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IN THIS ISSUE

PINEMAP is working to integrate key research, education, and outreach networks to create and disseminate the knowledge that enables landowners to:

- *harness planted pine forest productivity to mitigate atmospheric CO_2;*
- *more efficiently use nitrogen and other fertilizer inputs; and*
- *adapt forest management approaches to increase resilience in the face of climate variability and climate change.*

Visit the PINEMAP web site: http://www.pinemap.org

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Mapping the future of southern pine management in a changing world.

Project Director's Message

Timothy A. Martin
School of Forest Resources and Conservation, University of Florida

Greetings from PINEMAP!

The PINEMAP project is large and diverse, including research in fields ranging from silviculture and genetics to education and economics, with outreach programs designed to convey new information to forest landowners and managers about how to best manage their resources in a changing world. In this issue of the *PINEMAP Press*, we highlight a sampling of these important activities, including education programs for undergraduate students and secondary school students and teachers; the economics of forestry under uncertain future conditions; the biology of soil carbon dynamics; and a survey of the attitudes and interests of foresters in the region. I encourage you to peruse these diverse articles and to be on the lookout for future issues of the *PINEMAP Press* as we begin to report out on integrative activities designed to bring together the diverse threads of PINEMAP research in support of better forest management.

Please visit our web site (http://www.pinemap.org) and/or become a fan of our Facebook page (www.facebook.com/pinemap) for more information about PINEMAP and for ongoing project updates.

~Tim Martin

Daniel Markewitz, Professor, University of Georgia, demonstrates the use of soil moisture probes to PINEMAP team members during a field tour in April 2013.
Photo by John Seiler.

Unique Summer Research Experiences for Undergraduate Students

John Kidd and John Seiler
Department of Forest Resources and Environmental Conservation, Virginia Tech

The PINEMAP Undergraduate Fellowship Program is an innovative program that combines summer research experiences with a distance course. The fellowship program began its second year in May 2013, and funding allowed for the placement of 12 students in the summer of 2013, doubling the number from the 2012 pilot year. This cohort was more geographically and institutionally diverse than last year with students from six states (Florida, Texas, Oklahoma, Kansas, North Carolina, and Virginia) and eight universities. Fellows were paired with mentors from seven institutions and four of the six PINEMAP disciplinary areas including silviculture, modeling, education, and extension (Figure 1). Mentors this year included both graduate students and PINEMAP faculty or staff. Fellows completed their 12 week, full-time research work in mid-August and returned to their home universities where they are currently participating in the distance course.

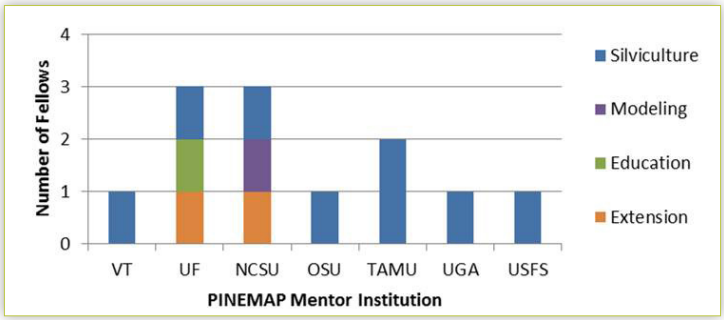


Figure 1. The 2013 Undergraduate Fellowship Program supported 12 students at 7 PINEMAP institutions in 4 of the project's disciplinary areas.

Fellows' backgrounds and majors varied considerably and included microbiology, geography, and other natural resource related majors; many fellows were exposed to new disciplines. Fellows participated in nearly all aspects of the research process from literature review to data analysis and will work to communicate their results this fall. Fellows will develop, with their mentor's assistance, scientific abstracts, posters, and presentations during the distance communication course. Using knowledge and skills gained from immersion in scientific research should provide participants with the ability to better understand that discipline and incorporate learned skills and perspectives into their personal fields of study.

To better understand fellows' experiences, we asked fellows to complete pre- and post- summer work surveys about their attitudes towards research and overall experience in the program. Fellows also kept a reflective journal where they were encouraged to blog twice per week.

Subjects for blogging included: what scientific research is, research ethics, personal goals for the summer, meeting personal goals, elevator speeches, and using photos and text to describe work performed (Figure 2). This fellowship was the first research experience for the majority of students. Nearly all students reported that their experiences met or exceeded their goals and expectations, although no one felt that their goals had changed because of it. One student remarked that the research experience "ranks up there as one of the best experiences of my life."

Figure 2. Brittany Baggett (left), a 2013 undergraduate fellow from the University of West Florida, helps launch a weather balloon at the Oklahoma State University research station in Idabel, OK.
Photo by Casey Meeks.

Applications for summer 2014 undergraduate fellowships will be accepted starting in December 2013. For additional information, contact John Kidd at jbkidd@vt.edu or access the fellowship program webpages at http://www.pinemap.org/education/undergraduate.

Economics of Climate Change in Even-aged Forest Management

Andres Susaeta, Douglas Carter, and Damian Adams
School of Forest Resources and Conservation, University of Florida

Climate change is expected to significantly affect growing conditions for forests in the southern United States (U.S.). Persistent changes in temperatures, concentration of atmospheric carbon dioxide (CO_2), and precipitation patterns are likely to affect forest productivity and, thus, the supply of timber. Studies have predicted that in the southern U.S., elevated atmospheric CO_2 would result in an increase in pine forest productivity but that elevated temperatures may reduce this positive effect. Studies have also shown that a substantial reduction in precipitation would decrease forest productivity. The secondary effects of climate change, including increased severity of disturbances such as wildfires, pest outbreaks, and hurricanes, are also expected to affect forest productivity and important forest-related ecosystem services.

In a recent study, we assessed the economics of forest management in southern planted pine stands under the risk of climate-change related disturbances using the standard Reed economic model. We predicted the impact of forest productivity scenarios on two pine species (loblolly pine and slash pine) at varying planting densities and how this might impact the overall land expectation value (LEV) (Figure 1). Slash pine is less susceptible than loblolly pine to breakage, uprooting by hurricanes, and deterioration resulting from outbreaks of insects and disease. Lower planting density decreases the accumulation of forest fuels that influence wildfires and tree mortality. It also reduces susceptibility to insect attacks.

Our results suggest that increased forest productivity scenarios lead to higher LEV and decreased forest productivity scenarios lead to lower LEV. If the risk of disturbance is higher, then it further decreases the LEV regardless of the forest productivity scenario, as certain disturbances could have disastrous effects on pine stands. In the case of decreased forest productivity scenarios, this effect could be greater, suggesting that continuing to invest in forestry in these situations may result in economic losses for landowners.

We simulated several adaptation strategies and found that under increased forest productivity scenarios, planting fewer loblolly pines per hectare generates higher LEVs than those for the original high density loblolly pine management. Slash pine is a less economically viable option compared to loblolly pine planted at either high or low density in most cases. Under certain conditions (increased silvicultural efforts to increase the salvage of damaged timber after a storm or fire), landowners will be better off planting slash pine instead of loblolly pine with high planting density. Thus, the selection of adequate forest species and management (e.g., silvicultural efforts to increase the amount of undamaged timber that can be recovered after a natural disturbance) become crucial to capturing the benefits and mitigating the negative effects of climate change.

For additional information on this research, contact Andres Susaeta at asusaeta@ufl.edu.

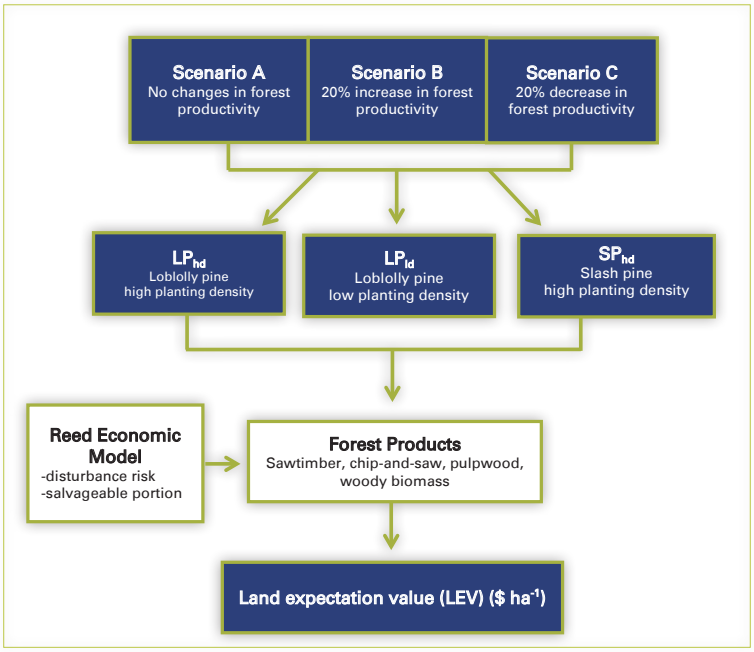


Figure 1. Overall framework of the economic study.

Climate Change Symposium for Teachers

Martha Monroe, Annie Oxarart, and Christine Li
School of Forest Resources and Conservation, University of Florida

In May 2013, 53 teachers attended a one-day climate change symposium in Gainesville, Florida. The goal of the symposium was to increase comfort and competence in teaching about projected climate change impacts to Florida's ecosystems. To achieve this goal, the symposium included faculty research presentations and discussions related to marine, coastal, forest, and agricultural systems and engaged educators in novel hands-on activities they can use to teach these topics in the classroom. Florida-specific projections and implications of climate change were used to consider potential risks to coastal development, ecosystems, and forest health. The symposium was organized by PINEMAP staff, students, and faculty and made possible with support from four partners—Florida Climate Institute, University of Florida Center for Precollegiate Education and Training, University of Florida School of Forest Resources and Conservation, and the League of Environmental Educators in Florida. Of the 12 concurrent sessions, 6 were conducted by PINEMAP faculty and students and featured activities from the new Southeastern Forests and Climate Change Project Learning Tree Secondary Module (Figure 1). Sessions were also led by faculty from Urban and Regional Planning, Agriculture and Biological Engineering, Fisheries and Aquatic Sciences, Florida Forest Service, and Florida Fish and Wildlife Conservation Commission.

The symposium was evaluated using a pre and post survey, which more than three-quarters of the participants completed (n=43). Survey respondents were mostly female (62%), teach 9-12th grade (77%), and teach biology or environmental science courses (50%) in public schools. After the symposium, a majority of the respondents, 88%, said that they plan to expand their coverage of climate change in the upcoming year; another 9% may expand their coverage of the topic. Over three-quarters of the respondents reported that the symposium influenced their plans to expand climate change coverage "very much" or "a fair amount." The symposium was most successful in providing a respectful learning atmosphere, using credible experts for presentations, and presenting information in a way that participants could understand (Table 1). Respondents also reported that the three most important characteristics to include in professional development for educators are credible experts, exposure to current research, and hands-on activities.

Figure 1. Maxwell Wightman, PINEMAP graduate student, shows participants how to use a homemade clinometer to measure tree height.
Photo by Jessica Ireland.

To what extent did the training:	Mean* (n)
Provide a respectful learning atmosphere	3.91 (43)
Use credible experts	3.86 (43)
Present information that you could understand	3.79 (43)
Help you feel like part of a community of educators interested in teaching about climate change	3.56 (43)
Increase your confidence to teach about climate change	3.26 (43)
Prepare you to incorporate climate change into your courses	3.26 (42)
Provide adequate time for reflection	3.05 (43)
Improve your ability to recognize and address common misconceptions your students may have	2.70 (43)
Increase confusion about the issue	1.19 (43)

Table 1. Participants' ratings of symposium characteristics.
*Scale of 1 to 4 in which 1 is "not at all" and 4 is "very much".

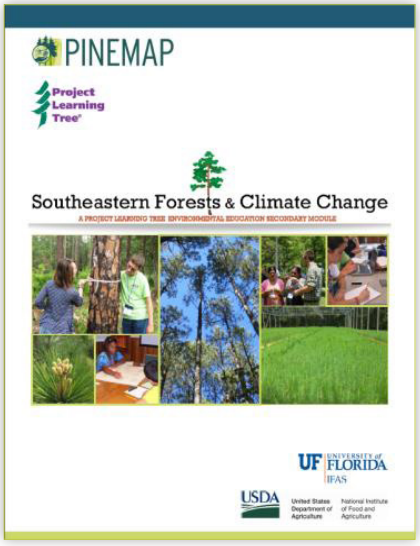
Respondents shared many positive comments about the symposium through their open-ended responses on the survey. For example, one teacher commented, "This was a great symposium with ideas and lesson plans immediately useful and ready to be integrated into classrooms from 5th-12th grade. I was very impressed with all the speakers I had the pleasure of hearing. I've got so many great tools to take back to my students and learned quite a bit myself."

The symposium organizers are currently developing a "how-to" guide that provides instructions, tips, and lessons learned from our experience organizing this event. We hope this report will be useful for PINEMAP collaborators who are interested in developing a similar teacher professional development program at their institution.

For additional information, contact Martha Monroe at mcmonroe@ufl.edu.

Southeastern Forests & Climate Change: A Project Learning Tree Environmental Education Secondary Module

PINEMAP and Project Learning Tree (PLT) have developed a secondary module called Southeastern Forests and Climate Change. This activity guide, now being pilot tested by more than 60 teachers in the Southeast, was designed to help educators teach about the effect of climate change on southeastern forest ecosystems, the role of forests in sequestering carbon, and strategies that people can use to mitigate and adapt to changing climatic conditions. The module has 13 experiential activities based on PINEMAP's research framework. The activities incorporate technology, data analysis, critical thinking, and systems thinking to encourage students to understand the interconnectedness of human, ecological, and physical systems.



Cover of the Southeastern Forests & Climate Change Secondary Module Activity Guide.

A web site has been established to help teachers understand and use the 13 activities (http://sfrc.ufl.edu/extension/ee/climate). The website includes teacher tools, such as audio-visual tours that provide tips for leading the activities, quizzes that gauge content comprehension prior to teaching each lesson, as well as videos that provide background information for many of the activities. Activity web pages also include downloadable slide presentations and student worksheets in a modifiable format so that educators can adapt the materials to better meet their needs.

Feel free to review or use these materials and offer additional suggestions for improvement. Contact Martha Monroe (mcmonroe@ufl.edu) or Annie Oxarart (oxarart@ufl.edu) with your comments or questions.

Pages from the Southeastern Forests & Climate Change Secondary Module web site (http://sfrc.ufl.edu/extension/ee/climate).

Refining Methods to Separate Autotrophic and Heterotrophic Respiration in Loblolly Pine Field Research Sites

Brett Heim, John R. Seiler, and Brian Strahm
Department of Forest Resources and Environmental Conservation, Virginia Tech

Understanding ecosystem-level carbon (C) sequestration, or net ecosystem productivity (NEP), requires the separation of soil respiration (R_S) into heterotrophic, microbial respiration (R_H) (respiration by organisms that gain C from consuming organic matter) and autotrophic plant root respiration (R_A) components. However, separating these two sources has been problematic since they are closely coupled. At the PINEMAP Tier III research sites, researchers are estimating R_H by installing root severing cores that cut off the supply of plant carbohydrates from the roots. Over time, the roots run out of carbohydrates for respiration and R_A falls to zero. At this time, soil CO_2 flux measurements inside the root severing cores will be derived only from R_H.

We conducted a controlled laboratory study to confirm whether root carbohydrates supply diminishes and root respiration decreases after severing. In this study, loblolly pine roots and soil were collected from the Virginia Tier III site. Roots and soil were homogenized and known amounts of each were placed into small containers (Figure 1). Root lengths and diameters approximately equaled those that were enclosed in the field-installed root severing cores. A component integration approach was used where total R_S, R_A, and R_H were measured on 10 harvested replicate samples a total of 8 times over a 90 day period.

Figure 1. PINEMAP Undergraduate Fellow Will Kennerley prepares loblolly pine root samples for placement into incubation cups.
Photo by John Seiler.

Following each measurement period, roots were separated and starch and sugars (non-structural carbohydrates, NSC) were measured. By the end of the 90 day study period, NSC components had declined by 43-60% (Figure 2a), and R_S and R_A declined 86% and 95%, respectively (Figure 2b). Over the measurement period, both R_S and R_A were highly correlated with NSC.

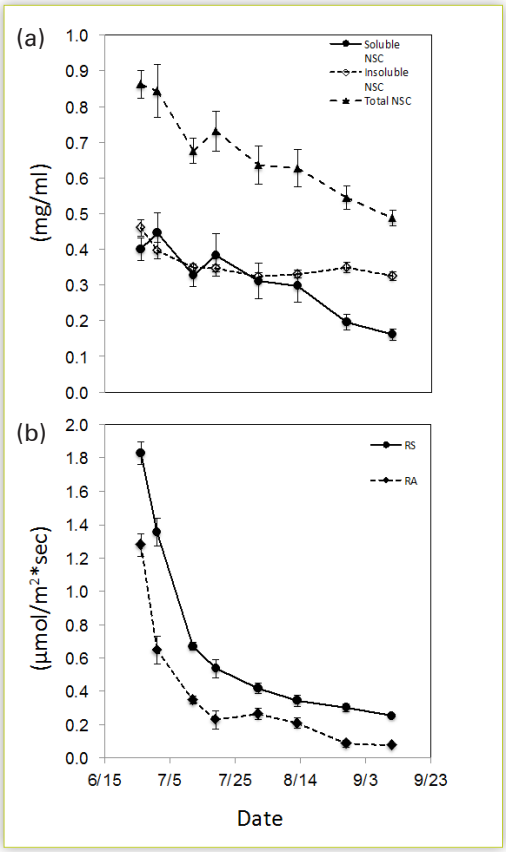


Figure 2. (a) Mean non-structural carbohydrates (n=8) and (b) mean respiration R_S and R_A (n=8) plotted over time for a period of 78 days from roots and soil collected at the Virginia Tier III site located near Dwillyn, VA. Error bars represent one standard error.

The results of the controlled laboratory study suggest that root use of stored NSC over time causes R_A to stop. This relationship between NSC and R_S and the steady decline in R_S and R_A over time validates the effectiveness of field-installed root-severing cores in stopping contributions of R_A within the cores. This method enables us to successfully partition R_S into R_H and R_A for a more accurate estimate of C storage in managed forest systems.

For additional information on this research, contact John Seiler at jseiler@vt.edu.

Climate Change Perceptions of Southern Foresters: Preliminary Survey Results

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[2]Department of Forestry and Environmental Resources, North Carolina State University

Professional foresters in the southeastern United States are an important stakeholder group for PINEMAP. This group, comprised of professionally trained individuals from private industry, consulting firms, public agencies, universities, and nonprofits, is well-positioned to implement changes to forest management practices that will increase forest resiliency. However, there is little to no information regarding the receptivity of foresters to climate change concepts and their willingness to implement 'climate-smart' forest management strategies. To better understand this audience, we conducted a survey to gain insight into experiences, perceptions, beliefs, attitudes, and interests in continuing education topics and formats regarding climate science and climate change. The survey also provides insight into several inferential questions regarding beliefs and values and associated receptivity to implement 'climate-smart' forest management practices.

The survey was conducted in early 2013, and about 1,700 foresters responded (27% response rate). Overall, a third of respondents believe that there is not sufficient evidence to say that climate is changing, 46% agree that climate change is occurring but attribute it to unknown or mostly natural causes, and 16% agree climate is changing and caused by humans (Figure 1). Sixty percent of responding foresters feel 'somewhat' to 'very knowledgeable' about climate and climate change and 65% are 'somewhat' to 'very interested' in learning more. Only 25% of respondents indicated that their clients asked about climate change, and about half think that changes in forest management strategies are necessary to respond to climate uncertainty.

Results from this survey will be used to work with forestry stakeholders on a variety of levels including continuing education and material development. It is evident from the results that many foresters are interested in educational programs that would help them increase forest resiliency on their client's properties. Results from this survey will help frame the PINEMAP extension team's approach to generating and implementing better educational programs.

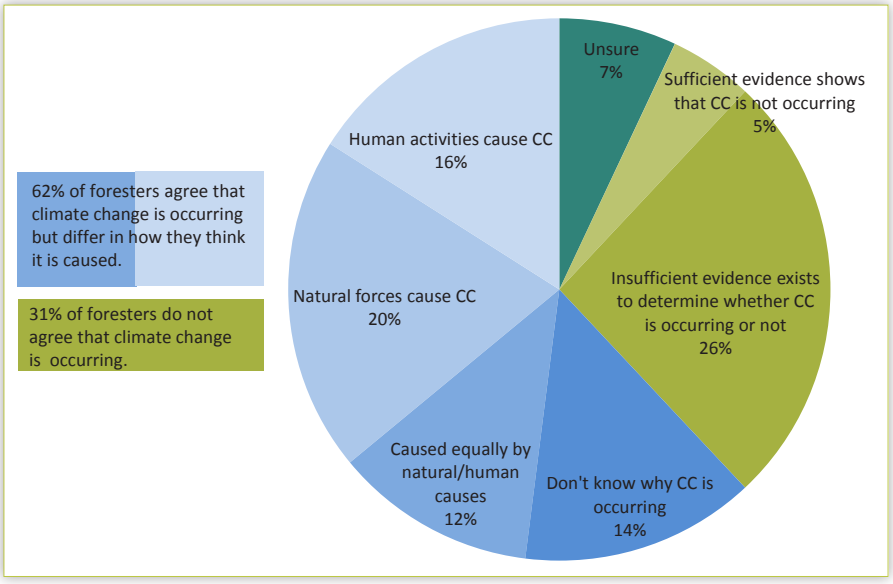

Figure 1. Foresters' perceptions of climate change (CC) and its causes.

For additional information on this research, contact Leslie Boby at lboby@sref.info.

United States Department of Agriculture
National Institute of Food and Agriculture

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