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Wildland-Urban Interface: Intersection of People, Resources, and Competing Uses

The term “wildland-urban interface” might sound like a clean alignment, but the intense competition for limited natural resources increasingly resembles a professional hockey game. Individuals, groups, developers, counties, States, small landowners—so many visions conflict over what constitutes proper use. Published by the Southern Research Station, *Human Influences on Forest Ecosystems; the Southern Wildland-Urban Interface Assessment* takes the pulse of people and southern forests as the South’s rapidly increasing population pushes against limited natural resources. The assessment, edited by Edward A. Macie and L. Annie Hermansen, opens a dialogue about the complex and evolving nature of these topics.

Financial ability to get away from the city and suburbia draws people to move further into the wild, to find their own peace, security, or adventure. The landscape keeps changing from what “natives” or “locals” valued when they were raised on that land or when they moved to that special place. Conflict comes to life at a county zoning meeting or a department of transportation hearing. Homeowners who choose to build in heavily wooded, sparsely populated areas can enjoy living in a remote setting—until a fire threatens lives and structures and challenges responders’ capabilities.

After the 1998 Florida wildfires, the Chief of the USDA Forest Service identified the wildland-urban interface as one of the main priorities for the Forest Service in the South. Representatives from the Forest Service; the Southern Group of State Foresters; universities;

the Cooperative Extension Service, Southern Region; and nonprofit organizations formed the Southern Wildland-Urban Interface Council. The group identified key issues and fleshed them out in focus groups that met in six Southern States. The assessment addresses these topics:

- Population and demographic trends
- Economic and tax issues
- Land use planning and policy issues
- Urban influences on forests
- Challenges to forest resource management and conservation
- Social consequences of change
- Fire

Human Influences on Forest Ecosystems; the Southern Wildland-Urban Interface Assessment (GTR SRS-55) is available in print and on the Web (www.interfacesouth.usda.gov and www.srs.fs.usda.gov). Visit www.interfacesouth.usda.gov to download a comprehensive literature database and supporting documents.

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- 27 Macie, Edward A.; Hermansen, L. Annie, eds. 2002. **Human influences on forest ecosystems: the southern wildland-urban interface assessment.** Gen. Tech. Rep. SRS-55. Asheville, NC: U.S. Department of Agriculture, Forest Service, Southern Research Station. 159 p.

Southern Pine Ecosystems

- 1 Barnett, J.P.; Dumroese, R.K.; Moorhead, D.J., eds. 2002. **Proceedings of workshops on growing longleaf pine in containers—1999 and 2001**. Gen. Tech. Rep. SRS-56. Asheville, NC: U.S. Department of Agriculture, Forest Service, Southern Research Station. 63 p.

This publication, a compilation of 20 papers concerning nursery production of longleaf pine seedlings in containers for reforestation, is a summary of longleaf pine workshops held in 1999 and 2001. The Longleaf Alliance and the USDA Southern Research Station and Southern Region Cooperative Forestry organized the first workshop in 1999. It was held in Jesup, Georgia, on September 21-23, 1999, and 15 papers were contributed. The University of Georgia Cooperative Extension Service hosted the second meeting on January 16-18, 2001, in Tifton, Georgia, and 5 papers are included from that effort. Papers are presented in an order that reflects a typical growing season and include information on nursery start-up costs; seed collection, processing, and treatment; irrigation and fertilization practices; container specifications; target seedling characteristics; water quality and irrigation concerns; experiences of small and large operators; pest control; marketing; and field planting.

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- 2 Barnett, James P.; Hains, Mark J.; Hernandez, George A. 2002. **Interim guidelines for growing longleaf seedlings in containers** [Brochure]. Gen. Tech. Rep. SRS-60. Asheville, NC: U.S. Department of Agriculture, Forest Service, Southern Research Station.

These interim guidelines are designed for producers and users of longleaf pine container stock. They are not meant to exclude any container product. The seedling specifications listed in the preferred category are attainable by the grower and will result in excellent field survival and early height growth.

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- 3 Bridgwater, F.E.; Smith, W.D. 2002. **Decline in values of slash pine stands infected with fusiform rust.** Southern Journal of Applied Forestry. 26 (3): 134-139.

Losses in product values due to fusiform rust, caused by *Cronartium quercuum* (Berk.) Miyabe ex Shirai f. sp. fusiforme, were estimated from four 2.5-yr-old slash pine (*Pinus elliotii* Engelm.) plantations planted in southern Mississippi over a range of sites with different growth potential and expected rust infection levels. The percentage of infected stems ranged from 2.5 percent to 62 percent at age 2.5 years. The conversion-return method was used to take into account logging, transportation, and milling costs. Estimated stand values between infected and noninfected stands were compared to determine the losses in product value due to fusiform rust. Decline in estimated stand stumpage values ranged from 5.6 percent to 15.5 percent at age 25 years. Stand stumpage values at age 25 declined 0.26 percent per 1 percent increase in stem rust infection at both ages 5 and 2.5. The strong linear relationship between the percentage of stems infected at age 5 and decline in stand stumpage values provides a useful tool for land managers who need to estimate the reduction in value of slash pine stands at harvest based on rust infection at age 5 years. Combining this information with estimates of losses from rust-

associated mortality and reduced growth of infected stems (from other studies) permits land managers to estimate the value of slash pine stands at harvest at early ages and decide among management alternatives.

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- 4 Cain, Michael D.; Barnett, James P. 2002. **Effects of early release on natural versus container loblolly pines 12 years after field establishment.** Southern Journal of Applied Forestry. 26(4): 173-180.

Genetically improved, container loblolly pine (*Pinus taeda* L.) seedlings were compared to naturally established loblolly seedlings on a cutover pine site. Crop pines on 6 of 12 plots were released from woody and herbaceous competition within a 2 ft radius of each stem. On release plots, woody competition was controlled by hand-cutting for 5 consecutive years, and herbaceous competition was controlled with herbicides for 4 consecutive years after pine establishment. Competition control increased 12 year survival by 68 percentage points for natural pines and by 47 percentage points for planted pines. Twelve years after field establishment, mean-tree volume of planted pines was no different than that of naturally established pines. Nevertheless, volume gains of 150 percent to 200 percent were achieved within regeneration techniques as a result of release.

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- 5 Cain, Michael D.; Shelton, Michael G. 2002. **Does prescribed burning have a place in regenerating uneven-aged loblolly-shortleaf pine stands?** Southern Journal of Applied Forestry. 26 (3): 117-123.

Before the 1981 growing season, a study was installed in southeastern Arkansas to examine the effects of three dormant-season burn intervals (low, moderate, and high frequency), and an unburned treatment on natural regeneration in uneven-aged stands of loblolly and shortleaf pines. Merchantable pine basal areas were maintained by harvesting on a 5 or 6 year cutting cycle. When the study began, hardwoods greater than 1 in. d.b.h. were injected with herbicide on all plots. During the next 19 years, there were eight high frequency, four moderate frequency, and three low frequency prescribed burns. In 1991, the unburned plots received a single, broadcast-herbicide treatment. Single-tree selection harvests were conducted in 1982, 1987, 1992, and 1997. Through 1999 (19 years), herbicides applied at 10 year intervals were more effective than dormant-season burns for enhancing the growth of sub-merchantable pines. Although recurring winter burns tended to stop the progression of both pines and hardwoods from seedling to sapling size classes, the data suggest that properly timed dormant-season burns might be used to secure natural pine regeneration in selection management.

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- 6 Collins, Christopher S.; Conner, Richard N.; Saenz, Daniel. 2002. **Influence of hardwood midstory and pine species on pine bole arthropods.** *Forest Ecology and Management.* 164: 211-220.

Arthropod density on the boles of loblolly pines (*Pinus taeda*) was compared between a stand with and a stand without hardwood midstory and between a stand of loblolly and shortleaf pines (*P. echinata*) in the Stephen F. Austin Experimental Forest, Nacogdoches County, Texas, USA from September 1993 through July 1994.

Arthropod density was greatest ($t = 5.67$, 10 d.f., $P < 0.001$) in an open pine stand nearly devoid of hardwood midstory than in a pine stand with dense hardwood midstory. Loblolly pine had greater ($t = 2.34$, 10.9 d.f., $P = 0.040$) arthropod densities than shortleaf pine. Vegetative characteristics within a pine stand rather than bark rugosity appear to be the dominant factor determining arthropod density on the boles of pines. The red-cockaded woodpecker (*Picoides borealis*) should benefit from greater abundances of arthropods on the boles of pines, particularly during the nesting season. In order to provide prime foraging habitat for the red-cockaded woodpecker, land managers should consider the vegetative community structure within foraging habitat.

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- 7 Franzreb, Kathleen E. 2002. [Book Review]. **The red-cockaded woodpecker: surviving in a fire-maintained ecosystem.** The Condor. 104(3): 701-703.

Southern Station research wildlife biologist Kay Franzreb reviews **The Red-cockaded Woodpecker: Surviving in a Fire-maintained Ecosystem.** Richard N. Conner, D. Craig Rudolph, and Jeffrey R. Walters wrote this comprehensive book on the biology, conservation, and recovery of *Picoides borealis*.

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- 8 Glitzenstein, Jeff S.; Streng, Donna R.; Wade, Dale D. 2003. **Fire frequency effects on longleaf pine (*Pinus palustris* P. Miller) vegetation in South Carolina and Northeast Florida, USA.** Natural Areas Journal. 23 (1): 22-37.

Southeastern United States habitats dominated by longleaf pine (*Pinus palustris* P. Miller) have declined precipitously in area and extent. Conservation of diverse ground-layer vegetation in these endangered habitats depends on prescribed fire. While the need for prescribed fire is now generally accepted, there is disagreement concerning the most appropriate fire regime. One of the more important variables is frequency of fire. Several hypothetical relationships between fire frequency and vascular plant richness and composition are suggested by the existing literature. Results of two long-term prescribed fire studies support the hypothesis that burning as frequently as fuels permit is optimal for maintaining the largest number of native ground-layer plant species. However, fire frequency effects on species composition differed between the two studies. Increasing fire frequency in South Carolina Ultisol flatwoods and wet savannas was associated with a distinct shift from woody to herbaceous-dominated communities. Herbs, particularly bunchgrasses and perennial forbs, dominated annual- and biennial-burn treatment plots, whereas triennial- and quadrennial-burn plots were shrub-dominated. In contrast, annual and biennial fires did not produce herbaceous dominated ground-layer vegetation in North Florida Spodosol flatwoods. Reduced dominance of saw palmetto and somewhat increased importance of forbs and grasses, particularly rhizomatous grasses, distinguished the annually burned plots. However, biennial- and quadrennial-burn plots were similar in composition and did not differ significantly in species richness at the largest spatial scale.

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- 9 Gwaze, D.P.; Bridgwater, F.E.; Williams, C.G. 2002. **Genetic analysis of growth curves for a woody perennial species, *Pinus taeda* L.** Theoretical and Applied Genetics. 105: 526-531.

Inheritance of growth curves is critical for understanding evolutionary change and formulating efficient breeding plans, yet has received limited attention. Growth curves, like other characters that change in concert with development, often have higher heritability than age-specific traits. This study compared genetic parameters of height-growth curves with those of age-specific heights for a conifer, *Pinus taeda* L. Growth curves were fitted with: (1) a linear regression model; and (2) a non-linear model based on Richards' function, using two sources of height data: two six-parent diallel tests assessed at age 2 to 10 years, and two tests from a nested mating design with 222 parents assessed at 1 to 25 years. Additive genetic control of growth-curve parameters was moderate ($h^2 = 0.06$ to 0.26) and slightly lower than that for age-specific heights. Additive variance exceeded dominance variance for rate and shape parameters, but not for the asymptote. Genetic correlations among growth-curve parameters were high. Early selection on height was as efficient as selection on growth-curve parameters.

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- 10 Ludovici, Kim H.; Zarnoch, Stanley J.; Richter, Daniel D. 2002. **Modeling *in-situ* pine root decomposition using data from a 60-year chronosequence.** Canadian Journal of Forest Research. 32: 1675-1684.

Because the root system of a mature pine tree typically accounts for 20-30 percent of the total tree biomass, decomposition of large lateral roots and taproots following forest harvest and re-establishment potentially impact nutrient supply and carbon sequestration in pine systems over several decades. If the relationship between stump diameter and decomposition of taproot and lateral root material, i.e., wood and bark, can be quantified, a better understanding of rates and patterns of sequestration and nutrient release can also be developed. This study estimated decomposition rates from *in-situ* root systems using a chronosequence approach. Nine stands of 55- to 70-year-old loblolly pine (*Pinus taeda* L.) that had been clear-cut 0, 5, 10, 20, 25, 35, 45, 55, and 60 years ago were identified on well-drained Piedmont soils. Taproot and lateral root systems were excavated, measured, and weighed. Although more than 50 percent of the total root mass decomposed during the first 10 years after harvest, field excavations recovered portions of large lateral roots (>5 cm diameter) and taproots that persisted for more than 35 and 60 years, respectively. Results indicate that decomposition of total root biomass, and its component parts, from mature, clear-cut loblolly pine stands, can be modeled with good precision as a function of groundline stump diameter and years since harvest.

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- 11 Rudolph, D. Craig; Conner, Richard N.; Schaefer, Richard R. 2002. **Red-cockaded woodpecker foraging behavior in relation to midstory vegetation.** Wilson Bulletin. 114 (2): 235-242.

Red-cockaded woodpeckers (*Picoides borealis*) nest and forage in pine-dominated forests. Research indicates that substantial hardwood midstory encroachment is detrimental to red-cockaded woodpecker populations, although the exact mechanisms are unknown. We examined foraging behavior in relation to midstory between August 1989 and February 1990. Red-cockaded woodpeckers foraged at greater heights in areas of taller and denser midstory in the loblolly-shortleaf pine (*Pinus taeda* and *P. echinata*, respectively) habitat, but not in longleaf pine (*P. palustris*) habitat with less-developed midstory vegetation than typical of loblolly-shortleaf pine habitat. In addition, red-cockaded woodpeckers concentrated foraging activities in or adjacent to forest stands or openings with reduced midstory vegetation. Overall, red-cockaded woodpeckers foraged disproportionately at heights and sites that minimized their exposure to dense midstory conditions. These results suggest that ecosystem management, preferably using prescribed fire, that reduces midstory vegetation will improve foraging habitat for red-cockaded woodpeckers.

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- 12 Sanchez, Felipe G.; Bursley, Maurice M. 2002. **Transient nature of rhizosphere carbon elucidated by supercritical freon-22 extraction and ^{13}C NMR analysis.** *Forest Ecology and Management*. 169: 177-185.

The region immediately adjacent to established roots of mature trees has been termed the “reoccurring rhizosphere” and it has been hypothesized that organic matter input from fine root turnover, root exudates, and sloughing may result in a build up of the soil carbon in this region. The “reoccurring rhizosphere”

for first-, second-, and third-order roots of select loblolly pines (*Pinus taeda* L.) were examined on sandy, loamy sand, and sandy loam soils. A significant carbon build up next to the root orders was confirmed for the sandy and loamy sand soils. The carbon build up was substantial (55 percent increase) next to the first-order roots of the sandy soil. However, the sandy loam soil did not display a significant amount of carbon build up next to the root orders. Extraction of the soil samples with supercritical freon-22 showed that the additional carbon in the “reoccurring rhizosphere” was highly soluble. Approximately 60 percent of the total soil carbon was extracted from the sandy and loamy sand soils, while approximately 40 percent was extracted from the sandy loam soil. A qualitative comparison of the extracts by liquid state ^{13}C nuclear magnetic resonance showed that the “reoccurring rhizosphere” region had a higher relative proportion of labile materials (i.e., carbohydrates, proteins, etc.) than the bulk soil. This information coupled with the high solubility in supercritical freon-22 suggests that the carbon build up in the “reoccurring rhizosphere” region of loblolly pines may be transient in nature.

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- 13 Sullivan, Brian T. 2002. **Evidence for a sex pheromone in bark beetle parasitoid *Roptrocerus xylophagorum***. *Journal of Chemical Ecology*. 28(5): 1045-1063.

Male *Roptrocerus xylophagorum* (Ratzeburg) (Hymenoptera: Pteromalidae) exhibited courtship and mating behaviors including wing fanning, antennation, mounting, and copulation attempts when exposed to glass bulb decoys coated with a whole-body

extract of females in hexane, acetone, or methanol. Activity of extract-treated decoys declined gradually over one week. Males responded much less strongly to freeze-killed female cadavers extracted with solvents than to unextracted cadavers; treatment of extracted cadavers with female extract restored male responses. The pheromone was found to be equally present over the surface of both the abdomen and head/thorax of females, and the origin of the pheromone could not be conclusively localized to any single body region. The activity of pheromone on females increased between day 1 and days 3-5 following eclosion; otherwise, pheromone activity was not significantly affected by either female age or mating. Males were arrested within the zone of a glass surface on which females had walked, suggesting that the pheromone might be substrate-borne. Recent exposure to females reduced male responsiveness, but responsiveness was fully restored after a few hours of male isolation from females. When hexane extracts of whole females were fractionated on silica gel, the pheromone's activity was largely recovered with the first, most non-polar fraction. Female extracts and fractions were analyzed by coupled gas chromatography-mass spectrometry. Cuticular hydrocarbon alkanes were identified as the extract components whose concentrations correlated best with male responses. Evidence of the pheromone's long persistence, low volatility, low polarity, and presence over the insect's entire body surface further supported the hypothesis that the pheromone was composed of one or more cuticular hydrocarbons.

Wetlands, Bottomlands, and Streams

- 14** Smith, David R.; Schiff, Nathan M. 2001. **A new species of *Xiphydria latreille* (Hymenoptera: Xiphydriidae) reared from river birch, *Betula nigra* L., in North America.** Proceedings of the Entomological Society of Washington. 103 (4): 962-967.

Xiphydria decem, n. sp., is described and separated from other North American species. It was reared from branches of river birch, *Betula nigra* L. (Betulaceae) in Illinois.

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- 15** Sun, G.; McNulty, S.G.; Amatya, D.M. [and others]. 2002. **A comparison of the watershed hydrology of coastal forested wetlands and the mountainous uplands in the Southern U.S.** Journal of Hydrology. 263: 92-104.

Hydrology plays a critical role in wetland development and ecosystem structure and functions. Hydrologic responses to forest management and climate change are diverse in the Southern United States due to topographic and climatic differences. This paper presents a comparison study on long-term hydrologic characteristics (long-term seasonal runoff patterns, water balances, storm flow patterns) of three watersheds in the Southern United States. These three watersheds represent three types of forest ecosystems commonly found in the Lower Atlantic Coastal Plain and the Appalachian Upland Mountains. Compared to the warm, flat, and shallow groundwater-dominated pine flatwoods on the coast, the inland upland watershed was found to have significantly higher

water yield, Precipitation/Hamon's potential evapotranspiration ratio (1.9 for upland vs 1.4 and 0.9 for wetlands), and runoff/precipitation ratio (0.53 ± 0.092 for upland vs 0.30 ± 0.079 and 0.13 ± 0.094 for wetlands). Streamflow from flatwoods watersheds generally are discontinuous most of the years, while the upland watershed showed continuous flows in most years. Stormflow peaks in a cypress-pine flatwoods system were smaller than that in the upland watershed for most cases, but exceptions occurred under extreme wet conditions. Our study concludes that climate is the most important factor in determining the watershed water balances in the Southern United States. Topography affects streamflow patterns and stormflow peaks and volume, and is the key to wetland development in the Southern United States.

Mountain and Highland Ecosystems

- 16** Greenberg, Cathryn H. 2002. **Response of white-footed mice (*Peromyscus leucopus*) to coarse woody debris and microsite use in Southern Appalachian treefall gaps.** *Forest Ecology and Management*. 164: 57-66.

The influence of treefall gaps and coarse woody debris (CWD) on white-footed mouse (*Peromyscus leucopus*) abundance was tested experimentally during 1996-1999 in a Southern Appalachian hardwood forest. I compared the relative abundance and body size of *P. leucopus* among unsalvaged gaps that were created by wind disturbance and retained high CWD levels,

salvage logged gaps where fallen and damaged tree boles had been removed, and closed-canopy controls. I also tested the relative use by mice of four microsite types: CWD, pits, woody brush, and open ground. One-hundred and forty-one *P. leucopus* were captured 310 times during the study. There were no differences in capture success, body size, or sex ratio among treatments before or after salvage logging, but abundance varied among years. Capture success was higher at traps set adjacent to CWD ($P < 0.05$) and in pits ($P < 0.10$) than at traps set under brush or on open ground. In the Southern Appalachians, windthrow-created canopy gaps and associated microsites do not affect habitat use by *P. leucopus* at a landscape level (as measured by relative abundance among treatments), but CWD influences the microdistribution of *P. leucopus* where it is present.

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- 17 Knoepp, Jennifer D.; Vose, James M. 2002. **Quantitative comparison of *in situ* soil CO₂ flux measurement methods.** Resch. Pap. SRS-28. Asheville, NC: U.S. Department of Agriculture, Forest Service, Southern Research Station. 11 p.

Development of reliable regional or global carbon budgets requires accurate measurement of soil CO₂ flux. We conducted laboratory and field studies to determine the accuracy and comparability of methods commonly used to measure *in situ* soil CO₂ fluxes. Methods compared included CO₂ traps; a multichamber open dynamic system (OC) with an infrared gas analyzer; and a headspace analysis system, with gas chromatograph with circulating fan (GCF) and gas chromatograph without circulating fan (GC),

measuring changes in headspace CO₂ concentration using a gas chromatograph. In the laboratory, we compared NaOH, OC, GCF, and GC using sand-filled cylinders to simulate a soil system. Three concentrations of standard CO₂ gas (representing low, medium, and high soil-CO₂ flux rates) entered the cylinders through individually monitored flow meters. Flux rates measured using the OC method equaled the actual CO₂ flux at all three CO₂ concentrations. Flux rates determined with GC and GCF were < 55 percent of the actual flux rate. The percent of actual CO₂ flux measured increased with increasing CO₂ concentrations. At all concentrations, NaOH collected between 40 and 47 percent of CO₂ entering the system. A field study was conducted to verify laboratory results and allow comparison with the soda lime trap (SODA) method. In laboratory and field studies, all methods detected significant differences in flux rates among the standard CO₂ concentrations and field sites. Regression analyses showed good relationships between NaOH, SODA, and GC methods with flux rates measured using the OC methods ($r^2 \geq 0.78$). Slope values for these regression equations ranged from 0.34 for NaOH to 0.54 for GC and SODA. These results suggest that data collected using the other methods could be standardized to OC flux rates. However, because methodological differences significantly affect CO₂ flux measurements, care should be used in applying these relationships.

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- 18 Oak, Steven W. 2002. **From the Bronx to Birmingham: impact of chestnut blight and management practices on forest health risks in the Southern Appalachian Mountains.** Journal of the American Chestnut Foundation. 16(1): 32-41.

Southern Appalachian forest landscapes evoke images of the primeval forest in many people today. Indeed, most vegetation components in these forests have been present in varying mixtures and distributions for at least 58 million years. However, the only thing constant about these landscapes has been change. Advancing and retreating ice sheets, drought, flood, wind, and fire all served to shape forest composition and structure. Irrepressible as these forces are, people have been perhaps the most important change agents since arriving in the region at least 9,000 years ago. In this context, the types and sequence of human-influenced disturbances since the middle of the 19th century have resulted in Southern Appalachian forests that bear little resemblance in terms of composition and structure to any that have existed in the past. These disturbances include the widespread use of fire, first by native people and then by European settlers; land clearing and agriculture followed by abandonment of marginally productive lands; widespread and sometimes abusive logging to supply fuel and building materials to a growing Nation; industrialization and concurrent urbanization; and the implementation of aggressive fire suppression.

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- 19 Prestemon, Jeffrey P.; Pye, John M.; Abt, Karen Lee [and others]. 2000. **Market definition for hardwood timber in the Southern Appalachians**. In: Munn, I.A.; Bullard, S.H.; Grado, S.C.; Grebner, D.L., eds. Proceedings of the 1999 southern forest economics workshop. Starkville, MS: Mississippi State University: 91-98.

Direct estimation of aggregate hardwood supply is seriously complicated by the diversity of prices,

species, and site conditions in hardwood stands. An alternative approach is to aggregate regional supply based on stumpage values of individual stands, arguably the real driver of harvest decisions. Complicating this approach is that species-specific prices are only available for logs delivered to the mill. To derive stumpage values, delivered prices must be reduced by the costs of harvesting and transport to the mill; hence, the spatial characteristics of the market may be important in defining the aggregate timber supply responsiveness to price. This paper represents an intermediate step in estimating an aggregate supply model for hardwood timber, where we tested the more limited hypothesis that harvest probability and hence stand age is positively related to timber value and negatively related to factors which reduce timber value. We regressed stand age on distances to three types of mills, slope of site, distance from the stand to the nearest road, site quality, and broad management type. We found that stand age increases with distance from mills for NIPF-, industry-, and government-managed stands in the Southern Appalachians. Stand age is negatively related to site quality, positively related to slope of stand, and not significantly affected by distance from the stand to the nearest road. Stand ages also vary by broad management type.

Large-Scale Assessment and Modeling

- 20** 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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- 21 Brockway, Dale G.; Gatewood, Richard G.; Paris, Randi B. 2002. **Restoring fire as an ecological process in shortgrass prairie ecosystems: initial effects of prescribed burning during the dormant and growing seasons.** *Journal of Environmental Management.* 65: 135-152.

Prior to Anglo-European settlement, fire was a major ecological process influencing the structure, composition, and productivity of shortgrass prairie ecosystems on the Great Plains. However during the past 125 years, the frequency and extent of grassland fire has dramatically declined as a result of the systematic heavy grazing by large herds of domestic cattle and sheep, which reduced the available levels of fine fuel and organized fire suppression efforts that succeeded in altering the natural fire regime. The greatly diminished role of recurrent fire in these ecosystems is thought to be responsible for ecologically adverse shifts in the composition, structure and diversity of these grasslands, leading specifically to the rise of ruderal species and invasion by less fire-tolerant species. The purpose of this study was to evaluate the ecological effects of fire season and frequency on the shortgrass prairie and to determine the means by which prescribed fire can best be restored in this

ecosystem to provide the greatest benefit for numerous resource values. Plant cover, diversity, biomass and nutrient status, litter cover, and soil chemistry were measured prior to and following fire treatments on a buffalograss-blue grama shortgrass prairie in northeastern New Mexico. Dormant-season fire was followed by increases in grass cover, forb cover, species richness, and concentrations of foliar P, K, Ca, Mg, and Mn. Growing-season fire produced declines in the cover of buffalograss, graminoids, and forbs, and increases in litter cover and levels of foliar P, K, Ca, and Mn. Although no changes in soil chemistry were observed, both fire treatments caused decreases in herbaceous production, with standing biomass resulting from growing-season fire ~600 kg/ha and dormant-season fire ~1200 kg/ha, compared with controls ~1800 kg/ha. The initial findings of this long-term experiment suggest that dormant-season burning may be the preferable method for restoring fire in shortgrass prairie ecosystems where fire has been excluded for a prolonged time period.

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- 22 Clark, Mark M.; Meller, Russell D.; McDonald, Timothy P. 2000. **A three-stage heuristic for harvest scheduling with access road network development.** *Forest Science*. 46(2): 204-218.

In this article we present a new model for the scheduling of forest harvesting with spatial and temporal constraints. Our approach is unique in that we incorporate access road network development into the harvest scheduling selection process. Due to the difficulty of solving the problem optimally, we develop a heuristic that consists of a solution construction stage

and two solution improvement stages. We call our approach INROADS and compare it to three other approaches by employing hypothetical example problems with 225 stands (or cut blocks) over a three-period planning horizon. Thirteen example forests that vary in terms of stand value and spatial dispersion are used to evaluate our heuristic, which outperforms the other approaches tested.

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- 23 English, Donald B.K.; Kocis, Susan M.; Zarnoch, Stanley J.; Arnold, J. Ross. 2002. **Forest Service national visitor use monitoring process: research method documentation**. Resch. Pap. SRS-57. Asheville, NC: U.S. Department of Agriculture, Forest Service, Southern Research Station. 14 p.

In response to the need for improved information on recreational use of National Forest System lands, the authors have developed a nationwide, systematic monitoring process. This report documents the methods they used in estimating recreational use on an annual basis. The basic unit of measure is exiting volume of visitors from a recreation site on a given day. Sites are stratified by type. Days are stratified by expected volume of exiting recreation visitors. A double sampling strategy is the primary means used to obtain measures of exiting recreation traffic. Where possible, observable counts of other measures highly correlated with visitation, such as fee envelopes, ski lift tickets, or concessionaire reports, are used to reduce variation in visitation estimates. In addition to showing how sampling units were defined, the authors also provide calculations they used in developing estimators for the mean and variance of visitation.

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- 24 Kilgo, John C.; Gartner, David L.; Chapman, Brian R. [and others]. 2002. **A test of an expert-based bird-habitat relationship model in South Carolina.** *Wildlife Society Bulletin.* 30(3): 783-793.

Wildlife-habitat relationships models are used widely by land managers to provide information on which species are likely to occur in an area of interest and may be impacted by a proposed management activity. Few such models have been tested. We used recent avian census data from the Savannah River Site, South Carolina to validate BIRDHAB, a geographic information system (GIS) model developed by United States Forest Service resource managers to predict relative habitat quality for birds at the stand level on national forests in the Southeastern United States. BIRDHAB is based on the species-habitat matrices presented by Hamel (1992). Species-specific accuracy rates for BIRDHAB predictions (the percentage of all stands in which a species was predicted correctly as present or absent) ranged from 33.6-93.0 percent, with a mean of 67.4 ± 17.3 percent (SD, $n=46$ species). Accuracy was >90 percent for 5 species, but <50 percent for 9 species. BIRDHAB performed well ($P < 0.05$) in predicting presence-absence of 32 species. Generally, the model was more accurate in predicting presence-absence for habitat specialists than for generalists. Habitat-specific accuracy rates (the percentage of species for which a habitat's prediction was correct) ranged from 52.7-92.7 percent, with a mean of $71.8 \pm (SD) 9.8$ percent ($n=26$ habitat types). BIRDHAB was a useful tool for many of the species that we tested, but it had no predictive ability for many others. Such species-specific variation in accuracy probably is common among wildlife-habitat relationships models, reinforcing the need for

thorough testing before these models are used in land-use planning.

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- 25 Ludovici, Kim H.; Zarnoch, Stanley J.; Richter, Daniel D. 2002. **Modeling in-situ pine root decomposition using data from a 60-year chronosequence.** Canadian Journal of Forest Research. 32: 1675-1684.

Because the root system of a mature pine tree typically accounts for 20-30 percent of the total tree biomass, decomposition of large lateral roots and taproots following forest harvest and re-establishment potentially impact nutrient supply and carbon sequestration in pine systems over several decades. If the relationship between stump diameter and decomposition of taproot and lateral root material, i.e., wood and bark, can be quantified, a better understanding of rates and patterns of sequestration and nutrient release can also be developed. This study estimated decomposition rates from *in-situ* root systems using a chronosequence approach. Nine stands of 55- to 70-year-old loblolly pine (*Pinus taeda* L.) that had been clear-cut 0, 5, 10, 20, 25, 35, 45, 55, and 60 years ago were identified on well-drained Piedmont soils. Taproot and lateral root systems were excavated, measured, and weighed. Although more than 50 percent of the total root mass decomposed during the first 10 years after harvest, field excavations recovered portions of large lateral roots (>5 cm diameter) and taproots that persisted for more than 35 and 60 years, respectively. Results indicate that decomposition of total root biomass, and its component parts, from mature, clear-cut loblolly pine stands, can be modeled with good precision as a function of groundline stump diameter and years since harvest.

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- 26 Luxmoore, Robert J.; Hargrove, William W.; Tharp, M. Lynn [and others]. 2002. **Addressing multi-use issues in sustainable forest management with signal-transfer modeling.** *Forest Ecology and Management*. 165: 295-304.

Management decisions concerning impacts of projected changes in environmental and social conditions on multi-use forest products and services, such as productivity, water supply or carbon sequestration, may be facilitated with signal-transfer modeling. This simulation method utilizes a hierarchy of simulators in which the integrated responses (signals) from smaller-scale process models are transferred and incorporated into the algorithms of larger spatial- and temporal-scale models of ecological and economic phenomena. Several innovative procedures germane to multi-issue sustainable forest management have been initiated in our signal-transfer modeling development for forests of the Southeastern United States. These developments include response surface interpolation for multi-factor signal-transfer, use of loblolly pine modeling to infer the growth of other southern pines, determination of soil nutrient limitations to productivity, multivariate clustering as a spatial basis for defining land units relevant to forest management, and variance propagation through the modeling hierarchy. Algorithms for larger scale phenomena are shown to constrain the variance introduced from a smaller-scale in a simulation of ambient ozone exposure effects on loblolly pine timber yield. Outputs of forest variables are frequency distributions that may be statistically compared for alternative environmental or management scenarios.

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- 27 Macie, Edward A.; Hermansen, L. Annie, eds. 2002. **Human influences on forest ecosystems: the southern wildland-urban interface assessment.** Gen. Tech. Rep. SRS-55. Asheville, NC: U.S. Department of Agriculture, Forest Service, Southern Research Station. 159 p.

This publication provides a review of critical wildland-urban interface issues, challenges, and needs for the Southern United States. Chapter topics include population and demographic trends; economic and tax issues; land use planning and policy; urban effects on forest ecosystems; challenges for forest resource management and conservation; social consequences of change; fire; and themes, research, and information needs for the wildland-urban interface.

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- 28 McCarty, John P.; Levey, Douglas J.; Greenberg, Cathryn H.; Sargent, Sarah. 2002. **Spatial and temporal variation in fruit use by wildlife in a forested landscape.** *Forest Ecology and Management*. 164: 277-291.

We monitored production and removal rates of fruit from 22 common plant species over 2 years in five habitats of a managed landscape in South Carolina (USA). Our long-term goal is to determine the importance of fruit as a resource for vertebrates and to provide recommendations for management of key species and habitats. This study lays the foundation for that goal by documenting fruit production and availability, variation in use by wildlife, and how these factors vary by plant species, habitat, and season. Six species produced >1 kg dry mass of pulp per hectare

per year. Vertebrates consumed 250 percent of fruits in 17 of the 22 plant species. Fruit loss to insects and microbes was generally small and varied significantly among seasons, being lowest in fall and winter. The length of time ripe fruit survived on plants varied among species from 3 to 165 days. Survival time of fruits did not vary significantly among habitats but was significantly shorter in the summer than in fall or winter. Approximately half the species produced fruit in the fall and winter, and these fruits were primarily consumed by over-wintering wildlife. This pattern is inconsistent with the general belief that fruit production in the Eastern United States is timed to correspond with periods of high bird abundance during fall migration. Production and consumption of winter fruits deserves further attention from forest managers, as relatively little other food is available in winter, energy demands of over-wintering birds are high, and current management practices often reduce fruit availability of key species (e.g., *Myrica cerifera*). We suggest that fruit is more important than generally realized in maintaining vertebrate diversity in temperate forests and that the focus of managers on hard mast production should be broadened to include fruiting plants.

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- 29** Prestemon, Jeffrey P.; Pye, John M.; Butry, David T. [and others]. 2002. **Understanding broadscale wildfire risks in a human-dominated landscape.** *Forest Science*. 48(4): 685-693.

Broadscale statistical evaluations of wildfire incidence can answer policy-relevant questions about the effectiveness of microlevel vegetation management

and can identify subjects needing further study. A dynamic time series cross-sectional model was used to evaluate the statistical links between forest wildfire and vegetation management, human land use, and climatic factors in Florida counties. Four forest wildfire risk functions were estimated: one for fires regardless of ignition source, and three others for fires of specific ignition sources: arson, lightning, and accident (unintentional anthropogenic). Results suggest that current wildfire risk is negatively related to several years of past wildfire and very recent site prep burning, and risk is positively related to pulpwood removals. The effect of traditional prescribed burning on wildfire risk varies by ignition source. El Niño-Southern Oscillation (ENSO) sea surface temperature (SST) anomalies were also significantly linked to forest wildfire risk, but a measure of the wildland-urban interface was not significant. Although these county-level results hold promise for aggregate risk assessment, modeling at finer spatial and temporal scales might further enhance our understanding of how land managers can best reduce the longer term risk of catastrophic wildfire damages.

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- 30 Rials, Timothy G.; Kelley, Stephen S.; So, Chi-Leung. 2002. **Use of advanced spectroscopic techniques for predicting the mechanical properties of wood composites.** *Wood and Fiber Science*. 34(3): 398-407.

Near infrared (NIR) spectroscopy was used to characterize a set of medium-density fiberboard (MDF) samples. This spectroscopic technique, in combination with projection to latent structures (PLS) modeling, effectively predicted the mechanical strength of MDF

samples with a wide range of physical properties. The stiffness, strength, and internal bond properties of the MDF sample could be predicted from the NIR spectra of the MDF surface. The technique is very rapid and provides molecular level insight on subtle changes in the properties of the MDF panels. The results highlight the potential value of NIR spectroscopy for process monitoring and quality control applications.

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- 31 Riitters, Kurt H.; Wickham, James D.; O'Neill, Robert V. [and others]. 2002. **Fragmentation of Continental United States forests**. *Ecosystems*. 5: 815-822.

We report a multiple-scale analysis of forest fragmentation based on 30-m (0.09 ha pixel⁻¹) land-cover maps for the conterminous United States. Each 0.09-ha unit of forest was classified according to fragmentation indexes measured within the surrounding landscape, for five landscape sizes including 2.25, 7.29, 65.61, 590.49, and 5314.41 ha. Most forest is found in fragmented landscapes. With 65.61-ha landscapes, for example, only 9.9 percent of all forest was contained in a fully forested landscape, and only 46.9 percent was in a landscape that was more than 90 percent forested. Overall, 43.5 percent of forest was located within 90 m of forest edge and 61.8 percent of forest was located within 150 m of forest edge. Nevertheless, where forest existed, it was usually dominant—at least 72.9 percent of all forest was in landscapes that were at least 60 percent forested for all landscape sizes. Small (less than 7.29 ha) perforations in otherwise continuous forest cover accounted for about half of the fragmentation. These results suggest that forests are connected over large regions, but

fragmentation is so pervasive that edge effects potentially influence ecological processes on most forested lands.

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- 32** Stanturf, J.A.; Madsen, P. 2002. **Restoration concepts for temperate and boreal forests of North America and Western Europe.** *Plant Biosystems*. 136(2): 143-158.

Throughout the boreal and temperate zones, forest restoration efforts attempt to counteract negative effects of conversion to other land use (afforestation and remediation) and disturbance and stress on existing forests (rehabilitation). Appropriate silvicultural practices can be designed for any forest restoration objective. Most common objectives include timber, wildlife habitat for game species, or aesthetics. Increasingly, other objectives are considered, including carbon sequestration, biological diversity, non-game mammals and birds, endangered animals and plants, and protection of water quality and aquatic resources, and recreation. Plantation forestry remains the most effective approach to restoration of forest cover to large areas, and recent trends toward more complex plantations are explored. Rehabilitation of degraded forests increasingly relies on re-establishing natural disturbance regimes and emphasizes “close-to-nature” approaches to regeneration and stand management. The objectives of this paper are to clarify concepts of forest restoration and to present examples of restoration activities in temperate and boreal forests of North America and Western Europe.

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- 33** Sword, Mary A.; Tiarks, Allan E. 2002. **Local soils information needed to define the root zone in process models on the Gulf Coastal Plain.** Gen. Tech. Rep. SRS-58. Asheville, NC: U.S. Department of Agriculture, Forest Service, Southern Research Station. 15 p.

We combined published information and our own experimental results from the Gulf Coastal Plain to evaluate how soil aeration and strength interact with loblolly pine root growth. Our results demonstrate that soil aeration and strength differ by soil series and year and are subject to vertical and horizontal spatial variation. Comparison of loblolly pine root phenology and seasonal redox potential indicates that oxygen is frequently limiting to new root growth. The strength of these soils may also restrict loblolly pine root growth. Physiological process models that predict southern pine productivity should apply accurate calculations of plant-available soil in simulations of potential root zone water storage and plant-available water. We propose a conceptual root zone submodel that predicts the volume of plant-available soil with soil aeration, strength, and water retention by horizon. Model parameters are components of the Natural Resources Conservation Service (NRCS) Soil Interpretation Record (SIR) database collected across the United States.

Inventory and Monitoring

- 34** Bechtold, William A.; Mielke, Manfred E.; Zarnoch, Stanley J. 2002. **Comparison of field methods and models to estimate mean crown diameter.** Northern Journal of Applied Forestry. 19(4): 177-182.

The direct measurement of crown diameters with logger's tapes adds significantly to the cost of extensive forest inventories. We undertook a study of 100 trees to compare this measurement method to four alternatives—two field instruments, ocular estimates, and regression models. Using the taping method as the standard of comparison, accuracy of the tested alternative was adequate for softwood species, but short of the specified measurement quality objective for estimating the mean crown diameter of hardwoods. Due to savings in field costs, ocular estimation and regression models were the best alternatives to direct measurement with logger's tapes.

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- 35** Bentley, James W.; Johnson, Tony G.; Howell, Michael. 2002. **Arkansas' timber industry—an assessment of timber product output and use, 1999.** Resour. Bull. SRS-79. Asheville, NC: U.S. Department of Agriculture, Forest Service, Southern Research Station. 40 p.

In 1999, roundwood output from Arkansas' forests totaled 692 million cubic feet. Mill byproducts generated from primary manufacturers were 290 million cubic feet. Almost all plant residues were used, primarily for fuel and fiber products. Saw logs were the leading roundwood product at 320 million cubic feet; pulpwood ranked second at 285 million cubic

feet; veneer logs were third at 84 million cubic feet. The number of primary processing plants was 336 in 1999. Receipts for those mills totaled 681 million cubic feet.

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- 36** Bragg, Don C. 2002. **A system to derive optimal tree diameter increment models from the Eastwide Forest Inventory Data Base (EFIDB)**. Southern Journal of Applied Forestry. 26(4): 214-221.

This article is an introduction to the computer software used by the Potential Relative Increment (PRI) approach to optimal tree diameter growth modeling. These DOS programs extract qualified tree and plot data from the Eastwide Forest Inventory Data Base (EFIDB), calculate relative tree increment, sort for the highest relative increments by diameter class, and generate an ASCII file for post-processing in any software package capable of customized ordinary least squares regression.

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- 37** Hartsell, Andrew J. 2002. **Forest statistics for southeast Alabama, 2000**. Resour. Bull. SRS-66. Asheville, NC: U.S. Department of Agriculture, Forest Service, Southern Research Station. 59 p.

This report summarizes a 2000 inventory of the forest resources of a 21-county area of Alabama. Major findings are highlighted in text and graphics; detailed data are presented in 49 tables.

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- 38** Howell, Michael; Wright, Robert. 2002. **Tennessee's timber industry—an assessment of timber product output and use, 1999**. Resour. Bull. SRS-76. Asheville, NC: U.S. Department of Agriculture, Forest Service, Southern Research Station. 39 p.

In 1999, roundwood output from Tennessee's forests was 325 million cubic feet. Mill byproducts generated from primary manufacturers totaled 125 million cubic feet. Ninety percent of the plant residues were used primarily for fuel and fiber products. Saw logs were the leading roundwood product at 185 million cubic feet; pulpwood ranked second at 121 million cubic feet; other industrial products were third at 13 million cubic feet. There were 451 primary processing plants operating in Tennessee in 1999. Total receipts amounted to 306 million cubic feet.

Foundation Programs

- 39** Bragg, Don C. 2002. [Product Review]. **Snagit, version 6.1 for Windows**. Bulletin of the Ecological Society of America. 83(4): 255-256.

Southern Station research forester Don Bragg reviews SNAGIT, Version 6.1 for Windows. He comments on the increasing demand for scientists to utilize digital files to publish their research. Bragg considers SNAGIT an effective and affordable screen capture utility that has evolved into a multi-feature graphics package.

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- 40 Grace, J.M., III. 2002. **Control of sediment export from the forest road prism.** Transactions of the American Society of Agricultural Engineers. 45 (4): 1127-1132.

The effectiveness of four road turn-out ditch treatments (vegetation, rip-rap, sediment fences, and settling basins) in reducing sediment export to the forest floor was evaluated. These four runoff control methods are commonly prescribed to control forest road runoff and sediments. The study utilized runoff samplers, runoff diversion walls, sediment filter bags, and erosion stakes to evaluate runoff concentration reductions through the treatments and sediment export downslope of the treatments. Settling basin, sediment fence, and vegetation treatments had no significant differences in runoff concentration reductions, which averaged more than 40 percent. The rip-rap was significantly less effective at reducing runoff concentration than were either the vegetation or sediment fence. The sediment basins were very effective during smaller storm events, but not during the largest storms, when they overflowed. The sediment basin exported the least amount of smaller-sized sediment that is likely to be delivered to stream systems.

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- 41 Wilson, A.D.; Lester, D.G. 2002. **Trench inserts as long-term barriers to root transmission for control of oak wilt.** Plant Disease. 86 (10): 1067-1074.

Physical and chemical barriers to root penetration and root grafting across trenches were evaluated for their effectiveness in improving trenches as barriers to root

transmission of the oak wilt fungus in live oaks. Four trench insert materials were tested, including water-permeable Tytar and Biobarrier, and water-impenetrable Geomembrane of two thicknesses. Systemic fungicide treatments of trees immediately outside of trenches also were tested. In the first several years following trench installation, an abundance of small adventitious roots commonly formed from roots severed by trenching. These roots provided opportunities for initiation of root grafts across trenches in subsequent years. Although trench inserts did not significantly improve trenches during the first three years following trench installation, water-permeable inserts did effectively improve the performance of trenches beyond the third post-trenching year, when trenches are normally effective, and extended trench longevity indefinitely. The water-permeable inserts were more effective root barriers because they did not direct root growth from the point of root contact. The water-impermeable materials, however, did tend to direct root growth around these barriers, leading to the development of new root graft connections and associated oak wilt root transmission across the trench. The additional cost of trench inserts above trenching costs was justified in urban and rural homestead sites, where high value landscape trees required more protection and additional retrenching costs were avoided.

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 Kerry Britton	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
Coweeta, 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 srsfia2.fs.fed.us	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.fed.us/soils/soilhome.htm	919-549-4092
Research Triangle Park, NC Greg Reams	4803	Forest Health Monitoring www.srs.fs.usda.gov/4803/	919-549-4014
Research Triangle Park, NC David Wear	4851	Economics of Forest Protection and Management www.rtp.srs.fs.fed.us/econ	919-549-4093
Saucier, MS Floyd Bridgwater	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 Leinger	4155	Center for Bottomland Hardwoods Research www.srs.fs.usda.gov/cbhr	662-686-3154



The Forest Service, United States Department of Agriculture (USDA), is dedicated to the principle of multiple use management of the Nation's forest resources for sustained yields of wood, water, forage, wildlife, and recreation. Through forestry research, cooperation with the States and private forest owners, and management of the National Forests and National Grasslands, it strives—as directed by Congress—to provide increasingly greater service to a growing Nation.

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