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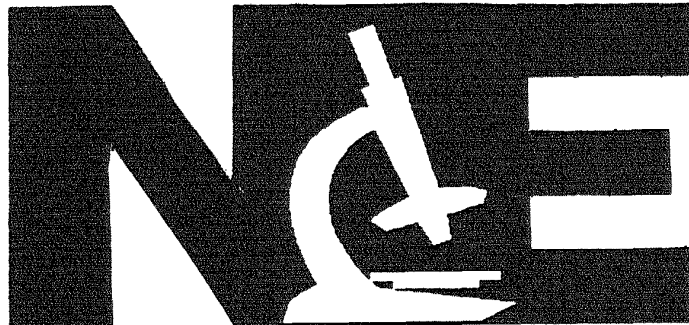
Forest Service

**Northeastern Forest
Experiment Station**

General Technical
Report NE-163

Publications of the Northeastern Forest Experiment Station: 1989 and 1990

Publications--1989

Most Station publications (Research Papers, Research Notes, General Technical Reports, and Resource Bulletins) are available from USDA Forest Service, 359 Main Road, Delaware, OH 43015. Attn: Publications Group. For copies of articles not published by the Station, contact a university library or the Northeastern Forest Experiment Station author or co-author. A list of Station authors by locations follows the citations. Full mailing addresses for headquarters and field locations are shown on the inside back cover.

Ashby, W. Clark; Davidson, Walter H.; Vogel, Willis G. 1989. **Soil pH guidelines for reclamation tree plantings.** In: Proceedings, 1988 Society of American Foresters national convention; 1988 October 16-19; Rochester, NY. SAF Publ. 88-01. Bethesda, MD: Society of American Foresters: 210-213.
Twenty-four species of forest trees up to 32 years old were grown on eastern/midwestern minesoils that ranged in surface soil pH from less than 3 (extremely acid) to above 8 (moderately alkaline). Statistical correlations of d.b.h., height, and/or survival of the different species with soil pH were established. Most species had a broad optimum pH range. Types of responses in the midwestern studies with increasing pH above 4.5 were greater growth and/or survival (black walnut), lesser growth (red maple and all pine species), and little effect (sweetgum).

Auchmoody, L. R. 1989. **A study to determine the factors limiting natural establishment and development of red oak seedlings.** In: VanSambeek, J. W.; Larson, M. M., eds. Proceedings of 4th workshop on seedling physiology and growth problems in oak plantings; 1989 March 1-2; Columbus, OH. Gen. Tech. Rep. NC-139. St. Paul, MN: U.S. Department of Agriculture, Forest Service, North Central Forest Experiment Station: 27. Abstract.

Auchmoody, L. R. 1989. **Fertilizing natural stands.** In: Clark, F. Bryan, tech. ed. Central hardwood notes. St. Paul, MN: U.S. Department of Agriculture, Forest Service, North Central Forest Experiment Station: 6.11-6.11-3.

Auchmoody, L. R.; Lilja, P. 1989. **Impact of forest liming on growth rates, vigor, and flowering and seed production of Allegheny hardwoods.** In: Agronomy Abstracts, 1989: 298. Abstract.
Dolomitic limestone was broadcast at 22.4 mg/ha to the forest floor of maturing Allegheny hardwood stands in northwestern Pennsylvania in 1985. Sixteen 0.2-ha plots received lime and 16 paired plots were not limed. The forest overstory on each plot was thinned to 50 percent relative density. Diameter-growth rates, tree vigor, and flowering and seed production of the residual trees were measured annually for 3 years. Lime had only minor impacts on the residual vegetation even though soil pH increased dramatically. During the 3-year period, lime did not improve diameter-growth rates of black cherry, sugar maple, or beech, had minor effects on vigor of black cherry, sugar maple, and beech, and did not influence flowering and seed production of dominant and codominant black cherry and sugar maple.

Auchmoody, L. R.; Walters, R. S. 1989. **Impact of deer browsing, understory competition, and soil aluminum on forest regeneration in Pennsylvania.** In: 64th annual meeting of Pennsylvania Academy of Science and Pennsylvania Chapter of the Wildlife Society; 1988 April 15-17; Champion, PA. Philadelphia, PA: Pennsylvania Academy of Science: 115. Abstract.
The impact of deer browsing, understory competition, and soil aluminum on natural regeneration obtained after partial forest cutting was determined at four sites in Potter County, Pennsylvania. Deer browsing was controlled by fencing, understory competition was eliminated with herbicide, and soil aluminum was neutralized with lime. After two growing seasons, seedling abundance, seedling height, and species diversity increased greatly where deer were excluded. Where deer were not excluded, few seedlings grew taller than 6 inches, and browsing virtually halted all understory development. There were fewer desirable species where herbicide was applied. Where lime was applied, a greater abundance of species that originate from dormant seed was observed, indicating a response to surface disturbance rather than a direct effect of liming. The major effect of liming on seedling nutrition was increased foliar Ca and Mg.

Barger, Jack H.; Hall, Richard W. 1989. **Effects of simulated acid rain on methoxychlor deposits,**

Delaware County, 1987. Insecticide & Acaricide Tests. 14: 340.

Baumgras, John E.; LeDoux, Chris B. 1989. **Impact of product mix and markets on the economic feasibility of hardwood thinning.** In: Rink, George; Budelsky, Carl A., eds. Proceedings of the 7th central hardwood forest conference; 1989 March 5-8; Carbondale, IL. Gen. Tech. Rep. NC-132. St. Paul, MN: U.S. Department of Agriculture, Forest Service, North Central Forest Experiment Station: 185-189. The economic feasibility of commercial hardwood thinning is affected by tree diameter, product mix, and primary product markets. Multi-product harvesting can increase revenues by $0.01 to $0.32/ft³. Small shifts in price levels or haul distance can postpone commercial thinning approximately 10 years.

Baumgras, John E.; LeDoux, Chris B. 1989. **Production analysis of two tree-bucking and product-sorting methods for hardwoods.** In: Stokes, Bryce J., ed. Proceedings of Southern Regional Council on Forest Engineering: 1st annual meeting; 1989 May 3-4; Auburn, AL. New Orleans, LA: U.S. Department of Agriculture, Forest Service, Southern Forest Experiment Station: 88-96.
Documents the cost and productivity of two tree-bucking and product-sorting methods used by West Virginia loggers harvesting three to four types of roundwood product. The methods include manual chain-saw bucking and bucking with a hydraulically powered chain-saw slasher. Results show that chain-saw bucking of trees averaging 53 ft³ produced 2,155 ft³/productive hour. This compares with 1,109 ft³/productive hour for mechanized bucking of trees averaging 33 ft³. Utilization levels below 50 percent for each method indicate that both were capable of greater production with increased felling and skidding production, and that added product sorting would not limit system output or increase harvesting cost.

Bellinger, Robert G.; Ravlin, F. William; McManus, Michael L. 1989. **Forest edge effects and their influence on gypsy moth (Lepidoptera: Lymantriidae) egg mass distribution.** Environmental Entomology. 18(5): 840-843.
Quantifying the presence of an edge effect in the distribution of gypsy moth egg masses is important in sampling egg masses to determine unbiased estimates of population density. Egg masses were counted on trees along the forest edge and on trees two chains (40.2 m) in from the forest edge in 16 locations in Virginia. Edge trees had about 2.4 times more egg masses than interior trees. The edge side of edge trees had about 3.2 times more egg masses than the edge side of interior trees and about 4.8 times more egg masses than the interior side of these same trees. Samples taken at or near the forest edge will overestimate population levels, or they will increase the probability of incorrectly classifying populations as being over thresholds if applied to larger areas using currently available sampling methods.

Berry, Frederick H. 1989. **Anthracnose.** In: Forestry nursery pests. Agric. Handb. 680. Washington, DC: U.S. Department of Agriculture. 88-89.

Birch, Thomas W. 1989. **Forest-land owners of New Hampshire, 1983.** Resour. Bull. NE-108. Broomall, PA: U.S. Department of Agriculture, Forest Service, Northeastern Forest Experiment Station. 96 p.
Reports results of a mail canvass of owners of private timberland in New Hampshire conducted in conjunction with the periodic forest survey of New Hampshire by the USDA Forest Service. The characteristics, attitudes, and intentions of forest-land owners with regard to their reasons for owning and managing timberland are discussed.

Birch, Thomas W. 1989. **Forest ownership in the Northeastern United States.** In: Finley, James C.; Brittingham, Margaret C., eds. Timber management and its effects on wildlife: proceedings of the Penn State forest resources issues conference; 1989 April 4-6; University Park, PA. University Park, PA: The Pennsylvania State University, School of Forest Resources and Cooperative Extension Service: 26-36.
Provides an overview of forest ownership in the Northeast and its relationship to forest ownership in the United States. The ownership of a basic resource such as forest land is the essential connecting link between people and the land. How resource managers maintain this resource will greatly affect wildlife in the Northeast.

Birch, Thomas W. 1989. **Change in New England forest-landowner intention to harvest has positive influence on timber availability.** In: 1989 Midwest forest economists meeting; 1989 August 23-25; St. Paul, MN. [Place of publication unknown]: [Publisher name unknown]. Abstract.

Recently completed forest inventories and surveys of woodland owners in New England show that owners have developed a more positive attitude toward timber cutting at a time when the forest resource is receiving more demands for products. About half of the private woodland owners have harvested timber from their holdings. Economics more than textbook silviculture may determine the kind of cutting that takes place. New England's woodlands have held their own and appear to be improving. Physical supplies of timber reveal a potential opportunity for significant expansion of wood use.

Birch, Thomas W.; Gansner, David A. 1989. **Vermont and New Hampshire landowners "more inclined to cut timber".** Northern Logger. 37(3): 8-9. Surveys indicate that private forest-land owners in New Hampshire and Vermont are much more inclined to cut timber now than they once were.

Birch, Thomas W.; Spencer, John S., Jr. 1989. **Chapter 2: the North and the Great Plains.** In: An analysis of the land base situation in the United States: 1989-2040. Gen. Tech. Rep. RM-181. Fort Collins, CO: U.S. Department of Agriculture, Forest Service, Rocky Mountain Forest and Range Experiment Station: 19-24.

Blyth, James E.; Widmann, Richard H. 1989. **1987 pulpwood production beats '86 record by one half million cords.** Northern Logger. 37(8): 16-17. Twenty-one northeastern and north-central states produced 17.5 million cords of pulpwood in 1987, up 3 percent from 1986. Four of every five cords came from roundwood; the remainder came from manufacturing residue such as slabs, edgings, veneer cores, and sawdust. Pulpwood production from roundwood rose 1 percent to a record 14.0 million cords, while production from manufacturing residue rose 11 percent to a record 3.5 million cords. Maine, New York, Pennsylvania, Michigan, Minnesota, and Wisconsin produced four-fifths of the pulpwood in the area. The number of active mills remained steady at 102.

Brisbin, Robert L. 1989. **Grading hardwood trees.** In: Clark, F. Bryan, tech. ed. Central hardwood notes. St. Paul, MN: U.S. Department of Agriculture, Forest Service, North Central Forest Experiment Station: 7.03-7.03-5.

Brooks, Robert T. 1989. **Status and trends of raptor habitat in the Northeast.** In: Proceedings of the northeast raptor management symposium and workshop. Sci. and Tech. Ser. No. 13. Washington, DC: National Wildlife Federation, Institute for Wildlife Research: 123-132.
Twenty-six raptor species have been reported to nest or winter in 11 Northeastern States. No single land use provides the optimum habitat condition for all species. A landscape of interspersed forest and open-habitat types would best support the majority of raptor species. Current and historical land-use patterns are described for the Northeast, and observations are made concerning potential raptor habitat conditions.

Brooks, Robert T. 1989. **Use of forest site quality in evaluating wildlife habitat: an untested technology.** In: Forest and wildlife management in New England--what can we afford? Proceedings of a joint meeting of the Maine Division of New England Society of American Foresters, Maine Chapter of the Wildlife Society, and Atlantic International Chapter of the American Fisheries Society; 1989 March 14-17; Portland, ME. CFRU Inf. Rep. 21; Misc. Rep. 336; SAF Publ. 89-05. Orono, ME: Maine Agricultural Experiment Station: 49-53.
Site quality is an integrated measure of many factors that determine the potential productivity of a forested location. While site quality has been considered a measure of potential timber yield, logic suggests that site quality also should reflect the productivity of a location for any forest resource. Three broad approaches have been used to quantify site quality: site index, vegetation classification, and multiple-factor (biophysical) classification. Site index is best applied to the evaluation of the potential production of vegetative features of wildlife habitat within forest stands. Vegetation and multiple-factor classifications can address the spatial attributes of wildlife-habitat condition as well as within stand attributes.

Brooks, Robert T. 1989. **History and future trends for wildlife and wildlife habitat in Northeastern United States.** In: Finley, James C.; Brittingham, Margaret C., eds. Timber management and its effects on wildlife: proceedings of the Penn State forest resources issues conference; 1989 April 4-6; University Park, PA. University Park, PA: The Pennsylvania State University, School of Forest Resources and Cooperative Extension Service: 37-54.

On a regional scale, land use patterns are a first approximation of wildlife habitat condition. As land use changes from forest to agriculture or intensely developed uses, habitat is altered such that individual wildlife species are locally extirpated. Cumulatively, these effects determine the composition of the wildlife community. Below the regional scale, landscape pattern, land cover, and land management activities influence species' abundances in the regional faunal community. The land use, land cover history of the Northeastern United States is one of dramatic regional changes. As land was converted from precolonal forest to agricultural use, and by subsequent abandonment of further development, the wildlife community changed.

Brooks, Robert T.; DiGiovanni, Dawn M. 1989. **Forest wildlife habitat statistics for Maryland and Delaware--1986.** Res. Bull. NE-110. Broomall, PA: U.S. Department of Agriculture, Forest Service, Northeastern Forest Experiment Station. 171 p.
A statistical report on the forest wildlife habitat survey of Maryland and Delaware (1986). Findings are displayed in 118 tables covering forest area, landscape pattern, mast potential, standing dead and cavity trees, and understory woody-stemmed vegetation. Data are presented at country and/or unit and state levels.

Brooks, Robert T.; Healy, William M. 1989. **Response of small mammal communities to silvicultural treatments in eastern hardwood forest of West Virginia and Massachusetts.** In: Proceedings, management of amphibians, reptiles, and small mammals in North America; 1988 July 19-21; Flagstaff, AZ. Gen. Tech. Rep. RM-166. Fort Collins, CO: U.S. Department of Agriculture, Forest Service, Rocky Mountain Forest and Range Experiment Station: 313-318.
We studied small-mammal communities and associated habitats in West Virginia and Massachusetts hardwood forests with different silvicultural treatments. In Massachusetts, density of white-tailed deer was a second interactive treatment. Total capture rates were relatively stable across all treatment classes. Composition of small-mammal communities and capture rates for individual species varied by treatment. Density of white-tailed deer had a greater effect on the small-mammal community than silvicultural practices.

Brooks, Robert T.; Kittredge, David B., Jr. 1989. **Massachusetts timber resources: volume and value change.** In: Resources and environment: management choices. Amherst, MA: University of Massachusetts, Cooperative Extension. 3 p.
Despite common public perception, Massachusetts has an extensive and valuable timber resource that supports a billion dollar timber industry. While there are barriers to industry growth, many of these will decline with changes in industrial practices and the development of larger and more diverse markets. There is a role for both the public and private sector in removing these barriers and increasing benefits from this valuable resource.

Buonaccorsi, John P.; Liebhold, Andrew M. 1989. **Estimating the size of gypsy moth populations using ratios.** In: McDonald, L.; Manly, B.; Lockwood, J.; Logan, J., eds. Proceedings, estimation and analysis of insect populations; 1988 January 25-29; Laramie, WY. Lect. Notes in Stat. 55. New York: Springer-Verlag: 404-415.
Estimates of gypsy moth populations can be obtained using a ratio of mean frass drop from a forest canopy to mean frass production for individually caged larvae. Appropriate statistical methods for point estimation and confidence intervals were developed. Those methods included the use of two resampling techniques, the jackknife and the bootstrap. Exact theoretical comparisons of the proposed methods are impossible. Computer simulations for a limited number of situations are evaluated.

Burk, Thomas E.; Hans, Richard P.; Wharton, Eric H. 1989. **Individual tree volume equations for the Northeastern United States: evaluation and new form quotient board foot equations.** Northern Journal of Applied Forestry. 6(1): 27-31.
Volume equations used in forest survey in the Northeastern United States were evaluated using data collected as part of utilization studies. Results are presented for both cubic- and board-foot equations for 16 species groups. Existing cubic-foot equations were satisfactory while the board-foot equations generally produced significantly large underestimates. New board-foot equations that include a measure of tree form were derived.

Carpenter, Roswell D.; Sonderman, David L.; Rast, Everette D.; Jones, Martin J. 1989. **Defects in hardwood timber.** Agric. Handb. 678. Washington, DC: U.S. Department of Agriculture. 88 p.
Includes detailed information on all common defects that may affect hardwood trees and logs. Rela-

tionships between manufactured products and those forms of round material to be processed from the tree for conversion into marketable products are discussed.

Chang, M. T.; Lanner-Herrera, C.; Fikes, M. 1989. **Nucleotide sequence of** *Lymantria dispar* **nuclear polyhedrosis virus polyhedrin gene.** Journal of Invertebrate Pathology. 53: 241-246.
The polyhedrin gene of the nuclear polyhedrosis virus of the gypsy moth (LdMNPV) was cloned and sequenced. A polyhedrin open-reading frame of 735 nucleotides (nt) was identified that can code for a protein of 245 amino acids. The protein predicted from the nucleotide sequence shows differences in several regions to that previously sequenced from the LdMNPV polyhedrin protein. The consensus sequence AATAAGTATTTT found at the mRNA start site of baculovirus hyperexpressed genes was located 55 nt upstream from the translational start site.

Colbert, J. J. 1989. **Dimension, scatter, and gather commands.** Foxtalk. 1989 October: 2-4.

Cole, Gerald L.; More, Thomas A. 1989. **Satisfaction with facilities and services in Delaware state parks, including a comparison of survey techniques.** In: More, Thomas A.; Donnelly, Maureen P.; Graefe, Alan R.; Baske, Jerry J., eds. Proceedings, 1989 northeastern recreation research symposium; 1989 April 3-5; Saratoga Springs, NY. Gen. Tech. Rep. NE-132. Broomall, PA: U.S. Department of Agriculture, Forest Service, Northeastern Forest Experiment Station: 25-30.
Satisfaction ratings for Delaware state parks were obtained during the summer of 1984 using both mailback questionnaires and personal interviews. Satisfaction varied across parks and individual visits, and generally was higher for inland, forested parks compared to coastal parks. Satisfaction ratings also were higher from personal interviews versus questionnaires, perhaps reflecting a reluctance of interviewees to offer negative feedback to an interviewer on site. Satisfaction ratings can supply managers with important information about the effectiveness of a variety of facilities and amenities.

Corbett, Edward S.; Lynch, James A. 1989. **Hydrologic production zones in a headwater watershed.** In: Woessner, W. W.; Potts, D. F., eds. Headwaters hydrology: proceedings of a symposium.
TPS-89-1. Bethesda, MD: American Water Resources Association: 573-578.
To investigate the hydrologic behavior and response of a small forested watershed, an irrigation system was designed to apply simulated rainfall to parts or all of a 19.59-acre experimental watershed in central Pennsylvania. Storm applications of 0.96 inch were made at both dry and wet antecedent soil moisture. Under dry antecedent conditions, the rising limb and hydrograph peak are produced by stormflow contributions from the channel and base slope zones, primarily in the front 30 percent of the watershed. The percentage of rainfall converted into quickflow ranged from 21.9 for the channel-base slope application to 9.8 for the total watershed application. Under wet antecedent conditions, the percentage of rainfall converted into quickflow ranged from 55.9 for the channel application to 82.6 for the channel-lower slope application.

Crawford, H. S.; Frank, R. M. [n.d.]. **Rating spruce-fir silviculture for wildlife and forestry.** Broomall, PA: U.S. Department of Agriculture, Forest Service, Northeastern Forest Experiment Station. 23 p.

Crawford, Hewlette S.; Jennings, Daniel T. 1989. **Predation by birds on spruce budworm** *Choristoneura fumiferana*: **functional, numerical, and total responses.** Ecology. 70(1): 152-163.
Examines the hypothesis that predation by forest birds restricts expansion of low-densisty populations of the spruce budworm. Bird populations were censused in spruce-fir stands of low to moderate spruce budworm density in northern New Hampshire and western Maine. Diets were determined from stomach contents of collected birds. Budworm population densities were estimated by sampling fourth-instar larvae and successfully emerged pupae (counted after moth emergence).

Crawford, Hewlette S.; Marchinton, R. Larry. 1989. **A habitat suitability index for white-tailed deer in the Piedmont.** Southern Journal of Applied Forestry. 13(1): 12-16.
A habitat suitability index based on winter foods was designed to evaluate habitat changes affecting white-tailed deer in the Piedmont Region of the Southeastern United States. Habitat components incorporated in the index were: (1) standing crop of available herbaceous vegetation and leaves of woody plants remaining green during late autumn and winter; (2) basal area of oak 10 inches d.b.h. and larger; (3) number of oak species in the stand

detected, provides a biologically meaningful and statistically defined assessment of the relative cold tolerance of plant tissues. A method is described for calculating critical temperatures in laboratory freezing studies that includes the use of electrical conductivity as a viability assay. Evidence indicates that critical temperatures are strongly correlated with field assessments of winter injury, sufficiently precise to detect subtle differences in cold tolerance, highly repeatable from year to year, and appropriate for a diversity of plant species.

Dempsey, Gilbert P. 1989. **Capital substitution and change in the pallet industry.** In: Potter, Richard H., ed. Proceedings of the 1989 southern forest economics workshop; 1989 March 1-3; San Antonio, TX. San Antonio, TX: [Publisher name unknown]: 233-239.
An assessment was made of selected aspects of the wooden pallet industry's operating structure and performance between 1972 and 1987. Despite higher costs, the U.S. wooden pallet industry is producing more pallets with less labor and at lower prices. Industry efficiency has increased by 83 percent, with the most significant improvements occurring between 1982 and 1987. The principal reasons for these advancements were the substitution of capital for labor and a more proficient labor force mix. The changes in pallet output and prices received are discussed, and shifts in the industry's use of capital and labor are examined.

Dempsey, Gilbert P. 1989. **The effect of regional economic initiatives on an underdeveloped area: an eastern experience.** Proceedings of the 23rd annual Pacific Northwest Regional Economic Conference; 1989 April 27-29; Corvallis, OR. Corvallis, OR: Pacific Northwest Regional Economic Conference and University of Washington, Northwest Policy Center: 105-110.
Discussed are selected physical, social, and economic changes that have occurred in the heavily forested, southern Appalachian region, and the developmental roles of two regional institutions unique to Appalachia: the Tennessee Valley Authority and the Appalachian Regional Commission.

Dennis, Donald F. 1989. **An economic analysis of harvest behavior: integrating forest and ownership characteristics.** Forest Science. 35(4): 1088-1104.
Provides insight into the determinants of timber supply from private forests through the development of

both theoretical and empirical models of harvest behavior. A microeconomic model encompasses the multiple objective nature of private ownership by examining the harvest decision for landowners who derive utility from forest amenities and from income used for the consumption of other goods. Tobit analysis is used to estimate the relationship between harvest behavior and forest, owner, and economic characteristics from cross-sectional data for individual forest plots in New Hampshire. The empirical results highlight the influence of forest characteristics and landowner affluence on the harvest decision. Decomposition of the Tobit coefficients indicates that changes in timber supply are expected to result primarily from changes in the number of acres from which timber is offered for sale and to a much lesser extent from changes in per-acre harvesting intensity.

Dennis, Donald F. 1989. **Timber growth, stumpage price trends pay off for northeastern landowners.** Northern Logger. 38(2): 12-13.

Dennis, Donald F. 1989. **Trends in New Hampshire stumpage prices: a supply perspective.** Northern Journal of Applied Forestry. 6(4): 189-190.
Updates stumpage price trends for New Hampshire that were reported for 1985. This study focuses on correlations between recent stumpage price trends and changes in forest inventory. Willingness to harvest and the influence of price expectations on the available timber supply and on price trends are discussed.

deSteiguer, J. E.; Hayden, L. W.; Holley, D. L., Jr.; Luppold, W. G.; Martin, W. G.; Newman, D. H.; Sheffield, R. M. 1989. **Southern Appalachian hardwood timber market trends.** Southern Journal of Applied Forestry. 13(1): 29-33.
Since 1980, the hardwood timber harvests in southern Appalachia, and particularly in western North Carolina, have risen to a 20-year high. Increased harvests accompanied by rising real stumpage prices for private timber could be interpreted as indications of economic scarcity, though large timber inventories indicate that physical supply is adequate. Tract subdivision and changes from farm to nonfarm ownerships may be creating supply problems. While real prices for private stumpage have risen in North Carolina, prices for National Forest timber have fallen drastically. Possible causes for this apparent inconsistency include accelerated National Forest harvesting and weak demand for

(more than 5 percent of total basal area); (4) site index of loblolly pine or mixed oak; (5) percentage of agricultural land; and (6) distance from agricultural land to forest or shrub cover. The rationale for including each component of the index is given, and methods for sampling each habitat component are described.

Cullen, J. B.; Leak, William. 1989. **New Hampshire's timber resource: past-present.** Forests and Lands. Concord, NH: New Hampshire Division of Forests and Lands, Department of Resources and Economic Development: 1: 3.

Dale, Martin E.; Hilt, Donald E. 1989. **Growth and yield models for central hardwoods.** In: Clark, F. Bryan, tech. ed. Central hardwood notes. St. Paul, MN: U.S. Department of Agriculture, Forest Service, North Central Forest Experiment Station: 5.10-5.10-5.

Dale, Martin E.; Hilt, Donald E. 1989. **Estimating oak growth and yield.** In: Clark, F. Bryan, tech. ed. Central hardwood notes. St. Paul, MN: U.S. Department of Agriculture, Forest Service, North Central Forest Experiment Station: 5.03-5.03-6.

Dale, Martin E.; Hilt, Donald E. 1989. **Stocking chart for upland central hardwoods.** In: Clark, F. Bryan, tech. ed. Central hardwood notes. St. Paul, MN: U.S. Department of Agriculture, Forest Service, North Central Forest Experiment Station: 5.02-5.02-3.

Dale, Martin E.; Lutz, David E.; Bailey, Herman J. 1989. **Yield of white pine plantations in Ohio.** Northern Journal of Applied Forestry. 6(2): 51-56.
Yield equations are presented for white pine plantations established in the residual soils region of southern and eastern Ohio. Estimates of board-foot and cubic-foot volume as well as tons of wood (either dry or green with or without bark) are given by site, age, and initial spacing. When established on suitable sites, white pine produces rapid growth and high yields compared to other native species in Ohio.

Davidson, Walter H. 1989. **First-year evaluation of excelsior pads on loblolly pine.** In: Walker, D. G.; Powter, C. B.; Pole, M. V., eds. Proceedings of the conference: reclamation, a global perspective; 1989 August 27-31; Calgary, AB. Rep. RRTAC 89-2. Calgary, AB: Alberta Land Conservation and Reclamation Council: 339-343.

A study was conducted in the spring of 1988 to test the effects of excelsior pads on loblolly pine survival and growth. Two types of pads were used: American Excelsior Company TREGRO type 100 and 200. Bare-root, 1-0 loblolly pine seedlings were mattock-planted on April 14 and the pads installed on April 15. The study design was random pairs of treatment (with pad) and control (no pad) seedlings. An evaluation on May 5 showed that survival attributed to planting technique was inconsistent. Three people planted seedlings: two had survival rates of 95 percent while the survival rate for the third planter was 77 percent. Evaluation at the end of the growing season showed that the pads had no apparent influence on survival. Overall survival was 72 percent with pads and 71 percent without pads. Seedlings with the type 200 pads were significantly taller than controls or type 100 seedlings.

deCalesta, David S. 1989. **Even-aged forest management and wildlife populations.** In: Finley, James C.; Brittingham, Margaret C., eds. Proceedings of the 1989 Penn State forest resources issues conference; timber management and its effects on wildlife; 1989 April 4-6; University Park, PA. University Park, PA: The Pennsylvania State University: 210-224.

DeGraaf, Richard M. 1989. **Territory sizes of song sparrows, *Melospiza melodia*, in rural and suburban habitats.** Canadian Field-Naturalist. 103(1): 43-47.
Territory sizes of song sparrows reported for several habitats suggest that territory size may vary with habitat type or structure. Sizes of 10 rural and 10 suburban song sparrow territories in Amherst, Massachusetts, were not significantly different during prenesting and nest-building stages. Shrub density and number of conspecific males together accounted for 51 percent of the variation in territory size. Separate analyses of rural and suburban territory sizes would have led to a different, unjustified, conclusion that habitat features were more useful in explaining territory size than numbers of adjacent conspecific territorial males.

DeHayes, D. H.; Williams, M. W., Jr. 1989. **Critical temperature: a quantitative method of assessing cold tolerance.** Gen. Tech. Rep. NE-134. Broomall, PA: U.S. Department of Agriculture, Forest Service, Northeastern Forest Experiment Station. 6 p.
Critical temperature, defined as the highest temperature at which freezing injury to plant tissues can be

detected, provides a biologically meaningful and statistically defined assessment of the relative cold tolerance of plant tissues. A method is described for calculating critical temperatures in laboratory freezing studies that includes the use of electrical conductivity as a viability assay. Evidence indicates that critical temperatures are strongly correlated with field assessments of winter injury, sufficiently precise to detect subtle differences in cold tolerance, highly repeatable from year to year, and appropriate for a diversity of plant species.

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Dempsey, Gilbert P. 1989. **The effect of regional economic initiatives on an underdeveloped area: an eastern experience.** Proceedings of the 23rd annual Pacific Northwest Regional Economic Conference; 1989 April 27-29; Corvallis, OR. Corvallis, OR: Pacific Northwest Regional Economic Conference and University of Washington, Northwest Policy Center: 105-110.
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Dennis, Donald F. 1989. **An economic analysis of harvest behavior: integrating forest and ownership characteristics.** Forest Science. 35(4): 1088-1104.
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Updates stumpage price trends for New Hampshire that were reported for 1985. This study focuses on correlations between recent stumpage price trends and changes in forest inventory. Willingness to harvest and the influence of price expectations on the available timber supply and on price trends are discussed.

deSteiguer, J. E.; Hayden, L. W.; Holley, D. L., Jr.; Luppold, W. G.; Martin, W. G.; Newman, D. H.; Sheffield, R. M. 1989. **Southern Appalachian hardwood timber market trends.** Southern Journal of Applied Forestry. 13(1): 29-33.
Since 1980, the hardwood timber harvests in southern Appalachia, and particularly in western North Carolina, have risen to a 20-year high. Increased harvests accompanied by rising real stumpage prices for private timber could be interpreted as indications of economic scarcity, though large timber inventories indicate that physical supply is adequate. Tract subdivision and changes from farm to nonfarm ownerships may be creating supply problems. While real prices for private stumpage have risen in North Carolina, prices for National Forest timber have fallen drastically. Possible causes for this apparent inconsistency include accelerated National Forest harvesting and weak demand for

federal timber due to "nuisance factors" associated with its purchase.

DeWalle, David R.; Sharpe, William E.; Edwards, Pamela J. 1989. **Canopy interactions with atmospheric deposition at three hardwood forest sites.** In: Rink, George; Budelsky, Carl A., eds. Proceedings of the 7th central hardwood forest conference; 1989 March 5-8; Carbondale, IL. Gen. Tech. Rep. NC-132. St. Paul, MN: U.S. Department of Agriculture, Forest Service, North Central Forest Experiment Station: 274-277.
Annual ion fluxes in bulk precipitaion and throughfall were compared at three deciduous forest sites to examine the role of hydrogen ions and organic compounds in canopy cation exchange. Hydrogen ions explained from 31 to 83 percent of annual canopy cation losses. Organic compounds played a significant role in canopy cation exchange as either weak acids or neutral salts.

Dubois, Normand R.; Huntley, Pamela J.; Newman, DeAdra. 1989. **Potency of *Bacillus thuringiensis* strains and formulations against gypsy moth and spruce budworm larvae: 1980-86.** Gen. Tech. Rep. NE-131. Broomall, PA: U.S. Department of Agriculture, Forest Service, Northeastern Forest Experiment Station. 25 p.
Two hundred and sixty strains and 70 commercial preparations of *Bacillus thuringiensis* were bioassayed against the gypsy moth and spruce budworm. Toxicity of individual strains differed between the two insects. Standardized commercial preparations produced in 1986 were 200 percent more efficacious than those produced in 1980. Regressions coefficients of preparations from one manufacturer were consistent but differed between manufacturers.

Echelberger, Herbert E.; More, Thomas A. 1989. **Federal, state, and local roles in providing outdoor recreation opportunities to an urbanizing population.** In: Proceedings, 1988 Society of American Foresters national convention; 1988 October 16-19; Rochester, NY. SAF Publ. 88-01. Bethesda, MD: Society of American Foresters: 389-390.
The loss of open space to urban growth is placing great strain on local forests and parks, budgets, and planners. This strain has been compounded by decreasing federal aid over the past 10 years. The three levels of government have reacted differently to these strains based on their distinct missions, on their self-perceived roles, and on their capabilities.

Echelberger, Herbert E.; More, Thomas A.; Glass, Ronald J. 1989. **Providing quality recreation opportunities in the Northeast: the challenge to Forest Service research over the next five years.** In: More, Thomas A.; Donnelly, Maureen P.; Graefe, Alan R.; Vaske, Jerry J., eds. Proceedings, 1989 northeastern recreation research symposium; 1989 April 3-5; Saratoga Springs, NY. Gen. Tech. Rep. NE-132. Broomall, PA: U.S. Department of Agriculture, Forest Service, Northeastern Forest Experiment Station: 1-3.
Recreation research at the USDA Forest Service's Northeastern Forest Experiment Station laboratory in Burlington, Vermont, will examine the social attributes that affect the perceived quality of forest recreation resources, the benefits that accrue to forest recreation users and to society in general, and how the supply/demand relationships for these resources affect these benefits. Several studies are described.

Echelberger, Herbert E.; Wiesel, Jonathan. 1989. **Economic analysis of the 1987-88 cross country season.** Ski Area Management. 28(6): 29, 86.
Presents findings of the latest survey to determine the economic health of the cross-country ski industry.

Edwards, Pamela J.; Mohai, Paul; Halverson, Howard G.; DeWalle, David R. 1989. **Considerations for throughfall chemistry sample-size determination.** Forest Science. 35(1): 173-182.
Both the number of trees sampled per species and the number of sampling points under each tree are important throughfall sampling considerations. Chemical loadings obtained from an urban throughfall study were used to evaluate the relative importance of both of these sampling factors in tests for determining species differences. Power curves for detecting differences among species derived from the noncentrality parameter that was developed indicate that the number of trees sampled per species affects power more than the number of points sampled under each tree.

Elkinton, Joseph S.; Gould, Juli R.; Liebhold, Andrew M.; Smith, Harvey R.; Wallner, William E. 1989. **Are gypsy moth populations in North America regulated at low density?** In: Wallner, William E.; McManus, Katherine A., tech. coords. Proceedings. Lymantriidae: a comparison of features of New and Old World tussock moths; 1988 June 26-July 1; New Haven, CT. Gen. Tech. Rep. NE-123. Broomall, PA:

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U.S. Department of Agriculture, Forest Service, Northeastern Forest Experiment Station: 233-249.

Federer, C. Anthony. 1989. **Depletion of nutrients by timber harvesting and acid precipitation in the northeastern United States.** In: Krecek, Josef; Grip, Harold; Haigh, Martin J.; Hocevar, Andry, eds. Headwater control, conference proceedings, vol. 2; 1989 November 21-23; Prague, Czechoslovakia. [Place of publication unknown]: International Union of Forestry Research Organizations: 206-212.

Federer, C. Anthony; Hornbeck, James W.; Tritton, Louise M.; Martin, C. Wayne; Pierce, Robert S.; Smith, C. Tattersall. 1989. **Long-term depletion of calcium and other nutrients in eastern US forests.** Environmental Management. 13(5): 593-601
Both harvest removal and leaching losses can deplete nutrient capital in forests, but their combined long-term effects have not been assessed. We estimated changes in total soil and biomass N, Ca, K, Mg, and P over 120 years from published data for a spruce-fir site in Maine, two northern hardwood sites in New Hampshire, central hardwood sites in Connecticut and Tennessee, and a loblolly pine site in Tennessee. For N, atmospheric inputs counterbalance the outputs, and there is little long-term change on most sites. For K, Mg, and P, the total pool may decrease by 2 percent--10 percent in 120 years depending on site and harvest intensity. For Ca, net leaching loss is 4 to 16 kg/ha/yr in mature forests, and whole-tree harvest removes 200 to 1100 kg/ha. Such leaching loss and harvest removal could reduce total soil and biomass Ca by 20 percent--60 percent in only 120 years. We estimated unmeasured Ca inputs from rock breakdown, rootzone deepening, and dry deposition; these should not be expected to make up the Ca deficit. Acid precipitation may be the cause of current high leaching of Ca.

Federer, C. A.; Tritton, L. M.; Hornbeck, J. W.; Smith, R. B. 1989. **Physiologically based dendroclimate models for effects of weather on red spruce basal-area growth.** Agricultural and Forest Meteorology. 46: 159-172.
Inter-annual variation in basal-area increment of red spruce was related to regional weather by dendroclimatological methods. A time series (1927-81) of detrended, delagged, average annual basal-area increment was obtained from hundreds of trees for each of three regions: Maine, New Hampshire-Vermont and the Adirondack Mountains of New York. Daily temperature and daily precipitation averaged over several stations in each region were used to calculate time series of several seasonal weather variables. Three multiple linear regression models, each with six or seven weather variables defined a priori, were tested against the basal-area series for each region. Model I variables were based on earlier results using monthly precipitation and mean temperatures. Model II variables included seasonal growing degree-days and soil-water deficits. Model III variables included seasonal accumulations of estimated daily photosynthesis and respiration. Models II and III explained less than 18 percent of the variance for all regions; Model I explained 18 to 33 percent.

Frank, Robert M. 1989. **Shelterwood--a technique to increase spruce production and reduce budworm problems.** In: Briggs, Russell D.; Krohn, William B.; Trial, Joan G.; Ostrofsky, William D.; Field, David B., eds. Proceedings of a joint meeting of the Maine Division of New England Society of American Foresters, Maine Chapter of the Wildlife Society, and Atlantic International Chapter of the American Fisheries Society; 1989 March 15-17; Portland, ME. SAF Publ. 89-05. Portland, ME: Maine Agricultural Experiment Station: 240. Abstract.
Increasing the production of spruce in spruce-fir stands should reduce the number of problems created by the spruce budworm. Research suggests that the shelterwood method of regeneration followed by precommercial thinning might be the best way to accomplish this objective. Mature spruce-fir stands containing only 23 percent spruce trees in the overstory and 50 balsam fir seedlings to each spruce seedling in the understory were regenerated to new stands. After spacing, these new stands contained less than 1,000 trees per acre, 60 percent of which were spruce.

Frieswyk, Thomas S.; DiGiovanni, Dawn M. 1989. **Forest statistics for Delaware--1972 and 1986.** Resour. Bull. NE-109. Broomall, PA: U.S. Department of Agriculture, Forest Service, Northeastern Forest Experiment Station. 86 p.
A statistical report on the third forest survey of Delaware (1986). Findings are displayed in 65 tables containing estimates of forest area, number of trees, timber volume, tree biomass, and timber products output. Data are presented at both state and county levels.

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Furnival, George M.; Gregoire, Timothy G.; Valentine, Harry T. 1989. **Confidence intervals and significance tests for a single trial.** Communications in Statistics. Part A: Theory and Methods. 18(10): 3749-3761.
Confidence intervals were developed for the location parameter of a continuous, symmetric, unimodal distribution in the case where only a single observation from the distribution is available. The result is extended to include distributions that can be standardized to have unit scale. The procedure is exemplified for the normal distribution, and the power of one- and two-sided significance tests are computed under normality.

Galford, Jimmy R. 1989. **Reducing borer damage in oak regeneration and sawtimber.** In: Clark, F. Bryan, tech. ed. Central hardwood notes. St. Paul, MN: U.S. Department of Agriculture, Forest Service, North Central Forest Experiment Station: 8.09-8.09-2.

Gansner, David A. 1989. **Impact of gypsy moth on timber supplies.** In: 1989 Midwest forest economists meeting; 1989 August 23-25; St. Paul, MN. [Place of publication unknown]: [Publisher name unknown]. Abstract.

Gansner, David A. 1989. **Timber value growth rates in New England.** In: 1989 Midwest forest economists meeting; 1989 August 23-25; St. Paul, MN. [Place of publication unknown]: [Publisher name unknown]. Abstract.
Rates of growth in the value of standing timber can vary greatly from stand to stand and from tree to tree. In New England, the compound annual rate of change in stand value between the two most recent forest inventories averaged 4.2 percent and ranged from -26 to +43 percent. Faced with this kind of variation, forest managers can use all the help they can get to determine financial rates of return for their woodlands. Tree species, size, quality and stand stocking are key predictors of the value of biological development in trees, and can be used to estimate rates of value change for New England's major timber species.

Gansner, David A.; Birch, Thomas W. 1989. **Effect of gypsy moth on forest condition: a tale of two infestations.** In: Proceedings of the 1988 national gypsy moth review; 1989 January 10-12; Dearborn, MI. Dearborn, MI: Michigan Department of Agriculture.
Changes in forest condition associated with gypsy moth have been measured for two infestations: northeastern Pennsylvania (1971-79) and central Pennsylvania (1978-85). Average damage levels were similar in these case studies. Oak timber, which has borne the brunt of gypsy moth attacks, accounts for a smaller proportion of total stocking than it used to, but other less vulnerable species such as red maple, ash, and yellow-poplar have grown to take up the slack. Average stocking changed little even though some plots suffered heavy damage. Rates of change in timber value were low during these episodes.

Garrett, Peter W.; Dudzik, Kenneth R. 1989. **Ray tissue as an indirect measure of relative sap-sugar concentration in sugar maple.** Res. Pap. NE-626. Broomall, PA: U.S. Department of Agriculture, Forest Service, Northeastern Forest Experiment Station. 7 p.
Attempts to correlate ray tissue as a percentage of total wood volume with sap-sugar concentrations of sugar maple progenies were unsuccessful. These results raise doubts about our ability to use a relatively constant value such as ray-tissue volume in a selection program designed to increase the sap-sugar concentration of sugar maple seedlings.

Garrett, Peter W.; Funk. David T.; Hawley, Gary J.; Wendel, George W. 1989. **Heritability in sugar maple families suggest breeding for response to wounding would pay.** Northern Journal of Applied Forestry. 6(2): 59-61.
There was no significant variation in response to wounding related to geographic origin in a 14-year-old provenance/progeny test of sugar maple. Narrow-sense heritability calculated for the 73 families was 0.38. The area of discolored wood was not correlated with tree size, suggesting the possibility of dual selection for growth and ability to compartmentalize discolored and decayed wood.

Gatchell, Charles J. 1989. **Recognizing interactions among lumber grading rules, gang-ripping technology, and industry needs could increase the use of No. 2 Common lumber.** Forest Products Journal. 39(2): 33-37.
Recognizing the interactions among lumber grading rules, gang-ripping technology, and the parts needs of the furniture and cabinet industries could increase the use of No. 2 Common lumber as a raw material. The minimum piece size used in establishing the No. 2 Common grade is 3 inches by 2 feet.

Industry often needs shorter and narrower pieces than this. No. 2 Common often contains areas that contribute to total yield but cannot be used to establish the grade. Results from an analysis of the effects of crook on yield when gang ripping narrow boards show that both No. 1 and No. 2 Common yield more long lengths and fewer short lengths than are required by industry. A discussion of computer-generated versus human-generated yields is included and a practical illustration of parts yields from gang ripping No. 1 and No. 2 Common lumber is presented.

Gatchell, Charles J. 1989. **The benefits of gang ripping first.** Woodextra/Wood & Wood Products: 28, 30-31.

Glass, Ronald J. 1989. **Habitat improvement costs on state-owned wildlife management areas in New York.** Res. Pap. NE-621. Broomall, PA: U.S. Department of Agriculture, Forest Service, Northeastern Forest Experiment Station. 15 p.
Estimates of management costs on New York's wildlife management areas indicate that human management is more costly than habitat management. Agricultural agreements and timber sales make a major contribution to habitat enhancement, and many wildlife species benefit.

Glass, Ronald J. 1989. **State-owned wildlife management areas in New England.** Res. Pap. NE-623. Broomall, PA: U.S. Department of Agriculture, Forest Service, Northeastern Forest Experiment Station. 9 p.
State-owned wildlife management areas play an important role in enhancing wildlife populations and providing opportunities for wildlife-related recreational activities. In the six New England States there are 271 wildlife management areas with a total area exceeding 268,000 acres. Many wildlife species benefit from habitat improvement activities on these areas.

Glass, Ronald J.; Muth, Robert M. 1989. **Personal use of fish and wildlife in a modernizing Alaskan community: recreation or subsistence?** In: Proceedings of the 2nd international wildlife symposium on economics and social aspects of wildlife; 1988 May 17-20; Acalpulco, Mexico. [Place of publication unknown]: The Wildlife Society: 449-485.
Subsistence has been traditionally associated with a high degree of dependency on the harvesting of fish, wildlife, and other natural resources for physical survival, but the forces of modernization have changed the form and role of subsistence to the extent that it is difficult to differentiate subsistence activities from recreation activities. The psychological and sociocultural payoffs associated with harvesting activities often appear to have become more important than their contributions to material survival. The economies of rural Alaskan communities are best described as mixed with three integrated sectors--the public, private, and subsistence. These sectors in the economy of the southeastern Alaska community of Yakutat are examined.

Glass, Ronald J.; Muth, Robert M. 1989. **The changing role of subsistence in rural Alaska.** Transactions of the 54th North America Wildlife and Natural Resources Conference: 224-232.

Glass, Ronald J.; Muth, Robert M. 1989. **Conflicts between recreation and subsistence use of fish and wildlife in New England.** In: More, Thomas A.; Donnelly, Maureen P.; Graefe, Alan R.; Vaske, Jerry J., eds. Proceedings, 1989 northeastern recreation research symposium; 1989 April 3-5; Saratoga Springs, NY. Gen. Tech. Rep. NE-132. Broomall, PA: U.S. Department of Agriculture, Forest Service, Northeastern Forest Experiment Station: 101-106.
Harvesting natural resources for personal use occurs in relatively affluent societies as well as in more remote areas. While these resources are seldom valuated, they can make an important contribution to the standard of living of low-income households. Conflicts are likely to arise between those who desire to have fish and wildlife to satisfy recreational motivations and to those who use these resources for food and other needs.

Gottschalk, Kurt W. 1989. **Impacts, silviculture, and the gypsy moth.** In: Wallner, William E.; McManus, Katherine A., tech. coords. Proceedings, Lymantriidae: a comparison of features of New and Old World tussock moths; 1988 June 26-July 1; New Haven, CT. Gen. Tech. Rep. NE-123. Broomall, PA: U.S. Department of Agriculture, Forest Service, Northeastern Forest Experiment Station: 217-231.

Gottschalk, Kurt W. 1989. **Effects of previous stand management on mortality following gypsy moth defoliation: preliminary results.** In: Miller, James H., comp. Proceedings of the 5th biennial southern silvicultural research conference; 1988 November 1-3; Memphis, TN. Gen. Tech. Rep. SO-74. New

Orleans, LA: U.S. Department of Agriculture, Forest Service, Southern Forest Experiment Station: 573-578.
Oak-hickory forest stands were sampled for tree mortality using a series of temporary plots. Stands were classified by gypsy moth defoliation and by timing of thinning treatment. Thinning of forest stands does reduce mortality in undefoliated stands, but the effect is not clear when stands are defoliated.

Gottschalk, Kurt W. 1989. **Effects of previous stand management on mortality following gypsy moth defoliation.** In: Rink, George; Budelsky, Carl A., eds. Proceedings of the 7th central hardwood forest conference; 1989 March 5-8; Carbondale, IL. Gen. Tech. Rep. NC-132. St. Paul, MN: U.S. Department of Agriculture, Forest Service, North Central Forest Experiment Station: 296. Poster presentation.

Gottschalk, Kurt W. 1989. **Interaction of previous stand management and gypsy moth defoliation.** In: Proceedings, 1989 national gypsy moth review; 1989 November 6-9; Annapolis, MD. [Place of publication unknown]: [Publisher name unknown]: 123-125.

Gottschalk, Kurt W. 1989. **Using silviculture to minimize gypsy moth impacts.** In: Clark, F. Bryan, tech. ed. Central hardwood notes. St. Paul, MN: U.S. Department of Agriculture, Forest Service, North Central Forest Experiment Station: 6.14-6.14-4.

Gottschalk, Kurt W.; Gansner, David A.; Twery, Mark J. 1989. **Impacts of gypsy moth on oak timber resources or will there be oak in 2001?** In: Proceedings, 17th annual hardwood symposium of the Hardwood Research Council; 1989 May 7-10; Merrimac, WI. [Place of publication unknown]: Hardwood Research Council: 11-22.
Gypsy moth has affected oak forests in New England for 80 to 100 years, yet there is still oak sawtimber present in many stands. Previous studies have shown mortality of up to 60 percent in New England oak stands following early outbreaks. Current outbreaks there typically have little effect on mortality, but affect growth and quality of the trees. The initial outbreaks in the Middle Atlantic States are resulting in losses similar to those experienced in New England stands earlier in the century. Salvage and utilization of dead oak trees is one option for recouping these losses. Trees dead one year or less are readily usable for sawtimber. Trees dead longer can be used for sawtimber, but with increasing volume and grade losses. Trees dead as long as 5 years can be used for pulpwood with little or no loss.

Gottschalk, Kurt W.; McGraw, James B.; Vavrek, Milan C. 1989. **Effect of defoliation on growth and photosynthesis of northern red oak seedlings grown under different conditions of light, nutrients, and water.** In: VanSambeek, J. W.; Larson, M. M., eds. 4th workshop on seedling physiology and growth problems in oak plantings; 1989 March 1-2; Columbus, OH. Gen. Tech. Rep. NC-139. St. Paul, MN: U.S. Department of Agriculture, Forest Service, North Central Forest Experiment Station: 5. Abstract.

Gottschalk, Kurt W.; Twery, Mark J. 1989. **Gypsy moth impacts in pine-hardwood mixtures.** In: Waldrop, Thomas A., ed. Proceedings of pine-hardwood mixtures: a symposium on management and ecology of the type; 1989 April 18-19; Atlanta, GA. Gen. Tech. Rep. SE-58. Asheville, NC: U.S. Department of Agriculture, Forest Service, Southeastern Forest Experiment Station: 50-58.
Gypsy moth has affected pine-hardwood mixtures, especially oak-pine stands, since the late 1800's. Several old and new studies on impacts in mixed stands are reviewed. When pines are heavily defoliated, considerable growth loss and mortality can occur. Mortality is heaviest in understory white pine trees. Impact information is used to suggest silvicultural management action to minimize damage in northern mixed stands. Pre-infestation treatments in southern mixed stands are suggested.

Gould, Juli R.; Van Driesche, Roy G.; Elkinton, Joseph S.; ODell, Thomas M. 1989. **A review of techniques for measuring the impact of parasitoids of Lymantriids.** In: Wallner, William E.; McManus, Katherine A., tech. coords. Proceedings, Lymantriidae: a comparison of features of New and Old World tussock moths; 1988 June 26-July 1; New Haven, CT. Gen. Tech. Rep. NE-123. Broomall, PA: U.S. Department of Agriculture, Forest Service, Northeastern Forest Experiment Station: 517-531.

Grinberg, Phyllis S.; Wallner, William E. 1989. **New and Old World Lymantriidae: discussion and research issues.** In: Wallner, William E.; McManus, Katherine A., tech. coords. Proceedings, Lymantriidae: a comparison of features of New and Old World tussock moths; 1988 June 26-July 1; New Haven, CT. Gen. Tech. Rep. NE-123. Broomall, PA:

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U.S. Department of Agriculture, Forest Service, Northeastern Forest Experiment Station: 549-554.

Hall, Richard W.; Fisher, Susan W.; Barger, Jack H. 1989. **Effects of simulated acid rain on insecticides used for gypsy moth control., Delaware County, 1987.** Insecticide & Acaricide Tests. 14: 351.

Harrison, Richard G.; ODell, Thomas M. 1989. **Mitochondrial DNA as a tracer of gypsy moth origins.** In: Wallner, William E.; McManus, Katherine A., tech. coords. Proceedings, Lymantriidae: a comparison of features of New and Old World tussock moths; 1988 June 26-July 1; New Haven, CT. Gen. Tech. Rep. NE-123. Broomall, PA: U.S. Department of Agriculture, Forest Service, Northeastern Forest Experiment Station: 265-273.

Healy, William M. 1989. **Uneven-age silviculture and wildlife habitat.** In: Finley, James C.; Brittingham, Margaret C., eds. Proceedings of the 1989 Penn State forest resources issues conference: timber management and its effects on wildlife; 1989 April 4-6; University Park, PA. University Park, PA: The Pennsylvania State University: 225-237.

Healy, William M. 1989. **Logging roads and log decks for wildlife habitat.** In: Clark, F. Bryan, tech. ed. Central hardwood notes. St. Paul, MN: U.S. Department of Agriculture, Forest Service, North Central Forest Experiment Station: 9.08-9.08-2.

Healy, William M. 1989. **Wildlife openings.** In: Clark, F. Bryan, tech. ed. Central hardwood notes. St. Paul, MN: U.S. Department of Agriculture, Forest Service, North Central Forest Experiment Station: 9.11-9.11-3.

Healy, William M.; Brooks, Robert T.; DeGraaf, Richard M. 1989. **Cavity trees in sawtimber-size oak stands in central Massachusetts.** Northern Journal of Applied Forestry. 6: 61-65.
Animals that use cavities in trees are an important component of hardwood ecosystems, but reserving cavity trees often is perceived as an impact on timber production. Cavities occurred in 4 percent of the live trees in even-aged, sawtimber-size oak stands with no previous silvicultural treatment. Cavity trees accounted for 8 percent of the total live tree basal area and occurred in all tree quality and diameter classes. Dead trees were well distributed by diameter class. Unthinned stands had about 2.9 times as many cavity trees and 1.8 times as many dead trees/ha as thinned stands. It is possible to conduct thinnings that both improve stand quality and retain cavity trees because 89 percent of the rough cull and 63 percent of the rotten cull trees did not have cavities.

Healy, William M.; Houf, Garry F. 1989. **Treating immature stands for wildlife.** In: Clark, F. Bryan, tech ed. Central hardwood notes. St. Paul, MN: U.S. Department of Agriculture, Forest Service, North Central Forest Experiment Station: 9.04-9.04-2.

Healy, William H.; Houf, Garry F. 1989. **Treating mature stands for wildlife.** In: Clark, F. Bryan, tech. ed. Central hardwood notes. St. Paul, MN: U.S. Department of Agriculture, Forest Service, North Central Forest Experiment Station: 9.05-9.05-2.

Heisler, Gordon M. 1989. **Wind reductions by trees in residential neighborhoods.** In: Proceedings, 1988 Society of American Foresters national convention; 1988 October 16-19; Rochester, NY. SAF Publ. 88-01. Bethesda, MD: Society of American Foresters: 220-224.
Wind measurements were made during daytime periods at 2 m above ground in neighborhoods of single-family homes with building densities between 6 and 12 percent of the land area and at an open reference site. With open windspeed (UA) between 3.5 mph and 12 mph, other houses throughout the neighborhoods apparently reduced mean approach UA at sample houses by 21 to 24 percent compared to windspeed at the reference location. Apparent average reductions in UA by trees ranged from 14 percent in a neighborhood with low tree density in winter to 46 percent in a neighborhood with high tree density in summer.

Heisler, Gordon M. 1989. **Effects of tree density on windspeed at the 2-m height in residential neighborhoods.** In: Proceedings of 19th conference on agriculture and forest meteorology and 9th conference on biometeorology and aerobiology; 1989 March 7-10; Charleston, SC. Boston, MA: American Meteorological Society: 268-271.

Helvey, J. D.; Kochenderfer, J. N.; Edwards, P. J. 1989. **Effects of forest fertilization on selected ion concentrations in central Appalachian streams.** In: Rink, George; Budelsky, Carl A., eds. Proceedings of the 7th central hardwood forest conference; 1989 March 5-8; Carbondale, IL. Gen. Tech. Rep.

NC-132. St. Paul, MN: U.S. Department of Agriculture, Forest Service, North Central Forest Experiment Station: 278-282.

Two small forested watersheds were fertilized in April 1976 with 336 kg/ha N as ammonium nitrate and 224 kg/ha P_2O_5 as triple superphosphate to determine fertilization effects on streamflow chemistry. Specific conductance and the concentration of nitrate-N and calcium in streamflow increased dramatically after fertilization. After reaching maximum concentrations in October 1976, fertilization effects declined gradually and concentrations were elevated only slightly in July 1979 when intensive sampling ended.

Hertel, Gerard. 1989. **Forest response program.** NE-INF-82-R-3/89. Broomall, PA: U.S. Department of Agriculture, Forest Service. Northeastern Forest Experiment Station.

Hilt, Donald E.; Dale, Martin E. 1989. **Thinning even-aged, upland oak stands.** In: Clark, F. Bryan, tech. ed. Central hardwood notes. St. Paul, MN: U.S. Department of Agriculture, Forest Service. North Central Forest Experiment Station: 6.06-6.06-7.

Hilt, Donald E.; Sonderman, David L.; Rast, Everette D. 1989. **Effects of understory removal in thinned upland oak stands--22-year results.** In: Rink, George; Budelsky, Carl A., eds. Proceedings of the 7th central hardwood forest conference; 1989 March 5-8; Carbondale, IL. Gen. Tech. Rep. NC-132. St. Paul, MN: U.S. Department of Agriculture. Forest Service. North Central Forest Experiment Station: 48-52.

Dense understory develops in thinned upland oak stands and potentially competes with overstory trees for moisture and nutrients. We examined the 22-year results of six plots in a 52-year-old stand thinned to 60 percent of normal stocking in 1963. The understory trees on three of the plots were removed by cutting and spraying with an herbicide. After 22 growing seasons, understory trees were larger and taller on the untreated plots. Understory removal treatments altered the species composition of the understory but did not prevent its reestablishment. Growth of overstory trees was not increased by removing the understory. Understory removal is not recommended as a viable management alternative to increase the growth of overstory trees.

Hilt, Donald E.; Teck, Richard M. 1989. **NE-TWIGS: an individual-tree growth and yield projection system for the northeastern United States.** The Compiler. 7(2): 10-16.

NE-TWIGS, an individual-tree growth and yield projection system for 14 Northeastern States, is now available. Individual-tree diameter growth and survival models that drive the system are discussed and model coefficients for 28 species groups are listed. Modifications to the TWIGS software are discussed and operating instructions are reviewed.

Hornbeck, James W. 1989. **Using tree rings to evaluate acid deposition and other causes of forest decline.** Proceedings, 1988 Society of American Foresters national convention; 1988 October 16-19; Rochester, NY. SAF Publ. 88-01. Bethesda, MD: Society of American Foresters: 72-74.

Tree-ring measurements on more than 5,000 trees indicate trends in regional basal-area increment for 10 major tree species in New England. Red spruce and balsam fir have had decreasing growth rates since the 1960's. The other eight species had constant or increasing growth from 1950. Normal aging is a probable cause for the decreasing growth rates of red spruce and balsam fir, and complicates the evaluation of acid deposition.

Horsley, Stephen B. 1989. **Effect of fern groundcover and overstory tree roots on nitrogen transformations in a partially cut *Prunus-Acer* Allegheny hardwood stand.** Supplement to American Journal of Botany. 76(6): 108. Abstract.

The effect of hayscented fern and overstory tree roots on NH_4-N and NO_3-N pool sizes and production was evaluated over a 2-year period after a shelterwood cut in a stand with a mosaic of patches with and without fern groundcover. Four vegetation treatments were established: ferns only, tree roots only, fern and tree roots, and no fern or tree roots. Vegetation treatments had little effect on NH_4-N pool size. Fern and overstory tree roots reduced NO_3-N pool size. Overstory tree roots had the greatest effect. Net mineral N production followed a sigmoid curve in both years, with amplitude greater in year 1 than year 2.

Horsley, Stephen B., comp. 1989. **International directory of woody plant physiologists.** Broomall, PA: U.S. Department of Agriculture, Forest Service, Northeastern Forest Experiment Station and International Union of Forestry Research Organizations. 202 p.

Contains the names of woody plant physiologists in 46 countries and is organized into four sections: an

alphabetical world directory of woody plant physiologists, and a list of woody plant physiologists by country, research interests, and important species they work with.

Horsley, S. B.; Gottschalk, K. W. 1989. **Ontogenetic changes in leaf development and photosynthesis of *Prunus serotina* seedlings.** Annales des Sciences Forestures (46 suppl.): 490s-492s.

Howard, Theodore E.; Sendak, Paul E. 1989. **Making multi-resource decisions: resource values in northern New England.** In: Forest and wildlife management in New England--what can we afford? Proceedings of a joint meeting of the Maine Division of New England Society of American Foresters; Maine Chapter of the Wildlife Society, and Atlantic International Chapter of the American Fisheries Society; 1989 March 15-17; Portland, ME. CFRU Inf. Rep. 21; Misc. Rep. 336; SAF Publ. 89-05. Orono, ME: Maine Agricultural Experiment Station: 64-70

Making management decisions about natural resource requires estimates of resource values. Identifies sources of timber stumpage prices and timberland price data, evaluates the quality of price reporting, analyzes trends in regional prices, and proposes a regional stumpage price index.

Huyler, Neil K. 1989. **Fuel supply structure of wood-fired power plants in the Northeast: loggers' perspectives.** Res. Pap. NE-624. Broomall, PA: U.S. Department of Agriculture, Forest Service, Northeastern Forest Experiment Station. 19 p.

A study of loggers' perceptions of the impact of large biomass demand centers on the forest resource base in the Northeast indicated that most loggers strongly believe that the post-harvest stand has improved. However, the impact of whole-tree chipping on the forest resource base was not made clear from the loggers' survey.

Huyler, Neil K.; LeDoux, Chris B. 1989. **Small tractors for harvesting fuelwood in low-volume small-diameter hardwood stands.** In: Proceedings of the 12th annual meeting of the Council on Forest Engineering; 1989 August 27-30; Coeur d'Alene, ID. [Place of publication unknown]: Council on Forest Engineering: 61-66.

Much of the nonindustrial private forest land in the Northeast is characterized by small-diameter trees with low volume. Conventional harvesting systems used in logging these stands generally result in submarginal economic returns. Often, small-scale har-

vesting systems have economic advantages in these areas. Time and motion studies were conducted for several small tractors over a range of silvicultural treatments to estimate preliminary cycle times and production rates. Research is progressing to incorporate these and additional simulation results into a generalized computer package for estimating stump-to-mill logging costs.

Jeffords, M. R.; Maddox, J. V.; McManus, M. L.; Webb, R. E.; Wieber, A. 1989. **Evaluation of the overwintering success of two European microsporidia inoculatively released into gypsy moth populations in Maryland.** Journal of Invertebrate Pathology. 53: 235-240.

The overwintering success of two European microsporidia released into gypsy moth populations in Maryland during 1986 is compared. Even though *Vavraia* sp. was not detected during 1987, *Nosema* sp. was found at levels similar to those of 1986. Infection levels were 7.9 percent in first-instar larvae, 6.5 percent in later instar larvae, and 10 percent in adults. *Vavraia* is not transovarialy transmitted. *Nosema* is transmitted transovarialy, which may account for its overwintering success. Microsporidian pathogens can be introduced into gypsy moth populations through inoculative release of contaminated egg masses.

Jennings, Daniel T.; Crawford, Hewlette S., Jr. 1989. **Predation by red squirrels on the spruce budworm *Choristoneura fumiferana* (Clem.) (Lepidoptera: Tortricidae).** Canadian Entomologist. September: 827-828.

Jennings, Daniel T.; Houseweart, Mark W. 1989. **Sex-biased predation by web-spinning spiders (Araneae) on spruce budworm moths.** Journal of Arachnology. 17: 179-192.

Web-spinning spiders of six families, 12 genera, and at least 15 species preyed on spruce budworm moths in Maine. Significantly more male than female moths were captured by nine web-spinner species, and the overall capture by spiders was significantly biased toward male moths. Most of the budworm-moth prey were found in webs of *Frontinella pyramitela* (Walck.) and *Theridion pictum* (Walck.). Multiple observations of the same web (temporal replication) indicated that *T. pictum* captured significantly more budworm moths/web than *F. pyramitela*. However, such differences in prey-capture rates were not detected over several locations. Trees occupied by *T. pictum* were significantly taller

and webs significantly higher than trees and webs of *F. pyramitela*. For both species, mean relative web height was more than 60 percent of tree height, possibly indicating nonrandom choices of foraging patch.

Jennings. Daniel T.; Penfield, Frederick B.; Stevens, Robert E.; Hawksworth, Frank G. 1989. **Spiders (Araneae) associated with dwarf mistletoes (*Arceuthobium* sp.) in Colorado.** Southwestern Naturalist. 34(3): 349-355.
Spiders of 10 families, 18 genera, and 22 species were associated with three species of *Arceuthobium* in northern Colorado. Spider-species composition varied among species of dwarf mistletoe. Two indices of similarity (QS and PS) indicated that spider faunas of *Arceuthobium cyanocarpum* and *A. vaginatum* were dissimilar. None of the spiders are restricted to dwarf mistletoes; species-habitat associations include numerous conifers. The presence of mistletoe pollen on spiders was recorded for the first time.

Jensen. Keith F. 1989. **Diagnosing forest vegetation for air pollution injury.** In: Clark, F. Bryan, tech. ed. Central hardwood notes. St. Paul, MN: U.S. Department of Agriculture, Forest Service, North Central Forest Experiment Station: 8.13-8.13-3.

Kessler, Kenneth J., Jr.; Houston, David R. 1989. **Oak decline.** In: Clark, F. Bryan, tech. ed. Central hardwood notes. St. Paul, MN: U.S. Department of Agriculture, Forest Service, North Central Forest Experiment Station: 8.12-8.12-2.

Kidd, William E., Jr.; Patric, James H.; Smith, H. Clay. [n.d.] **Woodlot management: how it grows.** Morgantown, WV: West Virginia University Extension Service and U.S. Department of Agriculture. 29 p.
Provides forest owners and forest users with a condensed and simplified account of how forests grow. It is useful to view the process of forest establishment on old fields and forest regeneration on previously forested areas; to examine in some detail the factors that affect tree growth; to paint a word picture of even- and uneven-aged stands as they develop over time.

Kidd, William E., Jr.; Smith, H. Clay. [n.d.]. **Woodlot management: helping it grow.** Morgantown, WV: West Virginia University Extension Service and U.S. Department of Agriculture. 19 p.

Aimed at woodlot owners who want to improve the market value of trees in their woodlots. Species composition, tree grade, and tree size are the most important determinants of market value in Appalachian hardwood stands and other types of hardwoods. Species is important because of differences in demand. Tree grade and size are important because a tree's yield of high-grade lumber increases as tree grade and size increase. Methods for improving the growth rate of high-quality stems of desirable tree species (crop trees) are discussed.

Kochenderfer, J. N.; Helvey, J. D. 1989. **Hydrologic impacts of mechanized site preparation in the central Appalachians.** In: Rink, George; Budelsky, Carl A., eds. Proceedings of the 7th central hardwood forest conference; 1989 March 5-8; Carbondale, IL. Gen. Tech. Rep. NC-132. St. Paul, MN: U.S. Department of Agriculture, Forest Service, North Central Forest Experiment Station: 283-289.
The effects of mechanized site preparation on sediment yield, streamflow chemistry, water temperature, and water yield were evaluated for a 4-year period on a 28.6 acre watershed. Annual sediment yields were slightly higher after site preparation. Growing season streamflow increased by 3.9, 2.8, and 1.5 inches during the first, second, and third growing seasons after treatments, respectively. Nitrate concentrations of streamflow increased slightly, but stream temperature did not change.

Kochenderfer, James N.; Helvey, J. D. 1989. **Forest access roads.** In: Clark, F. Bryan, tech. ed. Central hardwood notes. St. Paul, MN: U.S. Department of Agriculture, Forest Service, North Central Forest Experiment Station: 11.03-11.03-4.

Kochenderfer, James N.; Wendel, G. W.; Kidd, William E., Jr. [n.d.]. **Woodlot management: building roads.** Morgantown, WV: West Virginia University Extension Service and U.S. Department of Agriculture. 29 p.
The residual value of forest roads often is overlooked by landowners. Good roads provide woodlot access for posts and firewood as well as timber harvests, and can be used for hunter access and other needs. Because most timber in Appalachia is harvested from private land, road costs must be kept low enough to allow a reasonable profit for the owner. They should be located to protect other resources and be of high enough standards to provide residual value. Forest access is a principal concern of land managers in the Appalachian Region

because roads represent a significant portion of logging costs and are the source of most environmental problems during logging operations.

Kostelnik, K. M.; Lynch, J. A.; Grimm, J. W.; Corbett, E. S. 1989. **Sample size requirements for estimation of throughfall chemistry beneath a mixed hardwood forest.** Journal of Environmental Quality. 18: 274-280.
Six rainfall events were intensively sampled below a mixed hardwood forest canopy in central Pennsylvania to determine sample-size requirements for estimation of throughfall volumes and ionic concentrations. Evaluation of the ionic parameters of throughfall revealed that the concentrations of most major ions were not normally distributed. Differences in the distributions of concentrations were found between ions as well as between storms. Significant departures from normality were mainly due to right-skewness. None of the basic transformations were effective in normalizing all parameters. A high degree of spatial variability was observed for each of the chemical parameters.

Lacy, Susan E. 1989. **A risk-return analysis of timberland for the institutional investor.** In: 1989 Midwest forest economists meeting; 1989 August 23-25; St. Paul, MN. St. Paul, MN: U.S. Department of Agriculture, Forst Service, North Central Forest Experiment Station. Abstract.
The investment portfolio is a mix of assets that ideally will produce the highest available returns and minimizes risk. This study attempts to show that adding a timberland investment to an institutional portfolio may reduce risk and enhance returns. A harvest scheduling simulation model is used to calculate returns on a hypothetical southern pine plantation using actual stumpage prices from 1973 through 1982. By simulating 72 combinations of site index, stand density, age class distribution and stand rotation length, the impact of these variables on rate of return can be measured.

Lacy, Susan E. 1989. **A risk-return analysis of timberland for the institutional investor.** In: Forestry on the frontier. Proceedings of the 1989 Society of American Foresters national convention; 1989 September 24-27; Spokane, WA. Bethesda, MD: Society of American Foresters: 272-276.

Lamson, Neil I. 1989. **Silvicultural treatments in sapling stands.** In: Clark, F. Bryan, tech. ed. Central hardwood notes. St. Paul, MN: U.S. Department of Agriculture, Forest Service, North Central Forest Experiment Station: 6.03-6.03-3.

Lamson, Neil I.; Smith, H. Clay. 1989. **Crop-tree release increases growth of 12-year-old yellow-poplar and black cherry.** Res. Pap. NE-622. Broomall, PA: U.S. Department of Agriculture, Forest Service, Northeastern Forest Experiment Station. 7 p.
Precommercial thinning was done in a 12-year-old Appalachian hardwood sapling stand in West Virginia. Two crop-tree release techniques were used--crown touching and crown touching plus 5 feet. Results indicated that both treatments significantly increased 5-year d.b.h. growth for released yellow-poplar and black cherry crop trees. Although there was a major increase in d.b.h. growth, caution is suggested when using the crown-touching plus 5 feet treatment as butt log quality response was not conclusive. Releasing crop trees with the crown-touching approach seems appropriate in sapling stands when applied to desirable stems on better sites.

Leak, W. B. 1989. **Relation of site to silvicultural alternatives.** In: Martin, C. Wayne; Smith, C. Tattersall; Tritton, Louise M., eds. New perspectives of silvicultural management of northern hardwoods: proceedings of 1988 symposium on the conflicting consequences of practicing northern hardwood silviculture; 1988 June 9-10; Durham, NH. SAF Publ. 89-04: Gen. Tech. Rep. NE-124. Broomall, PA: U.S. Department of Agriculture, Forest Service, Northeastern Forest Experiment Station: 31-37.
In developing silvicultural alternatives, site affects choice of species to regenerate or favor in thinning, rotation or stand structure, risks from windthrow, fire, snow-glaze-frost and insects/diseases, impacts on aesthetics, wildlife habitat, and soils, and logging methods. Choice of species generally implies an optimum silvicultural system and rotation. This optimum system is then revised to overcome potential risks or impacts, comply with logging standards, and meet the many social and economic factors that enter into the choice of a silvicultural alternative. Most conflicts can be resolved because of the many silvicultural approaches available in northern hardwoods.

LeDoux, Chris B. 1989. **WCOST: A stump-to-truck cost estimating program for cable logging young-growth Douglas-fir.** The Compiler. 7(1): 9-10.

WCOST is a computer program designed to estimate the stump-to-truck logging cost of cable logging young-growth Douglas-fir. The program uses data from stand inventory, cruise data, and the logging plan for the tract in question to produce detailed stump-to-truck cost estimates for specific proposed timber sales. These estimates are then used in combination with specific landowner objectives to assess the economic feasibility of cable logging a given area. The program output is summarized in tabular format by harvesting component. Input parameters are presented in a summary table.

LeDoux, Chris B.; Baumgras, John E. 1989. **Contemporary logging technology for harvesting young.** In: Rink, George; Budelsky, Carl A., eds. Proceedings of the 7th central hardwood forest conference; 1989 March 5-8; Carbondale, IL. Gen. Tech. Rep. NC-132. St. Paul, MN: U.S. Department of Agriculture, Forest Service, North Central Forest Experiment Station: 190-195.
Thinning young central hardwood stands presents an opportunity to increase the growth and yield of quality sawtimber. Planners, loggers, and managers need to know what types of logging technology are available for young stands. Three types of logging technology applicable to central hardwoods are presented.

LeDoux, Chris B.; Baumgras, John E. 1989. **Development of regional stump-to-mill logging cost estimators.** In: Stokes, Bryce J., ed. Proceedings, Southern Regional Council on Forest Engineering meeting; 1989 May 3-4; Auburn, AL. Auburn, AL: Southern Regional Council on Forest Engineering: 1: 112-118.
Planning logging operations requires estimating the logging costs for the sale or tract being harvested. Decisions need to be made on equipment selection and its application to terrain. A methodology is described that has been developed and implemented to accurately estimate logging costs by region. The methodology blends field time and motion data, simulation analysis, non-linear regression models, and detailed feedback loops.

LeDoux, Chris B.; Baumgras, John E.; Selbe, R. Bryan. 1989. **PROFIT-PC: a program for estimating maximum net revenue from multiproduct harvests in Appalachian hardwoods.** Software. 1989 Winter: 27, 29, 31.
PROFIT-PC: is a menu driven, interactive computer program that estimates optimum product mix and maximum net harvesting revenue based on projected product yields and stump-to-mill timber harvesting costs. Required inputs include the number of trees per acre by species and 2 inches diameter at breast-height class, delivered product prices by species and product type, and haul distance by road class for each product. The product mix that maximizes net revenue is determined by comparing equivalent unit-product values for each species. The user can specify truck type for hauling and select from 10 yarding or skidding machines to estimate stump-to-mill harvesting costs.

Lewis, Robert, Jr. 1989. **Oak wilt.** In: Clark, F. Bryan, tech. ed. Central hardwood notes. St. Paul, MN: U.S. Department of Agriculture, Forest Service, North Central Forest Experiment Station: 8.04-8.04-3.

Liebhold, Andrew. 1989. **Critical examination of the focal-area theory: quantitative analysis.** In: Proceedings of the 1988 national gypsy moth review; 1989 January 10-12; Dearborn, MI. Dearborn, MI: Michigan Department of Agriculture: 270-274.
Reports on research aimed at quantifying the focal-area phenomenon. The objective is to examine the evidence critically for and against the concept that large regional gypsy moth outbreaks are caused by outbreaks in focal areas.

Liebhold, Andrew M.; Elkinton, Joseph S. 1989. **Spatial aspects of gypsy moth population dynamics.** In: Wallner, William E.; McManus, Katherine A. tech. coords. Proceedings, Lymantriidae: a comparison of features of New and Old World tussock moths; 1988 June 26-July 1; New Haven, CT. Gen. Tech. Rep. NE-123. Broomall, PA: U.S. Department of Agriculture, Forest Service, Northeastern Forest Experiment Station: 203-215.

Liebhold, Andrew M.; Elkinton, Joseph S. 1989. **Elevated parasitism in artificially augmented populations of Lymantria dispar (Lepidoptera: Lymantriidae).** Environmental Entomology. 18(6): 986-995.
Within 1-ha plots, gypsy moth densities were artificially elevated from low densities (about 20 egg masses/ha) to high densities (8,000 egg masses/ha) using field-collected eggs and F_1 sterile laboratory-reared eggs. At all sites including the feral and sterile release areas, densities decreased to undetectable levels (less than 10 egg masses/ha). In the sterile and feral release areas, parasitism by Cotesia melanoscela (Ratzeburg) was the largest source of identified mortality and was

significantly greater than in the surrounding area or in untreated plots. Within the feral release area, parasitism by *Compsilura concinnata* (Meigen) and *Parasetigena silvestris* (Robineau-Desvoidy) was substantial and was greater than in the surrounding area. This pattern was not observed in the sterile release area.

Liebhold, Andrew M.; Elkinton, Joseph S. 1989. **Characterizing spatial patterns of gypsy moth regional defoliation.** Forest Science. 35(2): 557-568.
Aerial sketch maps of defoliation caused by the gypsy moth in Massachusetts from 1961 to 1986 were digitized into an array of 1.9 X 1.9 km cells. Defoliation frequency was mapped by summing defoliation incidence for each cell. Spatial autocorrelation analysis indicated that defoliation was not distributed randomly over the state but was distributed in clumps of varying size. Directional spatio-temporal autocorrelation analysis showed no evidence for undirectional spread of defoliation through time.

Liebhold, Andrew M.; Elkinton, Joseph S. 1989. **Use of multi-dimensional life tables for studying insect population dynamics.** In: McDonald, L.; Manly, B.; Lockwood, J.; Logan, J., eds. Proceedings, estimation and analysis of insect populations; 1988 January 25-29; Laramie, WY. Lect. Notes in Stat. 55. New York: Springer-Verlag: 360-368.
In classical life-table analyses, density and mortality are measured for many generations as average values across an area. Presented as an alternative is the measurement of density and mortality from a multidimensional spatial matrix of sample points. This method is applied to studies of gypsy moth, population dynamics. Analysis for key factors and density-dependence may yield substantially different results between the two methods. Identification of a key mortality factor from classical life-table data indicates that the mortality is correlated with between generation changes in density. By contrast, identifications of a key factor from spatial data indicates that the mortality explains changes in the spatial heterogeneity of density. Conclusions about key factors and density-dependence derived from spatial data often vary among generations.

Liebhold, Andrew; Mastro, Victor; Schaefer, Paul W. 1989. **Learning from the legacy of Leopold Trouvelot.** Bulletin of the ESA: 20-22.
Traces the history of the gypsy moth in North America which began one summer day in 1868 or 1869 when several insects escaped out the window of the Medford, Massachusetts, home of Etienne Leopold Trouvelot.

Lundgren, Allen L., ed. 1989. **The management of large-scale forestry research programs and projects.** Proceedings of a meeting of IUFRO subject group S6.06, management of forestry research; 1989 April 17-19; Alice Holt Lodge, Farnham, UK. Gen. Tech. Rep. NE-130. Broomall, PA: U.S. Department of Agriculture, Forest Service, Northeastern Forest Experiment Station. 236 p.
Documents the efforts of the IUFRO working group on the management of forestry research to learn about the issues associated with the management of large and complex international research programs.

Luppold, William. 1989. **The changing hardwood lumber export market!** Import/Export Wood Purchasing News: 9, 13, 16.

Luppold, William G. 1989. **Hardwood material use: past, present, and future.** In: Waldrop, Thomas A., ed. Proceedings of pine-hardwood mixtures: a symposium on management and ecology of the type; 1989 April 18-19; Atlanta, GA. Gen. Tech. Rep. SE-58. Asheville, NC. U.S. Department of Agriculture, Forest Service, Southeastern Forest Experiment Station: 236-241.
There have been dramatic changes in the consumption of hardwood products over the last 30 years. Production of hardwood pallets and kitchen cabinets have soared while production of household wood furniture has shown less growth. There also has been major growth in the production of lower value hardwood pulpwood and the exportation of higher value hardwood lumber, logs, and veneer. Trends in domestic consumption, economic activity in Europe and Asia, and concerns over clearing and logging activities on tropical land indicate that demands for hardwood products should continue to increase through the remainder of this century.

Luppold, William G. 1989. **Shifting demand for eastern hardwood lumber.** In: Jones, Stephen B.; Stanturf, John A., eds. Proceedings of hardwood forest products opportunities: creating and expanding businesses (Lake States, Northeast, Mid-Atlantic); 1989 October 16-19; Pittsburgh, PA. University Park, PA: The Pennsylvania State University, School of Forest Resources: 11-17.

Hardwood lumber production has increased with shifts in regional production. Lumber use in the pallet, millwork, kitchen cabinet, and office furniture industries has increased compared with lumber use for household furniture and rail ties. Employment trends indicate that kitchen cabinets and millwork industries have been the greatest source of job formation. The potential of future market opportunities in the dimension, flooring, millwork, kitchen cabinet, pallet, and furniture industries is examined.

Luppold, William G. 1989. **Hardwood export market outlook.** In: Vantreese, Valerie L., ed. Hardwood exports: building a business strategy: conference proceedings; 1989 December 6-8; Lexington, KY. [Place of publication unknown]: [Publisher name unknown]: 6-10.
The hardwood export market changed throughout the 1980's and probably will continue to change in the 1990's. Anticipating change is difficult, but it becomes easier as additional information on the export market becomes available. Problems with export data, historical market trends, the U.S. share of major foreign markets, and factors that will affect U.S. exports in the future are discussed.

Luppold, William G.; Dempsey, Gilbert P. 1989. **New estimates of central and eastern U.S. hardwood lumber production.** Northern Journal of Applied Forestry. 6(3): 120-123.
New estimates of hardwood lumber production are higher than the widely used production statistics released by the U.S. Department of Commerce. These estimates were developed through use of USDA Forest Service timber product output studies, state tax records, and state level sawmill surveys. The analysis indicates that hardwood lumber production was higher in 1986 than at any time during the last 20 years and that hardwood lumber production is increasing in the northern regions relative to the southern regions. Because of underreporting, the returns from management investments in quality northern forest sites could be undervalued.

Luppold, William G.; Dempspey, Gilbert P. 1989. **Distribution and marketing of forest resource products.** In: Ellefson, Paul V., ed. Forest resource economics and policy research: strategic directions for the future. Boulder, CO: Westview Press: 288-302

Luppold, William G.; Dempsey, Gilbert P. 1989. **Current trends in regional hardwood lumber produc-**

tion and timber usage. In: Rink, George; Budelsky, Carl A., eds. Proceedings of the 7th central hardwood forest conference; 1989 March 5-8; Carbondale, IL. Gen. Tech. Rep. NC-132. St. Paul, MN: U.S. Department of Agriculture, Forest Service, North Central Forest Experiment Station: 201-206. Production of hardwood lumber is increasing with important shifts in output among producing regions. Comparative U.S. and alternative lumber production data are presented, regional shifts noted, and their impact on long-term timber availability discussed.

Luppold, William; Hansen, Bruce G. 1989. **Hardwood lumber export trends.** Import/Export Wood Purchasing News: 16(1): 1-2.

Luppold, William; Hansen, Bruce G. 1989. **U.S. export discrepancies explained.** National Hardwood Magazine. 63(12): 99-103.

Lynch, James A.; Corbett, Edward S. 1989. **Effectiveness of BMP's in controlling nonpoint pollution from silvicultural operations.** In: Woessner, W. W.; Potts, D. F., eds. Headwaters hydrology: proceedings of a symposium. TPS-89-1. Bethesda, MD. American Water Resources Association: 149-157.
Ten years of streamflow and water quality data were evaluated to determine the effectiveness of Best Management Practices (BMP's) in controlling nonpoint source pollution from an 110-acre commercial clearcut located in the Ridge and Valley Province of central Pennsylvania. The analyses addressed both short- and long-term changes in the physical and chemical properties and the hydrologic regime of the stream draining this 257-acre watershed. The BMP's on this commercial clearcut were effective in preventing serious deterioration of stream quality as a result of forest harvesting. Although there were significant increases in nitrate and potassium concentrations and temperature and turbidity levels, the increases were relatively small and, with the exception of turbidity, within drinking water standards.

Lynch, James A.; Corbett, Edward S. 1989. **Hydrologic control of sulfate mobility in a forested watershed.** Water Resources Research. 25(7): 1695-1703.
Five years of atmospheric wet sulfate deposition and stream sulfate export data were evaluated to determine the fate and mobility of sulfate in a forest-

ed watershed in central Pennsylvania. Sulfate concentrations in stream water were inversely related to sulfate concentrations in precipitation. Sulfate export from this watershed exceeded wet deposition by approximately 20 percent in 4 of the 5 years studied, indicating an additional source of sulfate, possibly dry deposition. The average sulfate export from this watershed during February through May was 69.8 percent of the total annual export. The fact that sulfate export during this 4-month period could not result from wet deposition during this period suggests that atmospherically deposited sulfate is temporarily stored on the water-shed and that the release of this stored sulfate is controlled strongly by the hydrologic responsiveness of the watershed.

Marquis, David A. 1989. **Forests of the northeast: history and future trends.** In: Finley, James C.; Brittingham, Margaret C., eds. Proceedings of the 1989 Penn State forest resources issues conference; timber management and its effects on wildlife; 1989 April 4-6; University Park, PA. University Park, PA: The Pennsylvania State University: 14-25.
Reviews the forest history of the Northeastern United States as a way of providing insight into our forest resource, and discusses forest conditions.

Marquis, David A.; Jacobs, Rodney. 1989. **Principles of managing stands.** In: Clark, F. Bryan, tech. ed. Central hardwood notes. St. Paul, MN: U.S. Department of Agriculture, Forest Service, North Central Forest Experiment Station: 6.01-6.01-6.

Marquis, David A.; Johnson, Robert L. 1989. **Silviculture of eastern hardwoods.** In: Burns, Russell M., tech. comp. Gen. Tech. Rep. WO-55. Washington, DC: U.S. Department of Agriculture, Forest Service: 9-17.
Describes extent and location of eastern hardwood forests, ecological characteristics, forest cutting practices, and effects of various cutting methods.

Martens, David G. 1989. **Restructuring of the raw material sources for pallets.** In: Potter, Richard H., ed. Proceedings of the 1989 southern forest economics workshop; 1989 March 1-3; San Antonio, TX. [Place of publication unknown]: [Publisher name unknown]: 229-232.
Pallets are the largest single user of hardwood lumber in the country and rank second only to the construction industry in total use of sawn products. At one time, the pallet industry obtained its raw material almost exclusively from the lower grades of lum-

ber produced as a byproduct of hardwood sawmills. However, demand for pallets, furniture, kitchen cabinets, flooring, and railroad ties has exceeded the supply of those lower grades. The result of these dynamic market pressures has been a major restructuring of traditional resource use patterns.

Martens, David G. 1989. **Raw material use in the pallet industry.** Pallet Enterprise. 9(6): 40-42.

Martens, David G. 1989. **Changing characteristics of the pallet industry.** Pallet Enterprise. 9(7): 22, 24. The pallet industry is constantly changing due to a number of internal and external economic factors. What began as a sideline or byproduct industry has become the largest consumer of hardwood lumber in the manufacturing sector. In 1988, approximately 465 million pallets were produced. In the process, more than 7 billion board feet of lumber were consumed, of which nearly 5.5 billion board feet were hardwood. The factors that have contributed to this change and that will continue to affect the pallet industry are discussed.

Martin, C. Wayne; Harr, R. Dennis. 1989. **Logging of mature Douglas-fir in western Oregon has little effect on nutrient output budgets.** Canadian Journal of Forest Research. 19(1): 35-43.
Precipitation and streamwater quantity have been sampled continuously on three adjacent watersheds since 1964 at the H. J. Andrews Experimental Forest on the western slopes of the Cascade Mountains of Oregon. The chemistry of streamwater has been sampled since 1972, and the chemistry of precipitation since 1973. These watersheds were covered primarily by a mature 130-year-old forest of Douglas-fir. In 1974, one of the watersheds was clearcut, the logs being removed primarily by a high-lead cable system. At the same time, 60 percent of the basal area was removed in a shelterwood cut from the adjoining watershed. The third watershed remained uncut for reference. Both harvested watersheds were broadcast burned in 1975 and planted to Douglas-fir in 1976. Streamwater chemistry data and input-output budgets for the three watersheds are presented for 10 years after cutting. Nitrate nitrogen was the only measured solute affected by logging.

Martin, C. W.; Hornbeck, J. W. 1989. **Revegetation after strip cutting and block clearcutting in northern hardwoods: a 10-year history.** Res. Pap. NE-625. Broomall, PA: U.S. Department of Agricul-

ture, Forest Service, Northeastern Forest Experiment Station. 17 p.

Changes in the density and biomass of trees, shrubs, and herbs were measured periodically over 10 years following a progressive strip cutting and block clearcutting of northern hardwoods. At 10 years after clearcutting, yellow birch was the most numerous commercial or uncommercial tree on the block clearcut while sugar maple was most numerous on the strip cut. Pin cherry dominated the biomass on the block clearcut and the first set of strips throughout the 10 years; yellow birch and sugar maple dominated the second and third sets of strips at 10 years.

Martin, C. Wayne; Smith, C. Tattersall; Tritton, Louise M., eds. 1989. **New perspectives on silvicultural management of northern hardwoods.** In: Proceedings of the 1988 symposium on the conflicting consequences of practicing northern hardwood silviculture; 1988 June 9-10; Durham, NH. SAF Publ. 89-04; Gen. Tech. Rep. NE-124. Broomall, PA: U.S. Department of Agriculture, Forest Service, Northeastern Forest Experiment Station. 107 p.

The objective of the symposium was to discuss the combined influences of sites, nutrients, pathology, entomology, equipment technology, and economics on the choice of a silvicultural system for the management of northern hardwood forests. All of these factors should be considered and should influence the prescriptions developed for the management of forest stands.

Mastro, V. C.; ODell, T. M.; Schwalbe, C. P. 1989. **Genetic control of Lymantriidae: prospects for gypsy moth management.** In: Wallner, William E.; McManus, Katherine A., tech. coords. Proceedings, Lymantriidae: a comparison of features of New and Old World tussock moths; 1988 June 26-July 1; New Haven, CT. Gen. Tech. Rep. NE-123. Broomall, PA: U.S. Department of Agriculture, Forest Service, Northeastern Forest Experiment Station: 275-302.

Progress in the current program to develop the sterile insect technique for control of gypsy moth is reviewed. The discussion includes a synopsis of radiation biology studies, competitiveness evaluation of sterile adults, and field testing of three application techniques.

McFadden, Max W. 1989. **The leucaena psyllid: an ecological catastrophe.** In: Proceedings, 1988 Society of American Foresters national convention;

1988 October 16-19; Rochester, NY. SAF Publ. 88-01. Bethesda, MD: Society of American Foresters: 321-323.

McManus, M. L.; Maddox, J. V.; Jeffords, M. R.; Webb, R. E. 1989. **Evaluation and selection of candidate european microsporidia for introduction into U.S. gypsy moth populations.** In: Wallner, William E.; McManus, Katherine A., tech. coords. Proceedings, Lymantriidae: a comparison of features of New and Old World tussock moths; 1988 June 26-July 1; New Haven, CT. Gen. Tech. Rep. NE-123. Broomall, PA: U.S. Department of Agriculture, Forest Service, Northeastern Forest Experiment Station: 455-468.

McManus, M.; Schneeberger, N.; Reardon, R.; Mason, G. 1989. **Gypsy moth.** For. Insect and Dis. Leafl. 162. Washington, DC: U.S. Department of Agriculture, Forest Service. 13 p.

McPherson, E. Gregory; Rowntree, Rowan A. 1989. **Using structural measures to compare twenty-two U.S. street tree populations.** Landscape Journal. 8(1): 13-23.

Our purpose is to use certain ecological measures, commonly adopted for understanding natural forest populations, to describe and compare street tree populations. Street trees compose only 10 to 20 percent of the urban forest, but there are sufficient data on these populations to apply certain measures of structure and to interpret the results. We used inventories from 22 U.S. cities to compare patterns in species and age composition, stocking levels, and growth forms. From this we infer trends toward greater species diversity and smaller tree size. These trends are discussed in terms of their implications for future costs and benefits.

Miller, Gary W. 1989. **Economic considerations of managing stands.** In: Clark, F. Bryan, tech. ed. Central hardwood notes. St. Paul, MN: U.S. Department of Agriculture, Forest Service, North Central Forest Experiment Station: 7.01-7.01-4.

Millers, Imants; Shriner, David S.; Rizzo, David. 1989. **History of hardwood decline in the Eastern United States.** Gen. Tech. Rep. NE-126. Broomall, PA: U.S. Department of Agriculture, Forest Service. Northeastern Forest Experiment Station. 75 p.

Tree mortality events that have occurred in the eastern hardwood forest during the last century were examined to determine whether there is a relation-

ship between patterns of mortality over time and current patterns of atmospheric pollution. The apparent increase in the decline and mortality of many hardwood species during the last few decades may be due to intensification of reporting and to the maturation of the forest itself. Most of the mortality is attributed to abiotic and biotic stress factors such as weather, silviculture, and damage by insects and diseases. There is evidence of damage to hardwoods by atmospheric pollutants from point sources such as smelters, and to eastern white pine by ozone. There is no conclusive evidence of an association between patterns of hardwood mortality and regional atmospheric pollution.

Montgomery, Michael E. 1989. **Relationships between foliar chemistry and susceptibility to *Lymantria dispar*.** In: Wallner, William E.; McManus, Katherine A., tech. coords. Proceedings, Lymantriidae: a comparison of features of New and Old World tussock moths; 1988 June 26-July 1; New Haven, CT. Gen. Tech. Rep. NE-123. Broomall, PA: U.S. Department of Agriculture, Forest Service, Northeastern Forest Experiment Station: 339-350.

Montgomery, Michael E.; McManus, Michael L.; Berisford, C. Wayne. 1989. **The gypsy moth in pitch pine-oak mixtures: predictions for the South based on experiences in the North.** In: Waldrop, Thomas A., ed. Proceedings of pine-hardwood mixtures: a symposium on management and ecology of the type; 1989 April 18-19; Atlanta, GA. Gen. Tech. Rep. SE-58. Asheville, NC: U.S. Department of Agriculture, Forest Service, Southeastern Forest Experiment Station: 43-49.
The dynamics of a gypsy moth outbreak in pitch pine-oak stands and in more mesic mixed hardwood stands in the Northeast were analyzed. Gypsy moth egg-mass densities were sufficient in all stands to cause severe defoliation, but such defoliation occurred only in the pitch pine-oak stands. In these stands, oaks were severely defoliated, most for 2 successive years, but few pines were severely defoliated. Mortality of oak species ranged from 7 to 36 percent while mortality of pitch pine was only 13 percent. Oaks generally did not die unless completely defoliated for 2 years. Pitch pine always died when completely defoliated and some died that were only 60 percent defoliated.

More, Thomas A. 1989. **Human/wildlife interaction problems in Argentina.** Human Dimension Wildlife Newsletter. 8(2): 12-13.

More, Thomas A.; Donnelly, Maureen P.; Graefe, Alan R.; Vaske, Jerry J., eds. 1989. **Proceedings, 1989 northeastern recreation research symposium;** 1989 April 3-5; Saratoga Springs, NY. Gen. Tech. Rep. NE-132. Broomall, PA: U.S. Department of Agriculture, Forest Service, Northeastern Forest Experiment Station. 156 p.
Contains 23 papers covering the following topics: recreation priorities in the Northeast, outdoor recreation and recreation management, socioeconomic aspects of recreation, travel, and tourism, and the psychological aspects of leisure.

More, Thomas A.; Glass, Ronald J. 1989. **Equity and allocation in the distribution of scarce hunting permits.** Human Dimensions in Wildlife Newsletter. 8(2): 21-22.

Murray, Kathleen D.; Elkinton, Joseph S.; Woods, Stephen A.; Podgwaite, John D. 1989. **Epizootiology of gypsy moth nucleopolyhedrosis virus.** In: Wallner, William E.; McManus, Katherine A., tech. coords. Proceedings, Lymanatriidae: a comparison of features of New and Old World tussock moths. 1988 June 26-July 1; New Haven, CT. Gen. Tech. Rep. NE-123. Broomall, PA: U.S. Department of Agriculture, Forest Service, Northeastern Forest Experiment Station: 439-453.

Northeastern Forest Experiment Station. 1989. **Publications of the Northeastern Forest Experiment Station--1987.** Gen. Tech. Rep. NE-127. Broomall, PA: U.S. Department of Agriculture, Forest Service, Northeastern Forest Experiment Station. 39 p.
An annotated list of publications of Northeastern Forest Experiment Station scientists and cooperators for 1987.

Noble, Reginald D.; Martin, Juri L.; Jensen, Keith F., eds. 1989. **Air pollution effects on vegetation including forest ecosystems.** In: Proceedings, 2nd US-USSR symposium; 1988 September 13-25; Corvallis, OR; Raleigh, NC; Gatlinburg, TN. Broomall, PA: U.S. Department of Agriculture, Forest Service, Northeastern Forest Experiment Station. 311 p.
To commemorate the 10th year of cooperation between the United States and the U.S.S.R. in the field of environmental protection, a symposium was organized, the major objectives of which were to acquaint U.S. and U.S.S.R. scientists with project accomplishments; to promote understanding of the nature of environmental problems that relate to effects of air pollution on vegetation on a more global

scale; to share research priorities, interests, and methodologies, and to plan future research cooperation.

Nolley, Jean W. 1989. **Bulletin of hardwood market statistics: winter 1988.** Gen. Tech. Rep. NE-125. Broomall, PA: U.S. Department of Agriculture, Forest Service, Northeastern Forest Experiment Station. 29 p.
Provides current and historical information on primary and secondary hardwood product production, prices, international trade, and employment.

Nolley, Jean W. 1989. **Bulletin of hardwood market statistics: spring 1989.** Gen. Tech. Rep. NE-128. Broomall, PA: U.S. Department of Agriculture, Forest Service, Northeastern Forest Experiment Station. 28 p.

Nolley, Jean W. 1989. **Bulletin of hardwood market statistics: summer 1989.** Gen. Tech. Rep. NE-133. Broomall, PA: U.S. Department of Agriculture, Forest Service, Northeastern Forest Experiment Station. 41 p.

ODell, Thomas M.; Chang, Pang-Yuan; Walton, Gerald S. 1989. **Effects of light on location of host egg masses by _Ooencyrtus kuvanae_ (Hymenoptera: Encyrtidae), and egg parasite of gypsy moth (Lepidoptera: Lymantriidae).** Environmental Entomology. 18(6): 1101-1104.
The effect of light on host finding and parasitism by _Ooencyrtus kuvanae_ (Howard), an egg parasitoid of gypsy moth, was studied. Parasitism by _O. kuvanae_ females confined in light or dark cylinders was not significantly different. When parasites were given a choice between light or dark chambers, significantly more chose the light chamber regardless of the presence or absence of an egg mass. However, chambers were significantly more attractive when they contained an egg mass, indicating that an egg mass contributes to host location over short distances. Parasitism of egg masses in dark chambers in which no _O. kuvanae_ were found demonstrates that the parasite may leave these sites after oviposition.

Ossenbruggen, H. Sharon. 1989. **Tree energy systems.** Journal of Arboriculture. 15(3): 53-58.
Keeping trees healthy, safe, and attractive while keeping utility lines clear necessitates difficult choices that can be made only with a thorough knowledge of tree health. Instituting innovative tree main-

tenance plans requires working closely with communities. Communication and education are critical components.

Ostrofsky, William D.; Houston, David R. 1989. **Harvesting alternatives for stands damaged by the beech bark disease.** In: Proceedings, 1988 Society of American Foresters national convention; 1988 October 16-19; Rochester, NY. SAF Publ. 88-01. Bethesda, MD: Society of American Foresters: 173-177.
The silvicultural objective of managing stands damaged by the beech bark disease is to reduce the amount of diseased and disease-susceptible beech, and to maintain or increase the amount of beech resistant to infestation by the beech scale. Before harvesting, resistant and/or low-risk beech must be identified, and measures to reduce root sprouting by harvested beech evaluated. Since beech and other associated northern hardwoods can be managed under a variety of silvicultural systems, and because stand damage differs as the disease develops over time, forest managers need to have available several different harvesting options. Equipment choice, season of harvest, and use of herbicides in concert with the harvesting options.

Overton, Ronald P.; Funk, David T. 1989. **Genetic principles.** In: Clark, F. Bryan, tech. ed. Central hardwood notes. St. Paul, MN: U.S. Department of Agriculture, Forest Service, North Central Forest Experiment Station: 2.02-2.02-4.

Peacock, John W. 1989. **Elm diseases.** In: Clark, F. Bryan, tech. ed. Central hardwood notes. St. Paul, MN: U.S. Department of Agriculture, Forest Service, North Central Forest Experiment Station. 8.05-8.05-4.

Peters, Penn A. 1989. **The forest engineering group in ASAE.** In: International summer meeting of American Society of Agricultural Engineers and Canadian Society of Agricultural Engineers; 1989 June 25-28; Quebec, PQ. ASAE Pap. 89-7068. St. Joseph, MI: American Society of Agricultural Engineers.
Introduces the Forest Engineering (FE) Group in ASAE, formed in 1987. Current challenges for the FE Group are to increase industry participation, prepare forest engineering standards, and improve logging safety.

Pogge, Franz L.; Bearce. Bradford C. 1989. **Germinating common and cat greenbrier.** Tree Planters' Notes. 40(1): 34-37.
Seeds of common greenbrier (*Smilax rotundifolia* L.) and cat greenbrier (*S. glauca* Walt) were tested for germinative energy, total germination, and germinative potential. Light appears to be a requirement for common greenbrier.

Potter, Fletcher I., III; Lynch, James A.; Corbett, Edward S. 1989. **The role of atmospheric deposition in streamflow generation and episodic water quality.** In: Woessner, W. W.; Potts, D. F., eds. Headwaters hydrology: proceedings of a symposium. TPS-89-1. Bethesda, MD. American Water Resources Association: 527-541.
Streamwater pH depressions as great as 2.37 units have been measured on the Leading Ridge Experimental Watersheds (LREW) in central Pennsylvania. Past research has linked acidic atmospheric deposition with observed changes in streamwater chemistry. Precipitation, throughfall, soilwater, groundwater, and streamwater were measured on a small headwater subbasin of LREW Unit One to quantify this relationship. Two methods were used to estimate atmospheric inputs to stormflow on a 16.5-ha study area. Direct channel precipitation produced 3.8 to 80.6 percent of total stormflow and up to 100 percent of stormflow. Additional atmospheric water appeared to reach the stream channel through macropore flow and other processes. Atmospheric inputs explained up to 80 percent of the hydrogen ions in streamwater during periods of pH depressions.

Profous, George V. 1989. **Reflections on Czechoslovak forestry.** Journal of Forestry. 87(2): 42-46.

Rast, Everette D. 1989. **External indicators of internal defects in black walnut.** In: Proceedings, 1989 4th black walnut symposium; 1989 July 30-August 2; Carbondale, IL. Carbondale, IL: Southern Illinois University: 16-20.
To properly classify or grade logs or trees, one must correctly identify defect indicators and assess the effect of the underlying defect on possible end products. Ten types of external indicators and associated defects in black walnut are discussed.

Rast, Everette D.; Beaton, John A.; Sonderman, David L. 1989. **Photographic guide of selected external defect indicators and associated internal defects in white oak.** Res. Pap. NE-628. Broomall,
PA: U.S. Department of Agriculture, Forest Service, Northeastern Forest Experiment Station. 24 p.
To properly classify or grade logs or trees, one must be able to correctly identify defect indicators and assess the effect of the underlying defect on possible end products. This guide assists the individual in identifying the surface defect indicator and shows the progressive stages of the defect throughout its development for white oak. It illustrates and describes nine types of external defect indicators and associated defects that are difficult to evaluate.

Robbins, Kathryn; Wargo, Philip M. 1989. **Root rots.** In: Clark, F. Bryan, tech. ed. Central hardwood notes. St. Paul, MN: U.S. Department of Agriculture, Forest Service, North Central Forest Experiment Station: 8.08-8.08-4.

Roberts, Bruce R.; Cannon, William N., Jr. 1989. **Changes in xylem pressure potential of red spruce seedlings treated with ozone and simulated acid rain.** Canadian Journal of Forest Research. 19(9): 1200-1203.
Two-year-old containerized seedlings of red spruce were exposed for 8 weeks to charcoal-filtered air (control) or to 7 and 15 parts per hundred million (pphm) ozone (O_3) alone and 15 pphm O_3 in combination with simulated acid rainfall at pH 4.2 and 3.0 prior to measuring shoot xylem pressure potential. Pressure potential determinations for seedlings treated with O_3 alone or O_3 plus acid rain were always higher (less negative) than similar determinations made on comparable seedlings grown in charcoal-filtered air. These results suggest that exposure to atmospheric deposition may affect xylem pressure potential indirectly by influencing transpirational water loss via stomatal closure and/or reductions in leaf area expansion.

Roesch, Francis A., Jr.; Green, Edwin J.; Scott, Charles T. 1989. **New compatible estimators for survivor growth and ingrowth from remeasured horizontal point samples.** Forest Science. 35(2): 281-293.

Rowntree, Rowan A. 1989. **Urban forestry, carbon dioxide and global climate change.** In: Forestry on the frontier: Proceedings of the 1989 Society of American Foresters national convention; 1989 September 24-27; Spokane, WA. Bethesda, MD: Society of American Foresters: 429-433.
Urban foresters are being asked serious questions about the relationship of their resource to global

warming and climate change. While there continues to be controversy over how to interpret global temperature data, changes in the gaseous composition of the atmosphere are not in dispute. Increases in carbon dioxide (CO_2) and other "greenhouse gases" will very likely lead to changes in climates and changes in vegetation structure and function. We must try to understand the role urban forests play in the global carbon cycle. Trees in urbanized areas of the United States are estimated to contain 1 to 2 billion tons of carbon and are sequestering 25 to 30 million tons of carbon annually. The 3 billion tons of CO_2 accumulating in the atmosphere each year can be reduced by urban forest design and management that considers the objectives of energy conservation and carbon sequestering.

Rowntree, R. A.; Zipperer, W. C. 1989. **Some research perspectives on the urban-forest interface.** In: Proceedings, 1988 Society of American Foresters national convention; 1988 October 16-19; Rochester, NY. SAF Publ. 88-01. Bethesda, MD: Society of American Foresters: 396-399.

The types of problems in the urban-forest interface zone vary with the pattern of settlement and forest. Many forest managers have been effective in working with urban planning groups in the interface. Research opportunities that have received little attention from foresters are: (1) demographics, and the human values that drive migration to the interface; (2) the ability of urban vegetation to carry fire from the wildland into the city; (3) the impact of regional fuel reduction on operation of forest ecosystems; and (4) developing good methods for monitoring patterns of land ownership, use, and cover change.

Sander, Ivan L.; Smith, H. Clay. 1989. **Managing mature, even-aged stands.** In: Clark, F. Bryan, tech. ed. Central hardwood notes. St. Paul, MN: U.S. Department of Agriculture, Forest Service, North Central Forest Experiment Station: 6.07-6.07-4.

Schier, George A. 1989. **Immissionsschaden bei** *Pinus strobus* **in Westdeutschland: Air pollution damage on** *Pinus strobus* **in West Germany.** In: Anbau fremdländischer Baumarten im Lichte der gegenwärtigen Waldschäden: Cultivation of foreign (exotic) tree species with respect to present forest damage. Ser. A: Appl. Sci. Vol. 370. Druck, Federal Republic of Germany: Landwirtschaftsverlag GmbH: 71-74. [In German.]

Schlisinger, Richard C.; Shigo, Alex L. 1989. **Pruning central hardwoods.** In: Clark, F. Bryan, tech. ed. Central hardwood notes. St. Paul, MN: U.S. Department of Agriculture, Forest Service, North Central Forest Experiment Station: 6.09-6.09-5.

Sendak, Paul E.; McEvoy, Thomas J. 1989. **Recent trends in Vermont stumpage prices.** Forest Products Journal. 39(4): 20-26.

Quarterly stumpage prices for 10 forest products were analyzed to determine the effects of season, region, and their interaction on reported price and to determine the existence of consistent reporting group bias. Stumpage prices were collected by the Extension Service in Vermont since the third quarter of 1981. Results of multivariate analysis of variance show that there was no seasonal effect, region effect was significant for 8 of the 10 products, and there was a significant season by region effect only for sugar maple sawtimber. Average sawtimber prices generally increased from north to south while pulpwood and firewood prices increased from south to north. The regional effect can largely be explained by the location of markets, timber resource distribution, and regional differences in timber quality. Consistent reporting group bias was tested for forester versus logger reported prices (seller/buyer differential) and private consulting forester versus public forester reported prices (private/public differential). There was some evidence of reporting group bias, but the magnitude of the bias was small.

Sheehan, Katharine A. 1989. **Models for the population dynamics of** *Lymantria Dispar.* In: Wallner, William E.; McManus, Katherine A., tech. coords. Proceedings, Lymantriidae: a comparison of features of New and Old World tussock moths; 1988 June 26-July 1; New Haven, CT. Gen. Tech. Rep. NE-123. Broomall, PA: U.S. Department of Agriculture, Forest Service, Northeastern Forest Experiment Station: 533-547.

Sheehan, Katharine A.; Kemp, William P.; Colbert, J. J.; Crookston, Nicholas L. 1989. **The western source budworm model: structure and content.** Gen. Tech. Rep. PNW-241. Portland, OR: U.S. Department of Agriculture, Forest Service, Pacific Northwest Forest and Range Experiment Station. 70 p.

The budworm model predicts the amounts of foliage destroyed annually by the western spruce budworm in a forest stand. The model can be used

independently or it can be linked to a stand prognosis model to simulate the dynamics of forest stands. Many processes that affect budworm population dynamics are simulated in detail, including budworm and host phenology, larval growth and feeding, larval and adult dispersal, and the effects of natural enemies. The structure, assumptions, and default parameter values of the budworm model are described.

Sheffield, Raymond M.; Birch, Thomas W.; Leatherberry, Earl C.; McWilliams, William H. 1989. **The pine-hardwood resource in the eastern United States.** In: Proceedings of pine-hardwood mixture: a symposium on management and ecology of the type; 1989 April 18-19; Atlanta, GA. Gen. Tech. Rep. SE-58. Asheville, NC: Department of Agriculture, Forest Service, Southeastern Forest Experiment Station: 9-19.
In the Eastern United States, 31 million acres of timberland are classified as pine-hardwood. Many additional stands classified as pine or hardwood types are diverse mixtures of softwood and hardwood species. The pine-hardwood resource is concentrated in the South. Natural forces and human activity cause these mixed stands to be transitory and dynamic.

Sherar, James R.; LeDoux, Chris B. 1989. **Shift level analysis of cable yarder availability, utilization, and productive time.** In: Implementing techniques for successful forest operations. Proceedings of the 12th annual meeting of the Council on Forest Engineering; 1989 August 27-30; Coeur d'Alene, ID. [Place of publication unknown]: Council on Forest Engineering: 37-40.
Decisionmakers, loggers, managers, and planners need to understand and have methods for estimating utilization and productive time of cable logging systems. In making an accurate prediction of how much area and volume a machine will log per unit time and the associated cable yarding costs, a reliable estimate of the availability, utilization, and productive time of the cable machine must be known. Important estimators for the Christy SWY III cable yarder operating in the southern Appalachians are analyzed.

Shigo, Alex L. 1989. **Trunk decays.** In: Clark, F. Bryan, tech. ed. Central hardwood notes. St. Paul, MN: U.S. Department of Agriculture, Forest Service, North Central Forest Experiment Station: 8.07-8.07-6.

Smith, Harvey R. 1989. **Predation: its influence on population dynamics and adaptive changes in morphology and behavior of Lymantriidae.** In: Wallner, William E.; McManus, Katherine A., tech. coords. Proceedings, Lymantriidae: a comparison of features of New and Old World tussock moths; 1988 June 26-July 1; New Haven, CT. Gen. Tech. Rep. NE-123. Broomall, PA: U.S. Department of Agriculture. Forest Service, Northeastern Forest Experiment Station: 469-488.

Smith, Harvey R.; Proctor, Noble S. 1989. **No home to return to.** Discovery. 21(2): 3-7.

Smith, H. Clay. 1989. **Response of sapling stands to cultural treatments.** In: Clark, F. Bryan, tech. ed. Central hardwood notes. St. Paul, MN: U.S. Department of Agriculture. Forest Service, North Central Forest Experiment Station: 6.04-6.04-3.

Smith, H. Clay. 1989. **Wild grapevine management.** In: Clark, F. Bryan, tech. ed. Central hardwood notes. St. Paul, MN: U.S. Department of Agriculture, Forest Service, North Central Forest Experiment Station: 6.13-6.13-4.

Smith, H. Clay; Lamson, Neil I.; Miller, Gary W. 1989. **An esthetic alternative to clearcutting?** Journal of Forestry. 87(3): 14-18.

Smith, H. Clay; Noughton, Gary G. 1989. **Choosing a silvicultural system.** In: Clark, F. Bryan, tech. ed. Central hardwood notes. St. Paul, MN: U.S. Department of Agriculture, Forest Service, North Central Forest Experiment Station: 2.04-2.04-3.

Smith, H. Clay; Sander, Ivan L. 1989. **Silvicultural systems for harvesting mixed hardwood stands.** In: Clark, F. Bryan, tech. ed. Central hardwood notes. St. Paul, MN: U.S. Department of Agriculture, Forest Service, North Central Forest Experiment Station: 2.07-2.07-6.

Smith, Kevin T. 1989. **Dynamics of decay in trees and timber.** Biodeterioration Research. 2: 435-449. Wood decay is a process with stages prior to structural degradation that can be identified using electrical resistance measurements and other techniques. There is no known single enzyme or reaction that applied to wood results in decay as seen in nature. Wood decay is an ordered process of many steps that in living trees may require the involvement of several types of organisms. Recognition of the com-

plexity of the process is the first step in improving control measures for wood decay.

Solomon, Dale S. 1989. **Regional assessment of forest growth decline in the Northeastern United States.** In: Global natural resource monitoring and assessments: preparing for the 21st century. Proceedings of the international conference and workshop (vol. 1); 1989 September 24-30; Venice, Italy. [Location of publisher unknown]: [Publisher name unknown]: 504-506.
Spatial and temporal analyses were made of five individual species within the spruce-fir and northern hardwood forest types in the Northeastern United States. A general growth decline for forest stands within both forest types was explained by and attributed to forest stand characteristics across time. There was no south-to-north spatial growth-rate difference. There was a west-to-east spatial growth-rate difference for red spruce and balsam fir that was not completely explained by stand variable covariates. However, this growth-rate pattern over time remained the same among regions and was consistent with that of a maturing healthy forest.

Solomon, Dale S.; Droessler, Terry D.; Lemin, Ronald C., Jr. 1989. **Segmented quadratic taper equations for spruce and fir in the Northeast.** Northern Journal of Applied Forestry. 6(3): 123-126.
Segmented quadratic taper equations were developed from red spruce and balsam fir stem analysis data in the Northeast. Estimated diameters and volumes from the taper equations were compared with actual diameters and volumes in a validation data set. They were precise and had negligible bias in prediction. The derived volume from the taper equation also was compared to existing total tree-volume equations for spruce and fir. The error analyses showed the segmented taper equations provided an accurate and precise alternative to total tree-volume equations.

Solomon, Dale S.; Hosmer, Richard A. 1989. **Growth model for forest managers of northern hardwoods.** In: Martin, C. Wayne; Smith, C. Tattersall; Tritton, Louise M., eds. New perspectives of silvicultural management of northern hardwoods: proceedings of 1988 symposium on the conflicting consequences of practicing northern hardwood silviculture; 1988 June 9-10; Durham, NH. SAF Publ. 89-04; Gen. Tech. Rep. NE-124. Broomall, PA: U.S. Department of Agriculture, Forest Service, Northeastern Forest Experiment Station: 97-100.

Growth and yields for northern hardwoods and associated forest types of different species mixtures can be predicted with the model FIBER. Changes in stand growth of multiple species composition are available within the model. The model uses diameter distributions of classes ranging from 4.5 to 30 0 inches for each of the commercial species in these forest types. Thinning and harvest yields can be obtained for managed and unmanaged, even-aged, and multi-aged stands over a range of densities, site indices, and intermediate treatments.

Solomon, Dale S.; Hosmer, Richard A. 1989. **Modeling northern hardwood stand development.** In: Martin, C. Wayne; Smith, C. Tattersall; Tritton, Louise M., eds. New perspectives of silvicultural management of northern hardwoods: proceedings of 1988 symposium on the conflicting consequences of practicing northern hardwood silviculture; 1988 June 9-10; Durham, NH. SAF Publ. 89-04; Gen. Tech. Rep. NE-124. Broomall, PA: U.S. Department of Agriculture, Forest Service, Northeastern Forest Experiment Station: 91-95.
SIMSAP and SIMTIM have been developed to simulate the stand growth and development of natural and treated even-aged northern hardwood stands. Using available data, the connecting phases of both models have been tested to determine the effects of silvicultural treatments (or no treatment) on long-term stand response. SIMSAP begins with species distributions by quality classes in sapling stands after regeneration. Treatments include pruning of crop trees and weeding. The sapling stage continues until the mean stand diameter reaches 3.0 inches, at which time understory trees are deleted, leaving only trees in the main crown canopy and a mean stand diameter of approximately 4.5 inches. SIMTIM, the poletimber-sawtimber-harvest phase, uses stocking guides based on quadratiac mean stand diameter number of trees, and basal area per acre of trees in the main crown canopy. Growth and yield predictions for managed and unmanaged stands are based on site index and age, and are allotted by residual basal area, percent saw-timber, and species composition.

Solomon, Dale S.; Marquis, David A. 1989. **A silvicultural decision model for forests of the Northeastern United States.** In: Burkhard, Harold E.; Rauscher, Michael H.; Johann, Klaus, eds. Artificial intelligence and growth models for forest management decisions. Publ. FWS-1-89. Blacksburg, VA:

Virginia Polytechnic Institute and State University: 377-385.
A computerized decision model is being developed for forests of the Northeastern United States that will provide expert support for land managers who must develop silvicultural prescriptions to achieve a variety of timber, wildlife, and aesthetic goals. Data on forest vegetation, site, and management objectives are the basis for management prescriptions generated by the program. In addition to generating an expert opinion on each stand, stand growth simulators incorporated into the program allow comparisons of the recommended treatment against other alternatives for varied species compositions.

Stevens, J. C.; Rowntree, R. A. 1989. **Research in urban forestry: studies of ecological structure and function.** In: Proceedings, 1988 Society of American Foresters national convention; 1988 October 16-19; Rochester, NY. SAF Publ. 88-01. Bethesda, MD: Society of American Foresters: 385-388.
The national mission of the Northeastern Forest Experiment Station's urban forestry research unit at Syracuse, New York, is to understand the structure and function of urban forests using a number of different approaches. In Dayton, Ohio, research focused on the ability of the urban forest to reduce storm runoff and lessen the summertime heat island effect. In the Salt Lake Basin, Utah, we are evaluating the regional effects of transforming that basin from semi-arid vegetation to an artificially watered, and exotic, urban forest. In the Baltimore-Washington corridor, we are documenting forest fragmentation and its impact on biodiversity, and in New York City, our work has ranged from developing an urban ecology interpretive center to assisting planners in forest policy for the 37-county tristate metropolitan region.

Tanaka, Seiji; Chang, Ming Tu; Denlinger, David L.; Abdel-Aal, Yehia A. I. 1989. **Developmental landmarks and the activity of juvenile hormone and juvenile hormone esterase during the last stadium and pupa of** *Lymantria dispar.* Journal of Insect Physiology. 35(11): 897-905.
Changes in juvenile hormone and juvenile hormone esterase activity were monitored during the last stadium and pupa of the gypsy moth. Methods were developed to separate the sexes and to stage larvae using morphological and behavioural markers. Juvenile hormone activity determined by the *Galleria melonella* bioassay was relatively high during the early development of the last larval stadium; the activity was 5 times higher in females (6th instar) than in males (5th instar). Juvenile hormone activity decreased rapidly during the middle of the stadium and further declined shortly before pupation. Low levels of juvenile hormone activity persisted throughout the pupal stage. Three peaks of juvenile hormone esterase activity were observed during the last stadium in both sexes.

Teck, Richard M.; Kidd, William E. 1989. **STOCKTAB: a computerized forest growth projection system for forest managers.** Northern Journal of Applied Forestry. 6(2): 86-88.
STOCKTAB, a computerized forest-growth projection system designed to project the volume and value growth of forest stands on small woodlots for three 5-year intervals, incorporates woodlot inventory data, local diameter-growth rates, USDA Forest Service tree grades, and species-specific regression equations to predict factory-grade lumber yields. Lumber value is then calculated based on current market prices for grade lumber.

Tilghman, Nancy G. 1989. **Impacts of white-tailed deer on forest regeneration in northwestern Pennsylvania.** Journal of Wildlife Management. 53(3): 524-532.
Browsing by white-tailed deer is a major cause of regeneration failure in Allegheny hardwood forests of northwestern Pennsylvania. The impact of deer at five densities (0, 10, 20, 40, and 80 deer/259 ha) was examined on tree seedlings, woody shrubs, and herbaceous plants in large enclosures over 5 years. Silvicultural treatments were clearcut, thinning, and no cut at each density. After 5 years, tree seedlings in the clearcuts at the lowest deer densities also reduced the diversity of tree seedlings, resulting in nearly pure black cherry. Fern cover increased with increasing deer densities and blackberry cover decreased.

Tilghman, Nancy G.; Marquis, David A. 1989. **Deer damage in central hardwoods: a potential problem.** In: Clark, F. Bryan, tech. ed. Central hardwood notes. St. Paul, MN: U.S. Department of Agriculture, Forest Service, North Central Forest Experiment Station: 8 01-8.01 3.

Tritton, Louise M. 1989. **The effect of cutting on nutrient cycling in northeastern forests.** In: Forest and wildlife management in New England--what can we afford? Proceedings of a joint meeting of the

Maine Division of New England Society of American Foresters, Maine Chapter of the Wildlife Society, and the Atlantic International Chapter of the American Fisheries Society; 1989 March 15-17; Portland, ME. CFRU Inf. Rep. 21; Misc. Rep. 336; SAF Publ. 89-05. Orono, ME: Maine Agricultural Experiment Station: 124-128.

Management aimed at nutrient conservation protects the fertility of forest sites in the Northeast. Studies of nutrient cycling in several small watersheds indicate that two major effects of cutting are removal of nutrients in the forest products and loss of nutrients in streamflow. Research on different cutting practices is summarized and recommendations for mitigating of regional stresses on forests indicate the need for protecting site fertility through a conservative approach to harvesting.

Tritton, Louise M.; Johnson, James E. 1989. **Protecting site productivity: an ecological perspective on northern hardwood silviculture.** In: Martin, C. Wayne; Smith, C. Tattersall; Tritton, Louise M., eds. New perspectives of silvicultural management of northern hardwoods: proceedings of 1988 symposium on the conflicting consequences of practicing northern hardwood silviculture; 1988 June 9-10; Durham, NH. SAF Publ. 89-04; Gen. Tech. Rep. NE-124. Broomall, PA: U.S. Department of Agriculture, Forest Service, Northeastern Forest Experiment Station: 39-48.

From an ecological perspective, site productivity reflects the ability of the entire forest ecosystem to promote the growth of merchantable northern hardwoods. The current understanding of how harvesting affects each of five ecosystem properties--soil characteristics, stand characteristics, quality of the forest environment, hydrology, and nutrient cycles--is discussed. Care and planning in the application of silvicultural systems are essential to minimize site disturbance and protect the native productivity of northern hardwood sites.

Tritton, Louise M.; Smith, C. Tattersall, Jr.; Martin, C. Wayne. 1989. **Finding common ground.** In: Martin, C. Wayne; Smith, C. Tattersall; Tritton, Louise M., eds. New perspective of silvicultural management of northern hardwoods: proceedings of 1988 symposium on the conflicting consequences of practicing northern hardwood silviculture; 1988 June 9-10; Durham, NH. SAF Publ. 89-04; Gen. Tech. Rep. NE-124. Broomall, PA: U. S. Department of Agriculture, Forest Service, Northeastern Forest Experiment Station: 27-30.

The original objective of this symposium was to find common ground among various professional concerns in the forestry community for choosing a silvicultural system (even-age, uneven-age, or none).

Tubbs, Carl. 1989. **Uneven-age management: when do conditions require this approach?** In: Martin, C. Wayne; Smith, C. Tattersall; Tritton, Louise M., eds. New perspectives of silvicultural management of northern hardwoods: proceedings of 1988 symposium on the conflicting consequences of practicing northern hardwood silviculture; 1988 June 9-10; Durham, NH. SAF Publ. 89-04; Gen. Tech. Rep. NE-124. Broomall, PA: U.S. Department of Agriculture, Forest Service, Northeastern Forest Experiment Station: 27-30.

Twery, Mark J. 1989. **Sampling *Armillaria* in forest stands.** In: Odell, Thomas M., comp. Proceedings of the 22nd annual northeastern forest insect work conference: the 1st joint meeting with the northeastern forest pathology workshop; 1989 April 3-5; Hyannis, MA. [Place of publication unknown]: State University of New York: 27-29.

Twery, Mark J. 1989. **Hazard rating for gypsy moth on a computer.** In: Proceedings, 1989 national gypsy moth review; 1989 November 6-9; Annapolis, MD. [Place of publication unknown]: [Publisher name unknown]: 153-158.

Twery, Mark J.; Gottschalk, Kurt W. 1989. **Silviculture vs. the gypsy moth: can it help?** Proceedings, 1988 Society of American Foresters national convention; 1988 October 16-19; Rochester, NY. SAF Publ. 88-01. Bethesda, MD: Society of American Foresters: 169-172.

The gypsy moth defoliates many species of trees, especially oaks. Introduced in 1869 in Massachusetts, it has since spread throughout the eastern and southern hardwood forests. Gypsy moths defoliate trees in late spring, producing extensive growth loss and mortality in forests and considerable nuisance in urban/suburban settings. Silviculture can minimize the impact of gypsy moth by reducing the number of insects and improving the vigor of the trees. During outbreaks, regeneration cuts reduce susceptibility of the stand and recover value from standing timber and direct aerial suppression minimizes damage to valuable stands. Post-outbreak treatments such as salvage, improvement, or regeneration cuts can recover dead

material, change species composition, and improve stand vigor before another outbreak.

Twery, Mark J.; Mason. Garland N.; Wargo, Philip M.; Gottschalk, Kurt W. 1989. **Abundance and distribution of rhizomorphs of *Armillaria* spp. in defoliated mixed oak stands.** In: Proceedings of the 1988 National gypsy moth review; 1989 January 10-12; Dearborn, MI. Dearborn, MI: Michigan Department of Agriculture: 159-166.
Quantity of inoculum of *Armillaria* may be an important factor in the extent of tree mortality after defoliation of mixed hardwood stands. Reported are preliminary results of studies in which the presence and abundance of rhizomorphs in the soil in undisturbed stands and stands defoliated previously by insects were quantified. Rhizomorph distribution within the plots was uniform in the undisturbed stand but was significantly greater near dead trees in the defoliated stands. Greater rhizomorph abundance near recently dead trees or stumps may have important implications for management decisions in the presence of gypsy moth infestations.

Tyree, M. 1989. **Cavitation in trees and the hydraulic sufficiency of woody stems.** Annales des Sciences Forestieres (suppl. 46): 330s-337s.
Examines the generality of the conclusions drawn from previous steady-state models used to calculate the "hydraulic sufficiency" of trees by computing the dynamics of embolism development in a nonsteady state model.

Tyree, M. T.; Sperry, J. S. 1989. **Vulnerability of xylem to cavitation and embolism.** Annual Review of Plant Physiology and Plant Molecular Biology. 40: 19-38.
Summarizes current knowledge of cavitation and embolism, and evaluates its biological significance in plants. Plants have evolved to survive the threat to their water supply that cavitation imposes. One of the questions addressed is how they have done so and what sacrifices were involved. The environmental conditions under which cavitation occurs, and the impact of consequent disruption of water transport on water relations and ecophysiology of plants are discussed.

Valentine, Harry T.; Furnival, George M. 1989. **Projections with ingrowth by Markov chains.** Forest Science. 35(1): 245-250.
A Markov chain that accounts for ingrowth as well as growth, death, and harvest of trees is formulated for projecting a size-class distribution. Live trees of minimal or greater size reside in size classes 1 through n. A special size class 0 serves as a reservoir of potential ingrowth trees and as a repository for dead or harvested trees. Ingrowth is the movement of a tree out of size class 0 and into a larger size class. Conversely, death or harvest is represented by the movement of a tree out of a larger size class and into size class 0. Application of the Markov chain, including the calculation of a stationary size-class distribution, is demonstrated.

Vogel, Willis G. 1989. **Results of planting oaks on coal surface-mined lands.** In: VanSambeek, J. W., Larson, M. M., eds. 4th workshop on seedling physiology and growth problems in oak plantings; 1989 March 1-2; Columbus, OH. Gen. Tech. Rep. NC-139; St. Paul, MN: U.S. Department of Agriculture, Forest Service, North Central Forest Experiment Station: 19. Abstract.

Waddell, Karel L.; Oswald, Daniel D.; Powell, Douglas S. 1989. **Forest statistics of the United States, 1987.** Resour. Bull. PNW-RB-168. Portland, OR: U.S. Department of Agriculture, Forest Service, Pacific Northwest Forest and Range Experiment Station. 106 p.
The Forest and Rangeland Renewable Resource Planning Act (RPA) of 1974 directs the U.S. Department of Agriculture to conduct a comprehensive assessment of all forest and range land resources on both public and private lands. Forest resource data collected from periodic surveys in each state and Forest Service region were entered into a database management system, compiled, and summarized for the United States. Tables include information on area, volume, removals, and timber product outputs.

Wade, Gary L. 1989. **Grass competition and establishment of native species from forest soil seed banks.** Landscape and Urban Planning. 17: 135-149.
Three pioneer plant communities, a reclamation mix of *Festuca arundinacea* (tall fescue), *Eraagrostis curvula* (weeping lovegrass), *Lolium* sp. (ryegrass) and *Lespedeza cuneata* (sericea lespedeza); a native species community derived from a forest topsoil seed bank; and a combination of native species plus the reclamation mix, were established on a thin layer of topsoil over mine spoils in microplots. The seed bank produced 84 taxa, including five tree species, seven shrubs or woody vines, 14 grasses

and 53 forbs identifiable at least to genus. The seed-bank treatment produced the greatest above-ground biomass. Adding seed of reclamation species to the seed bank resulted in a community which had less total biomass, less total biomass in native species and fewer established native species with lower populations and biomass than the native species community without reclamation species.

Wallner, William E. 1989. **Overview of pest Lymantriidae of North America.** In: Wallner, William E.; McManus, Katherine A., tech. coords. Proceedings, Lymantriidae: a comparison of features of New and Old World tussock moths; 1988 June 26-July 1; New Haven, CT. Gen. Tech. Rep. NE-123. Broomall, PA: U.S. Department of Agriculture, Forest Service, Northeastern Forest Experiment Station: 65-79.

Wallner, William. 1989. **Gypsy moth.** In: Clark, F. Bryan, tech. ed. Central hardwood notes. St. Paul, MN: U.S. Department of Agriculture, Forest Service, North Central Forest Experiment Station: 8.10-8.10-4.

Wallner, W. E.; Devito, A. S.; Zarnoch, S. J. 1989. **Regression estimators for late-instar gypsy moth larvae at low population densities.** Forest Science. 25(3): 789-800.
Two regression estimators were developed for determining densities of late-instar gypsy moth larvae from burlap band and pyrethrin spray counts on oak trees in Vermont, Massachusetts, Connecticut, and New York. Studies were conducted by marking larvae on individual burlap-banded trees within 15-m-diameter plots and recapturing them with pyrethrin sprays to tree crowns at night. Both estimators are based on data that are relatively easy and inexpensive to gather in the field. The estimator for individual trees may be useful in determining relative densities, but the plot estimator, which had an R^2 of 0.99, can be used with a high degree of confidence for determining absolute densities in plots containing several oak trees. Validation of the plot density estimator at five sites in Maryland demonstrated its utility for sampling late-instar gypsy moth.

Wallner, William E.; Elkinton, Joseph S., Gould, Juli R.; Ferguson, Carol S. 1989. **Density dependent response by tachinid parasitoids to discrete, experimentally elevated gypsy moth populations.** In: Proceedings, International Organization for Biological Control of Noxious Animals and Plants. East

Palaearctic Section; 1989 September 3-8; Borzhome, Georgia, U.S.S.R. [Place of publication unknown]: Gulisashvili V.Z. Research Institute of Mountain Forestry: 36-43.

Wallner, William E.; McManus, Katherine A., tech. coords. 1989. **Proceedings, Lymantriidae: a comparison of features of New and Old World tussock moths;** 1988 June 26-July 1; New Haven, CT. Gen. Tech. Rep. NE-123. Broomall, PA: U.S. Department of Agriculture, Forest Service, Northeastern Forest Experiment Station. 554 p.
Includes 34 papers on biology and population dynamics of lymantriid moths presented at an international conference, plus a summary and discussion of research issues.

Walters, R. S. 1989. **Shelterwood harvest for upland oak stand regeneration in southeastern Ohio.** In: Agronomy Abstracts, 1989: 313. Abstract.

Walters, Russell S. 1989. **Influence of site on regeneration development after partial cutting of upland oak forests.** In: 65th annual meeting of the Pennsylvania Academy of Science and Piedmont Aquatic Scientists Association; 1989 April 7-9; Mount Pocono, PA. Philadelphia, PA: Pennsylvania Academy of Science. Abstract.
Successful natural regeneration of mature upland oak forests to oak requires large advance oak seedlings in the understory before the final harvest. Often, oak regeneration is lacking, or it is too small or not vigorous enough to form a significant component in the forthcoming stand. Species composition and development of regeneration is largely a function of site. This study evaluated the impact of site and three levels of cutting on height growth of oak, yellow-poplar, and red maple reproduction in southeastern Ohio. Height growth increased with decreasing overstory density and with increasing initial seedling height at the time of cutting. Soil moisture and temperature regimes affected the growth rate of yellow-poplar and red maple seedlings but not that of the oaks.

Walters, R. S.; Auchmoody, L. R. 1989. **Vegetation re-establishment on a hardwood forest site denuded by brine.** Landscape and Urban Planning. 17(2): 127-133.
Brine from active oil wells seeped through the soil of a forested site in northwestern Pennsylvania and killed all vegetation in its path, leaving the affected area unproductive and unsightly. After the brine

source was eliminated, herbaceous plants, shrubs, and tree seedlings became established and developed rapidly. Establishment began in the first year and by year 4, the site had developed into a healthy young forest. Results show that Allegheny hardwood forest sites damaged by brine water rapidly revegetate once the brine discharge is stopped so long as there is a seed supply and the area is fenced to exclude deer.

Walters, Russell S.; Nyland, Ralph D. 1989. **Clearcutting central New York northern hardwood stands.** Northern Journal of Applied Forestry. 6: 75-78.
Clearcutting proved effective for regenerating central New York stands that were dominated by sugar maple along with American beech, black cherry, white ash, red maple, and basswood. Findings from five stands for periods of 7 to 13 years following clearcutting show densities equivalent to 2,400 to 9,400 saplings of commercial species per acre on 64 to 100 percent of the milacres sampled. In each stand, a minimum of 81 percent of the 6.6-foot- radius sample plots were stocked with at least one sapling of a commercial species, suggesting that site occupancy will be fairly complete and uniform as these stands mature. All sites contained abundant regeneration of commercial species immediately after logging, ranging from 15,000 to 57,000 seedlings per acre, but as many as 90 percent of these were less than 1 foot tall. The species composition generally reflected the original forest with abundant sugar maple and American beech. There also are large amounts of black cherry and white ash on some sites.

Wargo, Philip M. 1989. **Elevation and *Armillaria* species relationships in spruce-fir forests of northwestern United States.** In: Morrison, D. J., ed. Proceedings, 7th international conference on root and butt rots; 1988 August 9-16; Vernon and Victoria, BC. [Place of publication unknown]: [Publisher name unknown]: 340-346.
Isolates of *Armillaria* species were captured from dead red spruce, balsam fir, and hardwoods, primarily white birch, at four elevations on five mountainous sites in the Northeastern United States. Growth responses of paired diploid isolates on malt agar suggested more than one biological species of *Armillaria* at each elevation at all sites. Pairing of diploid field isolates with haploid tester strains confirmed the presence of several biological species.

Diploid isolates were compatible with tester strains for BS I, III, VII and IX.

Wargo, Philip M. 1989. **Gypsy moth, *Armillaria* root disease and oak management interactions.** in: Proceedings, 22nd annual northeastern forest insect work conference: the 1st joint meeting with the northeastern forest pathology workshop; 1989 April 3-5; Hyannis, MA. [Place of publication unknown]. State University of New York: 24-26.

Widmann, Richard H. 1989. **Pulpwood production in the Northeast--1987.** Resour. Bull. NE-111. Broomall, PA: U.S. Department of Agriculture, Forest Service, Northeastern Forest Experiment Station. 24 p.
Contains 1987 information compiled from a canvass of all pulpmills that use pulpwood produced in the 14 Northeastern States. In 1987, total production reached 9,387,700 cords, an increase of 5 percent since 1986. Roundwood production was 6,796,700 cords and pulpwood from residues was 2,591,000 cords. Each of these increased from the previous year by 3 and 10 percent, respectively. Receipts of pulpwood at mills in the region totaled 9,894,400 cords.

Wilkinson, Ronald C. 1989. **Seed source and family variation in the incidence of fungal cankering in a sugar maple progeny test plantation.** In: Proceedings, 31st northeastern forest tree improvement conference; 6th northcentral tree improvement association; 1988 July 7-8; University Park, PA. University Park, PA: The Pennsylvania State University: 162-169.
Sugar maples growing on a poor site and under stress are believed to be predisposed to infection by disease-causing organisms, including some fungi that cause cankers. In a sugar maple progeny test of 32 half-sib families from four seed sources, on a poor site with shallow soils at Underhill, Vermont, 28 percent of 594 trees have been infected by canker-causing organisms, predominately *Nectria* None of the trees from 25 of the same families growing in another plantation on a good site at Williamstown, Massachusetts, have been infected. Preliminary evidence, showing that some sugar maples may be genetically predisposed to invasion by fungal pathogens, suggests that there may be a need to delineate specific seed collection areas for sugar maples that are to be planted on less than optimum sites for sugarbush replacement, replenishment, or timber production.

Wright, Susan L.; Hall, Richard W.; Peacock, John W. 1989. **Effect of simulated insect damage on growth and survival of northern red oak (*Quercus rubra* L.) seedlings.** Environmental Entomology. 18(2): 235-239.

Effects of simulated insect damage--artificial defoliation and root damage in combination with two levels of watering--were studied to determine the potential effect on northern red oak seedlings. Treatments and treatment combinations caused significant differences in stem diameter, percentage of stem dieback, and mortality. Defoliation and a regime of decreased watering seemed to have the greatest effect on seedling growth and mortality. Root injury had no consistent direct effect but interacted significantly with other factors. Insect damage to foliage and roots, together with water stress, may be a factor in poor survival of oak seedlings under field conditions.

Yaussy, Daniel A. 1989. **Green lumber grade yields from black cherry and red maple factory grade logs sawed at band and circular mills.** Canadian Journal of Forestry Research. 19(11): 1436-1444.

Multivariate regression models were developed to predict green board-foot yields for the standard factory lumber grades processed from black cherry and red maple factory grade logs sawed at band and circular sawmills. The models use log measurements of grade, scaling diameter, length, and proportion of scaling defect. They can be used in computer programs related to sawmill simulations, economic modeling, or log-yard inventory systems.

Yaussy, Daniel A.; Brisbin, Robert L. 1989. **Evaluating standing timber using stump.** In: Proceedings, 17th annual hardwood symposium of the Hardwood Research Council; 1989 May 7-10; Merrimac, WI. Asheville, NC: Hardwood Research Council; 41-51.

STUMP is an integrated software package that allows estimation of end-product yield and value from hardwood-timber cruise data or from scaled-log data. It consists of four modules and data-entry routines that use standard timber-cruise or log-scale entries plus the quality measures of tree or log grade to estimate yield and value by log and lumber grade. The system uses existing tree- and log-quality models to predict expected lumber yields. Newly developed models are used to predict merchantable log yields and potential veneer yields from tree-cruise data. The use of the first two modules in evaluating standing timber as recorded in a field cruise is described. Volumes and values of lumber by lumber grade are estimated by Module 1, while Module 2 estimates the size and log grades of the logs that might be produced from the standing timber.

Zipperer, W. C.; Burgess, R. L.; Nyland, R. D. 1989. **Interaction of land use and forest island dynamics in central New York.** In: Proceedings, 1988 Society of American Foresters national convention; 1988 October 16-19; Rochester, NY. SAF Publ. 88-01. Bethesda, MD: Society of American Foresters: 137-140.

Within man-dominated landscapes, forest islands often play a critical role in maintaining biological diversity across regions. How these forest islands change in density and size over time is important in understanding the effects of isolation and size on this diversity. To detail forest island dynamics, we identified the individual landscape types within central New York, and examine the processes of deforestation and reforestation with respect to landscape types. During the 40-year study period, forest islands were fragmented by transportation systems and a rights-of-way, were eliminated through urban and agricultural practices, emerged from previously cleared agricultural and urban lands, or were consolidated into larger islands.

Publications--1990

Adams, M. B.; Edwards, N. T.; Taylor, G. E., Jr.; Skaggs, B. L. 1990. **Whole-plant ¹⁴C-photosynthate allocation in *Pinus taeda*: seasonal patterns at ambient and elevated ozone levels.** Canadian Journal of Forestry Research. 20: 152-158.

The whole-tree carbon dynamics of *Pinus taeda* seedlings was studied. The objectives were to determine the seasonal patterns of carbon gain and photosynthate allocation; investigate the effects of O_3 stress on whole-plant carbon dynamics; and evaluate the methodology of fascicle-specific ¹⁴C tagging to monitor photosynthate allocation from the source tissue. Allocation of photosynthate is defined in terms of spatial allocation within the plant to distinguish it from the partitioning of carbon into various chemical compounds (starches, sugars, etc.)

Adams, M. B.; Kelly, J. M.; Taylor, G. E., Jr.; Edwards, N. T. 1990. **Growth of five families of *Pinus taeda* L. during three years of ozone exposure.** New Phytology. 116: 689-694.

Loblolly pine seedlings of five half-sib families were grown for 3 years in the field in open-top chambers. The seedlings were fumigated during the growing seasons with ozone at the following target levels: subambient (CF), ambient (AMB), and ambient + 60 ppb (AMB+). At the end of the three growing seasons, there were no significant ozone effects on diameter, height, or total biomass of the seedlings, nor were there statistically significant ozone-family interactions. Analysis of growth trends suggests that drought during the second and third growing seasons may have interacted with the ozone treatments.

Alerich, Carol L. 1990. **Forest statistics for Kentucky--1975 and 1988.** Resour. Bull. NE-117. Radnor, PA: U.S. Department of Agriculture, Forest Service, Northeastern Forest Experiment Station. 295 p.

A statistical report on the fourth forest survey of Kentucky (1988). Findings are displayed in 204 tables containing estimates of forest area, number of trees, timber volume, tree biomass, and timber products output. Data are presented at three levels: state, geographic unit, and county.

Anderson, R. Bruce. 1990. **What you may not have considered about CNC machinery purchases.** Furniture Design & Manufacturing. 62(12): 48, 50, 52, 55-56, 58.

Successful investment in automated machinery requires more than justifying the purchase solely on economic criteria or expected productivity improvements. Factors that can affect the success of the purchase decision are discussed.

Andrus, Sheila M. 1990. **Eastern hardwoods research cooperative.** In: Lynch, James A.; Corbett, Edward S.; Grimm, Jeffrey W., eds. Proceedings of the conference on atmospheric deposition in Pennsylvania: a critical assessment; 1989 September 11-14; University Park, PA. University Park, PA: The Pennsylvania State University: 123.

Arner, Stanford L.; Gansner, David A.; Birch, Thomas W. 1990. **Rate of value change in New England timber stands.** Res. Pap. NE-639. Radnor, PA: U.S. Department of Agriculture, Forest Service, Northeastern Forest Experiment Station. 4 p.

Analyses of remeasured plot data show that between the last two forest inventories of New England, compound rates of value change in timber stands averaged 4.2 percent and ranged from -26 to +43 percent. Three key characteristics of stand condition (species composition, tree size, and stocking) can be used to estimate economic growth.

Auchmoody, L. R.; Lilja, Paul. 1990. **Impact of forest liming on vigor and diameter growth rates of Allegheny hardwoods.** In: 66th annual meeting of the Pennsylvania Academy of Science and Pennsylvania Biological Survey; 1990 April 20-22; Pittsburgh, PA. Philadelphia, PA: Pennsylvania Academy of Science: 207. Abstract.

Baumgras, John E.; LeDoux, Chris B. 1990. **Applications of harvesting system simulation to timber management and utilization analyses.** In: Managing forestry operations in a changing environment: Proceedings of the 13th annual meeting of the Council on Forest Engineering; 1990 August 12-16; Outer Banks, NC. Raleigh, NC: North Carolina State University: 175-183.

Simulated timber harvesting systems were applied to the economic analysis of forest management and wood utilization practices. The applications included estimating thinning revenue by stand age, estimating impacts of minimum merchantable tree di-

ameter on harvesting revenue, and evaluating wood utilization alternatives relative to pulpwood quotas and harvesting revenue.

Beckjord, Peter R.; Melhuish, John L., Jr.; Crews, Jerry T.; Farr, David F. 1990. **Epigeous ectomycorrhizal fungi of oaks and pines in forests on surface mines of western Maryland.** Tree Planters' Notes. 41(1): 15-23.
Epigeous basidocarps of ectomycorrhizal fungi were collected for 2 years from oak forests, 1 year from conifer forests, and 1 year from oak and conifer reforested surface mines in western Maryland. Botanical, physiographic, and edaphic data were collected. Two hundred and ninety-one specimens, representing 18 genera and 33 identified species, were obtained. Possible ecological implications for the occurrence of these fungi on these sites are proposed.

Bellinger, R. G.; Ravlin, F. W.; McManus, M. L. 1990. **Predicting egg mass density and fecundity in field populations of the gypsy moth (*Lepidoptera: Lymantriidae*) using wing length of male moths.** Environmental Entomology. 19(4): 1024-1028.
The relationship between mean wing length and density of gypsy moth is described for leading-edge populations in Virginia and Maryland. Mean number of moths per trap, egg-mass density, and eggs per mass in the succeeding generation were related to mean male moth wing length using regression and correlation analyses. Because of the variability in egg-mass density, predictions derived from regression models should be viewed as a part of a sequential approach to quantifying gypsy moth populations in management programs. Wing length estimates can assist in establishing priorities for egg-mass surveys in a pheromone trap-based monitoring system.

Blum, Barton M. 1990. **Red spruce.** In: Burns, Russell M.; Honkala, Barbara H., tech. coords. Silvics of North America: volume 1. Conifers. Agric. Handb. 654. Washington, DC: U.S. Department of Agriculture: 250-259.
Describes silvical characteristics of red spruce. Information on habitat, life history, and genetics is presented.

Bondietti, E. A.; Momoshima, N.; Shortle, W. C.; Smith, K. T. 1990. **A historical perspective on divalent cation trends in red spruce stemwood and the hypothetical relationship to acidic deposition.**

Canadian Journal of Forest Research. 20(12): 1850-1858.

Brooks, Robert T. 1990. **Analysis of forest survey and atmospheric deposition data in Pennsylvania.** In: Lynch, James A.; Corbett, Edward S.; Grimm, Jeffrey W., eds. Proceedings of the conference on atmospheric deposition in Pennsylvania: a critical assessment; 1989 September 11-14; University Park, PA. University Park, PA: The Pennsylvania State University: 121-122.

Brooks, Robert T. 1990. **State-of-the-art methodology of forest inventory: wildlife habitat assessment in the Northeastern United States.** In: LaBau, Vernon J.; Cunia, Tiberius, tech. eds. State-of-the-art methodology of forest inventory: a symposium proceedings; 1989 July 30-August 5; Syracuse, NY. Gen. Tech. Rep. PNW-263. Portland, OR: U.S. Department of Agriculture, Forest Service. Pacific Northwest Forest and Range Experiment Station: 538-543.
Assessments of forest wildlife habitat are mandated by Federal legislation. This responsibility has been delegated to regional Forest Inventory and Analysis research work units of the USDA Forest Service. In the Northeast, habitat assessment emphasizes both within-stand and landscape habitat features. Methodologies for habitat assessment differ among units, making compilation of standard national statistics difficult. Consensus on a standard habitat survey is difficult because of the absence of Federal direction and the lack of an effective constituency.

Brooks, Robert T. 1990. **Wildlife habitat evaluation tools: the U.S. Forest Service's forest inventory and analysis.** In: Science in forestry: IUFRO's 2nd century; 19th world congress. Proceedings, IUFRO conference (vol. 2); 1990 August 5-11; Montreal, PQ. [Place of publication unknown]: Canadian IUFRO World Congress Organizing Committee: 163-172.
In response to legislative mandate, Forest Inventory and Analysis (FIA) research units of the USDA Forest Service's research organization have taken varied actions to implement a survey of forest wildlife habitat resources. The survey provides information at the state and regional level to local users and is aggregated nationally for the assessment of wildlife resources required by the legislation. The two remaining tasks to satisfying the implementing legislation are agreement on a minimum set of habitat attributes and associated reporting standards for

national Assessments, and the validation of survey estimates as accurately measuring land-based attributes critical to wildlife resources.

Brooks, R. T.; Miller-Weeks, M. 1990. **Forest health monitoring in New England, 1990.** In: Global environmental issues: challenge for the 90s; 1990 November 11-15; Arlington, VA. [Place of publication unknown]: Society of Environmental Toxicology and Chemistry: 335. Abstract.

Cannon, William N., Jr. 1990. **Olfactory response of eastern spruce budworm larvae to red spruce needles exposed to acid rain and elevated levels of ozone.** Journal of Chemical Ecology. 16(12): 3255-3261.
Second-instar eastern spruce budworm larvae, were tested in a two-choice, Y-type, wind-tunnel olfactometer for preferences for red spruce needles exposed for 8 weeks to charcoal-filtered air (CFA) or 0.15 ppm ozone (O_3) in combination with acidified rainfall at pH 4.2 or 3.0. Volatiles from needles treated with CFA plus pH 4.2 rain (control) were preferred over those from needles exposed to pH 3.0 rain + O_3 or O_3 alone; O_3-treated needles were chosen over those exposed to pH 3.0 rain + O_3. No preference was shown between the pH 4.2 and 3.0 rain treatments. Larvae chose purified air flowing through the olfactometer over needle volatiles from the pH 3.0 rain + O_3 treatment.

Carter, Katherine K. 1990. **Virginia pine.** In: Burns, Russell M.; Honkala, Barbara H., tech. coords. Silvics of North America: volume 1. Conifers. Agric. Handb. 654. Washington, DC: U.S. Department of Agriculture: 513-519.
Describes silvical characteristics of Virginia pine. Information on habitat, life history, and genetics is presented.

Cochard, Herve; Tyree, Melvin T. 1990. **Xylem dysfunction in *Quercus*: vessel sizes, tyloses, cavitation and seasonal changes in embolism.** Tree Physiology. 6: 393-407.
Seasonal progression of xylem dysfunction from tylose and embolism induced both by cavitation and frost was studied in red and white oak branches. Vessel lengths and diameters were measured in current-year rings of branches of various ages. Vessels in current-year shoots are about the same size as those in many diffuse porous trees, but vessels in older branches are 2 to 6 times larger in diameter and typically more than 10 times longer. Large *Quercus* vessels were more vulnerable to cavitation than vessels of comparable size in diffuse porous species. Earlywood vessels are completely blocked by tyloses within a year of their formation. Tylose growth starts in winter, but the vessels are not fully blocked until the next summer. By contrast, many latewood vessels remain free of complete blockage for several years.

Colbert, J. J.; Racin, G. E. 1990. **Gypsy moth life system model.** In: Zazueta, Fedro S.; Watson, Dennis G.; Botcher, A. B. (Del), eds. Proceedings of the 3rd international conference on computers in agricultural extension programs; 1990 January 31-February 1; Lake Buena Vista, (Orlando) FL. Gainesville, FL. University of Florida: 115-120.
Software that models the life system of gypsy moth is described. The model is designed to simulate the dynamics and interactions of gypsy moth, its hosts, and natural enemies in a forest stand over a number of years, with or without human intervention. Working hypotheses of gypsy moth researchers can be synthesized. Also described are the purpose and objectives of model construction, the history of its development, its structure and subsystems, and plans for testing and additional developments.

Corbett, Edward S.; Lynch, James A. 1990. **Current results from atmospheric deposition-related research--the Leading Ridge Experimental Watersheds.** In: Lynch, James A.; Corbett, Edward S.; Grimm, Jeffrey W., eds. Proceedings of the conference on atmospheric deposition in Pennsylvania. a critical assessment; 1989 September 11-14; University Park, PA. University Park, PA: The Pennsylvania State University: 82-84.

Cost, Noel D.; Howard, James O.; Mead, Bert; McWilliams, William H.; Smith, W. Brad; Van Hooser, Dwane D.; Wharton, Eric H. 1990. **The forest biomass resource of the United States.** Gen. Tech. Rep. WO-57. Washington, DC: U.S. Department of Agriculture, Forest Service. 21 p.
Presents biomass statistics focused on standards related to the timber component of the forest resource, since most users of forest resource data continue to think in terms of timber production. For the first time additional data have been compiled on the total forest resource, which includes all forest land areas regardless of productivity potential. It also includes stumps, foliage, seedlings, saplings, and shrubs.

Crang, Richard F. E.; Kuras, Mieczyslaw; McQuattie, Carolyn J. 1990. **The influence of lead at different concentration and pH on the ultrastructure of root cells from germinating soybean seeds.** In: Proceedings, 12th international congress for electron microscopy. [Place of publication unknown]: [Publisher name unknown]: 682-683.
Discusses the influence of lead on roots of germinating soybean seeds over the course of 48-hour treatments at atomic concentrations of 0.0, 250, 500, and 2,000 ppm.

Crawford, Hewlette S.; Jennings, Daniel T.; Stone, Timothy L. 1990. **Red-breasted nuthatches detect early increases in spruce budworm populations.** Northern Journal of Applied Forestry. 7: 81-83.
Early suppression of increasing spruce budworm populations is essential to prevent epidemics. However, early changes in budworm numbers are difficult to detect, so an effective and inexpensive method to detect early increases is needed. Red-breasted nuthatches eat more spruce budworm larvae and pupae as the insect increases in number. We estimated the number of large larvae in Maine and northern New Hampshire forest stands in 1982 and 1983 by determining the number of these larvae in the birds' stomachs. When the mean number of spruce budworm in the stomach approached 1.7, budworm populations were nearing high density and could be expected to cause severe defoliation the following year.

Cruiziat, Pierre; Tyree, Melvin T. 1990. **La montee de la seve dans les arbres.** La Recherche. 21(220): 406-414.

Davidson, Walter H. 1990. **Effects of superabsorbents on hybrid poplar establishment and growth.** In: 1990 national symposium on mining; 1990 May 14-18; Knoxville, TN. Lexington, KY: University of Kentucky: 27-29.
In 1983 a study was initated to determine whether superabsorbents enhanced the establishment and subsequent growth of hybrid poplar cuttings. The study was installed on three mine sites: one in southern West Virginia, and one in central West Virginia, and one in western Maryland. Fifteen hybrid poplar clones were used. The treatments were two types of superabsorbent and a control. The superabsorbents appeared to improve both establishment and growth, though none of the analyses showed significant differences. Variations within clones seemed to mask the effects of the superabsorbents.

Davidson, Walter H. 1990. **Wildflowers for reclamation.** In: Skousen, J.; Sencindiver, J.; Samuel, D., eds. Proceedings of the 1990 mining and reclamation conference and exhibition; 1990 April 23-26; Charleston, WV. Morgantown, WV: West Virginia University: 597. Abstract.

Davidson, Walter H.; Freeland, Albert W.; Elison, Bradley. 1990. **Successful oak establishment on a reclaimed surface mine.** In: Skousen, J.; Sencindiver, J.; Samuel, D., eds. Proceedings of the 1990 mining and reclamation conference and exhibition; 1990 April 23-26; Charleston, WV. Morgantown, WV: West Virginia University: 295-297.
An 8-year-old northern red oak plantation on a reclaimed anthracite surface mine in Pennsylvania was evaluated. Survival exceeded 70 percent and some of the saplings grew 2 feet or more each year. The tallest trees were 14 feet and the plantation averaged 8 feet. The absence of a heavy herbaceous cover, little or no soil compaction, good planting technique, and sufficient moisture contributed to good seedling establishment. The success of this plantation shows that red oak can survive and grow well on reclaimed minesoils.

deCalesta, David S. 1990. **Design of rodent and bird-proof exclosures.** Journal of the Pennsylvania Academy of Science. 63: 210.
Lack of a design of exclosures that would exclude mice, squirrels, chipmunks, and blue jays from plots led to the design of a rodent/bird proof enclosure. It consisted of 0.64-cm mesh hardware cloth fence, buried 15.25 cm underground and extending 76 cm above ground, enclosing a 3.6 x 3.6-m plot. The fence was supported on 2.5-m metal fenceposts driven 0.6 m into the ground. A sheet metal overhang was stapled to the top of the fence, preventing small mammals from climbing over the top. Bird netting (1.9-cm mesh) was draped over the fence from wires stretched around the upper perimeter of the fenceposts and attached to the fence. Mice and chipmunks were excluded by the fence without the netting. Squirrels and jays were excluded by the addition of the netting.

deCalesta, David S. 1990. **Factors influencing number of road-killed deer in Pennsylvania.** Journal of the Pennsylvania Academy of Science. 63: 210. Abstract.

Regression analysis was used to determine the nature and strength of the relationship between overwinter deer density and average daily vehicle miles on the Pennsylvania interstate system, and number of road-killed deer in Pennsylvania from 1982-88. Numbers of road-killed deer steadily increased over the last decade; 39,143 were reported killed in 1988, up from 24,699 in 1981. This increase is linearly and significantly related to increases in estimated overwinter deer density and average daily vehicle traffic miles on the Pennsylvania interstate system.

deCalesta, David S.; Witmer, Gary W. 1990. **Driveline census for deer within fenced enclosures.** Res. Pap. NE-643. Radnor, PA: U.S. Department of Agriculture, Forest Service, Northeastern Forest Experiment Station. 4 p.
A technique for conducting drive-line counts to obtain absolute numbers of deer within small (< 560 ha) areas is presented. Planning and layout of the drive and the organization of persons who make up the drive-line teams are discussed, and procedures for maintaining proper spacing and alignment of drivers are described. The key elements of a successful drive are organization and communication before and during the drive.

DeGraaf, Richard M.; Healy, William M., comps. 1990. **Is forest fragmentation a management issue in the Northeast?** Gen. Tech. Rep. NE-140. Radnor, PA: U.S. Department of Agriculture, Forest Service, Northeastern Forest Experiment Station. 32 p.
Presents six papers from the technical session sponsored by the wildlife and fish ecology working group at the Society of American Foresters' annual convention in 1988.

DeGraaf, Richard M.; Rudis, Deborah D. 1990. **Herpetofaunal species composition and relative abundance among three New England forest types.** Forest Ecology and Management. 32: 155-165.
Drift fences and pitfall traps captured more than 2,000 reptiles and amphibians during 2 years; the most common species were wood frog, American toad, and redback salamander. There were differences in species abundances among streamside and upland habitats within three forest cover types: northern hardwoods, red maple, and balsam fir. Among streamside stands, fewer individuals were captured in balsam fir. The two hardwood types supported the most species. Generally, more individuals were captured in upland than in streamside habitats.

Demeritt, Maruice E., Jr. 1990. **Poplar hybrids.** In: Burns, Russell M.; Honkala, Barbara H., tech. coords. Silvics of North America: volume 2. Hardwoods. Agric. Handb. 654. Washington, DC: U.S. Department of Agriculture: 577-582.
Describes silvical characteristics of poplar hybrids. Information on habitat, life history, and genetics is presented.

Dempsey, Gilbert P.; Luppold, William G. 1990. **Growth in the United States' markets for solid hardwood products.** In: Science in forestry: IUFRO's 2nd century; 19th world congress. Proceedings, IUFRO conference (vol. 4); 1990 August 5-11; Montreal, PQ. [Place of publication unknown]: Canadian IUFRO World Congress Organizing Committee: 262.

Dennis, Donald F. 1990. **A probit analysis of the harvest decision using pooled time-series and cross-sectional data.** Journal of Environmental Economics and Management. 18: 176-187.

Dennis, Donald F. 1990. **Factors influencing recreational use of private woodland.** Res. Note NE-341. Radnor, PA: U.S. Department of Agriculture, Forest Service, Northeastern Forest Experiment Station. 3 p.
Probit analysis was used to estimate relationships between the probability that forest land was used for recreation and characteristics of the forest, owner, and surrounding community. Land held by owners with more formal education or those reared in large cities was more likely to be used for recreation while the opposite was true for land held by older owners. Correlations are drawn with other studies and policy implications are discussed.

Dennis, Donald F. 1990. **Factors influencing posting of private nonindustrial forests in the Northeast.** In: More, Thomas A.; Donnelly, Maureen P.; Graefe, Alan R.; Vaske, Jerry J., eds. Proceedings of the 1990 northeastern recreation research symposium; 1990 February 25-28; Saratoga Springs, NY. Gen. Tech. Rep. NE-145. Radnor, PA: U.S. Department of Agriculture, Forest Service, Northeastern Forest Experiment Station: 191-194.
Analyzes the relationships between posting and both forest and ownership characteristics for 258 privately owned parcels in Vermont. The results

suggest that although much private forest is not currently posted, concern is warranted. Increases in forest fragmentation, residential construction, education levels and age of owners, and the percentage of professional landowners all point to additional posting of private lands.

Dennis, Donald F. 1990. **Using tobit analysis to model harvest behavior in the private sector.** In: Science in forestry: IUFRO's 2nd century; 19th world congress. Proceedings, IUFRO conference (vol. 4); 1990 August 5-11; Montreal, PQ. [Place of publication unknown]: Canadian IUFRO World Congress Organizing Committee: 263.

DiGiovanni, Dawn M. 1990. **Forest statistics for West Virginia--1975 and 1989.** Resour. Bull. NE-114. Radnor, PA: U.S. Department of Agriculture, Forest Service, Northeastern Forest Experiment Station. 172 p.
Statistical report on the fourth forest survey of West Virginia (1989). Findings are displayed in 119 tables containing estimates of forest area, number of trees, timber volume, tree biomass, and timber products output. Data are presented at three levels: state, geographic unit, and county.

DiGiovanni, Dawn M.; Scott, Charles T. 1990. **Forest statistics for New Jersey--1987.** Resour. Bull. NE-112. Radnor, PA: U.S. Department of Agriculture, Forest Service, Northeastern Forest Experiment Station. 97 p.
Statistical report on the third forest survey of New Jersey (1987). Findings are displayed in 66 tables containing estimates of forest area, numbers of trees, timber volume, tree biomass, and timber products output. Data are presented at both the state and county level.

Dochinger, L. S.; Jensen, K. F. 1990. **Quantifying foliar responses of white ash to ozone and simulated acid precipitation: an assessment proposal for forest exposure studies.** Res. Pap. NE-641. Radnor, PA: U.S. Department of Agriculture, Forest Service, Northeastern Forest Experiment Station. 4 p.
Seedlings represent an important linkage for assessing the effect of air pollution on forests. The foliar responses of white ash seedlings to ozone and acid precipitation as a means of identifying atmospheric deposition effects on forests are examined.

Dochinger, L. S.; Peacock, J. W.; Wright, S. L. 1990. **Impact of weevil feeding and pathogenic fungi on oak acorn and seedling survival.** In: VanSambeek, J. W.; Larson, M. M., eds 4th workshop on seedling physiology and growth problems in oak plantings; 1989 March 1-2; Columbus, OH. Gen. Tech. Rep. NC-139; St. Paul, MN: U.S. Department of Agriculture, Forest Service, North Central Forest Experiment Station: 15. Abstract.

Elkinton, J. S.; Liebhold, A. M. 1990. **Population dynamics of gypsy moth in North America.** Annual Review of Entomology. 35: 571-596.
Summarizes current knowledge about the population dynamics of the gypsy moth, emphasizing research that has been done since the last major review in 1981. Also included are some of the earlier studies to provide the appropriate framework for more recent studies.

Federer, C. Anthony. 1990. **Change, persistence, and error in thirty years of hydrometeorological data at Hubbard Brook.** In: Greenland, David; Swift, Lloyd W., Jr., eds. Climate variability and ecosystem response. Proceedings of a long-term ecological research workshop; 1988 August 21-23; Boulder, CO. Gen. Tech. Rep. SE-65. Asheville, NC: U.S. Department of Agriculture, Forest Service, Southeastern Forest Experiment Station: 3-12.
Daily precipitation, air temperature, and solar radiation data have been collected on the USDA Forest Service's Hubbard Brook Experimental Forest, New Hampshire, for more than 30 years. A tradeoff occurs between cost and accuracy. Various instrument errors can make real climatic variation difficult to detect. Periods of above or below "normal" temperature or precipitation persist for up to several years, but their ecosystem effect probably is slight.

Federer, C. Anthony; Flynn, Louise D.; Martin, C. Wayne; Hornbeck, James W.; Pierce, Robert S. 1990. **Thirty years of hydrometeorologic data at the Hubbard Brook Experimental Forest, New Hampshire.** Gen. Tech. Rep. NE-141. Radnor, PA: U.S. Department of Agriculture, Forest Service, Northeastern Forest Experiment Station. 44 p.
Summarizes and interprets hydrologic and meteorologic data collected at the USDA Forest Service's Hubbard Brook Experimental Forest. Data are included on precipitation, streamflow, air temperature, solar radiation, humidity, windspeed and direction, soil temperature, snow, and soil frost. These variables have been measured on or near eight

small gauged watersheds since 1956, and form the basis of extensive research studies on cycling of water, energy, and nutrients in a northern hardwood forest.

Fleischer, S. J.; Ravlin, F. W.; Delorme, D.; Stipes, R. J.; McManus, M. L. 1990. **Marking gypsy moth (*Lepidoptera: Lymantriidae*) life stages and products with low doses of rubidium injected or implanted into pin oak.** Journal of Economic Entomology. 83(6): 2343-2348.
Systemic introduction of rubidium into pin oaks at low doses (25 and 50 g RbCl per tree) and water volumes was tested by four techniques: injection into flare roots with a pressurized cylinder, injection into flare roots with a syringe, injection into tree boles with a syringe, and implants into flare roots. Injection of solutions resulted in faster uptake into foliage than implantation of a crystalline solid. Foliar rubidium concentrations peaked 1 to 3 weeks after treatment. Flare root injection with a syringe of a 50 percent RbCl solution resulted in higher foliar rubidium concentrations that did not decline as quickly as with other techniques. Gypsy moth larvae were allowed to feed on foliage from treated trees. All gypsy moth life stages, frass, and pupal exuviae collected from all but the 25-g RbCl pressurized cylinder treatment held rubidium concentrations significantly higher than controls.

Flowers, J. C.; Hassler, C. C.; Luppold, W. G. 1990. **Utilization of yellow-poplar in the architectural moulding and millwork industry.** Forest Products Journal. 40(10): 35-38.
Results of a survey mailed to architectural millwork companies concerning the use of yellow-poplar are presented. The average firm used nearly 64,000 board feet of yellow-poplar per year. About 90 percent of the yellow-poplar lumber purchased for the manufacture of architectural millwork by the average firm is top grade (i.e., firsts and seconds or one-face). Mouldings account for 48 percent of the demand for yellow-poplar. Extensive lists are supplied of yellow-poplar millwork products that offer potential as well as those that have caused problems. The current use of yellow-poplar seems to be limited by the material's reputation for dimensional instability and by the omission of yellow-poplar in specifications by architects.

Frank, Robert M. 1990. **Balsam fir.** In: Burns, Russell M.; Honkala, Barbara H., tech. coords. Silvics of North America: volume 1. Conifers. Agric. Handb.

654. Washington, DC: U.S. Department of Agriculture: 26-35.
Describes silvical characteristics of balsam fir. Information on habitat, life history, and genetics is presented.

Frieswyk, Thomas S.; DiGiovanni, Dawn M. 1990. **Biomass statistics for Maryland--1986.** Resour. Bull. NE-113. Radnor, PA: U.S. Department of Agriculture, Forest Service, Northeastern Forest Experiment Station. 138 p.
Statistical report on the fourth forest survey of Maryland (1986). Findings are displayed in 97 tables containing estimates of forest area, tree biomass, and timber volume. Data are presented at both the state and country level.

Funk, David T. 1990. **European alder.** In: Burns, Russell M.; Honkala, Barbara H., tech. coords. Silvics of North America: volume 2. Hardwoods. Agric. Handb. 654. Washington, DC: U.S. Department of Agriculture: 105-115.
Describes silvical characteristics of European alder. Information on habitat, life history, and genetics is presented.

Furnival, George M.; Gregoire, Timothy G.; Valentine, Harry T. 1990. **An analysis of three methods for fitting site-index curves.** Forest Science. 36(2): 464-469.
The analysis of covariance method, the method of algebraic differences with all possible differences, and the method of weighted parameter prediction are shown to be identical for fitting a site-index equation that can be transformed into a simple linear model. Results of the analysis apply to both anamorphic and polymorphic systems, which are linear in the parameters.

Gabriel, William J. 1990. **Black maple.** In: Burns, Russell M.; Honkala, Barbara H., tech. coords. Silvics of North America: volume 2. Hardwoods. Agric. Handb. 654. Washington, DC: U.S. Department of Agriculture: 46-52.
Describes silvical characteristics of black maple. Information on habitat, life history, and genetics is presented.

Gabriel, William J. 1990. **Silver maple.** In: Burns, Russell M.; Honkala, Barbara H., tech. coords. Silvics of North America: volume 2. Hardwoods. Agric. Handb. 654. Washington, DC: U.S. Department of Agriculture: 70-77.

Describes silvical characteristics of silver maple. Information on habitat, life history, and genetics is presented.

Gabriel, William J.; Walters, Russell S. 1990. **Striped maple.** In: Burns, Russell M.; Honkala, Barbara H., tech. coords. Silvics of North America: volume 2. Hardwoods. Agric. Handb. 654. Washington, DC: U.S. Department of Agriculture: 53-59.
Describes silvical characteristics of striped maple. Information on habitat, life history, and genetics is presented.

Galford, Jim; Williams, Roger. 1990. **Laboratory culture of the nitidulids** *Stelidota octomaculata* **and** *S. ferruginea* **on acorns.** FRASS Newsletter. 13(1): 3. Abstract.

Gansner, David A.; Arner, Stanford L.; Birch, Thomas W. 1990. **Estimating timber value growth rates in New England.** In: Science in forestry: IUFRO's 2nd century: 19th world congress. Proceedings, IUFRO conference (vol. 4); 1990 August 5-11; Montreal, PQ. [Place of publication unknown]: Canadian IUFRO World Congress Organizing Committee: 105. Abstract.

Gansner, David A.; Arner, Stanford L.; Birch, Thomas W. 1990. **Timber value growth rates in New England.** Res. Pap. NE-632. Radnor, PA. U.S. Department of Agriculture, Forest Service, Northeastern Forest Experiment Station. 14 p.

Gansner, David A.; Arner, Stanford L.; Zarnoch, Stanley J. 1990. **Timber value growth rates in Maine.** Northern Journal of Applied Forestry. 7: 62-64.

Gansner, David A.; Birch, Thomas W.; Arner, Stanford L.; Zarnoch, Stanley J. 1990. **Cutting disturbance on New England timberlands.** Northern Journal of Applied Forestry. 7(3): 118-120.
Recently completed forest inventories and woodland owner surveys for each of the six New England States have given us insight into contemporary harvesting activities in the region. About half of the private woodland owners have harvested timber from their holdings at some time in the past. Still, timber harvesting continues to be a fairly concentrated activity. Remeasured plot data indicate that only 30 percent of the timberland had cutting disturbance between the last two inventories. And two-thirds of the cutting took place on one-tenth of the

timberland. New England's woodlands appear to be in relatively good shape. Physical supplies of timber reveal a potential opportunity for significant expansion in wood use.

Gansner, David A.; Widmann, Richard H. 1990. **Enough white ash for wooden bats?** Northern Logger. 38(10): 32-33.

Gansner, David A.; Widmann, Richard H.; DiGiovanni, Dawn M. 1990. **New West Virginia timber inventory reveals storehouse of economic potential.** National Woodlands. 13(3): 24-25.
West Virginia ranks behind Maine and New Hampshire as the third most densely forested state in the Nation. About 12 million acres, or 79 percent, of its total land area are forested. Preliminary results of the new inventory of West Virginia show that forest land has increased by 500,000 acres (4 percent) since the last survey in 1975. Virtually all of the resource is capable of producing commercial crops of timber. Timberland now accounts for more than 60 percent of the total land area in 48 of West Virginia's 55 counties. West Virginia has 19 billion cubic feet of growing-stock volume, a 37-percent increase over 1975.

Gatchell, Charles J. 1990. **Predicting strip width distributions from gang ripsaw setups.** Forest Products Journal. 40(1): 50-52.
A few saw spacings can be set in thousands of different sequences on a conventional gang ripsaw arbor. A procedure for predicting the effects of specified spacings on strip width distributions is described. Probability tables that are easily developed are used with a knowledge of the length and width distributions of the input lumber. The procedure is illustrated with an analysis of a sample of No. 1 and No. 2 Common lumber.

Gatchell, Charles J. 1990. **No. 1 and No. 2 Common red oak yields: similar part sizes when gang-ripping is used to process boards with crook.** Res. Pap. NE-636. Radnor, PA: U.S. Department of Agriculture, Forest Service, Northeastern Forest Experiment Station. 7 p.
Computer simulation was used to gang rip No. 1 and No. 2 Common red oak boards before and after the removal of crook. While No. 1 Common produced slightly more total yield, the part yields were similar. No. 1 Common was superior only in yielding 75-inch-long pieces. Either grade is an excellent choice for the furniture and cabinet industries.

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Gatchell, Charles J. 1990. **The effect of crook on yields when processing narrow lumber with a fixed arbor gang ripsaw.** Forest Products Journal. 40(5): 9-17.

Today's hardwood lumber resource is narrow and 22 percent of all kiln-dried boards may have one-half inch or more of crook or side bend. This could present a serious obstacle to the adoption of gang ripping as the initial lumber breakdown step. Among the negative effects of crook found in this study of fixed-arbor gang ripping are: 1) a decrease in the amount of primary yield; 2) an increase in the amount of salvage yield and work; 3) an increase in the importance of saw space sequencing; 4) an increase in the amount of salvage yield in long, thin pieces; and 5) a decrease in the total yield. Removing crook by an initial crosscut before gang ripping will result in yields that are mostly primary; reduce the need for extensive salvage operations; limit salvage to short, narrow pieces; and make the saw space sequence unimportant.

Gatchell, Charles J. 1990. **Increase the value of low-grade hardwood lumber by gang ripping first: a research progress report.** In: Wang, S. Y.; Tang, R. C., eds. Proceedings of the 1990 joint international conference on processing and utilization of low-grade hardwood and international trade of forest-related products; 1990 June 11-13; Taipei, Taiwan. [Place of publication unknown]: National Taiwan University and Auburn University: 233-242.

Crosscut-first rough mills cannot convert low-grade hardwood lumber to furniture and cabinet parts economically. Automated processing using vision systems and laser cutting is somewhere in the future. A third procedure, gang ripping, can be used to satisfy the needs of the furniture and cabinet industries using No. 2 Common lumber at one-half the price of No. 1 Common lumber.

Geballe, Gordon T.; Smith, William H.; Wargo, Philip M. 1990. **Red spruce seedling health: an assessment of acid fog deposition and heavy metal soil contamination as interactive stress factors.** Canadian Journal of Forest Research. 20: 1680-1683.

Two-year-old spruce seedlings were exposed to 12 treatment regimes of acid fog deposition and heavy metal soil amendment over a 2-year period. Seedling health was assessed by measuring five health indices: general vigor, height, diameter, bud number, and biomass (leaf, stem, and twig, and total). Soil was amended with cadmium, copper, lead, manganese, nickel, and zinc added in

amounts comparable to high-elevation forest soils in the Northeastern United States. Seedlings were also treated with simulated fog (ionic chemistry similar to high-elevation northeastern fog events.) adjusted to pH 3 or 5. The seedlings were planted in metal-amended soil and subjected to fog treatments in greenhouse chambers from August 6, 1986, to October 29, 1987, in weekly regimes of 30 h exposures. Of all the seedling stress factors imposed, only the lead amendment at 2,000 ppm concentration, which is approximately 10 times the current ambient forest floor high-elevation level, had a consistently adverse impact on the seedling health parameters measured.

Glass, Ronald J.; More, Thomas A.; Stevens, Thomas H. 1990. **Public attitudes, politics and extramarket values for reintroduced wildlife: examples from New England.** In: Transactions of the 55th North American wildlife and natural resources conference; [Place of publication unknown]. Washington, DC: Wildlife Management Institute: 548-557.

Extramarket values and related attitudes are examined for two species reintroduced to New England: the bald eagle and the wild turkey.

Glass, Ronald J.; Muth, Robert M.; Flewelling, Robert. 1990. **Distinguishing recreation from subsistence in a modernizing economy.** In: Vining, Joanne, ed. Social science and natural resource recreation management. Boulder, CO: Westview Press: 151-166.

Examines the conceptual bases of both subsistence and recreation, and considers the appropriateness of traditional precepts within the context of a relatively affluent, modernizing economy. Harvest and sociodemographic data are examined for the community of Yakutat in southeast Alaska.

Glass, Ronald J.; Muth, Robert M.; Flewelling, Robert. 1990. **Subsistence as a component of the mixed economic base in a modernizing community.** Res. Pap. NE-638. Radnor, PA: U.S. Department of Agriculture, Forest Service, Northeastern Forest Experiment Station. 9 p.

The mixed economic base of a modernizing rural community is examined with emphasis on the interrelationships between personal use of natural resources and other sectors of the economy.

Godman, Richard M.; Yawney, Harry W.; Tubbs, Carl H. 1990. **Sugar maple.** In: Burns, Russell M.; Honkala, Barbara H., tech. coords. Silvics of North

America: volume 2. Hardwoods. Agric. Handb. 654. Washington, DC: U.S. Department of Agriculture: 78-91.
Describes silvical characteristics of sugar maple. Information on habitat, life history, and genetics is presented.

Gottschalk, Kurt W. 1990. **Economic evaluation of gypsy moth damage in the United States of America.** In: Science in forestry: IUFRO's 2nd century; 19th world congress. Proceedings, IUFRO conference (vol. 4); 1990 August 5-11; Montreal, PQ. [Place of publication unknown]: Canadian IUFRO World Congress Organizing Committee: 235-246.
The positive, negative, or neutral ecological changes resulting from gypsy moth defoliation and mortality following outbreaks together with economic values and the impact on management objectives are discussed. Both timber and nontimber values are considered. Economic analyses can be used to help make decisions on pest management actions.

Gottschalk, Kurt W. 1990. **Gypsy moth effects on mast production.** In: McGee, Charles E., ed. Proceedings of the workshop: southern Appalachian mast management; 1989 August 14-16; Knoxville, TN. Knoxville, TN: University of Tennessee: 42-50.
Defoliation effects on acorn production range from reductions of 50 to 100 percent in the years during outbreaks. Losses are due to decreased flowers and abortion of seed due to low carbohydrate supply. The effect of oak mortality on acorn production ranges from small increases to large losses depending on the level of mortality. Mortality levels that exceed 60 percent significantly reduce acorn production. Shifts in species composition reduce mast yields in the long-term.

Gregoire, Timothy G.; Furnival, George M.; Valentine, Harry T. 1990. **A sampling procedure for board-foot volume of standing trees.** In: LaBau, Vernon J.; Cunia, Tiberius, tech. eds. State-of-the-art methodology of forest inventory: a symposium proceedings; 1989 July 30-August 5; Syracuse, NY. Gen. Tech. Rep. PNW-263. Portland, OR: U.S. Department of Agriculture, Forest Service, Pacific Northwest Forest and Range Experiment Station: 228-236.
A sampling procedure is presented that uses a taper function to provide approximate volumes in board feet of the logs in a standing tree. Logs are then sampled with probability proportional to approximate volume to estimate the board-foot volume of the tree. Variations in the determination of the number of logs in the tree and in the scaling procedures applied to selected logs are discussed. The performance of the sampling procedure is examined when it is applied to 223 yellow-poplar trees whose actual volumes are known from stem-analysis information.

Gregoire, T. G.; Scott, C. T. 1990. **Sampling at the stand boundary: a comparison based on mean square error of seven methods.** In: Science in forestry: IUFRO's 2nd century; 19th world congress. Proceedings, IUFRO conference (vol. 4); 1990 August 5-11; Montreal, PQ. [Place of publication unknown]: Canadian IUFRO World Congress Organizing Committee: 39.

Gregoire, Timothy G.; Scott, Charles T. 1990. **Sampling at the stand boundary: a comparison of the statistical performance among eight methods.** In: Burkhart, Harold E.; Bonnor, G. M.; Lowe, J. J.; eds. Research in forest inventory, monitoring, growth and yield; 1990 August 5-11; Montreal, PQ. Publ. FWS-3-90. Blacksburg, VA: Virginia Polytechnic Institute and State University, School of Forestry and Wildlife Resources: 78-85.
Mapped locations of 4,676 trees on two contiguous tracts were used to access the bias and mean square error of eight methods of handling the bias that results if neither the sampling nor estimation accounts for the altered probability of selection of trees near the stand boundary. A fixed-area circular plot was used with all methods, and total tree frequency, basal area, and volume were estimated.

Halverson, Howard G. 1990. **Qualitative assessment of mined land recovery by remote sensing.** In: Protecting natural resources with remote sensing: proceedings of the 3rd Forest Service remote sensing application conference; 1990 April 9-13; Tucson, AZ. Bethesda, MD: American Society for Photogrammertry and Remote Sensing: 392-398.
The Airborne Science and Applications Program sponsored an ER-2 aircraft photography mission in eastern Kentucky in 1989. Six flight lines were flown over the Redbird Ranger District of the Daniel Boone National Forest. The Redbird District is in the eastern Kentucky coal region and has a long history of mining.

Halverson, Howard G.; Gentry, Claude E. 1990. **Long-term leaching of mine spoil with simulated precipitation.** In: Skousen, J.; Sencindiver, J.;

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Samuel, D., eds. Proceedings of the 1990 mining and reclamation conference and exhibition; 1990 April 23-26; Charleston, WV. Morgantown, WV: West Virginia University: 27-32.

Fresh mine spoil at a pH of 3.84 was collected and transferred to leachate columns in early August 1988. The spoil was leached weekly with simulated precipitation at pH values of 5.6, 5.0, 4.6, 4.2, and 3.8. Control samples of mine spoil were simultaneously leached with distilled water at a pH of 6.47. Leachate was collected and analyzed by standard methods for cations, anions, conductivity, and pH. Cations and anions of major interest were iron, aluminum, manganese, and sulfate. The leachate initially was pH 2.1, with a conductivity of about 10,000 micromho and had concentrations of Fe, Al, Mn, and SO_4 greater than 4,000, 300, 400, and 24,000 mg/L, respectively. After 4 weeks, pH increased slightly to 2.2, conductivity declined to about 7,000, and the ionic concentrations declined to averages of 1,300 for Fe, 170 for Al, 175 for Mn, and 16,000 for SO_4. In the following weeks, contamination in the leachate continued to decline but at a lesser rate. At 20 weeks, pH remained near the 2.0 to 2.2 level; conductivity continued to decline to 4,500; and the Mn at 35, and SO_4 at 3,800 mg/L. After 46 weeks, the concentrations in the leachate had declined to lower levels. The leachate pH held steady at a value of about 2.1 and conductivity declined to 3,500. Ionic concentrations were Fe at 70, Al at 20, Mn at 6, and SO_4 at 900 mg/L.

Halverson, Howard G.; Sidle, Roy C. 1990. **Cumulative effects of mining on hydrology, water quality, and vegetation.** In: Skousen, J.; Sencindiver, J.; Samuel, D., eds. Proceedings of the 1990 mining and reclamation conference and exhibition; 1990 April 23-26; Charleston, WV. Morgantown, WV: West Virginia University: 97. Abstract.

Hansen, Bruce; Luppold, William. 1990. **Changing European market offers opportunities for U.S. exporters.** Import/Export Wood Purchasing News. June/July.

Healy, William M. 1990. **Symposium summary: looking toward 2000.** In: Healy, William M.; Healy, Georgette B., eds. Proceedings of the 6th national wild turkey symposium; 1990 February 26-March 1; Charleston, SC. Edgefield, SC: National Wild Turkey Federation: 224-228.

National wild turkey symposia provide a record of turkey restoration and the development of concepts about habitat requirements. Research in the next decade should focus on developing a unified theory of habitat use and a better understanding of population dynamics. Trap-and-transfer programs will continue to be important for population restoration for managing existing populations. It is estimated that turkey hunters spent about $567 million in 1989. The popularity of turkey hunting and innovations in hunting equipment will challenge hunter education programs.

Heisler, Gordon M. 1990. **Tree plantings that save energy.** In: Rodbell, Philip D., ed. Proceedings of 4th urban forestry conference; 1989 October 15-19; St. Louis, MO. Washington, DC: American Forestry Association. 257 p.

Initial estimates suggest that windbreak and shade effects of existing trees save approximately 0.5 percent of energy used annually in the United States. This figure might be doubled with added trees and more use of energy-conserving site design and maintenance. Tree crowns can be located where they will provide shade on buildings in warm times and little shade when it is cold. Carefully designed plantings can increase reductions of winter winds relative to reductions of summer winds. Research has developed useful general-guidelines for tree planting to save energy. This information should be communicated to urban foresters, landscape architects and homeowners.

Helvey, J. D.; Kochenderfer, J. N. 1990. **Soil density and moisture content on two unused forest roads during first 30 months after construction.** Res. Pap. NE-629. Radnor, PA: U.S. Department of Agriculture, Forest Service, Northeastern Forest Experiment Station. 6 p.

Reports results of soil density and soil moisture measurements on two roads in the central Appalachians over a 30-month period. Density increased slightly during the measurement period of most locations. Almost all of the density changes occurred during the first few months after construction. Moisture content decreased during the first few months after construction, then fluctuated with precipitation amounts.

Hiremath, S. T.; Fikes, M.; Carr, M. B. 1990. **Regulation of expression of hemolymph proteins by juvenile hormons analog in gypsy moth (*Lymantria dispar*) larvae. The FASEB Journal.** 4(7): 2344. Abstract.

Hix, D. M.; Fosbroke, D. E.; Hicks, R. R., Jr.; Gottschalk, K. W. 1990. **Effects of gypsy moth defoliation on regeneration of Appalachian plateau and ridge and valley hardwood stands.** In: Are forests the answer? Proceedings of the 1990 Society of American Foresters national convention; 1990 July 29-August 1; Washington, DC. SAF Publ. 90-02. Bethesda, MD: Society of American Foresters: 585-586. Poster.

Examines the effects of gypsy moth defoliation on hardwood stand regeneration in the Appalachian Plateau and Ridge and Valley physiographic provinces.

Hornbeck, James W. 1990. **Cumulative effects of intensive harvest, atmospheric deposition, and other land use activities.** In: Dyck, W. J.; Mees, C. A., eds. Proceedings, impact of intensive harvesting on forest site productivity. IEA/BE A3 workshop, South Island, New Zealand, 1989 March; IEA/BE T6/A6 Rep. FRI Bull. No. 159. Rotorua, New Zealand: Forest Research Institute: 147-154.

Research on nutritional consequences of intensive harvesting should include cumulative effects of other activities on the harvest site. Data and information from studies in the Northeastern United States are used to illustrate cumulative effects of whole-tree clearcutting, atmospheric deposition, and past land use. Whole-tree clearcutting of a spruce-fir forest in Maine generated about 45,000 eq H/ha compared with an estimated 58,000 eq/ha added in wet and dry deposition over a 65-year rotation. Acid precipitation is thought largely responsible for annual net losses of cations shown by input-output budgets. Net leaching losses over a rotation plus removals in harvested products can represent 1,300 to 2,300 kg Ca/ha or 20 to 40 percent of soil Ca capitals. An estimated additional 1.000 kg Ca/ha was lost from many presently forested sites when the land was cleared for crops or grazing in the 1800's.

Hornbeck, J. W.; Smith, C. T.; Martin, C. W.; Tritton, L. M.; Pierce, R. S. 1990. **Effects of intensive harvesting on nutrient capitals of three forest types in New England.** Forest Ecology and Management. 30: 55-64.

Effects of whole-tree clearcutting are being studied in three major forest types in the Northeastern States: a spruce-fir forest in central Maine, a northern hardwood forest in New Hampshire, and a central hardwood forest in Connecticut. Sampled at each site were total and extractable nutrient capitals, inputs and outputs of nutrient ions in precipita-

tion and streamflow, nutrient removals in harvested products, and nutrient accumulation in regrowth. Depending on location, combined losses of nutrients in harvested products and increased leaching to streams ranged from 374 to 558 kg/ha for Ca, 135 to 253 kg/ha for K, 50 to 65 kg/ha for Mg, 248 to 379 kg/ha for N, and 19 to 54 kg/ha for P. Opportunities for replacing these losses over the next rotation are best for N. Data on inputs in precipitation versus outputs in streamflow indicate that once effects of harvest subside, most N in precipitation will stay within the forest. By contrast, Ca shows a net output of 8 to 15 kg/ha/year from uncut watersheds.

Horsley, Stephen B. 1990. **Tank mixing roundup with adjuvants and other herbicides for striped maple control.** Northern Journal of Applied Forestry. 7(1): 19-22.

The possibility of increasing Roundup® activity on striped maple was evaluated by tank mixing 1 qt/acre of Roundup with one of eight adjuvants or other herbicides and comparing each tank mix with Roundup alone. Control of striped maple was evaluated 1 and 2 years after treatment. Two years were required to obtain the full effect of the treatments. Spray distribution in tree crowns was an important factor in determining herbicide effectiveness. Trees 10 to 20 feet tall that received the main air blast of herbicide spray had the highest kill. None of the tank mixes resulted in control that was significantly better than Roundup alone. Tank mixes of Roundup with either Sorbicide Herbicide Adjuvant or 2,4-D significantly reduced control of striped maple.

Horsley, Stephen B. 1990. **Control of grass and sedge in Allegheny hardwood stands with roundup-residual herbicide tank mixes.** Northern Journal of Applied Forestry. 7(3): 124-129.

Houston, David R.; Allen, Douglas C.; Lachance, Denis. 1990. **Sugarbush management: a guide to maintaining tree health.** Gen. Tech. Rep. NE-129. Radnor, PA: U.S. Department of Agriculture, Forest Service, Northeastern Forest Experiment Station. 55 p.

Many pests and other stresses affect maple trees growing in a sugarbush. Some pests can markedly reduce sap quantity, others, although conspicuous, are not important. Stresses can result from activities by people and from natural phenomena. Recognizing problems and understanding the factors that contribute to their occurrence, development, and significance are necessary to maintain tree health.

This report brings together current information on the living agents and nonliving factors that can cause problems in sugarbushes. Insects, diseases, improper forest stand management, and unwise sugaring practices are illustrated, and ways to prevent or reduce their effects are described.

Houston, David R.; Houston, Daniel B. 1990. **Genetic mosiacs in American beech: patterns of resistance and susceptibility to beech bark disease.** Phytopathology. 80(1): 119-120. Abstract.

Jennings, Daniel T.; Carniglia, Charles K.; DeLand, Loren F. 1990. **Development of an automated counter for egg masses of spruce budworms.** Tech. Bull. 1770. Washington, DC: U.S. Department of Agriculture, Forest Service. 23 p.
Describes the design and development of a machine that detects and automatically counts egg masses of the eastern and western spruce budworms. The machine evolved from basic discoveries of egg-mass fluorescence, from the use of the "blacklight technique" to improve accuracy and efficiency of foliage examinations, and from an illumination and detection system developed at the University of Maine.

Jennings, Daniel T.; Dimond, John B.; Watt, Bruce A. 1990. **Population densities of spiders (araneae) and spruce budworms (lepidoptera, tortricidae) on foliage of balsam fir and red spruce in east-central Maine.** Journal of Arachnology. 18: 181-193.
Spiders of 10 families, 17 genera, and at least 22 species were collected from crown foliage samples of balsam fir and red spruce in east-central Maine. Species of web spinners were more prevalent (68.2 percent of total species) among branch samples (N = 613 branches) than species of hunters (31.8 percent). Mean species per site (N = 8 sites) was 7.6 + 1.2. Numbers, life stages, and sex ratios of spiders differed between tree species; sex ratios were biased in favor of females. Spider densities per m^2 of foliage area generally were greater on red spruce than on balsam fir but sampling intensity was important. For intensely sampled sites, overall mean densities of spruce budworms/m^2 of foliage were not significantly different between tree species.

Jennings, Daniel T.; Vander Haegen, W. Matthew; Narahara, Annie M. 1990. **A sampling of forest-floor spiders (*Araneae*) by expellant, Moosehorn National Wildlife Refuge, Maine.** Journal of Arachnology. 18: 173-179.
Spiders of 14 families, 34 genera, and at least 36 species were collected by formalin extraction from sublitter habitats of the forest floor, Moosehorn National Wildlife Refuge, Washington County, Maine, in 1987. Species per family ranged from one to seven; the Erigonidae had the richest representation with 19.4 percent of all species. Most species (64 percent) were represented by sexually mature spiders, the ratio of female to male spiders was 3.2:1. Species of web-spinning spiders outnumbered species of hunting spiders 2 to 1.

Jensen, Keith F.; Loats, Kenneth V. 1990. **Responses of black and white oak seedlings to atmospheric deposition and water stress.** In: VanSambeek, J. W.; Larson, M. M., eds. 4th workshop on seedling physiology and growth problems in oak plantings; 1989 March 1-2; Columbus, OH. Gen. Tech. Rep. NC-139; St. Paul, MN: U.S. Department of Agriculture, Forest Service, North Central Forest Experiment Station: 6. Abstract.

Jensen, K. F.; Patton, R. L. 1990. **Response of yellow-poplar (*Liriodendron tulipifera* L.) seedlings to simulated acid rain and ozone. 1. Growth modifications.** Environmental and Experimental Botany. 30: 59-66.
One-year-old yellow-poplar seedlings were exposed to 0.0, 0.05, 0.1, or 0.2 ppm ozone (O_3) for 8 hours on each of 3 consecutive days. On day 4 they were treated with 1.25 cm of simulated rain at a pH of 3.0, 4.0, or 5.5. The plants were placed on a greenhouse bench for the remainder of the week. This procedure was repeated each week from late May until mid-October. Seedlings were harvested on 15 July, 1 September, and 15 October, and leaf area, leaf weight, new-growth weight, and height were determined. Both O_3 and rain acidity had an impact on growth. At the second harvest, only acidity had an impact on growth; in general, growth increased with a decrease in acidity. At the first and third harvests, O_3 alone or in combination with rain acidity affected growth. Growth decreased with an increase in O_3 concentration or a decrease in the acidity.

Kochenderfer, James N.; Edwards, Pamela J. 1990. **Design and construction of a low-cost stream-monitoring shelter.** Gen. Tech. Rep. NE-135. Radnor, PA: U.S. Department of Agriculture, Forest

Service. Northeastern Forest Experiment Station. 10 p.

The design and construction of a low-cost stream-monitoring shelter are discussed. Currently in use on the Fernow Experimental Forest in West Virginia, the shelter creates an environment for efficient sampling and chemical monitoring of small streams while protecting expensive equipment from weather extremes and damage from wildlife and vandals. Data accuracy and completeness with this shelter have exceeded levels obtained with other kinds of shelter.

Kochenderfer, J. N.; Edwards, P. J.; Helvey, J. D. 1990. **Land management and water yield in the Appalachians.** In: Watershed planning and analysis in action: symposium proceedings of IR conference; 1990 July 9-11; Durango, CO. New York: American Society of Civil Engineers: 523-532.

Watershed treatments on the Fernow Experimental Forest have included individual tree selection, commercial clearcutting, clearcutting upper and lower halves of watersheds, clearcutting all trees greater than 1 inch d.b.h., and maintaining clearcut watersheds barren with herbicides for several consecutive years. The paired watershed approach was used to compare each treatment watershed to a control watershed. Water yield was directly related to the percent of vegetation removed. Yield increases were greatest during the growing season.

Lamson, Neil I. 1990. **Red mulberry.** In: Burns, Russell M.; Honkala, Barbara H., tech. coords. Silvics of North America: volume 2. Hardwoods. Agric. Handb. 654. Washington, DC: U.S. Department of Agriculture: 470-473.

Describes silvical characteristics of red mulberry. Information on habitat, life history, and genetics is presented.

Lamson, Neil I. 1990. **Sweet birch.** In: Burns, Russell M.; Honkala, Barbara H., tech. coords. Silvics of North America: volume 2. Hardwoods. Agric. Handb. 654. Washington, DC: U.S. Department of Agriculture: 148-152.

Describes silvical characteristics of sweet birch. Information on habitat, life history, and genetics is presented.

Lamson, Neil I.; Smith, H. Clay; Perkey, Arlyn W.; Brock, Samuel M. 1990. **Crown release increases growth of crop trees.** Res. Pap. NE-635. Radnor,

PA: U.S. Department of Agriculture, Forest Service. Northeastern Forest Experiment Station. 8 p.

Two Appalachian hardwood stands in north-central West Virginia were thinned. The principal species were red oak, yellow-poplar, and chestnut oak. For both stands the site index for northern red oak averaged 75 feet. An areawide thinning using "basal-area control" was applied to a 54-year-old stand while specific crop trees were selected and released in a 12-year old stand. Individual-tree 5-year growth of codominant trees and crop trees was related to number of sides of the crown that was free-to-grow. Codominant trees and crop trees grew about 25 percent more in d.b.h. than similar trees released on one or two sides of the crown. For best diameter growth response, a tree should be released on at least three and preferably four sides of the crown.

LeDoux, Chris B. 1990. **Determining the economic feasibility of salvaging gypsy moth-killed hardwoods.** Forest Products Journal. 40(5): 43-46.

Oak sawlog and pulpwood losses in stands defoliated by gypsy moths have become a critical problem for some forest landowners. The salvage of gypsy moth-killed hardwoods can become an important source of pulpwood and sawlogs. A method and guidelines for determining defoliated oak stands that are economically salvageable are presented. Stand data from 574 defoliated oak stands were integrated with stump-to-mill logging costs and wood values. Cable and ground-based logging costs were integrated with three levels of sawlog and pulpwood-fuelwood prices to determine if salvage would be economical. The data and methodology were used to develop feasibility matrices for red, white, chestnut, scarlet, and black oak. Results indicate that most profitable salvage operations will be those in stands with high volumes, a valuable species mix and a large component of grade logs on gentle ground and that are close to the mill.

LeDoux, Chris B.; Baumgras, John E. 1990. **Cost of wetland protection using cable logging systems.** In: Managing forestry operations in a changing environment: proceedings of the 13th annual meeting of the Council on Forest Engineering; 1990 August 12-16; Outer Banks, NC. Raleigh, NC: North Carolina State University: 38-43.

Forest managers, loggers, land use planners, and other decisionmakers need an understanding of estimating the cost of protecting wetlands using cable logging systems to harvest timber products. Results

suggest that protection costs can range from $244.75 to $489.50 per acre depending on the degree of protection desired.

Lee, Wong S.; Chevone, Boris I.; Seiler, John R. 1990. **Growth response and drought susceptibility of red spruce seedlings exposed to simulated acidic rain and ozone.** Forest Science. 36(2): 265-275.
One-year-old red spruce seedlings were exposed to O_3 in combination with simulated rain for 10 weeks. After pollutant treatments, seedlings were subjected to two successive drought cycles. Whole-plant fresh weight increment (FWT) and dry weight were reduced after O_3 exposure, whereas FWT and shoot height growth were increased after simulated rain exposure at pH 3.0 compared to pH 5.6. No interaction between O_3 and rain treatments was observed for any growth variable measured. Foliar concentrations of K and S were greater in seedlings exposed to simulated rain at pH 3.0 compared with those at pH 5.6.

Li, H. G.; Schreuder, H. T.; Scott, C. T. 1990. **Combining estimates that are both in error subject to marginal constraints.** Canadian Journal of Forest Research. 20: 1675-1679.

Liebhold, Andrew M.; Elkinton, Joseph S. 1990. **Models of the spatial dynamics of epidemic gypsy moth populations.** In: Population dynamics of forest insects; 1989 September 25-29; Edinboro, Scotland. Andover, Hampshire, UK: Intercept Ltd.: 359-367.
Several statistical techniques have been developed for characterizing static and dynamic spatial patterns of gypsy moth. Several such statistical methods were applied to characterize historical defoliation records and to simulate hypothesized mechanisms of outbreak spread.

Liebhold, Andrew M.; Halverson, Joel A.; Elmes, Gregory A. 1990. **Use of a GIS to analyze and predict gypsy moth range expansion.** In: Proceedings of the 1990 annual gypsy moth review; 1990 October 23-25; Ottawa, ON. [Place of publication unknown]: [Publisher name unknown]: 222-227.
A model of future gypsy moth range expansion based on historical data was developed largely through the use of a geographical information system (GIS). This investigation demonstrates the power of GIS for studying landscape ecological processes.

Liebhold, Andrew M.; Halverson, Joel A.; Elmes, Gregory A. 1990. **Using GIS to describe and analyze gypsy moth spatial dynamics.** In: Proceedings, resource technology 90, 2nd international symposium on advanced technology in natural resources management; 1990 November 12-15; Washington, DC. Washington, DC: Georgetown University Conference Center: 684-692.
Historical data on the spread of gypsy moth through North America was assembled in a geographic information system (GIS). These data, along with climatological data, were used to develop a model that predicts future expansion of the gypsy moth's range.

Little, Silas; Garrett, Peter W. 1990. **Pitch pine.** In: Burns, Russell M.; Honkala, Barbara H., tech. coords. Silvics of North America: volume 1. Conifers. Agric. Handb. 654. Washington, DC: U.S. Department of Agriculture: 456-462.
Describes silvical characteristics of pitch pine. Information on habitat, life history, and genetics is presented.

Little, Silas; Garrett, Peter W. 1990. **Atlantic white-cedar.** In: Burns, Russell M.; Honkala, Barbara H., tech. coords. Silvics of North America: volume 1. Conifers. Agric. Handb. 654. Washington, DC: U.S. Department of Agriculture: 103-108.
Describes silvical characteristics of Atlantic white-cedar. Information on habitat, life history, and genetics is presented.

Luloff, A. E.; Schmidt, F. E.; Echelberger, H. E. 1990. **Attitudes and resource use: a study of north country citizens.** In: More, Thomas A.; Donnelly, Maureen P.; Graefe, Alan R.; Vaske, Jerry J., eds. Proceedings of the 1990 Northeastern recreation research symposium; 1990 February 25-28; Saratoga Springs, NY. Gen. Tech. Rep. NE-145. Radnor, PA: U. S. Department of Agriculture, Forest Service, Northeastern Forest Experiment Station. 203-207.
This paper reports on an analysis of attitudes and patterns of resource use of residents of Vermont and New Hampshire's northern counties. Solid waste disposal, population growth and the preservation of agricultural land, and the impacts of development upon lakeshores, wildlife, and rivers and streams were identified as the most serious community problems. This information is then used, along with sociodemographic data, in a multivariate analysis of differences in outdoor recreation use.

Luppold, William; Hanson, Bruce; Jen, I-an. 1990. **Revised estimates of U.S. hardwood exports to the Pacific Rim, 1980 to present.** In: Wang, S. Y.; Tang, R. C., eds. Proceedings of the 1990 joint international conference on processing and utilization of low-grade hardwood and international trade of forest-related products; 1990 June 11-13; Taipei, Taiwan. [Place of publication unknown]: National Taiwan University and Auburn University: 407-412. Official U.S. hardwood log and lumber export statistics significantly overestimated export volumes in the mid- to late-1980's. Errors in the data were due to the failure of computer programs to keep up with rising export prices and poor documentation. Estimates by the U.S. Department of Commerce's Bureau of the Census, old and revised, are compared with data developed from ocean freight ship manifests and Japanese and Taiwanese import statistics.

Lynch, James A.; Corbett, Edward S. 1990. **Management of source areas for water quality and quantity.** In: Majumdar, Shyamal K.; Miller, E. Willard; Parizek, Richard R., eds. Water resources in Pennsylvania: availability, quality and management. Philadelphia, PA: The Pennsylvania Academy of Science: 499-517.
Forest cover approximately 57 percent of the land surface in Pennsylvania, much of which serves as source areas for municipal water supplies. By the year 2020, the demand for water produced from these forests is expected to increase significantly. Part of this increase may be accounted for by vegetation management. While acknowledging the opportunities for forest management in helping to solve problems of water supply, it must be recognized that source-area management provides no solution as some management objectives are hydrologically incompatible with others.

Lynch, James A.; Corbett, Edward S. 1990. **Atmospheric deposition in Pennsylvania: a critical assessment (summary).** In: Lynch, James A.; Corbett, Edward S.; Grimm, Jeffrey W., eds. Proceedings of the conference on atmospheric deposition in Pennsylvania: a critical assessment; 1989 September 11-14; University Park, PA. University Park, PA: The Pennsylvania State University: 181.

Lynch, James A.; Corbett, Edward S.; Grimm, Jeffrey W., eds. 1990. **Atmospheric deposition in Pennsylvania: a critical assessment.** Proceedings, conference on atmospheric deposition in Pennsylvania: a critical assessment, 1989 September 11-14; University Park, PA. University Park, PA: The Pennsylvania State University: 181 p.

MacMahon, James A.; Chambers, Jeanne C.; Wade, Gary L. 1990. **Successional processes: importance for obtaining and evaluating reclamation success.** In: Skousen, J.; Sencindiver, J.; Samuel D., eds. Proceedings of the 1990 mining and reclamation conference and exhibition; 1990 April 23-26; Charleston, WV. Morgantown, WV: West Virginia University: 93. Abstract.

Marquis, David A. 1990. **Black cherry.** In: Burns, Russell M.; Honkala, Barbara H., tech. coords. Silvics of North America: volume 2. Hardwoods. Agric. Handb. 654. Washington, DC: U.S. Department of Agriculture: 594-604. Describes silvical characteristics of black cherry. Information on habitat, life history, and genetics is presented.

Martens, David G. 1990. **Don't overlook hardwood flooring.** Southern Lumberman. May: 45-47.
Discusses the hardwood flooring industry, which comprises four major segments: strip, parquet, plank, and laminated flooring.

Martin, C. Wayne; Hornbeck, James W. 1990. **Regeneration after strip cutting and block clearcutting in northern hardwoods.** Northern Journal of Applied Forestry. 7: 65-68.
Regeneration was studied during the first 10 years after clearcutting on two sites in the northern hardwood forest of New Hampshire. One site was a 12-ha block clearcut; the other was a 36-ha progressive strip cut harvested in three phases using 25-m-wide strips which approximated one tree height. Permanent plots on each site were measured at intervals of 1 to 4 years. Changes in the density and biomass of the major commercial species and their primary noncommercial competitors are presented. At 10 years after clearcutting, yellow birch was the most common tree on the block clearcut; sugar maple was most numerous on the strip cut. Pin cherry dominated the biomass on the block clearcut and the strips first cut (1970), but yellow birch and sugar maple biomass was greater on the strips cut later (1972 and 1974).

McGraw, James B.; Gottschalk, Kurt W.; Vavrek, Milan C.; Chester, A. L. 1990. **Interactive effects of resource availabilities and defoliation on photo-**

synthesis, growth, and mortality of red oak seedlings. Tree Physiology. 7(1-4): 247-254.
Responses of forest trees to defoliation by insects such as gypsy moth vary greatly from site to site and from individual to individual. To determine whether some of this variation could be explained by variation in other stress factors, red oak seedlings were exposed to low and high light, water, mineral nutrient, and defoliation treatments. Significant interactions were observed among factors for photosynthesis, growth, and mortality, indicating that the response to defoliation was influenced by other stresses. Defoliation increased the photosynthetic capacity per unit leaf area of seedlings grown in the low-water but not in the high-water regime.

McQuattie, C. J.; Schier, G. A. 1990. **Response of red spruce seedlings to aluminum toxicity in nutrient solution: alterations in root anatomy.** Canadian Journal of Forest Research. 20: 1001-1011.
One-year-old red spruce were grown for 37 days in a nutrient solution containing 0, 50, 100, or 200 mg/L Al. No macroscopic evidence of Al injury was observed in the shoots of seedlings; however, Al toxicity symptoms were well developed in the roots. Aluminum reduced root length but increased root diameter and the number of cell layers in the root cap. Light and electron microscopic examination of root tips and segments 5 to 10 mm from the tip revealed numerous cellular changes in Al-stressed roots; premature vacuolation, accumulation of phenolicke material, loss of cells from peripheral cell layers, formation of intercellular spaces, increased disruption of cellular membranes, and degeneration of the cytoplasm.

Melhuish, J. H., Jr.; Gentry, C. E.; Beckjord, P. R. 1990. *Paulownia tomentosa* **seedling growth at differing levels of pH, nitrogen, and phosphorus.** Journal of Environmental Horticulture. 8(4): 205-207.
This study examined the effects of various levels of acidity, nitrogen, and phosphorus on the survival and growth of *Paulownia tomentosa* seedlings. The seedlings grew within a pH range of 7.0 to 4.0, but there was little or no growth at pH 3.0. The seedlings grew well with nitrogen at 50 to 200 ppm and phosphorus at 5 ppm, but growth was greatly reduced below 10 ppm nitrogen.

Melhuish, J., Jr.; Wong, B.; Hildebrand, D. 1990. **Fatty acid content of mycorrhizal and non-mycorrhizal loblolly pine seedlings at low and high nitrogen concentrations.** In: Proceedings, 8th North American conference on mycorrhizae; innovation and hierarchical integration; 1990 September 5-8; Jackson, WY. Laramie, WY: University of Wyoming: 205. Abstract.
Mycorrhizal and non-mycorrhizal loblolly pines were grown for 4 months on a standard nutrient solution with N at 20 ppm. They were treated for 1 month at 0, 20, 100, 200, or 500 ppm N and a complete nutrient compliment minus N or distilled water. The seedlings were harvested and separated into roots, stems, and needles. Fatty acid methyl esters from each seedling component were prepared by transmethylation in a sulfuric acid and methanol solution and the resulting methyl esters were analyzed by gas chromatography. The roots and stems of mycorrhizal and non-mycorrhizal seedlings maintained a similar fatty acid pattern for all treatments, but the needles of the mycorrhizal and non-mycorrhizal seedlings showed a difference between low (0 and 20 ppm) and high (100, 200, and 500 ppm) levels of N in that the concentration of unsaturated fatty acids increased.

Melhuish, J. H., Jr.; Wong, B. L.; McQuattie, C. J. 1990. **A culture unit system for the study of responses of mycorrhizal and non-mycorrhizal seedlings to treatments.** Plant and Soil. 129: 157-163.
The culture unit described was designed to provide a method whereby the experimental condition of the substrate solution cna be maintained or manipulated while retaining the axenic integrity of the system. The culture unit was equipped with a modified polypropylene lid allowing entry and exit of treatment solutions that had been previously sterilized. Loblolly pine inoculated by *Pisolithus tinctorius* (Pers.) Coker and Couch was grown axenically for up to 6 months in this culture unit system. Growth of roots and mycorrhizal morphology in this system were similar to those observed in other systems.

Montgomery, Michael E. 1990. **Role of site and insect variables in forecasting defoliation by the gypsy moth.** Population Dynamics of Forest Insects (Chapter 7): 73-84.

More, Thomas A. 1990. **Factors affecting the productivity of urban parks.** Res. Pap. NE-630. Radnor, PA: U.S. Department of Agriculture, Forest Service, Northeastern Forest Experiment Station. 7 p.

The park system of two Massachusetts cities—Holyoke (pop. 44,819) and Fitchburg (pop. 39,332)—produced an estimated 605,608 visitor-hours of use during the summer of 1979. The average park produced 7,877 visitor-hours in Holyoke and 9,624 in Fitchburg, though use varied widely. Contrary to original expectations, neighborhood characteristics had little influence on use levels. Rather, park characteristics, particularly activities and amenities, had a significant effect on use.

More, Thomas A.; Donnelly, Maureen P.; Graefe, Alan R.; Vaske, Jerry J., eds. 1990. **Proceedings of the 1990 northeastern recreation research symposium;** 1990 February 25-28; Saratoga Springs, NY. Gen. Tech. Rep. NE-145. Radnor, PA: U.S. Department of Agriculture, Forest Service, Northeastern Forest Experiment Station. 207 p.
Contains 33 papers on recreation in the 1990's; outdoor recreation; travel, tourism, and community development; monitoring recreation systems; fisheries and wildlife management; beach and lake management; and northern forest management.

More, Thomas A.; Echelberger, Herbert E.; Koenemann, Edward J. 1990. **Factors affecting recreation participation by Vermont residents.** Res. Pap. NE-631. Radnor, PA: U.S. Department of Agriculture, Forest Service, Northeastern Forest Experiment Station. 7 p.
Long-term recreation planning requires an understanding of recreation participation patterns. Vermonters' participation in 27 leisure activities from three domains (outdoor, resource based, and indoor) was examined to see how such participation differed in each domain. Indoor activities were the most popular, followed by resource-based activities and general outdoor activities. Overall participation declined with age, though this effect was mitigated somewhat for older parents. Other socioeconomic and demographic variables had limited effects on participation.

More, Thomas A.; Glass, Ronald J. 1990. **Profiling Vermont trappers.** Human Dimensions in Wildlife Newsletter. 9(3): 20-22.
To learn more about trapping and trappers in Vermont, the USDA Forest Service, in cooperation with the Vermont Department of Fish and Wildlife, surveyed 293 randomly selected individuals who had trapped during 1988. Questionnaires concerning trapper effort, motivations, satisfactions, characteristics, and views about changing trapping environ-

ments were mailed in August 1989. The response rate was 51.5 percent.

More, Thomas A.; Glass, Ronald J.; Stevens, Thomas H. 1990. **The economics of wildlife reintroduction.** In: More, Thomas A.; Donnelly, Maureen P.; Graefe, Alan R.; Vaske, Jerry J., eds. Proceedings of the 1990 northeastern recreation research symposium; 1990 February 25-28; Saratoga Springs, NY. Gen. Tech. Rep. NE-145. Radnor, PA: U.S. Department of Agriculture, Forest Service. Northeastern Forest Experiment Station: 125-131.
Economic values associated with wildlife include personal use value and such extramarket values as option value and several forms of existence values. These values were examined for three species recently reintroduced into New England: the bald eagle, the wild turkey, and the Atlantic salmon. Results suggest that economic values, particularly existence values, are substantial for these species.

Murrimer, Edward C.; DiGiovanni, Dawn M.; Widmann, Richard; Gansner, David A. 1990. **West Virginia's fourth forest inventory.** The Forum. West Virginia Forestry Association (Spring): 5-7.

Northeastern Forest Experiment Station. 1990. **Publications of the Northeastern Forest Experiment Station--1988.** Gen. Tech. Rep. NE-136. Radnor, PA: U.S. Department of Agriculture, Forest Service, Northeastern Forest Experiment Station. 28 p.
Annotated list of publications of Northeastern Forest Experiment Station scientists and cooperators in 1988.

Northeastern Forest Experiment Station. 1990. **Gypsy moth research and development program.** Radnor, PA: U.S. Department of Agriculture, Forest Service, Northeastern Forest Experiment Station. 29 p.

Nolley, Jean W. 1990. **Bulletin of hardwood market statistics: fall 1989.** Gen. Tech. Rep. NE-137. Radnor, PA: U.S. Department of Agriculture, Forest Service, Northeastern Forest Experiment Station. 41 p.
Provides current and historical information on primary and secondary hardwood product production, prices, international trade, and employment.

Nolley, Jean W. 1990. **Bulletin of hardwood market statistics: winter 1989.** Gen. Tech. Rep. NE-139.

Radnor, PA: U.S. Department of Agriculture, Forest Service, Northeastern Forest Experiment Station. 41 p.

Provides current and historical information on primary and secondary hardwood product production, prices, international trade, and employment.

Nolley, Jean W. 1990. **Bulletin of hardwood market statistics: spring 1990.** Gen. Tech. Rep. NE-142. Radnor, PA: U.S. Department of Agriculture, Forest Service, Northeastern Forest Experiment Station. 43 p.

Provides current and historical information on primary and secondary hardwood product production, prices, international trade, and employment.

Nolley, Jean W. 1990. **Bulletin of hardwood market statistics: summer 1990.** Res. Note NE-342. Radnor, PA: U.S. Department of Agriculture, Forest Service, Northeastern Forest Experiment Station. 207 p.

Provides current and historical information on primary and secondary hardwood product production, prices, international trade, and employment.

Nowak, David J. 1990. **Street tree pruning and removal needs.** Journal of Arboriculture. 16(12): 309-315.

Street-tree pruning and removal needs were examined for 11 species from inventory data collected in 11 cities in the North Central and Northeastern United States. The needs ranged from predominantly no pruning and routine pruning of small trees to safety pruning and removal of large trees. Species were ranked in terms of overall pruning and removal urgency, with London planetree and honeylocust having the least urgent pruning and removal needs and American elm and boxelder the most urgent needs.

Nowak, David J. 1990. **Height-diameter relations of maple street trees.** Journal of Arboriculture. 16(9): 231-235.

Height and diameter measurements were taken for silver, sugar, and Norway maple street trees in Rochester and Syracuse, New York. Mature silver maples proved to be the tallest of the three species. Average height of sugar maple was consistently taller than that of Norway maple until diameters reached 28 inches. Average height of mature trees for all three species leveled off in the mid to upper 70-foot range. Estimates of tree age were derived from the literature. After age 35, silver maple seems

to dominate the maples with respect to tree height. Height-diameter and height-approximate age curves are given.

Nowak, David J. 1990. **USDA Forest Service research on urban forests.** In: Trees for Texas cities: proceedings of the 4th annual Texas urban forestry conference; 1990 May 9-11; Houston, TX. [Place of publication unknown]: [Publisher name unknown]: 8. Abstract.

Nowak, David J.; Rowntree, Rowan A. 1990. **History and range of Norway maple.** Journal of Arboriculture. 16(11): 291-296.

The Norway maple was introduced into the United States about 1756 after being cultivated in England since 1683. This species remained in relative obscurity in the United States until the mid to late-1800's, but is now one of the most popular urban trees. In certain regions of the United States, Norway maple dominates street-tree populations and commonly escapes to compete with native species. The extensive use of this species in North America has led to various problems across its new range. Some of these problems may be overcome by future introductions from its native range in Eurasia.

ODell, Thomas M. 1990. **Gypsy moth: a quiet neighbor about to Novemberize our June landscape. What are our options?** Habitat. 9(1): 10-11.

Outlines five steps for mitigating the impact of gypsy moth on natural resources and public health. The process avoids "crisis" management, which can create more environmental and community stress than the gypsy moth.

Percy, K. E.; Krause, C. R.; Jensen, K. F. 1990. **Effects of ozone and acidic fog on red spruce needle epicuticular wax ultrastructure.** Canadian Journal of Forest Research. 20: 117-120.

The effect of ozone and acidic fog on the epicuticular wax structure of elongating red spruce was examined. Needle exposure to 70 and 250 ppb ozone for 11 weeks resulted in a coalescence of crystalline tube ends within epistomatal chambers. Exposure to acid fog at pH 3.0 resulted in the formation of amorphous wax deposits over the existing tubes within the epistomatal chambers. New structures consisting of upright, irregular wax plates were observed in nonstomatal areas on needles exposed to pH 3.0 fog. These findings indicate that ozone and acid fog applied at near ambient doses can alter

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epicuticular wax ultrastructure on elongating red spruce needles.

Peters, Penn A. 1990. **Simple formula for the average skid distance of a rectangle.** Northern Journal of American Forestry. 7(4): 196.

Peters, P. A. 1990. **The load curve intercept method: estimating the effect of average piece size on skidding cost.** Transactions of the ASAE. 33(4): 1391-1401.
The load curve intercept method is a general method for analyzing systems whose load characteristics are constrained by the number of pieces and the maximum volume. The method is used to explain the effect of average piece size on skidding production and cost.

Peters, Penn A. 1990. **Logging fatalities and injuries due to felling trees.** In: Proceedings of 1990 international winter meeting of American Society of Agriculture Engineers; 1990 December 18-21; Chicago, IL. St. Joseph, MI: American Society of Agricultural Engineers.
Logging may be the most dangerous occupation and felling trees with a chain saw is the most dangerous of logging activities. The major cause of felling fatalities are a hangup fell (26 percent), poor felling technique (15 percent), butt rebound (11 percent), broken limbs or tops (11 percent), working too close (11 percent), a snag fell (8 percent), and struck from behind (5 percent). Felling into standing timber, a general category that includes hangup fell, snag fell, butt rebound, and broken limbs or tops, accounted for 56 percent of the felling fatalities. Compliance with the proposed Occupational Safety and Health Administration safety standard would improve the safety record for the causes of a hangup fell, working too close, poor felling technique, and a snag fell.

Peters, Penn A.; Nieuwewnhuis, Maarten A. 1990. **Optimum spur road layout near a forest boundary line.** Journal of Forest Engineering. 1(2): 3-7.
A simple method for determining the optimum length of spur roads and spacing in the vicinity of a forest boundary line is presented along with sample problems.

Racin, G. E. 1990. **Small embankment design using expert system and object oriented programming.** In: Zazereta, Fedro S.; Watson, Dennis G.; Botcher, A. B., eds. Proceedings of the 3rd international conference on computers in agricultural extension programs; 1990 January 31-February 1; Lake Buena Vista (Orlando), FL. Gainesville, FL: University of Florida: 111-114.
Describes software used to design small embankments using an expert system that incorporates object-oriented programming. With engineering criteria and design principles specified in the form of objects and embedded in rules, the flow of control is determined by the frequent evaluation of the data configuration. The expert system software requires watershed and site information. Methods (written in C) are attached to objects and produce CAD drawing files of the final embankment layout. The software operates within the LASER expert system shell.

Rast, Everette D.; Beaton, John A.; Sonderman, David L. 1990. **Photographic guide of selected external defect indicators and associated internal defects in yellow-poplar.** Res. Pap. NE-646. Radnor, PA: U.S. Department of Agriculture, Forest Service, Northeastern Forest Experiment Station. 29 p.
To properly classify or grade logs or trees, one must be able to correctly identify defect indicators and assess the effect of the underlying defect on possible end products. This guide assists the individual in identifying the surface defect indicator and shows the progressive stages of the defect throughout its development for yellow-poplar. Twelve types of external defect indicators and associated defects that are particularly difficult to evaluate are illustrated and described.

Rast, Everette D.; Beaton, John A.; Sonderman, David L. 1990. **Photographic guide of selected external defect indicators and associated internal defects in sugar maple.** Res. Pap. NE-647. Radnor, PA: U.S. Department of Agriculture, Forest Service, Northeastern Forest Experiment Station. 35 p.

Rast, Everette D.; Beaton, John A.; Sonderman, David L. 1990. **Photographic guide of selected external defect indicators and associated internal defects in yellow birch.** Res. Pap. NE-648. Radnor, PA: U.S. Department of Agriculture, Forest Service, Northeastern Forest Experiment Station. 25 p.

Rexrode, Charles O.; Smith, H. Clay. 1990. **Occurrence of gum spots in black cherry after partial harvest cutting.** Res. Pap. NE-634. Radnor, PA:

U.S. Department of Agriculture, Forest Service, Northeastern Forest Experiment Station. 7 p.

Bark beetles, primarily the bark beetle Phisosotribus liminori (Harris), are the major cause of gum spots in sawtimber-size black cherry. About 90 percent of all gum spots in the bole sections are caused by bark beetles. Gum spots were studied in 95 black cherry trees near Parsons, West Virginia. More than 50 percent of the bark beetle-caused gum spots occurred during the first 2 years following partial harvest cuts.

Roberts, Bruce R.; Schnipke, Virginia M.; Barger, Jack H. 1990. **Ethylene evolution and membrane permeability in red maple foliage fumigated with acute sulfur dioxide.** Horticultural Science. 25(5): 560-561.

Two-year-old seedlings of red maple were fumigated with SO_2 (0.0, 0.5, 2.0, and 4.0 ppm) 8 hours daily for two 3-day periods spaced 3 days apart. Response to acute SO_2 stress was determined by measuring changes in ethylene biosynthesis and membrane permeability. Ethylene evolution was a useful indicator of the onset of SO_2 stress in red maple, but was not a particularly good indicator of the degree of stress. Membrane permeability was not as sensitive to the initial stages of SO_2 stress, and significant changes in permeability were noted only at higher concentrations of this pollutant.

Rossiter, Marycarol; Yendol, William G.; Dubois, Normand R. 1990. **Resistance to *Bacillus thuringiensis* in gypsy moth (*Lepidoptera: Lymantriidae*): genetic and environmental causes.** Journal of Economic Entomology. 83(6): 2211-2218.

Second-instar gypsy moths from three wild populations and one laboratory population were challenged with *Bacillus thuringiensis* subspecies *kurstaki:*(HD-1 strain), which was incorporated into synthetic diet at concentrations ranging from 10 to 295 international units (IU) per ml. Susceptibility among the 16 to 19 families within each of the four populations varied significantly. Families within a population had variable regression coefficients. Significant variation in LC_{50}'s suggested the potential for resistance development through natural selection. There was significant variation among populations: the average LC_{50}'s for three wild populations and the laboratory strain were 76, 106, 121, and 180 IU/ml diet, respectively. Variation in B. *thuringiensis* susceptibility within families were measured by comparing LC_{50}'s of siblings from eggs of an egg

mass laid first versus laid last. Differential egg provisioning among eggs of a single mother yielded offspring with differential sensitivities to B. *thuringiensis*; the LC_{50} of larvae from eggs laid first versus those laid last averaged 401 IU/ml diet and 211 IU/ml diet, respectively.

Safford, L. O.; Bjorkbom, John C.; Zasada, John C. 1990. **Paper birch.** In: Burns, Russell M.; Honkala, Barbara H., tech. coords. Silvics of North America: volume 2. Hardwoods. Agric. Handb. 654. Washington, DC: U.S. Department of Agriculture: 158-171.

Describes silvical characteristics of paper birch. Information on habitat, life history, and genetics is presented.

Schier, George A. 1990. **Response of yellow-poplar (*Liriodendron tulipifera* L.) seedlings to simulated acid rain and ozone. 2. Effect on throughfall chemistry and nutrients in the leaves.** Environmental and Experimental Botany. 30: 325-331.

Each year, 1-year-old yellow-poplar seedlings grown in a greenhouse were fumigated with 0.0, 0.05, 0.1, or 0.2 ul/l ozone (O_3) for 8 hours on 3 consecutive days and treated once with 1.25 cm simulated acid rain of pH 5.5, 4.0, and 3.0. Effects of O_3 and acid rain on throughfall chemistry after 16 weeks of treatment and on mineral elements in the foliage of seedlings harvested on September 1 were determined. Except for K, the concentration of elements detected in throughfall (K, Ca, Mg, Fe, and Zn) grew with increasing acidity of the rain solution. Foliar leaching of mineral elements by pH 3.0 rain was increased by high levels of O_3. The concentration of most elements in yellow-poplar leaves was affected by O_3 or rain acidity. Rains of high acidity increased the concentrations of N, P, K, Ca, and Mn in seedling leaves. Ozone increased the concentration of Mn, Fe, and Zn; the concentration of Mn showed the greatest response to treatment with O_3 or acid rain.

Schier, George A.; McQuattie, Carolyn J.; Jensen, Keith F. 1990. **Effect of ozone and aluminum on pitch pine (*Pinus rigida*) seedlings: growth and nutrient relations.** Canadian Journal of Forestry Research. 20(11): 1714-1719.

Newly germinated pitch pine seedlings inoculated with the mycorrhizal fungus *Pisolithus tinctorius* (Pers.) Coker & Couch were grown for 13 weeks in sand irrigated with nutrient solution (pH 4.0) con-

taining 0, 12.5, 25, 50, or 100 mg/L of Al in growth chambers fumigated with 0, 50, 100, or 200 ppb ozone. Increasing the concentration of ozone or Al caused increasing reductions in needle length, seedling height, and biomass of needles, stems, and roots. Significant ozone X Al interactions indicated that ozone and Al were interacting synergistically in reducing growth. Effect of treatments on the root/shoot ratio demonstrated that shoot growth was more sensitive to Al than root growth, whereas root growth was more sensitive to ozone.

Scott, C. T. 1990. **TALLY: general data entry software for portable data recorders.** In: Adlord, Philip; Rondeux, Jacques, eds. Proceedings of the joint IUFRO workshop; 1989 April 3-5; Gembloux, Belgium. [Place of publication unknown]: International Union of Forestry Research Organizations: 133-138. Describes the TALLY software system that collects data for a variety of applications on a single data recorder, checks all data for errors as they are entered, and transfers data from the data recorder for further processing. TALLY is easy to use, making it ideal for large, continuing applications such as inventory or growth and yield studies, and has the flexibility needed for small, one-time research applications.

Scott, Charles T. 1990. **An overview of fixed versus variable-radius plots for successive inventories.** In: LaBau, Vernon J.; Cunia, Tiberius, tech. eds. State-of-the-art methodology of forest inventory: a symposium proceedings; 1989 July 30-August 5; Syracuse, NY. Gen. Tech. Rep. PNW-263. Portland, OR: U.S. Department of Agriculture, Forest Service, Pacific Northwest Forest and Range Experiment Station: 97-104. Since Bitterlich introduced point or variable-radius sampling in 1947, many investigators have compared it with fixed-area sampling for estimation of current attributes. A partial review of the literature that compares the two methods is given for successive or continuous forest inventories. The sampling methods are described in the areas of field implementation, components of change estimation, comparison methods used, and efficiency for both current and change estimates.

Scott, Charles T. 1990. **Computers in the field.** Forest Farmer. 49(3): 8-10.

Scott, Charles T.; Alegria, James. 1990. **Fixed-versus variable-radius plots for change estimation.** In: LaBau, Vernon J.; Cunia, Tiberius, tech. eds. State-of-the-art methodology of forest inventory: a symposium proceedings; 1989 July 30-August 5; Syracuse, NY. Gen. Tech. Rep. PNW-263. Portland, OR: U.S. Department of Agriculture, Forest Service, Pacific Northwest Forest and Range Experiment Station: 126-132. Much forestry literature has focused on fixed-area versus variable-radius plots for estimation of current forest characteristics. Variable-radius samples were found to be most efficient for current basal-area and volume estimates, but much controversy arose over their efficiency for change estimation. As an empirical test of the cost effectiveness of each method, 14.8-foot plots were compared with 26.5-ft^2/acre basal-area factor plots. Each pair was remeasured after 12 or 13 years and detailed cost measurements recorded for all aspects of the survey. With the exception of removals, fixed-area plots were more cost effective than variable-radius plots for all attributes involving number of trees. Fixed-area plots also were more efficient for basal-area and volume estimation of ingrowth and mortality, and the estimation of net change and net growth of basal area.

Shortle, Walter C. 1990. **Ionization of wood during previsual stages of wood decay.** Biodeterioration Research. 3: 333-348.

Shortle, Walter C.; Minocha, Rakesh. 1990. **Applications of ion chromatography to study pollution effects on forest trees.** In: Jandik, Petr; Cassidy, Richard M., eds. Advances in ion chromatography, vol. 2. Medfield, MA: Century International: 299-309. Demonstrates how ion chromatography can be applied to the analysis of extracts from stemwood of red spruce trees, an important forest tree species of the Eastern United States. Widespread growth declines of red spruce may be linked to acid deposition. Results of tissue analysis of red spruce are compared with those of red maple and balsam fir.

Shortle, Walter C.; Smith, Kevin T. 1990. **Decay column boundary layer formation in maple.** Biodeterioration Research. 3: 377-389. Sugar maple and red maple trees provide excellent experimental material for the study of wound responses due to the production of easily visible wound-initiated discoloration and a discrete, visibly distinct column boundary layer that separates the

discolored wood from health sapwood. The objective of this research was to determine: (1) the sequence in which the discolored wood and the column boundary layer are derived from sapwood during the initial phases of column development and how wound treatments alter the initial phases of development; and (2) whether the process of column development is consistent with either concept that limits wound-initiated discoloration and the decay process.

Shortle, W. C.; Smith, K. T. 1990. **The vulnerability of adult Picea rubens is related to sites varying in atmospheric deposition of polutants.** In: Science in forestry: IUFRO's 2nd century; 19th world congress. Proceedings, IUFRO conference (vol. 5); 1990 August 5-11; Montreal, PQ. [Place of publication unknown]: Canadian IUFRO World Congress Organizing Committee: 61.

Sinclair, Steven A.; Trinka, Mark W.; Luppold, William G. 1990. **Ready-to-assemble furniture: marketing and material use trends.** Forest Products Journal. 40(3): 35-40.
An exploratory study of ready-to-assemble (RTA) furniture producers was undertaken to better understand the importance of this industry in terms of sales growth, marketing practices, and material use trends. Sales growth has been rapid: sales increased by 224 percent from 1986 to 1987 and by 17 percent from 1987 to 1988.

Smith, H. Clay. 1990. **Mockernut hickory.** In: Burns, Russell M.; Honkala, Barbara H., tech. coords. Silvics of North America: volume 2. Hardwoods. Agric. Handb. 654. Washington, DC: U.S. Department of Agriculture: 226-233.
Describes silvical characteristics of mockernut hickory. Information on habitat, life history, and genetics is presented.

Smith, H. Clay. 1990. **Cucumbertree.** In: Burns, Russell M.; Honkala, Barbara H., tech. coords. Silvics of North America: volume 2. Hardwoods. Agric. Handb. 654. Washington, DC: U.S. Department of Agriculture: 433-438.
Describes silvical characteristics of cucumbertree. Information on habitat, life history, and genetics is presented.

Smith, H. Clay. 1990. **Bitternut hickory.** In: Burns, Russell M.; Honkala, Barbara H., tech. coords. Silvics of North America: volume 2. Hardwoods. Agric.

Handb. 654. Washington, DC: U.S. Department of Agriculture: 190-197.
Describes silvical characteristics of bitternut hickory. Information on habitat, life history, and genetics is presented.

Smith, K. T.; Shortle, W. C. 1990. **IAA oxidase, peroxidase, and barrier zone formation in red maple.** European Journal of Forestry Pathology. 20: 241-246.
Wounding the cambium of red maple altered peroxidase isoenzymes and enhanced the activities of peroxidase and indole-3-acetic acid oxidase in homogenates of adjacent cambial tissue. Four separate experiments were conducted in May and July in each of two successive years. Wounds made in July caused greater increases in enzyme activity than those made in May. Alterations in peroxidase isoenzyme pattern were consistent for all experiments.

Smith, Paul M.; West, Cynthia D. 1990. **A cross-national investigation of competitive factors affecting the United States wood furniture industry.** Forest Products Journal. 40(11/12): 39-48.
Few wood products industries in the United States have felt the competitive pressures from the globalization of their markets as much as the furniture industry. In 1978, imports claimed only 6.6 percent of the U.S. consumption of wood household furniture. By 1986, they had reached 26.6 percent of consumption. Globalization of an industry is an evolutionary process that is likely to become prevalent. The secondary wood products industry in the United States has largely been protected from foreign competitors because of its established position within the domestic market, abundance of raw materials, and certain transportation barriers. However, future strategies for this industry should be developed that consider global competition a possibility if not a reality. This paper examines the position of U.S. furniture producers within a global industry by examining important strategic issues and alternative strategies facing competitors in a global industry.

Smith, Robert B.; Hornbeck, James W.; Federer, C. Anthony; Krusic, Paul J., Jr. 1990. **Regionally averaged diameter growth in New England forests.** Res. Pap. NE-637. Radnor, PA: U.S. Department of Agriculture, Forest Service, Northeastern Forest Experiment Station. 26 p.
A regional sample of tree-ring measurements was used to determine average annual growth in trees of

10 major species in New England. There have been extended periods of decreasing growth rates in red spruce since about 1960 and in balsam fir since about 1965. The other eight species, which include sugar maple and white pine, showed constant or increasing growth rates through 1980. The decreases in growth rate in sampled red spruce and balsam fir were independent of physical site characteristics, elevation, and geographic location, indicating that regional factors are involved. Weather parameters were not closely correlated with growth rates, and the best predictive equation explained only 33 percent of annual variation.

Solomon, Dale S.; Leak, William B.; Hosmer, Richard A. 1990. **Detecting and modeling the migration of tree species in response to environmental change.** In: Burkhart, Harold E.; Bonner, G. M.; Lowe, J. J., eds. Research in forest inventory, monitoring, growth and yield. Proceedings, IUFRO conference: 1990 August 5-11; Montreal, PQ. Publ. FWS-3-90. Blacksburg, VA: Virginia Polytechnic Institute and State University, School of Forestry and Wildlife Resources: 230-239.

If predicted major changes occur in global climate, some scientists suggest that the effects on forest growth and survival could be unprecedented. Some species might survive only through their ability to migrate northward with sufficient speed. Previous estimates of migration rates of species in the Northeastern United States have been deduced from the pollen record. Although useful, this approach disregards the unusual climatic, edaphic, and biological conditions that existed during the early postglacial period. One approach to detecting migrational change and predicting rate of movement considers that migrating species develop advancing or retreating fronts where maximum age plotted over distance or elevation forms a descending linear or curvilinear trendline. The slope of the trend provides a means for estimating migration rate.

Solomon, D. S.; Leak, W. B.; Hosmer, R. 1990. **Modeling tree species migration in response to climatic change.** In: Science in forestry: IUFRO's 2nd century; 19th world congress. Proceedings, IUFRO conference (vol. 4); 1990 August 5-11; Montreal, PQ. [Place of publication unknown]: Canadian IUFRO World Congress Organizing Committee: 58.

Stout, Susan L. 1990. **Inventory to support silvicultural decisions.** In: LaBau, Vernon J.; Cunia, Tiberius, tech. eds. State-of-the-art methodology of forest inventory: a symposium proceedings; 1989 July 30-August 5; Syracuse, NY. Gen. Tech. Rep. PNW-263. Portland, OR: U.S. Department of Agriculture, Forest Service, Pacific Northwest Forest and Range Experiment Station: 158-166.

The SILVAH (Silviculture of Allegheny Hardwoods) system of stand inventory, analysis, and prescription facilitates the use of silvicultural research results. Timber management research in the Allegheny Region of the Eastern United States has identified 14 stand characteristics that lead to a unique silvicultural prescription for an individual forest stand. An inventory scheme to determine these characteristics is one component of the SILVAH system. A set of computer programs has been developed to summarize inventory data and identify the prescription. Such a system reduces the subjectivity traditionally used in making silvicultural decisions, increases the consistency of silvicultural decisions from stand to stand and among silviculturists, and ensures that all key stand characteristics are assessed and considered in decision making.

Stribling, H. Lee; Smith, Harvey R.; Yahner, Richard H. 1990. **Bird community response to timber stand improvement and snag retention.** Northern Journal of Applied Forestry. 7(1): 35-38.

Avian surveys were conducted in 1985 on four study areas in the Moshannon State Forest in Clearfield County, Pennsylvania. Bird populations and communities in Timber Stand Improvement (TSI) areas were compared with those in TSI areas with snags retained. On average, bird numbers were 1.7 times higher on the TSI plus snag area than on the TSI area. Average species richness also was significantly higher on the TSI plus snag area. During TSI operations, forest managers can improve habitat for cavity-nesting and bark-gleaning birds by leaving snags.

Tabor, Christopher A. 1990. **Recurrent appearance of bisporangiate strobili with proliferation on *Picea abies.*** Rhodora. 92(872): 257-263.

Observations of mature Norway spruce that developed numerous bisporangiate strobili with proliferation were documented over a period of 9 years. Most abnormal strobili had male characteristics at the proximal ends, female characteristics above, and vegetative proliferation at the distal ends. The degree of male, female, and vegetative characteristics varied among the hundreds of bisporangiate strobili observed, and there were many transitional

stages. They appeared on one tree during eight spring-flushing seasons, on another during two seasons, and on five trees in the season following two environmental stresses: an insect infestation and a dry period which occurred when primordia were differentiating on developing embryonic shoots within buds.

Teck, Richard M.; Hilt, Donald E. 1990. **Individual-tree probability of survival model for the Northeastern United States.** Res. Pap. NE-642. Radnor, PA: U.S. Department of Agriculture, Forest Service, Northeastern Forest Experiment Station. 10 p.
Describes a distance-independent individual-tree probability of survival model for the Northeastern United States. Survival is predicted using a six-parameter logistic function with species-specific coefficients. Coefficients are presented for 28 species groups. The model accounts for variability in annual survival due to species, tree size, site quality, and the tree's competitive position within the stand. Model performance is evaluated using the chi-square goodness-of-fit test. Results are presented for the calibration data and an independent validation set. The model has been incorporated into NE-TWIGS.

Timson, Floyd G.; Martens, David G. 1990. **OPTI-GRAMI for PC's: user's manual (version 1.0).** Gen. Tech. Rep. NE-143. Radnor, PA: U.S. Department of Agriculture, Forest Service, Northeastern Forest Experiment Station. 19 p.
OPTIGRAMI for PC's is a version of the mainframe program OPTIGRAMI (OPTimum GRade Mix) written for the personal desktop computer. As with the mainframe program, a user can determine the optimum or least-cost mix of lumber grade volumes required to produce a given cutting order in a furniture rough mill, dimension mill, specialty parts mill, or any plant cutting clear parts from rough lumber of known grades.

Tritton, Louise M.; Siccama, Thomas G. 1990. **What proportion of standing trees in forests of the Northeast are dead?** Bulletin of the Torrey Botanical Club. 117(2): 163-166.
On the basis of 46 data sets, documents standing dead trees as a proportion of total basal area and density of forest stands in the Northeast. Stands were grouped into six forest cover types ranging from coastal oak and pine types to montane spruce and fir. Over the wide diversity of stand histories, species, and sites studied, the proportion of dead

trees was 3 to 43 percent of total basal area and 5 to 36 percent of total density. Montane spruce-fir stands characteristically had high proportions of standing dead trees, expressed as basal area and density.

Tubbs, Carl H.; Houston, David R. 1990. **American beech.** In: Burns, Russell M.; Honkala, Barbara H., tech. coords. Silvics of North America: volume 2. Hardwoods. Agric. Handb. 654. Washington, DC: U.S. Department of Agriculture: 325-332.
Describes silvical characteristics of American beech. Information on habitat, life history, and genetics is presented.

Twery, Mark J. 1990. **Progress in developing GypsES, a decision support systems for gypsy moth management.** In: Proceedings of the national gypsy moth review; 1990 October 23-25; Ottawa, ON. [Place of publication unknown]: [Publisher name unknown]: 242-245.
Describes a computer program, GypsES, to help forest managers determine priorities for forest lands based on relative risk from gypsy moth and improve the efficiency of gypsy moth control efforts.

Twery, Mark J. 1990. **The varied effects of gypsy moth on forests.** In: Proceedings of the 1990 annual gypsy moth review; 1990 October 23-25; Ottawa, ON. [Place of publication unknown]: [Publisher name unknown]: 228-241.
Defoliation of trees by the gypsy moth has many and varied effects. It causes economic losses through lost forest production and reduced aesthetic qualities of the forest. However, defoliation may improve habitat for many species of wildlife and contribute to increased diversity of eastern forests. Effects on water resources, recreation, and other values differ with different levels of defoliation and different forest types. Primary and secondary effects of defoliation on forested ecosystems are reviewed.

Twery, Mark J.; Elmes, Gregory A.; Yuill, Charles B.; Millette, Thomas L. 1990. **Using GIS to assess gypsy moth hazard.** In: Proceedings of the 50th annual meeting of the ASPRS/ACSM 1990 annual convention. Vol. 3; 1990 March 18-23; Denver, CO. Bethesda, MD: American Society of Photogrammerty and Remote Sensing: 284-290.
The gypsy moth defoliates hardwood forests throughout northeastern North America and is spreading south and west. Repeated defoliation

causes significant growth loss and mortality in the gypsy moth's preferred host species, especially the oaks. Predicting which forested areas are likely to sustain damage from an infestation is an important challenge for natural resource managers. A geographic information system (GIS) is an ideal tool for improving the estimates of the danger to different areas. To rate the hazard to a given area, one must determine the species composition of the forest, the growing conditions within the forest, the management objectives of the landowner, and the population trends of the gypsy moth. Use of a GIS greatly simplifies management of these various types of data and is especially useful for generating estimates derived from spatial data in areas where detailed information is difficult to obtain.

Twery, M. J.; Mason, G. N.; Wargo, P. M.; Gottschalk, K. W. 1990. **Abundance and distribution of rhizomorphs of Armillaria spp. in defoliated mixed oak stands in western Maryland.** Canadian Journal of Forest Research. 20(6): 674-678.
The abundance and distribution of rhizomorphs of Armillaria spp. in the soil were quantified in undisturbed stands and in stands defoliated 1 and 5 years previously by insects. Although the species of Armillaria was not determined, similar mixed oak forests in south central Pennsylvania contain North American biological species VII (Armillaria bulbosa Barla.). Several analysis techniques were tested for sensitivity to differences in distribution of rhizomorphs. Rhizomorph distribution within the 0.04-ha study plots was uniform in the undisturbed stands, but was significantly greater near dead trees in the defoliated stands. Total rhizomorph abundance was greater on plots defoliated 5 years before sampling than on more recently defoliated plots, and it was least on undefoliated plots.

Tyree, Melvin T.; Scherbatskoy, Timothy D.; Tabor, Christopher A. 1990. **Leaf cuticles behave as asymmetric mebranes: evidence from the measurement of diffusion potentials.** Plant Physiology. 92: 103-109.

Tyree, Melvin T.; Tabor, Christopher A.; Wescott, Charles R. 1990. **Movement of cations through cuticles of Citrus aurantium and Acer saccharum diffusion potentials in mixed salt solutions.** Plant Physiology. 94: 120-126.

Tyree, M. T.; Wilmot, T. R. 1990. **Errors in the calculation of evaporation and leaf conductance in steady-state porometry: the importance of accurate measurement of leaf temperature.** Canadian Journal of Forest Research. 20: 1031-1035.
Leaf temperatures of sugar maple leaves were measured over three growth seasons using in situ copper-constantan thermocouples with wire and junction diameters of 70 and 130 um, respectively. The thermocouples were coated with a thin layer of adhesive and attached to the abaxial leaf surface over a length of 4 to 5 cm of wire. On sunny days, leaf temperatures usually rose 5° to 15° C above the air temperature. When leaf conductances and evaporative flux were measured with a Li-Cor steady-state porometer under the same conditions, similar leaf temperatures were rarely measured by the Li-Cor leaf thermocouple. The in situ thermocouple is more likely to measure the actual leaf temperature than the Li-Cor thermocouple. Consequently, the values for leaf conductance and evaporative flux computed by the Li-Cor microprocessor can be wrong by as much as a factor of 2.

Tyree, Melvin T.; Yang, Shudong. 1990. **Water-storage capacity of Thuja, Tsuga and Acer stems measured by dehydration isotherms: the contribution of capillary water and cavitation.** Planta. 182: 420-426.

Valaitis, A. 1990. **Two forms of juvenile hormone esterase from gypsy moth (Lymantria dispar) are structurally similar.** The FASEB Journal. 4(7): 785. Abstract.

Valentine, Harry T. 1990. **A carbon-balance model of tree growth with a pipe-model framework.** In: Dixon, Dr. Robert K.; Meldohl, Dr. Ralph S.; Ruark, Dr. Gregory A.; Warren, Dr. William G., eds. Process modeling of forest growth responses to environmental stress. Portland, OR: Timber Press: 33-40.
The pipe-model theory is used to define a structural framework for a detailed derivation of a carbon-balance model of a tree. Growth of the model tree is measured in terms of average stem length (from leaves to feeder roots), basal area, total woody volume, and total carbon equivalents of dry matter. Within the pipe-model framework, the rate of consumption of carbon substrate for maintenance and renewal of live tissue increases with the average stem length of the model tree. Maximum average stem length occurs where the rate of production of

carbon substrate equals the rate of maintenance respiration.

Valentine, Harry T.; Gregoire, Timothy G.; Furnival, George M. 1990. **Importance sampling for volume with a portable computer.** In: LaBau, Vernon J.; Cunia, Tiberius, tech. eds. State-of-the-art methodology of forest inventory: a symposium proceedings; 1989 July 30-August 5; Syracuse, NY. Gen. Tech. Rep. PNW-263. Portland, OR: U.S. Department of Agriculture, Forest Service, Pacific Northwest Forest and Range Experiment Station: 88-95.
A two-stage procedure is described that uses list sampling with probability proportional to size and importance sampling to estimate the total bole volume of the trees in a forest survey plot. This procedure can be programmed to run on a battery-powered, portable computer. The computer gives instructions to the field crew, performs all of the needed calculations, and furnishes the estimate of volume and its standard error. The procedure is suggested for use in surveys where accurage, unbiased volume equations are unavailable for the species that are likely to be encountered.

Vander Haegen, W. Matthew; Jennings, Daniel T. 1990. **Spiders (*Araneae*) in the diet of American woodcock in Maine.** Journal of Arachnology. 18: 360-362.
Documents the family, genus, and, in some cases, species of spiders consumed by American woodcock collected on the Moosehorn National Wildlife Refuge in Washington County, Maine.

Voorhis, Nancy G. 1990. **Precommercial crop-tree thinning in a mixed northern hardwood stand.** Res. Pap. NE-640. Radnor, PA: U.S. Department of Agriculture, Forest Service, Northeastern Forest Experiment Station. 4 p.
Analysis of growth measurements taken 7 years after thinning an 8-year-old hardwood stand showed significant increases in diameter and crown-diameter growth. Further analysis showed dissimilarities in the pattern of response of the three species observed: yellow birch, sugar maple, and paper birch.

Wade, Gary L.; Halverson, Howard G. 1990. **Forest resource potential of reclaimed mined lands.** In: Bagby, Jane W., ed. Environment in Appalachia. Proceedings of the 1989 conference on Appalachia;

1989 November 2-3; Lexington, KY. Lexington, KY: University of Kentucky, Appalachian Center: 55-61.
Describes the characteristics that make a forest ecosystem productive, shows results from studies of rapid development of forest soil from mine spoils, and provides examples of mediocre to good forest productivity on mined lands. Reasons for past successes and requirements for future successes in reclaiming mined lands to and through forestry are discussed.

Wade, Gary L.; Thompson, Ralph L. 1990. **Establishment of native plant species from forest topsoil seedbanks on a borrow area in Kentucky.** In: Skousen, J.; Sencindiver, J.; Samuel, D., eds. Proceedings of the 1990 mining and reclamation conference and exhibition. Vol. II; 1990 April 23-26; Charleston, WV. Morgantown, WV: West Virginia University: 451-460.
The seed banks in forest topsoils were used to introduce native species to an unreclaimed, xeric borrow area in eastern Kentucky. The results of using eight treatments are reported: (1) 1 cm topsoil + mulch, (2) 1 cm topsoil tilled into the substrate + mulch, (3) 2 cm topsoil + mulch, (4) 1 cm topsoil without mulch, (5) 4 cm topsoil in strips covering 25 percent of the area + mulch, (6) 1 cm topsoil + a grass-legume reclamation mix + mulch, (7) the reclamation mix + mulch without topsoil, and (8) mulch without topsoil or reclamation mix. The seed bank produced 90 species from 14 families, including seven tree species, seven shrubs, 16 graminoids, and 50 forbs. Forest topsoil use introduced 57 native or naturalized species during the first growing season and 82 species were present during the second growing season. Average ground cover of native species totaled only about 5 percent after 10 weeks of the first growing season. Wheat and timothy seed contained in the hay mulch increased mean ground cover to more than 70 percent.

Walters, Russell S. 1990. **Influence of site on regeneration development after partial cutting of upland oak forests.** In: VanSambeek, J. W.; Larson, M. M., eds. 4th workshop on seedling physiology and growth problem in oak plantings; 1989 March 1-2; Columbus, OH. Gen. Tech. Rep. NC-139; St. Paul, MN: U.S. Department of Agriculture, Forest Service, North Central Forest Experiment Station: 28. Abstract.

Walters, Russell S. 1990. **Shelterwood harvest for upland oak stand regeneration.** In: 66th annual

meeting of the Pennsylvania Academy of Science and Pennsylvania Biological Survey; 1990 April 20-22; Pittsburgh, PA. Philadelphia, PA: Pennsylvania Academy of Science: 229. Abstract.

Shelterwood cutting and understory control were evaluated in relation to site quality to secure oak regeneration. The dependent variable was oak seedling density relative to other competing species. The independent variables were residual stand density, understory control, and site quality. Oak advance regeneration was most abundant on medium-quality sites where site index was approximately 18.3 to 21.3 m and least abundant on sites of higher quality. The number of oak seedlings was not increased by any of the overstory and understory treatments, but non-oak species increased on the heavily cut good sites. Shelterwood cutting did not establish new oak regeneration.

Walters, Russell S.; Yawney, Harry W. 1990. **Red maple.** In: Burns, Russell M.; Honkala, Barbara H., tech. coords. Silvics of North America: volume 2. Hardwoods. Agric. Handb. 654. Washington, DC: U.S. Department of Agriculture: 60-69.

Describes silvical characteristics of red maple. Information on habitat, life history, and genetics is presented.

Wargo, Philip M. 1990. **Spread of *Armillaria* by rhizomorphs in forest stands.** In: 4th international mycological congress IMC4; 1990 August 28-September 3; Regensburg, Germany (F.R.G.). [Place of publication unknown]: [Publisher name unknown]: 99.

Wargo, P. M.; Bergdahl, D. R.; Tobi, D. R.; Olson, C. W. 1990. **Association of possible winter injury effects with growth loss in red spruce at high elevations on Whiteface Mountain, New York.** In: International conference on acidic deposition: its nature and impacts; 1990 September 16-21; Glasgow, Scotland. [Place of publication unknown]: Royal Society of Edinburgh: 323. Abstract.

Wargo, P. M.; Houston, D. R. 1990. **Etiology of forest tree declines in eastern forests.** In: Book of abstracts, symposium on forest declines, forest pest management working group, annual meeting of national society of American Foresters; 1990 July 29-August 3; Washington, DC. Bethesda, MD: Society of American Foresters. Abstract.

Wendel, G. W. 1990. **Eastern white pine.** In: Burns, Russell M.; Honkala, Barbara H., tech. coords. Silvics of North America: volume 1. Conifers. Agric. Handb. 654. Washington, DC: U.S. Department of Agriculture: 476-488.

Describes silvical characteristics of eastern white pine. Information on habitat, life history, and genetics is presented.

Wendel, G. W. 1990. **Pin cherry.** In: Burns, Russell M.; Honkala, Barbara H., tech. coords. Silvics of North America: volume 2. Hardwoods. Agric. Handb. 654. Washington, DC: U.S. Department of Agriculture: 587-593.

Describes silvical characteristics of pin cherry. Information on habitat, life history, and genetics is presented.

Widmann, Richard H. 1990. **Pulpwood production in the Northeast--1988.** Resour. Bull. NE-116. Radnor, PA: U.S. Department of Agriculture, Forest Service, Northeastern Forest Experiment Station. 26 p.

Contains 1988 information compiled from a canvass of all pulpmills that use pulpwood produced in the 14 Northeastern States. In 1988, total production reached 9,648,800 cords, an increase of 3 percent since 1987. Pulpwood from roundwood was 6,749,800 cords and pulpwood from manufacturing residues was 2,899,000 cord equivalents. Receipts of pulpwood at mills in the region totaled 10,133,600 cords.

Widmann, Richard H.; Blyth, James E. 1990. **Pulpwood production in 1988: increases continue in the northern states.** Northern Logger. 38(8): 24-25.

Widmann, Richard H.; Murriner, Edward C. 1990. **West Virginia timber products output--1987.** Resour. Bull. NE-115. Radnor, PA: U.S. Department of Agriculture, Forest Service, Northeastern Forest Experiment Station. 20 p.

The total industrial harvest in West Virginia exceeded 110 million cubic feet in 1987, a 24-percent increase since 1979. Sawlogs accounted for 70 percent of the total and pulpwood accounted for 21 percent. During this 8-year period, sawlog production was up by 35 percent to 563 million board feet. Pulpwood production reached 272,000 cords of roundwood and 286,000 cord equivalents of residue chips. The use of manufacturing residues produced at West Virginia mills increased from 75 to 90 percent. The largest use of residues was for fiber.

Wilkinson, Ronald C. 1990. **Effects of winter injury on basal area and height growth of 30-year-old red spruce from 12 provenances growing in northern New Hampshire.** Canadian Journal of Forest Research. 20: 1616-1622.

Basal-area increment and height growth of 30-year-old red spruce from 12 rangewide provenances growing in a plantation in northern New Hampshire were measured for a 3-year period 1986 through 1988 in which severe and/or frequent winter damage to needles occurred. Growth of uninjured trees and injured trees were compared. Basal-area increments were successively smaller for groups of trees arranged in increasing order of average needle damage as a portion of the upper crown and number of years that the trees were injured. A similar pattern was observed for height growth, but the effect of winter damage was not as great on height growth as on basal-area increment. Growth losses following winter injury, especially height growth, were much greater for trees in provenances classed as pure red spruce than for trees in provenances where introgressive hybridization with black spruce has been demonstrated.

Yaussy, Daniel A.; Brisbin, Robert L. 1990. **User's guide to STUMP: a system of timber utilization and mill processing.** Gen. Tech. Rep. NE-138. Radnor, PA: U.S. Department of Agriculture, Forest Service, Northeastern Forest Experiment Station. 24 p.

STUMP is an integrated software package that allows the estimation of end-product yield and value from hardwood timber cruise data or from scaled-log data. It consists of four modules and data-entry routines that use standard timber-cruise or log-scale entries plus the quality measures of tree or log grade to estimate yield and value by log and lumber grade.

Yaussy, D. A.; Brisbin, R. L. 1990. **STUMP: a system of timber utilization and mill processing.** In: Are forests the answer? Proceedings of the 1990 Society of American Foresters national convention; 1990 July 29-August 1; Washington, DC. SAF Publ. 90-02. Bethesda, MD: Society of American Foresters: 613-614. Poster.

Yendol, William G.; Bryant, Jonathan E.; McManus, Michael L. 1990. **Penetration of oak canopies by a commercial preparation of Bacillus thuringiensis applied by air.** Journal of Economic Entomology. 83(1): 173-179.

The volume of spray deposit throughout an oak canopy was measured at a single-leaf resolution. Profiles of deposit (international units per cm^2) are compared for upper and lower canopy levels and positions within these levels. Droplet sizes and densities are shown for upper and lower canopy levels. Artificial targets were used to measure the deposit at ground level, on a horizontal profile at midcrown, and over a vertical profile from the canopy top to the ground. No significant differences were found between the levels or positions in the canopy.

Zarnoch, S. J.; Gansner, D. A.; Powell, D. S.; Birch, T. A. 1990. **Stand basal-area and tree-diameter growth in red spruce-fir forests in Maine, 1960-80.** Res. Pap. NE-633. Radnor, PA: U.S. Department of Agriculture, Forest Service, Northeastern Forest Experiment Station. 18 p.

Changes in stand basal-area and d.b.h. growth of individual surviving red spruce from 1960 to 1980 were analyzed for red spruce-fir stands in Maine. Regression modeling was used to relate these measures of growth to stand and tree conditions and to compare growth throughout the period. Results indicate a decline in growth.

Zipperer, Wayne C.; Burgess, Robert L.; Nyland, Ralph D. 1990. **Patterns of deforestation and reforestation in different landscape types in central New York.** Forest Ecology and Management. 36: 103-117.

In landscapes of the Eastern United States, deforestation and reforestation are continuing processes. To better understand these processes, the change in density and size of forest islands within individual landscape types of central New York were documented. Thirty-one 30-km^2 sample landscapes were subdivided into 1-ha cells, and the cells were classified according to five land uses: forest, other natural vegetation, agriculture, urban, and water. Sample periods were 1938, 1959, and 1978. Using cluster analysis, sample landscapes were grouped as follows: urban-suburban, agricultural-urban, agriculture, transitional-urban, transitional-agriculture, and forest. The intensity of landscape use determined the frequency of fragmentation, elimination, consolidation, and emergence of forest islands. The suburban landscape type had the highest rates of fragmentation, elimination, and emergence. By contrast, the forest landscape type had the lowest rate for those processes but had the highest rate of consolidation.

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