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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.

Adams, Edward L. 1988. **Testing DESIM for designing and simulating the operation of hardwood sawmills.** Forest Products Journal. 38(7/8): 41-45.
The DESIM system was tested to determine how realistically it could simulate the operation of a hardwood sawmill. Individual values for test variables from one 10-hour operating shift with corresponding frequency distributions for 100 simulated 10-hour shifts were compared. Actual values for the test variables fell within two standard deviations of the mean simulated values. Since the actual and the mean simulated values were reasonably close, the DESIM system realistically simulated the operation of the test mill.

Alerich, David J.; Griffith, Douglas M. 1988. **Producing desired scale 35mm prints from high altitude transparencies for field use.** In: Remote sensing for resource inventory, planning, and monitoring: Proceedings of 2nd Forest Service remote sensing applications conference; 1988 April 11-15; Slidell, LA. Falls Church, VA: American Society for Photogrammetry and Remote Sensing: 223-226.
In 1984, the Forest Inventory and Analysis Unit (FIA) of the Northeastern Forest Experiment Station began using (NHAP) color infrared transparencies. Paper discusses photo advantages and disadvantages over black-and-white photography. Also describes the method used to produce these print production and authors' experience in using the prints.

Araman, Philip A. 1988. **U.S. hardwood trade in the Pacific Rim.** In: Johnson, Jay A.; Smith, W. Ramsay, eds. Proceedings, 3rd international symposium on world trade in forest products; 1987 March 18-20; Seattle, WA. Seattle, WA: University of Washington, College of Forest Resources and Center for International Trade in Forest Products: 99-104.
Explains the differences between U.S. domestic and export hardwood products and discusses the shift and growth of export markets. In addition, documents the emergence of the Pacific Rim market and examines the demands of major customers, Japan and Taiwan. Potential export dimension products for Japan, Taiwan, and Korea are also discussed.

Araman, Philip A. 1988. **Secondary products (markets, competition, and technological improvements).** In: Forest products research conference, 1987: the role of utilization research in enhancing U.S. competitiveness in forest products. 1987 October 6-8; Madison, WI. Madison, WI: U.S. Department of Agriculture, Forest Service, Forest Products Laboratory: 40-49.
Focuses on furniture products, including cabinets, as one of several types of secondary products. Also discusses the hardwood sawtimber resource situation for the Eastern United States, technological improvements, and potential research. Other hardwood products such as millwork, mouldings, dimension stock, flooring, and pallets are reviewed.

Araman, Philip A. 1988. **New patterns of world trade in hardwood timber products.** In: Proceedings, outlook '88, 64th agricultural outlook conference; 1987 December 1-3; Washington, DC. Washington, DC: U.S. Department of Agriculture: 391-401.
Several dramatic changes have occurred in the hardwood export market in the past 10+ years. World demand for U.S. hardwood logs, lumber, and veneer has nearly tripled since 1975. Exports to Europe and particularly the Pacific Rim, have grown significantly. Quantitatively assesses of the U.S. export by situation with estimates of potential 1987 and 1988 hardwood exports. Also addressed are the importance of exports to our primary industry, our hardwood resource situation, and likely short-term future developments in the hardwood export market.

Auchmoody, L. R.; Walters, R. S. 1988. **Revegetation of a brine-killed forest site.** Soil Science Society of America Journal. 52: 277-280.
Natural invasion of herbaceous plants and forest tree seedlings on a brine- killed forest site in northwestern Pennsylvania was evaluated over a 4-year

period. Brine generated from producing oil wells and accidentally discharged to the soil of an Allegheny hardwood stand killed all of the vegetation it contacted, leaving the site unproductive and visually annoying. Once the brine source was eliminated, heavy spring rains quickly reduced brine concentrations in the soil to below toxic levels, allowing invasion of vegetation to proceed rapidly. Herbaceous plants and tree seedlings became established in the first year; by year 2 the site had regenerated naturally to full stocking with a desirable mix of forest trees.

Auchmoody, L. R.; Walters, R. S. 1988. **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 on sites 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 an increase in foliar Ca and Mg.

Barger, Jack H.; Hall, Richard W. 1988. **Effects of simulated acid rain on efficacy of methoxychlor for elm leaf beetle control, Delaware County, Ohio, 1987.** Insecticide and Acaracide Tests. 13: 374-375.

Barger, J. H.; Hall, R. W.; Townsend, A. M. 1988. **Effects of ozone fumigation on elm leaf beetle, *Xanthogaleruca luteola* (Muller), host suitability.** In: Abstracts of submitted papers, North Central Branch, Entomological Society of America, 43rd annual meeting; 1988 March 20-23; Denver, CO. College Park, MD: North Central Branch, Entomological Society of America. Abstract 127.
Host-plant suitability for certain insects has been shown to be affected by atmospheric pollutants. Three-year-old elm trees were fumigated with ozone concentrations of 0.15 ppm, 0.30 ppm, 0.45 ppm and with charcoal-filtered air to determine, by bioassay, the effects on elm leaf beetle fecundity and leaf consumption.

Barnard, Joseph E.; Scott, Charles T. 1988. **Changes in tree-growth rates in Vermont.** Res. Note SE-350. Asheville, NC: U.S. Department of Agriculture, Forest Service, Southeastern Forest Experiment Station. 6 p.
At three separate times (1965, 1973, and 1983) over 2,300 trees were measured at various locations throughout Vermont. For 19 species or species groups, average annual basal area growth in the period 1965-72 was compared with that in the period 1973-83. Basal area growth of two species, red spruce and white spruce, declined significantly. Growth of several species, such as balsam fir, paper birch, and quaking aspen, warrant further study. For 11 species or species groups, basal area growth rates improved over the same periods.

Baumgras, John E. 1988. **Estimating biomass yields by source components for Appalachian hardwood thinnings.** Northern Journal of Applied Forestry. 5: 38-40.
Equations are presented for estimating biomass yields from thinning stands of Appalachian hardwoods. The equations were developed from sample plot data collected in overstocked poletimber and small sawtimber stands aged 50 to 70 years. Yields in green tons per acre can be estimated for three source components: roundwood and topwood of trees >5.0 inches d.b.h. and whole trees 1.0 to 4.9 inches d.b.h. Yield estimates are derived from the square feet of basal area to be removed per acre from specified tree d.b.h. classes. Application of the equations provides information to evaluate harvesting and utilization alternatives that include whole-tree chipping options.

Baumgras, John E.; LeDoux, Chris B. 1988. **Impact of stand diameter and product markets on revenue gains from multiproduct harvesting.** Forest Products Journal. 38(7/8): 57-63.
Data from 113 sample thinning plots and a microcomputer program called APTHIN were used to demonstrate the impact of mean stand diameter

and product markets on revenue gains from multi-product versus single-product pulpwood harvests in poletimber and small sawtimber stands of Appalachian hardwoods. The analysis of revenue gains included product mix derived from the quadratic mean diameter at breast height (d.b.h.), product market prices, and haul cost determined by market location. Yields of sawlogs, sawbolts, pulpwood fuelwood, and chips were estimated with APTHIN to determine shifts in the available product mix. Results show that as the mean d.b.h. of harvested trees increases from 6 to 12 inches, the proportion of total roundwood classified as pulpwood or fuelwood declines from 77 to 24 percent, with large sawlogs increasing from 0 to 49 percent.

Bellinger, Robert G.; Ravlin, F. William; McManus, Michael L. 1988. **Host plant species and parasitism of gypsy moth (Lepidoptera: Lymantriidae) egg masses by *Ooencyrtus kuvanae* (Hymenoptera: Encyrtidae).** Environmental Entomology. 17(6): 936-940.
Lymantria dispar (L.), egg masses (EMs) laid on different host species and substrates were studied in newly infested areas in Virginia. Parasitization rates of gypsy moth, EMs by *O. kuvanae* were highest on red maple and inanimate objects and lowest on oaks. The effect of host plant species on parasitism was independent of the number of eggs per mass and may be due to the effects of bark texture on egg mass geometry and searching behavior of *O. kuvanae*. Percent parasitization was also inversely related to eggs per mass. Eggs per mass are determined by host suitability and gypsy moth population density. *O. kuvanae* appears incapable of maintaining gypsy moth populations at low densities but may be an additional factor mediating against the reproductive success of individuals feeding on nonpreferred host-plant species.

Blum, Barton M. 1988. **Variation in the phenology of bud flushing in white and red spruce.** Canadian Journal of Forest Research. 18: 315-319.
Variation in bud flushing date as related to degree-day accumulation was determined among seed sources, families, and individual white spruce trees in both a provenance-study plantation and a progeny test of select trees on the Penobscot Experimental Forest in north central Maine. The primary purpose was to determine the feasibility of improving resistance to spruce budworm defoliation by selection for late bud flushing. Comparisons with native red spruce indicate that, while some improvement in late flushing may be possible, it is unlikely that late flushing dates comparable with the mean for native red spruce can be achieved for white spruce.

Bowers, Lynne Jordan; Melhuish, John H., Jr. 1988. **Silicon content in wood and bark of baldcypress compared to loblolly pine and southern red oak.** Transactions of the Kentucky Academy of Science. 49(1-2): 1-7.
The durability and resistance to decay of baldcypress wood have been attributed to the quantity and type of extractives in the wood. Studies of agricultural plants have linked variations in silicon content with the degree of resistance to herbivory and fungal attack. The data show that baldcypress bark and wood contain higher concentrations of silicon than pine and oak. The durability of baldcypress wood, as well as the ability of this tree to tolerate long periods of flooded soil, may be related to this higher silicon content.

Bowers, Lynne Jordan; Melhuish, John H., Jr. 1988. **Comparison of elemental concentrations in the wood of three tree species growing adjacent to an inactive chromium smelter.** Bulletin of Environmental Contamination and Toxicology. 40: 457-461.
Seventeen elements were measured in wood samples taken from three tree species growing approximately 1.2 km from an inactive chromium smelter. The species sampled were: baldcypress, loblolly pine, and southern red oak.

Brisbin, Robert L.; Rast, Everette D. 1988. **Weight and properties of Ohio plantation-grown white pine.** Northern Journal of Applied Forestry. 5(3): 176-180.
There has been increasing interest in the use of the plantation-grown white pine resource in Ohio. Potential uses include posts, poles, sawlogs, and pulp fiber. Estimates of specific gravity and weight prediction equations are needed to use this resource effectively. Specific gravity (or density) is the simplest and most useful index to the suitability of wood for many important uses. This research indicates that the specific gravity of plantation-grown white pine is significantly lower than the published values for natural-grown white pine. The research findings will affect the expected yields of dry pulp fiber and the strength of solid wood products. Equations are presented for predicting the weight of green wood, green bark, green wood plus bark, and dry wood and dry bark of the central stem from a 1-ft. stump to a 2-in. d.o.b. top.

Brooks, Robert T.; Birch, Thomas W. 1988. **Changes in New England forests and forest owners: implications for wildlife habitat resources and management.** In: Transactions of the 53rd North American wildlife and natural resources conference; 1988 March 18-23; Louisville, KY. Washington, DC: Wildlife Management Institute: 78-87.
Interprets the results of the last two New England forest surveys as they relate to wildlife habitats. Identifies possible changes in that resource and the characteristics of forest owners that may influence management options.

Carter, K. K.; DeHayes, D. H.; Demeritt, M. E., Jr.; Eckert, R. T.; Garrett, P. W.; Gerhold, H. D.; Kuser, J. E.; Steiner, K. C. 1988. **Tree improvement in the northeast: interim summary and recommendations for selected species.** Tech. Bull. 131. Orono, ME. Maine Agricultural Experiment Station, University of Maine. 50 p.
Provides an overview of current knowledge regarding genetic variation and tree-improvement practices for 11 common tree species in the Northeast.

Corbett, Edward S.; Lynch, James A. **Gypsy moth impacts on water quality indicator organisms.** Forest Resources. University Park, PA: The Pennsylvania State University. 4: 9-10.

Davidson, Walter H.; Ashby, W. Clark; Vogel, Willis G. 1988. **Progressive changes in minesoil pH over three decades.** In: Mine drainage and surface mine reclamation: Proceedings of a conference sponsored by The American Society for Surface Mining and Reclamation, The Bureau of Mines, and The Office of Surface Mining Reclamation and Enforcement; 1988 April 19-21; Pittsburgh, PA. Inf. Circ. 9184. Washington, DC: U.S. Department of the Interior, Bureau of Mines: 89-92. Vol. 2: Mine Reclamation, Abandoned Mine Lands and Policy Issues.
Surface minesoils that include a mixture of overburden materials located in the Appalachian and interior coal provinces, may experience rapid changes of pH in the early years after mining, followed by slow, longer-term changes. Reclamation plantings are commonly made on minesoils atypical of pH for the region. The pH's have ranged from extremely acid to moderately alkaline. Subsequent measurements on these plantings, including soil pH, have shown a high degree of regularity in convergence of pH toward values more typical of regional soils. The changed were most marked in extremely acid soils. One cause of the long-term changes may be the effects of plant cover.

Davidson, Walter H. 1988. **Potential for planting hardwoods in the Appalachians.** In: Smith, H. Clay; Perkey, Arlyn W.; Kidd, William E. Jr., eds. Guidelines for regenerating Appalachian hardwood stands: Workshop proceedings; 1988 May 24-26; Morgantown, WV. SAF Publ. 88-03. Morgantown, WV: West Virginia University Books: 255-268.
Artificial regeneration of hardwoods in the Appalachian Region is a desirable management technique to improve species composition in existing forest stands and to ensure regeneration following harvest cuts. The current knowledge on the artificial regeneration of hardwoods shows that considerable work has been accomplished and some techniques recommended. However, there are problem areas that need additional research and refinement. Where artificial regeneration is desired, the need is great for information on successful achievement. This paper presents a review of literature, personal opinion, a general how-to guide, and recommendations for future research.

Davidson, Walter H. 1988. **Don't write off direct seeding efforts too soon.** In: Graves, Donald H.; DeVore, R. William, eds. In: Proceedings, 1988 symposium on mining, hydrology, sedimentology, and reclamation; 1988 December 5-9; Reno, NV. UKY BU148. Lexington, KY: University of Kentucky, College of Engineering: 217-221.
Shows that direct seeding has potential for foresting of minesoils if compacting and competition from herbaceous species are not limiting.

DeGraaf, Richard M.; Bailey, Robert G.; Brooks, Robert T. 1988. **A comparison of five national land classification maps.** Agric. Handb. 672. Washington, DC: U.S. Department of Agriculture. 338 p.
Shows the relationships among the legends of five national vegetation maps in widespread use. The relationships provide a basis for comparison of land classification and ecosystems, and can assist in correlating data bases for interagency and intra-agency use.

Demeritt, Maurice E., Jr. 1988. **Seed and seedlings for the spruce-fir research cooperative.** In: Hertel, Gerard, tech. coord. Proceedings of the US/FRG research symposium: effects of atmospheric pollutants on the spruce-fir forests of the Eastern United States and the Federal Republic of Germany; 1987

October 19-23; Burlington, VT. Gen. Tech. Rep. NE-120. Broomall, PA: U.S. Department of Agriculture, Forest Service, Northeastern Forest Experiment Station: 67-68.

Dempsey, Gilbert P. 1988. **Capital labor substitution in the pallet industry.** Pallet Enterprise. November/December: 44, 46, 48, 50.
Despite higher costs, the U.S. wooden pallet industry is producing more pallet, with less labor at lower prices. Industry efficiency--as measured by labor productivity--has increased by 83 percent since 1972. The most significant improvements occurred between 1982 and 1987. Two reasons for the advancements are the substitution of capital for labor and the employment of a more proficient labor force.

DeWalle, David R.; Heisler, Gordon M. 1988. **Use of windbreaks for home energy conservation.** Agriculture, Ecosystems and Environment. 22(23): 243-260.
Windbreaks are effective in reducing energy needs for home heating by reducing air-exchange rates in homes. Air exchange in homes is caused by pressure differences resulting from temperature differences of inside and outside air or wind forces on the exterior surfaces of the house. Since windbreaks are effective only in reducing air exchange caused by wind forces, they are more successful in saving energy in windy climates. Data indicate that annual energy savings using windbreaks can be 10 - 15 percent in the Northeastern United States and 15 - 25 percent in the north central U.S. Economic analyses indicate that windbreaks are cost effective when over a 20-year windbreak life, energy savings exceed windbreak costs.

Dickson, David R.; McAfee, Carol L. 1988. **Forest statistics for Rhode Island--1972 and 1985.** Resour. Bull. NE-104. Broomall, PA: U.S. Department of Agriculture, Forest Service, Northeastern Forest Experiment Station. 96 p.
A statistical report on the third forest survey of Rhode Island (1984). Findings are displayed in 77 tables containing estimates of forest area, numbers of trees, timber volume, tree biomass, and timber products output. Data are presented at two levels: state and county.

Dickson, David R.; McAfee, Carol L. 1988. **Forest statistics for Connecticut--1972 and 1985.** Resour. Bull. NE-105. Broomall, PA: U.S. Department of Agriculture, Forest Service, Northeastern Forest Experiment Station. 102 p.
A statistical report on the third forest survey of Connecticut (1984). Findings are displayed in 77 tables containing estimates of forest area, numbers of trees, timber volume, tree biomass, and timber products output. Data are presented at two levels: state and county.

Dickson, David R.; McAfee, Carol L. 1988. **Forest statistics for Massachusetts--1972 and 1985.** Resour. Bull. NE-106, Broomall, PA: U.S. Department of Agriculture, Forest Service, Northeastern Forest Experiment Station. 112 p.
A statistical report on the third forest survey of Massachusetts (1984). Findings are displayed in 76 tables containing estimates of forest area, numbers of trees, timber volume, tree biomass, and timber products output. Data are presented at two levels: state and county.

Dochinger, Leon S. 1988. **Air pollution impacts on forest trees: foliar response.** Perspectives in Environmental Botany. 2: 1-24.
Many air-pollution problems can be resolved only by international cooperative research. Because conifers appear more sensitive and their injuries more conspicuous, little has been done in delineating the symptomatology of hardwood trees. The pollutants most important to trees are sulfur dioxide, fluoride, and ozone. Attempts to relate these contaminants to their effects on trees are hampered by deficiencies in instrumentation and methods of atmospheric analysis; by inadequate knowledge about how atmospheric factors alter comparatively simple gaseous forms into phpytotoxicants of indefinable composition; by the inability to distinguish air-pollution symptoms from those with other causes; and by insufficient information about interactions between air pollutants and the total environment. Investigations are needed to characterize symptoms of acute and chronic exposure to single and multiple pollutants, and to relate pollution injury to modifying environmental effects.

Dubois, Normand R.; Reardon, Richard C.; Kolodny-Hirsch, Douglas M. 1988. **Field efficacy of the NRD-12 strain of *Bacillus thuringiensis* against gypsy moth (Lepidoptera: Lymantriidae).** Journal of Economic Entomology. 81(6): 1672-1677.
Single and double aerial application treatments at 30 billion international units (BIU)/ha of an aqueous

formulation (SAN 415 SC 32LV) of the NRD-12 strain of *Bacillus thuringiensis* Berliner were evaluated against a moderately dense population of gypsy moth. Egg mass densities before spray averaged 5,055 egg masses per ha; egg mass density after spray increased to over 19,500 per ha in the control woodlots but decreased to 2,600 and 4,500 per ha in the single and double application treatments, respectively. These values were significantly less than the controls but not significantly different from each other. The decreases in egg mass densities represented population reduction estimates of 87 percent and 77 percent, which were correlated with the larval population reductions estimated by relative larval densities (83 percent and 79 percent) and with the estimated initial larval densities (85 percent and 72 percent) of the populations before (1986) and after (1987) treatments with NRD-12.

Dudzik, Kenneth R. 1988. **Macro-microscopic anatomy: obtaining a composite view of barrier zone formation in *Acer saccharum*.** IAWA Bulletin. 9(2): 183-186.
Discusses the technique for constructing a montage of large wood sections cut on a sliding microtome. Briefly, the technique involves photographing many serial micrographs in a pattern under a light microscope similar to the way flight lines are run in aerial photography. Assembly of the resulting overlapping photographs requires careful trimming. A composite of many low-power micrographs allows for a resolution of the sample that could not be obtained from a single photograph. A barrier zone in sugar maple is used as an example of a macro-microscopic montage. The scope of the montage aids in understanding the condition of the tree before injury, the tree's developing response to the problem, and the consequences of its defense strategy.

Duggin, M. J.; Rowntree, R. A.; Odell, A. W. 1988. **The application of spatial filtering methods to urban feature analysis using digital image data.** International Journal of Remote Sensing. 9(3): 543-553.
Describes a method of spatial filtering in the frequency domain which enhances edges and boundaries, making small urban features, such as parks, tree-lined streets, and new housing developments, visible on digital images with, for example, 30 m resolution. Until now, while satellite imagery has been useful because of its large area and repetitive coverage, the spatial resolution for multiband imagery has been such that it precluded the detailed studies which may now be possible. Though spatial frequency filtering, edge enhancement, high-boost, and directional filtering have been possible, they generally have used a convolution matrix whose elements were defined from general empirical rules. Frequency domain operations offer the advantage of selectively tailoring the filter to enhance certain features.

Echelberger, Herbert E.; Shepard, Robert G.; Wiesel, Jon. 1988. **XC economic analysis.** Ski Area Management. 27(5): 98-99.

Edwards, Pamela J.; Helvey, J. David. 1988. **Long-term changes in stream water chemistry on the Fernow Experimental Forest.** In: 1988 Northeast Fish and Wildlife Conference; 1988 March 27-30; White Sulphur Springs, WV. [Location of publisher unknown]: Northeast Association of Fish and Wildlife Resource Agencies. Abstract.

Edwards, Pamela J.; Helvey, J. David; Kochenderfer, James N. 1988. **Artificial acidification of a 34.4 ha catchment in the Central Appalachians.** Transactions, American Geophysical Union. 69(44): 1220. Abstract.
A three-year cooperative study by the Environmental Protection Agency and the Forest Service was started in October 1987 at the Fernow Experimental Forest near Parsons, West Virginia. Annual atmospheric deposition of sulfur and nitrogen is expected to triple by applying ammonium sulfate fertilizer with a helicopter. A contiguous, undisturbed catchment is planned as a control for this study. Acidification effects on streamflow chemistry is to be monitored in two ways at the catchment outlet. Specific conductance and pH will be continuously recorded *in situ* on both streams. Grab samples are to be collected weekly and storm samples (collected by automatic pumping samplers) when the stage changes by 15 mm. All stream samples are to be analyzed for specific conductance, alkalinity, and C1, No_3 -N, SO_4 Ca, Mg, K, and Na concentrations. Samples will be analyzed for dissolved organic carbon and monomeric, non-labile, and total Al. Soil water samples will be collected with zero-tension lysimeters after each storm at three soil depths and analyzed for the same constituents as for streamflow samples. Acidification effects on macroinvertebrate populations will be determined by the Fish and Wildlife Service.

Federer, C.A.; Hornbeck, J.W. 1988. **Regional dendrochronologies of red spruce and other species in New England.** In: Hertel, Gerard, tech. coord. Proceedings of the US/FRG research symposium: effects of atmospheric pollutants on the spruce-fir forests of the Eastern United States and the Federal Republic of Germany; 1987 October 19-23; Burlington, VT. Gen. Tech. Rep. NE-120. Broomall, PA: U.S. Department of Agriculture, Forest Service, Northeastern Forest Experiment Station: 285-290.
Basal-area increments, determined from thousands of cores from throughout New England, show the growth of *Picea rubens* and *Abies balsamea* has decreased since the early 1960's, apparently as a consequence of forest aging. However, this age trend may not be related to growth decrease and mortality of Picea at high elevations. Eight other conifer and hardwood species show no evidence of a growth decrease through 1980 that might be attributed to air pollution. Analysis of interannual variation in the growth of *P. rubens* shows effects of regional weather, especially winter temperature and temperature late in the previous growing season.

Federer, C. Anthony; Klemedtsson, Leif. 1988. **Some factors limiting potential denitrification in slurries of acid forest soils.** Scandinavian Journal of Forest Research. 3: 425-435.

Frieswyk, Thomas S.; DiGiovanni, Dawn M. 1988. **Forest statistics for Maryland--1976-1986.** Resour. Bull. NE-107. Broomall, PA: U.S. Department of Agriculture, Forest Service, Northeastern Forest Experiment Station. 157 p.
A statistical report on the fourth forest survey of Maryland (1986). Findings are displayed in 115 tables containing estimates of forest area, numbers of trees, timber volume, tree biomass, and timber products output. Data are presented at three levels: state, geographic unit, and county.

Galford, Jimmy R.; Peacock, John W.; Wright, Susan L. 1988. **Insects and other pests affecting oak regeneration.** In: Smith, H. Clay; Perkey, Arlyn W.; Kidd, William E. Jr., eds. Guidelines for regenerating Appalachian hardwood stands: Workshop proceedings; 1988 May 24-26; Morgantown, WV. SAF Publ. 88-03. Morgantown, WV: West Virginia University Books: 219-225.
Research on insects affecting oak regeneration and efforts to establish oak seedlings by acorn plantings in the forest understory have revealed a host of insect and other animal problems. In Ohio, significant establishment of white oak seedlings has occurred in only one area in the past 4 years. Establishment of red oak seedlings was not significant in 1987 even though the 1986 crop was heavy-to-bumper in most areas. This paper discusses the interplay of acorn crop size, insects, litter depth, and animal predation, and how these factors affect oak seedling establishment.

Gansner, David; Birch, Thomas; Frieswyk, Thomas. 1988. **Those resilient Yankee forests.** American Forests. 94(7/8): 32-33, 85-86.
Discusses recently completed state inventories showing that the region's woodlands have bounced back to a remarkable state of health and vigor.

Gansner, David A.; Birch, Thomas W.; Frieswyk, Thomas S. 1988. **What's up with acid rain.** New England Farmer. February: A2-A3.
Reports that the current status of sugar maple is in good order.

Gansner, David A.; Dickson, David R.; Birch, Thomas W. 1988. **New England sets stocking records.** Northern Logger. 36(13): 8-10.

Garrett, Peter W.; Hong, Sung Ho; Shim, Sang Yung; Sohn, Sung In; Han, Sang Don. 1988. **Growth of "Korean Hybrids" in test plantings of pitch x loblolly pine in northeastern United States.** Research Report of the Institute of Forest Genetics, Korea. 24: 13-19.

Gentry, Claude E.; Willis, Raymond B. 1988. **Improved method for automated determination of ammonium in soil extracts.** Communications in Soil Science and Plant Analysis. 19(6): 721-734.
An improved sodium salicylate-hypochlorite, automated method for ammonium in soil-extracting solutions using nitroprusside as catalyst has been investigated. This method is two to three times more sensitive than previously published procedures and also is less subject to interferences, has less noise in the signal, and has two alternative ranges. The range with maximum sensitivity is linear to about 2.5 ppm; the second range is linear to 9 ppm. The procedures and instrumentation are simple for both ranges.

Gottschalk, Kurt W. 1988. **Gypsy moth and regenerating Appalachian hardwood stands.** In: Smith, H. Clay; Perkey, Arlyn W.; Kidd, William E. Jr., eds. Guidelines for regenerating Appalachian hardwood

stands: Workshop proceedings; 1988 May 24-26; Morgantown, WV. SAF Publ. 88-03. Morgantown, WV: West Virginia University Books: 241-254.
Gypsy moth defoliation can affect the natural regeneration of Appalachian hardwood stands in several ways. Actual and potential effects on the regeneration process are outlined briefly. Regeneration treatments that may minimize these effects are recommended based on ecological and silvicultural information on the insects and their hosts.

Gottschalk, Kurt W.; Gansner, David A.; Herrick, Owen W.; Mason, Garland N. 1988. **Coping with gypsy moth: guidelines for forest managers.** In: Proceedings, 1987 Society of American Foresters national convention: Economics and social development: role for forests and forestry professionals; 1987 October 18-21; Minneapolis, MN. Bethesda, MD: Society of American Foresters: 72-76.
An integrated pest management process for forest managers to deal with potential defoliation by, and catastrophic losses from, the gypsy moth is described. The process outlines how to: (1) assess stand susceptibility, (2) rate stand vulnerability and project potential losses, (3) consider impacts on management objectives, (4) monitor gypsy moth populations, and (5) select action alternatives. Silvicultural treatments for minimizing gypsy moth effects are presented as one of the action alternatives available to the forest manager. Geographic information systems have been used to refine the selection of forest stands that have the highest risks and identify those areas in need of priority treatment.

Grant, Richard H.; Heisler, Gordon M.; Herrington, Lee P. 1988. **Full-scale comparison of a wind-tunnel simulation of windy locations in an urban area.** Journal of Wind Engineering and Industrial Aerodynamics. 31: 335-341.

Grimble, David G. 1988. **Pheromone lures to monitor sparse populations of spruce budworm, *Choristoneura fumiferana* (Lepidoptera:Tortricidae).** The Great Lakes Entomologist. 21(4): 141-145.
Four types of spruce budworm pheromone lures were field-tested in sparse spruce budworm populations in Maine. BioLures® with constant pheromone emission rates less than 1.0, ca. 1.0-1.5, and ca., 15.0 micrograms of pheromone per day were compared to polyvinyl chloride (PVC) lures with rapidly decreasing pheromone emission rates. Mean trap catch was roughly proportional to lure emission rates. All lures continued to catch moths over the entire flight period, but moth catches with the three lowest emission-rate lures were too low. BioLures, with the highest emission rate (15.0 micrograms of pheromone per day), showed the lowest variability in trap catch and the fewest zero trap catches.

Hall, Richard W.; Barger, Jack H.; Townsend, Alden M. 1988. **Effects of simulated acid rain, ozone and sulfur dioxide on suitability of elms for elm leaf beetle.** Journal of Aboriculture. 14(3): 61-66.

Halverson, Howard G. 1988. **High-altitude photography to evaluate coal-mine reclamation.** In: Greer, Jerry D., ed. Remote sensing for resource inventory, planning, and monitoring: Proceedings of the 2nd Forest Service remote sensing applications conference; 1988 April 11-15; Slidell, LA. Falls Church, VA: American Society for Photogrammetry and Remote Sensing: 360-365.
Images of four mines on National High-Altitude Program photography taken between 1981 and 1985 were examined. In each case, areas of the mines that appeared dark on the photograph have resisted reforestation. This qualitative study did not isolate the cause of the image color or the elimination of vegetation. Pyrite oxidation resulting in the production of iron oxide and sulfuric acid is a possible explanation for both effects.

Halverson, Howard G.; Wade, Gary L. 1988. **Chemical variation in acid mine drainage in southern Kentucky.** In: Graves, Donald H.; DeVore, R. William, eds. Proceedings, 1988 Symposium on mining, hydrology, sedimentology, and reclamation; 1988 December 5-9; Reno, NV. UKY BU148. Lexington, KY: University of Kentucky, College of Engineering: 95-104.
Acid mine drainage is a major environmental concern in much of the Eastern United States coal region, but variations in the chemical properties of individual acid mine seeps are not well documented. In this study, water quality of five seeps from coal seams in southeastern Kentucky was monitored from the spring of 1987 until the spring of 1988. The seeps originated in undocumented deep mines probably worked early in this century on two adjacent watersheds. One watershed had three seep sources while the second watershed had two. Analysis of data on seep water chemistry showed that variables such as pH, Fe, Al, sulfate, and many other constituents varied significantly among seeps. However, water quality of individual seeps was con-

sistent over time. Analysis of principal components indicated that two underlying factors, tentatively identified as mineral weathering and solubility-ion exchange, control most of the chemistry of these acid-mine seeps.

Healy, William M. 1988. **Effects of seed-eating birds and mammals on Appalachian hardwood regeneration.** In: Smith, H. Clay; Perkey, Arlyn W.; Kidd, William E. Jr., eds. Guidelines for regenerating Appalachian hardwood stands: Workshop proceedings; 1988 May 24-26; Morgantown, WV. SAF Publ. 88-03. Morgantown, WV: West Virginia University Books: 104-111.
The consumption and dispersal of seeds by animals are important processes in Appalachian forests. Seeds and fruits are sources of nutrients and energy for many animals. The relationships among seed predators, seed dispersers, and plants are complex, involving much of the plant and animal community. Managing Appalachian forests for quality sawtimber appears to be compatible with maintaining populations of plants and the animals that eat and disperse seeds.

Healy, William M.; Brooks, Robert T. 1988. **Small mammal abundance in northern hardwood stands in West Virginia.** Journal of Wildlife Management. 52(3): 491-496.
Describes small mammal communities concurrent with maturity of even-aged stands of northern hardwoods. Capture rates of seven small mammals (southern red-backed vole, deer mouse, northern short-tailed shrew, woodland jumping mouse, eastern chipmunk, southern flying squirrel, and rock voles) were not correlated with stand age or overstory structure in 12 stands ranging from 8 to 205 years old. Species composition of the catch was similar in all stands. The seven mammals and even-age silviculture are compatible.

Heisler, Gordon M.; DeWalle, David R. 1988. **Effects of windbreak structure on wind flow.** Agriculture, Ecosystems and Environment. 22(23): 41-69.
Functional effects of windbreaks are directly related to the effects of windbreaks on air flow. Additionally, the indirect effects of windbreaks on air temperature and humidity are interrelated with the effects of air movement. The horizontal extent of windbreak effects, upwind and downwind, is usually assumed to be proportional to windbreak height, h. For windbreaks that are long relative to their windbreak height, the most important structural feature is porosity. Maximum wind reductions are closely related to porosity, with low porosity producing high maximum reduction. Barriers with very low porosity create more turbulence downwind than medium-dense barriers. The higher turbulence may result in recovery of mean horizontal windspeeds to upwind speeds closer to low-porosity barriers, resulting in a shorter protected distance. However, the reduction in protected distance with very dense windbreaks, compared to medium dense windbreaks, is much less than much of the older literature suggests.

Helvey, J. David; Kochenderfer, James N. 1988. **Culvert sizes needed for small drainage areas in the central Appalachians.** Northern Journal of Applied Forestry. 5: 123-127.
Within the central Appalachians, peak discharge from small watersheds (54 to 96 ac) was well correlated with drainage area for recurrence intervals of 10, 20, and 50 years. Culvert sizes to carry the expected flow rates are tabulated for standard conditions where (1) the water surface at the culvert inlet is the same elevation as the top of the pipe, (2) the outlet is not submerged, and (3) the culvert slope is at least 2 percent. Culvert sizes are presented for drainage areas in the central Appalachians between 10 and 200 ac, and the results are tested for applicability in the Northeast. This limited test indicated that required culvert size for forested watersheds increases with latitude north of the central Appalachians.

Helvey, J. D.; Patric, J. H. 1988. **Research on interception losses and soil moisture relationships.** In: Ecological studies. New York: Springer-Verlag: 129-137. Vol. 66: forest hydrology and ecology at Coweeta.

Herrick, Owen W.; Gansner, David A. 1988. **Changes in forest condition associated with gypsy moth on new frontiers of infestation.** Northern Journal of Applied Forestry. 5: 59-61.
Changes in forest condition associated with gypsy moth have now been measured for two infestations: northeastern Pennsylvania (1971-79) and central Pennsylvania (1978-85). Despite the variation in changes inflicted across both affected areas, average damage levels were similar in these case studies. Measurements taken before and after infestation indicate that changes in average plot volume were 8 and 9 percent, respectively. Before outbreaks in the respective areas, 87 percent of the plots were fully stocked or overstocked; afterward,

79 and 93 percent were in this condition but with a reduced oak component.

Hertel, Gerard, tech. coord. 1988. **Proceedings of the US/FRG research symposium: effects of atmospheric pollutants on the spruce-fir forests of the Eastern United States and the Federal Republic of Germany;** 1987 October 19-23; Burlington, VT. Gen. Tech. Rep. NE-120. Broomall, PA: U.S. Department of Agriculture, Forest Service, Northeastern Forest Experiment Station. 543 p.
Includes 66 papers presented at the US/FRG research symposium on the effects of atmospheric pollutants on the spruce-fir forests of the Eastern United States and the Federal Republic of Germany, October 19-23, 1987, Burlington, Vermont.

Hertel, Gerard D.; Zarnoch, Stanley J.; Arre, Theresa; Eagar, Christopher; Mohnen, Volker; Medlarz, Susan. 1988. **Status of the spruce-fir research cooperative program.** In: Hertel, Gerard, tech. coord. Proceedings of the US/FRG research symposium: effects of atmospheric pollutants on the spruce-fir forests of the Eastern United States and the Federal Republic of Germany; 1987 October 19-23; Burlington, VT. Gen. Tech. Rep. NE-120. Broomall, PA: U.S. Department of Agriculture, Forest Service, Northeastern Forest Experiment Station: 19-25.
The Spruce-Fir Research Cooperative was formed in 1985 as part of the joint USDA Forest Service and U.S. Environmental Protection Agency (EPA) Forest Response Program (FRP). This paper describes the current condition of the spruce-fir forests in eastern North America, the support groups needed to conduct the necessary research, and a summary of the projects being funded to answer the policy and scientific questions addressed by the Spruce-Fir Research Cooperative.

Hilburn, Daniel J.; Jennings, Daniel T. 1988. **Tericolous spiders (araneae) of insecticide-treated spruce-fir forests in west-central Maine.** The Great Lakes Entomologist. 21(3): 105-114.
Spiders of 12 families, 42 genera, and at least 62 species were captured in linear-pitfall traps placed in insecticide-treated[3] (Sevin-4-Oil®, Dipel 4L®, Thuricide 16B®) and untreated spruce-fir forests of west-central Maine. Species richness per family ranged from 1 (Theridiidae, Araneidae, Salticidae) to 19 (Erigonidae). Most trapped species were web-spinners (67.2 percent); most trapped individuals were hunters (75.2 percent). Lycosidae accounted for 66.1 percent of all (n = 887) captured spiders. Total trapped spiders varied among insecticide treatments, sampling dates, and study sites. However, comparison of mean prespray and postspray trap catches indicated no significant reduction (ANOVA, ANCOVA, $P \leq 0.05$) in tericolous spiders following insecticide treatment. Increases in spider abundance during postspray sampling periods may have masked detection of treatment effects.

Hilt, Donald E.; Dale, Martin E. 1988. **Developing management guidelines with OAKSIM: An individual-tree growth and yield simulator for managed even-aged, upland oak stands.** In: Economics of eastern hardwood management, Penn State Forest Resources Issues Conference; 1987 March 9-11; University Park, PA. University Park, PA: The Pennsylvania State University: 188-209.
Describes the applications, data entry, and results of OAKSIM. Then describes the use of OAKSIM to develop management guidelines for a specific management objective: to maximize landowner income by producing high-quality sawlogs and veneer products.

Hilt, Donald E.; Dale, Martin E. 1988. **Uses and applications of OAKSIM: an individual tree growth and yield simulator for managed, even-aged, upland oak stands.** The Compiler. 6(2): 25-35.
The applications, data entry inputs, and results of OAKSIM are described. Methods for using OAKSIM to study the timing, intensity, and frequency of intermediate thinnings are discussed. The importance of considering tree quality in hardwood stands is emphasized. Management guidelines are summarized for a wide range of age, site, and stocking conditions in the upland oak timber type. Rotation age must be considered when developing guidelines for even-aged stands.

Hilt, Donald E.; Teck, Richard M. 1988. **Individual-tree diameter growth model for northern New England.** In: Ek, Alan R.; Shifley, Stephen R.; Burk, Thomas E., eds. Forest growth modeling and prediction. Proceedings, IUFRO conference; 1987 August 23-27; Minneapolis, MN. Gen. Tech. Rep. NC-120. St. Paul, MN: U.S. Department of Agriculture, Forest Service, North Central Forest Experiment Station: 86-93. Vol. 1.
A distance-independent, individual-tree diameter growth model is developed for 14 species groups in northern New England. Potential periodic annual diameter growth is modeled for each species determined by d.b.h. and site index. Potential growth is

modified according to the basal area per acre that is larger than the subject tree.

Hornbeck, James W. 1988. **Nutrient cycling: a key consideration when whole-tree harvesting.** In: Proceedings, Maine's hardwood resource: quantity versus quality markets--management. Misc. Rep 327. Orono, ME: University of Maine, Agriculture Experiment Station: 7-11.

Hornbeck, J. W.; Smith, R. B.; Federer, C. A. 1988. **Growth trends in 10 species of trees in New England, 1950-1980.** Canadian Journal of Forest Research. 18: 1337-1340.
Tree-ring measurements on increment cores collected from more than 5000 trees during a periodic survey of forest resources in New England indicate trends in regional basal-area increment by species for the period 1950-1980. Two species, red spruce and balsam fir, have had generally decreasing growth rates since the 1960s. Normal aging of the low-elevation, even-aged spruce-fir forest is a probable cause. Eight other species, including sugar maple, had constant or increasing growth throughout the period. White pine had considerably higher growth rates than the other species.

Horsley, Stephen B. 1988. **Control of understory vegetation in Allegheny hardwood stands with Oust.** Northern Journal of Applied Forestry. 5: 261-262.
Sulfometuron methyl (methyl 2-[[[[(4,6-dimethyl-2-pyrimidinyl) - amino] carbonyl]amino]sulfonyl] -benzoate), marketed under the trade name Oust Weed Killer by E. I. DuPont de Nemours and Co., was evaluated for its ability to control three herbaceous (hay-scented fern, New York fern, and short husk grass) and two woody species (striped maple and American beech) in the understory of Allegheny hardwood stands. The herbicide was applied at four rates, 0, 2, 4, and 8 oz. of product/ac, at the beginning of each month from May through November. Both ferns were almost completely controlled at all application rates made between July 1 and October 1. Other dates of application gave less control and were rate-dependent. Short husk grass was not completely controlled at any time, but the most effective treatments were for the highest rate applied from September 1 through November 1. Striped maple and beech were not affected by any of the treatments.

Horsley, Stephen B. 1988. **Site preparation for regeneration of Allegheny hardwoods.** In: Proceedings of the conference on forestry herbicides in the northeast. 1988 March 15-16; New Brunswick, NJ. New Brunswick, NJ: Society of American Foresters, New Jersey Division: 54-62.
About 50 percent of the Allegheny hardwood stands on the Allegheny Plateau contain undesirable understories of hay-scented and New York fern, grasses, striped maple, and beech that interfere with the establishment and growth of desirable regeneration. Herbicide treatment of these stands, followed by shelterwood cutting, is effective in removing the undesirable plants and establishing an adequate number of new seedlings to regenerate the stand.

Horsley, Stephen B. 1988. **How vegetation can influence regeneration.** In: Smith, H. Clay; Perkey. Arlyn W.; Kidd, William E. Jr., eds. Guidelines for regenerating Appalachian hardwood stands: Workshop proceedings; 1988 May 24-26; Morgantown, WV. SAF Publ. 88-03. Morgantown, WV: West Virginia University Books: 38-54.
Associated vegetation can have negative or positive effects on regeneration. Plants compete with each other for light, moisture, and nutrients, and they produce toxic chemicals that may interfere with a neighboring plant's ability to survive and grow. Nitrogen-fixing plants usually stimulate growth of desirable trees. A variety of plants interferes with regeneration of desirable Appalachian hardwoods. These include ferns, grasses, beech, striped maple, rhododendron, mountain laurel, grapevines, oriental bittersweet, and tolerant understories containing red maple, sourwood, dogwood, sassafras, and black gum. The evidence for interference of these plants with Appalachian hardwood regeneration is addressed in the paper.

Houston, David R. 1988. **Southern forest tree declines--lessons from some northern counterparts.** In: Southwide forest disease workshop; 1988 June 7-9; Alexandria, LA. Alexandria, LA: U.S. Department of Agriculture, Forest Service, Southern Forest Experiment Station. Abstract.

Houston, David R.; Valentine, Harry T. 1988. **Beech bark disease: the temporal pattern of cankering in aftermath forests of Maine.** Canadian Journal of Forest Research. 18: 38-42.
In North America, beech bark disease occurs when bark of American beech (*Fagus grandifolia*) is infested by beech scale (*Cryptococcus fagisuga*), then

infected and killed by a fungus, *Nectria coccinea* var. *faginata, Nectria galligena*, or both. In long-affected stands, internal defect results as trees are cankered over time. The amount of defect, patterns of defect development, and the relationship of climate to these patterns were studied in 50 trees from two stands in eastern Maine. Cankering began in stems 12-37 years old and 2-11 cm diameter. Rates of cankering increased over time; years of high or low cankering were synchronous between trees and stands. Cankering in year N + 1 was negatively correlated ($R^2 = 0.803$) with October rainfall in year N and number of severely cold days from December in year N - 1 through March in year N. Presumably, these factors adversely affect the survival and establishment of the beech scale and perhaps the development of an infection by *Nectria* spp. Mild winters and dry autumns since 1983 may have permitted the marked increases in beech scale and bark cankering observed in study plots throughout the range of beech bark disease.

Jeffords, M. R.; Maddox, J. V.; McManus, M. L.; Webb, R. E.; Wieber, A. 1988. **Egg contamination as a method for the inoculative release of exotic microsporidia of the gypsy moth.** Journal of Invertebrate Pathology. 51: 190-196.
Two species of microsporidia, a *Nosema* sp. and a *Vavraia* sp., obtained from gypsy moths in Portugal, were released in a central Maryland woodlot. Each woodlot had low but increasing gypsy moth populations. Both species of microsporidia were introduced by placing gypsy moth egg masses contaminated by microsporidian spores on trees centrally located in each woodlot. Three sampling methods, one for early instar and two for late instar larvae, were used to determine the incidence of microsporidia infection and the extent of dispersal of diseased larvae infections. Infected larvae had dispersed throughout the sample area. The two late instar larval samples had infection rates of 6.3 and 7.8 percent for *Nosema* sp. and 9.4 to 16.9 percent for *Vavraia* sp. Late instar collections also indicated that infestations had spread throughout the sampling plots. Studies indicate that contamination of egg masses is an acceptable technique for introducing these microsporidia into gypsy moth populations.

Jennings, Daniel T.; Dimond, John B. 1988. **Arboreal spiders (*araneae*) on balsam fir and spruces in east-central Maine.** Journal of Arachnology. 16: 223-235.

Spiders of 11 families, 22 genera, and at least 33 species were collected from crown foliage samples of *Abies balsamea* (L.) Mill., *Picea rubens* Sarg., and *Picea glauca* (Moench) Voss in east-central Maine. For both study years (1985, 1986), spider species composition varied by foraging strategy (web spinner, hunter) and among 10 study sites. Numbers, life stages, and sex ratio of spiders also differed between study years. Spider densities per m^2 of foliage area generally were greater ($P \leq 0.05$) on spruces ($\overline{X} = 16.3 \pm 1.1$) than on fir ($\overline{X} = 10.9 \pm 1.0$). Estimates of absolute populations of arboreal spiders ranged from 35, 139 to 323, 080/ha, and of spruce budworm from 271, 401 to 6,122,919/ha. Spider-budworm densities/ha covaried significantly $P \leq 0.001$) each year ($r = 0.84$, 1985; $r = 0.71$, 1986). None of the measured forest-stand parameters (basal area, tree species percentage) were reliable predictors of spider populations/ha.

Jennings, Daniel T.; Hilburn, Daniel J. 1988. **Spiders (*araneae*) captured in malaise traps in spruce-fir forests of west-central Maine.** Journal of Arachnology. 16: 85-94.
Spiders of 12 families, 20 genera, and 25 species were captured in modified Malaise traps deployed in spruce-fir forests of Somerset and Piscataquis Counties, Maine. Numbers of species and individuals differed between foraging strategies of web-spinner and hunter. Sorensen's similarity quotient (QS) indicated that the Malaise-trapped fauna had greater similarity to arboreal than to terrestrial spider faunas of northeastern spruce-fir forests. Spider-trap interactions include accidental capture and possibly attraction; attractive features include trap architecture, concentrated potential prey, and protective shelter.

Jennings, Daniel T.; Houseweart, Mark W.; Dondale, Charles D.; Redner, James H. 1988. **Spiders (araneae) associated with strip-clearcut and dense spruce-fir forests of Maine.** Journal of Arachnology. 16: 55-70.
Spiders of 15 families, 76 genera, and at least 125 species were collected by pitfall traps in a spruce budworm-infested forest of northern Maine. Species of Lycosidae were numerically dominant and accounted for 56.2 and 54.1 percent of the total trapped specimens in 1977 and 1978, respectively. For both study years, significantly more ($P \leq 0.05$) individuals and species of spiders were captured in clearcut strips than in either uncut residual strips or dense stands. Peaks in seasonal activity of spiders

generally coincided with the spruce budworm's early and late larval stages; spiders were also abundant and active during budworm oviposition and dispersal of first instars. Diversity of spider species was generally greater in dense stands and uncut residual strips than in clearcut strips. Individuals were distributed unevenly among species but more evenly in dense stands and uncut residual strips than in clearcut strips. Coefficients of community (CC) and percentage similarity (PS) values indicated that more spider species than individuals were shared in common among forest conditions. Neither age of strip clearcut (1-6 years) nor litter depth had much influence on mean catches and mean numbers of species of spiders per trap per week.

Jennings, Daniel T.; McDaniel, Ivan N. 1988. ***Latrodectus hesperus* (Aranea: Theridiidae) in Maine.** Entomological News. 99(1): 37-40.
A female and egg sac of the western black widow, *Latrodectus hesperus*, were introduced into Maine among household goods transported from Phoenix, Arizona. A total of 292 spiderlings emerged from the egg sac. Survival of offspring could have formed the nucleus of a breeding population.

Jensen, K. F.; Dochinger, L. S. 1988. **Response of ten hardwood species to ozone, SO_2, and acid precipitation.** In: 81st annual meeting of Air Pollution Control Association; 1988 June 19-24; Dallas, TX. Pittsburgh, PA: Air Pollution Control Association: 65. Abstract.

Jensen, Keith F.; Dochinger, Leon S. 1988. **Response of eastern hardwood species to ozone, sulfur dioxide and acid precipitation.** Publ. 88-70.3. [Presented at 81st annual meeting of Air Pollution Control Association; 1988 June 19-24; Dallas, TX]. Pittsburgh, PA: Air Pollution Control Association. 10 p.
Seedlings of 10 hardwood species, yellow birch, American beech, European beech, white oak, red maple, sugar maple, white ash, sweetgum, shagbark hickory, and yellow-poplar were potted in 15-cm pots in an artificial soil mixture and assigned to 18 fumigation and acid rain treatments. The fumigation treatments were 0.0, 0.07, and 0.15 ppm ozone 6 hours/day for 3 days with and without 0.02 ppm SO_2 24 hours/day (six treatments). The pH's of the acid rain treatments were 3.0, 3.5, and 4.2. The fumigation treatments were applied in CSTR fumigation chambers in a greenhouse. Ozone and acid rain affected one or more of the growth variables on six species tested. Air pollution injury was observed on yellow birch, red maple, yellow-poplar, sweetgum, and white ash.

Jensen, K. F.; Patton, R. L.; Schier, G. A. 1988. **Effects of simulated acid rain and ozone on red spruce seedlings: an interim report.** In: Hertel, Gerard, tech. coord. Proceedings of the US/FRG research symposium: effects of atmospheric pollutants on the spruce-fir forests of the Eastern United States and the Federal Republic of Germany; 1987 October 19-23; Burlington, VT. Gen. Tech. Rep. NE-120. Broomall, PA: U.S. Department of Agriculture, Forest Service, Northeastern Forest Experiment Station: 413-415.
Red spruce *(Picea rubens* Sarg.) seedlings are exposed to ozone (control: 0.15 ppm, 6 h/d; 0.15 ppm, 6 h/d + 0.07 ppm, 18 h/d) in combination with simulated acid rain (pH 4.5, 4.0, or 3.5) applied once (12.7 mm) per week. Plants harvested at 7-week intervals (five harvest dates) to examine the effects of treatment on growth photosynthesis, carbohydrate levels, and foliar leaching. Only data on growth and net photosynthesis from the first two harvests (7 and 24 weeks) are available at this time. The only variable significantly affected by treatment was new-stem dry weight in the first harvest. New-stem dry weight was higher at pH 4.0 than at 4.5 or 3.5, and higher at 24 h of ozone than at the control of 6 h of ozone. No interactive effects of the two pollutants were observed.

Johnson, D. W.; Kelly, J. M.; Swank, W.T.; Cole, D. W.; Van Miegroet, H.; Hornbeck, J. W.; Pierce, R. S.; Van Lear, D. 1988. **The effects of leaching and whole-tree harvesting on cation budgets of several forests.** Journal of Environmental Quality. 17(3): 418-424.
The effects of acid deposition, natural leaching, and harvesting on base cation export from forests in Maine, Tennessee, South Carolina, North Carolina, and Washington were compared. Based on previous literature, the hypothesis stated that base cation export via whole-tree harvesting (WTH) would be nearly independent of soil exchangeable base cation supplies; base cation export via leaching would be strongly dependent on the exchangeable cation supplies as well as the input, production, and mobility of anions. This hypothesis was supported by the data: mixed deciduous sites in Tennessee had among the highest base cation (principally Ca) exports via WTH (1.2 $kmol_c$ ha^{-1} yr^{-1}), yet the lowest soil exchangeable supplies (35

$kmol_c$ ha^{-1}), whereas the Washington sites had, by far, the highest base cation leaching (5-41 $kmol_c$ ha^{-1} yr^{-1}, due to very high levels of naturally produced HCO_3) and soil exchangeable supplies, yet only relatively moderate base cation exports via WTH (0.4 $kmol_c$ ha^{-1} yr^{-1}).

Kidd, William E., Jr.; Smith, H. Clay. 1988. **Regenerating Appalachian hardwoods: workshop objectives, terminology, and expectations.** In: Smith, H. Clay; Perkey, Arlyn W.; Kidd, William E., Jr., eds. Guidelines for regenerating Appalachian hardwood stands: Workshop proceedings; 1988 May 24-26; Morgantown, WV. SAF Publ. 88-03. Morgantown, WV: West Virginia University Books: 1-4.
Presents information on how to regenerate Appalachian hardwood stands. Topics range from common harvesting methods practiced on public, private, and industrial forest lands to evaluating how seed dispersal is influenced by birds and mammals. This information should help landowners and practicing foresters work together to understand the necessary hardwood regeneration techniques needed to satisfy specific objectives.

Kingsley, Neal P. 1988. **Role of the wildlife manager in nonindustrial private-forest management.** In: Transactions of the 53rd North American Wildlife and Natural Resources Conference; 1988 March 18-23; Louisville, KY. Washington, DC: Wildlife Management Institute: 33-40.
Addresses the role wildlife managers can and need to play in helping manage nonindustrial private forests.

Kingsley, Neal P.; Brock, Samuel M.; DeBald, Paul S. 1988. **Focus group interviewing applied to retired West Virginia nonindustrial private forest landowners.** Northern Journal of Applied Forestry. 5(3): 198-200.
In order to gain a deeper understanding of the interests and motivations of retired West Virginia forest landowners, the focus group interviewed four groups of retired resident owners. The techniques revealed a strong sense of stewardship toward the land and a concern for family, society and future generations. Those interviewed tended to downplay the financial aspects of timber production. A land ethic is clearly implied by their comments, which express a sense of security and well-being from the ownership of forestland and which evidence a deep feeling for nature. Focus group interviewing is valuable in understanding the land owning population--a technique that goes beyond the information provided by mail canvasses.

Lamson, Neil I. 1988. **Precommercial thinning and pruning of Appalachian stump sprouts--10-year results.** Southern Journal of Applied Forestry. 12(1): 23-27.
In northern West Virginia, sprouts at 7-year-old American basswood and 12-year-old red maple, black cherry, and northern red oak stumps received one of four treatments: unthinned control thinned to the best one or two codominant sprouts per clump branch pruned up to 75 percent of total height or thinned plus pruned. Analysis of 10-year growth data showed that height growth was not affected by any treatment. For all species, pruning slightly increased the length of clear stem and decreased periodic diameter growth by 0.1 to 0.8 inch.

Lamson, Neil I. 1988. **Role of stump sprouts in regenerating Appalachian hardwood stands.** In: Smith, H. Clay; Perkey, Arlyn W.; Kidd, William E. Jr., eds. Guidelines for regenerating Appalachian hardwood stands: Workshop proceedings; 1988 May 24-26; Morgantown, WV. SAF Publ. 88-03. Morgantown, WV: West Virginia University Books: 31-37.
Stump sprouts are an important source of regeneration in Appalachian hardwood stands. Tables are presented that show sprouting frequency and the percentage of stumps that produce sprouts. Generally, sprouting from cut stumps decreases as stump size and tree age increase. Recommendations are given for increasing or decreasing the number of sprouts in newly regenerated stands.

Lamson, Neil I., Smith, H. Clay. 1988. **Thinning cherry-maple stands in West Virginia: 5-year results.** Res. Pap. NE-615. Broomall, PA: U.S. Department of Agriculture, Forest Service, Northeastern Forest Experiment Station. 7 p.
In northern West Virginia, 60-year-old cherry-maple stands were thinned to 75, 60, and 45 percent relative stand density. Analysis of 5-year growth data showed that basal-area growth was not reduced by thinning. Cubic-foot and board-foot volume growth decreased slightly. Individual-tree growth of all trees and dominant/codominant trees in the 45 percent plots grew about 0.42 inch more in 5 years than those in the control plots. Optimum stand density probably is less than 60 percent of relative stand density.

Lamson, Neil I.; Smith, H. Clay. 1988. **Effect of logging wounds on diameter growth of sawlog-size Appalachian hardwood crop trees.** Res. Pap. NE-616. Broomall, PA: U.S. Department of Agriculture, Forest Service, Northeastern Forest Experiment Station. 3 p.
In previously thinned, even-aged Appalachian hardwood stands, 5-year diameter growth of 102 wounded and 102 unwounded codominant crop trees were compared. A wounded crop tree was defined as one with at least one exposed sapwood logging wound at least 100 inch^2 in size. An unwounded crop tree of the same species and size was selected near each of the 102 wounded trees. Five-year diameter growth of wounded crop trees averaged 1.34 inches, while unwounded crop trees averaged 1.40 inches. Paired t-test showed no significant differences in 5-year diameter growth between wounded and unwounded crop trees.

Lamson, Neil I.; Smith, H. Clay; Perkey, Arlyn W.; Wilkins, Brenda L. 1988. **How to release crop trees in precommercial hardwood stands.** NE-INF-80-88. Broomall, PA: U.S. Department of Agriculture, Forest Service, Northeastern Forest Experiment Station.

Leak, William B. 1988. **Effects of weed species on northern hardwood regeneration in New Hampshire.** Northern Journal of Applied Forestry. 5: 235-237.
Measurements on more than 1,500 milacres of northern hardwood were taken 8 years after cutting by commercial clearcutting, diameter limit, moderate and light selection. Milacres dominated by striped maple or hobblebush were respectively, 1/4 to 1/3 or 1/4 to 2/3 nonstocked with established commercial species. Milacres dominated by pin cherry showed no reduction in stocking of commercial tree species when compared to milacres without dominating weeds. Among individual commercial species, sugar maple and white ash showed the least response to dominating weed competition. The results provide preliminary guidelines on evaluating weed competition during regeneration surveys.

Leak, William B. 1988. **New guidelines on managing for quality trees.** In: Proceedings, Maine's hardwood resource: quantity versus quality markets--management. Misc. Rep. 327. Orono, ME: University of Maine, Agricultural Experiment Station: 12-17.

LeDoux, Chris B. 1988. **Impact of timber production and transport costs on stand management.** Res. Pap. NE-612. Broomall, PA: U.S. Department of Agriculture, Forest Service, Northeastern Forest Experiment Station. 5 p.
Evaluates the impact of cable logging technology, transportation network standards, and transport vehicles on stand management. Managers can use results to understand the impact of timber production costs on eastern hardwood management.

LeDoux, Chris B.; Baumgras, John E. 1988. **Analysis of harvesting opportunities for thinning eastern hardwoods on steep terrain.** In: Proceedings of international mountain logging and Pacific Northwest skyline symposium; 1988 December 12-16; Portland, OR. Portland, OR: Oregon State University: 93-96 p.
Harvesting cost and revenue models were used to evaluate yarding costs by yarder type and to compare stump-to-mill harvesting costs to revenues available from multiproduct thinnings in eastern hardwoods. Analysis includes six types of cable yarders and thinnings in stands where the average d.b.h. harvested trees ranged from 7 to 12 inches. Also includes four types of market factor: primary products, three product price levels, and three truck-haul distances. Results show cost savings by selection of harvesting equipment; and that, given favorable market conditions and efficient yarding, early entries for thinning can be economically feasible. Shows the importance of factoring product mix, product prices, and market location into the economic analysis of thinning opportunities.

Luppold, William G. 1988. **Material-use trends in U.S. furniture manufacturing.** Southern Journal of Applied Forestry. 12(2): 102-107.
Furniture manufacturers in the United States are major users of a variety of wood products. In the last two decades, traditional wood products--hardwood lumber, veneer, and plywood--have been, in part, replaced by composite panel products--particleboard, hardboard, and medium-density fiberboard. Examines in descriptive and numerical terms, the uses of traditional and composite wood products by the wood household, upholstered household, and commercial furniture industries. In the household wood furniture industry, substitution of composite products for traditional hardwood products has subsided in recent years but has continued in the commercial furniture industry. Softwood lumber use has grown in the household wood

industry and the household upholstered furniture industry but not in the commercial furniture industry. Although hardwood lumber has been displaced by softwood-based composite panel products, greater relative decreases have occurred in hardwood veneer and veneer core plywood use because of composite panel substitution. Most recent market activities, however, indicate increased use of hardwood lumber in furniture production during the 1980s.

Luppold, William G. 1988. **What determines the price of hardwood timber?** In: Economics of eastern hardwood management. Penn State forest resources issues conference; 1987 March 9-11; University Park, PA. University Park, PA: The Pennsylvania State University: 238-253.
Examines the actions of consumers, secondary and primary processors, loggers, and landowners, how the actions influence stumpage price, and the factors that influence the actions.

Luppold, William G. 1988. **Current trends in the price and availability of pallet lumber.** Pallet Enterprise. 8(5): 30, 32.

Luppold, William G. 1988. **Hardwood import trends.** Res. Pap. NE-619. Broomall, PA: U.S. Department of Agriculture, Forest Service, Northeastern Forest Experiment Station. 9 p.
Although imports of most hardwood products have varied since 1970 with no absolute trend, imports of hardwood plywood have decreased while imports of wood furniture have increased dramatically.

Luppold, William G.; Araman, Philip A. 1988. **Hardwood trade trends: U. S. exports.** Res. Pap. NE-611. Broomall, PA: U. S. Department of Agriculture, Forest Service, Northeastern Forest Experiment Station. 10 p.
Presents historic trends in the export of hardwood logs, lumber, veneer, and plywood. Discusses factors that will influence future hardwood product exports.

Lynch, James A.; Corbett, Edward S.; Grimm, Jeffrey W. 1988. **Atmospheric deposition: spatial and temporal variations in Pennsylvania--1987.** Publ. ER8806A. University Park, PA: The Pennsylvania State University, Environmental Resources Research Institute. 103 p. plus appendix.

Lynch, James A.; Corbett, Edward S.; Grimm, Jeffrey W. 1988. **Atmospheric deposition: spatial and temporal variation in Pennsylvania--1987.** Publ. ER8806. University Park, PA: The Pennsylvania State University, Environmental Resources Research Institute. 103 p.

MacLean, Colin D.; Scott, Charles T. 1988. **Interpolating current annual growth from two d.b.h. measurements.** In: Ek, Alan R.; Shifley, Stephen R.; Burk, Thomas E., eds. Forest growth modeling and prediction. Proceedings, IUFRO conference; 1987 August 23-27; Minneapolis, MN. Gen. Tech. Rep. NC-120. St. Paul, MN: U.S. Department of Agriculture, Forest Service, North Central Forest Experiment Station: 1118-1123. Vol. 2.
The current annual growth of inventory tally trees is frequently calculated by estimating the tree's volume 1 year ago and subtracting it from the current volume. For remeasured permanent plots, (d.b.h.) 1 year ago is interpolated between the current d.b.h. and the d.b.h. at the previous measurement. The estimated current annual growth depends on whether a constant rate of d.b.h. growth or basal area growth is assumed. To test various d.b.h. growth assumptions, remeasurement data were analyzed from over 5,000 sample trees in western Oregon and Vermont, each with three d.b.h. measurements spanning two inventory cycles. Using measured d.b.h. growth from occasion 1 to occasion 3 as a base, the d.b.h. of each tree at occasion 2 was estimated, using several d.b.h. growth-model assumptions. These estimates were then compared to the measured d.b.h. at occasion 2. The best model assumption varied by species, stand age, and stand density, with no single model offering acceptable results for all conditions.

Marquis, David A. 1988. **Guidelines for regenerating cherry-maple stands.** In: Smith, H. Clay; Perkey, Arlyn W.; Kidd, William E. Jr., eds. Guidelines for regenerating Appalachian hardwood stands: Workshop proceedings; 1988 May 24-26; Morgantown, WV. SAF Publ. 88-03. Morgantown, WV: West Virginia University Books: 167-188.
The major factors affecting natural regeneration in cherry-maple forests include: deer browsing, advance seedlings, interfering vegetation, seed supply, soil-site conditions and environmental conditions as influenced by stand density and cuttings. To prescribe regeneration treatments, it is recommended that these factors be assessed by collecting data on specific overstory, understory, and site variables, analyzing that data to determine the stand's regeneration potential, then deciding

upon a treatment using guidelines based on critical levels of the major factors. Clearcutting, shelterwood cutting, herbicide treatment of the understory, fencing, fertilization of young seedlings, and planting are all treatments that may be needed. A computer program called SILVAH is available to perform the stand analysis and prepare specific prescriptions for individual stands.

Martin, C. Wayne. 1988. **Soil disturbance by logging in New England--review and management recommendations.** Northern Journal of Applied Forestry. 5: 30-34.
The extent and magnitude of soil disturbance caused by mechanized, whole-tree harvesting was studied on a central hardwood site in Connecticut, a northern hardwood site in New Hampshire, and a spruce-fir site in Maine. Twenty-nine percent of the soil surface at the central hardwood site was undisturbed, but only 8 percent on the other sites was undisturbed. Mineral soil was exposed on 8 to 18 percent of soil surfaces after cutting, with wheel ruts more than 30 cm deep occupying less than 3 percent. Mechanized whole-tree harvesting causes a greater proportion of soil disturbance than other harvesting systems and will affect advanced and subsequent regeneration to a greater degree.

Martin, C. Wayne; Harr, R. Dennis. 1988. **Precipitation and streamwater chemistry from undisturbed watersheds in the Cascade mountains of Oregon.** Water, Air, and Soil Pollution. 42: 203-219.
Long-term records of precipitation and streamwater chemistry are rare; such records from forested watersheds relatively free of acidic deposition are even more rare. Precipitation and streamwater chemistry have been measured on two undisturbed forested watersheds at the H. J. Andrews Experimental Forest located on the western slopes of the Cascade mountains of Oregon. Data from one watershed spans the period 1973-1985, the other 1969-1985. The mean annual pH of precipitation was 5.5 with a range of 4.7 to 6.0 HCO_3^- was the dominant anion; Ca^{2+} and Na^+ were the dominant cations. The mean annual pH of streamwater was 7.3, and was dominated by HCO_3^- and Ca^{2+} . These data contrast sharply with data from other calibrated watersheds in the north Cascade mountains of Washington and British Columbia, and with data from New Hampshire and North Carolina where pH of precipitation averages 4.14 and 4.43, respectively, with SO_4^{2-} the dominant anion.

McKnight, M. E.; Jennings, Daniel T.; Hacker, Susanne C.; Knight, Fred B. 1988. **North American Coniferophagous *Choristoneura*: a bibliography.** Bibliogr. Lit. Agric. No. 59. Washington, DC: U. S. Department of Agriculture, Forest Service. 580 p.

McManus, Michael L. 1988. **Weather, behaviour and insect dispersal.** Memoirs of the Entomological Society of Canada. 146: 71-94.
Individual meteorological factors, particularly temperature and wind, directly influence the dispersal of arthropods, as do weather systems--formation and movement of air masses, cold and warm fronts, and air flows associated with topographical features such as mountains, valleys, and bodies of water. Models recently have been developed that simulate the effects of many of these systems on airborne dispersal of insects. Also, some attention has recently been directed toward the behaviour of arthropods during weather conducive to dispersal. Clearly, both winged and wingless forms of arthropods respond to certain stimuli for dispersal and behave specifically to enhance the potential for migration. Recent progress toward understanding the interplay between insect movement and mesoscale weather is particularly relevant to pest management.

McManus, M. L.; Twardus, D. 1988. **Identifying gypsy moth early larval instars.** NA-FB/P-32. Broomall, PA: U.S. Department of Agriculture, Forest Service, Northeastern Area State and Private Forestry. 1 p.
Describes the four principal characteristics to use in distinguishing the first three larval instars of gypsy moth under field conditions: (1) body size; (2) color on the upper body surface; (3) color of head capsule; (4) width of head capsule in relation to width of the body.

McNamee, Peter; Jones, Michael L.; Greig, Lorne A.; Webb, Timothy W.; Hertel, Gerard; Zarnoch, Stanley J. 1988. **Research planning for the spruce-fir research cooperative.** In: Hertel, Gerard, tech. coord. Proceedings of the US/FRG research symposium: effects of atmospheric pollutants on the spruce-fir forests of the Eastern United States and the Federal Republic of Germany; 1987 October 19-23; Burlington, VT. Gen. Tech. Rep. NE-120. Broomall, PA: U.S. Department of Agriculture, Forest Service, Northeastern Forest Experiment Station: 5-18.
Addresses the research planning activities within the Spruce-Fir Research Cooperative which were

initiated through a series of workshops involving research scientists, resource managers and policy makers. This effort resulted in a conceptual model that synthesized the current scientific knowledge on red spruce. In addition, a set of hypotheses of cause worthy of research was developed and a research strategy was outlined.

McPherson, E. Gregory; Herrington, Lee P.; Heisler, Gordon M. 1988. **Impacts of vegetation on residential heating and cooling.** Energy and Buildings. 12: 41-51.
Computer simulation has been used to test the effects of irradiance and wind reductions on the energy performance of similar residences of 143 m^2 in four U.S. cities--Madison, Salt Lake City, Tucson, and Miami--representing four different climates. Irradiance reductions from vegetation were modeled using SPS, which simulates shade cast from plants on buildings, and MICROPAS, a microcomputer-based energy analysis program. Space cooling costs were found to be most sensitive to roof and west wall shading, where-as heating costs were most sensitive to south and east wall shading. Irradiance reductions were shown to increase substantially annual heating costs in cold climates ($128, or 28 percent, in Madison), and reduce cooling costs in hot climates ($249, or 61 percent, in Miami). Dense shade on all surfaces reduced peak cooling loads by 31 to 49 percent or 3108-4086 W. A 50 percent wind reduction was shown to lower annual heating costs by $63 (11 percent) in Madison, and increased annual cooling costs by $68 (15 percent) in Miami. Planting designs for cold climates should reduce winter winds and provide solar access to south and east walls. This guideline also applies for temperate climates; however, it is also important to avoid blocking summer winds. In hot climates, high-branching shade trees and low ground covers should be used to promote both shade and wind.

McPherson, E. Gregory; Rowntree, Rowan A. 1988. **Geometric solids for simulation of tree crowns.** Landscape and Urban Planning. 15: 79-83.
Geometric solids are used to simulate tree crowns and their shadows. If tree crowns cannot be accurately modeled by standard geometric shapes, inaccurate estimates of shadow-pattern location can result. This error may cause substantial inaccuracies in subsequent calculations of tree-shade effects on space heating and cooling costs, as well as in estimates of crown volume and leaf surface area. This study found no statistically significant difference between formula- and photo-estimated tree-crown profile areas when open-grown trees were assigned geometric shapes using a template. Less than 10 percent mean difference was found between the measures for three crown shapes: paraboloids, vertical ellipsoids, and horizontal ellipsoids.

Miller, Gary W. 1988. **Economics of herbicide application methods in hardwoods.** In: Vodak, Mark C., ed. Proceedings of the conference on forestry herbicides in the Northeast; 1988 March 15-16; New Brunswick, NJ. Sponsored by New Jersey Division, Society of American Foresters, Rutgers University Cooperative Extension, Cook College, and U.S. Department of Agriculture, Forest Service. [Place of publication unknown]: [Publisher name unknown]: 89-99.
Forest managers can use the data to determine the least-cost herbicide application for precommercial thinning treatments in hardwood sapling stands. Herbicides used in managing immature hardwood stands must be applied using individual tree methods; broadcast applications in hardwoods are not selective and may result in significant damage to preferred crop trees. Individual-tree herbicide application methods include variations of injection, basal spraying, and cut-stump treatments after mechanical felling operations. Total costs per acre for these methods and for chain-saw felling were compared for a precommercial thinning in a hardwood sapling stand.

More, Thomas A. 1988. **The positive values of urban parks.** Urban Parks and Recreation. 25(3): 13-17.

More, Thomas A. 1988. **Introduction.** Urban Parks and Recreation. 25(3): 2-4.

More, Thomas A.; Stevens, Thomas; Allen, P. Geoffrey. 1988. **Valuation of urban parks.** Landscape and Urban Planning. 15: 139-152.
One reason why urban parks and open spaces are subject to development pressure is that planners and researchers have been unable to articulate their value in economic terms. Three valuation techniques--each with its own strengths and weaknesses--have been applied to urban parks. This paper reviews the three techniques and presents results from the hedonic valuation technique. Results alert landscape planners of the strengths and shortcomings of each technique.

Nevel, Robert L., Jr.; Wharton, Eric H. 1988. **The timber industries of southern New England--a periodic assessment of timber output.** Resour. Bull. NE-101. Broomall, PA: U.S. Department of Agriculture, Forest Service, Northeastern Forest Experiment Station. 28 p.
Evaluates regional timber output based on the results of a survey of the timber industries of southern New England. Contains statistics on industrial timber production and receipts in Connecticut, Massachusetts, and Rhode Island, by state and species; log shipments between states; sawmills, and lumber production; and the production and disposition of manufacturing residues. Comparisons are made with historical and recent data, and trends in industrial wood output are noted. Includes graphics and statistical tables.

Nolley, Jean W. 1988. **Bulletin of hardwood market statistics: summer 1988.** Gen. Tech. Rep. NE-121. Broomall, PA: U.S. Department of Agriculture, Forest Service, Northeastern Forest Experiment Station. 23 p.
Provides current and historical information on primary and secondary hardwood product production, prices, international trade, and employment.

Nolley, Jean W. 1988. **Bulletin of hardwood market statistics: fall 1988.** Gen. Tech. Rep. NE-122. 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.

Northeastern Forest Experiment Station. 1988. **Plant, soil, and water analysis laboratory.** NE-INF-79-88. Broomall, PA: U.S. Department of Agriculture, Forest Service, Northeastern Forest Experiment Station. 10 p.

Ossenbruggen, H. Sharon. 1988. **Tree health and care.** Greenmaster. 24(3): 11, 15.
Discusses how to protect trees from injury and keep them healthy so that they can respond to injury.

Patton, Roy L.; Jensen, Keith F. 1988. **Effects of ozone and acidified rain on carbohydrates in needles and roots of red spruce seedlings.** Phytopathology. 78(12): 1581.
One-year-old red spruce (*Picea rubens* Sarg.) seedlings were treated with ozone and acidified rain to determine the effects of these treatments on sugar and starch in foliage and roots. The ozone treatments (CSTR chambers) were (1) carbon-filtered air (CF), (2) CF plus 0.15 ul/l ozone for 6 h/d, and (3) CF plus 0.15 ul/l ozone for 6 h/d plus 0.07 ul/l ozone for 18 h/d. The seedlings were treated once each week with 1.25 cm of rain at pH 3.5, 4.0, or 4.5 (2:1 mixture of H_2SO_4 and HNO_3 in deionized water). After 21 weeks, sugar and starch concentrations in roots and needles were determined. Ozone caused total nonstructural carbohydrates (TNC) (sugar + starch) to increase in current needles and also increased the proportion of starch in those needles. TNC was higher in roots of plants treated with pH 3.5 rain than in roots of plants treated with pH 4.0 rain. The ozone and rain treatments had no effects on sugar or starch concentrations in 1-year-old needles.

Peacock, J. W.; Wright, S. L.; Galford, J. R. 1988. **Attraction of acorn-infesting *Cydia latiferreana* (Lepidoptera:tortricidae) to pheromone-baited traps.** The Great Lakes Entomologist. 21(4): 151-156.
Males of acorn-infesting *Cydia latiferreana* are attracted to an equilibrium mixture of the four isomers of 8, 10-dodecadien-1-ol acetate, the virgin female-produced pheromone. Trap height relative to the height of trees in which traps are placed appears a significant factor influencing moth catches at attractant-baited traps. In an oak woodlot and in an oak nursery, catches of male moths were greater in traps placed near the upper periphery of the canopy than at traps deployed at lower levels in the tree. Practical application of pheromone-baited traps in a forest situation will require further study on lure formulation and on trap deployment under forest conditions.

Perkey, Arlyn W.; Powell, Douglas S. 1988. **Regenerating Appalachian hardwoods: the current situation??** In: Smith, H. Clay; Perkey, Arlyn W.; Kidd, William E. Jr., eds. Guidelines for regenerating Appalachian hardwood stands: Workshop proceedings; 1988 May 24-26; Morgantown, WV. SAF Publ. 88-03. Morgantown, WV: West Virginia University Books: 5-16.
The relative quantity of regeneration cutting in the Appalachian Region is described, along with an indication of landowners' understanding and attitudes regarding regeneration cutting practices. Several foresters were asked to complete a questionnaire regarding the type of regeneration

they think is occurring in their respective geographic areas. These subjective observations are compiled for the oak, cove hardwood, and cherry-maple types.

Peters, Penn A. 1988. **The load curve intercept method: estimating the effect of average piece-size on skidding costs.** In: Proceedings of 1988 international winter meeting of American Society of Agricultural Engineers; 1988 December 13-16; Chicago, IL. St. Joseph, MI: American Society of Agricultural Engineers; 27 p.
The load curve intercept method is introduced as a general method to analyze 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.

Potter, F. I., III; Lynch, J. A.; Corbett, E. S. 1988. **Source areas contributing to the episodic acidification of a forested headwater stream.** Journal of Contaminant Hydrology. 3: 293-305.
A study was initiated on the Leading Ridge experimental watersheds in central Pennsylvania to investigate the extent to which episodic depressions of streamwater pH result from direct channel interception of acidified rainwater and from rapid subsurface stormflow. During a 4.78-cm rainfall event on June 6, 1986, stream pH declined from 5.93 to 5.46. Analysis of the storm hydrograph indicated that direct channel interception accounted for only 2.8 percent of the total stormflow volume but contributed 40 percent of the total increase in the concentration of H^+. At peak flow, channel interception accounted for 5.7 percent of the stormflow volume and 72 percent of H^+. Large increases in the height of the saturated soil zone and coinciding increases in H^+ concentrations in soilwater were measured at a number of soilwater observation wells. These fluctuations occurred almost simultaneously with measured fluctuations in both streamflow and streamwater H^+ concentrations, indicating direct interactions between saturated soilwater and the storm discharge. Results indicate that catchments in which soil macropores permit rapid subsurface flow could be especially susceptible to stream acidification.

Profous, George V.; Rowntree, Rowan A.; Lobe, Robert E. 1988. **The urban forest landscape of Athens, Greece: aspects of structure, planning and management.** Arboricultural Journal. 12: 83-107.
Seven neighborhoods in the Athens metropolitan area were sampled to study the structure of the urban forest. Species composition, diameter class, land-use, and tree condition were recorded. Although species diversity in older neighborhoods was higher, over 50 percent of the area sampled was composed of five species. More than 50 percent of the trees were under 7.6 cm with nearly 20 percent over 15.5 cm. Recent plantings of small diameter trees in areas with limited growing space differ from the larger diameter species surviving from earlier planting eras. Rapid development and intense land uses in many areas now govern the future of the urban forest. The fragmentation of local government into many units and the division of responsibility over several national ministries limit urban forest management. The 1979 Forest Preservation Decree (P.L. 998) set strict guidelines on tree removal, yet its effects are primarily felt on the rural fringe of the metropolitan area.

Quattrochi, D. A.; Rowntree, R.A. 1988. **Potential of Thermal Infrared Multispectral Scanner (TIMS) data for measurement of urban vegetation characteristics.** In: Greer, Jerry D., ed. Remote sensing for resource inventory, planning, and monitoring: proceedings of 2nd Forest Service remote sensing applications conference; 1988 April 11-15; Slidell, LA. Falls Church, VA: American Society of Photogrammetry and Remote Sensing: 344-354.
Discusses large-scale airborne Thermal Infrared Multispectral Scanner (TIMS) data for estimating the thermal characteristics of urban vegetation. Vegetation is an important component in the urban biophysical system. Due to the spatial heterogeneity of urban surfaces, specific properties of urban vegetation, such as biomass and thermal status, have been difficult to extract from satellite data. The TIMS sensor, however, obtains thermal measurement of surfaces within the city at different scales and at different times on a diurnal basis. The potential of TIMS data is evaluated for understanding dynamic attributes of urban vegetation. Data acquired by hand-held radiometers are used to illustrate the spatial and temporal variability in surface temperatures around the city, stressing the need for the TIMS as an integrator of spatial data.

Rast, Everette D.; Beaton, John A.; Sonderman, David L. 1988. **Photographic guide to selected external defect indicators and associated internal**

defects in black walnut. Res. Pap. NE-617. Broomall, PA: U.S. Department of Agriculture, Forest Service, Northeastern Forest Experiment Station. 24 p.
To classify or grade logs or trees properly, requires correct identification of defect indicators and assessment of the underlying defect effect on possible end products. This guide aids in identifying the surface-defect indicator and shows the progressive stages of the defect in black walnut. It illustrates and describes 10 particularly difficult types of external defect indicators and associated defects.

Rogers, Garry F.; Rowntree, Rowan A. 1988. **Intensive surveys of structure and change in urban natural areas.** Landscape and Urban Planning. 15: 59-78.
Discusses a methodology for surveying high value biotic resources typical of urban parks and natural areas. Procedures include (1) mapping vegetation by recognizing separate units or entities, referred to as "entitation", (2) establishing permanent camera stations for studying change, and (3) classifying the vegetation using a system derived from the life forms of the plants. Emphasizes cost-efficient techniques based on vegetation structure of physiognomy, and discusses use of vegetation maps and photographs for public presentations, planning of quantitative sampling, and studying of habitat change.

Rowntree, R. A. 1988. **Ecology of the urban forest: Introduction to part III. Landscape and Urban Planning.** 15: 1-10.
Overviews the collection of fourteen research reports devoted to three topics: the mapping and description of urban vegetation; the values and preferences assigned to urban vegetation; and the insert is not the values into law and planning policy. Briefly assesses the usefulness of the concepts "urban forest ecology", "urban forest structure and function", and "the urban ecosystem" which formed themes for the two preceding special issues. Briefly appraises remote sensor use in measuring and mapping urban forest structure. Discusses the roles of science and planning in stewarding the urban forest.

Schreiber, L. R.; Gregory, Garold F.; Krause, C. R.; Ichida, J. M. 1988. **Production, partial purification, and antimicrobial activity of a novel antibiotic produced by a *Bacillus subtilis* isolate from *Ulmus americana*.** Canadian Journal of Botany. 66: 2338-2346.
Antibiotic substances produced by a *Bacillus subtilis* isolate from the Xylem of an American elm (*Ulmus americana* L.) inhibited several fungal plant pathogens, including the Dutch elm disease pathogen, *Ceratocystis ulmi*. Bioassays indicated the bacterium produced a diffusible, methanol-soluble antibiotic on potato dextrose agar at 30° C. Cellulose-powder column chromatography separated the antibiotic, which was further purified on a Sephadex LH-20 column, yielding two peaks of antibiotic activity, BS1 and BS2. These were further purified by paper chromatography. High-performance liquid chromatography, using C-18 reverse-phase chromatography under isocratic conditions, resulted in five 280-nm absorbing peaks. Only one peak contained antibiotic activity. Upon ultrafiltration, the antibiotics passed through a 500 mol. wt. filter. The antibiotic was soluble in water, absolute methanol, ethanol, and chloroform, but not in hexane or petroleum ether. Antimicrobial activity was soluble in water, absolute methanol, ethanol, and chloroform but not in hexane or petroleum ether. Antimicrobial activity differed from that of other *B. subtilis* antibiotics, including iturin A, bacillomycin L, mycosubtilin, fengycin, and bacilysin. *Ceratocystis ulmi* exposed to BS1 produced short, twisted, and swollen hyphae with irregularly thickened cell walls.

Schreuder, H. T.; Li, H. G.; Ryan, M. G.; Scott, C. T. 1988. **Adjusting estimates in two-way tables by incorporating outside information.** Canadian Journal of Forest Research. 18(10): 1280-1285.
When outside estimates of resource statistics are more reliable than some existing tabular estimates, the outside estimates should be substituted for, or combined with, the tabular estimates to yield new estimates. Because of this substitution, cell estimates do not sum to the original marginal or overall totals. Various methods can be used to adjust the unchanged cell values to regain additivity. Classical and bootstrap variance estimators are given for the n x 2 case, setting a cell proportion at a presumed known value with fixed marginal totals, and for the n x m case, setting a cell proportion at a presumed known value with no marginal constraints except that the table total is fixed. For a 3 x 2 test case only, the bootstrap variance estimator yielded reliable estimates of precision for the other adjusted cell proportions in all cases. For the n x m case, a classical variance estimator was more stable than the bootstrap variance estimator, and both had about the same bias.

Scott, Charles T.; Hahn, Jerold T.; MacLean, Colin D. 1988. **Forest inventory and analysis needs for a growth processor.** In: Ek, Alan R.; Shifley, Stephen R.; Burk, Thomas E., eds. Forest growth modeling and prediction: Proceedings, IUFRO conference; 1987 August 23-27; Minneapolis, MN. Gen. Tech. Rep. NC-120. St. Paul, MN: U.S. Department of Agriculture, Forest Service, North Central Forest Experiment Station: 1133-1137. Vol. 2.
The Forest Inventory and Analysis (FIA) units at the experiment stations within the USDA Forest Service conduct periodic surveys of the forest lands of the United States. The FIA units project the forest resource; they must have appropriate growth projection modelling systems for all species and stand conditions. Currently, no such system or collection of systems exists that covers the full range of conditions encountered. The growth processor should be applicable at the state or regional level and at the individual-stand level. It also should be an individual-tree, distance-independent system containing several subsystems to include growth, mortality, removals, regeneration, and nontree vegetation.

Sendak, Paul E. 1988. **Teaching forest economics and policy: status and literature.** Journal of Forestry. 86(9): 23-29.

Sheehan, Katharine A. 1988. **Status of the gypsy moth life system model.** In: Proceedings of the national gypsy moth review; 1987 December 7-10; Charleston, WV. Charleston, WV: West Virginia Department of Agriculture: 166-171.

Shortle, Walter C.; Smith, Kevin T. 1988. **Aluminum-induced calcium deficiency syndrome in declining red spruce.** Science. 240: 1017-1018.
Prolonged suppression of cambial growth has apparently caused a decline in radial growth in many mature red spruce, *Picea rubens* Sarg. Surveys indicate that this decline occurs in trees throughout the natural range of red spruce and is independent of elevation, tree size, and age class. In addition, crowns of mature red spruce at high elevations across the northeastern United States have been dying back. Understanding the physiological basis for the growth decline is essential for management of the red spruce resource. A sequence of events is presumed through which an imbalance of aluminum and calcium in the fine root environment reduces the rate of wood formation, decreases the amount of functional sapwood and live crown, and leaves large trees more vulnerable to extant secondary diseases and insect pests.

Shortle, Walter C.; Stienen, Holger. 1988. **Role of ions in the etiology of spruce decline.** In: Hertel, Gerard, tech. coord. Proceedings of the US/FRG research symposium: effects of atmospheric pollutants on the spruce-fir forests of the Eastern United States and the Federal Republic of Germany; 1987 October 19-23; Burlington, VT. Gen. Tech. Rep. NE-120. Broomall, PA: U.S. Department of Agriculture, Forest Service, Northeastern Forest Experiment Station: 519-525.
An investigation of the soil and fine roots at eight locations across northern New England indicated that the relative acidity of humus and mineral soil, and the Al:Ca ratio of the fine roots of spruce and fir growing in those layers, was similar to that observed in spruce-fir stands in Germany. At Mount Abraham, Vermont, where trees are dying at an elevation of 1000 m, aluminum ions in the cortical apoplast of fine roots from the humus exceeded calcium ions by 3:1, a condition associated with severe forest damage in Germany. At all other locations, the Al:Ca ratio was <1 in fine roots of the humus layer, but in the few fine roots of the mineral subsoil, the Al:Ca ratio was often >1. This may threaten mature trees at those sites in the future.

Smith, H. Clay. 1988. **Herbicides in timber stand improvement.** In: Vodak, Mark C., ed. Proceedings of conference on forestry herbicides in the northeast; 1988 March 15-16; New Brunswick, NJ. Sponsored by New Jersey Division, Society of American Foresters, Rutgers University Cooperative Extension, Cook College, and U.S. Department of Agriculture, Forest Service. [Place of publication unknown]: [Publisher name unknown]: 64-72.
Herbicide application treatments are disucssed for several timber stand improvement practices; includes removing undesirable species, releasing crop trees, liberating regeneration, controlling sprout clumps, releasing conifers, and controlling grapevines.

Smith, H. Clay. 1988. **Possible alternatives to clearcutting and selection harvesting practices.** In: Smith, H. Clay; Perkey, Arlyn W.; Kidd, William E., Jr., eds. Guidelines for regenerating Appalachian hardwood stands: Workshop proceedings; 1988 May 24-26; Morgantown, WV. SAF Publ. 88-03. Morgantown, WV: West Virginia University Books: 276-289.

The key to forest management begins with landowner objectives. Once these are known, foresters need silvicultural alternatives to begin stand management and gain landowner confidence. Possible alternatives and modifications are suggested for clearcutting and selection harvesting practices. These relate to improving esthetics in clearcutting and regenerating more intolerant species when selection cutting. Leaving residual trees, using longer cutting cycles, and applying the diameter-limit concept are some of the possibilities.

Smith, H. Clay; Miller, Gary W. 1988. **Economic considerations of uneven-age hardwood management.** In: Economics of eastern hardwood management, Penn State forest resources issues conference; 1987 March 9-11; University Park, PA. University Park, PA: The Pennsylvania State University: 97-110.
Discusses approaches to improve the economic feasibility of uneven-age timber management in eastern hardwood stands.

Smith, H. Clay; Perkey, Arlyn W.; Kidd, William E., Jr., eds. 1988. **Guidelines for regenerating Appalachian hardwood stands.** Workshop proceedings, 1988 May 24-26; Morgantown, WV. SAF Publ. 88-03. Morgantown, WV: West Virginia University Books: 293 p.

Smith, Harvey R.; Sloan, Ronald J. 1988. **Estimated effective population size in a wild population of *Peromyscus leucopus*.** Journal of Mammology. 69(1): 176-177.

Smith, K. T. 1988. **Wounding, compartmentalization, and treatment tradeoffs.** Journal of Arboriculture. 14: 226-229.

Smith, Kevin T.; Shortle, Walter C. 1988. **Electrical resistance and wood decay by white rot fungi.** Mycologia. 80(1): 124-126.
The objective of this research was to determine the relationship of decay resistance to electrical resistance of wood tissue.

Solomon, Dale S. 1988. **Modeling stand dymanics of spruce-fir forests in the northeast.** In: Hertel, Gerard, tech. coord. Proceedings of the US/FRG research symposium: effects of atmospheric pollutants on the spruce-fir forests of the Eastern United States and the Federal Republic of Germany; 1987 October 19-23; Burlington, VT. Gen. Tech. Rep. NE-120. Broomall, PA: U.S. Department of Agriculture, Forest Service, Northeastern Forest Experiment Station: 75-78.
This research addresses two scientific questions in the Spruce-Fir Research Cooperative (SFRC):(1): Are changes in growth and mortality and the presence of unusual foliar symptomology in red spruce-fir forests greater than those attributable to typical trends and levels of natural variability? (2): What spatial patterns, if any, exist in growth and mortality and in the presence of unusual symptomology in red spruce-fir forests, and how do these patterns relate to spatial patterns of pollutant exposure? The forest growth model FIBER will be modified to incorporate elevational effects into diameter-growth equations for different periods for red spruce over the last three decades.

Solomon, Dale S.; Hosmer, Richard A. 1988. **A growth and yield model (FIBER) for multiple species stands within different forest types.** In: Ek, Alan R.; Shifley, Stephen R.; Burk, Thomas E., eds. Forest growth modeling and prediction: Proceedings, IUFRO conference; 1987 August 23-27; Minneapolis, MN. Gen. Tech. Rep. NC-120. St. Paul, MN: U.S. Department of Agriculture, Forest Service, North Central Forest Experiment Station: 217-223. Vol. 1.
Predicting growth and yields for spruce-fir, northern hardwood, and associated forest types of different species mixtures can be accomplished with a two-stage matrix model, FIBER. Changes in stand growth of multiple species composition are presented as ingrowth, probability of survivor growth, and probability of mortality. Annual transition probabilities are determined by tree size, basal area, and species composition. Thinning and harvest yields are obtainable for managed and unmanaged stands, both even-aged and multi-aged, over a range of densities, site indices, and intermediate treatments. FIBER is user friendly, written in Fortran 77, and is available for IBM compatible microcomputers.

Sonderman, David L.; Rast, Everette D. 1988. **Effect of thinning on mixed-oak stem quality.** Res. Pap. NE-618. Broomall, PA: U.S. Department of Agriculture, Forest Service, Northeastern Forest Experiment Station. 6 p.
Changes in limb-related stem defects were studied from 1977 to 1982 on 595 mixed-oak trees following a schedule of thinnings dating to 1962. All of the thinnings were controlled by stocking goals rather

than by predetermined time intervals. Results show that heavy and moderate thinnings, as opposed to light thinnings, had an adverse effect on the number and size of live and dead limbs. The light thinnings resulted in fewer live and dead limb defects per square foot of surface area but much slower diameter growth.

Stevens, Thomas; More, Thomas A. 1988. **The economic benefits and costs of urban parks: an overview.** Urban Parks and Recreation. 25(3): 30-33.

Stout, Susan L.; Larson, Bruce C. 1988. **Relative stand density: why do we need to know?** In: Proceedings, future forests of the mountain west: a stand culture symposium; 1986 September 29-October 3; Missoula, MT. Gen. Tech. Rep. INT-243. Ogden, UT: U.S. Department of Agriculture, Forest Service, Intermountain Forest and Range Experiment Station: 73-79.
Measures of relative stand density assess crowding in forest stands by comparing the growing space available to trees in open-grown conditions or in maximum density stands of the same species composition and average tree size. Because current measures differ in their handling of tree size and reference line, and do not provide identical results, the measure used should reflect management objectives. Better understanding of the effects of stand structure and species composition on growth responses will improve these tools.

Stringer, Jeffrey W.; Miller, Gary W.; Wittwer, Robert F. 1988. **Applying a crop-tree release in small-sawtimber white oak stands.** Res. Pap. NE-620. Broomall, PA: U.S. Department of Agriculture, Forest Service, Northeastern Forest Experiment Station. 5 p.
Small sawtimber white-oak crop trees in Kentucky were released by a crown-touching technique. In two cutting treatments, 20 and 34 crop trees were released per acre at a total cost of $35 and $42, respectively. Both treatments yielded commercial volumes of cut material. Total mean merchantable volume (>5.0 inches d.b.h.) in cut trees was 693 cubic feet/acre, with approximately 2,400 board feet/acre in sawtimber (≥11.0 inches d.b.h.). On the basis of early crop-tree stem response, the released trees are growing 0.16 inch/year compared with 0.13 inch/year for the unreleased trees.

Tabor, Christopher A. 1988. **Culture techniques to generate roots of red spruce for use in electrophysiological studies.** In: Hertel, Gerard, tech. coord. Proceedings of the US/FRG research symposium: effects of atmospheric pollutants on the spruce-fir forests of the Eastern United States and the Federal Republic of Germany; 1987 October 19-23; Burlington, VT. Gen. Tech. Rep. NE-120. Broomall, PA: U.S. Department of Agriculture, Forest Service, Northeastern Forest Experiment Station: 505-506.
To provide a reliable, continuous supply of red spruce (*Picea rubens*) roots with characteristics for use in electrophysiological experiments, seedlings were grown in perlite within plastic tree planting tubes from which light was excluded. The seeds were maintained under controlled environmental conditions in a growth chamber and provided with nutrients by an automatic irrigation system. Roots generated by these techniques have morphological characteristics comparable to those of plants grown in soil; are nonmycorrhizal, a condition necessary for the objectives of this stage of the research; are without algal growth on the surfaces; and have anatomical and physical characteristics needed to meet the technical criteria for measuring membrane potentials of individual cells.

Tanaka, S.; Chang, M. T.; Denlinger, D. L. 1988. **Development of the gypsy moth, *Lymantria dispar*: staging and juvenile hormone activity.** In: Proceedings, 18th International Congress of Entomology; 1988 July 3-9; Vancouver, B.C., Canada. [Place of publication unknown]: [Publisher name unknown]: 117. Abstract.
Several morphological and behavioral changes during the final larval instar of *L. dispar* have been noted that can serve as developmental markers for endrocinological studies. Maximum weight is attained in the middle of the stadium, followed in sequential order by a reduction in frass production, cessation of feeding, and initiation of silk production. In both sexes, the attainment of maximum weight, the reduction in frass production, the beginning of silk production are particularly useful staging landmarks. Changes in activity and juvenile hormone esterase (JHE) activity are discussed in relation to development.

Tobi, Donald R.; Wallner, William E.; Parker, Bruce L. 1988. **The conifer swift moth and spruce-fir decline.** In: Hertel, Gerard, tech. coord. Proceedings of the US/FRG research symposium: effects of at-

mospheric pollutants on the spruce-fir forests of the Eastern United States and the Federal Republic of Germany; 1987 October 19-23; Burlington, VT. Gen. Tech. Rep. NE-120. Broomall, PA: U.S. Department of Agriculture, Forest Service, Northeastern Forest Experiment Station: 351-353.

Tritton, Louise M.; Martin, C. Wayne; Hornbeck, James W.; Federer, C. Anthony. 1988. **Susceptibility of a central hardwood forest ecosystem to calcium depletion.** Abstracts. Notre Dame, IN: Ecological Society of America; 69(2): 322.

Turner, Terry L.; Huyler, Neil K.; Bousquet, Daniel W. 1988. **Farm tractor skidding costs in relation to profitability of a fuelwood harvesting.** Northern Journal of Applied Forestry. 5(3): 207-210.
The need to improve forest management on small private woodlands has stimulated interest in using smaller skidding tractors for tree removal. A Massey Ferguson four-wheel drive farm tractor used for fuelwood was assessed for productivity potential for one year. Using data from a range of site conditions, the tractor produced 1.04 cords per scheduled hour. At full-time tractor operation of 1800 scheduled hours per year, producing 1872 cords, the machine cost was $5.40 per cord for an average skidding distance of 878 ft. This is a favorable but not realistic skidding cost, but examination of a model fuelwood harvesting system in which this machine might operate showed that machine cost is much higher than projections suggested, in actual practice because the tractor is used only part of each workday.

Valentine, Harry T. 1988. **A growth model of a self-thinning stand based on carbon balance and the pipe-model theory.** In: Ek, Alan R.; Shifley, Stephen R.; Burk, Thomas E., eds. Forest growth modeling and prediction: Proceedings, IUFRO conference; 1987 August 23-27; Minneapolis, MN. Gen. Tech. Rep. NC-120. St. Paul, MN: U.S. Department of Agriculture, Forest Service, North Central Forest Experiment Station: 353-360. Vol. 2.
The pipe model theory provides a framework for a carbon-balance model that describes the growth of average stem length, total basal area, and total volume of an even-aged, self-thinning, mono-species stand. Variations of the volume-growth function are described for two situations: 1) substrate production and feeder-root turnover rates can be assumed constant over time, and 2) the rates are expected to change over time, such as in polluted environments. The growth of stand volume for the first situation agrees with yield tables.

Valentine, Harry T. 1988. **A carbon-balance model of stand growth: a derivation employing pipe-model theory and the self-thinning rule.** Annals of Botany. 62: 389-396.
A carbon-balance model of the growth of an even-aged, self-thinning, mono-specific stand of trees is derived from the pipe-model theory dry matter from root and shoot extension can be separated from that of the cross-sectional expansion of stems. This separation permits the models describing the growth of average stem length, total basal area, and total volume of the stand. Variations of the models are described for two situations: (1) the annual rates of substrate production and feeder-root turnover can be assumed constant over time; and (2) rates are expected to change over time, as in polluted environments. The model describing the growth of stand volume for the first situation fits published yield tables. Growth-rate models applicable to individual trees are also described.

Vogel, Willis G.; Rothwell, Frederick M. 1988. **Mushroom compost and papermill sludge influence development of vegetation and endomycorrhizae on acid coal-mine spoils.** In: Mine drainage and surface mine reclamation: Proceedings of a conference sponsored by The American Society for Surface Mining and Reclamation, The Bureau of Mines, and The Office of Surface Mining Reclamation and Enforcement; 1988 April 19-21; Pittsburgh, PA. Inf. Circ. 9184. Washington, DC: U.S. Department of the Interior, Bureau of Mines: 206-213. Vol. 2: Mine Reclamation, Abandoned Mine Lands and Policy Issues.
Several rates of spent mushroom compost and papermill sludge were evaluated as amendments in revegetation-abandoned acid-mine spoils (pH 3.3 to 4.1). Experiments show that mushroom compost and papermill sludge are useful material to aid revegetation of acid spoils, though the long-term effect of mycorrhizal inhibition in compost-treated spoils could not be predicted in this study. The estimated cost of applying these organic materials was about 2.5 times that of applying appropriate rates of lime, mineral fertilizer, and mulch, but yields of vegetation also were 2-3 times greater from the compost and sludge amendments.

Wade, Gary L. 1988. **Effective mining and reclamation as ecosystem construction.** In: Environmental

workshop--1988 proceedings; 1988 September; Darwin, Australia. Dickson, ACT: Australian Mining Industry Council: 175-190. Vol. 1.
Surface mining is one land use in a string of land use generations. Planning for mining and reclamation land use should recognize this and the long-term effects of the mining-reclamation process. The process should be approached as a problem in the construction of ecosystems from bedrock up. These constructed ecosystems will have a number of internal and external characteristics, of which several can be improvements over premining conditions. The greatest effects of mining reclamation can be in the areas related to site hydrology and soil productivity. Forests offer several advantages over other land uses in the first postmining land-use generation.

Wade, Gary L.; Halverson, Howard G. 1988. **Soil development under 22-year-old mixed hardwood, pine, and black locust plantations on a surface mine.** In: Mine drainage and surface mine reclamation: Proceedings of a conference sponsored by the American Society for Surface Mining and Reclamation, Bureau of Mines, and Office of Surface Mining Reclamation and Enforcement; 1988 April 19-21; Pittsburgh, PA. Inf. Circ. 9184. Washington, DC: U.S. Department of the Interior, Bureau of Mines: 54-62. Vol. 2: Mine reclamation, abandoned mine lands and policy issues.

Wade, Gary L.; Vogel, Willis G. 1988. **Surface-mined lands... Hope for future forests?** NE-INF-77-88. Broomall, PA: U. S. Department of Agriculture, Forest Service, Northeastern Forest Experiment Station. 12 p.

Wargo, P. M. 1988. **Carbohydrate and nitrogen content of roots of declining red spruce trees.** Phytopathology. 78(12): 1533.
Second order woody roots from three health classes of red spruce (*Picea rubens* Sarg.) growing above 900 m on Mt. Abraham, Lincoln, Vermont, were randomly selected and evaluated for total soluble carbohydrate (TSC), total starch (S) and soluble nitrogen (N). Health classes were based on the percentage of crown dieback and rated as either healthy, initially declining, or severely declining trees (<10, >10-50 and >50 percent dieback, respectively). A 10 cm section was removed from the proximal end of each of three roots from nine trees per health class. All samples were frozen, freeze dried, separated into bark and wood, ground, and then assayed for TSC, S, and N in wood, and minus S and N in bark compared to healthy trees. Healthy and initially declining trees had similar concentrations of TSC, S, and N in the wood, but declining trees had less S and N in the bark.

Wargo, P. M. 1988. **Root vitality and mycorrhizal status on different health classes of red spruce trees.** Phytopathology. 78(12): 1533.
Roots from healthy, declining, and severely declined (<10, >10-50 and >50 percent crown dieback, respectively) red spruce (*Picea rubens* Sarg.) growing above 900 m on Mt. Abraham, Lincoln, Vermont, were evaluated to determine root vitality and mycorrhizal status. Root systems were excavated by hand and judged either living or dead by color and texture. Number of root tips with mycorrhizae and number of mycorrhizal types were recorded. Woody roots of declining trees had a greater percentage of dead length and discolored wood and a greater number of wounds than healthy trees. Declining trees had fewer mycorrhizal tips and mycorrhizal types, a greater percentage of dead fine roots, and more dead length per total length of fine root than healthy trees. Severely declined trees had a greater percentage of dead root tissue for both woody and fine roots compared to declining trees.

Wargo, P. M; Bergdahl, D. R.; Olson, C. W.; Tobi, D. R. 1988. **Crown and root relationships in declining red spruce (*Picea rubens* Sarg.) trees.** Phytopathology. 78(11): 1511, 1512. Abstract.

Wargo, Philip M. 1988. **Amino nitrogen and phenolic constituents of bark of American beech, *Fagus grandifolia*, and infestation by beech scale, *Cryptococcus fagisuga*.** European Journal of Forest Pathology. 18: 279-290.
Concentrations of amino acids, total amino nitrogen, and phenols, ratio of phenol to amino nitrogen, and pH in the bark of American beech, *Fagus grandifolia*, were determined to see if these chemical constituents were correlated with susceptibility of trees to infestation by the beech scale, *Cryptococcus fagisuga*. The relationship of these bark constituents with scale infestation levels (none, light, and moderate), tree size (large, small trees), and bark shading was determined. Levels of some individual amino acids and total amino acid content in moderately infested trees were significantly higher than in uninfested trees. Large uninfested beech trees, which tend to be more readily infested by scale, had

significantly higher concentrations of aspartic acid. Concentrations of phenol in the outer bark of both infested and uninfested trees were significantly higher than in the inner bark. However, in bark infected by *Nectria*, phenol levels in the inner bark were significantly higher than in the outer bark.

Wargo, Philip M. 1988. **Quantifying rhizomorphs of *Armillaria* in soil around stumps in forest stands.** Phytopathology. 78(11): 1511. Abstract.
Rhizomorphs of *Armillaria* species were quantified in the soil around stumps which had been cut in different numbers of years, in 16 mixed oak stands in south-central Pennsylvania. Rhizomorphs were detected by three independent methods: (1) directly, by removing three blocks of soil (15x15 cm) down to the B horizon and measuring the lengths (cm) of rhizomorphs in the soil or indirectly, (2) by driving six stakes (20-35 cm) of red oak saplings or (3) by burying six potatoes in the soil in a 3 x 2 30-cm sq. grid and counting the number colonized by *Armillaria* after 35-40 and 120 days for potatoes and stakes, respectively. Rhizomorph density (cm/cc soil) increased with time after the cutting, and was low in stands not recently disturbed. On a stand basis, percentage of stumps with stakes colonized; percentage of stumps with tubers colonized; and percentage of stakes and tubers colonized, were positively correlated ($r = 0.52$ to 0.78 $\alpha=0.05$) with average rhizomorph density, and percentage of plots and percentage of stumps with rhizomorphs.

Wendel, G. W.; Kochenderfer, J. N. 1988. **Release of 7-year-old underplanted white pine using hexazinone applied with a spot gun.** Res. Pap. NE-614. Broomall, PA: U.S. Department of Agriculture, Forest Service, Northeastern Forest Experiment Station. 7 p.
Hexazinone, Velpar-L®, applied at rates of 1.0, 1.5, and 1.75 ml per spot, controlled competing hardwoods around 7-year-old underplanted white pine. Growth response was more pronounced when hexazinone was applied to release individual pines than when the entire area was treated on a 6 by 6-foot grid. In most cases, hexazinone killed white oak, chestnut oak, American beech, sourwood, red maple, and black gum. Yellow-poplar, red oak, cucumbertree, black cherry, sugar maple, sweet birch, and sassafras showed variable sensitivity to hexazinone. Three years after treatment, resprouting of killed stems and white pine mortality remain low.

Widmann, Richard H. 1988. **Pulpwood production in the Northeast--1986.** Resour. Bull. NE-103. Broomall, PA: U.S. Department of Agriculture, Forest Service, Northeastern Forest Experiment Station. 26 p.
This annual report contains 1986 information compiled from a canvass of all pulpmills that use pulpwood produced in the 14 northeastern states. In 1986 total production reached 8,952,400 cords. This was up by 2 percent since 1985. Roundwood production was 6,602,400 cords, whereas pulpwood from residues was 2,350,000 cords. Each of these increased from the previous year by 2 percent and 1 percent, respectively. Receipts of pulpwood at mills in the region were 9,385,300 cords.

Widmann, Richard H.; Birch, Thomas W. 1988. **Forest-land owners of Vermont--1983.** Resour. Bull. NE-102. Broomall, PA: U. S. Department of Agriculture, Forest Service, Northeastern Forest Experiment Station. 89 p.
Discusses statistical and analytical report on a mail canvass of private timberland owners in Vermont. The study was conducted in conjunction with the third forest survey of Vermont by the USDA Forest Service. Presents landowner characteristics, attitudes, and intentions regarding reasons for owning, recreational use, timber management, and harvesting.

Widmann, Richard H.; Blyth, James E. 1988. **Pulpwood production in 1986: record level reached; big gain in roundwood.** Northern Logger and Timber Processor. 36(8): 20-21.
Pulpwood production rose 6 percent in the 21 northeastern and north central states in 1986, totaling nearly 17 million cords. After a small decline in 1985, production climbed by 942,700 cords, reaching a new record high. The increase came from gains in roundwood production, as the production of pulpwood from manufacturing residues, such as sawmill slabs and edgings, fell slightly.

Wilkinson, Ronald C. 1988. **Geographic variation in needle morphology of red spruce in relation to winter injury and decline.** In: Hertel, Gerard, tech. coord. Proceedings of the US/FRG research symposium: effects of atmospheric pollutants on the spruce-fir forests of the Eastern United States and the Federal Republic of Germany; 1987 October 19-23; Burlington, VT. Gen. Tech. Rep. NE-120. Broomall, PA: U.S. Department of Agriculture, For-

est Service, Northeastern Forest Experiment Station: 507-514.
Variation in morphological characteristics of red-spruce needles was examined on a rangewide geographic basis to define the bases for ecological zones of inherent susceptibility to winter injury. The amount of epicuticular wax on needles was the characteristic most clearly related to measured rates of transpiration and winter injury of red-spruce seed sources, and also differed significantly from the amount found on needles of black spruce, a species resistant to winter injury. Potential genetic variation in amount of epicuticular wax could predispose high-elevation populations to winter injury, a pattern that is consistent with observed severity of decline.

Yandle, David O.; Myers, John R.; Mayo, Jefferson H.; Lamson, Neil I. 1988. **Development and application of a stand-based growth model for mixed hardwood stands.** In: Proceedings, IUFRO: forest growth modelling and prediction; International Union of Forestry Research Organizations; 1987 August 24-28; Minneapolis, MN. Gen. Tech. Rep. NC-120. St. Paul, MN: U.S. Department of Agriculture, Forest Service, North Central Forest Experiment Station: 231-238.
Presents model for predicting growth in mixed hardwood stands. Assuming future diameter growth is related to past diameter growth, the model is proposed for projecting the moments and functions of moments of tree diameter frequency distributions over time. Projections are made for stand attributes including basal area, board foot volume, and cubic foot volume in tree distributions of even-aged, mixed-species hardwood stands. The model incorporates a measure of shade tolerance to partially account for species growth differences. Further model enhancements are suggested.

Yaussy, Daniel A.; Brisbin, Robert L. 1988. **Predicting individual log dimensions and grade from hardwood cruise data.** In: Kent, Brian M.; Davis, Larry S., tech. coords. The 1988 symposium on systems analysis in forest resources; 1988 March 29-April 1; Pacific Grove, CA. Gen. Tech. Rep. RM-116. Fort Collins, CO: U.S. Department of Agriculture, Forest Service, Rocky Mountain Forest and Range Experiment Station: 75-80.
Describes software that allows estimation, from cruise data, of board-foot volume and numbers of logs by log grade in a hardwood stand. A two-stage estimation procedure was developed using regression techniques and linear discriminant analysis. A bucking simulator is then used to calculate the scaling diameter and length of each log.

Yaussy, Daniel A.; Brisbin, Robert L.; Humphreys, Mary J. 1988. **Predicting volumes and numbers of logs by grade from hardwood cruise data.** Res. Pap. NE-613. Broomall, PA: U.S. Department of Agriculture, Forest Service, Northeastern Forest Experiment Station. 15 p.
Equations presented allow the estimation of quality and quantity of logs produced from a hardwood stand based on cruise data. When packaged in appropriate computer software, the information will allow the mill manager to estimate the value of logs that would be added to a mill yard inventory from a timber sale.

Zarnoch, Stanley J. 1988. **Modeling activities within the spruce-fir research cooperative.** In: Hertel, Gerard, tech. coord. Proceedings of the US/FRG research symposium: effects of atmospheric pollutants on the spruce-fir forests of the Eastern United States and the Federal Republic of Germany; 1987 October 19-23; Burlington, VT. Gen. Tech. Rep. NE-120. Broomall, PA: U.S. Department of Agriculture, Forest Service, Northeastern Forest Experiment Station: 69--74.
The Spruce-Fir Research Cooperative is actively involved in a diversity of modeling approaches to address the effects of atmospheric deposition on the spruce-fir forests of the Eastern United States. Initially, a conceptual model was developed to assist in the research planning stages of the cooperative. Subsequently, efforts have been focused on stand level modeling with FIBER, a highly empirical model, and FORET, a more mechanistically-based, ecological model. These will be used for analysis of temporal/spatial variability and alternative pollution scenarios. Recently, an individual tree, process-based modeling approach has been initiated that will be instrumental in synthesizing and integrating the dose-responses, mechanistic research being conducted by the principal investigators.

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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.

An annotated list of publications by Northeastern Forest Experiment Station scientists and cooperators in 1988.

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