

## ANNOUNCEMENT OF PUBLICATIONS -- SEPTEMBER 1998

### In Memory of Paul Murphy, 1942-1998

The Southern Research Station and the forestry community lost a dear friend and colleague when Paul Murphy passed away in August. Paul served as Project Leader for the research work unit in Monticello, AR that focuses on Managing Upland Forest Ecosystems in the Midsouth. Paul also managed the Crossett Experimental Forest, a 1,675-acre research and demonstration forest. Paul began his 27 year career with the Forest Service in 1971 with Forest Inventory and Analysis in New Orleans.

In 1978, Paul joined the Monticello research work unit and Crossett Experimental Forest, where he became nationally recognized as an expert in the dynamics of uneven-aged stands, particularly the growth and yield of uneven-aged Coastal Plain loblolly-shortleaf pine, Interior Highlands shortleaf pine, and oak-hickory forest types. Paul became the research work unit's Project Leader in 1991. During Paul's Forest Service career, he published 80 papers and delivered more than 100 research presentations, poster sessions, and field tours for scientists and professional foresters.

Paul received a B.S. degree in forestry from Southern Illinois University in 1964, an M.S. degree in forestry from the University of Vermont in 1968, and a Ph.D. degree in forestry from the University of Georgia in 1973. He served as Chair of the Arkansas Division of the Society of American Foresters in 1995 and the Ouachita (Arkansas and Oklahoma) SAF Division in 1997. Also in 1997, the Southern Journal of Applied Forestry selected Paul as associate editor for growth and yield research.

We extend our sympathy to Paul's wife, Judy, and their three children -- Jeffrey Murphy of Urbana, IL; Matthew Murphy of Conway, AR; and Paula Murphy Wright of Star City, AR.

The Southern Research Station proudly announce in this catalogue **Individual-tree basal area growth, survival, and total height models for upland hardwoods in the Boston Mountains of Arkansas**, authored by Paul A. Murphy and David L. Graney. To order this publication, please circle number **55** on the request card.

## RECENT PUBLICATIONS -- SEPTEMBER 1988

Barry, Robert X.; Parresol, Bernard R.; Devall, Margaret S. 1995. **Neotropical migratory birds of the Kisatchie National Forest, Louisiana: abstracts for selected species and management considerations.** Gen. Tech. Rep. SO-115. New Orleans, LA: U.S. Department of Agriculture, Forest Service, Southern Forest Experiment Station. 72 p.

Available literature on 13 species of neotropical migrants that breed on the Kisatchie National Forest is reviewed. Population trends, forest management practices, and research needs are discussed. **(1)**

Bonner, F.T. 1998. **Testing tree seeds for vigor: a review.** Seed Technology. 20(1): 5-17.

This review examines the use of vigor tests for tree seeds. It suggests that precise evaluations of these tests and their application with seeds of woody plants is not yet possible. This is due to the wide genetic variation, primarily manifested in variable maturity and dormancy, that exists in most tree seed lots. Sensitive measurements of germination rate during standard germination tests have proved to be just as good, if not better, than any vigor test in judging the quality of seed lots. Accelerated aging, leachate conductivity, and germination rate all show promise, but extensive tests of field emergence are needed to validate the laboratory test procedures and interpretation.

The evolution of vigor testing in agricultural seeds has been a slow, arduous, and still unfinished process. Reaching agreement on a definition for "seed vigor" and which tests are suitable for each species has been difficult. The process still continues, however, as new methods are devised and old ones are improved. Users of tree seeds (foresters, nursery managers, horticulturists, etc.) perceive a need for vigor testing of tree seeds and have encouraged tree seed researchers to pursue that goal. This review presents the published research on vigor testing of tree seeds, some unpublished data, and suggests which vigor tests show promise for operational use with tree seeds. **(2)**

Bowker, J.M.; Leeworthy, V.R. 1998. **Accounting for ethnicity in recreation demand: a flexible count data approach.** Journal of Leisure Research. 30(1): 64-78.

The authors examine ethnicity and individual trip-taking behavior associated with natural resource based recreation in the Florida Keys. Bowker and Leeworthy estimate trip demand using the travel cost method. They then extend this model with a varying parameter adaptation to test the congruency of demand and economic value across white and Hispanic user subgroups. The researchers' findings indicate significant differences in price response leading to divergent per-trip consumer surplus and price elasticity between these two groups. These differences raise important distribution and equity concerns with respect to the possible future use of pricing policies like user fees. **(3)**

Bowker, J. M.; English, Donald B. K.; Donovan, Jason A. 1996. **Toward a Value for Guided Rafting on Southern Rivers.** Journal of Agricultural and Applied Economics. 28(2): 423-432.

This study examines per trip consumer surplus associated with guided whitewater rafting on two southern rivers. First, household recreation demand functions are estimated based on the individual travel cost model using truncated count data regression methods and alternative price specifications. Findings show mean per trip consumer surplus point estimates between \$89 and \$286, depending on modeling assumptions and river quality. Magnitudes of these surpluses are very dependent on assumptions about the opportunity cost of time. **(4)**

Brinker, Richard W.; Klepac, John F.; Stokes, Bryce J.; Roberson, Joe D. 1996. **Effect of tire size on skidder productivity.** In: Proceedings: Certification—Environmental implications for forestry operations; 1996 September 9-11; Quebec City, Quebec; joint conference, Canadian Woodlands Forum, Canadian Pulp and Paper Association, and International Union of Forest Research Organizations: E85-E89.

During the spring of 1996 a collaborative effort among Mead Coated Board, the Auburn University School of Forestry, and the Southern Research Station was initiated to evaluate skidder production performance as a function of tire size and soil condition (i.e., wet and dry season). The objective of the study was to determine production and cost differences among 28L-26, 30.5L-32, 67x34.00-25, and 66x43.00-25 tires. The first portion of the study was completed for dry sites, and there proved to be no significant differences in productivities among the tires tested. Wider tires do not hinder productivity under dry conditions. Additional data for the same tires will be collected under wet conditions in order to make comparisons among the tires and between the seasons. The goal is to develop a strategy for optimal tire management. **(5)**

Bruce, Richard C. 1996. **Life-history perspective of adaptive radiation in desmognathine salamanders.** Copeia. 4:783-790.

This study investigates interspecific variation in age at first reproduction, fecundity, and body size in multispecies assemblages of desmognathine salamanders. The hypotheses tested are that interspecific differences in body size among desmognathines stem proximately from variation in age at first reproduction and that variation in the latter trait is positively correlated with variation in fecundity among species. It is shown that a correlation between age at first reproduction and fecundity, combined with a uniform rate of survival, based on available estimates of these parameters will yield equivalent values of net reproductive rate among the species of a given assemblage. Such equivalence represents a form of life-history symmetry. Data from two assemblages are presented in support of the argument for symmetry. Such life-history symmetry may reflect uniformity in morphological specialization in desmognathines. Given the morphological adaptations to burrowing (head-wedging) in the subfamily, the relationship between adult body size and habitat preference in *Desmognathus* may reflect adaptation to the size of cover objects and composition of the substratum along the aquatic-terrestrial habitat gradient. The scientist proposes that these variables, in association with predation and competition, represent the selective factors responsible for body size diversification in *Desmognathus*. **(6)**

Bucci, G.; Kubisiak, T.L.; Nance, W. L.; Menozzi, P. 1997.

**A population 'consensus', partial linkage map of *Picea abies* Karst. based on RAPD markers.** Theoretical Applications of Genetics. 95:643-654.

The authors built a "consensus" partial linkage map based on RAPD markers using 48 sibships of eight megagametophytes each from a natural population of Norway spruce. A RAPD linkage map for a single individual from the same population had previously been constructed. Using 30 random decamers that had yielded 83 RAPD markers in the single-tree map, eight megagametophytes for each of the 48 sibships were screened. The linkage relationship among markers was estimated considering each family of eight megagametophytes as a progeny of a phase-unknown backcross mating between a heterozygous mother and a fictitious "recessive" father. Markers were assigned to windows using  $LOD = 2.0$  and  $\theta = 0.4$  as thresholds, and ordered using a criterion of interval support  $\geq 2.0$ . For eight "windows" of recombination selected on the single-tree map, the scientists investigated the consistency of marker order in the two maps. They adopted restrictive criteria for rejecting co-linearity between the two locus orders. For each window the authors imposed the most likely locus order obtained from one data set to the other (and vice versa), obtaining two symmetrical log-likelihood differences. They considered the hypothesis of co-linearity rejected when both symmetrical differences were significant ( $\Delta LOD > 3.0$ ). By bootstrapping a subset of markers for each window (highly informative, "framework" loci chosen on the previous single-tree map using a matrix correlation method) the sampling variability of the single-tree and population maps was estimated. As expected, the population map was affected by a larger variability than the single-tree map. Heterogeneity in pairwise recombination fractions among groups of sibship revealed a (possible) alternative genomic arrangement detected within a single recombination window. **(7)**

Burkman, William G.; Vissage, John S.; Hoffard, William H.; and others. 1998. **Summary report: forest health monitoring in the South, 1993 and 1994.** Resour. Bull. SRS-32. Asheville, NC: U.S. Department of Agriculture, Forest Service, Southern Research Station. 91 p.

The U.S. Department of Agriculture, Forest Service, various State forestry and agriculture agencies, and other Federal agencies launched a cooperative program, Forest Health Monitoring, to monitor the health of the Nation's forests. Several indicators have been measured on permanent plots in 17 States. This report summarizes data gathered in 1993 and 1994 from Alabama, Georgia, and Virginia. Simple proportions of crown ratings and damage data from sample plots do not suggest any widespread problems in these States, except for Virginia pine, where crown conditions continue to decline. A synopsis of forest insect and disease surveys in the southern region shows that certain pests continue to cause damage and mortality. **(8)**

Carter, Emily; Rummer, Bob; Stokes, Bryce. 1997. **Site disturbances associated with alternative prescriptions in an upland hardwood forest of northern Alabama.** In: Proceedings: 1997 ASAE [American Society of Agricultural Engineers] annual international meeting; 1997 August 10-14; Minneapolis, MN. St. Joseph, MI: American Society of Agricultural Engineers; 975013: 18 p.

A study was installed in an upland hardwood forest to evaluate the site impacts associated with three alternative prescriptions --- clearcut, deferment cut, and strip cut. Two methods of site impact assessment were employed: 1) assignment of disturbance classes to selected points within each treatment area; and 2) measurement of soil bulk density, gravimetric water content, and soil strength at points previously evaluated for soil disturbance class. Clearcut and deferment cut treatments produced the greatest impacts, as evidenced by higher percentage of slightly and highly disturbed areas and increases in bulk density and soil strength. Strip cut treatments had less impact on a stand-wide basis but cut strips experienced similar impacts. **(9)**

Clark, Mark M.; Meller, Russell D.; McDonald, Timothy P.; Ting, Chao Chi. 1997. **A new harvest operation cost model to evaluate forest harvest layout alternatives.** In: Forest operations for sustainable forests and healthy economies; Proceedings, Council on Forest Engineering, 20<sup>th</sup> annual meeting; 1997 July 28-31; Rapid City, SD. Rapid City, SD: Council on Forest Engineering: 42-47.

The authors develop a new model for harvest operation costs that can be used to evaluate stands for potential harvest. The model is based on felling, extraction, and access costs, and is unique in its consideration of the interaction between harvest area shapes and access roads. The scientists illustrate the model and evaluate the impact of stand size, volume, and road cost when determining harvest layouts. Since the approach lays the foundation for operational and tactical integration, future research will integrate the two levels for both the single and multi-period problem. **(10)**

Conner, Roger C. 1998. **South Carolina's forests, 1993**. Resour. Bull. SRS-25. Asheville, NC: U.S. Department of Agriculture, Forest Service, Southern Research Station. 78 p.

Timberland area in South Carolina now totals 12.4 million acres, a 2 percent increase since 1986. Nonindustrial private timberland amounts to 8.9 million acres, up by 648,000 acres. Forest industry timberland declined for the first time, dropping from 2.7 million acres to 2.4 million acres. Area of loblolly pine increased 12 percent to 4.3 million acres. The decline in acres of longleaf pine continued, falling 7 percent to 369,000 acres. Hardwoods now occupy 5.0 million acres, a decline of 206,000 acres since 1986. Softwood growing-stock volume dropped 10 percent to 8.0 billion cubic feet. Hardwood inventory declined to 8.7 billion cubic feet, 5 percent decrease. Damage from Hurricane Hugo is responsible for much of the decline in volume. Annual mortality averaged 407.3 million cubic feet, an increase of 263.2 million cubic feet since 1985. Current net annual growth is 525.6 million cubic feet. Total removals from growing stock increased 16 percent, averaging 728.0 million cubic feet per year between 1986 and 1993. **(11)**

Connor, K.F.; Bonner, F.T. 1998. **Physiology and biochemistry of recalcitrant *Guarea guidonia* (L.) Sleumer seeds**. Seed Technology. 20(1):

Investigations of recalcitrant, or desiccation-sensitive, seeds have as yet failed to identify the causes of this phenomenon. Experiments with *Guarea guidonia* (L.) Sleumer (American muskwood) were initiated to determine the effects of desiccation on the physiology and biochemistry of the seeds of this tropical tree species. Seeds were air-dried at room temperature for 7 days. At intervals, germination was tested, moisture content determined, and lipids extracted. The bulk lipids, nonpolar lipids, monoglycerides, and phospholipids were analyzed by gas chromatography (GC), thermal characteristics of whole tissue samples were examined using differential scanning calorimetry (DSC), and moisture content was determined using the Karl Fisher analysis. DSC thermograms showed that as moisture content and germinability of seeds declined, so did enthalpy values and onset temperatures of cotyledon tissue and embryonic axes. GC analyses determined that unsaturated fatty acids accounted for approximately 70 percent of the bulk lipids; however, ratios of unsaturated/saturated fatty acids and amounts of individual fatty acids fluctuated between test periods. Palmitic acid was the most common saturated fatty acid, and linoleic acid was the most prevalent unsaturated fatty acid. Generally, Karl Fisher analyses of seed moisture content offered the best possibility of monitoring seed deterioration during drying. **(12)**

Connor, K.F.; Ferraz, I. D. Kossmann; Bonner, F.T.; Vozzo, J.A. 1998. **Effects of desiccation on the recalcitrant seeds of *Carapa guianensis* Aubl. and *Carapa procera* DC**. Seed Technology. 20(1):

This study was undertaken to determine if the seeds of *Carapa guianensis* Aubl. and *Carapa procera* DC. undergo physiological, biochemical, and ultrastructural changes when they are desiccated; and to find if these changes can be used to monitor viability in *Carapa*. Seeds were air-dried at room temperature for 7 to 11 days. Samples were taken at frequent intervals and germination was tested, moisture determined, lipids extracted, and samples taken for electron microscopy. The moisture content (MC) of the embryonic axes remained high throughout the experiment. The cotyledons were drier and had a higher MC variation between individual seeds during desiccation. While Karl Fisher moisture analyses indicated no relationship between axis MC and seed viability, differential scanning calorimetry (DSC) thermograms showed a strong relationship between the melting endotherm peak onset values, enthalpy (heat content), and seed germinability. Both techniques were ineffective in determining changes in seed viability when viability remained above 50 percent. Analyses of the bulk lipids indicated that changes were taking place, but gas chromatography (GC) results were inconsistent from year to year. Electron microscopy (EM) examinations found that cellular contents of

*Carapa* showed little organization when seeds were fresh, but that spherosomes accumulated as desiccation progressed. These data and those from the moisture, DSC, and GC analyses, add support to the hypothesis that storage problems of recalcitrant seeds are associated with intact seed MC and with lipid composition, metabolism, and distribution in the cells. **(13)**

Devall, Margaret S. 1998. **An interim old-growth definition for cypress-tupelo communities in the Southeast.** Gen. Tech. Rep. SRS-19. Asheville, NC: U.S. Department of Agriculture, Forest Service, Southern Research Station. 13 p.

An interim definition of old-growth cypress-tupelo forests is presented to assist in management of these communities until comprehensive definitions based on research can be formulated. The basic criteria for identifying old-growth cypress-tupelo (*Taxodium distichum-Nyssa aquatica*) communities in the South are presented. **(14)**

Devall, Margaret S.; Baldwin, Virgil C., comps., 1998. **Long-term research does pay off; a summary of the Southern Station experience.** Gen. Tech. Rep. SO-124. Asheville, NC: U.S. Department of Agriculture, Forest Service, Southern Research Station. 190 p.

Description and summaries of completed and ongoing long-term research studies (those in existence for 5 or more years) conducted by scientists of the USDA Forest Service's former Southern Forest Experiment Station (now part of the Southern Research Station) are presented in this report. **(15)**

Devall, Margaret S.; Parresol, Bernard R.; Armesto, Juan J. 1998. **Dendroecological analysis of a *Fitzroya cupressoides* and a *Nothofagus nitida* stand in the Cordillera Pelada, Chile.** Forest Ecology and Management. 108: 135-145.

Lumbering of *Fitzroya cupressoides* in Chile began in 1599 and continued until 1976, when the species was declared a national monument and cutting of live trees was prohibited. Today, *F. cupressoides* is threatened; many of the remaining stands in the coastal range appear to be declining, with a predominance of standing dead stems and patchy, sparse regeneration. The scientists performed tree-ring analysis on a *F. cupressoides* stand and a nearby *Nothofagus nitida* stand in the Cordillera Pelada of coastal Chile (40°S) in order to examine the ecological history of two stands in the montane forest. Analysis demonstrates that the *F. cupressoides* stand has undergone several periods of growth release and disturbance; the last 34 years of the chronology show a trend of increasing growth. In contrast, after 1865 radial growth of the *N. nitida* stand is fairly constant and steady. Radial growth of these two species is highly correlated with spring rainfall. November rainfall of the current growing season proved to be the best growth predictor of *F. cupressoides*, whereas current June and December rain and December rain of the past growing season best predicted growth of *N. nitida*. Although episodic disturbances have occurred, the chronologies demonstrated that these stands are vigorous, despite the presence of dead stands nearby. These results do not support the idea that climatic deterioration is responsible for the decline of *F. cupressoides* during the past 77 years. **(16)**

Dickson, James G. 1997. **Birds of the Southeastern United States: A Historical Perspective.** In: Benz, George W.; Collins, David E., eds. Aquatic fauna in peril: the southeastern perspective. Decatur, GA: Lenz Design & Communications: 233-243.

Historic freshwater aquatic and wetland ecosystems of the Southeastern United States were predominantly rivers and streams and associated natural bottomland forests. These systems have been drastically altered through the creation of reservoirs via damming, through other alterations of water courses and their associated forests, and through conversion to other uses. In this chapter the author addresses historical aspects of bird communities of southeastern aquatic systems by considering the original composition of forested wetlands, the changes that have been wrought to them, and how these changes have most probably influenced bird communities. **(17)**

Froelich, R. C.; Schmidting, R.C. 1998. **Survival of slash pine having fusiform rust disease varies with year of first stem infection and severity.** Southern Journal of Applied Forestry. 22(2): 96-100.

Probabilities of death of young slash pine infected by fusiform rust pathogen varied with timing and severity of infection. Trees in nine slash pine plantations varying widely in site quality and initial number of trees per acre had similar probabilities of death from rust. About 90 percent of trees with stem infections in the first three growing seasons died by age 15 if the gall spanned more than 50 percent of the circumference of the stem by age 5. If 50 percent gall encirclement occurred after age 5, mortality rates dropped to about 30 percent at age 15. Where first stem infection occurred after the fifth year, probability of death was essentially the same as for rust-free trees. Methods are given for using timing-severity data to estimate future stocking. **(18)**

Gardiner, Emile S.; Hodges, John D. 1998. **Growth and biomass distribution of cherrybark oak (*Quercus pagoda* Raf.) seedlings as influenced by light availability.** Forest Ecology and Management. 108: 127-134.

Cherrybark oak (*Quercus pagoda* Raf.) seedlings were established and raised in the field under four light levels (100 percent, 53 percent, 27 percent or 8 percent of full sunlight) to study the effects of light availability on their shoot growth, biomass accumulation, and biomass distribution. After two growing seasons, greatest stem growth was observed on seedlings which received intermediate light levels, and this growth was associated to a greater accumulation of total seedling biomass and a distribution pattern which balanced accumulation of root and shoot biomass. In contrast, less biomass accumulation and a biomass distribution pattern that favored root growth over stem growth were characteristic of seedlings receiving full sunlight. These results suggest that regeneration of cherrybark oak on mesic sites may be limited by preferential root growth, but reproduction of this species may be amenable to silvicultural practices that improve the light environment through stand manipulation. **(19)**

Glasser, Wolfgang G.; Rials, Timothy G.; Kelly, Stephen S.; Dave, Vipul. 1998. **Studies of the molecular interaction between cellulose and lignin as a model for the hierarchical structure of wood.** In: Heinze, Thomas J.; Glasser, Wolfgang G., eds. Cellulose derivatives: modification, characterization, and nanostructures; American Chemical Society Symposium series 688; Orlando, FL; 1996 August 25-29; Washington, DC, American Chemical Society: 265-282.

Wood and dietary fiber products all belong to a class of biomolecular composites that are rich in cellulose and lignin. The interaction between cellulose and lignin determines such properties as mechanical strength (wood); creep, durability, and aging; cellulose purity (pulp); and digestibility (nutrients). The understanding of the interaction between cellulose and lignin can be approached from various types of analyses involving the natural biocomposites, or it can be explored by studying the physical mixtures of the two types of macromolecules. The latter can be prepared by mixing the respective polymers in solid, solution, or melt form within the constraints of solubility and melt flowability. Such mixtures have been examined, and the results suggest that cellulose and its derivatives form two distinct phases with lignin and its derivatives; a crystalline polysaccharide-phase and a continuous amorphous phase that provides evidence for strong intermolecular interaction between the two components. In addition, results suggest that lignin and/or its derivatives are capable of contributing to the supermolecular organization of cellulose (derivatives). The interaction between lignin and cellulose varies in relation to chemical differences, as well as molecular parameters. The results are consistent with the view that the hierarchical structure of the natural biocomposite wood is not only the consequence of a sequence of biochemical events, but that it is the result of various thermodynamic driving forces that are independent of the biosynthetic origin. **(20)**

Goelz, J.C.G.; Burk, T.E. 1998. **Long-term trends in height growth of jack pine in North Central Ontario.** Forest Science. 44(1): 158-164.

Although most investigations of long-term growth trends of trees involve description of radial growth of trees, investigation of height growth of dominant and codominant trees also warrants attention for two significant reasons -- the dependent variable is largely independent of stand density and it represents an index of stand productivity. Residuals from a height growth equation for jack pine (*Pinus banksiana* Lamb.) were used to examine long-term trends in height

growth. No consistent long-term trend was apparent; however, a period of superior growth was identified during the 1960's. Short term changes in climatic variables could account for a short duration of increased growth. As anthropogenic factors, such as air pollution, did not exhibit a trend coincident with the growth trend, they do not represent a reasonable explanation. An additional benefit of detailed examination of trends in residuals is the ability to uncover misidentification of models. The examination may suggest an inappropriate form for the equation was used, or may suggest that important variables are missing from the model. **(21)**

Grace, J.M., III; Rummer, B.; Stokes, B.J.; Wilhoit, J. 1998. **Evaluation of erosion control techniques on forest roads.** Transactions of the American Society of Agricultural Engineers. 4(2): 383-391.

The cutslope and fillslope on a newly constructed forest road on the Talladega National Forest near Heflin, AL were treated with three erosion control techniques: wood excelsior erosion mat, native grass species, and exotic grass species. Bare soil plots were used as the experimental controls. Total sediment yield was measured during the period 21 September 1995 to 18 March 1996. A randomized complete block design was used to evaluate treatment methods on the basis of sediment yield and runoff volume. No significant difference in sediment yield was found from the fillslope among the treatments. However, on the cutslope, significant differences were detected among all treatments. The erosion mat treatment was most effective in mitigating erosion losses, with a 98 percent reduction in cutslope sediment yield and 88 percent reduction in fillslope sediment yield. **(22)**

Grace, John M., III; Rummer, Bob; Stokes, Bryce J. 1997. **Sediment production and runoff from forest road sideslopes.** In: Proceedings: 1997 ASAE [American Society of Agricultural Engineers] annual international meeting; 1997 August 10-14; Minneapolis, MN. St. Joseph, MI: American Society of Agricultural Engineers; 975019; 19 p.

Sediment and runoff production from three erosion control treatments were investigated on a newly constructed road during a two-year study period. The treatments included a wood excelsior erosion mat, native grass species, and exotic grass species. Sediment and runoff production were significantly reduced on both the cutslope and fillslope by the treatments. Grass treatments showed more than a 90 percent reduction in sediment production between the two study years. The erosion mat treatment showed relatively insignificant sediment production for both years during the study. **(23)**

Greenberg, Cathryn H.; McNab, W. Henry. 1998. **Forest disturbance in hurricane-related downbursts in the Appalachian mountains of North Carolina.** Forest Ecology and Management. 104: 179-191.

The authors characterized five 0.2 to 1.1 ha gaps created by downbursts during Hurricane Opal in xeric oak forest at the Bent Creek Experimental Forest, Asheville, NC. Direction of windthrow was nonrandom in four of the five gaps, but differed among gaps, suggesting that each was caused by an independent downburst. Windthrows reduced tree density by 19 to 39 percent and basal area (BA) by 30 to 53 percent within gaps. Most windthrows were uprooted (17 to 38 percent of all trees) versus broken below 1.8 m height (0 to 3 percent). Most species were uprooted in proportion to their abundance regardless of canopy position. Red oaks (*Quercus coccinea*, *Quercus rubra*, and *Quercus velutina*) were disproportionately uprooted, while *Nyssa sylvatica* and *Acer rubrum* were resistant to uprooting. As a group, *Quercus* lost 27 to 47 percent of individuals and 41 to 50 percent of BA. *Q. coccinea* lost  $\geq 44$  percent of trees and  $> 55$  percent of BA in sites where it occurred. Only minor shifts in canopy species dominance were evident. For several species, significantly more large-diameter individuals uprooted than their smaller counterparts. No relationship between d.b.h. and number uprooted was detected for the red oaks, however. Canopy position appeared to have little bearing on this relationship. Uprooting disturbed 1.6 to 4.3 percent of the ground area and displaced 130 to 587 m<sup>3</sup> of root-soil-rock masses (rootmasses) per gap. Greenberg and McNab suggest that episodic, high-intensity wind is not uncommon, and has a substantial influence on forest structure, species composition, regeneration, and microtopography of the Southern Appalachian mountains at variable scales. **(24)**

Greenlaw, Jon S.; Shackelford, Clifford E.; Brown, Raymond E. 1998. **Call mimicry by eastern towhees and its significance in relation to auditory learning.** *Wilson Bulletin.* 110(3): 431-434.

The authors document cases of eastern towhees (*Pipilo erythrophthalmus*) using mimicked alarm calls from three presumptive models (blue jay (*Cyanocitta cristata*), brown thrasher (*Toxostoma rufum*), and American robin (*Turdus migratorius*)). In four instances, male towhees employed heterospecific calls without substitution in their own call repertoires. Three birds (New Jersey, New York) used jay-like calls mixed with "Chewink" calls in the same bouts of calling. One bird (New York) increased the frequency of its mimicked call during intense reactions to disturbance (high rate of calling). A Texas towhee employed jay-like and Chewink calls separately in different contexts. In another case, sequences of robin-like alarm calls were used by a towhee to form unusual, distinctive song-types during bouts of singing. These observations suggest that some aspects of towhee alarm call repertoires may be influenced by auditory learning, and that mimicked alarm calls also can be incorporated into song repertoires. **(25)**

Groom, Leslie H.; Zink, Audrey G. 1998. **Techniques in experimental mechanics applicable to forest products research – Proceedings of a plenary session at the Forest Products Society annual meeting;** 1994 June 26-29; Portland, ME: Gen. Tech. Rep. SO-125. Asheville, NC: U.S. Department of Agriculture, Forest Service, Southern Research Station. 45 p.

This publication presents opening remarks and presentations of five speakers from a plenary session on techniques in experimental mechanics presented at the Forest Products Society annual meeting in Portland, ME on June 26-29, 1994. Information presented in this report is aimed at forest products researchers and the forest products industry. **(26)**

Guldin, James M.; Baker, James B. 1988. **Uneven-aged silviculture, southern style.** *Journal of Forestry.* 96(7): 22-26.

Data spanning 60 years on uneven-aged loblolly-shortleaf pine stands in Arkansas show that two regulation methods have been successful in regulating stand development. Key attributes of these methods are that regulation is more important than balance, residual basal area drives stand development, and regeneration is the first indicator of sustainability. Marking uneven-aged stands is best kept simple: mark to cut the poorest trees and leave the best, regardless of target structure or method of regeneration. To be successful in the long term, new methods of regulating uneven-aged and multiaged stands should share these attributes. **(27)**

Haag, Wendell R.; Warren, Melvin L., Jr. 1998. **Role of ecological factors and reproductive strategies in structuring freshwater mussel communities.** *Canadian Journal of Fisheries and Aquatic Sciences.* 55: 297-306.

Freshwater mussel community composition within two drainage basins in Alabama, U.S.A., was better explained by patterns of variability in the fish community and the type of strategy used by mussels for infecting host-fishes than by patterns of variability in microhabitat. Mussel species richness increased in a downstream direction, and large-stream sites were characterized by a distinctive faunal assemblage that was similar between drainages. In contrast, faunal composition of headwater sites varied widely between drainages. Patterns of mussel community variation were correlated with patterns of fish community variation but not with habitat. Densities of host-specialist mussels with elaborate host-attracting mechanisms and host-generalist mussels were independent of host-fish densities, and these mussels were present throughout the drainages. Densities of host-specialist mussels without elaborate host-attracting mechanisms were correlated positively with host-fish densities and were absent or rare in headwater and midreach streams. Haag and Warren propose that mussel species dependent on host-fish density are restricted to sites with stable numbers of hosts, but mussels not dependent on host-fish density are able to persist in areas with more unstable fish assemblages, such as headwaters. **(28)**



Haywood, James D.; Tiarks, Allan E.; Elliot-Smith, Michael L.; Pearson, Henry A. 1998. **Response of direct seeded *Pinus palustris* and herbaceous vegetation to fertilization, burning, and pine straw harvesting.** 1998. Biomass and Bioenergy. 14(2): 157-167.

Fallen pine straw (needles) is a renewable biological resource valued as a mulch in horticulture and for landscaping. However, its harvesting may have detrimental long-term effects on forest soils and vegetation. To compare current pine straw harvesting practices, a randomized complete block splitplot study was established during 1990 in a 34-year-old stand of direct-seeded longleaf pine (*Pinus palustris* Mill.) that had been prescribed burned every 3 years since establishment. Practices included no fertilizer or applications of 50 kg ha<sup>-1</sup> N and 56 kg ha<sup>-1</sup> P in both 1991 and 1997 as the main plot treatment. The subplot management practices were prescribed burning and the mechanical baling and removal of straw. Pine straw harvesting eventually removed the forest floor and increased soil bulk density by 1993. The growth of longleaf pine was not significantly affected by treatments over a 5-year period from early 1991 to early 1996. Herbaceous plant productivity was determined in July 1997, and there were shifts in plant dominance associated with treatments. Fertilization increased current-year herbaceous plant biomass by 59 percent on an oven-dried weight basis. Among management practices, prescribed burning in early 1991, 1994, and 1997, with two annual straw harvests in early 1992 and 1993, resulted in the greatest herbaceous plant yields by July 1997. The lowest yields in 1997 were on plots that were either annually harvested six times or had been left untreated for over 6 years. Burning every 3 years favored pinehill bluestem (*Schizachyrium scoparium* var. *divergens* (Hack.) Gould), which is often the dominant grass on longleaf uplands in the West Gulf Coastal Plain of the U.S.A. Raking straw shifts herbaceous plant dominance to other grasses, principally the panicums (*Dicanthelium* spp. and *Panicum* spp.). The cessation of management favored bracken fern (*Pteridium aquilinum* var. *pseudocaudatum* (Clute) Heller). (29)

Hildebrand, Robert H.; Lemly, A. Dennis; Dolloff, C. Andrew; Harpster, Kelly L. 1998. **Design considerations for large woody debris placement in stream enhancement projects.** North American Journal of Fisheries Management. 18: 161-167.

Log length exerted a critical influence in stabilizing large woody debris (LWD) pieces added as an experimental stream restoration technique. Logs longer than the average bank-full channel width (5.5 m) were significantly less likely to be displaced than logs shorter than this width. The longest log in stable log groups was significantly longer than the longest log in unstable groups. The distances moved by displaced logs demonstrated a quadratic relationship associated with log length; longer logs moved less often, but they moved farther when entrained in the current than the majority of mobile smaller logs. Log stability did not differ between a treatment section with randomized placement of LWD and a section in which LWD was placed systematically to best modify channel habitats. Channel scouring typically occurred around LWD oriented as ramps and as dams perpendicular to stream flow; aggradation occurred above and below pieces oriented as dams angled to the current. Microscale channel responses to LWD additions varied. (30)

Howell, Michael; Johnson, Tony G. 1998. **Oklahoma's timber industry -- an assessment of timber product output and use, 1996.** Resour. Bull. SRS-30. Asheville, NC: U.S. Department of Agriculture, Forest Service, Southern Research Station. 16 p.

In 1996, roundwood output from Oklahoma's forests totaled 113 million cubic feet. Mill byproducts generated from primary manufacturers was 42 million cubic feet. Almost all plant residue was used primarily for fuel and fiber products. Saw logs were the leading roundwood product at 54 million cubic feet; pulpwood ranked second at 40 million cubic feet. There were 73 primary processing plants operating in Oklahoma in 1996. Receipts totaled 110 million cubic feet. (31)

Howell, Michael; Levins, Robert. 1998. **Arkansas' timber industry—an assessment of timber product output and use, 1996.** Resour. Bull. SRS-28. Asheville, NC: U.S. Department of Agriculture, Forest Service, Southern Research Station. 23 p.

In 1996, roundwood output from Arkansas' forests totaled 636 million cubic feet. Mill byproducts generated from primary manufacturers was 286 million cubic feet. Almost all plant residues were used primarily for fuel and fiber products. Saw logs were the leading roundwood product at 315 million cubic feet; pulpwood ranked second at 242 million cubic feet; veneer logs were third at 74 million cubic feet. The number of primary processing plants was 147 in 1996. Total receipts were 661 million cubic feet. **(32)**

Huang, Hongwen; Dane, Fenny; Kubisiak, Tom L. 1998. **Allozyme and RAPD analysis of the genetic diversity and geographic variation in wild populations of the American chestnut (FAGACEAE)**. American Journal of Botany. 85(7): 1013-1021.

Genetic variation among 12 populations of the American chestnut (*Castanea dentata*) was investigated. Population genetic parameters estimated from allozyme variation suggest that *C. dentata* at both the population and species level has narrow genetic diversity as compared to other species in the genus. Average expected heterozygosity was relatively low for the population collected in the Black Rock Mountain State Park, GA ( $H_e = 0.096 \pm 0.035$ ), and high for the population in east central Alabama ( $H_e = 0.196 \pm 0.048$ ). Partitioning of the genetic diversity based on 18 isozyme loci showed that ~10 percent of the allozyme diversity resided among populations. Cluster analysis using unweighted pair-group method using arithmetic averages of Rogers' genetic distance and principal components analysis based on allele frequencies of both isozyme and RAPD loci revealed four groups: the southernmost population, south-central Appalachian populations, north central Appalachian populations, and northern Appalachian populations. Based on results presented in this study, a conservation strategy and several recommendations related to the backcross breeding aimed at restoring *C. dentata* are discussed. **(33)**

Johnson, Cassandra Y.; Bowker, J.M.; English, Donald B.K.; Worthen, Dreamal. **Wildland recreation in the rural South: an examination of marginality and ethnicity theory**. 1998. Journal of Leisure Research. 30(1): 101-120. **(34)**

The ethnicity and marginality explanations of minority recreation participation provide the conceptual basis for the authors' inquiry. These theories are examined for a sample of rural African-Americans and whites. Using logistic regression, the researchers test for black and white differences in: 1) visitation to wildland areas in general; 2) visitation to national forest wildland areas; and 3) household visitation to the Apalachicola National Forest. Next, the authors test the marginality/ethnicity paradigm by examining reasons for non-visitation and latent demand for visitation. Findings show that race, sex, and age, as well as a race/poor (poor black) interaction term are strong predictors of visitation. However, race appears to be less effective in predicting reasons for non-visitation and latent demand for wildland visitation. Overall, results do not provide strong support for either ethnicity or marginality as a sole explicator of racial differences in wildland recreation. Rather, results indicate that the two probably work in combination to explain racial differences. The poor black interaction also suggests that rural black visitation to wildlands varies depending upon income, with less affluent blacks actually participating more than those with higher incomes. This contradicts the marginality assertion that recreation participation varies positively with income and suggests that marginality theory may need to be qualified depending upon residence (rural versus urban) and type of activity.

Johnson, Tony G.; Gober, Jim R.; Nix, J. Stephen. 1998. **Alabama's timber industry - - an assessment of timber product output and use, 1995**. Resour. Bull. SRS-27. Asheville, NC: U.S. Department of Agriculture, Forest Service, Southern Research Station. 28 p.

In 1995, roundwood output from Alabama's forests totaled 1.3 billion cubic feet. Mill byproducts generated from primary manufacturers amounted to 471 million cubic feet. Almost all plant residues were used primarily for fuel and fiber products. Pulpwood was the leading roundwood product at 698 million cubic feet; saw logs ranked second at 473 million cubic feet; veneer logs were third with 94 million cubic feet. The number of primary processing plants was 211. Total receipts amounted to 1.4 billion cubic feet. **(35)**

Johnson, Tony G.; Stratton, Daniel P. 1998. **Historical trends of timber product output in the South.** Resour. Bull. SRS-33. Asheville, NC: U.S. Department of Agriculture, Forest Service, Southern Research Station. 56 p.

Historical data of periodic canvasses of primary wood-using plants are presented for the 13 Southern States. They are Alabama, Arkansas, Florida, Georgia, Kentucky, Louisiana, Mississippi, North Carolina, Oklahoma, South Carolina, Tennessee, Texas, and Virginia. Cubic foot and standard volume tables are presented for production only. Production is the sum of timber harvested and used within a State, plus all roundwood exported to other U.S. States. **(36)**

Kluender, R.A.; Stokes, B.J. 1996. **Felling and skidding productivity and harvesting cost in southern pine forests.** In: Proceedings: Certification—Environmental implications for forestry operations; 1996 September 9-11; Quebec City, Quebec; joint conference Canadian Woodlands Forum, Canadian Pulp and Paper Association, and International Union of Forest Research Organizations: 35-39.

Sixteen stands were harvested at various levels of basal area removed (intensity). Chainsaw felling productivity was more sensitive to stem diameter than harvest intensity. Skidding productivity was highest when removing large trees at high intensity. Harvesting cost was more sensitive to stem size than harvest intensity, although harvest intensity was a very important factor in cost of removing small stems. **(37)**

Knoepp, Jennifer D.; Swank, Wayne T. 1997. **Long-term effects of commercial sawlog harvest on soil cation concentrations.** Forest Ecology and Management. 93: 1-7.

There is increasing concern about the effects of nutrient removal associated with various forest harvesting practices on long-term site productivity. The authors measured exchangeable soil cation concentration responses to a commercial clearcut sawlog harvest in mixed hardwoods on a 59-ha watershed in the Southern Appalachians. Soils were sampled 17 months prior to and periodically for 17 years after harvest. Concentrations of Ca, Mg, and K increased significantly in the 0 to 10 cm soil layer for 3 years following harvest compared to pre-treatment levels. Concentrations of Mg and K were still significantly above pre-treatment levels 17 to 20 years following harvest. Calcium concentrations did not change significantly at the 10 to 30 cm depth, but both Mg and K showed significantly higher concentrations in some post-treatment years. Soils in the adjacent reference watershed showed no significant changes in soil cation concentrations over the same 17-year period. Results indicate that sawlog harvest using cable-yarding techniques on these sites does not adversely impact soil cation concentrations. **(38)**

Knowe, Steven A.; Foster, G. Sam; Rousseau, Randall J.; Nance, Warren L. 1998. **Height-age and height-diameter relationships for monocultures and mixtures of eastern cottonwood clones.** Forest Ecology and Management. 106: 115-123.

Data from an eastern cottonwood clonal mixing study in Mississippi and Kentucky, USA, were used to test the effects of planting locations and genetics (clonal proportions) on height-age and height-d.b.h. functions. Planting locations, which accounted for 5.6 percent of the variation in observed dominant height growth ( $p = 0.0001$ ), were more important than clonal proportions, which accounted for only 1.0 percent of the variation ( $p = 0.0077$ ). Interactions between clones in mixtures were not significant ( $p = 0.9178$ ), but three cases of overcompensation and undercompensation paralleled those observed for basal area. Planting locations were associated with differences in maximum height in the height-d.b.h. function and clonal proportions were associated with differences in height of trees with smaller than average d.b.h. Although statistically significant, the effects of planting locations and clonal proportions were not important enough to incorporate into the final height-d.b.h. model. **(39)**

Kormanik, Paul P.; Sung, Shi-Jean S.; Zarnoch, Stanley J. 1998.

**Immature Loblolly Pine Growth and Biomass Accumulation: Correlations with Seedlings Initial First-Order Lateral Roots.** Southern Journal of Applied Forestry. 22(2): 117-123.

Five to seven years after being graded by first-order lateral root (FOLR) numbers and outplanted, loblolly pine (*Pinus taeda* L.) seedlings were excavated using a commercial tree spade and root systems reevaluated. Current competitive position of trees was related to initial FOLR numbers of 1-0 seedlings. Current FOLR numbers were comparable among tree size classes, but root diameters where the spade severed the root were different. The dominant and codominant individuals had much larger FOLR cross sectional area at the severed point. The larger diameter laterals allow exploration of larger soil volume since they extended greater distances from the tree. Root biomass was readily predicted based on either stem diameter breast height squared ( $D^2H$ ), or total aboveground biomass. Approximately 75 percent of standing tree biomass was aboveground and 25 percent belowground for all initial root grades, current crown classes, and sites. Subsoil compaction layers appeared to have a major impact on tree development at any specific location within a plantation. Compaction layers affected heights and diameters but not root/top ratios or the relative competition position based on initial FOLR numbers. These compaction layers resulted in plate-like taproots that suggested further root penetration was unlikely. (40)

Lancia, Richard A.; Braun, Clait E.; Collopy, Michael W.; and others 1996. **ARM! For the future: adaptive resource management in the wildlife profession.** Wildlife Society Bulletin. 24(3):436-442. (Ed. Note: Nancy G. Tilghman [Herbert] is the Station's author for this publication.)

The authors encourage wildlife professionals to shift from a traditional, agricultural paradigm to an ecological one through adaptive resource management (ARM). The wildlife profession has a long-established tradition of examining and debating the quality and direction of wildlife research. This introspection is good, for it encourages the profession to improve and mature. In this essay, the authors provide what we hope will be a significant milepost in that process by advocating a general philosophy and protocol for wildlife research and management. Rather than articulating a list of specific research priorities and reiterating the need for additional research money, the authors encourage an encompassing, fundamental shift that will promote more efficient use of current research and management dollars. Over the last several years, various groups and many individuals interested in the management of natural resources have recognized a need for reform in natural resources-related research. These include the Ecological Society of America's Committee for a Research Agenda for the 1990's, the National Research Council's Committee on Forestry Research, the Society of American Forester's Task Force on Sustaining Long-term Forest Health and Productivity, and many others. There appears to be a general consensus that change is due. Furthermore, intensifying political debates about management of natural resources (e.g., timber harvests and ancient forests, sustainable development, and the preservation-conservation of biodiversity) call for integrated research and management to address uncertainty in wildlife and ecosystem management, and thereby ameliorate controversy in the future. Research and management can no longer afford to be "two solitudes"; distinctions between basic and applied research have blurred. The central issue is the application of sound scientific principles to solve problems. (41)

Lanford, Bobby; Stokes, Bryce J. 1996. **Comparison of two thinning systems. Part 2. Productivity and costs.** Forest Products Journal. 46(11/12): 47-53.

A side-by-side comparison of two popular thinning systems, a skidder system and a forwarder system, was made during winter logging conditions in southern Alabama. The first report of this study addressed stand and site impacts of these two thinning systems. This report focuses on productivity and costs while thinning an 18-year-old loblolly pine plantation. The skidder system used a feller-buncher with a shear head followed by a grapple skidder that transported bunches of trees and delimbed them with a grade delimber. A loader/slasher combination processed trees into 7.5-foot lengths and loaded tractor trailers. The forwarder system used two machines: a harvester and a forwarder. The harvester felled, delimbed, and bucked trees into 7.5-foot or cut-to-length pulpwood. The forwarder loaded processed wood and transported it to setout trailers. Production rates were sampled using time and production studies for each machine in the two systems. Production rates and estimated costs were combined for each system to give overall system costs. System

production was limited by the woods transport vehicles, the single skidder for the skidder system, and the forwarder for the forwarder system. Weekly production rates were 261 cords for the skidder system and 249 cords with cut-to-length wood and 200 cords with 7.5-foot wood for the forwarder system. Cost per cord was slightly lower for the forwarder system using cut-to-length wood as compared to the skidder system, a difference of \$0.14, and higher for the forwarder system in 7.5-foot wood, a difference of \$3.77. **(42)**

Lavdas, Leonidas G. 1997. **Accuracy of National Weather Service wind-direction forecasts at Macon and Augusta, Georgia.** National Weather Digest. 22(1): 22-26.

National Weather Service wind forecasts and observations over a nine-year period (1985 to 1993) were analyzed to determine the usefulness of these forecasts for forestry smoke management. Data from Macon, GA indicated that forecasts were accurate to within plus or minus 22.5° about 38 percent of the time. When a wider plus or minus 67.5° window was used, accuracy increased to about 79 percent. When forecast wind speeds were 15 mph or more, forecast wind direction improved in accuracy by about 15 percent. Some bias was present in wind-direction forecasts. Errors of 22.5 to 67.5° to the left of the forecast direction (one semiquadrant left) were more common than similar errors to the right. This bias is most pronounced for forecasts verifying at night, with leftward errors occurring up to 2.5 times more frequently than rightward errors. The bias was much less during 1985 to 1986 than during later years. Some wind directions were forecast more accurately and with less bias than others. Limited data at Augusta, GA showed forecast accuracy and bias were generally similar to that at Macon. Forecast performance for specific wind directions varied considerably between Macon and Augusta. **(43)**

Lemly, A. Dennis. 1998. **Bacterial growth on stream insects: potential for use in bioassessment.** Journal of North American Benthological Society. 17(2):228-238.

Growth of filamentous bacteria (*Sphaerotilus* sp., *Leptothrix* sp.) on aquatic insects was evaluated for its usefulness as a bioindicator of detrimental nutrient levels in streams. Field measurements of insect abundance, nutrient concentrations, and incidence/ degree of bacterial growth on insects upstream and downstream of livestock pastures were made in 2 Virginia, USA streams. Laboratory studies were conducted to determine the effect of bacterial growth on insect survival. Elevated concentrations of dissolved nutrients (0.13 to 0.35 mg/L orthophosphate, 1.29 to 2.13 mg/L nitrate) downstream of pastures were associated with growth of filamentous bacteria, which colonized the gills and body surface of aquatic insects. Significantly lower densities of insects (up to 66 percent less) occurred at downstream sites. In laboratory studies, 100 percent mortality of heavily infested mayflies (>25 percent of body covered, including gills) occurred within 30 days, whereas >85 percent of individuals without bacterial growth survived and grew normally. The pattern of mortality in the laboratory closely paralleled the differences in density observed in the field. Bacterial growth on aquatic insects appears to be a reliable bioindicator of nutrient enrichment, and the degree of infestation associated with reduced insect survival can be quickly detected in the field or laboratory using a hand lens (10 to 15X magnification). This bioindicator shows promise as a significant addition to EPA Rapid Bioassessment Protocols because simple visual assessment of benthic samples may be sufficient to identify a cause for impaired macroinvertebrate communities. Bacterial growth should be useful for detecting nutrient impacts in streams, as well as evaluating the success of management practices to control nutrients from point or non-point sources. **(44)**

Lockaby, B.G.; Rummer, R. 1996. **Impacts of harvesting in wetlands; results from studies at Auburn University.** Forest Landowner. 55(6): 24, 26-27.

Bottomland hardwoods have long been considered a highly valued resource among forest companies and non-industrial private forest landowners in the Southern United States. Unfortunately, over the past century in particular, approximately 27 million acres of bottomland hardwoods have been converted to other land uses (principally agriculture). Consequently, only about one-third of the original acreage of these highly productive ecosystems remain forested. In addition to their potential for timber, wildlife, and other on-site uses, bottomland or "riparian" hardwood forests have the capacity to influence the quality of surface and subsurface waters associated with large areas of the southern landscape.

This attribute has been referred to as the “kidney” function; waters that drain watersheds encompassing thousands of acres pass through and are influenced by processes within the riparian forests. For example, nitrates coming from non-point pollution in subsurface and surface drainage are greatly reduced when the water passes through a riparian forest. This reduction occurs through conversion of nitrate to gaseous N and uptake in vegetation, two fates that produce much more environmentally stable forms of nitrogen compared to waterborne nitrates. Consequently, society’s benefits due to the presence of bottomland hardwood forests extend well beyond their geographic boundaries. Bottomland forests are like a valuable antique auto; while the car is attractive to look at, the owner cannot realize the full rewards of ownership without driving it. Since it is a complex, high-performance vehicle, the owner wants to ensure that it is driven without causing any damage. Many of the values of bottomland hardwood forests come from active management and use. But it is critical to ensure that use does not compromise function. Fortunately, these goals are not mutually exclusive for either the car or bottomland hardwood manager. **(45)**

Lockaby, B.G.; Clawson, R.G.; Flynn, K.; and others. 1997. **Influence of harvesting on biogeochemical exchange in sheetflow and soil processes in an eutrophic floodplain forest.** 1997. *Forest Ecology and Management*. 90: 187-194. (Ed. Note: SRS scientists Robert Rummer, Bryce Stokes, and John Stanturf co-authored this publication.)

Floodplain forests contribute to the maintenance of water quality as a result of various biogeochemical transformations which occur within them. In particular, they can serve as sinks for nutrient run-off from adjacent uplands or as nutrient transformers as water moves downstream. However, little is known about the potential that land management activities may have for alteration of these biogeochemical functions. This paper examines the effects of three harvesting regimes (unharvested control, clearcut, and partial cut) on the physical and chemical parameters within the Flint River floodplain located in southwestern Georgia, USA. Data presented in this paper were collected during the year following initiation of the harvesting treatments which occurred in September of 1993. Sheetflow water chemistry (total suspended solids (TSS), total dissolved solids (TDS), nitrate, phosphate, sulfate, calcium, potassium, magnesium, ammonium, total phosphorous, total nitrogen, total carbon, dissolved organic carbon (DOC)), sedimentation rates, depth of soil oxidation after flooding, saturated hydraulic conductivity, and bulk density were measured. During the year immediately after treatment installation, alterations in some of the physical and chemical properties of floodwaters crossing harvest plots were detected. Soil oxidation depths, saturated hydraulic conductivity, and bulk density also changed with treatment. The meaning of the changes detected is uncertain but they suggest the nature of potential changes in nutrient spiralling and non-point source cumulative effects that may occur within a managed watershed. Second-year data may offer an interesting comparison of sheetflow chemistry and sedimentation changes between vegetated and non-vegetated conditions. **(46)**

Loeb, Susan C. 1996. **Effectiveness of flying squirrel excluder devices on red-cockaded woodpecker cavities.** *Proceedings of the Annual Conference of the Southeastern Association of Fish and Wildlife Agencies*. 50: 303-311.

The author tested the effectiveness of squirrel excluder devices (SQED’s) in deterring southern flying squirrels (*Glaucomys volans*) from using artificial red-cockaded woodpecker (*Picoides borealis*) cavities by placing them on approximately one-half of the cavities in 14 inactive recruitment clusters on the Savannah River Site, SC. SQED’s consisted of 2 pieces of 35.5-cm wide aluminum flashing placed 7.6 cm above and below the cavity entrance. Cavities with (N = 37) and without (N = 35) SQED’s were checked once per month from February 1995 to January 1996: all flying squirrels found in cavities were removed and destroyed. Cavities with and without SQED’s did not differ in cavity height (P = 0.70), distance to first branch  $\geq$  1 m in length (P = 0.09), distance to the nearest tree (P = 0.29), number of trees within 8 m (P = 0.82), or previous use by flying squirrels (P = 0.67). Flying squirrels used cavities without SQED’s throughout the year and occupied 5.7 to 38.2 percent of the cavities/month. In contrast, only 1 flying squirrel was found in a cavity with an SQED; thus, SQED’s effectively impeded flying squirrels from using red-cockaded woodpecker cavities and should be considered a tool in red-cockaded woodpecker management where flying squirrels are a potential threat to population stability or expansion. **(47)**

Loeb, Susan C.; Lennartz, Michael R.; Szaro, Robert C. 1998. **The role of fish, wildlife, and plant research in ecosystem management.** Landscape and Urban Planning. 40(1998):131-139.

This paper examines the concepts of ecology, ecosystems, and ecosystem management and then further examines the role of fish, wildlife, and plant ecology research in ecosystem management, past, present, and future. It is often assumed that research in support of ecosystem management will entail comprehensive studies of entire ecosystems, whereas research programs that focus on one species do not constitute ecosystem management level research. The supposed dichotomy between single species and ecosystem level approaches has been the focus of considerable debate. However, this is a false dichotomy and ecosystem studies and single-species studies simply represent two ends of a spectrum of approaches for understanding ecological processes. Given that the level of scientific investigation (e.g., individual species, community, or ecosystem) does not differentiate ecosystem management research from more traditional approaches, what are the distinguishing features? Ecosystem management research is broader in scope than more traditional ecological studies. A greater emphasis is also placed on integrating results of various studies and programs to understand larger scale interactions and the structure and function of ecosystems. Model building also plays a greater role in ecosystem management research efforts as a means of not only understanding ecosystem processes but also as a means of generating hypotheses. Although the primary responsibilities of research and management are different, there is much room for interaction and integration of functions. Consequently, adaptive management has become an important part of ecosystem management and will likely become a larger part of basic research programs. However, adaptive management experiments should not be the endpoint. Instead, results from adaptive management studies should be used to generate hypotheses that can be tested with more traditional and rigorous scientific methods. As managers begin to deal at larger spatial and longer temporal scales, changes in the end-products of research will be necessary. The task of assessing present as well as future conditions will greatly increase the need for user-friendly analytical tools (e.g., simulation models) that allow managers to visualize conditions on a large scale. A balance of adaptive management and traditional experimental designs will ultimately lead to better models of management. (48)

McAlister, Robert H.; Clark, Alexander, III; Saucier, Joseph R. 1997. **Effect of initial spacing on mechanical properties of lumber sawn from unthinned slash pine at age 40.** Forest Products Journal. 47(7/8): 107-109.

The effect of initial planting density on strength and stiffness of slash pine (*Pinus elliotti* Engelm. var *elliotti*) from a 40-year-old plantation on the Georgia Coastal Plain was examined. A stratified random sample of trees with diameters at breast height ranging from 8 to 16 inches from replicated stands representing tree spacing of 6 by 8, 8 by 8, 10 by 10, and 15 by 15 feet was processed into lumber. Visually graded No. 1 and No. 2, 2 by 4 and 2 by 6 lumber from the study was tested for stiffness (modulus of elasticity) and strength (modulus of rupture) according to the provision of American Society for Testing and Materials Standard Method D 198. Only the modulus of rupture of the No. 2 grade 2 by 4's showed a significant ( $p = 0.05$ ) decrease with increased tree spacing. All spacings tested produced dimension lumber with excellent mechanical properties. (49)

McDonald, Timothy P.; Seixas, Fernando. 1997. **Effect of slash on forwarder soil compaction.** Journal of Forest Engineering. 8(2): 15-26.

A study of the effect of slash on forwarder soil compaction was carried out. The level of soil compaction at two soil moisture contents, three slash densities (0, 10, and 20 kg/m<sup>2</sup>), and two levels of traffic (one and five passes) were measured. Results indicated that, on dry, loamy sand soils, the presence of slash did not decrease soil compaction after one forwarder pass, but did provide some protection from subsequent passes. The density of slash (over 10 kg/m<sup>2</sup>) did not affect compaction. On the same soils in a wetter condition, however, slash density at 20 kg/m<sup>2</sup> was significantly less than on bare plots. At 10 kg/m<sup>2</sup>, the increase in bulk density after five passes was smaller than on the bare plots, but not significantly so. (50)

McDonald, Tim; Stokes, Bryce. 1997. **Visual quality assessment of alternative silvicultural practices in upland hardwood management.** In: Forest operations for sustainable forests and healthy economies; Proceedings, Council

on Forest Engineering, 20<sup>th</sup> annual meeting; 1997 July 28-31; Rapid City, SD. Rapid City, SD: Council on Forest Engineering: 165-169.

Visual impacts of forest operations are of increasing concern to forest managers. Tools are available for evaluating, and potentially avoiding, problems in visual quality resulting from poorly designed harvest unit boundaries. One of these visualization tools is applied in comparing various harvest unit shape alternatives in an upland hardwood stand on steeply sloping ground. Visualization tools were found to be most suited to placing small leave strips within larger clearcuts for obscuring some areas from view and giving the impression of a series of smaller cutting units. **(51)**

McDonald, Tim; Way, Tom; Lofgren, Bjorn; and others. 1996. **Load and inflation pressure effects on soil compaction of forwarder tires.**

In: Proceedings: Certification -- Environmental implications for forestry operations; 1996 September 9-11; Quebec City, Quebec; joint conference, Canadian Woodlands Forum, Canadian Pulp and Paper Association, and International Union of Forest Research Organizations; 1996 September 9-11; Quebec City, Quebec. Quebec City, Quebec: Canadian Pulp and Paper Association: 67-70.

A standard forwarder tire (600/55-26.5) was tested to determine its range of soil compaction with various inflation pressures and dynamic loads. Past research has shown that compaction of heavier equipment can be somewhat mitigated by operating with lower inflation pressures. Results indicated a significant effect of both load and inflation pressure on bulk density, rut size, and soil cone index. **(52)**

McNabb, K.L.; Miller, M.S.; Lockaby, B.G.; and others. 1997. **Selection harvests in Amazonian rainforests: long-term impacts on soil properties.** Forest Ecology and Management 93: 153-160.

Surface soil properties were compared among disturbance classes associated with a single-tree selection harvest study installed in 1979 in the Brazilian Amazon. Response variables included pH, total N, total organic C, extractable P, exchangeable K, Ca, Mg, and bulk density. In general, concentrations of all elements displayed residual effects 16 years after harvests with N, P, K, and C being inversely related to disturbance intensity, while Ca and Mg levels as well as pH were directly related. Elemental contents exhibited fewer residual effects except in the cases of Ca and Mg contents, which generally increased with disturbance intensity. Higher intensity disturbance classes were associated with increased bulk density. Soil impacts apparent after 16 years suggest a combination of direct effects of harvests (e.g., as in the case of bulk density) combined with indirect influences of the ecophysiology of the *Cecropia* sp. which dominate disturbed areas. **(53)**

McNulty, Steven G.; Vose, James M.; Swank, Wayne T. 1997. **Regional hydrologic response of loblolly pine to air temperature and precipitation changes.** Journal of the American Water Resources Association. 33(5); 1011-1022.

Large deviations in average annual air temperatures and total annual precipitation were observed across the Southern United States during the last 50 years, and these fluctuations could become even larger during the next century. The authors used PnET-IIS, a monthly time-step forest process model that uses soil, vegetation, and climate inputs to assess the influence of changing climate on Southern U.S. pine forest water use. After model predictions of historic drainage were validated, the potential influences of climate change on loblolly pine forest water use was assessed across the region using historic (1951 to 1984) monthly precipitation and air temperature which were modified by two general circulation models (GCM's). The GCM's predicted a 3.2°C to 7.2°C increase in average monthly air temperature, a -24 percent to +31 percent change in monthly precipitation and a -1 percent to +3 percent change in annual precipitation. As a comparison to the GCM's, a minimum climate change scenario using a constant 2°C increase in monthly air temperature and a 20 percent increase in monthly precipitation was run in conjunction with historic climate data. Predicted changes in forest water drainage were highly dependent on the GCM used. PnET-IIS predicted that along the northern range of loblolly pine, water yield would decrease with increasing leaf area, total evapotranspiration, and soil water stress. However, across most of the Southern U.S., PnET-IIS predicted decreased leaf area, total



evapotranspiration, and soil water stress with an associated increase in water yield. Depending on the GCM and geographic location, predicted leaf area decreased to a point which would no longer sustain loblolly pine forests, and thus indicated a decrease in the southern most range of the species within the region. These results should be evaluated in relation to other changing environmental factors (i.e., CO<sub>2</sub> and O<sub>3</sub>) which are not present in the current model. (54)

Murphy, Paul A.; Graney, David L. **Individual-tree basal area growth, survival, and total height models for upland hardwoods in the Boston Mountains of Arkansas.** 1988. Southern Journal of Applied Forestry. 22(3):184-192,

Models were developed for individual-tree basal area growth, survival, and total heights for different species of upland hardwoods in the Boston Mountains of north Arkansas. Data used were from 87 permanent plots located in an array of different sites and stand ages; the plots were thinned to different stocking levels and included unthinned controls. To test these three tree models, stand development for 5 and 10 years were simulated in terms of stand basal area/ac, numbers of trees/ac, and quadratic mean diameter. Percent mean differences for the three variables indicated no serious biases. A long-term projection of 100 years to test model reasonableness showed development that would be consistent with these stands. These equations provide forest managers the first upland hardwood individual-tree growth models specifically for this region. (55)

New, Kirsten C.; Hanula, James L. 1998. **Effect of time elapsed after prescribed burning in longleaf pine stands on potential prey of the red-cockaded woodpecker.** Southern Journal of Applied Forestry. 22(3): 175-183.

The effects of dormant and growing season prescribed burns on the potential arthropod prey of the red-cockaded woodpecker (*Picoides borealis*) were studied in longleaf pine (*Pinus palustris* Mill.) stands on the upper Coastal Plain of South Carolina. Sampling was conducted 0, 1, 2, or 3 years post burn. Stands were burned once during the winters of 1991, 1992, 1993, and 1994 or in the summer of 1992. Four types of traps sampled arthropods in the litter layer, the herbaceous understory, and on the bole of pine trees. Woodpecker prey abundance and biomass were sampled continuously from June 30, 1993 to June 30, 1994. Overall arthropod diversity was sampled seasonally in June, October, January, and April of the same year. The different trap types had similar arthropod diversity and evenness, but most had low faunal overlap, which indicates that they effectively sampled different parts of the arthropod community. When captures from all trap and prey types were combined for each plot, no significant differences were found among winter-burned plots or between winter- and summer-burned plots. However, certain prey types were affected by burning. Among stands burned in winter, spider abundance was highest in samples from the soil/litter layer of stands burned 3 years prior to sampling. Comparison of stands burned in winter 1992 to those burned in the summer showed that the winter 1992 burns had higher spider and ant (Hymenoptera: Formicidae) biomass on the tree boles. Spiders appeared to be the only group affected by winter burning, while spiders and ants were affected by the summer burning. In general, time elapsed after the prescribed burns were applied had little effect on the primary arthropod prey of the red-cockaded woodpecker. (56)

Parresol, Bernard R. 1998. **Prediction and error of baldcypress stem volume from stump diameter.** Southern Journal of Applied Forestry. 22(2): 69-73.

The need to estimate the volume of removals occurs for many reasons, such as in trespass cases, severance tax reports, and post-harvest assessments. A logarithmic model is presented for prediction of baldcypress total stem cubic foot volume using stump diameter as the independent variable. Because the error of prediction is as important as the volume estimate, the author demonstrates construction and use of simple and joint confidence intervals about the mean and individual predictions. For completeness, the author addresses prediction and error from inventory estimates of removal. (57)

Parresol, Bernard R.; Cao, Fuliang. 1998. **An investigation of crystalline intensity of the wood of poplar clones grown in Jiangsu Province, China.** Res. Pap. SRS-11. Asheville, NC: U.S. Department of Agriculture, Forest Service, Southern Research Station. 7 p.

Observed trends from limited sampling are reported in this paper. Using x-ray diffractograms, differences in wood fiber crystalline intensity (CrI%) among four southern-type poplar clones (I-69/55, I-63/51, I-72/58, and I-214) and across four planting spacings (4 m by 4 m, 5 m by 5 m, 6m by 6m, and 7 m by 7 m) were examined. The analyses showed poplar clones I-63/51 and I-214 have the highest CrI%, followed by I-69/55 and I-72/58. Crystalline intensity of wood gradually increased across annual rings; hence CrI% of sapwood was a little higher than that of heartwood. Crystalline intensity of late wood of three of the poplar clones was larger than that of early wood (there was no difference in I-72/58); and as stand density increased, CrI% of wood also increased. A fully replicated study is needed to firmly establish these trends. **(58)**

Pepper, W.D.; Zarnoch, S.J.; DeBarr, G.L.; and others. 1997. **Choosing a transformation in analyses of insect counts from contagious distributions with low means.** Res. Pap. SRS-5. Asheville, NC: U.S. Department of Agriculture, Forest Service, Southern Research Station. 13 p.

Guidelines based on computer simulation are suggested for choosing a transformation of insect counts from negative binomial distributions with low mean counts and high levels of contagion. Typical values and ranges of negative binomial model parameters were determined by fitting the model to data from 19 entomological field studies. Random sampling of negative binomial distributions was simulated and ANOVA's were performed on simulated data for randomized complete blocks designs with treatment means corresponding to means of negative binomial distributions. The influence of analysis variable, treatment-mean configuration, range in treatment means, significance level of statistical tests, level of contagion, number of blocks, and number of replication in time on observed power and Type I error of F-tests was studied. A computer program was developed to recompute observed power of F-tests for any combination of these factors. The program facilitates choosing a transformation and may also be used to evaluate tradeoffs and determine affordable experimental factors for a future design with a given set of statistical attributes. **(59)**

Perry, Roger W.; Tappe, Phillip A.; Peitz, David G.; and others. 1996. **A comparison of snap traps for evaluating small mammal populations.** Proceedings of the annual conference of Southeastern Association of Fish and Wildlife Agencies. 50: 280-286.

The authors compared rat, mouse, and museum special snap traps to determine if differences existed in capture efficiency of small mammals and whether type of trap affected indices of richness, evenness, and diversity. Small mammals were trapped in 57 streamside study areas in 1990 to 1995 in the Ouachita Mountains, AR. Efficiency of mouse traps was equal to or greater than that of museum special traps in capturing a small mammal species. Rat traps were most efficient for capturing the 2 largest small mammal species recorded, the eastern wood rat (*Neotoma floridana*) and the cotton rat (*Sigmodon hispidus*). The authors found no difference among the types of traps in their susceptibility to being inadvertently sprung by extrinsic factors such as rain. Mean species richness, evenness, and diversity did not differ among trap types. A combination of mouse and rat traps increased species richness and diversity over mouse traps alone. A combination of mouse, rat, and museum special traps did not greatly increase any community measure relative to the mouse and rat trap combination. The scientists conclude that use of museum special traps for sampling small mammals is unnecessary unless the objective is to acquire museum specimens. **(60)**

Perry, Roger W.; Thill, Ronald E. ; Tappe, Philip A.; Melchiors, M. Anthony. 1997. **Presence of hantavirus in small mammals of the Ouachita Mountains.** Journal of the Arkansas Academy of Science. 51:210-211.

In 1993, an outbreak of human hantavirus pulmonary syndrome (HPS) occurred in the southwestern United States causing severe pulmonary dysfunction and death among most of those infected. Shortly after the outbreak, the causative agent was identified as the Sin Nombre virus (SNV), a virus of the genus *Hantavirus*. Several hantaviruses have since

been identified in North America, and rodents have been identified as the hosts of these hantaviruses. Each hantavirus has been associated with a single primary host species in which it causes a chronic, persistent infection involving the shedding of virus in saliva, feces, and urine. Infection to humans is thought to be from inhalation of aerosolized virus (breathing of small particles such as dust from feces, blood, or urine). However, rodent bites or direct contact with broken skin or mucus membranes also are potential sources of infection. The authors discuss the findings of their research to determine the incidence of hantavirus antibodies in Arkansas small mammals to ascertain potential risks for human hantavirus infection. **(61)**

Poteet, Micah L.; Thill, Ronald E.; Whiting, R. Montague, Jr.; Rayburn, R. Lee. 1996. **Deer use of riparian zones and adjacent pine plantations in Texas.** 1996 Proceedings of the annual conference of Southeastern Association of Fish and Wildlife Agencies. 50: 541-549.

The authors monitored white-tailed deer (*Odocoileus virginianus*) use of riparian zones (RZ's) and adjacent pine plantations of 3 age classes (young, 1 to 3 years old; intermediate, 5 to 7 years old; and older, 9 to 13 years old) using radio telemetry for 2 years on a 1,300 ha study area near Alto, TX. Riparian zones comprised 22.0 percent of the area; young, intermediate, and older pine plantations comprised 19.1 percent, 45.7 percent, and 13.2 percent, respectively. Based on data from 4 to 9 deer the first year and 12 to 17 deer the second year, home ranges averaged 103, 71, 95, and 114 ha during spring, summer, fall, and winter, respectively, and were composed primarily of intermediate-age plantations and RZ's. Deer showed significant preferences for intermediate-age pine plantations during all seasons and for RZ's during fall and winter. Older plantations produced little forage due to canopy closure, and were generally avoided throughout the year. Young plantations, which provided the most forage but the least cover, received relatively light yearlong use and were a minor component of deer home ranges. For females and young males, this study demonstrates that, where available, RZ's may comprise an important component of deer home ranges in intensively managed forests. **(62)**

Rhodes, Douglas J.; Hayes, Jane Leslie; Steiner, Chris. 1998. **Retention of external and internal markers by southern pine beetles (Coleoptera: Scolytidae) during gallery.** Journal of Entomological Science. 33(2): 221-232.

If retained, markers used in mark-release-recapture studies of bark beetle dispersal could provide valuable tools in the determination of post-dispersal fate. Retention of the internal marker rubidium (Rb) and of the external marker fluorescent powder during egg gallery construction, oviposition, and feeding were quantified at intervals from 0 to 96 hours by allowing marked southern pine beetles, *Dendroctonus frontalis* Zimmermann, to carry out these activities in untreated host material. Significant differences in Rb concentrations were found between fed and unfed Rb-marked beetles at all intervals after 12 hours. Unfed Rb-marked beetles were detectable at all intervals, whereas reliable detection of fed Rb-marked beetles declined with time. Over 90 percent of fed southern pine beetle marked with fluorescent powder were detectably marked after 96 hours, while less than 50 percent of the Rb-marked beetles were detectable after 72 hours. Neither marking technique adversely affected the gallery length or number of eggs produced by marked beetles compared to unmarked beetles allowed to excavate for 96 hours. Practical aspects of both techniques are considered. **(63)**

Rummer, Bob. 1997. **Niche logging.** APA [American Pulpwood Association, Inc.] Technical Paper 97-P-9. Rockville, MD: American Pulpwood Association: 1-5.

Logging is facing a world of change. A logger's niche can be defined by terrain, climate, location, timber and product, local government, Federal government, landowners, and mills. The author offers strategies for survival and successful competition. **(64)**

Rummer, Bob. 1997. **Safety and health concerns in forestry operations.** APA [American Pulpwood Association, Inc.] Technical Paper 97-P-4. Rockville, MD: American Pulpwood Association: 1-5. **(65)**

The author discusses several safety models, including the “Three E’s”: engineering, education, and enforcement; the Heinrich-Lateiner model; the organizational model; and the behavioral safety model. Rummer encourages approaching safety from a broader perspective, enabling the industry to track changes in all aspects and to keep leading the safety target. **(65)**

Rummer, Bob. **Working safely in summertime heat.** 1997. APA [American Pulpwood Association, Inc.] Technical Release 97-R-39. Rockville, MD: American Pulpwood Association: 1-2.

As logging operations continue in the hotter months of the year, the safety hazard of heat stress appears. Loggers are particularly at risk, because the combination of hard physical work and outdoor conditions puts high demands on the body. While loggers rarely die from heat stress, they may suffer heat illness symptoms ranging from the discomfort of heat rash to nausea or heat cramps. The best prevention is awareness. Workers and supervisors need to understand heat illnesses and know how to recognize and prevent them. **(66)**

Rummer, Bob; Baumgras, John; McNeel, Joe. 1997. **Forest operations for ecosystem management.** In: Barbour, R. James; Skog, Kenneth E., eds. Role of wood production in ecosystem management: Proceedings of the Sustainable Forestry Working Group at the IUFRO all division 5 conference; 1997 July 7-12; Pullman, WA. Madison, WI: U.S. Department of Agriculture, Forest Service, Forest Products Laboratory: 46-52.

The evolution of modern forest resource management is focusing on ecologically sensitive forest operations. This shift in management strategies is producing a new set of functional requirements for forest operations. Systems to implement ecosystem management prescriptions may need to be economically viable over a wider range of piece sizes, for example. Increasing demands for more efficient fiber utilization and recovery from forest operations also put pressure on merchandizing the resource for maximum value recovery. Conventional forest operations are often not well suited to meet these constraints. This paper reviews the development of functional requirements for forest operations in ecosystem management and summarizes regional investigations in the Northeast, South, and Pacific Northwest. **(67)**

Rummer, Bob; Stokes, Bryce J.; Schilling, Alvin. 1997. **Wetland harvesting systems -- developing alternatives for sustainable operation.** In: Forest operations for sustainable forests and healthy economies; Proceedings, Council on Forest Engineering, 20<sup>th</sup> annual meeting; 1997 July 28-31; Rapid City, SD. Rapid City, SD: Council on Forest Engineering: 7-11.

Wetland forests represent some of the most productive forest lands in the Southeast. They are also an environmentally sensitive ecotype which presents unique problems for forest operations. Sustaining active management in these areas will require systems which can operate on weak soil conditions without adversely affecting soil properties or stand regeneration. The systems must also operate economically. This paper reviews current investigations of alternative systems including large-capacity forwarders, clambunk skidders, and the skidder/shovel logger system in the southeastern U.S. The systems are compared in terms of production, cost, and potential site impacts. **(68)**

Schaefer, Richard R.; Saenz, Daniel. 1998. **Red-cockaded woodpecker cavity tree resin avoidance by southern flying squirrels.** The Wilson Bulletin. 110(2): 291-292.

While examining red-cockaded woodpecker (*Picoides borealis*) cavity contents in eastern Texas, the authors observed cavity tree resin avoidance by southern flying squirrels (*Glaucomys volans*). The tree surface around an active red-cockaded woodpecker cavity is coated with sticky resin which flows from resin wells created by the woodpecker. The southern flying squirrel is a competitor for red-cockaded woodpecker cavities and is known to be quite capable of entering active cavities in trees with a well developed resin coating. However, observation indicates that in some circumstances the resin coating can offer some deterrence. **(69)**

Stokes, Bryce J.; Watson, William F. 1996. **Plantation thinning systems in the Southern United States.** In: Mitchell, Paul; Stevens, Eric; Kofman, Pieter D., eds. Problems and prospects for managing cost effective early thinnings; a report from the concerted action "Cost effective early thinnings"; AIR2-CT93-1538. Horsholm, Denmark: Danish Forest and Landscape Research Institute: 107-121.

This paper reviews southern pine management and thinning practices, describes three harvesting systems for thinning, and presents production and cost estimates, and utilization rates. The costs and product recoveries were developed from published sources using a spreadsheet analysis. Systems included tree-length, flail/chip, and cut-to-length. The estimated total harvesting, transport, and woodyard cost per m<sup>3</sup> of pulpable fiber at the digester was US\$24.15 for tree-length and US\$19.84 for flail/chip. The same costs for cut-to-length was US\$27.66, US\$ 27.87, and US\$29.15 per m<sup>3</sup> for chainsaw, feller-buncher/ processor, and harvester systems, respectively, when producing 2.3-m boltwood. When processing the trees into 5.3-m bolts, the cost for the harvester system was US\$29.05. Fiber recovery to the digester was approximately 55 percent of standing biomass for all the systems. **(70)**

Stokes, Bryce J. 1997. **Southern regional report.** In: Forest operations for sustainable forests and healthy economies; Proceedings, Council on Forest Engineering, 20<sup>th</sup> annual meeting; 1997 July 28-31; Rapid City, SD. Rapid City, SD: Council on Forest Engineering: 172-174.

It appears as if many in wood procurement, forest management, operations, manufacturing, and sales in the Southern U.S. are simultaneously biting the bullet and showing signs of guarded optimism for the future. On the one hand, during last year, purchasing costs were high, selling prices were low, quotas ruled, and machine purchases sagged. However, there is continued commitment to training, investments in timberland and facilities in the South, new technology implementation, and a common hope that forestry will survive and prosper in the South. As the South becomes the wood basket for the Nation, many see opportunities and the potential for a better future. The questions are "how can we afford to get where our industry needs to be" and "who will pay." These questions will need to be addressed in the near future. **(71)**

Stokes, Bryce J.; Kluender, R.A.; Klepac, J.F.; Lortz, D.A. 1997. **Harvesting impacts as a function of removal intensity.** In: Stokes, Bryce; Lauhanen, Risto; Klepac, John, comps. Forest operations and environmental protection: Proceedings of a symposium organized by IUFRO Project Group P3.11.00 at the IUFRO World Congress; 1995 August 6-12; Tampere, Finland. Auburn, AL: U.S. Department of Agriculture, Forest Service, Southern Research Station: 207-216.

Single-tree selection, group selection, shelterwood, seed-tree, and clearcut harvesting methods were evaluated for residual site impacts. The stands were harvested during the summer of 1993 on the Ouachita National Forest in Arkansas. Manual felling and rubber-tired skidders were used to harvest all 23 stands. Percentage of area in primary skid trails was 8.2, 9.6, 13.2, 12.5, and 13.7 for the single-tree selection, group selection, shelterwood, seed-tree, and clearcut treatments, respectively. The single-tree selection treatment had the most undisturbed soil area (39.4 percent) after harvesting, as compared to 25.6 percent for the group selection, 13.1 for the shelterwood, 9.1 for the seed-tree, and 6.0 for the clearcut. Residual pine damage was greatest for the group selection treatment. **(72)**

Stokes, Bryce J.; Schilling, Alvin. 1997. **Improved harvesting systems for wet sites.** Forest Ecology and Management. 90: 155-160.

Environmentally acceptable and economical forest operations are needed for sustainable management of forest resources. Improved methods for harvesting and transporting timber are especially needed for wet sites. As the demand for hardwood lumber continues to increase, improved and alternative methods are needed to ensure acceptance of timber harvesting for the wet site conditions that are typical of bottomland hardwoods. Some alternative technological developments include grapple saw feller-bunchers, wide tires, larger forwarders, clambunk skidders, two-stage hauling, mats, cable systems, helicopters and towed vehicles, and air-cushioned vehicles. These developments have the

potential to improve the performance of the harvesting system and to reduce the negative effects of conventional operations on conventional sites and on difficult sites such as wet areas. Although many of these new alternatives are now operational, others are just concepts or evolving prototypes. More research is still needed to optimize these alternative technologies and to reduce costs associated with their implementation. **(73)**

Stratton, Daniel P.; Howell, Michael; Rometry, Randal. 1998. **Mississippi's timber industry—an assessment of timber product output and use, 1995**. Resour. Bull. SRS-29. Asheville, NC: U.S. Department of Agriculture, Forest Service, Southern Research Station. 23 p.

In 1995, roundwood output from Mississippi's forests totaled 1.0 billion cubic feet. Mill byproducts generated from primary manufacturers was 357 million cubic feet. Almost all plant residue was used primarily for fuel and fiber products. Saw logs were the leading roundwood product at 493 million cubic feet; pulpwood ranked second at 454 million cubic feet; veneer logs were third at 63 million cubic feet. There were 105 primary processing plants operating in Mississippi in 1995. Receipts totaled 878 million cubic feet. **(74)**

Stratton, Daniel P.; Wright, Robert C. 1998. **Tennessee's timber industry—an assessment of timber product output and use, 1995**. Resour. Bull. SRS-31. Asheville, NC: U.S. Department of Agriculture, Forest Service, Southern Research Station. 21 p.

In 1995, roundwood output from Tennessee's forests was 284 million cubic feet. Mill byproducts generated from primary manufacturers was 113 million cubic feet. Almost all plant residue was used primarily for fuel and fiber products. Saw logs were the leading roundwood product at 168 million cubic feet; pulpwood ranked second at 109 million cubic feet; veneer and other industrial products were third at 6 million cubic feet. There were 503 primary processing plants operating in Tennessee in 1995. Total receipts were 262 million cubic feet. **(75)**

Sword, M.A. 1998. **Seasonal development of loblolly pine lateral roots in response to stand density and fertilization**. Plant and Soil. 200: 21-25.

In 1989, two levels each of stand density and fertilization treatments were factorially established in a 9-year-old loblolly pine plantation on a P-deficient Gulf Coastal Plain site in Rapides Parish, Louisiana, USA. In 1995, a second thinning was conducted on the previously thinned plots and fertilizer was re-applied to the previously fertilized plots. The morphology of new long lateral roots was evaluated at 2-week intervals in five Plexiglas rhizotrons per plot of two replications. The overall objective of this study was to evaluate the seasonal initiation of six morphological categories of long lateral roots ( $\geq 2.5$  cm in length) in response to stand density and fertilization. Lateral root development exhibited a seasonal pattern with the initiation of branched lateral roots predominantly occurring in spring and summer. The initiation of non-branched lateral roots occurred throughout the year regardless of season. Stand density did not affect lateral root morphological development. However, fertilization stimulated the initiation of branched lateral roots that were greater than 1 mm in diameter. **(76)**

Sword, Mary A.; Tiarks, Allan E.; Haywood James D. 1998. **Establishment treatments affect the relationships among nutrition, productivity and competing vegetation of loblolly pine saplings on a Gulf Coastal Plain site**. Forest Ecology and Management. 105: 175-188.

After cultural treatments such as site preparation, release, and fertilization, changes in the supply of mineral nutrients relative to each other and shifts in the composition of vegetation may have a delayed effect on the nutrition, carbon partitioning, and growth of forest trees. This study was conducted to evaluate the influence of early management options that control vegetation and fertility on the nutrition and productivity of a young loblolly pine (*Pinus taeda* L.) plantation on a phosphorus-deficient site in the Gulf Coastal Plain. Two levels each of herbicide application, fertilization, and litter addition were applied in a factorial arrangement to three open-pollinated families of newly planted loblolly pine seedlings.

Competing vegetation was evaluated after three growing seasons; loblolly pine nutrition and tannin synthesis were evaluated after four growing seasons; and loblolly pine productivity was quantified after five growing seasons. Fertilization and herbicide application increased the growth and decreased the foliar tannin concentration of loblolly pine. Herbicide application also increased the potassium concentration of loblolly pine foliage. A negative correlation between foliar tannin and potassium concentrations was found on plots that were fertilized with nitrogen and phosphorus. On southern pine sites that are fertilized with phosphorus, the accelerated growth of planted pine and invading vegetation may create new nutrient limitations. Where phosphorus is limiting, however, nutrient utilization may not be great enough for new deficiencies to develop. Loblolly pine stand productivity and foliar nutrient concentrations were affected by genetic family and the foliar calcium and magnesium concentrations of loblolly pine families responded differently to the establishment treatments. The authors also found that the establishment treatments influenced the occurrence of herbaceous and woody competitors. They hypothesize that corresponding treatment effects on exchangeable cation concentrations and pH of the soil were caused by changes in vegetation. (77)

Thompson, Michael T. 1998. **Forest statistics for north central Georgia, 1998.** Resour. Bull. SRS-34. Asheville, NC: U.S. Department of Agriculture, Forest Service, Southern Research Station. 60 p.

This report summarizes a 1998 inventory of the forest resources of a 32-county area of Georgia. Major findings are highlighted in text and graphs; detailed data are presented in 51 tables. (78)

Tiarks, Allan E.; Buford, Marilyn A.; Powers, Robert F.; and others. 1997. **North American long-term soil productivity research program.** In: Northeastern Forest Experiment Station. Communicating the role of silviculture in managing the national forests: Proceedings of the National Silviculture Workshop; 1997 May 19-22; Warren, PA. Gen. Tech. Rep. NE-238. Radnor, PA: U.S. Department of Agriculture, Forest Service, Northeastern Forest Experiment Station: 140-147.

The National Long-term Soil Productivity research program was chartered to address National Forest Management Act concerns over possible losses in soil productivity on national forest lands. The program supports validation of soil quality monitoring standards and process-level productivity research. Summarized results are supplied to forests as collected. National forest managers use them in developing forest plans and modifying management practices. Results are treated as the best available evidence and are used within the adaptive management process. (79)

Tobiason, Fred L.; Kelley, Stephen S.; Midland, M. Mark; Hemingway, Richard W. 1997. **Temperature dependence of (+)-catechin pyran ring proton coupling constants as measured by NMR and modeled using GMMX search methodology.** Tetrahedron Letters. 38(6): 985-988.

The pyran ring proton coupling constants for (+)-catechin have been experimentally determined in deuterated methanol over a temperature range of 213 K to 313 K. The experimental coupling constants were simulated to 0.04 Hz on the average at a 90 percent confidence limit using a LAOCOON method. The temperature dependence of the coupling constants was reproduced from the Boltzmann distribution of the conformational ensemble generated by the GMMX searching program. (80)

Vose, James M.; Swank, Wayne T.; Clinton, Barton D.; and others. 1997. **Using fire to restore pine/hardwood ecosystems in the Southern Appalachians of North Carolina.** In: Greenlee, Jason M., ed. Proceedings: First conference on fire effects on rare and endangered species and habitats conference; 1995 November 13-16; Coeur d'Alene, ID; Fairfield, WA: International Association of Wildland Fire: 149-154.

In the Southern Appalachians, mixed pine/hardwood ecosystems occupy the most xeric sites (i.e., south/west aspect ridge sites). They are typically comprised of varying proportions of pitch pine (*Pinus rigida*), Virginia pine (*Pinus*

*virginiana*), and/or shortleaf pine (*Pinus echinata*) and a mixture of hardwoods, including scarlet oak (*Quercus coccinea*), chestnut oak (*Quercus prinus*), and red maple (*Acer rubrum*). Mountain laurel (*Kalmia latifolia*), an evergreen ericaceous shrub, is a major component of these ecosystems. While the pine/hardwood ecosystem is limited in extent (e.g., <5 percent of the landscape in the Southern Appalachians), it is a unique vegetation type that provides important habitat for both flora and fauna.

The pine component of many of these pine/hardwood ecosystems is in a serious state of decline. R.N. Smith determined in 1991 that 98 percent of the pine/hardwood stands at the Coweeta Hydrologic Laboratory in western North Carolina have little or no remaining live pine. Smith's study showed that pine has been declining since the early 1970's; however, a major loss of pine occurred in the mid 1980's. This loss is coincident with a severe drought in the region which weakened trees and caused widespread and severe southern pine beetle infestations.

The initial origin of many mixed pine/hardwood stands in the Southern Appalachians is largely a result of past agricultural activities which created microsite conditions conducive to pine regeneration (i.e., mineral soil, limited competition). However, many of these stands are located on sites which could not be cultivated due to steep topography and poor soils, and fire has been advanced as the major factor determining their origin. In either case, the maintenance of pine/ hardwood ecosystems is hypothesized to depend on intense wildfires. Because pine/ hardwood sites are typically dry, hot, and contain substantial quantities of flammable fuels, natural or human-caused fires have the potential for the high intensity fire necessary for pine regeneration. Fire suppression has limited the role of either human-caused or natural fires in perpetuating these ecosystems. While fuel loads in these stands are currently substantial (due to pine mortality and large amounts of mountain laurel), fire suppression efforts will continue to limit the extent of intense wildfires in these ecosystems, even during dry conditions. As an alternative, silvicultural treatments may have equal success in regenerating these stands. Over the past 10 to 20 years, some of these degraded pine/hardwood stands have been chainsaw felled, burned, and planted to white pine (*Pinus strobus*) in an attempt to increase overall site productivity. As another alternative, the authors have initiated research on the use of prescribed "stand replacement" fires to restore degraded pine/ hardwood stands. In this application, the objective of the fire is to produce a high intensity fire (i.e., a simulated wildfire) sufficient to produce seedbed conditions for pine seed germination and reduce mountain laurel vigor to allow for seedling establishment. This approach has only recently been applied in the southern Appalachians and very little is known about ecosystem responses to this prescription. The authors' objective is to compare the effectiveness of the fell and burn method with stand replacement techniques for restoring pine/hardwood ecosystems in the Southern Appalachians of North Carolina. This is accomplished by comparing pine regeneration and overstory composition among an unburned reference site, a 13-yr-old fell and burn site, a 25-yr-old wildfire site, and a stand replacement fire site. They also briefly compare the effects of burning on aboveground nitrogen (N) pools. (81)

Warren, Melvin L., Jr.; Angermeier, Paul L.; Burr, Brooks M.; Haag, Wendell R. 1997. **Decline of a diverse fish fauna: patterns of imperilment and protection in the Southeastern United States.** In: Benz, George W.; Collins, David E., eds. Aquatic fauna in peril: the southeastern perspective. Decatur, GA: Lenz Design & Communications: 105-164.

The Southeastern United States harbors the richest freshwater fish fauna on the North American continent north of Mexico, but portents of decline of this great fauna are increasingly acknowledged. Southeastern fishes (493 species) comprise about 47 percent of the North American fish fauna (1,061 species) and 62 percent of the fauna in the United States (790 species). Within the United States, imperilment of southeastern fishes is second only to that of western fishes. Increasing recognition of the decline of fishes and aquatic habitats in the Southeast, both harbingers of the western situation, should be the clarion call for proactive efforts toward conservation of the richest fish fauna in the United States. Development of models associating vulnerability to the extinction process and ecological and zoogeographic characteristics of organisms and communities is a high priority for conservation biology. Aside from this effort, few related analyses are available for fishes in the Southeast. Geographic and ecological range restrictions are primary among attributes associated with many southeastern imperiled, extirpated, and extinct fishes. To date, there has been little effort to examine large-scale patterns of diversity and imperilment of southeastern fishes with the objectives of discovering general principles underlying imperilment that may be useful in proactive management or conservation triage. The authors provide a beginning toward the large-scale synthesis of accounting, and, to a limited extent, ecological information for fishes of the Southeastern United States. They present an up-to-date, comprehensive



inventory of fishes of the Southeast and use geographical displays of fish and stream diversity and imperilment to convey the richness, spatial extent, and variation in these characteristics. For individual fishes and fish families, the scientists ask two questions: is range size associated with imperilment, and is imperilment a function of familial membership? For major river drainages of the Southeast, the authors pose three questions: is fish imperilment associated with drainage area, native fish taxa richness, endemism, or stream-type diversity; which of these variables are the best predictors of imperilment; and what are the implications of the identified predictors? The authors' specific objectives are to provide an updated distributional checklist of all southeastern freshwater fishes; summarize geographical patterns of fish imperilment, fish diversity, and stream diversity by State and major rivers in the Southeastern United States; and examine relationships of numbers of imperiled taxa to native fish taxa richness, geographic range, drainage area, and stream-type diversity. They believe the maps and accompanying analyses are useful initial steps in prioritizing and coordinating conservation actions for fishes and other aquatic resources in the Southeast and in highlighting the urgent need for holistic approaches to aquatic conservation.

The last line of defense against extinction of fishes in the Southeast and elsewhere in the United States is the Endangered Species Act of 1973, as amended. The authors present evidence of widespread, pervasive decline of aquatic habitats across the Southeast. The associated problems, if there is a will to correct them, are simply beyond the statutory and fiscal abilities of any one piece of legislation or Agency to correct. Shifts in management approaches could avert continued endangerment of fishes. The foundation of such an approach should include a system-led (e.g., drainage unit) rather than species-led focus; explicit biological integrity goals in the context of preventing degradation of high quality systems and restoring poor-quality systems; commitment to implementing effective land-water management practices rather than implementing bureaucracies; and recognition of land and water resources as integrated parts of the same system. **(82)**

Wear, David N. ; Turner, Monica G.; Naiman, Robert J. 1998. **Land cover along an urban-rural gradient: implications for water quality.** Ecological Applications. 8(3): 619-630.

Development pressures in rural mountainous areas of the United States hold crucial implications for water quality. Especially important are changes in the extent and pattern of various land uses. The authors examine how position along an urban-rural gradient affects landscape patterns in a Southern Appalachian watershed, first by testing for the effect of distance from an urban center on land-cover change probabilities and then simulating the implied development of a landscape at regular distance intervals. By simulating a common hypothetical landscape, the scientists control for variable landscape conditions and define how land development might proceed in the future. Results indicate that position along the urban-rural gradient has a significant effect on land-cover changes on private lands but not on public lands. Furthermore, position along the gradient has a compounding effect on land-cover changes through interactions with other variables such as slope. Simulation results indicate that these differences in land-cover changes would give rise to unique "landscape signatures" along the urban-rural gradient. By examining a development sequence, Wear, Turner, and Naiman identify patterns of change that may be most significant for water quality. Two locations along the urban-rural gradient may hold disproportionate influence over water quality in the future: (1) at the most remote portion of the landscape, and (2) at the outer envelope of urban expansion. These findings demonstrate how landscape simulation approaches can be used to identify where and how land use decisions may have critical influence over environmental quality, thereby focusing both future research and monitoring efforts and watershed protection measures. **(83)**

Yarnell, Susan L. 1998. **The Southern Appalachians: a history of the landscape.** . Gen. Tech. Rep. SRS-18. Asheville, NC: U.S. Department of Agriculture, Forest Service, Southern Research Station. 45 p.

Natural and geological processes have changed the Southern Appalachian landscape repeatedly over millions of years. About 12,000 years ago, humans arrived and became important agents of change. The extent and degree of human influence increased along with the population. Today, pressure remains intense on the Southern Appalachian landscape and management issues bring contention as different groups seek to use the region's resources in different ways. **(84)**