

COMPASS

Recent Publications
of the Southern Research Station

Summer 2003

The Southern Research Station of the USDA Forest Service produces *Compass*, a quarterly catalog of recent publications and technologies. The Southern Station works with universities, other Government agencies, corporations, and non-government organizations on studies that contribute to the sustainability of southern forest resources. We employ about 150 research scientists in disciplines ranging from tree physiology to the social sciences, from genetics to landscape ecology. Each year, our scientists' names appear as authors on 500 to 600 journal articles, research papers, resource assessments, handbooks, videotapes, and computer programs.

In addition to featuring a few highlights, *Compass* lists our most recent publications. You can order hard copies, or download electronic versions from our Web site (**www.srs.fs.usda.gov**) by using the reference number in bold print. We welcome input on the quality of our research program and our success in offering products that meet customer needs. For more information, contact Claire Payne at 828-257-4392.

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Nonnative Invasive Plants Blanket the South

Demand for Jim Miller's colorful guide to nonnative invasive plants grows as fast as the plants it covers. You might consider *Nonnative Invasive Plants of Southern Forests—A Field Guide for Identification and Control* as a "most wanted" rap sheet for the invasive plants that are sweeping over the southern landscape. Miller, Southern Research Station research ecologist in Auburn, AL, says, "The ever spreading and worsening problems caused by invasive plants are complex and will require planned programs with agencies, private companies, landowners, and non-government organizations coordinating activities, with the field guide being a catalyst at this time for action."

Nonnative Invasive Plants of Southern Forests (GTR SRS-62) includes text and pictures of plants by season and addresses ecology, resemblance to natives, history, and use. Principles for controlling nonnative invasive plants and prescriptions for eradication make this publication a staple tool for land managers, educators, nursery owners, landscapers, and homeowners—anyone fighting the stampede of nonnative invasive plants. A glossary and sections on control information, flower parts and arrangements, and parts of a grass plant round out the book.

Problems with nonnative invasive plants reach deeper than what you see on our forests, roadsides, and backyards. The compost or mulch you nurture your garden with might be contaminated with nonnative invasive species. Scarified seeds, those spread by birds, provide one of the greatest sources of contamination. Eradication of nonnative invasive species requires collaboration and diligence on many fronts. Miller calls

the invasion “a major problem that is consuming our native forest communities and becoming more severe with the continued unrestricted importation of new ornamental species that require no proven status of noninvasiveness.”

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- 2 Gan, Jianbang; Miller, James H. 2001. **In the eye of the beholders: public views on the aesthetic value of pine stands regenerated by different methods.** Forest Landowner. 60 (2): 16-21.

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- 28 Miller, James H. 2003. **Nonnative invasive plants of southern forests: a field guide for identification and control.** Gen. Tech. Rep. SRS-62. Asheville, NC: U.S. Department of Agriculture, Forest Service, Southern Research Station. 93 p.

Productivity and Ownership of Southern Forests Evolve

In *Productivity of Southern Pine Plantations: Where Are We and How Did We Get Here?* John Stanturf and colleagues state that efforts by researchers and managers have resulted in the South’s forests being the Nation’s most productive, perhaps pine plantations in particular. The South produces more timber than any other country in the world. Stanturf, project leader, Southern Research Station, Athens, GA; Robert C. Kellison, forestry consultant, Raleigh, NC; F.S. Broerman, forestry consultant, Savannah, GA; and Stephen B.

Jones, vice-chancellor, North Carolina State University, Raleigh, discuss productivity and sustainability on several levels. Productivity can refer to productive capacity in the sense of yield of usable biomass at the plantation stand level. At the site level, bioeconomic productivity refers to tree-environment and tree-vegetation interactions, including biologically and technically feasible options. Socioeconomic productivity merges Government regulations and management of scarce resources—finding the economic optimum yield level within the constraints of being a good corporate citizen. Companies must meet legal and social norms for protecting water quality and quantity, air quality, human health, wildlife, and other valuable and finite resources.

Sustainability frames the matrix in which cultural values and other societal concerns (e.g., inter-generational equity, biodiversity maintenance, and long-term site productivity) are embedded. Working within Government regulations internalizes the social costs of producing wood fiber. Attending to the issue of sustainability adds complexity, depth, and significance to the cost of doing business. Stanturf and his co-authors ask, “Does research to address regulatory or sustainability questions qualify as productivity research? Probably not. But productivity research that ignores sustainability concerns likely is irrelevant.”

Productivity of Southern Pine Plantations: Where Are We and How Did We Get Here? reports that mergers of forest industry companies and land sales to financial institutions have resulted in transfers of more than 15 million acres in the past four years, with a further 12 to 15 million acres expected to transfer out of industry ownership over the next 10 years. Financial

institutions typically act as timber investment management organizations (TIMO) or real estate investment trusts (REIT). These corporate owners own timberland as part of an investment portfolio for clients and presumably will sell timber and land at some economically optimum rotation age. A TIMO offers an economic advantage over industrial timberland ownership in that income at time of sale is taxed only once, whereas industrial income is taxed twice—at the corporate level and again at the shareholder level. An REIT pays no tax on income, but is required to distribute 90 percent of its net proceeds. Recognizing this new ownership category—“other corporate owners”—creates a significant change in the mosaic of southern landholders. Looking ahead seven or 15 years to the time when tree crops will likely be harvested, Stanturf and his co-authors wonder what will happen to the land. Will it be held by the corporate owners and regenerated, or sold? If the land is sold, will it be developed for urban uses, converted to agriculture, or kept in forest? The answers have far-reaching ramifications not only for the forestry profession, but also the South as a region, we who live here, and others whose livelihood and quality of life benefit from the area’s natural resources.

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- 11 Stanturf, John A.; Kellison, Robert C.; Broerman, F.S.; Jones, Stephen B. 2003. **Productivity of southern pine plantations—where are we and how did we get here?** *Journal of Forestry*. 101 (3): 26-31.

Station News

Chief Bosworth Recognizes Station Employees

Bernie Parresol combines his skills as a biometrician with his interest in international forestry and culture. Chief Bosworth gave Bernie the Global Stewardship Award for outstanding work with the People's Republic of China, Mexico, Portugal, and Spain, and for helping host the International Wetlands Symposium in China this spring. Bernie works in Asheville at Station headquarters. **João Paul Carvalho**, a Fulbright Fellow visiting from Portugal, works with Bernie on accuracy testing of the southern variant of the forest vegetation simulator. João is a professor of silviculture at the Universidade de Tras-os-Montes e Alto Douro.

Ingrid Sather and the National Technology Team, of which she is a member, earned the Chief's Award for Excellence in Technology Transfer. Ingrid worked in the Southern Region with Ed Macie to develop a strong technology transfer program for urban forestry in the region. Her leadership and collaborative skills make her an invaluable information broker. Visit urbanforestrysouth.org for assistance. Ingrid is a member of Ken Cordell's Recreation, Wilderness, Urban Forest, and Demographic Trends unit in Athens, GA.



Hermann Gucinski Has Left the Building

Photographs reveal so much about a person. While preparing to retire from more than 28 years of public and academic service, **Hermann Gucinski** shared pictures and newspaper clippings of his career and life—so interwoven with academic and practical endeavor, enthusiasm, and discovery. Pictures of him as a young professor—in one photo teaching chemistry, in another teaching physics—then on board research vessels—the *Advance II*, the *Westward*, the *Bottlenose*, the *Aquarius*, and the *Silas Bent*—then in

pictures with family members and colleagues—these photographs reveal the whole person.

Hermann Gucinski came to the Southern Research Station in October 2000, injecting passion for scientific query, promoting the need for results, blending that drive with laughter and compassion. He has overseen large scale assessment and wetlands research and served on the Station Leadership Team. A member of the Joint Fire Science Program Governing Board from 2000-2003, he received an award for his contributions to wildland fire and fuels management. He came to Asheville from the Pacific Northwest Station. In Corvallis, OR, he served as program manager for the ecosystem processes research program and line officer for the Corvallis Forest Sciences Laboratory. Before joining the Forest Service, he worked for the U.S. Environmental Protection Agency as a Man Tech contractor. His Ph.D. in biophysics served as a catalyst to a fulfilling career in which his impacts cannot be measured.

Hermann and Barbara, his wife, will celebrate his retirement by hiking another section of the Continental Divide Trail. They have adopted the phrase “walk it out” to tackle life’s challenges. We wish them happy trails, with many returns to Asheville and the Southern Station.

Southern Pine Ecosystems

- 1 Fowlkes, Mark D.; Michael, Jerry L.; Crisman, Thomas L.; Prenger, Joseph P. 2003. **Effects of the herbicide imazapyr on benthic macroinvertebrates in a logged pond cypress dome.** *Environmental Toxicology and Chemistry*. 22 (4): 900-907.

Increased herbicide use in silviculture over the last several decades has led to concern over potential water contamination, which may affect biotic health. In the Southeastern United States, pine flatwoods are important for timber production and are often interspersed with cypress wetlands. Cypress domes are isolated, shallow basins that collect surficial waters from adjacent forested areas and therefore might be expected to contain pesticide from storm runoff. This study utilizes *in situ* microcosm experiments to assess the effects of a concentration gradient of the herbicide imazapyr (0.184, 1.84, and 18.4 mg/L, equivalent to 1, 10, and 100 times the expected environmental concentration from a normal application rate) on the macroinvertebrate community of a logged pond cypress dome using changes in macroinvertebrate composition, chironomid biomass, and chironomid head-capsule deformities. The control core was not significantly different from the surrounding cypress dome for any parameter, suggesting that enclosure effects were likely of minimal importance in the final experimental results. The lack of statistical difference ($p < 0.05$) in macroinvertebrate community composition, chironomid deformity rate, and chironomid biomass between treatments suggests that imazapyr did not affect the macroinvertebrate community at the concentrations tested. Chironomid

deformity rate ranged from 0.97 percent for imazapyr control to 4.96 percent for the 100x treatment, with chironomid biomass being 1.79 and 1.87 mg/L, respectively.

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- 2 Gan, Jianbang; Miller, James H. 2001. **In the eye of the beholders: public views on the aesthetic value of pine stands regenerated by different methods.** Forest Landowner. 60 (2): 16-21.

Most people enjoy the beauty of forest scenery. There is a unique beauty that emanates from forests that has been treasured by generations of Americans and continues to inspire us all at times. Many non-industrial private forest landowners consider forest scenery as one of their top ownership objectives. Public forest managers, on the other hand, must consider the “visual aspects” of forest when planning any management activity. Forest aesthetics is becoming one of the most demanded “non-timber outputs” and often drives forest policy decisions, like limiting clearcutting. Yet, how do we manage for forest aesthetics? How do we assign value to aesthetic attributes? How do people vary in their sense of forest stand aesthetics? Answering these questions is only in the initial stages and will take some time. Assessing or valuing forest scenery is a challenging job, especially since there is no real market or price for it. It is also common that one person’s likes may be another person’s dislikes.

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- 3 Greenberg, Cathryn H. 2003. **Vegetation recovery and stand structure following a prescribed stand-replacement burn in sand pine scrub.** *Natural Areas Journal*. 23: 141-151.

Vegetation and stand structure of sand pine scrub in Central Florida, USA, were measured before a prescribed stand-replacement burn and for > 8 years afterward. Herbaceous species richness peaked within 16 months postburn, then gradually declined, although significant differences were detected only between 16 months and > 8 years postburn. Twenty-two plant species were detected after the burn that were not recorded prior to the burn. Woody plant species richness recovered to preburn levels within 5 months. Myrtle oak (*Quercus myrtifolia* Willd.), the dominant species, regained its preburn cover within 16 months and preburn height within 40 months. Scrub palmetto (*Sabal etonia* Swingle ex Nash) regained its preburn cover and height within 5 months. After > 8 years sand pine (*Pinus clausa clausa* [Chapm. Ex Engelm.] Vasey ex Sarg.) had regained 29 percent cover and 2.3 m height. Litter layer thickness was reduced by the fire but was subsequently stable. Bare ground increased postburn but was similar to preburn levels within 64 months. Light at breast height peaked at 28-64 months postburn, and light at ground level increased postburn and remained high. Coarse woody debris cover and diameter increased beginning 28 months postburn as snags fell. Under the right conditions, prescribed stand-replacement fire can be used in sand pine scrub to enhance species richness, temporarily increase cover and reproduction by some endemic plant species, and temporarily eliminate the

sand pine canopy to restore a historically common stand structure.

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- 4 Koehn, Anita C.; Roberds, James H.; Doudrick, Robert L. 2003. **Variation among slash pine families in chlorophyll fluorescence traits.** Canadian Journal of Forest Research. 33: 1102-1109.

Photochemical quenching, nonphotochemical quenching, and yield of photosystem II were measured on seedlings of full-sibling, open-, and self-pollinated slash pine (*Pinus elliotii* Engelm. var. *elliotii*) families. Our results reveal that genetic variation in photochemical quenching and yield of photosystem II exists within this species. The pattern of variation found in these traits is consistent with the variance profile expected to occur as a result of segregation among nuclear genes. Variation among families accounted for 17 percent of the total variation observed in photochemical quenching, whereas the component for trees within families made up slightly more than 25 percent of the total. Less variation, both among families as well as among trees within families, was found for yield of photosystem II. A strikingly different pattern was observed for nonphotochemical quenching. Other than the error term, only pretreatment effects contributed significantly to the variation observed. This suggests that nonphotochemical quenching is largely influenced by environmental factors. With regard to associations between fluorescence and growth traits, both height and diameter growth were found to be positively correlated with photochemical quenching (0.36 and 0.33, respectively) when selfed and open-pollinated

families were analyzed along with control-pollinated families.

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- 5 Kubisiak, T.L.; Nelson, C.D.; Nance, W.L.; Stine, M. 1995. **RAPD linkage mapping in a longleaf pine x slash pine F₁ family.** Theoretical Applications of Genetics. 90: 1119-1127.

Random amplified polymorphic DNAs (RAPDs) were used to construct linkage maps of the parents of a longleaf pine (*Pinus palustris* Mill.) slash pine (*Pinus elliottii* Englm.) F₁ family. A total of 247 segregating loci [233 (1:1), 14 (3:1)] and 87 polymorphic (between-parents), but non-segregating, loci were identified. The 233 loci segregating 1:1 (testcross configuration) were used to construct parent-specific linkage maps, 132 for the longleaf-pine parent and 101 for the slash-pine parent. The resulting linkage maps consisted of 122 marker loci in 18 groups (three or more loci) and three pairs (1367.5 [centimorgans] cM) for longleaf pine, and 91 marker loci in 13 groups and six pairs for slash pine (952.9 cM). Genome size estimates based on two-point linkage data ranged from 2348 to 2392 cM for longleaf pine, and from 2292 to 2372 cM for slash pine. Linkage of 3:1 loci to testcross loci in each of the parental maps was used to infer further linkages within maps, as well as potentially homologous counterparts between maps. Three of the longleaf pine linkage groups appear to be potentially homologous counterparts to four different slash pine linkage groups. The number of heterozygous loci (previously testcross in parents) per F₁ individual, ranged from 96 to 130. With the 87 polymorphic, but non-segregating, loci that should also be heterozygous in the F₁

progeny, a maximum of 183-217 heterozygous loci could be available for mapping early height growth (EHG) loci and for applying genomic selection in backcross populations.

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- 6 Kubisiak, T.L.; Nelson, C.D.; Nance, W.L.; Stine, M. 1996. **Comparison of RAPD linkage maps constructed for a single longleaf pine from both haploid and diploid mapping populations.** *Forest Genetics*. 3(4):203-211.

Considerable concern has been voiced regarding the reproducibility/transferability of RAPD markers across different genetic backgrounds in genetic mapping experiments. Therefore, separate gametic subsets (mapping populations) were used to construct individual random amplified polymorphic DNA (RAPD) linkage maps for a single longleaf pine (*Pinus palustris* Mill.). A haploid mapping population consisting of megagametophytic DNAs from 88 wind-pollinated seeds of longleaf pine (clone 3-356), and a diploid population including 86 F₁ progeny from a controlled cross [longleaf pine 3-356 (female) x slash pine H-28 (male)] were employed. Seventy-one RAPD primers selected for this study identified a total of 137 mapped loci in longleaf pine 3-356 based on amplification of megagametophytic DNAs. Of the 137 loci useful for comparative purposes, 62 loci (45.3 percent) could not be scored when DNAs of F₁ progeny from the controlled cross were amplified. Of the 75 loci that were scorable, 26 loci (34.7 percent) were fixed in slash pine H-28, and 49 (65.3 percent) were segregating (42 1:1, and seven 3:1). Comparisons were made using the 49 loci common to both the haploid-

and diploid-based maps. The 49 loci allowed us to determine homologous counterparts between maps. Orders were conserved for those groups containing three or more loci. Genetic distance estimates were found to vary considerably, but not in any systematic manner.

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- 7 Mihelcic, Nenad; Hanula, James L.; DeBarr, Gary L. 2003. **Pathogenic microorganisms associated with the southern pine coneworm (Lepidoptera: Pyralidae) attacking loblolly pine.** Florida Entomologist. 86 (1): 1-7.

Larvae of the Southern pine coneworm, *Dioryctria amatella* (Hulst) (Lepidoptera: Pyralidae), were collected monthly during the growing seasons of 1996 and 1997 from loblolly pine, *Pinus taeda* L., seed orchards in Alabama, Florida, Georgia, South Carolina, and Virginia, and examined for pathogenic microorganisms. One fungus, *Beauveria bassiana* (Bals.) Vuill, a granulosis virus (Baculoviridae: Eubaculovirinae), and a protozoan (phylum Microspora) were found. Five larvae from three localities were infected with *B. bassiana*, 37 larvae from six localities were infected with the granulosis virus, and 69 larvae from 5 locations were infected with the microsporidian. Laboratory trials confirmed that *B. bassiana* and the granulosis virus caused coneworm mortality. *B. bassiana* isolates from all three locations were equally virulent to late instar larvae. Spores of the unidentified microsporidian are free, elongate oval, binucleate, and contain 13-14 turns of an isofilar polar filament. The primary sites of infection were the Malpighian tubules and the silk glands. The

microsporidian was found in 2 to 51 percent of larvae sampled. It caused 100 percent mortality in early instar larvae allowed to feed on artificial diet contaminated with 3×10^3 or 4.5×10^3 spores. More work is needed to determine the importance of these pathogens in regulating populations of southern pine coneworms or their potential utility in an integrated pest management program.

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- 8 Nelson, C.D.; Kubisiak, T.L.; Stine, M.; Nance, W.L. 1994. **A genetic linkage map of longleaf pine (*Pinus palustris* Mill.) based on random amplified polymorphic DNAs.** Journal of Heredity. 85:433-439.

Eight megagametophyte DNA samples from a single longleaf pine (*Pinus palustris* Mill.) tree were used to screen 576 oligonucleotide primers for random amplified polymorphic DNA (RAPD) fragments. Primers amplifying repeatable polymorphic fragments were further characterized within a sample of 72 megagametophytes from the same tree. Fragments segregating in a 1:1, present-to-absent ratio were classified as Mendelian markers and mapped using multipoint linkage analysis. The analysis revealed 16 linkage groups of at least three markers, ranging in size from 21.1 to 185.6 cM (centimorgans), and six linked pairs (5.5 to 23.0 cM) of markers. The 22 groups and pairs included 133 RAPD markers and covered approximately 1,635 cM of genetic map distance. Genome size estimates, based on the linkage data, ranged from 2,612 to 2,656 cM. Using a 30-cM map scale and including the 11 unlinked markers and the ends of the 16 linkage groups and six linked pairs, the

set of RAPD markers accounts for approximately 2,265 cM, or 85 percent of the genome.

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- 9 Prestemon, Jeffrey P. 2003. **Evaluation of U.S. southern pine stumpage market informational efficiency.** *Canadian Journal of Forest Research.* 33: 561-572.

The literature on informational efficiency of southern timber markets conflicts. Part of this conflict is because of differences in how efficiency was tested. In this paper, price behavior tests are based on deflated ("real") southern pine (*Pinus* spp.) sawtimber stumpage prices, using some of the same data and tests used in previous research and some new data and tests. Here different results are found in many cases regarding price behavior, as compared with the existing literature. Using a valid and consistent data-based model selection procedure, augmented Dickey-Fuller tests cannot reject a null of a unit root for most deflated monthly and all quarterly southern pine timber price series evaluated. Regressions of long-term deflated timber price ratios on their own lags lead to results similar to those offered by other authors when not corrected for bias, but produce fewer similarities when bias is addressed. The results of those regressions support a contention that most of the monthly series contain nonstationary as well as stationary components, and that quarterly prices tested in this framework using data through 2001 are closer to pure nonstationary processes. These results have implications for harvest timing approaches that depend on serial dependence of timber prices, provide support for certain kinds of policy and catastrophic shocks

modeling procedures, and address the validity of statistical approaches best suited to evaluating interconnections among timber markets.

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- 10** Rideout, Sandra; Oswald, Brian P.; Legg, Michael H. 2003. **Ecological, political, and social challenges of prescribed fire restoration in East Texas pineywoods ecosystems: a case study.** *Forestry*. 76 (2): 261-269.

The effectiveness of prescribed fire restoration of forested sites in three State parks in East Texas, USA was studied. Two sites consisted of mixed shortleaf (*Pinus echinata* Mill.) or loblolly pine (*Pinus taeda* L.) and broadleaf overstories. The third site was a longleaf pine (*Pinus palustris* Mill.) / little bluestem (*Schizachyrium scoparium* (Michx.) Nash.) stand. Mid- and understories at all sites consisted of a variety of shrubs and herbaceous vegetation. Prolonged drought resulting in county burn bans prohibited burning until immediately after rain events. Results indicated no effect from the burns in the overstory, seedling, shrub or herbaceous layers at any park. At two sites, there was a significant increase in the percentage of dead standing saplings in the burn plots from pre- to post-burn. The only significant decreases in fuels were in the weight and depth of combined O_i and O_e horizons (litter). Compliance with burn bans greatly reduced the restorative powers of the burns. Park visitors' attitudes concerning fire were also examined, indicating a need for education concerning differences between wildfire and prescribed fire, and benefits of prescribed fire.

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- 11 Stanturf, John A.; Kellison, Robert C.; Broerman, F.S.; Jones, Stephen B. 2003. **Productivity of southern pine plantations—where are we and how did we get here?** *Journal of Forestry*. 101 (3): 26-31.

The productivity and extensiveness of southern forests in general, and pine plantations in particular, have placed the South at the forefront of production forestry in the United States. That industrial loblolly pine plantations are very productive is a result of researchers and managers developing and applying increasingly intensive silvicultural practices. Our estimates of the percentage of productivity gains attributable to improvements made in individual management practices are based on our collective experience, anecdotal information, and discussions with knowledgeable colleagues. Such informed judgments are based on potential productivity revealed by designed experiments coupled with estimates of how well technology has been implemented.

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- 12 Weng, C.; Kubisiak, T.L.; Nelson, C.D.; Stine, M. 2002. **Mapping quantitative trait loci controlling early growth in a (longleaf pine x slash pine) x BC₁ family.** *Theoretical Applications of Genetics*. 104:852-859.

Random amplified polymorphic DNA (RAPD) markers were employed to map the genome and quantitative trait loci controlling the early growth of a pine hybrid F₁ tree (*Pinus palustris* Mill. x *P. elliotii* Engl.) and a recurrent slash pine tree (*P. elliotii* Engl.) in a (longleaf pine x slash pine) x slash pine BC₁ family consisting of 258 progeny. Of the 150 hybrid F₁ parent-specific

RAPD markers, 133 were mapped into 17 linkage groups covering a genetic distance of 1,338.2 cM (centimorgans). Of the 116 slash pine parent-specific RAPD markers, 83 were mapped into 19 linkage groups covering a genetic distance of 994.6 cM. A total of 11 different marker intervals were found to be significantly associated with 13 of the 20 traits on height and diameter growth using MAPMAKER/QTL. Nine of the 11 marker intervals were unique to the hybrid parent 488 genome, and two were unique to the recurrent parent 18-27 genome. The amount of phenotypic variance explained by the putative QTLs ranged from 3.6 percent to 11.0 percent. Different QTLs were detected at different ages. Two marker intervals from the hybrid parent 488 were found to have QTL by environment interactions.

Wetlands, Bottomlands, and Streams

- 13** Clawson, Robin G.; Lockaby, B. Graeme; Rummer, Bob. 2001. **Changes in production and nutrient cycling across a wetness gradient within a floodplain forest.** *Ecosystems*. 4: 126-138.

Floodplain forest ecosystems are highly valuable to society because of their potential for water quality improvement and vegetation productivity, among many other functions. Previous studies have indicated that hydrology influences productivity, but that the relationship between hydroperiod and productivity is a complex one. Consequently, we compared multiple indexes of productivity, nutrient circulation, and hydroperiod among three communities on the Flint

River floodplain, GA, that differed in terms of inundation frequency. We hypothesized that (a) the wettest community would have the lowest total net primary production (NPP) values because of saturated soil conditions; (b) as wetness increases, nutrient circulation in litterfall would decrease because of the hypothesized lower productivity in the wetter community; and (c) as wetness increases, internal translocation would become more efficient. The study site was partitioned into three wetness types—somewhat poorly drained (SPD), intermediate (I), and poorly drained (PD). We found that belowground biomass was greatest on the SPD, litterfall was similar for all three sites, and that woody biomass current annual increment (CAI) was greatest in the PD community. However, when the three variables were totaled for each site, the PD had the greatest NPP, thus disproving hypothesis (a). For hypothesis (b), we observed that P content in litterfall, although not significant, followed the predicted trend; nitrogen (N) content displayed the opposite pattern (PD > I > SPD). As wetness increased, internal translocation became more efficient for phosphorus (support for hypothesis (c)), but the SPD community was more efficient at retranslocating N (contradiction of hypothesis (c)).

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- 14** Grace, Johnny M., III. 2003. **Minimizing the impacts of the forest road system.** In: Proceedings of conference 34, International Erosion Control Association; ISSN 1092-2806. [Place of publication unknown]: International Erosion Control Association: 301-310.

Sediment movement from forest road systems is a major concern in forest management due to the

degrading impacts of stream sedimentation. Controlling sediment movement from road systems is a key objective to achieve the goal of reducing the impact of forest management activities. Sediment control systems minimizing sediment travel distances downslope are likely essential to reducing the environmental impact of road systems. The USDA Forest Service, Southern Research Station initiated a study in an attempt to evaluate alternative means of filtering sediment-laden road runoff before it reaches the forest floor on the Tuskegee National Forest in Alabama. The effectiveness of four alternative road sediment control treatments: vegetation, riprap, sediment fences, and settling basins (detention ponds), in reducing sediment export to the forest floor were evaluated over a 42-month period. The sediment basin, sediment fence, and vegetation treatments were similar in efficacy to reduce runoff concentrations with 89, 85, and 66 percent reductions. Riprap was significantly less effective than the sediment basin and sediment fence in reducing concentrations over the study period. The findings suggest that the sediment basin and sediment fence treatments, with concentration reductions greater than 80 percent, may have some applicability as primary sediment control structures on forest road turn-outs.

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- 15** Sanchez, Felipe G.; Carter, Emily A.; Klepac, John F. 2003. **Enhancing the soil organic matter pool through biomass incorporation.** *Biomass & Energy*. 24: 337-349.

A study was installed in the Upper Coastal Plain of South Carolina, USA that sought to examine the

impact of incorporating downed slash materials into subsoil layers on soil chemical and physical properties as compared with the effect of slash materials left on the soil surface. Baseline levels of slash were estimated by establishing transects within harvested stands and estimating the quantity of down wood and stumps. An equivalent quantity of biomass and two times the baseline levels were incorporated into subsurface soil layers by a CMI RS 500B™ reclaimer/stabilizer. Two sites were examined which differed in soil textural composition: sandy vs. clay. Site differences had no impact on machine productivity and machine costs were estimated at \$US 521 ha⁻¹ and \$US 633 ha⁻¹ on the sandy and clay sites, respectively. The feasibility of the CMI™ for biomass incorporation is low due to high unit area costs, but increased machine productivity would reduce costs and improve its potential. Biomass incorporation improved carbon and nutrient content of each site, especially on the sandy site. Slash levels had an impact on nutrient content but the differences were not statistically significant. For the sandy site, improvements in soil physical properties were evident in response to incorporation and machine planting operations. Bulk density and soil strength were reduced in response to biomass incorporation and tillage to levels that would not limit root production. The differences in soil physical response between incorporated treatments were minimal and not statistically significant.

Mountain and Highland Ecosystems

- 16** Bragg, Don C. 2002. **Checklist of major plant species in Ashley County, Arkansas noted by General Land Office surveyors.** *Journal of the Arkansas Academy of Science.* 56: 32-41.

The original General Land Office (GLO) survey notes for the Ashley County, AR area were examined to determine the plant taxa mentioned during the 1818 to 1855 surveys. While some challenges in identifying species were encountered, at least 39 families and approximately 100 species were identified with reasonable certainty. Most references were for trees used to witness corners or lines. Prominent arboreal genera recorded in these early survey records included *Quercus*, *Pinus*, *Carya*, *Liquidambar*, *Nyssa*, *Ulmus*, *Acer*, *Fraxinus*, and *Taxodium*. A number of shrubs, vines, graminoids, and herbaceous species were also reported, including notable genera like *Vaccinium*, *Lindera*, *Crataegus*, *Myrica*, *Rubus*, *Smilax*, *Vitis*, *Arundinaria*, and *Bidens*. Even though very few GLO surveyors had formal training in plant identification, their familiarity with local and regional floras (undoubtedly supplemented by their field crews' knowledge) contributed to the relative accuracy of the effort. Taxonomic discrepancies (e.g., shifting species names, delineation of new taxa since the survey was completed, obscure common names) have obscured a number of identifications in this study. Nevertheless, the GLO records are a valuable and systematic (statewide) source of information from a period of time that predates most formal botanical investigations.

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- 17 Clinton, Barton D.; Vose, James M. 2003. **Differences in surface water quality draining four road surface types in the Southern Appalachians.** *Southern Journal of Applied Forestry*. 27 (2): 100-106.

Improved and unimproved roads can be the primary source of stream sediment in forested watersheds. We assessed differences in production of total suspended solids (TSS; ppm) from four road surface conditions in a Southern Appalachian watershed: (1) a 2-yr-old paved surface (P); (2) an improved gravel surface with controlled drainage and routine maintenance (RG); (3) an improved gravel surface with erosion and sediment control structures installed and routine maintenance (IG); and (4) an unimproved poorly maintained gravel surface (UG). Variation was high among and within road surface types. The P surface generated the least amount of TSS, which was comparable to control sites, while the UG surface generated the most. The P surface produced significantly less TSS than the UG surface, but not less than the IG and RG surfaces. Variation among road surface types was related to TSS travel distance below the road, precipitation amount, time of year, and the existence of functioning erosion and sediment control structures. TSS decreased with travel distance (P = -81 percent over 38.5 m; IG = -30 percent over 30.5 m; RG = -89 percent over 39.4 m; and UG = -22 percent over 28.1 m). Also in this study we assessed the delivery of total petroleum hydrocarbons (TPH; ppm) from the P surface and found concentrations of < 0.5 ppm, which are well below published US EPA and North Carolina Department of Natural Resources and the Environment TPH standards for sediment. Paving is an attractive option for reducing maintenance costs and

sediment production and transport; however, levels of TPH from freshly applied asphalt are unknown.

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- 18** Knoepp, Jennifer D.; Swank, Wayne T. 2002. **Using soil temperature and moisture to predict forest soil nitrogen mineralization.** *Biology and Fertility of Soils*. 36: 177-182.

Due to the importance of N in forest productivity, ecosystem and nutrient cycling research often includes measurement of soil N transformation rates as indices of potential availability and ecosystem losses of N. We examined the feasibility of using soil temperature and moisture content to predict soil N mineralization rates (N_{min}) at the Coweeta Hydrologic Laboratory in the Southern Appalachians. We conducted seasonal laboratory incubations of A and AB horizon soils from three sites with mixed-oak vegetation using temperature and moisture levels characteristic of the season in which the soils were collected. The incubations showed that temperature and temperature-moisture interactions significantly affected net soil N_{min}. We used the laboratory data to generate equations relating net N_{min} to soil temperature and moisture data. Using field-collected temperature and moisture data, we then calculated N_{min} on similar forest sites and compared predicted rates with *in situ*, closed-core N_{min} measurements. The comparison showed that the *in situ* N_{min} was greater than rates predicted from laboratory-generated equations (slope = 3.22; $r^2 = 0.89$). Our study suggests that while climatic factors have a significant effect on soil N_{min}, other factors also influence rates measured in the laboratory and *in situ*.

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- 19 McNab, W. Henry; Lloyd, F. Thomas; Loftis, David L. 2002. **Preliminary evaluation methods for classifying forest site productivity based on species composition in Western North Carolina.** In: Doruska, P.F.; Bragg, D.C., eds. Proceedings of the Southern Mensurationists conference. Monticello, AR: Arkansas Forest Resources Center: 10-18.

The species indicator approach to forest site classification was evaluated for 210 relatively undisturbed plots established by the USDA Forest Service, Forest Inventory and Analysis unit (FIA) in Western North Carolina. Plots were classified by low, medium, and high levels of productivity based on 10-year individual tree basal area increment data standardized for initial stocking. Chi-square analysis of contingency tables indicated that productivity classes were not independent ($p < 0.05$) of the frequencies of occurrence for 4 of 27 common tree species. Multiple logistic regression of a binary variable formed by the high productivity class compared to the combined low and medium classes resulted in a model consisting of elevation and seven significant ($p < 0.05$) species that produced a classification accuracy of 85 percent; a similar model based on the low productivity class resulted in classification accuracy of 70 percent. A multinomial logistic regression model indicated that elevation and six species were significantly ($p < 0.05$) associated with the three productivity classes, but overall classification accuracy dropped to 61 percent, mainly due to the poor predictability of low productivity classes. Chestnut oak (*Quercus prinus*) and serviceberry (*Amelanchier* spp.) were the most consistent indicator species. Results of this exploratory study suggest that using indicator species for site

classification shows promise in hardwood stands by avoiding problems associated with conventional methods based on site index.

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- 20** Swift, Lloyd W., Jr. 1985. **Forest road design to minimize erosion in the Southern Appalachians.** In: Blackmon, B.G., ed. Proceedings of forestry and water quality: a mid-south symposium. Monticello, AR: University of Arkansas. 141-151.

Excessive erosion and low serviceability of roads are continuing problems associated with forest management in the mountains of the Southeastern United States. Road and erosion research at Coweeta Hydrologic Laboratory in Western North Carolina dates from roadbank stabilization work in the 1930s. Emphasis has been to develop and demonstrate a low-cost, low-maintenance road design. Results cover such features as drainage and the broad-based dip, cut-bank design and stabilization; roadbed surfacing; brush barriers and filter strips; culvert sizing; and transportation planning. Application of knowledge gained permits roads to be built and maintained at lower cost, while providing practical control of sediment input to streams.

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- 21** Swift, L.W., Jr. 1988. **Forest access roads: design, maintenance, and soil loss.** In: Swank, W.T.; Crossley, D.A., Jr. Ecological Studies. Vol. 66: Forest hydrology and ecology at Coweeta. New York: Springer-Verlag: 313-324.

The regional guide for the South [United States Department of Agriculture 1984] recognizes that roads and skid trails are the major sources of sediment from forestry-related activities. The overall environmental impact statement for the Southern Region estimates an existing national forest road network of 56,300 km (31,000 miles) with approximately 200 km (125 miles) of new construction or reconstruction each year. About 70 percent of this annual construction is classed as local road; i.e., the low-standard, limited-use road that terminates the transportation system. Local roads are often developed for access to timber sales. More than 40 years of road studies and land management demonstrations at Coweeta show both an early recognition that roads were a problem and a continuing effort to describe the magnitude of soil loss and develop technologies to control it. This chapter gives a history of road-related research at Coweeta and summarizes the findings of that research.

Large-Scale Assessment and Modeling

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- 22** Blomquist, C.; Kubisiak, T.L. 2003. **Laboratory diagnosis of *Phytophthora ramorum* from field samples. Sudden oak death: How concerned should you be?** American Phytopathological Society online symposium on Sudden Oak Death. http://www.aspnet.org/online/SOD/Papers/blomquist_kubisiak/default.htm. [Date accessed:] June 26, 2003.

A single plant disease should never be diagnosed on the basis of a single test. Using as much information as possible leads to the most informed diagnosis. The

species of host plant, its symptoms, the location of the plant, the status of the county or State (known infested versus not infested with the pathogen), the culture results, and the results of DNA tests should all be used to make the diagnosis. In the case of Sudden Oak Death (SOD), caused by *Phytophthora ramorum* (*Pr*) (Phylum Oomycota), different kinds of proof are required depending upon whether a sample comes from an infested county versus a county or State not yet known to be infested. In an infested county, recognized host plants with characteristic symptoms and an unequivocal DNA test result are adequate to confirm the presence of *Pr*. To confirm *Pr* in a previously uninfested county or State, or infecting a new host species, the pathogen must be grown in culture and identified using morphological characteristics and DNA sequence analysis. To be unequivocally confirmed, the sequence of the intergenic transcribed spacer (ITS) region of the ribosomal DNA of the suspect organism must exactly match that of *Pr*.

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- 23** Bowker, J.M.; English, Donald B.K. 2002. **Mountain biking at Tsali: an assessment of users, preferences, conflicts, and management alternatives.** Gen. Tech. Rep. SRS-59. Asheville, NC: U.S. Department of Agriculture, Forest Service, Southern Research Station. 28 p.

Tsali Recreation Area is part of the Cheoah Ranger District of the Nantahala National Forest. Overlooking the Great Smoky Mountains, it is one of the premier mountain biking sites in the Eastern United States. The results of a 13-month on-site survey of 1,359 Tsali

visitors examine the demographics, behavior, current trip profile, and attitudes toward user fees, current management policies, and future management alternatives. More than 70 percent of visitors were male, 96 percent were white, 85 percent had attended college, 90 percent were between the ages of 20 and 49, and more than 60 percent had incomes over \$50,000. Sixty percent of the visitors had four or more years of experience; 16 percent were beginners. Visitors averaged 21 biking trips totaling 59 days yearly, averaging 3 visits to Tsali. Fifty-five percent were first-time visitors, while 80 percent said Tsali was their “favorite place” to ride. Trail surface and congestion were the most important site attributes to visitors. Surfaces rated high in performance, indicating that management practices are successful. Congestion on trails rated slightly less than “good,” suggesting management consideration. Site facilities rated “good” or better on average. Parking and security were ranked highly for both performance and importance. Toilet facilities ranked the lowest in performance but high in importance, suggesting another area for management consideration. Most visitors (95 percent) agreed that fees are a “good tool to manage public recreation areas,” in general and at Tsali. Visitors overwhelmingly supported future management alternatives that proposed more trail miles, even though these were combined with fee increases.

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- 24** Gardiner, Emile; Hahn, Katrine; Löf, Magnus. 2003. **Introduction: forest restoration in temperate and boreal zones.** *Forestry*. 76 (2): 125-126.

The past decade has witnessed an acceleration of forest restoration activities around the globe. Afforestation of former agricultural land, rehabilitation of natural forest processes and structures at the stand and landscape levels, and conversion of single-species plantations to mixed-species stands are among the prominent types of restoration practices currently being implemented throughout temperate and boreal forests. The impetuses for these forest restoration activities are diverse, but restoration goals often include increasing the land base of a particular forest ecosystem, increasing biodiversity, increasing ecosystem resilience and resistance, and increasing forest sustainability.

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- 25 Huang, H.; Layne, D.R.; Kubisiak, T.L. 2002. **Molecular characterization of cultivated pawpaw (*Asimina triloba*) using RAPD markers.** Journal of American Society of Horticultural Science. 128(1):85-93.

Thirty-four extant pawpaw (*Asimina triloba* (L.) Dunal) cultivars and advanced selections representing a large portion of the gene pool of cultivated pawpaws were investigated using 71 randomly amplified polymorphic DNA (RAPD) markers to establish genetic identities and evaluate genetic relatedness. All 34 cultivated pawpaws were uniquely identified by as few as 14 loci of eight primers. Genetic diversity of the existing gene pool of cultivated pawpaws, as estimated by Nei's gene diversity (H_e), was similar to that of wild pawpaw populations. The genetic relatedness among the cultivated pawpaws examined by unweighted pair-group mean cluster analysis (UPGMA) separated 34 cultivars and selections into two distinct clusters: (1) a

cluster of PPF (the PawPaw Foundation) selections; and (2) a cluster including a majority of the extant cultivars selected from the wild and their derived selections. The results are in general agreement with the known selection history and pedigree information available. The consensus fingerprint profile using the genetically defined RAPD markers is a useful and reliable method for establishing the genetic identities of the pawpaw cultivars and advanced selections. This also proved to be an improved discriminating tool over isozyme markers for the assessment of genetic diversity and relatedness. RAPD profiling of data presented in this study provides a useful reference for germ-plasm curators engaged in making decisions of sampling strategies, germ-plasm management, and for breeders deciding which parents to select for future breeding efforts.

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- 26** Kubisiak, T.L.; Roberds, J. 2003. **Genetic variation in natural populations of American chestnut.** Journal of American Chestnut Foundation. 16 (2):42-48.

Prior to the blight epidemic, American chestnut (*Castanea dentata* Borkh.) was one of the most important timber and nut-producing tree species in Eastern North America. Its native range extended from Southern Maine and Ontario in the North to Georgia, Alabama, and Mississippi in the South. It now exists primarily as stump sprouts across its entire native range. After nearly a century of blight, numerous living stems of American chestnut still exist. Prolific stump sprouting and the fact that the blight fungus does not infect the root system have enabled American chestnut trees to persist. However, sexual reproduction

is infrequent and its gene pool will likely face serious erosion when old root systems fail to produce sprouts and perish.

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- 27** Macie, Edward A.; Hermansen, L. Annie. 2003. **Human influences on forest ecosystems: the southern wildland-urban interface assessment: summary report.** Gen. Tech. Rep. SRS-64. Asheville, NC: U.S. Department of Agriculture, Forest Service, Southern Research Station. 13 p.

This summary report synthesizes the findings contained in the Southern Wildland-Urban Interface Assessment (General Technical Report SRS-55). The Assessment provides a review of critical wildland-urban interface issues, challenges, and needs for the Southern United States. Topics include population and demographic trends, economic and tax issues, land use planning and policy issues, urban influences on forest ecosystems, challenges for forest resource management and conservation, social issues, and themes and research needs for the wildland-urban interface.

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- 28** Miller, James H. 2003. **Nonnative invasive plants of southern forests: a field guide for identification and control.** Gen. Tech. Rep. SRS-62. Asheville, NC: U.S. Department of Agriculture, Forest Service, Southern Research Station. 93 p.

Invasions of nonnative plants into forests of the Southern United States continue to go unchecked and

unmonitored. Invasive nonnative plants infest under and beside forest canopies and dominate small forest openings, increasingly eroding forest productivity, hindering forest use and management activities, and degrading diversity and wildlife habitat. Often called nonnative, exotic, nonindigenous, alien, or noxious weeds, they occur as trees, shrubs, vines, grasses, ferns, and forbs. This book provides information on accurate identification and effective control of the 33 nonnative plants and groups that are currently invading the forests of the 13 Southern States, showing both growing and dormant season traits. It lists other nonnative plants of growing concern, control strategies, and selective herbicide application procedures. Recommendations for preventing and managing invasions on a specific site include maintaining forest vigor with minimal disturbance, constant surveillance and treatment of new unwanted arrivals, and, finally, rehabilitation following eradication.

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- 29** Monroe, Martha L.; Bowers, Alison W.; Hermansen, L. Annie. 2003. **The moving edge: perspectives on the southern wildland-urban interface: southern wildland-urban interface assessment focus group report.** Gen. Tech. Rep. SRS-63. Asheville, NC: U.S. Department of Agriculture, Forest Service, Southern Research Station. 35 p.

To better understand the wildland-urban interface across the 13 Southern States and to identify issues to be covered in the USDA Forest Service report, "Human Influences on Forest Ecosystems: The Southern Wildland-Urban Interface Assessment," 12 focus

groups were conducted in 6 of the Southern States in May and June 2000. The groups were guided through a series of questions that enabled them to describe the interface in their region, list the factors that are driving change, and identify the key issues associated with the interface. The groups also discussed the challenges and opportunities in the interface and what they need to do a better job.

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- 30** Parresol, Bernard R. 2003. **Recovering parameters of Johnson's S_B distribution.** RP SRS-31. Asheville, NC: U.S. Department of Agriculture, Forest Service, Southern Research Station. 9 p.

A new parameter recovery model for Johnson's S_B distribution is developed. This latest alternative approach permits recovery of the range and both shape parameters. Previous models recovered only the two shape parameters. Also, a simple procedure for estimating the distribution minimum from sample values is presented. The new methodology employs the median and the first and second moments of the distribution. The methodology is demonstrated by modeling diameter distributions of unthinned loblolly pine plantations. Compatible equations for projecting per-hectare values of number of trees and basal area from initial stand conditions are presented, as well as equations for predicting median diameter, mean diameter, and the location parameter. Given estimates of these five stand attributes, the range and the two shape parameters of the S_B distribution can be recovered. The χ^2 goodness-of-fit test rejected 56 cases out of 527 for conformance to an S_B distribution. Though the S_B distribution is very flexible in terms of

distribution shape, about 10 percent of the loblolly plantation observations did not follow this distribution. Nonetheless, deviation analysis showed reasonable results, with 77 percent of the variation explained in current and projected distributions (numbers of trees by 2.5-cm diameter class). Overall, the recovered S_B distributions provided good approximations of the observed diameter distributions.

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- 31** Riitters, Kurt H.; Coulston, John W.; Wickham, James D. 2003. **Localizing national fragmentation statistics with forest type maps.** *Journal of Forestry*. 101 (4): 18-22.

Fragmentation of forest types is an indicator of biodiversity in the Montreal Process, but the available national data permit assessment of only overall forestland fragmentation, not forest type fragmentation. Here we illustrate how to localize national statistics from the 2003 National Report on Sustainable Forests by combining State vegetation maps with national forestland fragmentation maps. The degree and scale of fragmentation of different forest types can be gauged from the amount of forestland that meets certain fragmentation thresholds at multiple scales of analysis.

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- 32** Tabor, G.M.; Kubisiak, T.L.; Klopfenstein, N.B. [and others]. 2000. **Bulked segregant analysis identifies molecular markers linked to *Melampsora medusae* resistance in *Populus deltoides*.** *Phytopathology*. 90:1039-1042.

In the North Central United States, leaf rust caused by *Melampsora medusae* is a major disease problem on *Populus deltoides*. In this study we identified molecular markers linked to a *M. medusae* resistance locus (*Lrd1*) that was segregating 1:1 within an intraspecific *P. deltoides* family (C9425DD). Previous field results were confirmed in the controlled environment of a growth chamber through an excised whole-leaf inoculation method. Using bulked segregant analysis we identified two random amplified polymorphic DNA (RAPD) markers (OPG10₃₄₀ and OPZ19₁₈₀₀) that are linked to *Lrd1*. Based on segregation in a total of 116 progeny, the genetic distances between OPG10₃₄₀ and OPZ19₁₈₀₀ and the resistance locus were estimated as 2.6 and 7.4 Haldane centimorgans (cM), respectively. Multipoint linkage analyses strongly suggest the most likely order for these loci is *Lrd1*, OPG10₃₄₀ and OPZ19₁₈₀₀. These markers may prove to be instrumental in the eventual cloning of *Lrd1*, as well as for marker-assisted selection of leaf-rust resistant genotypes.

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- 33** Weekley, C.; Kubisiak, T.L.; Race, T. 2002. **Genetic impoverishment and cross-incompatibility in remnant genotypes of *Ziziphus celata* (Rhamnaceae), a rare shrub endemic to the Lake Wales Ridge, Florida.** Biodiversity and Conservation. 11:2027-2046.

The loss of genetic diversity in fragmented populations of self-incompatible plant species may result in sexual reproductive failure and local extinctions. Florida ziziphus (*Ziziphus celata*) is a self-incompatible clonal shrub known only from five genetically depauperate populations on the Lake Wales Ridge, Florida, USA. Recovery of this species requires identification of cross-

compatible genotypes that can be used to create viable (i.e., sexually reproducing) populations. To further development of a recovery program for this highly imperiled species, we investigated its genetic structure and sexual reproductive viability. We used random amplified polymorphic DNAs (RAPDs) to investigate genetic variability within remnant populations, and we conducted experimental compatibility trials to determine the cross-compatibility of remnant genotypes. One hundred and ninety-nine unique stem samples collected from one *ex situ* and five *in situ* populations were assayed for the presence or absence of a band for 32 RAPD markers. Based on unweighted pair-group mean cluster analysis (UPGMA), only 11 multi-locus genotypes (MLGs) were identified. Eight of these MLGs correspond to MLGs identified in an earlier allozyme study. In addition, we identified three new RAPD-based MLGs. Three of the five natural populations consisted of only one MLG, while the largest and most genetically diverse population comprised only four MLGs. Coefficients of similarity ranged from 96.6 percent for the most closely related MLGs to 20.7 percent for the most distantly related. The compatibility trials demonstrated that most MLGs are cross-incompatible. With 69 percent of all possible one-way crosses tested (38/55), we have identified only eight compatible crosses via germination trials. Based on the results of the compatibility trials, we assigned MLGs to self-incompatibility (SI) mating types. On present evidence, the current breeding population of Florida ziziphus may comprise as few as two SI mating types. These SI mating types will be used to guide future breeding efforts and an experimental introduction.

Inventory and Monitoring

- 34** Bentley, James W. 2003. **The South's timber industry—an assessment of timber product output and use, 1999.** Resource Bulletin SRS-85. Asheville, NC: U.S. Department of Agriculture, Forest Service, Southern Research Station. 71 p.

In 1999, industrial roundwood output from the South's forests totaled 8.7 billion cubic feet, 1 percent less than in 1995. Mill byproducts generated from primary manufacturers increased 1 percent to 3.1 billion cubic feet. Almost all plant residues were used primarily for fuel and fiber products. Pulpwood was the leading roundwood product at 3.75 billion cubic feet; saw logs ranked second at 3.74 billion cubic feet; veneer logs were third at 897 million cubic feet. The number of primary processing plants decreased from 2,812 in 1995 to 2,551 in 1999. Total receipts declined less than 1 percent to 8.7 billion cubic feet.

- 35** Johnson, Tony G.; Stepplenton, Carolyn D.; 2003. **Southern pulpwood production, 2001.** Resour. Bull. SRS-84. Asheville, NC: U.S. Department of Agriculture, Forest Service, Southern Research Station. 34 p.

In 2001, the South's production of pulpwood declined 5 percent to 63.5 million cords. Roundwood production dropped to 42.3 million cords and accounted for 67 percent of the total pulpwood production. The use of wood residue declined 5

percent to 21.2 million cords. Alabama continued to lead the South in total production and number of mills. In 2001, 94 mills were operating and drawing wood from the 13 Southern States. Southern mills' pulping capacity dropped from 130,337 tons per day in 2000 to 123,105 tons per day in 2001, but still accounted for more than 70 percent of the Nation's total pulping capacity.

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- 36** Zarnoch, Stanley J.; Clark, Alexander, III; Souter, Ray A. 2003. **Comparison of past, present, and future volume estimation methods for Tennessee.** Res. Note SRS-12. Asheville, NC: USDA Forest Service, Southern Research Station. 8 p.

Forest Inventory and Analysis 1999 survey data for Tennessee were used to compare stem-volume estimates obtained using a previous method, the current method, and newly developed taper models that will be used in the future. Compared to the current method, individual tree volumes were consistently underestimated with the previous method, especially for the hardwoods. The taper models produced estimates very similar to the current method for both hardwoods and softwoods. When expanded to a statewide basis, the previous method differed from the current by -2.128×10^9 cubic feet, which represents an 8.16-percent underestimate. Hardwoods again were more severely underestimated than softwoods. Conversely, results from the taper method deviated only 0.230×10^9 cubic feet from the current method, or 0.88 percent, which is of little concern.

Foundation Programs

- 37** Patterson, David W.; Kluender, Richard A.; Granskog, James E. 2002. **Economic feasibility of producing inside-out beams from small-diameter logs.** *Forest Products Journal*. 52 (1): 23-26.

Previous work has shown that it is technically feasible to produce inside-out (ISO) beams by taking small-diameter (5 to 7 in.) logs, slabbing four sides, quartering the cant, and turning the quarters inside out and gluing them together. After drying, the beams were found to be straight, with no cracks, and of equal or better mechanical properties than solid sawn beams of the same material. The objectives of this study were to determine if it was economically feasible to produce ISO beams and if interest rate or daily production level influenced economic feasibility. Present net worth (PNW) with a 10-year planning horizon was used in the analysis. The interest rates were 8, 12, 16, 20, and 24 percent and the daily production levels were 400, 600, and 800 tree-length stems yielding 464, 696, and 928 small-diameter logs, respectively. Results indicated that the constraining variable in determining feasibility was production level, although discount rate was also important in determining PNW. The PNW of a 400-stem production level was always negative, while it was always positive for the 600- and 800-stem production levels. The break-even point was indicated to be approximately 550 stems per day for the equipment and production facility used in this study.

Research Work Units

Location & Project Leader	Unit	Name & Web Site	Phone
Asheville, NC David Loftis	4101	Ecology and Management of Southern Appalachian Hardwood Forests www.srs.fs.usda.gov/bentcreek	828-667-5261
Athens, GA John Stanturf	4104	Disturbance and the Management of Southern Pine Ecosystems www.srs.fs.usda.gov/disturbance	706-559-4315
Athens, GA Jim Hanula	4505	Insects and Diseases of Southern Forests www.srs.fs.usda.gov/4505	706-559-4285
Athens, GA Ken Cordell	4901	Assessing Trends, Values, and Rural Community Benefits from Outdoor Recreation and Wilderness in Forest Ecosystems www.srs.fs.usda.gov/trends	706-559-4264
Auburn, AL Charles McMahon	4105	Vegetation Management Research and Longleaf Pine Research for Southern Forest Ecosystems www.srs.fs.usda.gov/4105	334-826-8700
Auburn, AL Robert Rummer	4703	Biological/Engineering Systems and Technologies for Ecological Management of Forest Resources www.srs.fs.usda.gov/forestops	334-826-8700
Blacksburg, VA Andrew Dolloff	4202	Coldwater Streams and Trout Habitat in the Southern Appalachians www.trout.forprod.vt.edu	540-231-4016
Blacksburg, VA Philip Araman	4702	Integrated Life Cycle of Wood: Tree Quality, Processing, and Recycling www.srs4702.forprod.vt.edu	540-231-4016

Research Work Units

Location & Project Leader	Unit	Name & Web Site	Phone
Charleston, SC Carl Trettin	4103	Center for Forested Wetlands Research www.srs.fs.usda.gov/charleston	843-727-4271
Clemson, SC Susan Loeb	4201	Endangered, Threatened, and Sensitive Wildlife and Plant Species in Southern Forests www.srs.fs.usda.gov/4201	864-656-3284
Franklin, NC James Vose	4351	Evaluation of Watershed Ecosystem Responses to Natural, Management, and Other Human Disturbances	828-524-2128
Knoxville, TN James Perdue	4801	Forest Inventory and Analysis www.srsfia.usfs.msstate.edu	865-862-2027
Monticello, AR James Guldin	4106	Managing Upland Forest Ecosystems in the Midsouth www.srs.fs.usda.gov/4106	870-367-3464
Nacogdoches, TX Ronald Thill	4251	Integrated Management of Wildlife Habitat and Timber Resources www.srs.fs.usda.gov/wildlife	936-569-7981
New Orleans, LA James Granskog	4802	Evaluation of Legal, Tax, and Economic Influences on Forest Resource Management www.srs.fs.usda.gov/4802	504-589-6652
Pineville, LA James Barnett	4111	Ecology and Management of Even-Aged Southern Pine Forests www.srs.fs.usda.gov/4111	318-473-7215

Research Work Units

Location & Project Leader	Unit	Name & Web Site	Phone
Pineville, LA Kier Klepzig	4501	Ecology, Biology, and Management of Bark Beetles and Invasive Forest Insects of Southern Conifers www.srs.fs.usda.gov/4501	318-473-7232
Pineville, LA Les Groom	4701	Utilization of Southern Forest Resources www.srs.fs.usda.gov/4701	318-473-7268
Raleigh, NC Steven McNulty	4852	Southern Global Change Program www.sgcp.ncsu.edu	919-513-2974
Research Triangle Park, NC Kurt Johnsen	4154	Biological Foundations of Southern Forest Productivity and Sustainability www.rtp.srs.fs.usda.gov/soils/soilhome.htm	919-549-4092
Research Triangle Park, NC Greg Reams	4803	Forest Health Monitoring http://willow.ncfes.umn.edu/fhm/fhm_hp.htm	919-549-4014
Research Triangle Park, NC David Wear	4851	Economics of Forest Protection and Management www.rtp.srs.fs.usda.gov/econ	919-549-4093
Saucier, MS Dana Nelson	4153	Southern Institute of Forest Genetics	228-832-2747
Starkville, MS Terry Wagner	4502	Wood Products Insect Research www.srs.fs.usda.gov/termites	662-338-3100
Stoneville, MS Ted Leininger	4155	Center for Bottomland Hardwoods Research www.srs.fs.usda.gov/cbhr	662-686-3154



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