covariance and biometric measurements showed the same trend and magnitude during plantation development. The newly planted site released up to 15.6 Mg C ha⁻¹ yr⁻¹ during the first three years after planting, and became a carbon sink by year four. After canopy closure net ecosystem production (NEP) fluctuated from 4 to > 8 Mg C ha⁻¹ yr⁻¹ until rotation age, with interannual variation in NEP attributable primarily to environmental fluctuations. Increases in NEP during the early stages of stand development were explained by changes in leaf area index. Annual fluctuations in NEP after canopy closure were explained by fluctuations in the water table. Variability in seasonal gross ecosystem production (GEP), induced by climatic variability, controlled annual net ecosystem production.
Understanding Genetic Diversity, Physiologic Expression and Carbon Dynamics in Longleaf Pine: A New Research Planting at the Harrison Experimental Forest

John R. Butnor¹, Kurt H. Johnsen¹, and C. Dana Nelson². ¹USDA Forest Service, Southern Research Station, ²USDA Forest Service, Southern Institute of Forest Genetics, Saucier, MS.

Abstract: In 1960, an experiment was established on the Harrison Experimental Forest in southeast Mississippi to compare productivity and wood properties of planted longleaf, loblolly and slash pines under different management regimes. It was discovered that longleaf pine lagged in productivity the early years, but eventually surpassed loblolly and slash pine. Hurricane Katrina (August 2005) left the experiment heavily damaged; especially the loblolly plots, providing a new opportunity for continuing longleaf pine research on the site. In addition, there is strong region-wide interest in restoring longleaf pine to its former range, with one important goal being to increase forest resilience to climate change and extreme climate events. However, little is known about how regional seed sources and how within seed source variability affects adaptive traits. Our goal is to better understand genetic control of physiologic traits which enhance survivorship and productivity at a hurricane prone site with relatively low native soil fertility. This new installation will allow a direct comparison of four longleaf pine sources originating from similar latitudes from Texas to South Carolina under three planting densities. Physiologic differences between and within the sources will be analyzed along differences in height, diameter, stem taper and carbon allocation to specific components (foliage, branches, stems, roots) across the planting density gradient. Allelic states of several genes will be related to survival and performance traits to determine which genes affect which traits and to measure and monitor the resident genetic diversity in these sources as the stand matures. Experiments such as this will inform development of genetic guidelines for restoring resilient longleaf pine ecosystems.
Regional Differences in Soil Carbon in Alabama and Georgia

Robert Carter, Jacksonville State University, Jacksonville, AL.

Abstract: Soils from plant communities in the Coastal Plain of Alabama, the Ridge and Valley Region of Alabama, Lookout and Sand Mountains [green pitcher plant (Sarracenia oreophila) bogs] in Alabama, and the Pine Mountain Range in Georgia were compared to determine the differences in percent carbon of the A-horizon and total volume of A-horizon carbon. All sites, with the exception of the Lookout and Sand Mountains, had longleaf pine (Pinus palustris) as a component of the overstory. A paired t-test of all communities indicated a significant difference between percent soil carbon of Coastal Plain soils and soils from other regions. Coastal Plain soils had a lower percent carbon. However, Coastal Plain soils have a greater depth resulting in a greater the A-horizon volume. The volume of carbon by community based on soil depths was calculated and compared with a paired t-test. A significant difference was found between soils from the Lookout and Sand Mountains and Pine Mountains and all other soils. The Lookout, Sand, and Pine Mountains tended to have a greater volume of soil carbon. The differences are likely due to the sandstone/quartzite parent material found on Lookout, Sand, and Pine Mountains.
Carbon Content within a Longleaf Pine Ecosystem: The Effects of Land Use and Soil Type on Carbon Concentration

Claire Ike, University of Georgia, Athens, GA.

Abstract: Increasing atmospheric concentrations of CO₂ and proposals for possible C cap-and-trade systems have led to interest in C sequestration in forest soils and vegetation to provide a biological sink for atmospheric CO₂. Effects of land use and land cover on C storage in different soil types are inadequately quantified as are means for estimating soil C across landscapes. This work compares the contents of soil C among differing land cover and soil types on the Dougherty Plain of the upper coastal plain, including burned longleaf pine (*Pinus palustris*) woodlands. Carbon contents of dominant soil great groups are compared and partitioned by land cover types. Samples were collected from 821 long term monitoring plots from depths of 0-5, 5-20, and 20-50 cm. They were analyzed for total C and N, and will be used to determine dominant effects upon soil C across the landscape using multivariate methods and GIS based approaches to soil mapping. Results depict soil C concentration to vary mainly among land cover types, with depletions primarily influenced by agricultural land use history. C concentrations in soil surface horizons within areas dominated by longleaf pine are similar to those in areas dominated by hardwood species.
A Flexible Hybrid Model of Life Cycle Carbon Balance of Southern Pine Plantation Management Systems

Carlos A. Gonzalez-Benecke, Tim A. Martin, Wendell Cropper Jr. and Rosvel Bracho, University of Florida, Gainesville, FL.

Abstract: University of Florida’s Carbon Resources Science Center has developed a flexible modeling system for even-aged pine forest carbon sequestration which combines growth and yield models with biometric equations to estimate fluxes and stocks of carbon for slash pine (in review), loblolly pine, and longleaf pine. The longleaf pine model system will use the same framework as the validated slash pine model. Specifically, the hybrid model integrates an even-aged longleaf pine growth and yield model based on equations reported for slash pine fitted to longleaf pine yield tables published elsewhere. Allometric equations for stand biomass components were obtained by fitting a general model to data and equations reported in peer reviewed literature. Dynamics of understory biomass accumulation and litterfall biomass accumulation were assumed to follow the same dynamic as reported for the slash pine model (in review) and LAI-dependent understory and annual litterfall models were obtained. The effects of thinning on carbon fluxes of forest floor and understory biomass were also incorporated into the model. At the time of thinning, reductions in slash pine LAI were set to be proportional to reductions in BA due to thinning and therefore forest floor and understory biomass were affected due to their LAI-dependence. The modeling system also tracks the fate of harvested carbon removed from the site and processed into forest products. The slash pine model was compared to data from eddy-covariance and biometric net ecosystem exchange data from long-term plantation eddy-covariance sites. The model predictions of cumulative site carbon sequestration agree well with measured data. Validation of the longleaf pine and loblolly pine models is currently underway.
Are Longleaf Pine Forests Carbon Sinks?

Lisa Samuelson, Ben Whitaker, and Tom Stokes, Auburn University’s Center for Longleaf Pine Ecosystems, Auburn, AL.

Abstract: Longleaf pine ecosystems may offer significant opportunities to sequester carbon, because longleaf pine is a long-lived tree species and because of the focus on restoration and protection of longleaf pine ecosystems as habitat for threatened and endangered species. Although carbon is sequestered on an annual basis in above and belowground woody biomass, it is unclear if the longleaf pine ecosystem is a net carbon sink because of low basal areas typical of longleaf pine forests and warmer soil temperatures in open canopy forests that may increase soil respiration rates. Net ecosystem sequestration is the balance of the carbon fixed into woody biomass versus the carbon lost to the atmosphere from the soil through root and microbial respiration, the sum of which is soil respiration. To better understand carbon dynamics in longleaf pine forests, we examined soil respiration and tree growth in 50-year-old longleaf pine stands varying in basal area from 7-34 m² ha⁻¹. Stands were located in the Escambia Experimental Forest in southeastern Alabama and burned on three year intervals. Soil respiration was only weakly related to stand structural characteristics but was exponentially and strongly related to soil temperature, with 96% of the variation in soil respiration explained by soil temperature. From 0.4-5.2 Mg C ha⁻¹ yr⁻¹ was sequestered in longleaf pine biomass, but soil respiration was higher and ranged from 11-18 Mg C ha⁻¹ yr⁻¹, demonstrating that stands were net sources of carbon. Including a maximum sequestration of 2 Mg C ha⁻¹ yr⁻¹ by shrubs, at the ecosystem level stands were still significant sources of carbon with net carbon emissions ranging from 9-14 Mg C ha⁻¹ yr⁻¹. While carbon stocks can be stored in longleaf pine biomass on a long-term basis given its long lifespan and longer rotations, amenity benefits other than carbon sequestration should also be considered.
Directory of Meeting Attendees
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