

*Compass—Winter 2001*  
**The Southern Research Station**  
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**National Forests and Grasslands—Watersheds for Water Quality**

When we turn on the faucet, we expect to see clear water, clean and ready to drink. Report of a community's water supply being interrupted by a water main break or contaminated by a flood makes the news. Yet more and more Americans drink bottled or filtered water, carrying it to work, ordering it in restaurants. The purity of our drinking water no longer strikes everyone as a given. The Safe Drinking Water Act (SDWA) Amendment of 1996 established a time line to assess the status of all drinking water sources across the country and to publish the results by 2003. Southern Research Station scientists joined scientists and land managers from across the Forest Service to write **Drinking Water from Forests and Grasslands: A Synthesis of the Scientific Literature**. Edited by water quality consultant George E. Dismeyer, this publication aims to assist forest and grassland managers in their efforts to comply with the SDWA. It reviews and synthesizes the scientific literature about how the management of Forest Service lands affects public drinking water sources.

We rely on forests and grasslands as sources of clean drinking water for two reasons: (1) forests mainly grow under conditions that produce relatively reliable water runoff; and (2) properly managed forests and grasslands can yield water relatively low in contaminants when compared with many urban and agricultural land uses. Approximately 3,400 towns and cities depend on National Forest System watersheds for their public water supplies. About 60 million Americans served by public water supplies live in communities that draw source water from national forests and grasslands.

**Drinking Water from Forests and Grasslands: A Synthesis of the Scientific Literature** focuses on potential contamination of source water associated with ordinary land uses in national forests and grasslands. This book aims to inform managers about specific effects of land-use practices on drinking water, giving them the best tools with which to decide how to protect human health by protecting drinking water. **Drinking Water from Forests and Grasslands: A Synthesis of the Scientific Literature** examines how uses of national forests and grasslands impact watersheds and water quality. Measured effects include recreation and built environment; vegetation management; grazing animals, birds, and fish; and mining and oil and gas development.

**Drinking Water from Forests and Grasslands: A Synthesis of the Scientific Literature** speaks to public land managers, as well as managers of public and private forests and grasslands, managers of public water supplies, and community groups concerned with drinking water quality. The book's structure separates it into chapters by types of land use; but the authors recognize that in most practical situations, effects on source waters result from the cumulative effects of multiple land uses that often overlap in space and change over time. The inclusion of a glossary of abbreviations and acronyms and a glossary of terms strengthen the publication's readability.

You can download or print **Drinking Water from Forests and Grasslands: A Synthesis of the Scientific Literature** by accessing its PDF form. If you prefer, request a print copy of publication 14.

To get information about a source water assessment program (SWAP) from a particular State, go the U.S. Environmental Protection Agency (EPA) homepage to view the SWAP contact list. You can find names and telephone numbers of State source water contacts and hotlinks to State homepages. Visit the EPA homepage at <http://epa.gov/OGWDW/protect.html>.

## On the Bookshelf

### Riparian Wetland Restoration—The Pen Branch Project

Carl Trettin, project leader for the Southern Research Station's Center for Forested Wetlands Research in Charleston, SC, co-edited *Restoration of a Severely Impacted Riparian Wetland System—The Pen Branch Project*. This long-term study focuses on the restoration of a bottomland hardwood system in the Upper Coastal Plain of South Carolina. *Restoration of a Severely Impacted Riparian Wetland System—The Pen Branch Project* contributes uniquely to restoration literature because it addresses both terrestrial and aquatic habitats through consideration of biological and physical properties and processes. Trettin's co-editors include Eric A. Nelson, Westinghouse Savannah River Technology Center; Randall K. Kolka, Department of Forestry, University of Kentucky; and Joe Wisniewski, Wisniewski & Associates.

The Pen Branch Project, an interdisciplinary effort, originated to moderate long-term damage to the bottomland from thermal discharge on the Savannah River Site, now a Southern Research Station lab surrounding a nuclear power-generating facility. In 1991 the Forest Service and the Westinghouse Savannah River Technology Center developed plans for the restoration and a comprehensive monitoring plan. Trettin, who contributed to guest editorials and research products about hydrology and nutrient cycling, worked with more than 30 scientists and 10 graduate students to provide a unique understanding of ecosystem functions following restoration.

Southern Research Station ecologist John Kilgo, located at the Savannah River Site, co-authored an article about faunal recolonization. Julian Singer, forestry technician at the Savannah River lab, co-authored an article about hydrology and nutrient cycling. Elsevier published *Restoration of a Severely Impacted Riparian Wetland System—The Pen Branch Project* as a book and as an issue of *Ecological Engineering*, a journal devoted to ecotechnology and restoration. To purchase a copy of the book or journal, contact Elsevier Science at 212.633.3730 or visit them on the Web at [www.elsevier.nl/locate/ecoleng](http://www.elsevier.nl/locate/ecoleng).

### People and Natural Resources: How We Fit Together

We have learned to consider people as components of dynamic ecosystems, but we stumble over how to integrate social sciences with the biological and physical sciences. The social sciences help us understand how humans function. H. Ken Cordell and John C. Bergstrom applied their collaborative skill to edit *Integrating Social Sciences with Ecosystem Management: Human Dimensions in Assessment, Policy, and Management*. The 18 chapters address policy perspectives, the core uses of social science in ecosystem management, and evaluation of applied case studies.

Ken Cordell serves as project leader for the Assessing Trends, Values, and Rural Community Benefits from Outdoor Recreation and Wilderness in Forest Ecosystems research unit in Athens, GA. John Bergstrom teaches and conducts research in the University of Georgia's Department of Agricultural Economics. Reading and applying the collective knowledge in *Integrating Social Sciences with Ecosystem Management: Human Dimensions in Assessment, Policy, and Management* can benefit natural resource policy makers and managers, educators and students, scientists and planners, industry and environmental leaders. To purchase a copy, visit Sagamore Publishing on the Web: [www.sagamorepub.com](http://www.sagamorepub.com) or call 800-327-5557.

## On the Web

## Tax Tips for 2000

Compliments of the Southern Region, we can offer forest landowners some help with their income taxes. Forest management and taxation specialist Larry Bishop prepares **Tax Tips for Forest Landowners**, available on the Southern Region's Web site—[www.r8web.com](http://www.r8web.com). You can also access these tax tips on the Southern Research Station's Web site at [www.srs.fs.usda.gov](http://www.srs.fs.usda.gov). If you want us to send you a copy, circle **Tax Tips** on the response card.

## Station News

### New Faces, New Places

The Southern Research Station welcomes **Hermann Gucinski** as Southern Global Change Research program manager. Hermann oversees large scale assessment and wetlands research and serves on the Station Leadership Team. Hermann comes 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. Hermann managed 8 research teams in 3 States, covering Long Term Ecological Research sites in Oregon and Alaska, biodiversity conservation, and wildlife research, including the only temperate mesic forest canopy research effort.

On arrival in Asheville, Hermann spent about a week at the Station before heading off to The Hague in the Netherlands as U.S. delegate to the international conference on global climate change treaties. Although almost non-stop meetings ended with a last minute collapse, negotiations to implement the Kyoto Protocol will resume. Hermann believes that uncertainties regarding climate change do not suggest that the "no action" alternative is the least costly one, and that this will drive future progress.

**Sam Foster**, assistant director for the western part of the Station, leaves us to join Mississippi State University in Starkville. We will call on Sam as Dean of the College of Forest Resources and Director of the Forest and Wildlife Research Center. Sam joined the Forest Service as a research geneticist in 1988. He developed a genetics research work unit in Huntsville, AL, then became assistant director for the Southern Forest Experiment Station in 1992. When the Southern and Southeastern Forest Experiment Stations consolidated into the Southern Research Station in 1995, Sam moved to Asheville as assistant director for the new Station.

Sam spent 12 years in private industry, where he worked for Weyerhaeuser, Crown Zellerbach, and the International Forest Seed Company before he joining the Forest Service. Sam says moving to academia feels like a natural progression to round out his career in forestry and genetics. We will miss Sam and wish him and his family well as they head further south.

**John Stanturf** moved recently to Athens, GA, to serve as project leader for the Disturbance and Management of Southern Pine Ecosystems. John left the Center for Bottomland Hardwoods in Stoneville, MS in the able hands of project leader **Ted Leininger**. **Ken Stolte** took over as project leader for the Economics of Forest Protection and Management research work unit in Research Triangle Park, NC. **Robert Mangold**, former project leader for this RTP unit, heads up the Forest Protection Program in the Forest Service's Washington Office.

### Exotic Pests—A Global Workshop for a Global Problem

Exotic pests destroy the ecological, economic, and aesthetic value of many forests. The chestnut blight, caused by an Asian fungus and identified in 1904, killed 25 percent of trees in the Eastern U.S. This devastating loss still affects our

wildlife, culture, the health of our forests, and the economy. Consider the effects of just a few pests in the U.S.: the balsam wooly adelgid, the gypsy moth, the termite, and kudzu continue to ravage forests, eat our homes, and redefine the southern landscape. Scientists, managers, nursery owners, landscapers, and homeowners scramble for answers.

The stories in different regions of the country and world vary, but concern runs as high as the costs to our forests and their dependents. What an opportune time to invite you to participate in the international online workshop “Risks of Exotic Forest Pests and Their Impact on Trade.” The USDA Forest Service and the American Phytopathological Society provide primary funding for this online workshop, going live April 16–April 19, 2001. The workshop’s scope will include solid wood packing material, logs, wood chips, unseasoned lumber, and propagative material. Conference planners hope to attract the participation of policymakers, scientists, forest industry representatives, environmentalists, educators, and international shippers.

Specific workshop objectives include:

- Discussing risks of exotic pests to global forest resources
- Discussing trade issues and the science behind current and proposed regulations
- Helping industry prepare to implement new regulations
- Improving communication between scientists, regulators, and industry
- Identifying knowledge gaps inhibiting effective regulation of exotic pests
- Transferring information about these issues to users and educators

After the discussion sessions, moderators will compile the content, which will be posted to the Internet. The workshop’s results will be made available either in a book or CD. To learn more about the conference, visit the American Phytopathological Society’s Web site: [www.apsnet.org/meetings/ExoticPests/top.htm](http://www.apsnet.org/meetings/ExoticPests/top.htm).

## Southern Pines Research

Ayres, Matthew P.; Wilkens, Richard T.; Ruel, J.; and others. 2000. **Nitrogen budgets of phloem-feeding bark beetles with and without symbiotic fungi.** *Ecology*. 8(18): 2198-2210. [Editor's note: Erich Vallery, Southern Research Station forestry technician at the Southern Pine Beetle: Ecology, Behavior, and Management research unit, co-authored this publication.]

The nitrogen content of plant tissue is low relative to that of herbivores; as a consequence, dietary N can limit the growth and reproduction of herbivores and select for attributes that increase N acquisition. Bark beetles face a particularly severe challenge because the phloem that they consume is very low in nitrogen and phosphorus relative to their requirements. We quantified variation in the phloem concentrations of N and P in the host tree, *Pinus taeda*, and evaluated the following hypotheses regarding the role of symbiotic fungi in nutrient budgets of the herbivore *Dendroctonus frontalis*. *D. frontalis* experience variation in phloem nutrient concentrations across several spatial scales (H<sub>1</sub>); mycangial fungi enhance the diet of *D. frontalis* larvae by contributing to the acquisition of N and P (H<sub>2</sub>); *Ophiostoma minus*, an apparently antagonistic fungal symbiont, hinders *D. frontalis* larvae because it does not enhance nutrient concentrations of the phloem as much as mycangial fungi do (H<sub>3</sub>); and larvae of bark beetle species that lack mycangial fungi must consume more phloem to accomplish the same growth as larvae of *D. frontalis* (H<sub>4</sub>). In addition, we developed a general model for the N budgets of herbivorous insects that identifies the possible combinations of dietary and physiological parameters that can allow developmental success on low-nutrient diets.

Spatial variation in phloem N was mostly at the level of trees within sites (a scale of meters) while P mostly varied among sites (a scale of kilometers). Trees with higher N content produced larger *D. frontalis* adults. Prior to infestation by beetles, phloem nutrient concentrations were very uniform within trees and very low relative to that of the bark beetles (N and P concentrations of *D. frontalis* adults were 28 and 8 times greater, respectively). During infestation, phloem nutrient concentrations increased overall and became highly variable within trees. Nitrogen concentrations increased from  $0.40 \pm 0.01$  percent (mean  $\pm 1$  SE) in uninfected phloem to  $0.86 \pm 0.03$  percent in the phloem surrounding successfully developing *D. frontalis* larvae, which are typically associated with one or two species of mutualistic mycangial fungi. Nitrogen concentrations were intermediate in other microhabitats within infested trees, including regions with no adult colonization, with failed larval development, or colonized by the antagonistic bluestain fungus *O. minus*. We parameterized a general nutrient-budget model for *D. frontalis* and a sympatric non-mycangial bark beetle, *Ips grandicollis*, which indicated that (1) mycangial fungi provide their benefits by concentrating dietary N for larvae; (2) *O. minus* may exert its antagonistic effects on *D. frontalis* larvae by failing to concentrate dietary N as much as mycangial fungi do; (3) non-mycangial bark beetles meet their N budgets through high consumption of unaltered, low-N phloem; and (4) larvae should easily meet their P requirements with any combination of consumption rate and development time that allows them to meet their N requirements. Alternative strategies for N acquisition may have general consequences for the population dynamics and community interactions of bark beetles. (1)

Baldwin, Jr., V. Clark; Peterson, Kelly D.; Clark, Alexander, III; and others. 2000. **The effects of spacing and thinning on stand and tree characteristics of 38-year-old loblolly pine.** *Forest Ecology and Management*. 137: 91-102.

The effects of early and continuous density control on the characteristics of mature loblolly pine (*Pinus taeda* L.) were measured at age 38 and analyzed. Trees in plots planted at spacings of 1.8 x 1.8, 2.4 x 2.4, 2.7 x 2.7, 3.0 x 3.0, and 3.7 x 3.7 m were either left unthinned or thinned every 5 years beginning at age 18, to residual basal areas of 27.5, 23.0, 18.4, and 13.8 m<sup>2</sup> ha<sup>-1</sup>. Trees thinned from plot buffer zones at age 38 were selected to represent a final harvest cross-section of each treatment for evaluation of bole form, component biomass, and crown architecture. Volume and biomass of cut trees from all thinnings were included with the age 38 data for stand level yield comparisons. Results show thinning effects were generally more pronounced than spacing effects. Trees of the same diameter at breast height and total height from heavily thinned stands had more cylindrical lower boles, more upper stem taper, longer crowns with more and larger

branches, more total foliage, and hence more biomass than trees from unthinned or lightly thinned stands. All levels of thinning increased the yield of the stand in terms of foliage and branch biomass, while only light or moderate thinning increased bole biomass and volume yields. The magnitude of these differences are presented. (2)

Cao, Quang V.; Dean, Thomas J.; Baldwin, V. Clark, Jr. 2000. **Modeling the size–density relationship in direct-seeded slash pine stands.** *Forest Science*. 46(3): 317-321.

The relationship between quadratic mean diameter and tree density appeared curvilinear on a log–log scale, based on data from direct-seeded slash pine (*Pinus elliotti* var. *elliotti* Engelm.) stands. The self-thinning trajectory followed a straight line for high tree density levels and then turned away from this line as tree density decreased. A system of equations was developed to model the reciprocal effects of stand diameter and density through time. The equations performed well for these data. Since the model is constrained according to the self-thinning rule, it should provide reasonable extrapolation. (3)

Hanula, James L.; Engstrom, R. Todd. 2000. **Comparison of red-cockaded woodpecker (*Picoides borealis*) nestling diet in old-growth and old-field longleaf pine (*Pinus palustris*) habitats.** *American Midland Naturalist*. 144(2): 370-376.

Automatic cameras were used to record adult red-cockaded woodpecker (*Picoides borealis*) nest visits with food for nestlings. Diet of nestlings on or near an old-growth longleaf pine (*Pinus palustris*) remnant in southern Georgia was compared to that in longleaf pine stands established on old farm fields in western South Carolina. Diets of nestlings were expressed as percent nest visits and percent prey biomass. The method of calculating nestling diet composition had little effect on the relative ranking of prey. Roaches (Blattaria: Blattellidae) were the most common arthropod fed to nestlings, ranging from 33-57 percent of the prey brought to nest cavities by adults, or 55-73 percent of the prey biomass. Other common prey were spiders, centipedes, and caterpillars. The latter were primarily larvae of coneworms (Lepidoptera: Pyralidae, *Dioryctria* spp.) that bore into and feed on pine cones. Scorpions (Scorpiones: Buthidae, *Centruroides* sp.), an unusual prey, were recorded several times at the south Georgia location. Morisita's index ( $C$ ) of diet overlap showed a high degree of similarity in nestling diets among years in the old-growth remnant ( $C = 0.91$  to  $0.94$ ), as well as a high degree of similarity in the diets of nestlings among woodpecker groups within locations and between old-growth and old-field habitats ( $C = 0.89$ – $0.95$ ). Our study shows that old trees on relatively undisturbed sites provide the same prey as younger trees growing on old farm fields and the relative importance of the different prey was similar for both habitats. (4)

McAlistir, R.H.; Powers, H.R.; Pepper, W.D. 2000. **Mechanical properties of stemwood and limbwood of seed orchard loblolly pine.** *Forest Products Journal*. 50(9): 91-94.

Tests were made on micro-bending specimens prepared from stem and limb sections of 11 rust-resistant loblolly pines from a central Georgia seed orchard. A fair correlation ( $r = 0.45$  to  $0.55$ ) emerged between the stemwood and limbwood modulus of elasticity (MOE) and stemwood and limbwood modulus of rupture (MOR) values. An excellent correlation ( $r = 0.8$  to  $0.9$ ) appeared between the MOE and MOR of the stemwood and also between the MOE and MOR of the limbwood. Including specimen specific gravity (SG) did not increase the prediction power of the regression equation. Further work on at least 30 forest-grown trees is planned. (5)

Nolte, Dale L.; Barnett, James P. 2000. **A repellent to reduce mouse damage to longleaf pine seed.** *International Biodeterioration & Biodegradation*. 45: 169-174.

Direct seeding is a potential method for reforestation of pines on many southern sites. The success of direct seeding, however, depends, at least in part, in reducing seed predation by birds and rodents. We conducted a series of tests to assess the efficacy of capsicum and thiram in reducing mouse damage to longleaf pine (*Pinus palustris*) seeds. House mice (*Mus musculus*) predation was reduced ( $P < 0.05$ ) by treating seeds with either capsicum or thiram or a mixture of the two ingredients. Deer mice (*Peromyscus maniculatus*) avoided seeds treated with a mixture of capsicum and thiram. We conclude that the capsicum and thiram mixture should be pursued as a potential repellent to protect longleaf pine seeds from animal predation when these seeds are used in direct seeding efforts to establish southern pine forests. (6)

## **Wetlands, Bottomland Hardwoods, and Streams Research**

Lonzarich, D.G.; Lonzarich, M.R.; Warren, M.L., Jr. 2000. **Effects of riffle length on the short-term movement of fishes among stream pools.** Canadian Journal of Fisheries and Aquatic Sciences. 57: 1508-1514.

Recent research has suggested that the within-habitat dynamics of fish populations and assemblages can be affected by the spatial distribution of habitats within streams. In this study, we determined the extent to which pool isolation (length of riffles connecting adjacent pools) influenced fish movement in two Arkansas streams. We marked individuals from 12 pools assigned to two treatment categories: pools separated by long riffles (>50 m) and those separated by short riffles (<10 m). Repeatedly snorkeling pools for 3 days in 1995 and 1997, we discovered substantial emigration (>20 percent) and significant effects of riffle length. Total emigration from short-riffle pools was three times higher (29 percent) than movement from long-riffle pools (10 percent). Further, marked fish in short-riffle pools moved upstream and downstream with equal frequency, whereas fish in long-riffle pools moved twice as often downstream. Collectively, these results indicate significant effects of habitat spacing on short-term movement patterns by fish. In streams, where fish are distributed within a mosaic of habitats of varying quality, such movements may allow individuals to assess spatial variability in resource conditions (e.g., food, predators). Because land-use activities can alter habitat spacing, these findings have important implications for fish conservation in degraded streams. (7)

## **Southern Appalachians Research**

Knoepp, Jennifer D.; Coleman, David C.; Crossley, D.A., Jr.; Clark, James S. 2000. **Biological indices of soil quality: an ecosystem case study of their use.** Forest Ecology and Management. 138: 357-368.

Soil quality indices can help ensure that site productivity and soil function are maintained. Biological indices yield evidence of how a soil functions and interacts with the plants, animals, and climate that comprise an ecosystem. Soil scientists can identify and quantify both chemical and biological soil-quality indicators for ecosystems with a single main function, such as agricultural lands and forest plantations. However, quantifying these indices in complex ecosystems—that have multiple uses or goals such as maintaining biodiversity, aesthetics, recreation, timber production, and water quality—is much more difficult. In an ecosystem context all components—plants, animals and humans—interact with the soil differently, making soil quality indices variable. These interactions result in a combination of biological processes that make each ecosystem unique. We examined the soil and site quality of five forest stands (xeric oak-pine; two mixed hardwood; cove hardwood; northern hardwood), within the 2185-ha Coweeta Hydrologic Laboratory. An initial rank of soil quality based on soil chemical and physical properties was assigned. The ranking was then compared with four common groups of soil biological indicators: (1) nitrogen availability; (2) litter decomposition; (3) soil microarthropod populations; and (4) carbon availability. We also examined estimates of overstory productivity, overstory biodiversity, and total aboveground productivity for each site as indices of site quality. We found that soil and site quality rankings varied with the indicator, showing that the soil or site of greatest quality may change depending on the use or goal of the ecosystem under examination. (8)

Loeb, Susan C.; Tainter, Frank H.; Cázares, Efren. 2000. **Habitat associations of hypogeous fungi in the Southern Appalachians: implications for the endangered northern flying squirrel (*Glaucomys sabrinus coloratus*)**. American Midland Naturalist. 144: 286-296.

Sporocarps of hypogeous mycorrhizal fungi (truffles) are the major food of northern flying squirrels (*Glaucomys sabrinus*). The two subspecies of northern flying squirrels that occur in the southern Appalachians, *G. s. coloratus* and *G. s. fuscus*, are endangered species which are primarily found in the ecotone between high-elevation spruce-fir and northern hardwood forests. Our objective was to determine the microhabitat and macrohabitat characteristics associated with the presence and abundance of truffles in suitable habitat for northern flying squirrels. We sampled for truffles in 24–26, 1-m<sup>2</sup> plots on each of 10 northern flying squirrel sites in North Carolina and measured micro- and macrohabitat characteristics associated with sample plots and sites. *Elaphomyces granulatus* was the most common species of truffle found (78.7 percent). Red spruce (*Picea rubra*) was significantly more likely to be one of the three closest trees to plots with truffles. Further, spruce was the most important species in plots with truffles, followed by beech (*Fagus grandifolia*), red oak (*Quercus rubra*), and yellow birch (*Betula lutea*), whereas the most important species in plots with no truffles were beech, followed by yellow birch, spruce, and red oak. At the macrohabitat (site) level, spruce was the most important species in sites with high truffle production, followed by beech and red oak, whereas the most important species in sites with low truffle production were beech, yellow birch, spruce, and rhododendron (*Rhododendron* spp.). Significant variables entered into a linear regression model predicting the number of truffles in a site were the importance values of fir (*Abies fraseri*), spruce, and silverbell (*Halesia carolina*). Our data suggest that spruce-fir or mixed spruce-fir/hardwood stands are important foraging sites for northern flying squirrels in the Southern Appalachians. (9)

McNab, W. Henry; Parresol, Bernard R.; Ritter, Brian A. 2000. **Evaluation of two eastern white pine site index equations at Biltmore Estate, North Carolina**. Res. Pap. SRS-21. Asheville, NC: U.S. Department of Agriculture, Forest Service, Southern Research Station. 7 p.

The accuracy of two white pine (*Pinus strobus* L.) polymorphic site index equations was compared with field data from three plots in a 100-year-old stand at Biltmore Estate, Asheville, NC. One equation was developed from New Hampshire data and the other from Southern Appalachian data. Tree height has been measured periodically on those plots between stand age 34 and 72 years. At 50 years, site index ranged from 54 to 73 feet (ft). Absolute deviations of actual from estimated site index averaged 2.5 ft for the Southern Appalachian equation and 2.7 ft for the New Hampshire equation. Site index estimates of the New Hampshire model were highly correlated ( $r = 0.92$ ) with estimates of the Southern Appalachian model. Our evaluation indicates that the New Hampshire equation, which has desirable properties lacking in the Southern Appalachian equation, may be applicable on low- to moderate-quality sites beyond the area in which it was to be used. We suggest that a regional approach to site index development for white pine may be appropriate. (10)

McNab, W. Henry; Ritter, Brian A. 2000. **The Old Orchard white pine plantation at Biltmore**. Journal of Forestry. 98(11): 18-23.

A pioneering case study in the Old Orchard Plantation on Biltmore Estate near Asheville, North Carolina, considered current yields and the effects of periodic thinning on height and basal area growth, as well as cubic volume and board-foot yields. Established in 1899, one of three plots of this eastern white pine stand was first thinned in 1916. Beyond providing growth-and-yield data, the Old Orchard Plantation demonstrates the value of maintaining permanent forest research plots for long-term ecological and silvicultural studies. (11)



## Interior Highlands Research

Cain, Michael D.; Shelton, Michael G. 2000. **Survival and growth of *Pinus echinata* and *Quercus* seedlings in response to simulated summer and winter prescribed burns.** Canadian Journal of Forest Research. 30: 1830-1836.

First-year seedlings of shortleaf pine (*Pinus echinata* Mill.), southern red oak (*Quercus falcata* Michx.), and white oak (*Quercus alba* L.) were subjected to simulated prescribed burns during August (growing season) or January (dormant season) on an Upper Coastal Plain site in southeastern Arkansas, U.S.A. Survival and growth of resprouting rootstocks were compared with control seedlings through one growing season after burning. Although 100 percent of the oaks and 99 percent of the pines were topkilled by the fires, survival of resprouting rootstocks exceeded 95 percent for all three species in the year following the winter burn. No pines resprouted following the summer burn, but rootstock survival of oaks averaged >65 percent. Compared with controls, winter burns reduced ( $P < 0.01$ ) mean height and groundline diameter (GLD) of shortleaf pine sprouts through the next growing season. For southern red oak, season of burning did not negatively affect ( $P > 0.05$ ) the growth of sprouts during the year after burning. Although mean heights and GLD's of white oak sprouts versus controls were reduced ( $P = 0.04$ ) when means were averaged across burns, white oak sprouts on winter-burn plots were comparable in size with the control seedlings. (12)

## Large Scale Assessment and Modeling Research

Achtemeier, Gary L. 2000. **PB-Piedmont: A numerical model for predicting the movement of biological material near the ground at night.** In: Proceedings of the 24th conference on agricultural and forest meteorology; 14-18 August 2000; Davis, CA. Boston, MA: American Meteorology Society: 178-179.

PB-Piedmont is a numerical model designed to simulate near-ground smoke movement at night under clear skies and near calm winds over irregular terrain characterized by ridge/valley elevation differences of the order of 50 m. Although the model was developed for monitoring smoke at night, the model is equally suitable for monitoring movement of agricultural odors and airborne organisms with flight speeds and/or terminal velocities that are small relative to air speeds. PB-Piedmont is designed to be run on a desktop computer by the non-technical land manager. (13)

Dissmeyer, George E., ed. 2000. **Drinking Water from Forests and Grasslands: A Synthesis of the Scientific Literature.** Gen. Tech. Rep. 39. Asheville, NC: U.S. Department of Agriculture, Forest Service, Southern Research Station. 246 p.

This report reviews the scientific literature about the potential of common forest and grassland management to introduce contaminants of concern to human health into public drinking water sources. Effects of managing water, urbanization, recreation, roads, timber, fire, pesticides, grazing, wildlife and fish habitat, and mineral, oil, and gas resources on public drinking water source quality are reviewed. Gaps in knowledge and research needs are indicated. Managers of national forests and grasslands and similar lands in other ownerships, environmental regulators, and citizens interested in drinking water may use this report for assessing contamination risks associated with land uses.

(14)

Warren, Melvin L., Jr.; Burr, Brooks, M.; Walsh, Stephen J.; and others. 2000. **Diversity, distribution, and conservation status of the native freshwater fishes of the Southern United States.** Fisheries. 25(10): 7-29.

The Southeastern Fishes Council Technical Advisory Committee reviewed the diversity, distribution, and status of all native freshwater and diadromous fishes across 51 major drainage units of the Southern United States. The Southern United States supports more native fishes than any area of comparable size on the North American continent north of Mexico, but also has a high proportion of its fishes in need of conservation action. The review included 662 native freshwater and diadromous fishes and 24 marine fishes that are significant components of freshwater ecosystems. Of this total, 560 described, freshwater fish species are documented, and 49 undescribed species are included provisionally pending formal description. Described subspecies (86) are recognized within 43 species, 6 fishes have undescribed subspecies, and 9 others are recognized as complexes of undescribed taxa. Extinct, endangered, threatened, or vulnerable status is recognized for 28 percent (187 taxa) of southern freshwater and diadromous fishes. To date, 3 southern fishes are known to be extinct throughout their ranges, 2 are extirpated from the study region, and 2 others may be extinct. Of the extant southern fishes, 41 (6 percent) are regarded as endangered, 46 (7 percent) are regarded as threatened, and 101 (15 percent) are regarded as vulnerable. Five marine fishes that frequent fresh water are regarded as vulnerable. Our assessment represents a 75 percent increase in jeopardized southern fishes since 1989 and a 125 percent increase in 20 years. The trend for fishes in the Southern United States is clear; jeopardized fishes are successively being moved from the vulnerable category to that of imminent threat of extinction. (15)

## **Inventory and Monitoring Research**

Clark, Neil A.; Wynne, Randolph H.; Schmoltdt, Daniel L. 2000. **A review of past research on dendrometers.** Forest Science. 46(4): 570-576.

The purpose of a dendrometer is to measure tree diameter. Contact and noncontact dendrometers accomplish this task by collecting different metrics, including girth or distance between tangent points on a tree stem. Many dendrometers have been developed in the last quarter century and many have been retired. This article summarizes instrument developments and application results, contains an interpretation of the results, and provides guidance for dendrometer selection. (16)

Jacobs, Dennis M. 2000. **February 1994 ice storm: forest resource damage assessment in northern Mississippi.** Resour. Bull. SRS-54. Asheville, NC: U.S. Department of Agriculture, Forest Service, Southern Research Station. 11 p.

During February 8-11, 1994, a severe winter storm moved from Texas and Oklahoma to the mid-Atlantic, depositing in northern Mississippi a major ice accumulation of 3 to 6 inches. An assessment of forest resource damage was initiated immediately after the storm by performing an airborne video mission to acquire aerial imagery linked to global positioning coordinates. Interpretation of the aerial video imagery generated data that were used to map zones of similar damage severity. The Geographic Information System map data were linked with recent State forest resource inventory data to provide estimates of forest resource damage. There were 2.1 million acres of forest land within the 3.7-million-acre study area in northeast Mississippi. Less than 1 percent of the forest land remained untouched by some degree of damage. Net loss to live-tree volume, due to probable mortality, amounted to 16.5 percent of hardwoods and 15.3 percent of softwoods. The majority of volume loss occurred in areas that received about 25 percent mortality to the forest resource. (17)

Jacobs, Dennis M.; Cooke, William H., III. 2000. **Generating continuous surface probability maps from airborne video using two sampling intensities along the video transect.** Res. Pap. SRS-22. Asheville, NC: U.S. Department of Agriculture, Forest Service, Southern Research Station. 5 p.

Airborne videography can be an effective tool for assessing the effects of catastrophic events on forest conditions. However, there is some question about the appropriate sampling intensity to use, especially when trying to develop

correlations with probabilistic data sets such as are assembled through the Forest Inventory and Analysis (FIA) surveys. We used airborne videography to assess damage to forest resources by Hurricane Andrew and the catastrophic February 8-11, 1994, ice storm; but those efforts were limited by the absence of a direct link between video imagery and FIA field plots. In this study, we used the 1994 ice storm in northern Mississippi to test bias and accuracy at two sampling intensities—14.5- by 14.5-km spacing (square) and a 14.5- by 1.6-km spacing (rectangular). Results showed that the square pattern resulted in less biased estimates of damage. We suggest that this bias would be lessened further if sampling was made on the 4.8-km sample grid of FIA data points. We assert that bias could be eliminated if imagery was acquired directly over FIA plots. (18)

Rosson, James F., Jr. 2000. **Forest resources of east Texas, 1992**. Resour. Bull SRS-53. Asheville, NC: U.S. Department of Agriculture, Forest Service, Southern Research Station. 70 p.

The principal findings of the sixth forest survey of east Texas (1992) and changes that have occurred since the previous survey are presented. Topics examined include forest area, ownership, forest-type groups, stand structure, basal area, timber volume, growth, removals, mortality, harvesting, and management activity. (19)

## **Foundation Programs Research**

English, Donald B.K. 2000. **Calculating confidence intervals for regional economic impacts of recreation by bootstrapping visitor expenditures**. Journal of Regional Science. 40(3): 523-539.

In this paper I use bootstrap procedures to develop confidence intervals for estimates of total industrial output generated per thousand tourist visits. Mean expenditures from replicated visitor expenditure data included weights to correct for response bias. Impacts were estimated with IMPLAN [Impact for Planning]. Ninety percent interval endpoints were 6 to 16 percent above or below the original sample's point estimate depending on the calculation method. Due to the linearity of input-output, a shortcut method that estimates confidence interval endpoints from the distribution of mean expenditure profiles yields nearly identical results. (20)

Gupta, Nand K.; Schmoldt, Daniel L.; Isaacson, Bruce. 1999. **Tangential scanning of hardwood logs: developing an industrial computer tomography scanner**. In: Pollock, David G., ed. Proceedings of the eleventh international symposium on nondestructive testing of wood; 1998 September 9-11; Madison, WI. Madison, WI: Forest Products Society: 131-139.

It is generally believed that noninvasive scanning of hardwood logs such as computer tomography (CT) scanning prior to initial breakdown will greatly improve the processing of logs into lumber. This belief, however, has not translated into rapid development and widespread installation of industrial CT scanners for log processing. The roadblock has been more operational than economic. Currently available CT scanners were developed for medical applications, where imaging needs are very different from those in hardwood log processing. The latter is also very different from softwood log scanning needs. By examining the evolution of CT scanners, including designs and limitations, we argue that the need to scan large-size material at high through-put rates and with relatively fine resolution requires a very different approach to scanning. Tangential scanning is a viable alternative to traditional axial tomography because it offers simple mechanical operation, fast scan speeds per volume, relatively low power requirements, and no image artifacts. Initial work has demonstrated its feasibility for log scanning. Ongoing efforts have enlisted industry support to delineate operational parameters for industrial log scanning, build a technically sound prototype, and improve image reconstruction algorithms. (21)

Huang, Hongwen; Layne, Desmond R.; Kubisiak, Thomas L. 2000. **RAPD inheritance and diversity in pawpaw (*Asimina triloba*)**. Journal of American Society of Horticultural Science. 125(4): 454-459.

Twelve, 10-base primers amplified a total of 20 intense and easily scorable polymorphic bands in an interspecific cross of PPF1-5 pawpaw (*Asimina triloba* (L.) Dunal.) x RET (*Asimina reticulata* Shuttlew.). In this cross, all bands scored were present in, and inherited from, the *A. triloba* parent PPF1-5. Nineteen of the 20 bands were found to segregate as expected (1:1 or 3:1) based on chi-square goodness-of-fit tests, and were subsequently used to evaluate genetic diversity in populations of *A. triloba* collected from six states (Georgia, Illinois, Indiana, Maryland, New York, and West Virginia) within its natural range. Analysis of genetic diversity of the populations revealed that the mean number of alleles per locus was  $A = 1.64$ , percent polymorphic loci was  $P = 64$ , and expected heterozygosity was  $H_e = 0.25$ . No significant differences were found among populations for any of the polymorphic indices. Partitioning of the population genetic diversity showed that the average genetic diversity within populations was  $H_s = 0.26$ , accounting for 72 percent of the total genetic diversity. Genetic diversity among populations was  $D_{st} = 0.10$ , accounting for 28 percent of the total genetic diversity. Nei's genetic identity and distance showed a high mean identity of 0.86 between populations. Genetic relationships among the populations examined by unweighted pair-group mean clustering analysis separated the six populations into two primary clusters: one composed of Georgia, Maryland, and New York, and the other composed of Illinois, Indiana, and West Virginia. The Georgia and Indiana populations were further separated from the other populations within each group. This study provides additional evidence that marginal populations within the natural range of *A. triloba* should be included in future collection efforts to capture most of the rare and local alleles responsible for this differentiation. (22)

Tinus, R.W.; Burr, K.E.; Atzmon, N.; Riov, J. 2000. **Relationship between carbohydrate concentration and root growth potential in coniferous seedlings from three climates during cold hardening and dehardening**. Tree Physiology. 20: 1097-1104.

Greenhouse-cultured, container-grown seedlings of Aleppo pine (*Pinus halepensis* Mill.), radiata pine (*Pinus radiata* D. Don), and interior Douglas fir (*Pseudotsuga menziesii* var. *glauca* (Beissn.) Franco) were cold acclimated and deacclimated in growth chambers over 24 weeks. Needle and root cold hardiness and root growth potential (RGP) were measured weekly. Root, needle, and stem analyses for soluble sugars and starch were performed biweekly. In all tissues, there was a close correspondence between cold hardiness and the absolute concentration of soluble sugars, as well as between the increase and decrease in concentration of soluble sugars during cold hardening and dehardening, respectively, supporting the theory that soluble sugars function as cryoprotectants in plant tissues. The magnitude of starch concentration did not parallel the magnitude of the cold hardiness attained, and changes in starch concentration were related to production and consumption factors, rather than timing of changes in cold hardiness. The rise and fall of RGP paralleled the rise and fall of total carbohydrate concentration in roots. The behavior of the three species was surprisingly similar, considering the different climates to which they are adapted. (23)