

**USDA Forest Service
Southern Research Station
Recent Publications -- June 1999**

Water – The Resource That Commands Attention and Requires Protection

Water dominates the agenda of many groups in the arid Western United States. The population explosion in the Southeast and cumulative effects of drought years are causing water levels to drop and tensions to rise east of the Mississippi also. The Chattahoochee River's headwaters originate in the Chattahoochee National Forest, just off the Appalachian Trail in the mountains of north Georgia. The river flows southwest through Atlanta, then heads further west, where it courses along the Georgia-Alabama border. Continuing south, the Chattahoochee merges with the Apalachicola River in Florida, and empties into the Gulf of Mexico. At the beginning of this decade, Alabama and Florida filed suit against Georgia because their water needs exceeded the amount they could take from the Chattahoochee and because of their concern about water quality.

The States continue to work toward compromise, now mandated by two compacts signed by President Clinton on November 20, 1997. The Apalachicola-Chattahoochee-Flint Rivers (ACF) and the Alabama-Coosa-Tallapoosa (ACT) Rivers compacts govern the allocation of water for the "purposes of promoting interstate comity, removing causes of present and future controversies, equitable apportioning surface waters of the ACT and ACF, engaging in water planning, developing and sharing common data bases." The States' deadline for developing a mutually agreeable water allocation formula is December 31, 1999.

Mike Dombeck, Chief of the USDA Forest Service, identifies watershed protection and restoration as the first priority in our natural resource agenda. Dombeck's commitment to restore, protect, and maintain healthy ecosystems at the watershed level speaks to the significance of the Forest Service's role in ensuring a pure water supply. The national forests contain numerous municipal watersheds, and 80 percent of the Nation's freshwater sources originate on national forest land. Dombeck explains, "We must protect our healthiest watersheds and restore those that are degraded. We must also continue our long tradition of protecting wild areas, such as wilderness, so they can remain important reserves of clean water and biological diversity."

Southern Research Station scientists contribute significantly to the Forest Service's knowledge base regarding water resources. The **Coweeta Hydrologic Laboratory** in Coweeta, NC, received the **1998 Chief's Stewardship Award** for outstanding stewardship accomplishments leading to conservation of soil, water, and air resources. In the June 1999 issue of **Recent Publications of the Southern Research Station**, Wayne T. Swank, project leader at Coweeta, discusses a study of more than 30 years duration in **Multiple Use Forest Management in A Catchment Context**. Swank emphasizes the significance of demonstration and education to advance integrated catchment management. To learn more about this study, please request number 37.

This issue of the SRS catalogue includes two publications co-authored by Steve McNulty, project leader of the Southern Global Change Program in Raleigh, NC, and former member of the Coweeta research work unit, and Sun Ge, assistant research professor of forest hydrology at North Carolina State University. In **The Development and Use of Best Practices in Forest Watersheds Using GIS and Simulation Models**, McNulty and Ge explore the demands on forest watersheds. To receive a copy of this publication, please request 25.

In **Modeling Soil Erosion and Transport on Forest Landscape**, Sun and McNulty cite century-long studies on the impacts of forest management in North America that suggest sediment can cause major reduction on stream water quality. The objective of this study is to develop a user friendly management

tool for land managers to design forest management activities (e.g., road building, prescribed burning) that may minimize water quality impacts. Sun and Ge concluded that poorly managed roads are the main source of sediment in a forested watershed and that the spatial location of forest roads affected sediment contribution to streams. Request number **36** to receive a copy..

A. Dennis Lemly, research biologist in the Coldwater Streams and Trout Habitat in the Southern Appalachians research work unit in Blacksburg, VA, addresses **Selenium Transport and Bioaccumulation in Aquatic Ecosystems: A Proposal for Water Quality Criteria Based on Hydrological Units**. Lemly argues for recognition of the hydrological connections between the various aquatic habitats that may be present in a watershed basin – wetlands, rivers, streams, and impoundments. The connectivity of a watershed’s aquatic habitats results in the toxic threat from selenium contamination also being connected. Lemly’s research (publication number **20**) points out the need to test water quality using a hydrological unit approach to avoid biological and legal problems.

Sustainability – Monitoring, Using, and Conserving Natural Resources

The complexity of monitoring and using natural resources while ensuring their ability to survive and thrive requires the Forest Service’s commitment to collaborate more closely than ever with colleagues from many disciplines and organizations. The Southern Annual Forest Inventory System (SAFIS) provides an example of how well professionals and private landowners can come together to accomplish a goal. The Forest Inventory and Analysis (FIA) units of the Forest Service conduct the only inventory of public and private lands, making FIA reports uniquely valuable to regional, national, and international customers. Forest Service administrators, scientists, technicians, and land managers, State foresters, industry leaders, and university scientists are working to upgrade the inventory system.

In **A New Annual Forest Inventory System for the South**, Noel Cost, the SAFIS coordinator, discusses the need to change the inventory cycle and reporting schedule. He also details the implementation schedule for SAFIS and its benefits. SAFIS provides for continuous inventory within each Southern State, a significant improvement from the previous 10 year interval. SAFIS provides uniform information from State to State, annual observation of events and trends, and annual collection of data and stable confidence intervals. State reports will be published when data for an entire State have been analyzed. To learn more about SAFIS, request number **5**.

The spruce-fir forests of the Blue Ridge Mountains attract much attention for their reported – and some would say apparent – decline. J.C.G. Goelz, research forester at the Southern Hardwoods Laboratory in Stoneville, MS, collaborated with Thomas E. Burk, University of Minnesota, and Shepard M. Zedaker, VPI, to publish **Long-term Growth Trends of Red Spruce and Fraser Fir at Mt. Rogers, VA and Mt. Mitchell, NC**. The authors state that analysis of cross-sectional area growth provided no evidence of growth decline. Goelz, Burk, and Zedaker suggest that subordinate crown position or previous top damage caused growth decline in individual discs. To learn more about this research, request number **9**.

The Southern Appalachian spruce-fir forests also provide the setting for a study on environmental equity by Joseph E. Aldy, Council of Economic Advisers; Randall A. Kramer, Duke University; and Thomas P.

Holmes, Southern Research Station research forester in the Economics of Forest Protection and Management research work unit in Research Triangle Park, NC. The authors examine **Environmental Equity and the Conservation of Unique Ecosystems: An Analysis of the Distribution of Benefits for Protecting Southern Appalachian Spruce-Fir Forests**. Request number 1 to learn how the authors weave together the health and value of the Southern Appalachian spruce-fir ecosystem, contingent valuation and regression analysis, and management of natural resources based on an environmental equity framework.

Southern Research Station scientists David N. Wear and Raymond M. Sheffield collaborate with Rei Liu and J. Michael Foreman from the Commonwealth of Virginia to study **The Effects of Population Growth on Timber Management and Inventories in Virginia**. Wear leads the Economics of Forest Protection and Management research work unit in Research Triangle Park, NC. Sheffield is a research forester in the Forest Inventory and Analysis research unit in Asheville, NC. As domestic and global populations increase, the demand for natural resources -- both products and amenities -- increases also. The authors examine the relationship between the increase in population density and timber management and supply in Virginia. As urban-rural interfaces change the landscape, the amount of land dedicated to timber production decreases. To find out more about the implications, request number 46 to receive this publication.

Aldy, Joseph E.; Kramer, Randall A.; Holmes, Thomas P. 1999. **Environmental equity and the conservation of unique ecosystems: an analysis of the distribution of benefits for protecting Southern Appalachian spruce-fir forests.** *Society & Natural Resources*. 12(2): 93-106.

Some critics in the environmental equity literature argue that low-income populations disproportionately have environmental risks, while the wealthy and better educated gain disproportionately from protecting unique ecosystems. The authors test this hypothesis in an analysis of the decline of Southern Appalachian spruce-fir forests. They calculate willingness-to-pay measures for forest protection through a contingent valuation survey. Survey respondents consider spruce-fir forest protection to be a normal good (income elasticity: 0.421). Education does not influence willingness-to-pay. In an assessment of willingness-to-pay scaled by income, the authors found that income has a negative effect, implying that as income increases, willingness-to-pay as a percentage of income decreases. Education weakly influences willingness-to-pay in this assessment. Given the substantial existence and bequest values associated with these forests, these results substantiate rejection of the hypothesis that conserving this unique ecosystem only benefits the wealthy and better educated. (1)

Cain, M.D. 1998. **A 9-year comparison of hardwood control treatments for enhancing natural regeneration and growth of loblolly-shortleaf pines in an uneven-aged stand.** In: Dusky, Joan A., ed. *Proceedings, 51st annual meeting of the Southern Weed Science Society; 1998 January 26-28; Birmingham, AL.* Champaign, IL: Southern Weed Science Society: 235-240.

Preharvest control of hardwoods facilitated natural regeneration of loblolly and shortleaf pines (*Pinus taeda* L. and *P. echinata* Mill.) in an overstocked, uneven-aged stand in southern Arkansas. During spring 1983, hardwoods were controlled by either basal injection of Tordon® 101R, soil application of Velpar® L, or rotary mowing following by a broadcast spray of Tordon® 101 applied over the hardwood stubble. After hardwood control, an improvement cut in summer reduced merchantable pine basal area from 97 to 70 sq ft/ac, just before a bumper pine seed crop that winter. Two additional improvement cuts in July 1987 and June 1991 left 55 and 48 sq ft/ac, respectively, in merchantable pine basal area. Nine years after hardwood control, untreated check plots had an adequate density of pine regeneration for uneven-aged stands, but dominant stems of pine regeneration on check plots were of low vigor, small in size, and overtopped by nonpine competing vegetation. In contrast, dominant pine regeneration on plots where hardwoods were controlled 9 years earlier averaged 10 feet taller and 1.3 inches larger in groundline diameter than the dominants on untreated plots. (2)

Cain, Michael D.; Shelton, Michael G. 1998. **Viability of litter-stored *Quercus falcata* Michx. acorns after simulated prescribed winter burns.** *International Journal of Wildland Fire*. 8(4): 199-203.

Partially stratified (11 days) southern red oak (*Quercus falcata* Michx.) acorns were placed at three depths in a reconstructed forest floor and subjected to simulated prescribed winter burns. Within the forest floor,

acorns were placed within the L layer, at the upper-F/ lower-F interface, and at the lower-F/mineral-soil interface. Winds for a backfire and headfire were generated by electric box-fans. After the burns, acorns were transferred to moist sand flats, stratified for an additional 16 days, then assessed for viability during a 45-day germination test. As depth within the forest floor increased, germinative capacity of acorns increased. All acorns placed within the L layer during prescribed burning failed to germinate. Germinative capacity of acorns placed at the upper-F/lower-F interface was lower ($P=0.03$) in the backfire (8.75 percent) than in the headfire (55.00 percent). At the lower-F/mineral-soil interface, there was no difference ($P=0.09$) in germinative capacity between backfire (92 percent) and headfire (89 percent), and their mean was no different ($P=0.26$) than the 93 percent achieved by unburned control acorns. (3)

Clinton, Barton D.; Vose, James M. 1999. **Fine root respiration in mature eastern white pine (*Pinus strobus*) in situ: the importance of CO₂ in controlled environments.** *Tree Physiology*. 19: 475-479.

Clinton and Vose measured seasonal fine root respiration rate in situ while controlling chamber temperature and [CO₂]. Atmospheric and [CO₂] ([CO₂]_a) and measured soil [CO₂] ([CO₂]_s) were alternately delivered to a cuvette containing intact fine roots of eastern white pine (*Pinus strobus* L.). Respiration rates were consistently higher in [CO₂]_a than in [CO₂]_s, and were almost three times higher during midsummer. Respiration rates were immediately reversed after returning to the alternate [CO₂] (i.e., [CO₂]_a → [CO₂]_s → [CO₂]_a, and vice versa) suggesting a direct effect of elevated [CO₂] on apparent respiration. Soil[CO₂]-based respiration rates decreased with increasing [CO₂] on a dry mass and tissue [N] basis. The authors conclude that estimates of soil CO₂ flux and soil carbon budgets may be improved by more completely accounting for the rhizosphere microclimate (i.e., soil temperature and [CO₂]_s) during measurement of fine root respiration. (4)

Cost, Noel D. 1999. **A new annual forest inventory system for the South.** *Forest Landowner*. 58(2): 16-19.

The author and director of the Southern Annual Forest Inventory System (SAFIS) details the Forest Service's Forest Inventory and Analysis program and the demand for more timely and reliable forest inventory data that led to the new annual inventory program. Cost discusses the research and implementation of SAFIS and the benefits the program has already produced. (5)

Devall, Margaret S.; Van Deusen, Paul C.; Reams, Gregory A. 1999. **Defining old growth in the Southeast: example of cypress.** In: Miller, Gary L., ed. *The value of old growth forest ecosystems of the Eastern United States: conference proceedings; 1993 August 26-28; Asheville, NC.* Asheville, NC: University of North Carolina, Asheville: 81-86.

There is a lot of misunderstanding over what comprises an old growth stand, because there is no well accepted definition of old growth. Malcolm Hunter proposed a broad conceptual definition: "old-growth forests are relatively old and relatively undisturbed by humans." Because there can be large differences among forest types, Hunter suggested that specific definitions for each forest type could be derived from

the broad definition and that age and disturbance criteria that may be ecologically significant could be modified to form locally appropriate definitions. This is the approach that the USDA Forest Service has taken. In this paper the authors review the process of defining old growth in the Southeast, the format for the definitions of old growth forest type groups, and the progress that has been made, and they discuss an example of one forest type group: the cypress-tupelo type. (6)

Flebbe, Patricia. 1999. **Trout use of woody debris and habitat in Wine Spring Creek, North Carolina.** *Forest Ecology and Management*. 114: 367-376.

Wine Spring Creek basin, in the mountains of North Carolina's Nantahala National Forest, is an ecosystem management demonstration site, in which ecological concepts for management and restoration are tested. Large woody debris (LWD) is an important link between streams and the adjacent riparian forest, but evidence for the connection between LWD and trout in the Southern Appalachian streams is limited. Woody debris loadings, trout habitat, and brook trout (*Salvelinus fontinalis*) and rainbow trout (*Oncorhynchus mykiss*) were inventoried for the entire 9.8 km that trout occupy in Wine Spring Creek. Compared to two reference streams in North Carolina old-growth forests, Wine Spring Creek had less LWD, evidence of conditions associated with mid-successional riparian forests. More units in Wine Spring Creek lacked LWD altogether and accumulations of two or more pieces of LWD were less common than was the case in the reference watersheds. On average, about 71 percent of pools and riffles in Wine Spring Creek were occupied by trout, compared to about 90 percent in reference streams. Trout nearly always occupied pools with at least two pieces of LWD, but rates of occupancy for pools with one or no LWD pieces and riffles were unusually low compared to reference streams. Habitats on the lower and middle reaches on the mainstem of Wine Spring Creek had highest trout numbers and were nearly always occupied by trout. In these reaches, riparian ages were older and stream habitat had abundant LWD or boulder substrate. Upper reaches of Wine Spring Creek and its tributaries, however, were characterized by less mature riparian forest, less LWD, and little boulder substrate, low rates of trout occupancy, and lower trout numbers. These conditions are the basis for an LWD addition experiment in headwater reaches. (7)

Franzreb, Kathleen E. 1999. **Factors that influence translocation success in the red-cockaded woodpecker.** *Wilson Bulletin*. 111(1): 38-45.

To restore a population that had declined to 4 individuals by late 1985, 54 red-cockaded woodpeckers (*Picoides borealis*) were translocated at the Savannah River Site in South Carolina between 1986 and 1995. Translocation success was evaluated by sex, age, and distance between the capture and release site. For moves involving females, the presence of a resident male and the status of the male (breeder, inexperienced, or helper) also was assessed. Of the factors evaluated, only the distance of the move was statistically significant, with increasing success associated with increasing distance. The presence of a resident male at the female's release site led to no more success than releasing the female concurrently with a male; nor did the male's status appear to play a significant role in female translocation success. Overall, 31 of 49 (excluding nestlings) translocated birds remained at or near the release site for at least 30 days,

resulting in a success rate of 63.2 percent. Of the birds that were successfully translocated, 51.0 percent had reproduced by July 1996. (8)

Goelz, J.C.G.; Burk, Thomas E.; Zedaker, Shepard M. 1999. **Long-term growth trends of red spruce and fraser fir at Mt. Rogers, Virginia and Mt. Mitchell, North Carolina.** Forest Ecology and Management. 115: 49-59.

Cross-sectional area growth and height growth of Fraser fir and red spruce trees growing in Virginia and North Carolina were analyzed to identify possible long-term growth trends. Cross-sectional area growth provided no evidence of growth decline. The individual discs were classified according to parameter estimates of the growth trend equation. The predominant pattern of growth was a steady increase followed by fluctuation about a horizontal line. Other cross-sections exhibited a steady increase throughout the series. The only discs that represent declining growth patterns were from trees in subordinate crown position or which had previous top damage. No unexplained growth decline was present in any disc. The results regarding height growth were uncertain. A slight decline in height growth was present, although the authors suggest that this observation was due to problems with the data or the model used to fit height growth. These findings contradict other studies, suggesting that a recent growth decline has occurred in red spruce in the Southern Appalachians. (9)

Goelz, J.C.G.; Meadows, J.S. 1999. **Precommercial thinning of water tupelo stands on the Mobile-Tensaw River Delta: third-year results.** Res. Pap. SRS-17. Asheville, NC: U.S. Department of Agriculture, Forest Service, Southern Research Station. 6 p.

Three 4-year-old stands were selected for precommercial thinning. Treatment consisted of two components: (1) thinning water tupelo (*Nyssa aquatica* L.) stump sprouts and dense patches of water tupelo seedlings and (2) cutting all stems of Carolina ash (*Fraxinus caroliniana* Mill.) and black willow (*Salix nigra* Marsh.) (cleaning). This approach provided a 2 by 2 factorial with two replications in each stand. Thinning increased average diameter growth of water tupelo stump sprouts, with the greatest increase in one stand that had the highest density of stumps and apparently the highest productivity; cleaning did not increase diameter growth. Thinning decreased stand basal area growth; cleaning did not affect basal area growth. Mortality of water tupelo stump sprouts was negligible. Cleaning may increase the number of water tupelo seedlings, although the evidence from this study is not compelling. Precommercial thinning will probably provide a favorable response in stands with high density of stumps and high productivity. (10)

Haywood, James D.; Martin, Alton, Jr.; Pearson, Henry A.; Grelen, Harold E. 1998. **Seasonal biennial burning and woody plant control influence native vegetation in loblolly pine stands.** Res. Pap. SRS-14. Asheville, NC: U.S. Department of Agriculture, Forest Service, Southern Research Station. 8 p.

This paper documents the results of a study to determine the effects of selected vegetation-management

treatments in loblolly pine. Vegetation in precommercially thinned, 6-year-old stands was subjected to five biennial growing season burns in either early March, May, or July, coupled with hand felling of residual woody stems. Using a randomized complete block design, the authors compared the vegetation-management treatments to an unthinned, unburned, and unweeded check. By stand age 17, intensive vegetation management increased pine diameter growth by 2 centimeters ($\alpha = .004$) and volume growth by 0.04 cubic meters (m^3) per tree ($\alpha = .02$) when compared to the check. However, this was a small biological gain in growth. Among the burned treatments, five burns in early March reduced average pine total height by 0.8 m ($\alpha = .004$), diameter at breast height by 1.5 cm ($\alpha = .03$), and volume per tree by 0.04 m^3 ($\alpha = .06$) compared to burning in early May or July. Vegetation management significantly reduced the height of hardwood trees and shrubs ($\alpha = .0001$), but the number of trees and shrubs per hectare was not significantly affected. Vegetation management significantly increased total herbaceous plant production ($\alpha = .003$). Pinehill bluestem was not on the check plots, but it was the most productive herbaceous species on the vegetation-management treatments, composing 49 percent of the average total annual production of 457 kilograms per hectare. (11)

Hse, Chung-Yun; Bryant, Ben S. 1993. **Mechanical and physical properties of wood fiber-reinforced, sulfur-based wood composites.** In: Hse, Chung-Yun; Branham, Susan J.; Chou, Chun, eds. Adhesive technology and bonded tropical wood products. Taiwan, China: Taiwan Forestry Research Institute: 572-580.

Sulfur-based composite was made from sulfur impregnated, oven dried, wet-formed fiber mats. The fiber mats consisted of a 50/50 mixture of recycled newsprint pulp and mechanical hardwood pulp from several species made from chips in a laboratory refiner. The thickness of the composites was 0.125 inch and the specific gravity of the unimpregnated fiber mat was 0.2. The average MOR of the sulfur-based composites is in the order of the MOR of particleboard that contains more than three times as much fiber per unit volume (i.e., specific gravity of 0.65). The high MOE of the sulfur-based composites, nearly four times greater than that of particleboard, is most impressive. After the 24-hour soak test, the composites retained 64 percent of MOR and 28 percent of MOE. They swelled significantly less in thickness as compared to most wood composites and expanded significantly more in length. The only species used to make the composite that appeared to be consistently superior in mechanical properties was sweetgum. The lack of permeability of white oak might also have accounted for its good show in its wet MOR and MOE. A conceptual understanding of the high strength properties of the sulfur-based composites is presented. (12)

Johnsen, Kurt H.; Major, John E. 1999. **Shoot water relations of mature black spruce families displaying a genotype \times environment interaction in growth rate. I. Family and site effects over three growing seasons.** Tree Physiology. 19(6): 367-374.

Pressure-volume curves were determined for black spruce (*Picea mariana* (Mill.) BSP) trees from four full-sib families. During the first two years, trees were measured from a plantation on a dry site. In the third year, trees were sampled from the dry site and a wet site. Diurnal measurements of shoot water potential allowed *in situ* shoot turgor to be estimated in addition to standard water relations traits. Over all years, Female 59 progeny displayed lower osmotic potentials at saturation (Ψ_{sat}) than Female 63 progeny. Genetic

differences in Ψ_{sat} were similar on both the dry and wet sites. Modulus of elasticity (ϵ) was greater for Female 59 progeny than for Female 63 progeny, producing a compensatory effect resulting in no genetic or site differences in osmotic potential at turgor loss point (Ψ_{tp}) or relative water content at turgor loss point (RWC_{tp}). Mean and predawn shoot turgor pressures (P_x and P_{pd}) were higher for Female 59 progeny than for Female 63 progeny and higher at the wet site than the dry site. Genotype \times environment trends were observed; compared to Female 63 progeny, Female 59 progeny displayed 9.8 and 5.1 percent higher P_{pd} on the dry and wet sites, respectively, and 3.4 and 9.8 percent greater P_{pd} values in wet and dry years, respectively. Tree volume growth showed no relationship to Ψ_{tp} or RWC_{tp} , but was correlated with Ψ_{sat} and P_x ; however, the strongest correlation was with P_{ph} ($r=0.90$). (13)

Johnson, Tony G.; Steppleton, Carolyn D. 1999. **Southern pulpwood production, 1997**. Resour. Bull. SRS-37. Asheville, NC: U.S. Department of Agriculture, Forest Service, Southern Research Station. 34 p.

In 1997, the South's production of pulpwood increased 11 percent to 75.9 million cords. Roundwood production increased to 54.2 million cords and accounted for 71 percent of the total pulpwood production. The use of wood residue increased to 21.7 million cords. Alabama leads the South in total production, number of mills, and pulping capacity. Currently, 103 mills are operating and drawing wood from the 13 Southern States. Southern mills' pulping capacity of 140,153 tons per day account for more than two-thirds of the Nation's total pulping capacity. (14)

Kard, Brad. 1999. **Mesh may fit in as a termite barrier**. Pest Control. February: [Not paged].

Stainless steel mesh tests are currently being conducted in an effort to investigate alternatives or supplements to termiticides for control of subterranean termites. Some people are extra sensitive to insecticides or would prefer to use non-insecticidal means to control termites, and stainless steel mesh may provide one such alternative. (15)

Koehn, Anita C.; Doudrick, Robert L. 1999. **Diurnal patterns of chlorophyll fluorescence and CO₂ fixation in orchard grown *Torreya taxifolia* (Arn.)**. Journal of the Torrey Botanical Society. 126(2): 93-98. (16)

Diurnal patterns of chlorophyll fluorescence and CO₂ fixation in orchard measurements were taken on sunny days in October 1996, on three *Torreya taxifolia* (Arn.) plants grown in an open canopy orchard. Information from chlorophyll fluorescence quenching analysis indicated that during periods of highest light intensity and temperatures there were reductions in yield of photosystem II photochemistry and photochemical quenching and increases in nonphotochemical quenching. Photochemical quenching and yield of photosystem II recovered by the end of the measurement period in late afternoon to levels measured at the beginning of the day. Nonphotochemical quenching remained at high levels for a longer period of time and by late afternoon had not returned to levels measured at the beginning of the day. Diurnal patterns of CO₂

fixation and stomatal conductance showed decreases in the afternoon as ambient temperatures remained high and light intensity began to decrease. Internal CO₂ partial pressures remained constant throughout most of the day, possibly indicating the presence of nonstomatal limitations to photosynthesis. The measurements of CO₂ fixation and chlorophyll fluorescence on the three *T. taxifolia* plants in this study indicate that the plants recovered from daily periods of high light and temperatures suggesting that they may tolerate higher light conditions than found in their native habitat.

Kormanik, P.P.; Sung, S.S.; Kormanik, T.L. [and others]. 1998. **Effect of acorn size on development of northern red oak 1-0 seedlings.** Canadian Journal of Forest Research. 28: 1805-1813.

The effect of acorn size on seedling development was determined for 20 northern red oak (*Quercus rubra* L.) mother tree selections from the USDA Forest Service's Eastern Tennessee Watauga seed orchard. Acorns from each mother tree were visually separated into three size groups, weighed, and sown separately in forest nurseries located in Georgia, North Carolina, and Tennessee. Seedling height, root collar diameter, and survival within sibling seedlots were significantly related to acorn mass. The three sizes of acorns showed the same trends in seedling development among the four nurseries. Heritability (h^2) estimates for the variables were uniformly high among all acorn sizes. A wide range in sibling seedling quality occurred within each acorn size class regardless of nursery location. This suggests that while sizing of acorns into several categories may result in more uniform germination within a seedbed, it will not result in uniform seedling development even when using sibling seedlots and acorns of uniform size. (17)

Landis, T.D.; Barnett, J.P., tech. coords. 1999. **National proceedings: forest and conservation nursery associations – 1998.** Gen. Tech. Rep. SRS-25. Asheville, NC: U.S. Department of Agriculture, Forest Service, Southern Research Station. 192 p.

This proceedings is a compilation of 43 papers that were presented at the 3 regional nursery meetings in 1998. The Southern Forest Nursery Association Conference was held in Lafayette, LA, on July 13-16. The Northeastern Forest Nursery Association Conference was held in Annapolis, MD, on July 27-30. The Combined Forest Nursery Association of British Columbia/Western Forest and Conservation Nursery Association meeting was held on August 10-13 in Victoria, BC, Canada. The subject matter ranged from seed collection and processing – through nursery cultural practices – to harvesting, storage, and outplanting. (18)

Lee, Andy W.C.; Hse, Chung Y. 1993. **Evaluation of cement-excelsior boards made from yellow-poplar and sweetgum.** In: Hse, Chung-Yun; Branham, Susan J.; Chou, Chun, eds. Adhesive technology and bonded tropical wood products. Taiwan, China: Taiwan Forestry Research Institute: 565-571.

Previous research conducted in the laboratory pointed out several hardwood species which were either superior, comparable, marginal, or unsuitable for manufacturing cement-excelsior board (CEB). In this study, forty full-sized boards were manufactured in a commercial production facility with the following

species: yellow-poplar, sweetgum, southern pine, and sweetgum/southern pine mixture. The properties of hardwood CEB were evaluated and compared with those of standard southern pine CEB. Results indicate that CEB made with yellow-poplar has equal or better properties than southern pine CEB. However, CEB made with all sweetgum or 50 percent sweetgum/50 percent southern pine does not meet the requirement of bending strength. (19)

Lemly, A. Dennis. 1999. **Selenium transport and bioaccumulation in aquatic ecosystems: a proposal for water quality criteria based on hydrological units.** *Ecotoxicology and Environmental Safety*. 42: 150-156.

Local water quality criteria for selenium should be based on an assessment of the degree of toxicological hazard to fish and wildlife, which is influenced by the spatial and temporal variation of the selenium cycle at the site under consideration. The physical area from which measurements are taken to evaluate selenium residues and biological effects, i.e., the database for setting site-specific criteria, must encompass more than an isolated segment of river, a tributary stream, etc. Because of hydrological connections between the various aquatic habitats that may be present in a watershed basin -- wetlands, rivers, streams, and impoundments -- the toxic threat from selenium contamination is also connected. For example, a criterion that is appropriate for a stream or river where low bioaccumulation occurs may result in *seemingly* harmless concentrations of selenium becoming a problem in downstream impoundments or in off-channel bays and wetlands where bioaccumulation is greater. The hydrologically connected parts of a basin downstream of a selenium discharge (natural or synthetic selenium source), extending to the point at which new sources of low-selenium water dominate the hydrology (e.g., confluence with larger tributary or river, spring, or ground-water inflow), should be the area evaluated and given a specific criterion, not isolated components. Thus, a hydrological unit should be identified and used as the "site" for the purpose of setting criteria. Importantly, criteria derived in such a fashion will reflect the transport and bioaccumulation of selenium within the entire hydrological unit rather than simply focusing on a small, artificially designated segment of the system. Failure to use a hydrological-unit approach can set the stage for significant biological and legal problems. (20)

Loeb, Susan. 1999. **Responses of small mammals to coarse woody debris in a southeastern pine forest.** *Journal of Mammalogy*. 80(2): 460-471.

The importance of coarse woody debris (CWD) to small mammals in a managed pine forest in South Carolina was tested experimentally during summer and autumn 1990 and winter and spring 1991-1994. Abundance and demographics of small mammals were compared between plots with abundant CWD created by a tornado (unsalvaged plots) and plots where tornado-created CWD had been removed (salvaged plots). Species composition was similar between unsalvaged and salvaged plots, but more small mammals were captured on unsalvaged plots. Cotton mice (*Peromyscus gossypinus*) were the most abundant species captured in all plots and were significantly more abundant in unsalvaged plots in every trapping period. Adult female *P. gossypinus* in unsalvaged plots had greater survival and were more likely to be in reproductive condition than adult females in salvaged plots. Southern short-tailed shrews (*Blarina carolinensis*) and cotton rats (*Sigmodon hispidus*) tended to be more abundant in unsalvaged plots. Fox squirrels (*Sciurus*

niger), the second most abundant species in salvaged plots, were never captured on unsalvaged plots. Large amounts of CWD improve habitat quality of pine forests for *P. gossypinus*, and CWD is probably an important habitat component for other species. (21)

Lowe, W.J.; Byram, T.D.; Bridgwater, F.E. 1999. **Selecting loblolly pine parents for seed orchards to minimize the cost of producing pulp.** Forest Science. 45(2): 213-216.

Southern pine cooperative breeding programs currently emphasize genetic improvement of growth rates. When a deployment population, typically a seed orchard, is established, there is an opportunity to emphasize traits other than growth rate to maximize the profit of individual cooperators in the breeding program. The authors studied a southeast Texas breeding population and developed selection indexes to optimize profits for Kraft and mechanical pulp mills. The relative economic weights for volume and wood density were 1:8.1 and 1:8.6 for Kraft and mechanical pulp mills, respectively. Choosing parents with these indexes increased expected profit per ton of dry pulp by 3.4 percent for both mill types. Expected gains in profit were 3.3 percent when parents were chosen based on wood density alone. If parents were chosen based solely on volume growth, expected gains in profit were only 0.3 to 0.4 percent. (22)

Major, John E.; Johnsen, Kurt H. 1999. **Shoot water relations of mature black spruce families displaying a genotype × environment interaction in growth rate. II. Temporal trends and response to varying soil water conditions.** Tree Physiology. 19(6): 375-382.

Pressure-volume curves and shoot water potentials were determined for black spruce (*Picea mariana* (Mill.) BSP) trees from four full-sib families at the Petawawa Research Forest, Ontario, Canada. Trees were sampled from a dry site in 1992 and from the dry site and a wet site in 1993. Modulus of elasticity (ϵ), osmotic potential at turgor loss point (Ψ_{tp}) and relative water at turgor loss point (RWC_{tp}) all decreased during the growing season. Osmotic potential at saturation (Ψ_{sat}) and turgor displayed no general temporal trend. Across a range of environmental conditions, Female 59 progeny had equal or lower Ψ_{sat} and higher or similar ϵ , mean turgor pressure (P_x) and predawn turgor pressure (P_{pd}) compared with Female 63 progeny. Osmotic potential at saturation decreased as water stress increased from mild to moderate and increased as water stress increased from moderate to severe. Stable genetic differences in Ψ_{sat} were maintained by the same rate of osmotic adjustment from low to moderate water stress. Modulus of elasticity and RWC_{tp} decreased with decreasing water availability, whereas Ψ_{tp} showed no response. The combined effects of Ψ_{sat} and ϵ resulted in no change in P_{pd} as water stress increased from low to moderate values, but turgor declined sharply as water stress increased from moderate to high values. The authors conclude that drought tolerance traits strongly influence the growth of these black spruce families across sites of varying water availability. (23)

Martin, Jonathan G.; Kloeppe, Brian D.; Schaefer, Tara L. [and others]. 1998. **Aboveground biomass and nitrogen allocation of ten deciduous southern Appalachian tree species.** Canadian Journal of Forest

Research. 28: 1648-1659. (Editor's note: Steven G. McNulty, Southern Research Station project leader and scientist, co-authored this publication.)

Allometric equations were developed for mature trees of 10 deciduous species (*Acer rubrum* L.; *Betula lenta* L.; *Carya* spp.; *Cornus florida* L.; *Liriodendron tulipifera* L.; *Oxydendrum arboreum* (L.) DC.; *Quercus alba* L.; *Quercus coccinea* Muenchh.; *Quercus prinus* L.; and *Quercus rubra* L.) at the Coweeta Hydrologic Laboratory in Western North Carolina, U.S.A. These equations included the following dependent variables: stem wood mass, stem bark mass, branch mass, total wood mass, foliage mass, total biomass, foliage area, stem surface area, sapwood volume, and total tree volume. High correlation coefficients (R^2) were observed for all variables versus stem diameter, with the highest being for total tree biomass, which ranged from 0.981 for *Oxydendrum arboreum* to 0.999 for *Quercus coccinea*. Foliage area had the lowest R^2 values, ranging from 0.555 for *Quercus alba* to 0.962 for *Betula lenta*. When all species were combined, correlation coefficients ranged from 0.822 for foliage area to 0.986 for total wood mass, total tree biomass, and total tree volume. Species with ring versus diffuse/semiring porous wood anatomy exhibited higher leaf area with a given cross-sectional sapwood area, as well as lower total sapwood volume. *Liriodendron tulipifera* contained one of the highest foliar nitrogen concentrations and had consistently low branch, bark, sapwood, and heartwood nitrogen contents. For a tree diameter of 50 cm, *Carya* spp. exhibited the highest total nitrogen content, whereas *Liriodendron tulipifera* exhibited the lowest. (24)

McNulty, Steven G.; Sun, Ge. 1998. **The development and use of best practices in forest watersheds using GIS and simulation models.** In: International Research and Training Center on Erosion and Sedimentation, ed. Proceedings of the international symposium on comprehensive watershed management; 1998 September 7-10; Beijing, China. Beijing, China: Patent Documentation Publishing House: 391-398.

Forest watersheds provide timber and water, wildlife and fisheries habitat, and recreational opportunities. However, not an entire watershed is equally suited for each activity. Steeper slopes may be better left forested and used for wildlife habitat, while more gentle slopes of the watershed could be used for timber production. Logging steep slopes can lead to soil erosion that can seriously degrade stream water quality and reduce long-term site productivity. Best Management Practices (BMP's) are forest practices designed to minimize negative environmental impacts caused by human forest use. The difficulty in developing BMP's arise when multiple objectives (e.g., improved timber production, water quality, and recreation) are applied to a single watershed. The objective of this research was to maintain long-term stream water quality, fisheries, and timber productivity, while minimizing soil erosion and negative water quality impacts associated with forest management. Computer simulation models and a geographic information system (GIS) were used to create management scenarios that test how a watershed could best be managed to maximize its multiple potential use. The authors used an 1143 ha forest watershed in Western North Carolina, USA. Basin elevations range from 920 m to 1655 m. The scientists combined a GIS, three desired future conditions, the Universal Soil Loss Equation (USLE), and a terrestrial transport model to predict BMP's for the watershed. Through the use of a GIS, model predictions of sediment production and transport can be spatially distributed across the watershed and displayed as map outputs of soil movement. This paper demonstrates how land managers could identify BMP's using a GIS-based modeling system.

Once identified, alternative management scenarios can be developed to assess the cumulative effects of management practices on forested watershed health and sustainability. (25)

Miller, James H. 1999. **Controlling exotic plants in your forest.** Forest Landowner. 58(2): 60-64.

The author discusses the impacts of exotic plants and suggests control and rehabilitation measures. Trees, shrubs, and vines addressed include silk tree or mimosa, Chinese and Japanese privet, kudzu, multiflora rose, Japanese honeysuckle, and Chinese wisteria. (26)

Nakamura, Hitoshi; Kaneko, Shigeru; Spaine, Pauline. 1998. **Differences in molecular characteristics between *Cronartium quercuum* from Japan and fusiform rust from USA.** In: Jalkanen, Risto; Crane, Patricia (Pat) E.; Walla, James (Jim) A.; Aalto, Tarmo, eds. Proceedings of the first IUFRO [International Union of Forestry Research Organizations] rusts of forest trees working party conference; 1998 August 2-7; Saariselka, Finland. Research Papers 712. Metla, Finland: Finnish Forest Research Institute: 235-241.

The molecular characteristics were compared among *Cronartium quercuum* f. sp. *densiflorae* and *C. quercuum* f. sp. *thunbergii* from Japan and *C. quercuum* f. sp. *fusiforme*, fusiform rust from the USA. The authors examined the PCR-amplified internal transcribed spacer (ITS) region of six collections (RFLP) analysis and nucleotide sequences. The ITS regions of six collections from *Pinus densiflora* and four collections from *P. thunbergii* from Japan and five collections from the native American hosts *P. taeda* or *P. elliotii* were amplified by PCR. The RFLP patterns with the three enzymes *Dra I*, *Hinf I*, and *Taq I* showed clear differences between the two Japanese *formae speciales* and the American *C. quercuum* f. sp. *fusiforme*. No differences were found in the RFLP patterns between ff. spp. *densiflorae* and *thunbergii*. Nucleotide sequences of the ITS2 region confirmed the distinction between ff. sp. *densiflorae* and *fusiforme*. Comparisons with sequence data obtained from GenBank database on the other *formae speciales* in *C. quercuum* also confirmed the distinctiveness of f. sp. *densiflorae*. These molecular data supported the morphological differences reported earlier between the Asian and American forms in the *C. quercuum* complex. (27)

Peitz, David G.; Tappe, Philip A.; Shelton, Michael G.; Sams, Michael G. 1999. **Deer browse response to pine-hardwood thinning regimes in southeastern Arkansas.** Southern Journal of Applied Forestry. 23(1): 16-20.

Understanding relationships between stand thinning and browse production allows land managers to encourage both white-tailed deer (*Odocoileus virginianus*) browse production and timber production. In this study, browse biomass was determined before thinning and two and four growing seasons after thinning a 35 yr. old natural loblolly pine-hardwood stand (initially 27 m²/ha of pine and 8 m²/ha of hardwood basal area). Combinations of 3 loblolly pine (15, 18, 21 m²/ha) and 3 hardwood (0, 3.5, and 7 m²/ha) basal areas were replicated 3 times, resulting in a total of 27 0.08 ha plots. Understory biomass was determined for 14 browse species on 25 understory plots systematically located within each plot. Browse production following thinning was dominated by grape (*Vitis* spp.), blackberry (*Rubus* spp.), Japanese

honeysuckle (*Lonicera japonica*), and greenbrier (*Smilax* spp.). Most deer browse species responded negatively to retained pine and/or hardwood basal areas, with hardwoods having the greater impact. Thinning improved overall browse biomass availability for deer, but responses varied by individual species. (28)

Schaberg, Rex H.; Holmes, Thomas P.; Lee, Karen J.; Abt, Robert C. 1999. **Ascribing value to ecological processes: an economic view of environmental change.** Forest Ecology and Management. 114: 329-338.

Decisions made by individual landowners and public land managers can have a significant impact on the rates of ecological change. Interdisciplinary cooperation is desirable if economists and ecologists are to correctly interpret the impacts of individual choices for landscape management. This paper reports results from two studies of the residents of North Carolina which contrast individual preferences for utilitarian forest benefits and financial returns with less tangible benefits of forest amenities and ecosystem stability. One study reports preliminary findings from a forest-benefit mail survey on the Nantahala and Pisgah National Forests; the second study presents an analysis of harvest decisions by private landowners. Economic methods pertinent to valuation of environmental goods are briefly considered. Individual behavior is described which suggests that segments of the public recognize welfare benefits specifically from forest amenities, and from "natural" production of environmental goods and services. The two studies suggest how economic tools may be extended to help quantify complex social and biological values associated with ecological processes. (29)

Scholl, Eric R.; Waldrop, Thomas A. 1999. **Photos for estimating fuel loadings before and after prescribed burning in the upper coastal plain of the southeast.** Gen. Tech. Rep. SRS-26. Asheville, NC: U.S. Department of Agriculture, Forest Service, Southern Research Station. 25 p.

Although prescribed burning is common in the Southeastern United States, most fuel models apply to only western forests. This paper documents a fuel classification system that was developed for plantations of loblolly and longleaf pines for the Upper Coastal Plain region. Multivariate analysis of variance and discriminant function analysis were used to confirm eight discrete fuel groups. A photo series describing these unique fuel complexes is presented to display preburn loading and postburn reductions. This photo series will improve the accuracy of fuel-loading estimates and will provide a measure of the effectiveness of prescribed fires for rough reduction. (30)

Shear, Theodore H.; Summerville, K.O., eds. 1999. **Proceedings: Atlantic white-cedar: ecology and management symposium;** 1997 August 6-7; Newport News, VA. Gen. Tech. Rep. SRS-27. Asheville, NC: U.S. Department of Agriculture, Forest Service, Southern Research Station. 82 p.

As the past decade has seen a resurgence of interest in Atlantic white-cedar (*Chamaecyparis thyoides* (L.) B.S.P.), a conference was convened in August 1997 to present the latest information in the research and management of the species. New information included, among other things: natural and artificial

regeneration and growth after harvesting; genetics and seedling production; management on public lands; development of new taper equations for predicting wood volume; and distribution and composition of plant communities dominated by Atlantic white-cedar. These were reported in 16 oral presentations and 3 abstracts. (31)

Shelton, Michael G.; Cain, Michael D. 1999. **Structure and short-term dynamics of the tree component of a mature pine-oak forest in southeastern Arkansas.** *Journal of the Torrey Botanical Society.* 126(1): 32-48.

The R.R. Reynolds Research Natural Area is a 32-ha second-growth forest with little human intervention for nearly 60 years. In this paper, the authors characterize the existing vegetation, which represents 60 years of successional change with no major disturbances, and report vegetative changes over a 5-year period, which suggest the future successional direction. Trees ≥ 9.0 cm d.b.h. were inventoried in twenty 0.1-ha plots and placed into four species groups: pines, oaks, other overstory trees, and midstory trees. Loblolly pine (*Pinus taeda* L.) was the dominant tree species, accounting for 51 percent of the total basal area and having the largest mean d.b.h. (56.5 cm) and height (35.7 m). Tree ages ranged from 50 to 140 years for the pines and from 40 to 150 years for the oaks. However, 70 percent of the pines became established in the 4 decades that followed harvest of the virgin forest in the 1910's, while the oaks showed two peaks of establishment (one after harvest and one 50 years before harvest). The pines displayed a bell-shaped d.b.h.-class, distribution, while the oaks displayed a gradual decline in numbers as d.b.h.-class increased. In contrast, the other overstory trees and midstory trees had negative exponential distributions. Multiple occupancy was common within the canopy, which had a horizontal coverage of 97 percent. Canopy positions of the species groups were as follows: pines>oaks>other overstory trees>midstory trees. The growth of individual trees was positively related with tree size. Stand-level survivor growth was positively related with the basal area of the species group. Recruitment was greatest for the other overstory trees and midstory trees (totaling 6.2 trees $\text{ha}^{-1} \text{yr}^{-1}$), but did not occur for the pines and oaks. Mortality of large pines during the observation period (averaging 3.3 trees $\text{ha}^{-1} \text{yr}^{-1}$) resulted in net losses in basal area and volume for that species group. By contrast, hardwood species groups displayed net increases, totaling 0.17 $\text{m}^2 \text{ha}^{-1} \text{yr}^{-1}$ for basal area and 1.59 $\text{m}^3 \text{ha}^{-1} \text{yr}^{-1}$ for volume. Stand dynamics suggest that the shade-intolerant pines are rapidly being replaced by more shade-tolerant hardwoods. (32)

Spaine, Pauline. 1998. **Research on the biology of fusiform rust in the southeastern United States.** In: Jalkanen, Risto; Crane, Patricia (Pat) E.; Walla, James (Jim) A.; Aalto, Tarmo, eds. *Proceedings of the first IUFRO [International Union of Forestry Research Organizations] rusts of forest trees working party conference; 1998 August 2-7; Saariselka, Finland.* Research Papers 712. Metla, Finland: Finnish Forest Research Institute: 231-234.

The incidence of fusiform rust has continued to be one of the major forest disease problems in the Southeastern United States. In the past, much of the research has concentrated on field studies with provenance selection and genetic breeding of pine families to increase resistance in the host. In the last 10 years, there has been an increased interest in the actual biology of the fusiform rust fungus. Three areas of research on-going in the South are overlapping the areas of molecular, cellular, and population biology.

In order to control the disease, a combination of host genetics will be valuable, but so will a biological understanding of the survival mechanisms and ecology of *Cronartium* species. In the last decade, research has started in the Southeastern United States with collaborations between Federal and State agencies concentrated on the biology of fusiform rust. (33)

Spetich, Martin A.; Shifley, Stephen R.; Parker, George R. 1999. **Regional distribution and dynamics of coarse woody debris in Midwestern old-growth forests.** *Forest Science*. 45(2): 302-313.

Old-growth forests have been noted for containing significant quantities of deadwood. However, there has been no coordinated effort to quantify the deadwood component of old-growth remnants across large regions of temperate deciduous forest. The authors present results of a regional inventory that quantifies and examines regional and temporal trends for deadwood in upland old-growth forest remnants within Indiana, Illinois, Missouri, and Iowa. From 1992 to 1994, down wood ≥ 10 cm in diameter and standing trees ≥ 10 cm d.b.h. were inventoried on 328 one-tenth ha plots at 12 sites. The mean ratio among the sites by diameter class of the number of standing dead to standing live trees (dead/live ratio) ranged from 0.08 to 0.11 and was consistent for trees ≤ 65 cm in diameter. The dead/live tree ratio was generally greater for old-growth than for mature second-growth forests (70 to 90 yr old). Mean volume of standing dead trees across all old-growth sites was 21.4 m³/ha and down wood was 60.4 m³/ha. However, both standing and down wood volume (total deadwood) increased along a regional gradient of increasing productivity from southwest Missouri to northeast Indiana and also increased with increasing age of dominant and codominant trees. Old-growth forests on high productivity sites averaged more pieces/ha of down wood in all diameter classes and higher volume/ha of down wood in nearly all diameter classes than did old-growth forests on low productivity sites. A chronosequence of forests from 10 yr to more than 200 yr since stand establishment indicated a sharply declining down wood volume from age 10 to 70 yr followed by increasing volume between 80 and 200 yr. (34)

Stelzer, H.E.; Doudrick, R.L.; Kubisiak, T.L.; Nelson, C.D. 1999. **Prescreening slash pine and *Cronartium* pedigrees for evaluation of complementary gene action in fusiform rust disease.** *Plant Disease*. 83(4): 385-389.

Single-urediniospore cultures of the fusiform rust fungus were used to inoculate seedlings from 10 full-sib families of a five-parent slash pine diallel at two different times in 1994. The presence or absence of fusiform rust galls was recorded for each inoculated seedling at 9 months postinoculation, and percent infection levels for each family-inoculum-time combination were used for detecting differences among host families and fungal cultures and for identifying differential interactions. The existence of differential interactions between two or more fungal cultures and two or more host families verifies that complementary gene action does exist in this pathosystem. Some host families may be excluded from more detailed interaction studies on the basis of their redundancy and lack of participation in differential interactions. (35)

Sun, Ge; McNulty, Steven G. 1998. **Modeling soil erosion and transport on forest landscape.** In: *Winning solutions for risky problems: Proceedings of conference 29; 1998 February 16-20; Reno, NV.* Steamboat Springs, CO: International Erosion Control Association: 189-198.

Century-long studies on the impacts of forest management in North America suggest sediment can cause major reduction on stream water quality. Soil erosion patterns in forest watersheds are patchy and heterogeneous. Therefore, patterns of soil erosion are difficult to model and predict. The objective of this study is to develop a user friendly management tool for land managers to design forest management activities (e.g., road building, prescribed burning) that may minimize water quality impacts. This system has the capability to predict long-term soil erosion and sediment transport from hillslopes to stream networks under different climate conditions and forest management scenarios. A Geographic Information System (GIS) coupled with the Universal Soil Loss Equation (USLE) model was used to facilitate database development, manipulation, and output display. The 1140 ha watershed was divided into 30 by 30 m grid cells and gross soil erosion was first predicted by the USLE model for each cell. The Arc/Info GIS utilities are employed to calculate the total mass of sediment moving from each cell to the nearest stream network. Field measurements were used to develop sediment movement routing functions. This study concluded that poorly managed roads are the main source of sediment in a forested watershed. The spatial location of forest roads affected sediment contribution to streams. (36)

Swank, Wayne T. 1998. **Multiple use forest management in a catchment context.** In: Cresser, M.; Pugh, K., eds. *Multiple land use and catchment management; Proceedings of an international conference; 1996 September 11-13; Aberdeen Research Consortium, Land Management and Environmental Sciences Research Centre.* Aberdeen, Scotland, United Kingdom: The Macaulay Land Use Research Institute: 27-37.

The objectives in this contribution are (1) to briefly review the history of multiple use forest management on public lands in the United States; (2) to illustrate, with examples, past and present approaches to multiple use management in a catchment context; and (3) to suggest promising approaches, methods, and technology to meet future needs. (37)

Tang, R.C.; Pu, Jianhua; Hse, C.Y. 1993. **Effect of resin variables on the creep behavior of high density hardwood composite panels.** In: Hse, Chung-Yun; Branham, Susan J.; Chou, Chun, eds. *Adhesive technology and bonded tropical wood products.* Taiwan, China: Taiwan Forestry Research Institute: 606-614.

The flexural creep behavior of oriented strandboards (OSB) fabricated with mixed high, density hardwood flakes was investigated. Three types of adhesives, liquid phenolic-formaldehyde (LPF), melamine modified urea-formaldehyde (MUF), and LPF (face)/MUF (core) were chosen in this investigation. The resin contents (RC) used were 3.5 percent and 5.0 percent. The flakes prepared from white oak, southern red oak and post oak with a mixed ratio of 1:1:1 were used for the panel fabrication. Results indicated that the panels fabricated with 5.0 percent RC of MUF had highest bending modulus of rupture (MOR), and the group fabricated with 3.5 percent RC of LPF (face)/MUF (core) was the lowest. Significant differences

among the modulus of elasticity (MOE) of each resin type and resin content group were not found. Highest internal bond (IB) strength was observed in the specimens with 5.0 percent RC of LPF (face)/MUF (core) whereas lowest one was found in the group with identical resin combination but with a 3.5 percent RC. The flexural creep behavior of the fabricated OSB under a cyclic RH of 65 percent ↔ 95 percent at a constant temperature of 75° F (23.9°C) was also investigated. The frequency of cyclic RH was 96-hour and the duration of load was 794 hours (approx. 1 month) while the duration of recovery (after unloaded) was 286 hours under constant 65 percent RH at 75° F. Results indicated that the creep resistance of OSBs are very sensitive to the cyclic RH of 65 percent ↔ 95 percent at 75° F. MUF-boards performed best in creep resistance; LPF/MUF groups were the weakest. Significant effect of resin content level on the creep resistance in LPF- and MUF-OSBs was not found. (38)

Thompson, Michael T. 1999. **A forested tract-size profile of Florida's NIPF landowners.** Res. Pap. SRS-15. Asheville, NC: U.S. Department of Agriculture, Forest Service, Southern Research Station. 10 p.

Information gathered from 2,713 permanent Forest Inventory and Analysis (FIA) sample plots showed that over 1.0 million acres, or 15 percent of the nonindustrial private forest (NIPF) timberland in Florida is in forested tracts ≤ 10 acres. Forested tracts ranging from 11 to 100 acres accounted for the largest proportion of NIPF timberland. By NIPF-ownership group, over 23 percent of other privately owned land was in forested parcels < 11 acres, whereas the other corporate and farmer-owned categories each recorded 6 percent. There was a higher proportion of natural pine stands in small forested tracts than in planted stands. Average softwood and hardwood growing-stock volume varied significantly by forested tract-size category. There was significantly more softwood growing-stock removals in the largest tract-size category than in the smallest. Comparisons of harvest and regeneration rates by forested tract size indicate that harvest and regeneration rates are considerably lower in tracts < 11 acres. (39)

Tomita, Bunichiro; Yoshida, Yasunori; Hse, Chung-Yun. 1993. **Kinetics on cocondensation of phenol and urea.** In: Hse, Chung-Yun; Branham, Susan J.; Chou, Chun, eds. Adhesive technology and bonded tropical wood products. Taiwan, China: Taiwan Forestry Research Institute: 71-83.

The chemical kinetics on cocondensation between methylolphenols and urea under acidic condition were investigated using 2- and 4-hydroxybenzyl alcohols as well as 2,4,6-trimethylolphenol as model compounds. The reactivity of the cocondensation were compared between o- and p-methylol groups. Moreover, the kinetics on self-condensations of monomethylolphenols and cocondensation between monomethylolphenols and urea were determined simultaneously. (40)

Vose, James M.; Swank, Wayne T.; Clinton, Barton D. [and others]. 1999. **Using stand replacement fires to restore southern Appalachian pine-hardwood ecosystems: effects on mass, carbon, and nutrient pools.** Forest Ecology and Management. 114: 215-226.

Pine-hardwood ecosystems in the Southern Appalachians are in serious decline due to fire exclusion and

insect infestations. Fire has been advanced as a tool to restore these ecosystems, yet there are few studies evaluating overall ecosystem effects. The authors' objectives were to evaluate the effects of stand restoration burning on forest floor nitrogen (N) and carbon (C) pools, and soil and stream chemistry. The scientists measured changes in forest floor (coarse woody debris, small wood, litter, and humus) mass, N, and C; changes in soil chemistry (calcium (Ca), potassium (K), magnesium (Mg), cation exchange capacity (CEC), pH, C, and N); and changes in stream nitrate (NO₃). Results showed that significant reductions in mass, N, and C occurred only for litter and small wood on the ridge, where N losses were 52.9 kg ha⁻¹ for litter and small wood combined. No significant effects were observed on the mid- or lower slope of the treatment watershed. Losses on the ridge are considerably lower than losses which occur with alternative burning treatments used in the region, such as the fell and burn treatment. Soil and stream chemistry showed no response to burning. Spatial heterogeneity in fire intensity (combustion temperatures ranged from <52→800°C) and severity associated with stand replacement burning results in a mosaic of fire effects and considerably less consumption and subsequent nutrient losses. (41)

Wagner, John E.; Holmes, Thomas P. 1998. **Estimating economic gains for landowners due to time-dependent changes in biotechnology.** *Forest Science*. 45(2): 163-170.

This paper presents a model for examining the economic value of biotechnological research given time-dependent changes in biotechnology. Previous papers examined this issue assuming a time-neutral change in biotechnology. However, when analyzing the genetic improvements of increasing a tree's resistance to a pathogen, this assumption is untenable. The authors derive analytical expressions for the optimal rotation age given non-constant changes in biotechnology. Their model is then implemented using (1) growth and yield simulations; (2) optimal rotation calculations; and (3) survey data on genetic resistance of slash pine (*Pinus elliottii*) to fusiform rust. Non-parametric regression models are used to estimate the economic gain functions which, for the cases considered, averaged about 1 percent of forestland value per year. (42)

Waldrop, Thomas A.; Brose, Patrick H. 1999. **A comparison of fire intensity levels for stand replacement of table mountain pine (*Pinus pungens* Lamb.).** *Forest Ecology and Management*. 113: 155-166.

Stand-replacement prescribed fire has been recommended to regenerate stands of table mountain pine (*Pinus pungens* Lamb.) in the Southern Appalachian Mountains because the species has serotinous cones and is shade intolerant. A 350 ha prescribed fire in northeast Georgia provided an opportunity to observe overstory mortality and regeneration of table mountain pine at various levels of fire intensity. Fire intensity for each of 60 study plots was classified by discriminant function analysis. Fires of low and medium-low intensity gave rise to abundant regeneration but may not have killed enough of the overstory to prevent shading. High-intensity fires killed almost all overstory trees but may have destroyed some of the seeds. Fires of medium-high intensity may have been the best choice; they killed overstory trees and allowed abundant regeneration. The forest floor remained thick after fires of all intensities, but roots of pine seedlings penetrated duff layers up to 7.5 cm thick to reach the mineral soil. In this study area, fire intensity levels did not have to reach extreme levels in order to successfully regenerate table mountain

pine. (43)

Walker, Joan. 1999. **Longleaf pine forests and woodlands: old growth under fire!** In: Miller, Gary L., ed. *The value of old growth forest ecosystems of the Eastern United States: conference proceedings; 1993 August 26-28; Asheville, NC.* Asheville, NC: University of North Carolina, Asheville: 33-40.

The author discusses a once widespread forest type of the Southeast – longleaf pine dominated forests and woodlands. This system depends on fire – more or less frequent, and often of low intensity. Because human-mediated landscape fragmentation has drastically changed the behavior of fire on longleaf pine dominated landscapes, these forests and woodlands will never be self-sustaining. Additionally, virtually all of these forests have been disturbed (cutting, plowing, fire exclusion), or converted irreversibly to other uses. Consequently, preserving existing remnant old forest will only partially fulfill an objective to conserve the range of diversity in longleaf pine ecosystems. It is likely that protecting minimally to moderately disturbed second growth longleaf pine forests, in order to produce some facsimile of “old growth forests” in the future, will be an important part of the old growth management strategy for the East. The author describes natural longleaf forests, and provides an overview of the environmental factors and ecological processes important in creating and maintaining their diversity. Walker presents information about historical and current distribution and its status. Based on the ecology and status of the forests, the author offers suggestions for management to preserve the biological diversity associated with old growth longleaf pine systems. (44)

Walkinshaw, C.H. 1999. **Promising resistance to fusiform rust from southeastern slash pines.** Res. Pap. SRS-16. Asheville, NC: U.S. Department of Agriculture, Forest Service, Southern Research Station. 6 p.

Two hundred twenty-four disease-free slash pines with good growth and form were tested for rust resistance. Trees in Alabama, Florida, Louisiana, and Mississippi were selected. After artificial inoculations, a low percentage of open-pollinated progeny of 32 selected trees had galls. In progeny from six of those, the number of gall-resistant trees increased from 50 to 75 percent after one round of crossing. Analysis of seedling height, gall length, formation of adventitious shoots, and pith necrosis suggests that the six families may differ in their response to infection, even though they form similar percentages of galls. This resistance appears to be stable in a variety of fungus field isolates. (45)

Wear, David N.; Liu, Rei; Foreman, J. Michael; Sheffield, Raymond M. 1999. **The effects of population growth on timber management and inventories in Virginia.** *Forest Ecology and Management.* 118: 107-115.

Expanding human populations may have important effects on the availability of timber from private lands in the South. To examine the effects of development on timber supply, the authors compared the density of populations and various site variables with expert opinions on the future location of commercial

timberland for a study site in Virginia. Population density is a significant predictor of commercial timberland and resulting probability equations provide a method for adjusting timber inventories. Findings indicate that the transition between rural and urban land use occurs where population density is between 20 and 70 people per square mile. Population effects reduce commercial inventories between 30 and 49 percent in the study area. (46)