Historic, archived document

Do not assume content reflects current scientific knowledge, policies, or practices.

a5011
452
(4477)

United States
Department of
Agriculture

Forest
Service

General
Technical
Report
WO-53

Protecting and Enhancing America's Forests and Rangelands

1986 Research Accomplishments

United States
Department of
Agriculture

Forest
Service

General
Technical
Report
WO-53

Protecting and Enhancing America's Forests and Rangelands

1986 Research Accomplishments

December 1987

Foreword

Forest Service scientists are working cooperatively with specialists from universities and other Federal and State agencies on a wide variety of topics, to improve our ability to manage the Nation's forests and rangelands. This year's Research Accomplishments Report highlights over 80 major efforts, including both individual studies that came to fruition during 1986 and long-term, multi-Station projects. The report ends with a 2,600-item bibliography that lists all the publications about Agency-funded research released since late 1985.

Forest Service research falls into six categories: Environment, Insects and Disease, Fire and Atmospheric Sciences, Timber Management, Resource Economics, and Products and Harvesting. Both the research highlights and the list of research-related publications are divided along these subject matter lines.

We are especially proud of our research on acid deposition, wildlife habitat, threatened and endangered species, and biotechnology--areas that should receive even greater emphasis in the coming decade. Our people continue to make applications-oriented discoveries, such as how to use a lignin-degrading enzyme to break down pollutants without chemical intervention and how to turn forest wastes and low-value trees into panel products. And they work on basic problems, too, such as how to improve streamflow by converting chaparral to grasses, how to reduce sediment pollution after harvesting timber, and how to lessen stand susceptibility to major insect pests like southern pine beetle or gypsy moth. We are working to improve growth and yield for the Nation's timber producers (including our own national forests) and to enhance the quality of our wildland areas for the benefit of all citizens. We

study how to design bike trails to please city dwellers and suggest where to plant tress for maximum energy savings around houses. And since wood is our biggest product, we help professionals and laypersons preserve it with a comprehensive publication on exterior finishes.

Our economics people have forecast for the coming century a scenario of increasing population and corresponding increases in the demand for all the natural resources the Forest Service manages--timber, recreation, wildlife, water, minerals, range. Forest Service research aims to protect these assets and enhance them by developing improved management techniques for the benefit of all our citizens.

F. DALE ROBERTSON
Chief

Contents

	Page
Environment	1

Insects and Disease	33

Fire and Atmospheric Sciences	56

Timber Management	65

Resource Economics	81

Products and Harvesting	98

Research Publications	109
Research Headquarters	220

Research Publications

	Page
Environment	109
Watershed Management	109
Wildlife Habitat	114
Range	121
Fisheries Habitat	126
Forest Recreation	127
Urban and Community Forestry	130
Disturbed Areas Rehabilitation	132
Atmospheric Deposition and Air Pollution	134
Insects and Disease	137
Insect Detection and Evaluation	137
Insect Biology	140
Insect Control and Management Strategies	145
Disease Detection and Evaluation	149
Disease Biology	153
Disease Control and Management Strategies ...	155
Mycorrhizae	156
Wood Products Organisms	157
Fire and Atmospheric Sciences	159
Fire Physics, Chemistry, and Behavior	159
Fire Management, Economics, and Prevention ..	159
Fire Ecology and Effects	161
Meterology and Climatology	163
Air Resource Management	163

	Page
Timber Management	165
Forest Biology	165
Silviculture and Management	172
Growth and Yield	181
Genetics and Tree Improvement	185
Resource Economics	190
Forest Inventory and Analysis	190
Forest Economics	194
Products and Harvesting	202
Forest Engineering Systems	202
Wood Structural Engineering	205
Chemistry, Fiber, and Fuel Products	208
Utilization Potential and Processing of Wood	210
Protection of Wood in Use	215
General	218

Janet [Searcy] Wintermute, of the office of the Deputy Chief for Research in Washington, DC, edited and coordinated production of this report.

The use of trade and company names is for the benefit of the reader; such use does not constitute an official endorsement or approval of any service or product by the U.S. Department of Agriculture to the exclusion of others that may be suitable.

Environment

Sediment and Forestry Practices in the South

Sediment is the primary pollutant from southern forest lands. The Forest Service reviewed the results of small catchment studies conducted on diverse soils and topography across the hilly Piedmont and Coastal Plain, comparing them with 189 years of records. Data revealed a narrow range of average annual sediment concentrations for undisturbed forests of southern pine. The undisturbed pine in the Coastal Plain wetlands and the interior highlands produced less sediment. The average concentrations for these physiographic areas can be used as standards from which to measure changes due to forestry practices.

It should not be necessary to monitor pretreatment levels.

Increased sediment concentrations following prescribed burning and harvesting were slight and short lived. Concentrations following sequences of treatments that included intensive mechanical site preparation varied considerably in the Piedmont and Coastal Plain. In some cases, they approached those from agricultural lands during the first year. Concentrations were highest in hilly terrain with unstable channels. Sediment production decreased more than one-half during the second year and more than two-thirds during the third year. Choosing mechanical methods that provide onsite storage for rainfall and sediment in these areas reduces sediment production

risks. And, where channels are erosive, minimizing increases in storm flow volumes can protect water quality downstream from the disturbed site.

The data suggest that the mean values for undisturbed forests, and for disturbances other than intensive mechanical site preparation in the Piedmont-Coastal Plain, can serve as the state-of-the-art. That is, the variations among studies are less than the error of estimates derived from the costly application of available models. Acceptance of this premise together with application of Best Management Practices can result in very large savings for all sectors of southern forest management activities and can simplify regulatory functions designed to protect water quality.

Controlling Postfire Erosion and Sediment Production

Erosion and sediment production in southern California have been a major problem for nearly a century. Engineering and maintaining structures to trap or control distribution of this sediment is expensive, and disposal of sediment trapped by these structures is a problem. It seems apparent that it would be cheaper and easier to keep as much of this sediment as possible on the hillslopes where it originated.

When fires destroy protective vegetation, sediment-producing events occur more often and do more

damage. Rain splash, overland sheet flow, and rill formation by concentrated flow are traditionally seen as major causes of sedimentation. Researchers at the Pacific Southwest Station have found that dry ravel (dry unconsolidated flow of particles on steep slopes) and small landslides can be more important than overland flow water erosion on freshly burned slopes. This erosion can be as much as 100 times greater than that from similar unburned areas. Postfire storms can further increase sediment production because of overland flow erosion. Canyon bottoms can store eroded

sediment under favorable conditions and may provide opportunities for managing sediment production.

Seeding ryegrass (a fast-growing, introduced species) to stabilize surface soils after fire should theoretically help control sediment. But variability in precipitation patterns and site conditions can complicate the problem. Continuing research is testing the effects of seeding burned slopes and the long-term consequences of introducing an aggressive exotic species in chaparral environments.

Can Low-Cost, Low-Maintenance Forest Road Design Protect Water Resources?

Access roads are an essential feature of forest management. But they can contribute significantly to environmental degradation if poorly designed and carelessly constructed. Forest Service scientists at several locations throughout the United States have been working for several years to develop road designs and construction techniques that are environmentally sound and economical. Several recent developments are particularly significant.

A filter strip is a buffer zone, between a road and a stream or lake, that catches sediment that might otherwise reach the water. In North Carolina, we have been studying the utility of filter strips adjacent to roads. Narrow filter strips effectively control sediment. Outsloped roads with broad-base dips and obstructions such as brush barriers, and grass-covered road fills all contribute to decreased sediment travel.

Depth of surfacing material on minimum-standard roads has been studied in West Virginia. Soil losses from these roads, even without gravel, are not greater than that reported from higher standard roads in other parts of the Nation. Soil losses decrease and utility is improved when at least 3 inches of clean limestone gravel surfacing is used.

In Idaho, scientists have studied the effects of road design standards on erosion during construction. Road design has little effect: erosion depends more on the stage of construction when a storm occurs. Results emphasize the need for erosion control during construction. Cofferdams above culvert installation sites and pumping around the site during construction reduce stream sedimentation.

Low-cost, low-maintenance forest roads can be designed and built with features that protect water resources from unnecessary siltation.

Most of us know that snow has always provided more than a soft landing place for an awkward skier. For example, water from snow plays a key role in the vitality of this Nation, particularly in the West, where vast expanses of otherwise uninhabitable land are made pleasant by the slow release of water from snowpacks in the surrounding mountains. We also know that snowmelt water can be a problem. Its quantity, quality, and timing determine whether it will be available for productive use or become a liability. Through Forest Service research, we are learning how human activities can affect these critical properties.

Pollutants contaminating the air also accumulate in winter snowfalls. Research in remote

locations like the central Sierra Nevada in California helps us begin to understand the effects of pollutants on snowmelt quality. Recent research has demonstrated that snowmelt water is no more acid than rainfall, and the greatest acidity occurs when rain falls on the snowpack. In contrast, snowmelt caused by high air temperatures can produce alkaline pulses. This evidence suggests there may be some redistribution of snowpack pollutants before snowmelt begins in the spring.

Recent research indicates that clearcut logging in western Oregon forests alters snow accumulation and melting enough to increase the size of peak flows during rain-on-snow events. Higher peak flows indicate

a higher rate of water delivery to soils. This can increase the potential for both hillslope and channel erosion.

Increased streamflow is not necessarily undesirable. Research in Wyoming has demonstrated that blowing snow trapped by snow fences can increase streamflow. A snow fence one-half mile long and 12 feet high, built on a shrub-covered watershed, more than doubled streamflow. About 85 percent of the snow trapped by the fence was measured as streamflow, without appreciably increasing peak flow rates. This first documentation of actual streamflow increases suggests that fencing windswept lands is an economical way to augment water supplies.

**"New England Wildlife: Habitat,
Natural History, and Distribution**

New England's forests provide a diversity of habitats supporting a rich assortment of wildlife species. A new book by scientists of the Northeastern Forest Experiment Station presents the most comprehensive treatment of this resource that has ever been compiled. Nearly 500 pages of text present detailed life history accounts, range maps, and key habitat requirements for 335 New England wildlife species (26 amphibians, 30 reptiles, 220 birds, and 59 mammals). Preferred and suitable seasonal habitats of each species are shown for nine major forest-cover types by timber-size class and for 27 terrestrial and aquatic nonforest habitats.

This publication addresses the needs of land managers for a definitive reference that presents wildlife habitats in terms of managed New England forests. Public land managers must consider wildlife in forest management. Also, in New England, private woodland owners are frequently more interested in wildlife than in timber management. They need to know about the value of forest management in enhancing overall wildlife diversity. Both public managers and private landowners will benefit from this book.

The eastern box turtle and the blue-spotted salamander, two species featured in "The Natural History of New England Wildlife."

Bald eagles nest in limited numbers along major rivers in central Arizona, and several hundred from other parts of the country winter on national forest timberlands of Arizona and New Mexico. Significantly, the status of this endangered species is particularly precarious in the Southwest. The small breeding population, unique in its use of cliffs and desert habitat for nesting, is on the periphery of the species' range and relatively isolated from other breeding populations. Also, improper timbering operations can negatively affect habitat for wintering eagles.

Research by scientists of the Rocky Mountain Station is providing

Bald eagles in the Southwest do well in mild winters (characterized by high waterfowl populations) and in fairly severe winters (characterized by high populations of mammal prey), but their numbers decrease sharply when winters are so cold that prey availability drops off drastically.

resource managers with information needed to protect, enhance, and manage critical bald eagle habitat through development of habitat models, management guidelines, and manipulative techniques. A first-generation model, for example, has shown amount of cliff, degree of river curvature, miles of permanent side drainages, and extent of riparian vegetation to be important variables that discriminate nesting habitat. Another dimension of this research has examined the sensitivity of nesting eagles to human disturbance.

Investigations of wintering populations have shown that these migrants from more northern climates

prefer to live at higher elevations because severe winter weather there concentrates available prey much more than in the warmer deserts below. Increasingly severe weather during winter provides a relatively constant abundance of prey, with waterfowl commonly used early in the season (before lakes freeze over) and big game carrion and small mammals used more heavily later in the winter. Bald eagles in the Southwest--unlike those that use other wintering areas--roost alone or in small groups and change their roosting areas opportunistically in response to changing prey abundance and weather conditions.

Some wildlife species depend on or reach their highest populations in forests that are older than the ideal age for economic harvest for wood products. We call such forests "old growth." Research being conducted by the Southeastern, Southern, Intermountain, Rocky Mountain, Pacific Northwest, and Pacific Southwest Stations seeks to learn how to integrate habitat management for the wildlife species that need old growth with management of younger and more vigorous forests for timber and fiber production.

One line of research, for example, focuses on habitat requirements of those 85 species of North American birds and 49 species of mammals that use tree cavities. Related research examines ways of producing suitable habitat for cavity-excavating species where it is lacking, such as by injecting selected trees with a wood-decay fungus.

Additional research studies wildlife species that require other components of old-growth habitat. In southeastern Alaska, for example, Sitka black-tailed deer are closely associated with old-growth Sitka

spruce-western hemlock forests. Research focuses on understanding the nature of this relationship and development of habitat models to predict the response of deer to changes in habitat.

The most comprehensive old-growth habitat research ever undertaken by the Forest Service is in progress in Washington, Oregon, and California, where stands of Douglas-fir often exceed 250 years of age. The northern spotted owl has been found to be associated with these forests and could be irreparably harmed by indiscriminate and large-scale cutting of old-growth stands. Preliminary results of research in progress suggest that other species may also be associated with these forests. The aim of our Douglas-fir old-growth research is to provide new information needed to ensure that populations of these species are maintained in concert with other essential forest uses.

Studies are identifying characteristics of habitats across moisture gradients and stand age so that a comprehensive Douglas-fir old-growth classification system can

be developed. Large-scale studies of wildlife distribution and abundance are providing information about species associated with old growth, including major prey of the northern spotted owl. The Forest Service is initiating more detailed investigation of individual species and groups of species to learn their specific needs and the nature of their association with old-growth habitat so that management guides can be developed.

Among the latter studies, special emphasis is being given to the northern spotted owl. Current spotted owl research is focusing on study of movements, habitat use, breeding activity and success, juvenile dispersal, prey ecology, effectiveness of management guides, and potential competition with barred owls.

Examples of 1986 old-growth research accomplishments follow:

- The proceedings of a symposium on the ecology and management of the spotted owl in the Pacific Northwest has been published. The symposium, cosponsored with

the Cooper Ornithological Society and Humboldt State University, brought together the current state of the knowledge on spotted owl management, the most recent results of research, and the latest thoughts on application of population theory to spotted owl management.

- In California, certain species are sensitive to size of Douglas-fir old-growth stands. They are found only in old-growth stands greater than 25 acres.
- Tests of a spotted owl habitat model in California have identified variables important to refining such models.
- Investigations of a multispecies model for the Douglas-fir type in California showed that the model adequately predicted species occurrence but not abundance.
- In eastern Oregon, large-diameter standing dead trees and downed logs, found in old-growth forests, are essential habitat for the pileated woodpecker.

- In the Southeast, research on the endangered red-cockaded woodpecker has quantified the sex ratio of young birds, which is an essential link in the knowledge base needed to estimate population viability. Also, finding more males than females is the first empirical evidence of a biased sex ratio in cooperative breeding birds--a subject of great theoretical significance to evolutionary scientists.

The northern spotted owl--an endangered species native to the old-growth Douglas-fir stands of the Pacific Northwest--is the subject of several Forest Service studies. We are trying to determine its habitat requirements so that adequate acreages of old-growth can be set aside to ensure that spotted owl numbers will not be further reduced.

Forest Service research is seeking innovative ways to assess habitat and monitor changes in habitat quality. Investigators at the Southern Forest Experiment Station have found evidence that a bird's song may tell something about the quality of its habitat. Cardinals with less complex songs hold better quality territories with more understory foliage and insect food, and raise more young than cardinals with more complex songs. Cardinals in three different habitats (sapling, pole, and sawtimber stands) used songs with different

characteristics. Young cardinals may use complex songs when first establishing a territory, but less complex songs in subsequent years, when more effort is expended in nest defense and care of young.

Experts can only speculate on the meaning of these findings to avian behavior and ecology. Nevertheless, the research has opened up a new arena of study for the science of ornithology and potentially could provide a means of assessing changes in habitat induced by forest management.

Recording the songs of northern cardinals has shown that they sing differently depending on their numerical concentrations in a given area. In the long run, increased understanding of song patterns and frequency could enable scientists to verify the success of habitat manipulations with simple recording equipment.

Within the contiguous United States, rangelands include approximately 650 million acres of land on which native vegetation is predominantly grasses, herbs, or shrubs. These include natural grasslands, savannahs, shrublands, moist deserts, and wet meadows. Also, additional millions of acres of associated woodlands supporting an understory or periodic cover of shrubby vegetation could be considered range. Among their many uses, rangelands provide essential habitat for hundreds of wildlife and fish species, including some that are threatened or endangered and many that are important for their economic and recreational values.

Forest Service research seeks to define habitat requirements of rangeland wildlife and fish species, clarify the relationship between livestock grazing and fish and wildlife, and develop and test new plants and methods for rehabilitation and management of rangeland habitats. Research in this program area is being conducted by the Pacific Northwest, Pacific Southwest, Intermountain, Rocky Mountain, and Southern Stations.

Developments completed during 1986 include the following:

- A new research unit established in Boise, ID, will study riparian-stream ecology and management. Work will focus on habitat relationships among riparian wildlife species, development of a comprehensive land-aquatic classification system, development of riparian rehabilitation methods, and testing of grazing strategies for compatibility with wildlife and fish habitat-management objectives.
- A major research endeavor was initiated in eastern Oregon to provide a scientific basis for forage and habitat allocation among cattle, deer, and elk so that the outcome of management alternatives can be predicted.
- A new book entitled "Wildlife Habitats in Managed Rangelands" was completed in cooperation with the Bureau of Land Management. The purposes of this book are (1) to develop a common understanding of wildlife

habitats of managed rangelands, (2) to provide a system for predicting the impacts of range-management practices on wildlife, and (3) to show how the system can be applied to a specific area--in this case, the Great Basin of southeastern Oregon.

- Research in the Southwest is addressing the relationship of land use to stream habitat. Recent investigations have revealed that desert streams historically received a substantial but sporadic input of downed large logs and trees, which are important in forming fish habitat. This material is not available today because of interception by reservoirs and because improper streambank management practices have prevented tree replacement.
- Current studies in the northern high High Plains seek to define and describe plant communities and associated wildlife. Investigations have identified key ecological relationships of bird communities among several prairie woodland types.

Some 3,000 species of vertebrate animals inhabit national forest lands, and many of them are found in managed forest stands--those areas that have been previously cut or otherwise silviculturally treated and that will be harvested before old age and decadence set in. To provide for wildlife, forest managers must have knowledge of all wildlife within their planning units and be able to anticipate the response of individual wildlife species and wildlife communities (groups of species) to planned changes in vegetation composition and structure.

A major segment of the Forest Service's wildlife research program is directed toward meeting this goal for the managed forest. Research focuses on discovery of habitat requirements of individual species and development of models to predict changes in distribution and abundance of species with changes in habitat. On a broader scale, other investigations are examining what groups of species, or wildlife communities, live in different habitats and how these communities change over time with forest harvesting, stand treatment, and stand development. Effort is also being made to devise cost-effective

methods to measure, or monitor, wildlife response resulting from management activities.

Here are some examples of research completed in 1986:

- Research in Missouri by the North Central Station has developed and tested habitat capability models for the ovenbird and wood thrush that will provide a useful tool in predicting response of these species to forest-management activities.
- Studies of monitoring techniques could not demonstrate any hourly variation in counts of birds

during the first 5 hours of morning, indicating that timing of census taking is not critical.

- Research in California is identifying nonhabitat factors that affect songbird populations. In the Sierras, winter weather and not habitat is the dominant influence on winter bird populations.
- Scientists at the Southeastern Station have found that, to be used by fox and gray squirrels, uncut streamside strips in clearcut areas must be at least 160 feet wide and connected to an adjacent forest.

- Scientists at the Northeastern Station have developed a foraging guild classification for North American birds, based on major food, feeding substrate, and foraging technique. Managers need such a system to accurately consider many species simultaneously when evaluating impacts of habitat alteration.
- The Intermountain Station has developed a system to estimate elk hiding cover from standard timber-stand information. Output can be displayed in graphs or tables.

Research develops basic information and habitat capability models to predict future response of wildlife species, such as the ovenbird, to forest-management activities.

Changes in Ranch Operations Because of Shifts in Permitted Use

The publication "Rancher Response to Changes in Federally Permitted Livestock Numbers in Eastern Oregon" grew from the need to determine the actual changes ranchers make when provided an opportunity to increase the number of permitted livestock on Federal range. Previous modelling efforts of the Forest Service and other agencies have typically assumed direct linear relationships between base herd livestock numbers and permitted use, although changes in ranch operations that accompany shifts in permitted use have not been well documented. The Oregon Range Evaluation Project provided an opportunity to examine these shifts in private cooperator ranch operations.

First, the investigators determined how ranchers reacted to being given permission to adjust their livestock numbers through an increase in permitted grazing. Next, the study consulted ranchers who did not receive an increase in grazing permits, to find out how they anticipated shifting their livestock numbers if they were to receive an increased grazing allotment. The study also examined the response ranchers said would result from decreases in permitted use.

Findings indicate that not all ranchers who were given increases in permitted livestock use actually increased their herd size. One-fifth of these ranchers moved their existing herd to different summer grazing rather than increasing its size. The majority did increase herd size by increasing both cows and yearlings. The study also found indirect responses to increases in permitted livestock.

Ranchers acknowledged that additional winter forage was needed to sustain the increased herd numbers. Ranchers who did not receive the increase did not recognize many changes necessary to accommodate increased herd size. All ranchers not receiving increases thought they would increase herd size if given an increase in permitted use.

Responses to hypothesized cuts in permitted use followed patterns similar to those observed with the increase in use. Those who had an actual increase suggested more changes in ranch operations than those who had no experience with recent increases in permitted use.

Implications of the study relate to modeling of anticipated changes in

ranch resources when permitted use increase or decrease. To model a simple, direct linear relationship between permitted use and base herd size leads to errors. The induced effects in ranch operation due to changes in permitted use must also be considered.

Changes in ranch operations induced by adjustments in permitted livestock numbers on Federal land are complex and difficult to predict.

New Guidelines Developed for Proper Grazing of High Sierra Mountain Meadows

Mountain meadows in the Sierra Nevada are areas where livestock, wildlife, and recreational activities concentrate. As such, they produce separate but mutually influenced products: use for any one product affects other products and uses. The mountain meadow manager's job is to find an optimal balance among often conflicting uses which assures maintenance of multiple-resource productivity.

Forest Service scientists found the basic requirements for mountain meadows are watershed and slope relationships which provide for an accumulation of fine-textured materials and geologic strata that promote constant water levels. They also found herbage production decreases as elevation increases, toward the extremes of moisture gradient, and as range conditions decline. Herbage production peaks when vegetation is at or near climax. Meadow type classification, meadow occurrence and development, and meadow seasonal aspects are summarized primarily from data

presented in the Forest Service General Technical Report PSW-84.

Key factors in management of meadow grazing are carbohydrate reserves, weather, current use, and soil condition. Grazing too early or too late or both can critically reduce winter survival and spring growth of vegetation. Soil should be sufficiently firm when grazing starts that animals do not leave deep imprints; herbage should be sufficient to meet animal needs. Grazing should end while weather is conducive to regrowth and replenishing carbohydrate reserves.

Current use should aim to maintain leaf area near the optimum for photosynthesis and carbohydrate production. Leaving 55 or 65 percent of the average annual production on sites in excellent condition is suggested. Higher percentages of forage should be left on sites in poorer condition. The report also estimates range readiness dates for different elevations and for years of varying moisture status.

Proper grazing is possible on Sierra Nevada mountain meadows if consideration is given to elevation, moisture regimes, and current health of the specific meadow.

The Upper Rio Puerco Watershed in northwestern New Mexico was classified into 45 ecological phyto-edaphic (plant-soil) communities based on plant species-importance values. Species-importance values were calculated from the relative cover, relative density, and relative frequency values. The community descriptions consist of vegetation and soil surface characteristics; landform; soil series, association, or complex; ecological stage; and potential natural vegetation. The communities represented 11 vegetation series consisting of 2 woodland, 5 shrubland, and 4 grassland formations. Three soil orders, 27 soil series, 9 associations, and 3 soil complexes

were identified. The combination of landform, vegetation, and soil were considered phyto-edaphic communities. A dicotomous key was developed for field identification.

Phyto-edaphic communities classified on an ecological basis allow for extrapolation of research results to similar environments and provide land managers a scientific basis for interpretation of ecological succession and for predicting phyto-edaphic community response to a management prescriptions. Management costs can be reduced by utilizing the phyto-edaphic community classification system to select for a particular treatment only those communities most likely to respond.

The ability of semiarid sites to respond to management practices can be predicted by a unique combination of vegetation, soil, and landform characteristics.

Converting Chaparral Shrubland to Grassland Increases Streamflow

Chaparral is the dominant vegetation on about 3 million acres of shrubland in the Southwest, mostly in central Arizona. In this dry climate about 95 percent of the precipitation is returned to the atmosphere through evaporation and through transpiration by the vegetation, leaving very little for streamflow. Scientists at the Rocky Mountain Station in Tempe, AZ, have been studying the possibility of reducing chaparral shrub density to increase the amount of water that reaches streams. But two important considerations regarding streamflow increases must be determined before a particular shrub-management practice can be recommended for wide application. First, on the positive

side, how much additional water can be expected from removing the shrubs? Second, on the negative side, does this increase contribute to major flood flows and subsequent property damage?

Scientists have known for some time that shrubs use more water than grasses. Converting shrub communities to grass should leave more water for streamflow and still protect the soil from erosion. To test this theory, a 303-acre watershed was partially converted to grass (55 percent) in a mosaic pattern designed to favor wildlife, water quality, and landscape esthetics. Streamflow increased 2.68 inches per year, or 72

percent. Increases, evident in all seasons, were greatest in winter. Significant increases in water supply are possible if extensive shrubland is converted to grassland in a similar mosaic pattern.

A related study examined the contribution of increased flow to flood flows on two small chaparral watersheds by converting one to grass and comparing it with the other. Mean storm flow volume increased 224 percent, and mean peak flow rate increased 77 percent. The results indicate that large chaparral conversions in the Phoenix area would increase major flood flows by less than 4 percent.

Developing an understanding of commodity and noncommodity resource interrelationships on intensively managed forest range is a primary Forest Service research objective. Investigations to develop an understanding of forest range resource relationships are in progress at a number of locations within the Pacific Northwest, Pacific Southwest, Intermountain, Rocky Mountain and Southern Experiment Stations. Escalation in the number and intensity of demands placed on the Nation's approximately 550 million acres of forest range provide an increasing challenge for scientists to develop acceptable alternatives for integrated resource management. Although new and emerging critical information needs continue to arise, many significant recent accomplishments have been made by forest range scientists.

Timber management and land use influence forage production per acre and the total number of acres available for forage production. On commercial forestland in the States of Arkansas, Alabama, Louisiana, Missouri, Tennessee, and eastern Oklahoma and Texas, a Forest Service scientist found that forage is a

function of forest type, growing stock volume of timber, site index, timber stocking level, and management activities such as burning and harvesting. Four forest types are modeled: planted pine, natural pine, oak-pine, and upland hardwoods. The model, FORAGE-SOUTH, is initialized on commercial forestland with Forest Inventory and Analysis data and on pasture and rangeland with Soil Conservation Service Natural Resource Inventory data. Future timber-management scenarios from the regional timber inventory model, TRIM, and future land-use changes from the southern land-use model are input to FORAGE-SOUTH. The impact of these activities on the forage production is examined over a 50-year time horizon.

The Forest Inventory and Analysis (FIA) Unit of the Intermountain Station established and inventoried ponderosa pine sites throughout Colorado and Wyoming during 1981-83. Range scientists from the Rocky Mountain Station, as part of a cooperative study with the Intermountain Station, reinventoried these sites in 1984. The goal of the study was to develop a regional

forage production model for the central Rocky Mountains. Overstory canopy cover and abiotic site factors, such as soil and water, were considered in developing the regional model. Canopy cover was a highly significant predictor of total forage production in the resulting logarithmic model. Approximately two-thirds of the variation in total forage production was explained by the model.

Subterranean clover is a cool-season, nutritious forage legume that can be grown in the Southeastern United States. Available varieties grow best on well-drained sites and tolerate acid soil conditions, producing adequate forage without addition of lime if soil pH is 4.8 or higher. However, at least during the first few years, annual applications of at least 50 kg/ha of P_2O_5 and K_2O are needed to maintain good production. In addition, summer growth of competing vegetation must be removed annually in late August or early September by heavy livestock grazing, use of herbicide, or close mowing. Unlike other clovers, subterranean will reseed even if heavily grazed during the flowering

stage. Initial establishment under pine timber in the Southeast can be achieved by removal of hardwoods, prescribed burning, and broadcasting freshly inoculated seed on top of the soil in late October or early November when the soil surface is wet. Production of adequate forage before midwinter remains a problem, especially if unregulated use is heavy. Subterranean clover is preferred by cattle and deer. One-year nursery stock of longleaf, loblolly, and slash pines can be successfully planted in grazed, cutover subterranean clover pastures. Conifer survival varied with species of planted pine, but survival of planted pine was similar within species whether pines were protected from grazing by exclosures or completely exposed to grazing.

A long-term study conducted in the Blue Mountains of northeastern Oregon has shown that grazing significantly influences the development of forest vegetation

National forest lands like this stand outside Alexandria, LA, provide low-cost forage for thousands of head of livestock. Better understanding of the relationships between forest and range will improve our management of such lands for multiple uses.

following timber harvest. Summer browsing by deer and elk during the first few seasons after logging disturbance limit or preclude the establishment of abundant shrub seedlings and favor the development of a longer grass-forb successional stage. Eleven seasons after logging, shrub cover in the portion of a clearcut protected from grazing was 10 times that where deer and elk grazed. Similiar effects have been noted in partial-cut and unlogged stands. Minimal damage to either planted or naturally established conifer seedlings has been found.

The results of this research have made it obvious that patterns of past and present animal use are important factors to consider when classifying vegetation and characterizing ecosystem processes in these forests. They may also have important implications for the formulation of vegetation-management strategies that may affect timber, watershed, wildlife habitat, and other resource values.

Planned or unplanned, forest harvests and associated practices create mosaics of forage and cover

that strongly influence the distribution and degree of forest grazing. By understanding and considering animal needs, managers have opportunities to manipulate the size, arrangement, and structure of habitats to either minimize grazing effect or utilize it as a subtle but effective management tool.

In a study conducted in the Black Hills of South Dakota and Wyoming, Forest Service scientists determined that 48 plants make up the diet of cattle. Cattle diets averaged 54 percent grasses, 17 percent forbs, and 28 percent shrubs-trees during the grazing season. Sedges and wheatgrasses were the most abundant plants in the diet throughout the season. Bur oak, ponderosa pine, and Oregon grape were common in the diet. Shrubs and trees made up 37 percent of the diet in September. When forage is widely available, in August, cattle diets are not very similar, indicating that cattle graze selectively. Public and private land managers will use these data to develop improved livestock-management plans with consideration of dietary needs and season of use by livestock.

Mule deer in the Sierra Nevada rely heavily on mountain whitethorn and deerbrush as summer forage. Forest Service scientists found annual production by deerbrush and mountain whitethorn shrubs in the south-central Sierra Nevada of California was related to shrub volume, volume squared, and mixed conifer overstory crown closure. Production increased as shrub volume and volume squared increased, and it decreased as overstory crown closure increased. Samples of shrub forage were also analyzed for calcium, phosphorus, crude protein, in-vitro digestible dry matter, gross energy, digestible energy, and sequential fibers. Overstory crown closure and shrub age had only minor effects on forage quality, but significant annual differences were found in several variables in both shrub species. Under conditions common to the southern Sierra Nevada, annual differences in precipitation may have been more important than available light in determining forage quality. Forage deficiencies in late summer may have a substantial adverse affect on newly weaned fawns.

Improved Rearing Habitat for Chinook Salmon

Spring-run chinook salmon, a stock of great importance to sport and commercial fisheries of the West, spend more than 1 year growing in fresh water as juveniles before migrating to sea. Much of the rearing habitat for these fish occurs in streams on the national forests, but loss of both quantity and quality of habitat due to past logging, mining, and grazing, coupled with migration problems at hydroelectric facilities, has resulted in a decline of wild spring chinook stocks. Research is investigating ways to improve habitat conditions for these wild fish and other anadromous salmonids.

Cooperative research with the University of Idaho indicates that undercut stream banks are a preferred habitat for juvenile spring chinook in small streams. Results of the studies indicated that given a choice, 82 percent of the fish in the channel chose to reside in areas with simulated undercut streambanks. These findings suggest that natural undercut banks, or undercut banks simulated by artificial shelters or enhancement structures, are an important summer habitat component for juvenile chinook and should be recognized as such.

Improved rearing habitat for steelhead and chinook salmon can be achieved with mechanical imitations of underwater debris barriers and modifications of the natural stream bank.

Providing Structures To Improve Fish Habitat: What Natural Obstructions in Streams Tell Us

Resistant obstructions in and along stream channels, such as large woody debris, bedrock outcrops, or rooted bank projections, are vital to fish habitat. They greatly diversify aquatic habitat by disrupting the even flow of water and sediment downstream and by causing pools to scour and spawning gravels to deposit. In the past decade or so, fishery managers have attempted to improve habitat by adding artificial structure in the form of logs, boulders, and gabion weirs, and by controlling inputs of large woody debris. Though the success of most of these efforts to increase fish production remains unknown, there have been some obvious successes and failures to create the desired changes in physical habitat. The success rate in a variety of streams can best be improved by understanding better how natural obstructions affect channel processes.

This year, scientists of the Pacific Southwest Station completed a study on how natural obstructions affect fish habitat in a California stream supporting runs of both coho salmon and steelhead trout. Large obstructions were found to stabilize the stream channel despite the large

volumes of sediment transported downstream. The channel changed only where large woody debris had moved. Obstructions were important for the distribution of habitats as well. Of the pools where larger fish resided in summer, most (85 percent) were formed by scour around obstructions. Bars, where spawning gravel was stored, were deposited upstream and downstream of obstructions. These results highlight the need to maintain numerous, stable obstructions in fishery streams in order to keep a diverse and stable habitat.

Additional findings from this research provide specific guides to design of artificial habitat improvement structures. For example, results indicated that maximum scour depth for pool formation could be achieved by structures which extend above the stream banks and are one-third the width of the stream channel.

Future research in a variety of streams will broaden our understanding of the role of obstructions so that managers can better duplicate how natural processes form diverse and productive habitats for fish.

In this shot from Bald Mountain Creek, in California, natural obstructions form a lateral scour and then a plunge. Studies of how logs and boulders create fish habitat are providing information on how to design fish habitat improvements.

Managing Bicycle Trails in the Urban Forest

Bicycling continues to be an important activity in urban forest areas, and there are strong demands for additional trails. Existing forest preserve trails in the Chicago area are heavily used, with up to 3,000 bicycles passing a given point per day. Peak flows may reach 500 bicycles per hour on Sunday afternoons. Management of existing trails and the construction of new ones pose important challenges to urban forest resource managers.

In a cooperative research effort carried out by the North Central Station and Southern Illinois University, trail users identified which trail attributes were most important to them and then indicated their level of satisfaction with

trails that had varying combinations of attributes. A model was then developed that predicts user satisfaction with a trail, given characteristics of the trail surface, length, distance from home, terrain, and variety in the surrounding forest landscape. The model suggests that trail surface and distance from home are particularly important to bicyclists.

The model enables planners and managers to predict changes in user satisfaction that are likely to accompany changes in existing trails or the construction of new ones--before expensive alterations are made.

Building new bike trails or reconstructing old ones is an expensive business. In a joint study with Southern Illinois University, we polled cyclists to find out what trail qualities appealed to them the most. This information will save us money in the future as we continue to invest in improvements to the recreation facilities on our national forests.

Saving Energy Use Through Proper Tree Selection and Placement

If you want to save energy for heating and cooling of your home, it's important to carefully choose where you plant shade trees in your yard. Forest Service researchers at the Northeast and Pacific Southwest Stations have taken some long strides toward development of improved guides for optimizing the pattern of shade on houses throughout the year. Computer programs SOLPLOT and SPS were developed to help in selecting the optimum planting location. The computer programs, developed to give optimal control of sunlight and shade on windows, graphically illustrate shade location and show energy saved. These programs are now available for either mainframe computers or microcomputers.

The effectiveness of trees to provide shade in summer and permit sunlight penetration through the crown in the winter was found to vary by species, tree shape, tree density, and length of in-leaf season. These traits coupled with information on geographic location, solar radiation, and wind all influence the energy budget for a dwelling.

Research suggests that the maximum potential annual effect of trees on energy use in conventional houses is about 20 percent compared to energy costs for the same house in the open. While there is no clear choice of best species or location design for any specific house, there are usually numerous alternatives that will save energy and suit the homeowner.

Tree on
South—Noon

Tree on
West—4:00 pm

Homeowners can achieve significant energy savings by planting trees where their shade will be most beneficial at "problem" times during the day.

New Seed Technology Makes Native Plants More Available for Resource Rehabilitation

In many Western States the wildland seed market comprises a significant fraction of the commercial seed industry. Wildland species are used as ornamentals, as plant materials for revegetation of range and wildlife habitat, and in roadside and other disturbed-site plantings. Growing demand for seeds of wildland species has increased the need for reliable information on seed quality. Official testing procedures enhance the validity of laboratory assessments regarding the value of such seed for planting.

Research designed to improve methods for evaluating the quality of seed for wildland planting has resulted in the adoption of official testing

procedures by the Association of Official Seed Analysts for six important range species. Official testing procedures will be proposed for adoption for approximately 20 additional species in the next 18 months. The project--a joint undertaking of Utah's Department of Agriculture and Division of Wildlife Resources and the Intermountain Station's Shrub Sciences Laboratory--should increase the reliability of seed quality test results and improve communication between buyers and sellers of wildland seed.

In addition, the research is yielding a wealth of basic information on the germination

biology of key shrub and forb species. A knowledge of germination response patterns and how they vary within widely distributed species such as antelope bitterbrush, big sagebrush, or rubber rabbitbrush will be useful in enhancing artificial seeding success with these species. Scientists are identifying between-population germination differences and relating them to the probability of successful seeding on specific site types. The research represents an aspect of plant materials evaluation which could lead quickly to significant management applications.

**To Reclaim Surface Mine Spoils,
Put Your Money on Seed Banks**

Forest topsoil can be used as a seed source for native species in reclamation and revegetation of surface-mined lands in Appalachia. Seeds that naturally occur in a soil and that have accumulated for years are called the "seed bank." The seed bank from a forest soil in the Cumberland Mountains of Tennessee supplied 84 kinds of native or naturalized pioneer plant species, including five kinds of trees. The plants were grown from a thin layer of topsoil spread over a surface-mine spoil. When seeds from a

commonly recommended reclamation ground-cover mix (three grasses and Sericea lespedeza) were added to the topsoil, the natural species in the seed bank did poorly. Growth was stunted, and the number of naturally occurring species was reduced.

The natural seed bank community produced greater aboveground plant biomass and held on to more nitrogen, phosphorus, potassium, calcium, and magnesium than did the reclamation mix or a combination of the seed bank and reclamation mix.

The reclamation mix established good ground cover more quickly than the seed bank, but the differences were insignificant 16 weeks after establishment. The seed bank, or native species community, developed a deep, strong root system that improved the stability of surface-mine spoils.

Use of topsoil seed banks in Appalachia can greatly enhance the diversity of plant communities and accelerate succession to more stable conditions on disturbed lands.

Atmospheric Deposition Research Enhanced Through Scientific and Technical Exchange With Germany

Since September 1984, forestry researchers from the United States and the Federal Republic of Germany have cooperated to determine the role of air pollution and acid precipitation in forest damage. Both countries have similar research programs but different strengths. Onsite visits, firsthand discussions with colleagues, and exchange of scientific materials have given American and German scientists greater understanding of the complexities involved than either group could have reached alone. Although only 2 years old, this team approach has saved hundreds of thousands of dollars in research time and development and is already producing significant findings.

Examples of activity under this exchange include (1) a joint research program on wood biology between scientists at the Northeastern Station and at the University of Hamburg, and (2) a joint evaluation and refinement of German survey methods used to assess atmospheric deposition damage by members of the Forest Service Forest Pest Management Group and faculty of the University of Freiburg.

Study results on the anatomical and physiological parameters in healthy and declining fir were presented at and published in the proceedings of the 18th World Congress of the International Union of Forestry Research Organizations, held in

Yugoslavia. A publication summarizing forest-damage inventory techniques used in West Germany and their applicability to forests in the United States was published within 6 months after the respective exchange visit.

This bilateral agreement, entitled "Cooperation in Agriculture Science and Technology between the United States and the Federal Republic of Germany," is an excellent example of what can be accomplished through joint efforts of the scientific communities of two nations.

When Americans think "forest," they probably visualize the pristine environment of our alpine and subalpine wilderness ecosystems in the West. But while these wilderness areas may seem far removed from civilization, air pollution affects many of them. Managers of these areas need to know how the air resource is changing and how specific changes are likely to change other qualities of the wilderness ecosystems they are responsible for. Forest Service scientists are determining how air pollutants are affecting the plants, animals, air, soil, and water of alpine and subalpine ecosystems. They are examining how pollutants are deposited in sensitive ecosystems, how they are concentrated in winter snows and released during spring runoffs, and

how the natural life cycles of sensitive species are colliding with the cyclical release of pollutants into their habitats.

Forest visitors are often disturbed to find smoke, whether from a naturally occurring fire or from an ecologically sound prescribed fire. In the case of prescribed burning, visitors have the right to know that forest managers are creating the least amount of smoke possible while meeting the objectives of the prescribed fire. Forest Service scientists have long provided knowledge relating to fire safety, but now they are also developing the knowledge needed to assure that minimum smoke is being created by the positive use of fire. Basic questions about what to burn, when to burn, and how to burn--to limit

smoke generation--can now be answered, thanks to the research findings.

People visiting forests near large population centers frequently notice visible effects of air pollution on forest trees. More than two decades of research have made it possible to explain many of the observed effects, identify the pollutant causing specific damage patterns, demonstrate appropriate dose-response relationships, and develop forest-survey techniques that allow much earlier detection of pollution damage by trained observers. In addition, we now understand a sequence of pathologies that begins with air pollution-caused tree weakening. The knowledge gained about the effects of long-term air pollutant exposures provides a

fundamental basis for determining pollution effects of lesser magnitude and duration at sites farther removed from urban pollution centers.

The combined research results of many Forest Service scientists over a period of several years form the basis of air resource management in the Agency. Worldwide concern about forest productivity and health as related to atmospheric changes is growing. Concern about how forest management practices affect the atmosphere locally, regionally, and globally is growing also. Forest Service research findings are viewed as the foundation upon which to build international efforts to better understand forest-atmosphere interactions and to treat air as a forestry resource.

Forest Service scientists are measuring particles deposited from the atmosphere, such as acidifying materials, to better understand their effects on forest ecosystems.

Effects of Ozone on Growth of Jeffrey Pine in the Sierra Nevada

Previous studies have documented the impact of prolonged exposure to ozone on the growth of ponderosa and Jeffrey pines in montane forests adjacent to the Los Angeles Basin, where the highest concentrations of ozone in North America occur. Ozone concentrations are much lower in the southern Sierra Nevada (maximum hourly concentrations of 0.15 parts per million) but are relatively high compared to most regions of North America. Symptoms of ozone injury to pines have been recorded in the area, but no data are available on growth impact.

Growth of Jeffrey pines at sites with symptoms of ozone injury

(exposed) was compared to growth at sites with no symptoms (control) at Sequoia and Kings Canyon National Parks. Growth impact was determined by tree-ring analysis, with ring-width data standardized to remove age- and size-related trends. Growth index values were then used to compare growth on a relative scale.

Growth index values for exposed trees were 11 percent less than those of control trees since 1965. Prior to 1965, the exposed trees had a higher growth index than the controls, indicating a change in relative growth patterns since that time. Trees larger than 40 cm in

diameter and more than 100 years old appeared to have a greater growth reduction than younger trees. Ozone-stressed trees were more sensitive to variation in precipitation and temperature than the controls, suggesting a change has occurred in the relationship between growth and environment in trees with symptoms of ozone injury.

These results are the first evidence of tree growth reduction associated with ozone injury in western North America outside the Los Angeles Basin.

Before several years of ozone exposure, the Jeffrey pine from which this core was taken exhibited good annual growth. Lately, however, the annual rings are much closer together. Growth index studies in the Sequoia and Kings Canyon National Parks indicate that older trees experience greater growth reductions due to ozone injury than younger trees.

The rugged alpine and subalpine wilderness areas of our western mountains are one of America's great natural treasures. While the very survival of such ecosystems in some of the most inhospitable of natural environments testifies to their ruggedness, they are actually quite fragile in terms of their ability to withstand potential damage associated with human-caused pollution. Those pollutants, carried to the wildernesses by the atmosphere, consist of a wide variety of potentially damaging chemicals. Because the materials of concern are carried by the atmosphere and deposited on the ecosystems, scientists term the phenomena "atmospheric deposition." The most worrisome class of pollutants is the ones that are acid. They are deposited dry (in particles) and wet (incorporated in falling rain and snow and in fog and frost).

Rocky Mountain Station scientists and their cooperators have developed new techniques for characterizing the effects of air pollution on wilderness ecosystems. They have also developed protocols for consistent description of the current conditions of the subject ecosystems. Included are measures to quantify the atmospheric environment, soil and geology, aquatic chemistry, and aquatic and terrestrial biota. Now, for the first time, a wide variety of scientific investigators and other interested parties will have a set of consistent standards on which to base future work.

Many years of research lay ahead to determine specific cause-and-effect dose-response relationships between specific pollutants and individual ecosystem effects, but this protocol establishment effort will provide a firm scientific foundation for those years of effort.

This device collects cloud water for measuring atmospheric deposition in wilderness areas.

Insects and Disease

Meteorology Research Provides a New Way To Track Movements of Gypsy Moth Larvae

When a new gypsy moth infestation is found, the immediate question is, how rapidly and far will the insects spread? The answer to that question is a major factor in determining what procedures should be used to combat the infestation and what the cost of those procedures will be. Studies of windborne larval dispersion were conducted in the early years of this century, but until we could predict the behavior of changing currents of wind that bore the moth larvae, we could not make practical predictions of windborne dispersal.

Scientists at the Pacific Southwest Station have developed computer wind models that combine with knowledge of gypsy moth life cycles to predict the spread of the moth from a newly discovered infestation. The computer models were originally developed to portray how the wind would affect forest-fire spread and dispersion of smoke. By making modifications in those models and inserting information on the dynamics of windborne larvae, our

scientists were able to use computer graphic simulations to show the probable spread of the gypsy moth. The computer models begin with a terrain base and develop a wind flow field. Then, based on settling velocities of the moth larvae, the models display probable

This computer-generated topographic map shows various concentrations of gypsy moth larvae as wind-dispersed throughout the Los Angeles Basin.

concentrations of moth larvae per hectare on a map of the outbreak area.

Growth-Differentiation Balance: A Basis for Understanding Southern Pine Beetle-Tree Interactions

A Southern Station scientist has proposed a general hypothesis about tree resistance to attack by the southern pine beetle (SPB), based on knowledge of beetle activity and application of a concept formulated years ago to predict or explain plant behavior. The concept is known as plant growth-differentiation balance--a balance between the plant's use of energy supplies either in (1) cell division and enlargement (growth), or (2) changes in cell chemistry and form (differentiation). According to the concept, environmental conditions that limit growth but do not adversely affect energy supplies and transport in pines favor differentiation over growth. Oleoresin production is one of

Cross section of loblolly pine stem wood showing one annual ring. Larger thin-walled cells (light band, known as earlywood) are characteristic of wood formed in the spring and early summer, when growth processes predominate. Thick-walled cells (dark band, known as latewood) are typical during the summer, when growth has slowed and differentiation processes are favored. Note that the dark latewood zone contains vertical resin ducts (v), which store most of the oleoresin the pines use to defend themselves against southern pine beetle. The light earlywood zone (formed during the rapid growth period of spring) contains no such resin-carrying ducts.

several differentiation processes. The hypothesis connects long-observed seasonal changes in beetle behavior with seasonal changes in the way trees use the energy available to them.

Pine trees defend themselves against SPB attack primarily by exuding gooey oleoresin and pushing out the beetles as they try to penetrate the bark. In the spring, when growing conditions are optimal, trees apply their energy more to growing than to producing oleoresin. With limited resin available, the trees are especially susceptible to beetle attacks. But in mid to late summer, moderate water shortages "convince" the trees to shift more of their energy to differentiation.

Freehand longitudinal (tangential) section in loblolly pine latewood, showing a number of radial resin ducts (r) and portions of two vertical ducts (v). Note that the vertical ducts, the principal reservoirs of a tree's oleoresin supply, are several times larger in diameter than the radial ducts. When beetles attack during the formation of earlywood, resin must flow relatively long distances through the small-diameter radial ducts to wound locations. But when they attack during the formation of latewood, resin can move in quantity to wound sites, greatly enhancing the trees' ability to repel beetles.

Synthesis of oleoresin increases, and the trees are much better able to fend off attacking SPB.

The beetles change their behavior drastically around the same time that moderate water deficits stimulate the pines to grow less and differentiate more. Instead of dispersing in the forest, as the insects do in the spring when they can easily establish new infestations, SPB reaching maturity in the summer tend to concentrate on trees at the edges of existing infestations, attacking en masse. This behavior enhances the potential success of attacking beetles when tree resistance is high.

Although the general hypothesis helps us to better understand observations and the results of past research on SPB-tree interactions, it is only a first step. The

growth-differentiation balance concept provides a sound basis for bark beetle research heretofore lacking. Most importantly, it dispels the long-held idea that moisture stress is inherently bad for trees and good for beetles. Actually, the timing and degree of moisture stress largely determine its effects; and, surprising to some, a little stress can help trees fight insect enemies, such as the SPB!

The concept of plant growth-differentiation balance has long been part of the general knowledge in agronomy and horticulture. Now, it appears to be relevant and applicable to a wide range of insect-plant interactions and to provide a sound rationale for researchers studying ecological and evolutionary theory of plant defense against herbivores.

Bluestain in Pines May Be a Marker for Southern Pine Beetle Outbreaks

Outbreaks of the southern pine beetle occur unpredictably and are a serious threat to the pine forests in the Southern United States. Current outbreaks in Texas and Louisiana are the worst on record. Recently, researchers have found a relationship between the presence of a fungus and bark beetle population levels that could help in predicting the trend of an outbreak.

The southern pine beetle carries a number of fungi, including the bluestaining fungus, Ceratocystis minor, long recognized as a common associate of the insect. The fungus grows into the sapwood and causes the characteristic stain seen in beetle-killed trees. Ceratocystis minor is known to kill pine trees, and many researchers believe it must

be present in order for the beetle to overcome healthy trees.

Experiments conducted in Texas and Louisiana show that trees killed by the southern pine beetle generally had less bluestain in areas where the beetle infestation was most severe. Under outbreak conditions, some beetle-killed trees may not have bluestain at all. These findings may be of practical importance as a diagnostic or predictive tool for pest-management specialists. Stain caused by this fungus is easy to recognize, and measurements of the amount of stain present in trees killed by the southern pine beetle may prove useful in predicting the onset or collapse of bark beetle epidemics.

This loblolly pine was killed by the southern pine beetle. Removing the bark reveals both the insect's S-shaped galleries and dark patches of stain caused by the fungus Ceratocystis minor. Though the beetle and C. minor often travel together, recent research indicates that very high southern pine beetle populations kill trees without any help from bluestain fungi.

Pecan and ten species of hickory are native to the Eastern United States. Most of these trees are economically important in timber production, commercial nut production, or as ornamentals, and serve as an important food for wildlife. Although a number of insects, including borers, pruners, and girdlers, are injurious to pecan and hickory and are widely distributed, they seldom threaten trees over large areas. Damage tends to be local, in nurseries, nut-producing groves, young timber plantations, and ornamental plantings. Damage includes a loss of tree form; reduced nut crops; defects in wood that reduce its value for lumber, veneer, and other products; loss of esthetic beauty of

shade and ornamental trees; destruction of grafts; and, sometimes, death. Damage can be minimized by good management, especially through cultural practices that maintain and promote tree health.

"A Guide to the Insect Borers, Pruners, and Girdlers of Pecan and Hickory" should be of interest to a wide audience, including forest managers, nut growers, entomologists, extension agents, pest-control specialists, educators, and homeowners. This publication explains how to identify the insects that attack shoots, branches, trunks, and roots of pecan and hickory, and how to prevent or reduce the damage they cause.

The gallery of a hickory borer, in a cross section of hickory.

Adapting the Douglas-fir Tussock Moth Virus to a Substitute Host

A nuclear polyhedrosis virus of the Douglas-fir tussock moth (DFTM) has been developed as a safe microbial insecticide for use in suppressing DFTM outbreaks. This is the first such virus registered by the Environmental Protection Agency for use against a forest insect pest. Currently, we produce it on living laboratory colonies of the tussock moth. Although DFTM is the natural host of this virus, there are many reasons why it is not the best host for production of the microbial insecticide. Rearing the DFTM is expensive because fastidious manual care by trained personnel is required to assure a successful production schedule. Hairs on the larvae and cocoons can cause

irritations or allergic reactions in laboratory workers. Protective clothing and filter masks are required for the safety of production-plant personnel. The tussock moth has a long life cycle that includes overwintering in the egg stage. This extends the generation time to several months and impedes production.

In 1986, scientists at the Pacific Northwest Station successfully concluded a search for a substitute host to grow the DFTM virus. The cabbage looper has many advantages over the DFTM as a medium for production of the virus. It has a brief life cycle (24 days from adult

to adult) and yields a virus product of much higher potency. The looper's hairs do not cause allergic reactions, and the insect is much easier to handle and rear in the laboratory than the DFTM.

Because of these advantages, and since large-scale rearing procedures and facilities for the cabbage looper have been in use for many years, the incentive for commercial production and registration of the virus by private industry is much improved. The Forest Service can divest itself of the expense and inconvenience of production and registration if private industry decides to fill that role.

The Douglas-fir tussock moth (DFTM) is the most serious defoliator of conifers in the West. It can be suppressed with chemical insecticides, or by introducing the nuclear polyhedrosis virus into DFTM populations. Researchers at the Pacific Northwest Station have developed a way of growing the virus in an alternate host insect--one much easier to rear in the lab. This breakthrough should make it much more economical to use the virus for DFTM control.

Silvicultural Options for Reducing Forest and Stand Susceptibility to Western Spruce Budworm

The western spruce budworm, a serious insect defoliator of western conifer forests, can cause extensive damage under certain forest and stand conditions. Outbreaks of the budworm occur in dense, multistoried stands composed mostly of host trees that are shade tolerant, such as grand and white firs and Douglas-fir. These stand conditions occur over much of the range of budworm, primarily because (1) the frequency of forest fires has been very low compared to pre-1910 periods, allowing the shade-tolerant species to proliferate; and (2) selective harvesting practices have removed much of the shade-intolerant or "seral" conifer species, such as ponderosa pine and western larch, which are not primary hosts for the insect.

Reducing the habitat that favors budworm epidemics by using silvicultural methods is an effective long-term approach for dealing with this pest in the northern U.S. Rocky Mountains and

perhaps elsewhere. Even-aged silvicultural practices, such as clearcutting and seed-tree and shelterwood cutting, can be used to create conditions unfavorable to budworm. Shade-tolerant hosts are removed and replaced with the fast-growing and productive seral pines and larch. Stands like this are poor for budworm but excellent for timber, wildlife, and recreation. These stands usually are not multistoried, and stand density is easily controlled to optimal levels. In prime budworm habitat, conversion of uneven-aged host stands to mosaics of even-aged stands will dramatically reduce the budworm problem over the length of a single rotation.

Whether or not susceptibility to and damage by the budworm can be reduced forestwide will depend on forest economics, the political climate, and the willingness of forest managers to make provisions for budworm control in their forest-management planning.

Douglas-fir is extremely susceptible to western spruce budworm attack. Therefore, in areas where it is the climax species, Douglas-fir should be harvested and a few seed trees of less susceptible species, such as pine and larch, should be left behind, to provide a next generation of trees that will be less likely to appeal to the budworm. Since this photo was taken, the overstory of seed trees has been removed. What remains is a thrifty young stand with very low susceptibility to western spruce budworm. Even-aged silviculture like this--not extensive spraying--is the key to effective budworm management in the West.

The gypsy moth is a threat to millions of acres of forest land outside its present territory in the Northeastern United States. Some species can withstand only 1 year's defoliation; if the gypsy moth hits stands with these species again in a subsequent year, nearly all the attacked trees succumb. As this destructive defoliator spreads into uninfested forests, managers must search for ways to cope with the invasion. The course of action taken will be guided by an understanding of how much tree defoliation may occur, what the losses may be following defoliation, and how these losses will affect management objectives and action alternatives.

Forest Service scientists have described an integrated pest management (IPM) decision process to help forest managers select options for reducing stand and forest impacts from gypsy moth defoliation. The IPM decision process leads the manager faced with a gypsy moth threat through a step-by-step approach for determining tree and stand susceptibility and for estimating which stands are likely to be most heavily damaged. Once these determinations are made,

the manager must decide if the amount of loss projected will jeopardize goals for that site. If the answer is yes, insect monitoring should be instituted to determine the proximity of any infestation and the level of local moth populations. Managers then select appropriate actions based on projected losses, treatment thresholds dictated by primary forest use, and compatibility with management goals.

Heavy timber mortality, particularly in oak stands, follows the gypsy moth's progress in the East.

IPM DECISION PROCESS FOR GYPSY MOTH

Managers can use the flowchart to guide their decisions about whether--and where--to spray for tree protection.

Identifying and Managing Forests Susceptible to Mountain Pine Beetle

Lodgepole pine is one of the most important conifer species in the Western United States. It ranks fourth among timber types in area covered--13.3 million acres of commercial forest land in the West. These forests provide wood products, cover for watersheds, forage for livestock, habitat for wildlife, and scenic and other recreational values. But lodgepole pine has a formidable enemy in the mountain pine beetle (MPB), a native insect. It is the most aggressive bark beetle attacking these pines and has decimated extensive areas of lodgepole in the West. During an MPB outbreak, millions of trees can be killed in 1 year. The beetle also attacks and kills ponderosa, sugar, and western white pines.

MPB-caused losses can have catastrophic impacts, depending on landowners' objectives. From the standpoint of timber production, beetle infestations seriously affect the sustained yield and even flow of wood products. Outbreaks disrupt management plans and affect local and regional economies. They increase fire hazards and diminish recreational values and esthetics.

In the course of studying MPB epidemics over the past 20 years at the Intermountain Station, we have greatly increased our understanding of factors influencing the dynamics of beetle populations. This knowledge has led to the development of (1) methods to identify stands susceptible to beetle infestation,

An adult mountain pine beetle, no bigger than a grain of rice.

(2) techniques to predict lodgepole pine losses caused by MPB, and (3) silvicultural prescriptions to help prevent or reduce these losses.

The extensive research on MPB dynamics has greatly increased our understanding of beetle biology and behavior and the insect's interactions with the host tree. This research has been pivotal in clarifying the reasons why trees and stands become susceptible to attack. We found that beetle outbreaks are strongly related to tree and stand conditions. In an outbreak, the beetle first kills the older, large-diameter trees usually associated with unmanaged mature and overmature stands. It survives and reproduces best in these trees. Identifying stands having characteristics conducive to beetle attack permits managers to treat those stands before outbreaks can get started. Methods for rating the risk of beetle damage are based on characteristics that promote outbreaks. Techniques have been developed and are now in use to determine the expected rate and amount of tree loss once a stand becomes infested. Using modeling

Two stands of lodgepole pine from northern Utah's Wasatch National Forest illustrate the difference silvicultural management can make. The unthinned stand on the left sustained heavy losses to mountain pine beetle; the adjacent thinned stand incurred no damage.

tools, the resource manager can estimate tree and volume losses per year and how long an infestation will last on different habitat types.

The most satisfactory long-term solution to the MPB problem is preventive management based on manipulation of tree and stand conditions to reduce vulnerability to beetle infestation. This is true because little can be done to reverse the trend of an MPB outbreak once underway. Silvicultural guidelines now available provide the most efficient and environmentally suitable tools for achieving such a long-term solution.

The work that remains is to increase our understanding of beetle dynamics

when populations are at endemic (low) levels. This research is well underway and will contribute significantly to understanding the process of transition from endemic to epidemic populations. Data already in suggest that the MPB is a "follower" during endemic periods: it prefers lodgepole pines already infected by root rot or secondary bark beetles. This change of MPB from "leader" during epidemics, where it initiates the attack, to "follower" during endemic periods, where it follows on the heels of other pest invasions, appears to be a reflection of changes in beetle genetics. Once we have a better grip on MPB dynamics at low levels, we should be able to formulate sound preventive strategies to curb losses by this major forest pest.

On the Wasatch National Forest, scientists are using traps baited with pheromones and kairomones to study beetle population numbers after thinning. They are also measuring the microclimate in unthinned lodgepole stands to determine its effect on the beetle.

Managing Spruce Budworms and Budworm-Susceptible Forests

The spruce budworms are ranked among the most serious forest pests in North America. Tree mortality, top killing, reduced growth rates, lowered timber quality, and failure of stand regeneration are serious consequences of unmanaged outbreaks. In 1977, the U.S. Department of Agriculture and Canada's Department of the Environment agreed to cooperate in an expanded and accelerated research and development effort, the Canada/United States Spruce Budworms Program (CANUSA), aimed at the spruce budworm in the East and the western spruce budworm in the West. The objective of CANUSA was to design and evaluate strategies for controlling the spruce budworms and managing budworm-susceptible forests, to help forest managers attain their objectives in an economically and environmentally acceptable manner. This international cooperative program, which ended in 1984, provided forest managers with new and improved information and technology for dealing with the spruce budworms.

Results of the program have been made available through a comprehensive technology transfer effort conceived early in the program. Scientific information of worldwide interest is appearing in hundreds of journal articles and technical papers. User-oriented publications for forest managers and pest-management specialists are being distributed; at least 38 major handbooks on specialized subjects will be published in USDA series. During the program, technology was transferred through many workshops, seminars, symposia, training sessions, and user-group meetings on specialized subjects.

The CANUSA-sponsored research symposium at Bangor, ME, in September of 1984 was the final technology transfer effort of the joint program. The proceedings of the symposium, "Recent Advances in Spruce budworms Research," published by the Canadian Forestry Service, is both a compilation of the contributions to new knowledge achieved during the program and a

A sixth-instar larva of the western spruce budworm--the life stage that eats the most voraciously--makes short work of these conifer needles.

state-of-knowledge summary of information about the spruce budworms and their effects on spruce-fir forests of North America.

Information and technology provided by CANUSA has influenced how forest managers deal with budworm problems. Eastern forest managers have:

- Reduced acreage sprayed in control programs by applying "targeted harvesting/targeted spraying," using improved aircraft navigation, remote-sensing and photointerpretation, and refined hazard-rating guides.
- Increased dramatically the use of nonchemical insecticides based on Bacillus thuringiensis (B.t.).
- Improved management planning by applying a wood-supply model and a budworm impact study.
- Improved utilization of budworm-threatened and -damaged balsam fir.

- Demonstrated use of an efficient system developed by CANUSA for monitoring moth populations using pheromone-baited traps.

For western forest managers, CANUSA has:

- Provided a package of computer models that allow forest managers to project the effects of defoliation on trees in various age groups over several stand rotations under various management systems.
- Developed more efficient and precise sampling methods for three life stages--eggs, larvae, and pupae.
- Identified major forest zones with different outbreak frequencies and developed methods to predict outbreak frequency.

For forest managers and pest management specialists in the East and West, CANUSA has:

- Developed a variety of methods for hazard-rating forest stands for susceptibility to budworms.
- Provided silvicultural prescriptions to reduce the likelihood of damage in outbreaks.
- Developed, refined, and evaluated an automated egg-mass detector/counter for more efficient population evaluations.

A particularly important achievement of CANUSA was registration of a new strain of Bacillus thuringiensis as a microbial insecticide. Since 1970, the HD-1 strain of B.t. has been in commercial production for use in controlling insect pests. A new strain of B.t. was isolated from spruce budworm larvae by scientists at the Northeastern Station's Center for Biological Control of Northeastern Forest Insects and Diseases, at Hamden, CT. The new strain, called NRD-12, was extensively field tested in the United States and Canada and is now

registered by the Environmental Protection Agency for forestry use, and for vegetable, cotton, and hay crops.

The NRD-12 strain is twice as potent as HD-1 against the spruce budworm and kills the pests almost twice as fast. Speed of kill is very important when foliage protection is the prime consideration.

To meet the objectives of the CANUSA program, scientists at the Pacific Northwest Station developed elaborate population models for western spruce budworm populations to interface with refined models of host-forest stand dynamics. In the course of population studies, the role of birds and ants as predators of all budworm life stages was found to be far more significant than had been assumed, at least at low to moderate budworm densities.

The implications of these findings are important to people managing budworm-susceptible forests in the face of recurring outbreaks over the

life of the rotation. CANUSA-sponsored research indicated that silvicultural practices can increase the beneficial effects of birds and ants, and thereby decrease the frequency of outbreaks. The costs of implementing these practices are projected to be significantly less than management of budworm populations with insecticides.

Budworm outbreaks are naturally recurring events in susceptible forests of the United States and Canada. Over the last decade, science has made great strides in understanding these pests and developing rational approaches to dealing with them. Although the CANUSA program has ended, base-funded research to develop safe, effective, and practical strategies for protecting our forests from the spruce budworms will continue.

In the Great Plains, natural tree growth occurs mainly along rivers, streams, and drainage ways. Since the days of the earliest settlements, people inhabiting the region have planted trees to protect soil resources from wind and water erosion, to protect crops and livestock, to beautify the land, and to conserve energy in rural farmsteads. But tree planting in the Great Plains has not always been successful. Many of the tree species planted were poorly adapted to the rigorous climate of the area. Also, pest damage has often curtailed tree establishment. Nearly all the tree and shrub species planted in the Great Plains are susceptible to one or more serious disease and insect pests.

Since the early 1960's, research by Federal and State agencies on diseases affecting trees in shelterbelt plantings in the Great Plains has been greatly

accelerated. This increased effort has generated a great deal of information on tree diseases and prompted the pest management committee of the Great Plains Agricultural Council to gather this information into a single document so it would be more useful to landowners, foresters, pathologists, and extension specialists. The result was "Diseases of Trees in the Great Plains," written by 31 contributors from throughout the area and recently published by the Rocky Mountain Station. This handbook describes the hosts, distribution, symptoms and signs, disease cycles, and control measures for 46 hardwood and 15 conifer diseases that commonly damage trees planted in the Great Plains. Effects of environmental stress and damage from herbicides are also covered. Color photographs of the disease symptoms will greatly aid in disease diagnosis.

A healthy two-level windbreak shelters a field of corn in the Great Plains.

The Somaclones Are Coming!

Recently forest scientists have identified a useful supplement to traditional tree-breeding programs. The phenomenon involved is called somaclonal variation. This approach to tree improvement can incorporate desirable traits into forest trees without going through the traditional breeding cycle of 20 to 30 years. The term "somaclonal variation" was proposed to describe variation exhibited by plantlets obtained from aseptic plant tissue cultures. With this technique, it is now possible to take old plant lines and literally turn them into dozens of new plant lines in a matter of months.

Many plants regenerated from aseptic tissue cultures are not true to

type. Forest pathologists at the North Central Station have used somaclonal breeding techniques to develop increased resistance to the fungus Septoria musiva in selected hybrid poplar clones. This fungus causes a serious canker disease that limits the productivity of some of the best poplar clones. Approximately 60 days are required from the time a poplar plant is placed into tissue culture until a resistant plant variant is rooted in the greenhouse. In the first 2 years of this study, over 500 somaclones expressing resistance in laboratory tests have been generated. The resistant plants are now being field-tested in Wisconsin prior to release to other workers.

The plantlets in this plastic cup were developed from tissue culture; they are resistant to Septoria wilt.

Managing Southern Pine To Reduce Losses From Fusiform Rust

Fusiform rust, caused by a fungus, is the most serious disease of slash and loblolly pines in the Southern United States. The disease has reached epidemic proportions in many parts of the South, with annual losses estimated at more than \$130 million. Because of the economic impact of the disease, an extensive research program has been conducted in recent years by Federal and State agencies, universities, and private companies. Scientists from the Southern and Southeastern Stations and their cooperators have played an important role in this research and have made significant progress in reducing losses from this disease.

The primary emphasis of the overall research program has been on the development of disease-resistant pines. The first breakthrough was finding four geographic areas of loblolly pine where trees exhibit considerable resistance to rust. Seed collected from one of these areas--Livingston Parish, LA--has

been widely used in reforestation programs where rust hazard is high. In other research, individual trees of slash and loblolly pines that showed resistance to rust were selected, cloned, and used to establish rust-resistant seed orchards. An artificial inoculation technique was developed that allows rapid evaluation of rust resistance of progeny from individual tree selections in breeding programs. Seedling seed orchards were established using survivors from these inoculation tests. Seed are already being collected from these clonal and seedling seed orchards, and progeny show an improvement in rust resistance of 40 to 50 percent. Until large supplies of resistant seed are available, their deployment will be restricted to areas identified to have high potential for fusiform problems. Such areas are characterized by high populations of oaks, the alternate host of the rust fungus, in or around pine plantations.

These broken and deformed trees in a 14-year-old stand of slash pines in South Carolina are typical of areas with severe fusiform rust infection.

Fusiform rust is a particularly serious problem in tree nurseries. For years the disease has been controlled by the fungicide ferbam, which is applied 35 to 40 times per year. Recently a new systemic fungicide, Bayleton[®], was found to

be very effective in controlling the rust. It is now used in almost all nurseries in the Southern United States. This material, which acts as both protectant and eradicant, needs to be applied only three or four times a year.

Much research has been done on influence of various management practices on the incidence and impact of fusiform rust. Intensive cultural practices, such as site preparation and fertilization, tend to increase incidence of fusiform rust. However, increase in volume resulting from such practices may offset even a 50-percent rust infection rate. Thinning has little or no practical value in reducing incidence of rust since most infection occurs in the early stages of stand development. But thinning can affect total wood production in heavily infected stands by utilizing trees certain to die before the final harvest. A preliminary growth and yield prediction model for rust-

Slash pine the way it ought to look. This is a seed orchard planted with rust-resistant trees.

infected slash pine stands has been developed to help evaluate some of the more common forest-management practices that can reduce losses from this disease.

Exterior structural timbers can be serviceable for decades with proper care and maintenance. These timbers are usually pressure treated, but deep seasoning checks that penetrate the treated shell can develop. The result is interior decay and premature replacement of timbers at inflationary costs.

Preservatives applied by ordinary flooding from a brush or spray penetrate the wood only slightly and so cannot stop this decay.

Researchers at the Forest Products Laboratory, in cooperation with the U.S. Naval Facilities Engineering Command, have shown that fumigants such as Vapam and chloropicrin, applied to holes drilled in the timbers (for example, curbing) and plugged, can eradicate important fungi that decay wood products. The study also determined the extent and speed of penetration of toxic amounts of fumigants through horizontally oriented timbers as well as the longevity of toxic

concentrations of fumes in timbers. Effectiveness of treatments varies, depending on fumigant used and timber species.

The cost to replace decayed timbers has increased out of all proportion to the cost of the raw material. Furthermore, timber has been estimated to increase in value nearly 24 times between the stump and delivery of the finished product. Application of these research findings has potential for high financial return by extending the service life of structures and avoiding costly repairs.

In this schematic diagram, although conventional wood preservatives have penetrated part way into this railroad tie, drying checks have opened up the inner core--past the treated zone--so decay-causing organisms can find their way in. A new fumigation treatment developed at the Forest Products Laboratory will protect wood even in the face of such deep seasoning checks.

Pinewood Nematode in Exported Southern Pine Chips

Recently the Nordic countries placed an embargo on importation of pine chips and other raw softwood products from the United States after imported chips were found to be infested with the pinewood nematode, which causes the pine wilt disease. Although this disease is minor in the United States, some European pine species are known to be highly susceptible. Curtailing chip exports represents a serious loss to the forest industry.

Researchers at the Southeastern Station are currently studying how the nematode becomes established in pine chips, what influences its survival in chip piles at export terminals, and how it might be eradicated from chips before and during export.

The nematode infests wood through the activities of insect vectors, most commonly the pine sawyers. These beetles colonize pine logs and bolts held in storage yards or standing dead or weakened trees, and introduce the nematode while laying their eggs. The nematodes remain alive after the wood is processed into chips and feed on fungi that colonize the chips.

The survival of the nematodes in chip piles is mainly governed by temperature. Though temperatures near the shell of a chip pile may be lower than in surrounding air, heat near the center of the pile can exceed 60°C . Optimum temperature for reproduction of the nematode in chips is 35 to 40°C , but populations rapidly decline above 45°C . At 60° the nematodes are killed in 1 hour or less; thus none survive in the center of large piles. However, the nematodes do survive in parts of the pile where temperatures are more favorable. Nematodes can also reproduce in ship's holds during ocean crossings since the temperature in the lower part of the cargo hold averages about 35°C .

It is not economically feasible to use heat to control the nematode because of the limited heat-conductive qualities of wood and the rate at which chips are loaded onto ships. Other methods of control, including fumigation, are currently under study.

Exporting wood chips is big business. Here, a load of southern pine chips (38,000 tons!) is ready for shipment to Sweden.

Borates Protect Latin American Hardwood Imports From Termites, Beetles, and Fungi

Wood-destroying beetles cause annual damage amounting to an estimated \$50 million in hardwood lumber and secondary manufactured products such as flooring, furniture, millwork, molding, and picture framing. The true powderpost beetles cause the greatest damage because they can infest and reinfest wood after it is dry, reducing it to a dry powder. Losses from termites and decay are much higher.

Current research on integrated protection against beetle infestations by scientists at the Southern Station has yielded effective dip-diffusion procedures using boron compounds to protect moldings made from a Brazilian hardwood (banak) against damage by beetles. In limited commercial use for over 4 years, the borate treatment has generated no complaints about insect, stain fungi, or decay damage to the manufacturer.

Borate dip-diffusion treatments of Latin American hardwood lumber will

Hardwood lumber being treated with borates using the dip-diffusion method.

effectively protect it through fabrication and distribution of the final product. Wood products are immersed for 1 minute in a borate solution and stored under cover for 7 days. Storage permits the borate to thoroughly diffuse through and penetrate the wood. Lumber so treated and moldings made from this treated lumber show excellent protection from damage by powderpost beetles, and considerable protection from damage by termites or brown-rot decay fungi. Adding another fungicidal chemical to the borate solution also prevents discoloration from mold, mildew, and sapstain fungi.

Boron compounds such as boric acid and borax may be used for wood treatment. In wood, borax and other polyborates convert to boric acid, which is toxic to many insects and decay fungi. Though boron treatments are new to the American wood industry, they have been employed in Australia and New Zealand for over 40 years, a testimonial to their usefulness.

Fire and Atmospheric Sciences

Planning the Rejuvenation of Aspen Forests Using Prescribed Fire

Trembling aspen, a widely distributed forest tree species throughout North America, occupies roughly 7 million acres in the Western United States alone. These forests are especially important for their wildlife, esthetic, recreation, watershed, and forage-production values. Fires have played an important role in developing and maintaining aspen forests, and without periodic fires, the aspen is being replaced by conifers in many areas. This successional process reduces forage production and water yields and diminishes vegetation diversity and the quality of wildlife habitat. Prescribed burning has shown potential as an economically and environmentally acceptable means of reversing this process.

Fire scientists at the Intermountain Fire Sciences Laboratory have

developed a method for appraising fuels and flammability in aspen forests to assist in preparing fire prescriptions to promote aspen regeneration. The appraisal process is based on studies of physical fuel properties and vegetation occurring in southeastern Idaho and western Wyoming. It includes a classification of aspen fuels, appraisal of fire behavior potential, and evaluations of seasonal change in live-fuel moisture content. Derived fuel types have been illustrated with color photographs accompanied by information on fuel amounts, vegetation characteristics, fire-behavior ratings, and ratings for the likelihood of burn success. Knowledge of how fine-fuel moisture content, vegetation curing, windspeed, and topographic slope determine fire behavior has been refined to aid in writing effective burn prescriptions for maintaining healthy aspen forests.

In this aspen stand from the Rockies, prescribed fire is used to control unwanted tree and shrub species.

Use of prescribed fire is necessary for good forest-ecosystem management in many parts of the country. In the Pacific Northwest, it is of particular ecological and economic importance. But smoke from forestry-prescribed fires and other open-air burning can cause air-quality problems when too much smoke enters a limited volume of the atmosphere in too short a time. Forestry managers need help to minimize the amount of smoke they generate while accomplishing prescribed-burning objectives.

Pacific Northwest Station scientists are helping to assure good air quality and good forest-management practices by gaining basic knowledge of the factors contributing to smoke generation and by turning that knowledge into technology that is

being used by foresters. The scientists have combined fire-science theory with extensive field experiments to determine what combinations of harvesting practices and weather conditions produce the least smoke for a given prescribed-burning objective. They have used this hard-won knowledge to develop a new smoke-management and emissions inventory system. The new system includes such factors as size of logging residue materials, terrain slope, time since rainfall, temperature, wind, humidity, and other weather data. Smoke amounts can vary by more than 50 percent, depending on the variables involved. All forests in the Forest Service's Pacific Northwest Region and the State of Oregon Department of Forestry have adopted the new system for use.

Prescribed burning is an important forestry tool, but for it to remain useful, we must be able to prove that the amount of smoke generated is manageable. Studies in Oregon and Washington reveal that burning in springlike weather results in less smoke.

People often ask why live, green trees and other vegetation burn in forest fires, and why those fires can be so dangerous. When they witness actual forest fires, they are often amazed by how rapidly living trees can ignite and how intensely they can burn. To understand why living trees ignite and burn, we must also understand the role of dead forest materials. Scientists have found that the moisture content of dead leaves, twigs, and branches is an important factor influencing the danger and behavior of forest fires. When sufficiently dry, these fuel materials can often burn fiercely enough to dry out and ignite the moist, living vegetation surrounding them. The result is explosive and potentially dangerous fire behavior.

How do these dead forest materials actually dry out? Although researchers have been studying the moisture relationships of these materials for some time, they have not attained a full understanding of forest drying mechanisms. Results of basic Forest Service research are providing new insights into the wood drying process. Our findings provide a fascinating view into the

microscopic world of cellulose molecules and how moisture enters and leaves that world. These studies on the sorption of water vapor by cellulose materials can be applied to treated lumber as well as to dead forest materials. The basic insights gained have been applied in the development of a mathematical

model describing temperature and moisture changes of common southern forest fuels as they respond to changing air temperature and relative humidity. Results of this research are being incorporated into a new generation of fire danger-rating and fire behavior-prediction models.

HOW DOES MOISTURE MOVE IN AND OUT OF WOOD AND FOREST FUELS ?

Though visitors know that forests are living, many would be surprised to learn that the microscopic movement of moisture in dead forest

materials helps to determine how forest fires start and spread--and whether the forest will continue to live well.

To grow competitively priced timber in the Southeast, forest managers rely heavily on the use of prescribed fire as a silviculture treatment technique. To be cost effective, prescribed fires must be ignited in numbers over large acreages during intervals when weather conditions, combined with burning techniques, will produce the desired treatment results within budget. The large, and often dispersed, acreages involved suggest that airborne ignition is the best way of getting the job done. However, these ignition techniques must work well for airborne delivery, must meet the ignition patterns required for the silvicultural objectives, and must be inexpensive.

After several years of research, our scientists have perfected methods for airborne prescribed fire ignition. Two techniques have been shown to be particularly effective--the helitorch and the Ping-Pong ball system. Of equal importance are the research results that demonstrate that each technique is favored for different sets of desired burning objectives and for different types of aircraft. As the name would suggest, the helitorch is particularly applicable to helicopter delivery; the Ping-Pong technique works well with fixed-wing aircraft. Burns started with a helitorch have higher fireline intensities than those ignited using the Ping-Pong ball system. The completed research shows that conclusions drawn are valid for all southeastern combinations of fuel and weather.

The helitorch and Ping-Pong systems provide two tested methods for igniting the prescribed fires that are heavily used in the South for silviculture treatments.

When veteran firefighters talk about the worst forest fires they have faced, when rookie firefighters are warned about dangerous situations they may encounter, and when fire researchers describe the most challenging problems they must solve, crown fires are at the top of all three lists. Crown fires involve the active burning of the upper portion, or crown, of forest vegetation. No matter what species is burning, crown fires are intense and fed by the most volatile part of the plants involved.

Forest Service fire scientists have made remarkable progress in developing computer models that predict the behavior of wildfires. These model predictions are used onsite by fire managers to employ their resources in the most efficient ways. But today's operational fire-behavior models are not capable of accurately predicting

Schematic diagram of a computer simulation showing the relationship between heat generated by a fire (vertical axis) and the degree to which trees in advance of the fire front are nearing ignition, over distance (horizontal axis).

the behavior of crown fires, the most destructive type of wildland fire. Intermountain Station scientists have embarked on a systematic research attack to produce the needed fire-behavior predictions of crown fires. Their approach is to develop a series of mathematical models that will evolve over the next several years into a definitive predictive system for crown-fire behavior. Initial progress has been made by modeling the spread of a line fire through wildland fuel for situations in which unignited vegetation is heated by radiation and cooled by reradiation and convection. Success in depicting the complex physics of crown fires with this initial modeling attempt demonstrates that the scientists are off to a good start in their planned approach to solving the problem of predicting the behavior of these most destructive forest fires.

A Better Method for Predicting Subsurface Soil Temperatures During Wildfires

Soil heating caused by wildfires and prescribed burns plays a large role in determining the effects of fires on wildland resources. The intensity, depth, and duration of soil heating affect soil stability and fertility as well as subsequent vegetation responses. The ability to understand and predict these responses is a critical prerequisite for effective prescribed-burning programs.

Scientists at the Pacific Southwest Station have studied ground surface heating both analytically and experimentally to develop new information on the relationships of flame and soil characteristics to soil temperatures. Results of these studies have provided a predictive mathematical model of heat transfer to soils. The important heat transfer processes identified are conduction of heat into the soil; radiant exchange between the flame, soil, and surroundings; and radiant

exchange between the soil, surface, and smoldering embers left behind the flame front. Important fire characteristics that drive these processes include the duration of burning at a single location, and the geometry and temperatures of flame and embers.

Results indicate that the location of maximum surface temperature depends only on the flame characteristics, but the magnitude of the surface temperature depends on properties of both the flame and the soil. Actual measurements of soil temperature during experimental burns agree well with the model's predictions.

Use of the soil heating model will improve the effectiveness of prescribed burning as a means of managing wildland vegetation. It is especially applicable in the highly flammable chaparral communities of southern California.

Damage to soil and soil microorganisms from forest fire heat can now be better predicted by mathematical models. Experimental data verified the analytical mathematical solutions as shown here.

Research on fire weather, wildland fuel characteristics, and fire behavior has provided an array of operational systems and decision aids for fire-management personnel. Their jobs include (1) prepositioning firefighting forces and equipment on a national and regional scale, (2) designing fire-management organizations to meet local needs, and (3) devising fire-suppression tactics on individual fires. Two automated fire behavior/weather-related systems are especially noteworthy: the National Fire Danger Rating System and BEHAVE.

The National Fire Danger Rating System was designed to track relative trends in fire danger over broad geographic areas. This system uses local weather observations and forecasts with information about wildland fuel flammability to produce indices of expected wildfire occurrence and behavior. The system is used to preposition firefighting resources and plan fire-management activities by all Federal land-

management agencies and more than 30 State and private wildland fire-protection agencies.

BEHAVE, a system of interactive computer programs to aid in predicting fire behavior, is used in deploying initial attack forces to actual fires. It also makes real-time projections of a fire's perimeter to help managers make suppression decisions. Finally, BEHAVE assists managers in developing strategies and tactics for the controlled use of fire to attain specific management objectives.

Operational use of BEHAVE during the 1985 fire season was credited with saving millions of dollars in suppression costs, structural losses, and forest resource damages--as well as human lives. The Forest Service projects combined cost savings attributable to these two research products of \$3 million to \$10 million annually, depending on severity of the fire season.

Estimating the progress of wildfires is much more accurate thanks to computer programs that factor in topographic weather and fuel data.

Reliable predictions of wildland fire behavior are needed for a wide range of fire- and resource-management tasks. These predictions are useful not only for more effective suppression of wildfires but also for improving the cost, safety, and success of fire use and for determining the long-term growth and effects of natural fires allowed to burn in remote areas. Twenty years of continuing Forest Service research on the behavior of free-burning fires in wildland fuels has produced a basic understanding of surface fire phenomenology. The process by which a surface fire spreads can be visualized as a series of ignitions of the particles of fuel that are burned at or near the fire's leading edge.

By a combination of theoretical development and laboratory experimentation, scientists at the Intermountain Fire Sciences Laboratory have provided quantitative knowledge of surface-fire behavior that is especially applicable when a steady-state, line-fire is spreading in a

Experiments at the Intermountain Fire Sciences Laboratory have told us a great deal about how steady-state line fires spread at ground level--the burning conditions for most forest and range fires.

spatially uniform fuelbed at ground level. (The vast majority of forest and range fires burn under these conditions.) The research results have provided the predictive basis for an array of operational fire systems and decision aids. Ongoing

research will concentrate on extending fire behavior knowledge to less frequent but more complex fire-management situations involving spotting, crown fire development, and multilayer or nonuniform fuelbeds.

Timber Management

Increasing Success of Forest Regeneration Through Better Ecological Knowledge

Forests of the northern Rocky Mountain and Intermountain areas are characterized by a wide diversity of site conditions. Research-based knowledge of specific sites and their ecological properties and processes can make it possible to greatly reduce losses and failures in both natural and artificial forest regeneration.

More than 10 years of forest ecology studies have resulted in keys to coniferous forest habitat types for northern, central, and eastern Idaho and all of Montana and Utah. Similar work has been done for the aspen forests of Utah, southeastern Idaho, western Wyoming, and Nevada. More recent work, some still underway, has provided keys to

ecological processes and stages for the most important timber-producing forest habitat types.

Habitat type classification provides a system for predicting the potential vegetation on a given site. The large, widely scattered ponderosa pines illustrated in the figure will be replaced by a dense stand of Douglas-fir, and the sward of grass will be replaced by low-growing shrubs. Prescribed burning and timber harvest patterns can be used to alter the successional trend so as to maximize resource values.

Several handbooks have been prepared for field silviculturists. Four General Technical Reports have been issued, and training sessions are held annually. This work has been a result of close cooperation between Forest Service Research and the National Forest System's Northern and Intermountain Regions.

The striped stick is part of an inconspicuous monitoring device.

Although white pine was the premier species logged to build ships and houses for almost 300 years, it now accounts for less than 1 percent of all softwood timber removals, and only half the species' annual growth is cut yearly. Opportunities exist, however, for managing white pine to enhance log quality, volume, and value. To provide an update on such opportunities, as well as current information on the white pine resource base, protection, marketing, and wildlife amenities, a symposium was held in Durham, NH, in June of 1985. The University of New Hampshire, the Society of American Foresters, and the Ruth E. Farrington Fund joined the Forest Service in sponsoring the meeting and publishing the proceedings.

Although white pine occurs in pure stands, most of it grows in mixture with other eastern species. Landowners generally try to favor white pine by controlling competition from less valuable hardwood species. Pure stands can be regenerated very successfully by planting white pine. Growing this species for timber production also provides wildlife habitat and enhances woodland esthetics.

The primary impact of white pine weevil damage is reduced wood quality, whereas blister rust infection often results in tree mortality. Not all stands are attacked, however, and both problems are less severe in the southern part of the white pine range. Managers can make better use of knowledge about blister rust incidence zones in selecting plantation sites, and chemicals can control the weevil. But there is still a need to develop strains of eastern white pine that have genetic resistance to the rust and to weeviling.

Now used primarily for finish carpentry and furniture, select-grade white pine lumber commands prices five times as high as industrial-grade white pine, which is often used for shipping pallets and boxes. Considerable opportunity exists for manufacturing logs to grade, thus adding 200 percent to their value through drying, dressing, and grading. Careful cutting in the woods can maximize the number of clear logs and group defects in other logs.

Guidelines for forest managers and silviculturists overseeing spruce-fir forests in the central and southern Rocky Mountains, and Front Range ponderosa pine and lodgepole pine in the central Rocky Mountains are now available as three reports from the Rocky Mountain Station. The reports offer suggestions on developing even- and/or uneven-aged cutting practices for converting old- and mixed-growth stands into managed stands for a variety of resource needs.

Guidelines consider stand conditions, succession, windfall risk, and insect and disease susceptibility. Suggested cutting practices are designed to integrate timber production with increased water yield, maintained water quality, improved wildlife habitat, and enhanced opportunities for recreation and scenic values.

No one silvicultural system or cutting method meets all resource needs. Cutting small openings provides maximum yields of timber at minimum costs, promotes the largest increases in water production without serious reduction in quality, produces diversity in food

supply and cover favored by many wildlife species, and is compatible with the development of ski trails and homesites. Shelterwood cuts also provide maximum timber yields over the same time interval, but at increased costs; they produce a wide range of wildlife habitats, but with less forage than openings and less cover than uncut forests. After shelterwood cutting, water yields are increased over natural streamflow but less than with clearcutting small openings. Shelterwood cutting provides a partial retention of the forest landscape, but only when the overstory is retained for a long time. Group selection and shelterwood cutting methods impact the same resource values as patch or strip clearcuts, but the former are more complex and expensive to implement.

Not all resource needs can be met on a given site, nor is any one cutting method compatible with all uses. Land managers must recognize the potential multiple-use values of each area, determine the primary and secondary uses, and then select the management alternative that is most likely to enhance or protect these

values. On an individual site, some uses must be sacrificed or diminished to maintain the quantity and quality of others.

Fairly large patch cuts (3 acres) in lodgepole pine benefit water yield and wildlife habitat while enabling owners to realize income from their forest land without damaging the environment.

To ensure that oaks will replace themselves after cutting, managers must make sure that advanced oak reproduction is already established on the forest floor at harvest time. But on sites in the southern Appalachians that are capable of producing high-quality sawlogs, large advanced reproduction of northern red oak does not develop until the stand is disturbed (such as by thinning or wildfire). Similarly, forest managers in the Central States often find that oak advanced reproduction is inadequate to regenerate oak stands on high-quality sites.

Research conducted by the Southeastern Station on the Bent Creek Experimental Forest in North Carolina and the Chattahoochee National Forest in north Georgia over the past 10 years indicates that basal area reductions of up to 40 percent in mature stands lead to better growth of established red oak seedlings, without the simultaneous development of species that can outgrow red oak after overstory

removal. The basal area reduction should be done from below using herbicides, leaving the main canopy largely intact. Final harvesting of crop trees can be made 10 to 15 years after this initial treatment. The large released oak seedlings then successfully compete with seedlings of other shade-intolerant species, and the herbicide treatment leaves few stump sprouts of tolerant understory species.

Researchers at the North Central Station in Columbia, MO, also advise forest managers on how to successfully regenerate northern red oak in the Central States by underplanting within stands before final harvest. The four-step prescription is to (1) create a shelterwood of medium density during harvest of the current oak stand, (2) control unwanted woody vegetation with a herbicide, (3) underplant large transplants or undercut nursery stock with clipped tops, and (4) remove the shelterwood three growing seasons after planting.

There is plenty of advanced reproduction of northern red oak in this stand, which was treated with herbicides 9 years ago. When the overstory is harvested, these 10-foot trees will take over. Without early herbicide intervention, other less desirable species would dominate in the absence of red oak seed trees.

Forest resource assessments and vegetation maps have been completed for the territories of Guam and American Samoa, the Federated States of Micronesia, and the Republic of Palau. With the aid of this area and volumetric information and the type maps, the islanders will be better prepared to manage their scarce natural resources. Imagine how difficult it has been for the Pacific people to develop plans without quantitative knowledge of the extent, location, and composition of their resources. The surveys and inventories were conducted jointly by forest assessment specialists from the Pacific Southwest and the Pacific Northwest Stations. Support was provided by the island forestry agencies and Peace Corps volunteers.

The people on the high island of Yap are considered to form the most conservative society in the Caroline Islands. Yet they have developed the most productive agroforestry system in Micronesia. A Pacific Southwest Station biologist is

examining the species composition and productivity of this island's agroforests. Opportunities to supplement the islanders' diets through the introduction of superior multiple-use trees are being examined. Advanced agroforestry practices developed on Yap could readily be transferred to the many similar islands in the Pacific.

The low coral atolls in the Marshall Islands support relatively few food plants and tree species. The Pacific Southwest Station is conducting fertilizer trials for agroforest species on Majuro. These trials revealed that small amounts of a complete fertilizer greatly increase growth and yields. At the request of the government of the Marshall Islands, the Pacific Southwest Station is conducting species and fertilizer trials on the overpopulated atoll of Ebeye. This research is part of that government's efforts to establish windbreaks and create amenity plantings.

At the request of the government of the Marshall Islands, the Pacific Southwest Station is conducting species and fertilizer trials on the overpopulated atoll of Ebeye. This research is part of that government's efforts to establish windbreaks and create amenity plantings. Fertilizing can make a big difference; a treated coconut palm is on the right, an untreated tree on the left.

The Institute of Tropical Forestry, part of the Southern Forest Experiment Station, recently completed a 3-year study of five eastern Caribbean islands for the U.S. Agency for International Development. Part of the U.S. Government's contribution to the Caribbean Environmental Action Plan, the five-phase study provided quantitative assessments of the state of natural resources in the Caribbean islands, trained young people in the management of these resources, and provided guidelines for such management using principles oriented toward maximizing vegetation cover and sustaining resource use.

Each of these phases produced important results with implications to island development. For example, 24 Caribbean foresters representing seven islands received training in tropical forestry. Many of these

young men and women have advanced in position and responsibility in their respective forest services and continue to communicate with the Institute on technical matters. The wildlife assessments were conducted on nine islands and involved many additional activities, such as seminars, consultations with local authorities, and interviews for use in mass communication media. Habitat destruction was found to be the most severe threat to the wildlife of these islands.

Watershed studies produced 3 years of continuous information (taken at 15-minute intervals) on rainfall and stream discharge of three major watersheds on three islands. Sediment and water-quality data were also collected and used to develop predictive equations of watershed behavior. This work was conducted in cooperation with the U.S. Geological Survey and is the first such study in the eastern Caribbean. Data are being used for planning of water-development

projects, and island governments want to continue the program.

Prescriptions for forest management with the goal of minimizing hurricane damage to trees were developed from detailed assessments of damage of hurricanes to plantations and natural forests in three islands. Hurricane damage was pervasive islandwide. In addition, the first comprehensive forest survey of Saint Vincent revealed that about 38 percent of the island is forested. The need to protect native stands on steep areas was highlighted in the recommendations.

Results were transferred throughout the region in the form of five major publications and in meetings of Caribbean foresters. The synthesis of this study, which focuses on environment and development, was presented at a global conference on island development sponsored by the United Nations' Man and the Biosphere Program in Puerto Rico in October of 1986.

Students from various Caribbean islands during their 3-month forestry course at the Southern Station's Institute of Tropical Forestry. Their mentor, Station scientist Ariel Lugo, is in the second row, to the left of the "T" in "Tropical."

Over the years, Forest Service researchers and their colleagues in the university and forest-industry sectors have developed extensive information on the silviculture and management of Appalachian hardwoods. Much of this information was recently summarized for field foresters and landowners during a workshop entitled "Guidelines for Managing Immature Appalachian Hardwood Stands" and in the accompanying proceedings.

Speakers presented "how-to" guidelines based on the literature and their knowledge and experience. They made recommendations on how to manage sapling, pole, and small-sawtimber stands and discussed the role of past history on present stand composition, the benefits of quality timber products, market trends, and coordination of wildlife- and timber-management practices.

Researchers recommended that Allegheny hardwood stands be thinned to maintain 60- to 80-percent relative density, with emphasis on removing poor-quality trees. Another presentation focused on Appalachian cove hardwood stands that will produce large, high-quality timber with minimal silvicultural treatment. Even in these productive stands, initial thinnings when stand height is about 50 feet and perhaps subsequent thinnings every 10 to 20 years will concentrate growth on high-value trees and shorten rotations by 30 to 50 percent.

The workshop was sponsored by West Virginia University and the Northeastern Station, in cooperation with the Allegheny Society of American Foresters. There is a major market for this research, as evidenced by the fact that over 300 people, from 43 organizations and 15 States, attended the workshop.

Removing larger hardwoods gives the remaining trees a bigger share of nutrients and sunlight, thus promoting faster growth in this healthy stand.

Maintaining or improving the productivity of the land is part of the forestry ethic. In the long rotations of traditional forestry, obtaining adequate reproduction after harvests satisfied management's concerns for the future. Now with short rotations and chipping of entire trees, including foliage, soil nutrients may be taken away faster than they have ever been taken before in well-managed forests. To manage this possible long-term decline in site productivity, a forester must have some understanding of nutrient cycling--the movement of nutrients into, within, and out of forest ecosystems. A new guide, "Foresters' Primer in Nutrient Cycling," provides the sort of information a forest manager needs. It tells the concentrations of nitrogen, phosphorus, and potassium found in various tree parts as the trees age. It gives the quantities of nutrients that accumulate in the forest beneath loblolly pine and the quantities that break down and pass to mineral soil. It also estimates the nutrient losses associated with prescribed burning and other forms of site preparation.

As forest treatments go, fertilizer application is fairly expensive--too expensive to do without assurance of a positive result. The new management guide "When and Where To Apply Fertilizer" tells forest managers about using foliar analysis to determine fertilizer applications, the levels of phosphorus to add to most soils, the greater response to nitrogen on sites where it is limiting but moisture conditions are favorable, and the expected returns of 10 to 28 percent for fertilizer applications on some sites.

On poorly drained, heavy soils, logging can destroy soil structure, block drainage, injure seedlings, and remove valuable nutrients. On Coastal Plain sites, as much as two-thirds of a logged area can be damaged, and costs in lost productivity can be \$60 to \$90 per acre, according to the guide "Managing Site Damage from Logging." Historically, the blame for this damage has been placed on the logging contractor, but much of it can be prevented by careful timber-sale planning, preparing the site for logging, and careful supervision during the logging.

In all, five "pocket guides" have been published to update forest managers on years of research conducted by scientists participating in the Loblolly Pine Management program in the Southeast. They offer advice on applying fertilizer, nutrient cycling, and managing site damage from logging. In 1987, guides on site preparation and southern seed sources will be printed as part of the Forest Service's commitment to sharing its research results with users.

A handsome and healthy stand of planted loblolly pine (6- by 6-foot spacing) in Louisiana's Alexander State Forest. The photo was taken after the initial thinning, at stand age 25.

In the last two decades, Forest Service research has developed timber growth-and-yield models that can be used to describe the present forest and predict its response to change resulting from human activities and natural events. Using these computer models, an inventory of the forest, and a "what if" approach to the decisionmaking process, forest land managers can relate alternative forest-management strategies to yield of forest products.

Enhancements to these growth and yield simulators include computer programs that consider (1) the impacts of insects and diseases on forest development, (2) genetic gain information for estimating increased production resulting from improved planting stock, and (3) evaluation of regeneration prescriptions; and tie the growth of trees to wildlife habitat and watershed protection concerns.

The usefulness of these highly sophisticated computer models is being reinforced through the addition of economic options that

allow the user to look at costs and revenues at the same time that forest-management alternatives are being simulated.

Computer programs for these models and supporting user's guides for many of the major hardwood and conifer forest types of North America are available from the forest experiment stations. Although many of these models require a large computer, several have versions or were developed specifically for personal computers.

Sufficient seed supplies are critical to reforestation. Research in the Southern Station has shown that seed production can be greatly increased by locating pine seed orchards in warmer climates. Problems with reproductive phenology, however, may limit transfer into subtropical climates. Research is continuing on whether "after effects" of the seed-production climate persist after seedlings are planted in cooler locations. The photograph shows an abundant cone crop harvested from a grafted Virginia pine tree planted in south Mississippi (450 miles southwest of its origin). This seed will be planted at more northern sites, and seedling progress will be closely monitored.

As increasing quantities of genetically improved seed are available from seed orchards, forest

managers need to make informed decisions about deploying this material. The challenge is to maintain genetic diversity in commercial forests while at the same time seizing opportunities for greater yields through the use of genetically improved stock.

If seeds harvested from seed orchards are collected by family and sown separately in the nursery, forest managers can plant stands with mixtures of desirable genotypes, on the basis of fiber-yield capacity or other traits of interest to the manager. By varying the timing and spatial patterns of genetic groups, almost any pattern of genetic diversity could be achieved with either pure or mixed stands. Also, different management regimes can be tailored to match the requirements of the planted genetic material.

This Virginia pine produced a substantial cone crop despite being planted in southern Mississippi, 450 miles southwest of its origin.

Classifying and Evaluating Forest Sites in the Interior Uplands

Because forest managers are faced with the challenge of producing more wood on a diminishing acreage of commercial forest land, the need for site-classification and productivity information is a high priority. This need has been met for the interior uplands in the Southeastern United States. A scientist at the Southern Station's silviculture laboratory in Sewanee, TN, has developed a comprehensive but practical forest site-classification and evaluation system.

Geographically, the system covers the Cumberland Plateau and Highland Rim-Pennsylvanian physiographic provinces (about 29 million acres) in parts of five States (Alabama, Georgia, Tennessee, Kentucky, and Virginia). Six regional guides have been published, and several articles have been written describing the rationale and methodology involved.

The uplands, like the entire eastern hardwood forest region, has a long

history of indiscriminate cutting, burning, grazing, and clearing for agriculture. On the average, productivity is far below potential because of poor stocking, an undesirable mix of species, and the presence of defective and low-vigor trees. Consequently, in the development of the system, vegetation was relegated to a position of minor importance.

The hierarchical system, which is based primarily on geomorphology and soils, can best be described as a process of successive stratifications of the landscape: physiographic province, region, subregion, landtype association, and landtype. Nearly 200 landtypes have been defined in the six regional guides.

In the published guides, each landtype is described in terms of nine elements--geographic setting, dominant soils, bedrock, depth to

bedrock, surface soil texture, internal soil drainage, relative soil water supply, soil fertility, and vegetation. Each landtype is evaluated in terms of productivity and desirability of selected hardwoods and conifers for timber production. Also, each landtype is rated for five soil-related problems that can affect management operations--plant competition, seedling mortality, equipment limitations, erosion hazard, and windthrow hazard.

An intensive study of the chemical and physical soil properties on three major landtypes on the mid-Cumberland Plateau showed that the system separates the landscape into units with relatively homogeneous soil properties and potential timber productivity. Use of the system for evaluating wildlife habitat is currently being studied.

Forest Service researchers at Rhinelander, WI, Olympia, WA, and Honolulu, HI, are developing methods for farming fast-growing trees using agronomic practices common to corn or wheat production. Trees are grown at close spacing, usually with intensive weed control, fertilization, and irrigation. If the demand for wood increases and supplies become short, land managers will have this alternative system to grow large supplies of wood near plant locations, for fiber, fuel, and wood products.

Field trials in Rhinelander have shown that wood production can be increased three to five times over that of a natural forest, and that yields of 15 tons per hectare per year--equivalent to 43 barrels of oil--can be attained. Scientists have developed new silvicultural systems for establishing and managing fast-growing plantations of hybrid poplar, including cultivation for weed control, as illustrated in

the figure. They have also shown that rapidly grown, intensively cultured wood is suitable for reconstituted products such as kraft paper and structural particleboard. Poplar foliage can be used for animal feed. Although growing trees rapidly requires considerable energy input, it pays in terms of energy production: for every unit of energy input in the northern Wisconsin tests, there are 10 units of energy produced in harvested and chipped wood.

Short-rotation forestry trials in Oregon and Washington are focused on developing cultural practices for red alder and hybrid poplar, evaluating and exploiting genetic variation, and predicting site productivity. Spacing trials in red alder plantations throughout the Northwest are generating information on the effects of five planting densities on mortality, individual tree growth, and biomass production per hectare.

Because of their quick growth and high yields, Eucalyptus saligna and E. grandis species are especially favored for wood, fiber, and fuel production in Hawaii. They have been planted extensively in a cooperative venture by the BioEnergy Development Corporation, the Forest Service, and the Department of Energy. In field trials evaluating the effects of stand density, fertilizer, weed control, and seed sources, biomass yields have exceeded 25 dry tons per hectare per year on most average sites. To compensate for nitrogen deficiencies in most soils, two leguminous tree species of the Acacia and Albizia families were planted in mixtures with eucalyptus along the Hamakua coast, on the island of Hawaii. After five and a half years, crop yields averaged 38 tons per hectare in pure eucalyptus, 52 in eucalyptus with Acacia, and 95 in eucalyptus with Albizia, demonstrating the potential for interplanting leguminous trees with eucalyptus.

The machine digs the hole for the new tree seedling, the men drop the containerized seedlings into the hole and tamp them down with their feet, and the machine waters the seedlings before moving forward in the row. This system combines the best of both machine and hand planting.

The first commercially important foreign gene has been genetically engineered into a forest tree. In cooperative research, scientists from the University of Wisconsin, Calgene, Inc., and North Central Station used the bacterium Agrobacterium to insert an herbicide tolerance gene into a hybrid poplar. The gene, which confers tolerance to the Monsanto herbicide Roundup[®], was isolated from the bacterium Salmonella by Calgene scientists. The hybrid poplar that contains this new gene has exhibited increased but not complete tolerance to sprays of the herbicide in initial greenhouse tests. Poplar totally tolerant to herbicides would be excellent for intensive forestry plantations, where weed control using chemicals is difficult to achieve without killing the crop trees.

Biotechnology techniques are of even greater potential benefit in forestry than in agriculture because

traditional approaches to plant breeding require a disproportionately longer time in large, long-lived forest trees than in agronomic crops. The Forest Service has taken the lead in the application of this new technology to the genetic improvement of woody plants. But until now, opportunities for forest scientists to develop a working knowledge of biotechnology have been limited. To meet this need, the Institute of Forest Genetics gave an intensive 4-week course in biotechnology to promote the use of recombinant DNA, tissue culture, and isozyme technologies in forestry. Designed for senior scientists from university, government, and industrial research organizations, the new course was invaluable in quickly moving molecular and cellular technologies into forestry, building an interactive network of forest scientists, and multiplying the Forest Service effort manyfold.

The genetically engineered hybrid poplar clone on the right is much more robust than its control partner.

Southern Pine Growth Decline in the Southeast

Periodic timber inventories at the Southeastern Station show that net annual growth of pine in the Atlantic Coast States from Virginia to Florida has peaked and turned downward after many years of increase. We knew that three factors--inadequate pine regeneration, fewer acres of timberland, and increased pine mortality--have contributed to this reduction in pine volume growth. In addition, during a comprehensive analysis of pine growth over the past three decades, we discovered that growth rates for natural pine trees and stands had declined.

The study shows that average annual radial growth of yellow pines under 16 inches in diameter has declined by 30 to 50 percent over the past 30 years. Lower rates of individual tree growth have translated into reduced stand-level growth. In the Coastal Plain, much of the reduction in growth rate appears to have occurred in the 1960's, followed by more stable growth patterns. In the Piedmont plateau, declines are evident throughout the past two to three decades.

Average stand age and density have been increasing in the Southeast, and these changes probably have contributed to the declines in growth. Analyses indicate, however, that these factors do not explain a majority of the decline. Other possible causes include drought,

Both loblolly and slash pines grew more slowly in Georgia during the 1972-82 period than in prior decades. Researchers have not yet

atmospheric pollution, an increase in hardwood competition, and a loss of old-field conditions, or perhaps some combination of these factors. The Forest Service is continuing to investigate the reason or reasons for these growth declines in natural pine stands.

determined why, but several studies are underway to evaluate the situation.

The latest California forest resource inventory, as published in five Forest Service resource bulletins, shows that the volume of hardwoods has increased since the last inventory and the area of hardwood timberlands (closed forests) has increased, while the area of hardwood woodlands (open forests) has decreased. This information proved timely since the California Board of Forestry designated a special task force to study the hardwood situation. Currently, the State's forest practice law applies only to timberlands. The Board is assessing the question of whether or not woodland areas should be regulated.

New statistics for the North Coast Resource Area, the most important timber-producing region of the State, showed that hardwood volume has increased an average of 2.65 percent annually since the previous inventory, while conifer volume decreased 1.35 percent annually. Acreage in hardwood types has increased commensurately, occupying

about 800,000 acres that formerly supported Douglas-fir and redwood. Comparative statistics showed that while conifer volume declined, the total number of conifer trees increased by 55 percent and the condition of timberland improved in terms of future stand productivity. Poorly stocked areas decreased from 22 percent of total forest area to only 5 percent, and conifer growth rates increased.

While hardwoods on timberland have increased, the area of hardwood woodland has decreased, and some hardwood species--blue oak and valley oak especially--seem to be declining. Range clearing, urban expansion, and road and reservoir construction have eliminated over a million acres of hardwood woodland since 1945. In addition, regeneration of oaks is not keeping up with natural mortality in the remaining woodland areas. Woodland is gradually phasing into nonforest in many parts of the State. Some observers believe firewood cutting is speeding up the decline of

California oaks and grazing is a factor in poor oak regeneration.

This current resource information was included in a jointly written report to the California Board of Forestry and will be essential to their deliberations. In addition, it will be entered into the California Department of Forestry's geographic information system and used in several ongoing analytical models.

Production and Consumption of Veneer Logs
Continue To Rise

To make appropriate decisions about harvesting and replanting, timberland managers need up-to-date statistics on how much northeastern timber is being used for industrial forest products. Periodically, the Forest Service assesses production and consumption of a single timber product to determine its importance to the entire timber industry of a region. A 1984 canvass of veneer manufacturers in the Northeast showed that veneer manufacturing ranks third in the region in terms of wood received at primary wood-processing mills.

Earlier assessments of veneer production and consumption have been conducted in the area, beginning in 1963. During the latest period, between 1980 and 1984, total veneer-

log production increased by 19 percent, rising to over 187 million board feet by 1984. Receipts at northeastern veneer mills, the consumption of veneer logs, rose 28 percent, to approximately 154 million board feet. These increases occurred even though the number of veneer mills declined by five in the Northeast between 1980 and 1984.

Northeastern timber harvesters continue to supply high-quality veneer logs to mills located in the region and elsewhere. Since 1963, regional exports have exceeded imports. Declining in the mid-1970's, the net export of veneer logs has subsequently increased, reaching approximately 26 million board feet by 1984, a 14-percent surplus.

Sharp increases in the production and receipts of veneer logs at mills characterize the last decade.

How To Estimate Operability and Location of the Timber Resource

Foresters and loggers know that not all timberland is created equal--some is more easily managed or logged than other land, and some, perhaps, should not presently be managed or logged at all. "Operability" is the word used to define this relative ease or difficulty of managing or harvesting timber because of physical conditions in the stand or on the site. If land managers or timber-procurement personnel could rate timberland for operability, it would help them to screen out marginal management or harvest opportunities and to give priorities to the remaining ones.

Scientists at the North Central Station developed a method for evaluating the operability of timberland using information routinely collected during Statewide forest inventories by Forest Inventory and Analysis field crews. The technique uses seven items computed from data collected on permanent sample plots, such as stand area, volume per acre, and percent of cull trees in the stand. The method allows the user to ignore up to three of the seven operability components deemed unimportant to him. It also permits the user to determine the area of timberland and the volume of timber by operability class and by its distance from wood-using centers in a State.

Aerial photography helps foresters determine the operability of timber stands before they make harvesting decisions.

Transmitting Forest Inventory Data

Forest Service inventory and analysis foresters tally sample trees the way salesclerks inventory groceries. The use of data recorders for forest inventory work in the United States was pioneered by the Forest Inventory and Analysis (FIA) unit at the Southern Station in 1978. Subsequently, an evaluation of portable data recorders by the Pacific Northwest Station and the implementation of a Servicewide computer network provided the impetus for other FIA units throughout the country to field test these recorders.

We are finding that young inventory field foresters, who are familiar with video games and personal computers, prefer using data recorders over traditional plot tally sheets. The software programs necessary for data transmission and entry are being developed jointly by several experiment stations. Telecommunications and data capture and subsequent processing are reliable and efficient. Key punching costs, time requirements, and the associated errors of handling the data at several stages of entry are eliminated. Our experience in manipulating FIA data demonstrates that new technology is not always conceived from "Star Wars" types of research and development.

We found that younger field workers are most comfortable using handheld calculators and other electronic devices for transmitting forest inventory data.

The Forest Inventory and Analysis program provides continuing information about the Nation's changing forest and rangeland resources. Forest industry, financial consultants, and State resource planners who depend upon this inventory data, need updated statistics in order to monitor the

effectness of their activities. New statistical publications were issued this year for California, Illinois, Louisiana, Montana, Nebraska, New Hampshire, Vermont, Virginia, and Wisconsin. These reports describe the volume and species of timber, its quality, the condition of the

forest understory, and other variables, for the forest resource in each State. In addition, reports of special studies dealing with timber production, attitudes of forest owners, and the application of improved technology to forest inventories were published.

The implementation of Forest plans involves decisions regarding when, where, and how to harvest timber, as well as when, where, and to what standard to construct timber-access roads. Such decisions can considerably affect both economic efficiency and the environment. Many resource managers believe that area-level analysis (ALA), an interdisciplinary process concerned with the management of contiguous land areas from 5,000 to 50,000 acres, is the logical next step once the information from a Forest plan is extracted in as much detail as is practical. Numerous approaches for ALA are possible, ranging from straightforward simulation to optimization techniques. Economists at the Intermountain Station have tested four analytical approaches to measure efficiency differences across the continuum from simulation to optimization.

1. **Fixed-Access Simulation (FX).** Managers decide how each potential harvest unit is to be accessed and fix this information in the simulation model. They then decide which units to harvest for each alternative developed (access routes are fixed in the analysis).
2. **Variable-Access Simulation (VR).** Managers choose which units to harvest and how to access those units for each alternative developed (access routes can be changed in the analysis).
3. **Simulation With Minimization of Road Costs (MC).** Managers select the units to harvest and then use an optimization routine to determine the least costly transportation plan for accessing those units.
4. **Optimization (MX).** A model selects the harvest and road

construction activities that maximize or minimize a specified objective function while satisfying other management objectives specified as constraints.

Each approach was tested twice on three actual planning areas, using the same data and management objectives within each area over the 50-year planning horizon. Forest Service managers selected the harvesting and road construction projects in the simulation approaches. The discounted net timber revenues per acre for the MX approach were significantly higher than for the other approaches. From the results of this study, it appears that the MX approach has much potential for increasing cash-flow while achieving other management goals and objectives specified in Forest plans.

Ad valorem property taxes have long been criticized as a method of taxing forest properties because they impose an annual tax on both land and timber even though most forest properties do not provide annual income. In response to this criticism, several States have enacted optional yield tax laws, which attempt to encourage better forest management by deferring all timber taxes until timber is actually harvested. At present, 9 States have a total of 11 such statutes.

These laws were recently studied under the terms of a cooperative agreement involving economists from the Southern Station and North Carolina State University. Major objectives of the study were (1) to determine the extent to which each piece of legislation was being used,

and (2) to identify what, if any, administrative problems were being encountered. The results indicated that only four of the programs--those of Massachusetts, Michigan, Missouri, and Wisconsin--had succeeded in attracting a substantial number of participants.

The principal reason for the generally low levels of landowner acceptance seemed to be (1) absence of an obvious tax advantage, (2) severe eligibility restrictions, (3) unawareness of all relevant tax options, (4) reluctance to relinquish control over certain management decisions, and (5) unwillingness to allow free public access to enrolled acreage. These findings were used by the investigators to formulate several recommendations for improving program effectiveness.

The owner of this 17-year-old pine plantation in Mississippi and his consulting forester have plenty to smile about. A pulpwood cut removed about 20 percent of the stems, providing interim income to the owner, and the remaining trees will bring top prices in a few more years. Tax treatment of standing timber greatly influences how much "management" the typical landowner can afford.

How Much Will Future Wood Supplies Cost?

Forest economists at the North Central Station have developed a timber harvest scheduling model that provides a relatively inexpensive methodology for analyzing the consequences of alternative future scenarios of regional timber use. The model utilizes both dynamic programming and basic concepts of

timber-production economics. A recent application of this model examined the impacts of the use of wood for energy on future timber supply in northeastern Minnesota. Specific attention was directed to the impact of wood energy use on the supply costs for other timber products users. Six scenarios of

future use levels of conventional timber products and wood for energy were evaluated. The results indicated that with appropriate management actions, wood energy use could be increased significantly without raising the supply costs of other timber products.

An Improved Framework for Estimating Wildland Resource Values

To comply with the Renewable Resources Planning Act (RPA) of 1974, the Forest Service must inventory forest and rangeland resources and determine their economic value. It is relatively easy to assign a value to tangibles like timber or water, but some of our finest wildland assets, like outdoor recreation, cannot be measured easily. Three Rocky Mountain Station economists have been working on this problem.

"Toward an Improved Framework for Estimating RPA Values," by George L. Peterson, Thomas C. Brown, and

Donald H. Rosenthal, identifies and separates the important issues and provides new concepts and guidelines for assigning economic values to the varied products and uses of our Nation's forest and rangeland resources. One of the most important of several contributions is identification of subaccounts by which to estimate economic values. These subaccounts represent different objectives that may be of concern to different interest groups affected by forest planning. The results of this research will be used in the development of the 1989 RPA program.

Harvesting and Regeneration Cost Trends for Southern Forest Management

The profitability of investments in forest land and forest management depend not only on the prices received for timber harvested but also on the costs of forest management. Economists at the Southern Station analyzed trends in harvesting and regeneration costs from 1979 to 1984 and found that the cost trends differ depending on the management activity.

Harvesting costs have kept pace with inflation, except for marking and whole-tree chipping. Marking costs increased 50 percent faster than inflation, primarily because labor costs have increased faster than labor productivity. Chipping costs have increased at twice the rate of inflation. Downward trends in fuel prices during 1985-86 are a two-edged sword, reducing the cost of chipping but also reducing the chips' value as an energy source. Though chipping can help reduce the cost of site preparation by removing harvest residues and residual vegetation, such benefits may not offset the reduction in fuel value of the chips produced.

Site-preparation costs have also kept pace with inflation, primarily because managers have shifted to

less-intensive preparation practices to hold down cost increases. The result is that harvest residues are not broken down as effectively, and more vegetation remains to compete with seedlings for light, water, and nutrients. Consequently, broadcast burning costs have risen faster than inflation.

The cost of planting seedlings by machine has kept pace with inflation. But the acreage planted by machine has declined because rougher sites remain after less-intensive site preparation. In the South, 70 percent of planting is now done by hand. This process--25 percent less expensive today than in 1979--is now less expensive than machine planting.

Analysis of the cost trends shows that controlling competing vegetation is the driving force behind shifts in practices and costs. If not controlled prior to harvest, unmerchantable trees and brush respond to a harvest operation by moving quickly to dominate the site. Controlling competing vegetation before harvest not only reduces regeneration costs and improves regeneration success but also pays harvesting dividends by

increasing stumpage prices and reducing marking costs. Harvesting and regeneration operations must be integrated to secure the most economic benefits.

This field crew is planting pine seedlings by hand, to regenerate an old burned area on the Francis Marion National Forest in South Carolina. Changes in labor costs have made hand-planting cheaper than machine-planting in the late 1980's.

Forest-Products Industry in the Economy of Several Southern States

The South's forest-products industry experienced significant growth during the 1970's. How this change affected employment, earnings, and productivity is the subject of a series of analyses by Forest Service and cooperating university economists for each of the 13 Southern States.

Between 1970 and 1980, most of the States increased their share of the Nation's employment and earnings in the forest-products industry. North Carolina, for example, had nearly 20,000 more employees in 1980 than it would have had if its forest-products industry had grown at the national rate; its earnings were nearly a quarter of a billion dollars more than otherwise. Arkansas and Louisiana were exceptions--they both had a smaller share of employment in 1980 than in 1970.

The forest-products industry is a significant component of the economic base of most Southern States (the economic base is comprised of industries producing for export outside the State). In 1980, for example, the forest-products industry accounted for one out of six basic employees in Arkansas, North Carolina, and Mississippi.

Increases in productivity exceeded increases in payroll per worker between 1972 and 1977 for all Southern States, a fact that is responsible in part for the South's comparative advantage in the forest-products industry. The average productivity for all manufacturing industries exceeded that of the forest-products industries in 11 of 13 Southern States. But the forest-products industries in five States--Alabama, Georgia, Louisiana, Oklahoma and South Carolina--exceeded the industry's average for the Nation.

Slash pine plantations like this one near St. Matthews, SC, keep the South's timber industry humming. Forest products account for a tremendous share of the region's contribution to the gross national product.

Area changes for land uses are important considerations in analyzing prospective supplies of natural resources such as timber, wildlife, and forage. In the South, timberland occupies approximately three-fifths of the land base and is chiefly in private ownership. This proportion has been dropping since the early 1960's as agriculture and developed uses expanded. Researchers at the Southeastern Station analyzed data pertaining to land use and associated determinants of private-area change dating back

to the 1940's to find out how and why the region's timberland base is changing.

Econometric analysis of the data revealed that changes in the acreage of timberland in private ownerships occur due, largely, to forces outside the forestry sector, primarily changes in population and personal income. Our economists used estimated relationships between land-use areas and variables such as population, personal income, and income from agriculture and forestry

to develop models of area change for the South.

With these models, we projected area changes for 12 Southern States in an ongoing study of the timber supply situation in the South. Projections indicate that timberland area will continue to drop in the South, in large part due to continued conversion of timberland to urban and developed uses. The projected timberland area reduction is primarily on farm ownerships.

The Economic Impact of Timber Utilization Research

For the Renewable Resources Planning Act and other planning processes, the Forest Service needs better means to evaluate the benefits of timber utilization research. A recent study done at the University of Minnesota in cooperation with our Forest Products Laboratory analyzed the benefits of forest-products research by determining its impact on softwood timber utilization. Selected improvements in seven groups of technologies were analyzed, including lumber production and use, and the production of panel products and pulp and paper. The cost of research to develop the improvements in the 1970's was compared to expected discounted net savings of

softwood timber through the year 2000.

Results indicate that expenditures on timber utilization research in the 1970's have been well justified. In fact, the benefits from the seven technologies analyzed justify the expenditure for all timber utilization and timber management research done in the 1970's by public and private laboratories. The expected benefits from the selected utilization improvements constitute an estimated 18-percent rate of return on 1970's timber utilization and timber utilization research through the year 2000.

Forest Products Laboratory employees load a section of veneer log onto the lathe that will peel off the veneer. Ongoing experiments deal with increasing the amount of usable material from trees via improved logging and machining techniques.

Multiple-Resource Tradeoffs and Joint Costs in Forest Ecosystems

In managing forest resources for multiple uses, joint outputs from the same tract of land or ecosystem occur frequently. A vexing problem for managers of public forest lands is allocation of costs to separate products or values in situations where the management inputs occur as nonseparable costs. Economists at the Rocky Mountain Station conducted a rigorous theoretical and empirical investigation into the nature of a managed forest ecosystem as a multiple-use production unit. The theoretical work concludes that if production processes--for example, timber and wildlife--are interrelated, then joint cost-allocation problems can occur. The empirical work analyzed a particular forest area and tested this hypothesis. Management treatment

costs were appraised as single output costs and then appraised as portions of joint costs. The actual errors encountered in costing outputs individually vary from 8 percent to 60 percent of the actual joint cost.

The policy implications of these findings are simple: if attempts are made to cost forest and range outputs independently, the sum of output costs may be less than the true cost of producing the set of outputs. Thus, if decisions are made concerning the level of different outputs based on individual output costs, misallocation of resources may result. This research is currently being applied in developing the 1989 RPA Assessment.

America's national forests provided unparalleled recreation opportunities. Here in the Mammoth Lakes Recreation Area on the Inyo National Forest, in California, a fisherman and a group of riders make use of the State's natural beauty. Part of the Forest Service's job is to evaluate the tradeoffs in restricting timber harvesting to maintain recreation areas such as this.

Taxes, their relationship to forest land ownership, and their implications for forest-management decisionmaking have been a matter of great interest in United States forestry circles for more than a half century. In 1923, for example, a U.S. Senate select committee on reforestation ranked taxes as the second most serious obstacle to private forestry, behind forest fires. Congress passed the Clarke-McNary Act the following year.

One section of the act called for a nationwide study of forest taxation. The study's major report, entitled "Forest Taxation in the United States," was published in 1935. It was a monumental and comprehensive work and is still a basic forest tax reference.

Today the influence of taxes on forest management is as lively a subject as it was in the 1930's. Many forest economists rank taxation as the most influential factor in determining the viability of a forestry investment. The impact of taxes is a dynamic process--tax laws are constantly changing, new tax legislation of some type is always being enacted, and new judicial interpretations of existing law are continually being rendered.

Many State and Federal taxes currently pose serious obstacles to forest investment. At the same time, however, many offer overlooked economic opportunities. In recent years the Forest Service has responded to this changing tax environment by conducting a

comprehensive, continuing forestry tax research program centered at the Southern Forest Experiment Station. Examples of recent research include (1) development of guidelines for forest landowners to determine the best way to recover silvicultural costs on their Federal income tax; (2) analyses of court decisions on interpretations of landowner's eligibility to claim long-term capital gain on timber sales; and (3) analyses of the features of 11 existing optional State forest yield-tax laws, including owner eligibility, procedures, and apparent success. The results of these and other forest taxation studies are presented in Station papers, journal articles, and other published materials.

Researchers at the Intermountain Station in Missoula, MT, have been conducting studies to identify and evaluate both the nature and magnitude of timber harvest costs borne for multiple goals and nontimber outputs. Three lines of research are being pursued. First, researchers are measuring the costs of mitigation and enhancement activities undertaken on behalf of nontimber objectives during timber harvests in the Northern and Intermountain Regions. Costs include agency-incurred sale preparation and administration costs as well as reductions in stumpage receipts resulting from operator-incurred costs. This research builds on recently completed research that estimated an average

cost of \$26 per thousand board feet for nontimber provisions in Northern Region timber sales. A second line of research is developing the technology needed for planning groups of timber sales within a subarea of a national forest.

Research results indicate that potential cost savings from the systematic integration of timber harvest and transportation development activities are enormous. Research has focused on comparing the relative efficiency and effectiveness of different analytical approaches to this integration. Current research is streamlining analytical procedures and making them easier to use.

Finally, researchers are involved with studies pertaining to apportionment of joint costs in timber sales--costs incurred in the simultaneous and unavoidable production of multiple products. This research is designed to assess the opportunities, options, and problems for apportioning timber-sale costs to the products and objective served.

Results of this research program are available in Intermountain Research Station papers INT-361 on timber sale planning and INT-351, along with an article appearing in the June 1986 issue of American Forests on timber-sale costs. Other results are currently being prepared for Station and journal publication.

Products and Harvesting

Improving Sediment Yield Estimates From Forest Roads

Controlling erosion from forest roads is hampered by our limited ability to estimate sediment yield from these roads and to evaluate the effectiveness of erosion-control treatments. Studies at the Intermountain Station address the problems of (1) developing better ways to predict sediment yield and, concurrently, (2) evaluating the cost-effectiveness of various erosion-control treatments for forest roads.

Our scientists have developed sediment yield information for a wide range of road standards, road gradients, and geologic materials. Two basic methods of determining rates of surface erosion are being used: (1) simulated rainfall applied to selected road sections to establish relative differences in sediment yield for roads built in different geologic formations or built to different gradients or standards, and (2) instrumented road

sections established to provide actual long-term differences in sediment yield between different roads under conditions of natural rainfall and snowmelt. The two methods are complementary. Simulated rainfall allows us to obtain directly comparable sediment yield information for road sections subjected to a common "design storm" of known magnitude and energy. Instrumented road sections provide a way to measure the effects of natural storms over a longer period of time.

We found wide variability among geologic materials in erodibility and rate of sediment production. The effectiveness of erosion-control treatments in reducing sediment generation and movement also varies. Some of the more cost-effective treatments are gravel surfacing, vegetative or mulch cover on cut-and-fill slopes, and filter windrows of slash at the base of fill slopes.

Our information has been incorporated into computer models

that significantly improve our ability to predict sediment yields from either existing or proposed roads and help specify the most cost-effective road design, construction, and treatment practices to reduce erosion. The sediment yield information can be used as part of a national effort directed by the USDA Agriculture Research Service for development of improved soil loss-prediction models.

To discover how rainfall affects sediment production from forest roads, we apply an artificial rainstorm of known intensity and duration to an instrumented section of road. Later, a technician will collect sediment samples for analysis.

A large timber base has been established by the extensive planting of southern pines in the South over the past three decades. In the next few years, many of these stands will require thinning to achieve the best economic return. A mixture of methods and equipment is currently being used for thinning, but managers need improved machines and systems to reduce costs.

Research engineers at the Southern Station have evaluated several mechanical thinning systems in terms of both production and cost. They evaluated functions such as grapple skidding, gate delimbing, flail delimbing, and felling with rubber-tired, swing feller-bunchers. Production and cost estimates were also developed for

the individual functions and machines. This information can now be used for evaluating alternative thinning systems in southern pine plantations.

In support of the field studies, several new research tools have been developed. They include a hand-held calculator system for recording elemental time-study data, a pine plantation stand-plotting program, and an interactive microcomputer model for simulating feller-buncher operations. Actual, partial, or composite stands can be generated and plotted to evaluate alternative felling methods. The interactive simulation model coupled with the stand plots can be used to develop felling patterns and to determine the operating characteristics of various feller-bunchers.

This swing feller-buncher fells trees and bunches them up in clumps for easy removal during thinning operations in a southern pine plantation.

The chemical makeup of wood is basically that of a three-dimensional substance, composed primarily of the polymers cellulose, hemicellulose, and lignin. These polymers make up the wood cell walls and are responsible for most of wood's physical and chemical properties. Therefore, if the basic chemistry of the cell-wall polymers is changed, the basic properties of the wood will be changed.

Untreated wood swells when exposed to moisture because its cell-wall polymers attract water molecules and form chemical bonds with them. This bonding process is reversible: under lower moisture conditions, the water molecules are lost, and the wood shrinks. This lack of dimensional stability can be a serious problem when wood is used for such purposes as millwork, furniture, and cabinets because the movement during moisture gain or loss can distort the finished product. However, research has shown that the undesirable swelling and shrinking of wood can be reduced considerably, making it more stable, through the process of cell-wall modification.

Treating wood with acetic anhydride causes the cell-wall polymers to form acetyl bonds, making them incapable of attracting moisture molecules. The net effect of this treatment is greater dimensional stability.

Research chemists at the Forest Products Laboratory have successfully demonstrated that the problems inherent in the acetic anhydride treatment can be overcome by using a special dip procedure, followed by a period of heating. This new technique treats small flakes, particles, or fibers and results in their complete acetylation, which makes the treatment more cost effective. The treated material can be formed into panel or molded products that have greatly improved water resistance and dimensional stability. Research has shown that this acetylation process has little effect on the strength properties of the resulting wood material, and there is very little color change in the finished product.

Chemical modification of wood at the Forest Products Laboratory has substantially increased its dimensional stability.

Measuring the Mechanical Properties of Paperboard in a Changing Humidity Environment

The mechanical response of paperboard to creep deformation, long-term loading, and cyclic changes in humidity is critical to its performance in structural applications. Yet in the past, industry has virtually ignored these effects because of the difficulty of performing controlled tests.

Researchers at the Forest Products Laboratory have developed a unique apparatus for investigating the performance of paperboard under changing conditions of humidity and edgewise compression. A vacuum restraint system holds the paperboard specimen in position for compressive testing, and specimen equilibration time is reduced from several hours to a few minutes. With this apparatus, it is possible more accurately and reliably to measure stiffness, compressive strength, and duration-of-load performance during creep tests in constant or changing humidity conditions.

This versatile new apparatus makes possible a more complete analysis of paperboard properties in real-world conditions. This opens the door to true performance-based evaluation of

structural paperboards, which will lead to improved design of corrugated containers and lower container cost.

This apparatus measures strength, stiffness, and deformation of paperboard at variable rates of load and humidity.

Moisture Content and the Mechanical Properties of Lumber

Recent research on the effect of moisture content on the mechanical properties of Douglas-fir and southern pine dimension lumber indicates that strength generally increases as lumber dries, but not as much as has been assumed in engineering design codes. This new research indicates that low-quality lumber (for example, No. 3 grade) would not increase in strength as it dries. The strength of high-grade lumber (such as Select Structural) would increase 40 percent in drying from green to 12-percent moisture content. Our researchers have developed analytical models that can be used to predict changes in lumber strength as a function of a change in moisture content. These models are applicable to all grades and all widths of dimension lumber and to all strength levels within a grade.

The new analytical models are currently being used to adjust data being collected in both the U.S. and Canadian "In-Grade" testing programs. The models will form the basis for new adjustment procedures in engineering design codes in both countries. These models allow more accurate design of timber structures by architects and engineers.

A Forest Products Laboratory procedure for adjusting flexural properties of dimension lumber will allow revisions in codes and standards.

Integrating new construction methods in our conventional building system is particularly challenging. Light-frame construction methods have been based on traditional methods, which do not relate directly to performance requirements or capabilities. Construction designed to meet performance standards is usually cheaper than that based on convention and tradition. Considerable progress has been made to design low-cost housing that is energy efficient, structurally sound, and has long-term durability. Advances in mechanical fasteners, semirigid adhesives, engineered structural components, and structural analysis techniques have enabled the housing industry to use products compatible with the changing raw material supply in an efficient way. One such example is the truss-framed system for housing which integrates roof truss, floor truss, and wall studs into unitized frames. Public patent No. 4,005,556 is available to anyone who desires to make use of it. Several thousand truss framed houses have been built to date.

Using the Truss-Frame System, a small crew of laborers can frame up an average house in just a few hours.

Much of the 60 million tons of wood pulp produced annually in the United States is converted into paper and paperboard material to protect products ranging from fresh vegetables to computers. Because the strength of paper and paperboard diminishes rapidly when they are exposed to high humidity and moisture, it is critical to improve and maintain paper strength under these adverse conditions. SOFORM--a new process developed by scientists at the Forest Products Laboratory--solves this problem.

SOFORM is a chemical treatment that imparts wet stiffness (stiffness after long-term soaking) to paper and paperboard. It involves formaldehyde crosslinking using sulfur dioxide as a catalyst. These

linkages lock the cellulose molecules together, which prevents swelling and loss of strength and stiffness. Studies have shown the process can improve paper's dimensional stability by about 80 percent and maintain wet stiffness almost equivalent to its dry stiffness.

If material the size of conventional wall panels can be made insensitive to moisture, paperboard products will become suitable for a wide range of engineered structural uses. Some of the potential uses for SOFORM-processed fiberboard materials are emergency shelters for disaster victims, wall and ceiling panels, and other related building applications.

Double-wall fiberboard, crosslinked in the Forest Product Laboratory's SOFORM process, may be used in engineered structural operations.

Oxidation of Pollutants by a Lignin-Degrading Enzyme

Past work at the Forest Product Laboratory's Institute for Microbial and Biochemical Technology resulted in the discovery of ligninase, the first described enzyme to degrade lignin (the material in cell walls of wood that accounts for its stiffness). This enzyme is secreted by a fungus that causes white-rot decay in wood. During degradation, the enzyme causes oxygen from the air to be combined with lignin, resulting in breakdown of the lignin.

Further research has shown that the fungus and its isolated ligninase also oxidize certain environmental pollutants, including polycyclic

aromatic hydrocarbons and chlorinated dioxins. This ability to degrade pollutants evidently parallels the enzyme's capacity to degrade lignin because the molecular structure of many of these pollutants resembles that of lignin.

Because the enzyme and the fungus degrade aromatic pollutants, they have been proposed as agents for biological waste treatment. We believe that the lignin-degrading system of wood-rotting fungi could play a significant role in the detoxification of human-caused pollutants.

Forest Products Laboratory research shows that the enzyme ligninase oxidizes certain human-caused environmental pollutants. We are hopeful that ligninase will have applications in detoxifying pollutants whose chemical structure resembles that of lignin, the natural cell-wall polymer in wood.

Composite Panels From Low-Value Trees and Residues

Good forest management often dictates the removal of small and cull trees, but managers will not implement such cuttings unless a profitable market exists for this material. Also, forest residues (such as limbs and branches of merchantable trees left in the forest) and mill wastes (such as sawdust, planer shavings, slabs, and edgings) are often wasted fiber or become serious disposal problems. But such material can be turned into valuable products when utilized for the production of flakeboard, particle board, and oriented strand board.

Research published by the Forest Products Laboratory explains how to produce composite panels from low-value trees and residues. Several publications have been instrumental in successfully transferring this new technology to user groups.

We know this research is valuable because existing mills accepted it readily, and new plants are being built in New England, the East, the South, and the Rocky Mountain area. These new plants alone have created hundreds of new jobs, mostly in rural communities, and the increased production of composite panels is helping to strengthen our Nation's economy.

Particleboard made by the Forest Products Laboratory's steam injection pressing process may incorporate furnish from low-value trees and residues. The development of economical uses for such waste products will encourage managers to clear debris out of their woods, decreasing fire danger at the same time by reducing fuels on the forest floor.

There are several million acres of small-diameter, stagnated stands of lodgepole pine in the West. These forests are growing very slowly and present a significant management challenge across much of the region. Besides being an underutilized wood and fiber resource, such stands occupy lands upon which effective multiresource management for watershed, wildlife, recreation and other uses is critical.

A recently completed 5-year effort has evaluated harvesting, utilization, and silvicultural alternatives in small-diameter lodgepole pine stands. Studies included testing harvesting systems and techniques under both clearcut and partial cut silvicultural

prescriptions, developing information on tree and stand characteristics as part of products and processing research, evaluating product recovery and value opportunities, evaluating biological and nontimber resource response to stand treatment, and estimating longer term economic and management consequences of harvesting in these stands.

The collective results of this research provide a basis from which managers can select the alternative management and utilization practices for small-diameter lodgepole pine stands. Results have been documented in various publications that are available from the Intermountain Forest and Range Experiment Station in Ogden, UT.

A small trailer-mounted cable yarder is an economical and efficient way to recover small timber from steep slopes. Managers who can make some financial recovery from small-stem lodgepole pine stands through an intermediate harvest are more likely to practice thinning, which helps protect stands from insect pests like the mountain pine beetle.

The results of more than 60 years of continuing Forest Products Laboratory research on exterior wood finishing are brought together in the 56-page Agriculture Handbook No. 647, entitled "Finishing Wood Exteriors: Selection, Application, and Maintenance."

This practical handbook will be a useful guide for do-it-yourself homeowners, and serve as a valuable reference work for professional builders, architects, and wood finishers. It begins with the basic characteristics of wood and reconstituted wood-based products, focusing on their finishing and performance characteristics, manufacturing and construction practices that affect surfaces to be finished, and the ways that various finishes interact with these characteristics. The handbook provides detailed information on various types of exterior wood finishes, together with the proper

application procedures for each. Principal subjects include paints, solid-color stains, semitransparent penetrating stains, transparent coatings, and water-repellent preservatives. Other topics of interest include the weathering of wood, treated wood products, fire retardants, and moisture-excluding finishes. Special applications and treatments needed for wood decks and porches, fences, roofs, log structures, and marine environments are outlined in several sections. Steps are also given for diagnosing and correcting finish failures on wood surfaces.

Copies of Agriculture Handbook No. 647 are available from the Superintendent of Documents, U.S. Government Printing Office, Washington, DC 20402. Stock number: 001-000-044-50-8. Or from the Consumer Information Center, Department 137R Pueblo, CO 81009. Price: \$3.25.

Sixty years of continuing research by scientists at the Forest Products Laboratory is summarized for homeowners in "Finishing Wood Exteriors."

Environment

Watershed Management

- Aguado, Edward. Radiation balances of melting snow covers at an open sites in the central Sierra Nevada, California. Water Resources Research. 21(11): 1649-1654; 1985.
- Anderson, Loren R.; Keaton, Jeffrey, R.; Saarinen, Thomas, F.; Wells, Wade G., II. The Utah landslides, debris flows, and floods of May and June 1983. In: Delineation of landslide, flash flood, and debris flow hazards in Utah; 1984 June 14-15; Logan, UT. Gen. Ser. UWRL/G-85/03. Logan, UT: Utah Water Research Laboratory, Utah State University; 1985. 14 p.
- Azuma, David L. Estimating snow load in California for three recurrence intervals. Res. Note. PSW-379. Berkeley, CA: U.S. Department of Agriculture, Forest Service, Pacific Southwest Forest and Range Experiment Station; 1985. 6 p.
- Baker, Malchus B. Effects of ponderosa pine treatments on water yield in Arizona. Water Resources Research. 22(1): 67-73; 1986.
- Beasley, R. Scott; Granillo, Alfredo B. Soil protection by natural vegetation on clearcut forest land in Arkansas. Journal of Soil and Water Conservation. 40(4): 379-382; 1985.
- Benda, L. E. Behavior and effect of debris flows on streams in the Oregon Coast Range. In: Delineation of landslide, flash flood, and debris flow hazards in Utah; 1984 June 14-15; Salt Lake City, UT. Salt Lake City, UT: Utah State University; 1985: 153-162.
- Benda, L. E. Delineation of channels susceptible to debris flows and debris floods. In: International symposium on erosion, debris flows, and disaster prevention; 1985 September 3-5; Tsukuba, JA. Tsukuba, JA: [Publisher unknown]; 1985: 195-201.
- Berg, Neil H. Blowing snow at a Colorado alpine site: measurements and implications. Arctic and Alpine Research. 18(2): 147-161; 1986.
- Bergman, James A. In situ electrical measurements of snow wetness in a deep snowpack in the Sierra Nevada snow zone of California. In: Kane, D. L., ed. Symposium cold regions hydrology; 1986 July 22-25; Fairbanks, AK. Bethesda, MD: American Water Resources Association; 1986: 367-386.
- Berish, C. W.; Ragsdale, H. L. Metals inflow-elevation, southern Appalachian forest floor and soil. Journal of Environmental Quality. 15(2): 183-187; 1986.
- Beschta, Robert L.; Plattes, William S. Morphological features of small streams: significance and function. Water Resources Bulletin. 22(3): 369-379; 1986.
- Blackburn, W. H.; Wood, J. C.; DeHaven, M. G. Storm flow and sediment losses from site-prepared forestland in east Texas. Water Resources Research. 22(5): 776-784; 1986.
- Bush, P. B.; Neary, D. G.; Dowd, J. F.; Allison, D. C.; Nutter, W. L. Role of models in environmental impact assessment. In: Proceedings, 39th annual meeting of Southern Weed Science Society; 1986 January 20-22; Nashville, TN. SWSPBE 39: 1-616. [Place of publication unknown]: [Publisher unknown]; 1986: 502-516.
- Campbell, Allan G. Spatial variability of stored sediment in several steep channels along the front of the San Gabriel Mountains. In: Proceedings of the chaparral ecosystems research conference; 1985 May 16-17; Santa Barbara, CA. Rep. 62. Davis, CA: California Water Resources Center; 1986: 39-44.
- Carlson, Clinton, E.; Bahls, Loren L., eds. Proceedings, Clark Fork River symposium; 1985 April 19; Butte, MT. Butte, MT: Montana College of Mineral Science and Technology; 1986. 168 p.
- Clayton, James L. An estimate of plagioclase weathering rate in the Idaho Batholith based upon geochemical transport rates. In: Colman, S. M.; Delthier, D. A., eds. Rates of chemical weathering of rocks and minerals. New York: Academic Press; 1986: 453-466.
- Clayton, James L.; Kennedy, Debora A. Nutrient losses from timber harvest in the Idaho Batholith. Soil Science Society of America Journal. 49(4): 1041-1049; 1985.
- Clayton, James L.; Megahan, Walter F. Erosional and chemical denudation rates in the southwestern Idaho Batholith. Earth Surface Processes and Landforms. 11(4): 389-400; 1986.
- Colling, Gene F., prod. The Horse Creek study. Ogden, UT: U.S. Department of Agriculture, Forest Service, Intermountain Forest and Range Experiment Station; 1986. Video tape, color, 3/4 inch, 15 minutes.
- Collins, Brian D.; Dunne, Thomas. Erosion of tephra from the 1980 eruption of Mount St. Helens. Geological Society of America Bulletin. 97: 896-905; 1986.
- Conard, Susan G. Comparative water relations of three shrub species--preliminary results. Fir Report. 7(4): 4-5; 1986.
- Corbett, Edward S.; Lynch, James A. Management of streamside zones on municipal watersheds. In: Riparian ecosystems and their management: reconciling conflicting uses: 1st North American riparian conference; 1985 April 16-18; Tucson, AZ. Gen. Tech. Rep. RM-120. Fort Collins, CO: U.S. Department of Agriculture, Forest Service, Rocky Mountain Forest and Range Experiment Station; 1985: 187-190.
- Davis, E. A.; DeBano, L. F. Nitrate increases in soil water following conversion of chaparral to grass. Biogeochemistry. 2: 53-65; 1986.

- DeByle, Norbert V. Water and watershed. In: DeByle, Norbert V.; Winokur, Robert P., eds. Aspen: ecology and management in the Western United States. Gen. Tech. Rep. RM-119. Fort Collins, CO: U.S. Department of Agriculture, Forest Service, Rocky Mountain Forest and Range Experiment Station; 1985: 153-160.
- Diaz, Pedro L.; Lugo, Ariel E.; McDowell, William H. General hydrology and water quality of three rivers in the eastern Caribbean. In: Lugo, Ariel E., ed. Development, forestry, and environmental quality in the eastern Caribbean. Rio Piedras, PR: U.S. Department of Agriculture, Forest Service, Southern Forest Experiment Station, Institute of Tropical Forestry; 1985: 11-34.
- Duffy, P. D.; Schreiber, J. D.; Ursic, S. J. Nutrient transport by sediment from pine forests. In: Proceedings of the 4th Federal interagency sedimentation conference; 1986 March 24-27; Las Vegas, NV. Vol. 2. Washington, DC: Subcommittee on Sedimentation, Interagency Advisory Committee on Water Data; 1986: 8-57 - 8-65.
- Durgin, Philip B. Organic matter content of soil after logging of fir and redwood forests. Res. Note PSW-346. Berkeley, CA: U.S. Department of Agriculture, Forest Service, Pacific Southwest Forest and Range Experiment Station; 1980. 4 p.
- Eads, Rand E.; Boolootian, Mark R. Controlling suspended samplers by programmable calculator and interface circuitry. Res. Note PSW-376. Berkeley, CA: U.S. Department of Agriculture, Forest Service, Pacific Southwest Forest and Range Experiment Station; 1985. 8 p.
- Elling, Arthur E. Managing vegetation on peat-sand filter beds for wastewater disposal. Res. Note NC-333. St. Paul, MN: U.S. Department of Agriculture, Forest Service, North Central Forest Experiment Station; 1985. 3 p.
- Everett, Richard L.; Sharrow, Steven; Thran, Diana. Soil nutrient distribution under and adjacent to singleleaf pinyon crowns. Soil Science Society of America Journal. 50(3): 788-792; 1986.
- Fowler, W. B.; Lopushinsky, W. Wind-blown volcanic ash in forest and agricultural locations as related to meteorological conditions. Atmospheric Environment. 20(3): 421-425; 1986.
- Frissell, Christopher A.; Liss, William J.; Warren, Charles E.; Hurley, Michael D. A hierarchical framework for stream habitat classification viewing streams in a watershed context. Environmental Management. 10(2): 199-214; 1986.
- Geist, J. Michael; Schuster, Robert L. Hole-in-the-wall gulch landslide, Baker County, Oregon. In: Proceedings of the 22d symposium on engineering geology and soils engineering; 1986 February 24-26; Boise, ID. Portland, OR: [Publisher unknown]; 1986: 227-244.
- Harr, R. Dennis. Effects of clearcutting on rain-on-snow runoff in western Oregon: a new look at old studies. Water Resources Research. 22(7): 1095-1100; 1986.
- Heede, B. H. Designing for dynamic equilibrium in streams. Water Resources Bull. 22(3): 351-357; 1986.
- Heede, Burchard H. Channel adjustments to the removal of log steps: an experiment in a mountain stream. Environmental Management. 9(5): 427-432; 1985.
- Helvey, J. D.; Kunkle, Samuel H. Input-output budgets of selected nutrients on an experimental watershed near Parsons, West Virginia. Res. Pap. NE-584. Broomall, PA: U.S. Department of Agriculture, Forest Service, Northeastern Forest Experiment Station; 1986. 7 p.
- Hibbert, Alden R. Storm runoff and sediment production after wildfire in chaparral. In: Hydrology and water resources in Arizona and the Southwest: Proceedings of the 1985 meetings of the Arizona section of the American Water Resources Association and the hydrology section of the Arizona-Nevada Academy of Science. Vol. 15; 1985 April 27; Las Vegas, NV. Tucson, AZ: Arizona Water Resources Association; 1986: 31-42.
- Hibbert, A. R.; Davis, E. A. Streamflow response to converting Arizona chaparral in a mosaic pattern. In: Hydrology and water resources in Arizona and the Southwest: Proceedings of the 1986 meetings of the Arizona section of the American Water Resources Association, the hydrology section of the Arizona-Nevada Academy of Science, and the Arizona Hydrological Society. Vol. 16; 1985 April 19; Glendale, AZ. Tucson, AZ: Arizona Water Resources Association; 1986: 123-131.
- Hibbert, A. R.; Knipe, O. D.; Davis, E. A. Streamflow response to control of chaparral shrubs along channels and upper slopes. In: Proceedings of the chaparral ecosystems research conference; 1985 May 16-17; Santa Barbara, CA. Rep. 62. Davis, CA: California Water Resources Center, University of California, Davis; 1986: 95-103.
- Howe, Marmion; Noble, Dan. Effect of cyanide residue on vegetation bordering a Black Hills stream. In: Proceedings of the South Dakota Academy of Science. 64: 112-122; 1985.
- Ingwersen, James B. Fog drip, water yield, and timber harvesting in the Bull Run Municipal watershed, Oregon. Water Resources Bulletin. 21(3): 469-473; 1985.
- Jones, John R.; DeByle, Norbert V. Climates. In: DeByle, Norbert V.; Winokur, Robert P., eds. Aspen: ecology and management in the Western United States. Gen. Tech. Rep. RM-119. Fort Collins, CO: U.S. Department of Agriculture, Forest Service, Rocky Mountain Forest and Range Experiment Station; 1985: 57-64.

- Jones, John R.; DeByle, Norbert V. Soils. In: DeByle, Norbert V.; Winokur, Robert P., eds. Aspen: ecology and management in the Western United States. Gen. Tech. Rep. RM-119. Fort Collins, CO: U.S. Department of Agriculture, Forest Service, Rocky Mountain Forest and Range Experiment Station; 1985: 65-70.
- Kattelmann, Richard. Measurements of snow layer water retention. In: Kane, D. L., ed. Symposium cold regions hydrology; 1986 July 22-25; Fairbanks, AK. Bethesda, MD: American Water Resources Association; 1986: 377-386.
- Kattelmann, Richard C. Macropores in snowpacks of Sierra Nevada. In: Proceedings of the symposium on snow and ice processes at the Earth's surface. Vol. 6.; 1984 September 2-7; Sapporo, JA. Cambridge, EN: International Glaciological Society; 1985: 272-273.
- Kattelmann, Richard C. Snow compaction effects on nighttime freezing. In: Shafer, B. A., ed. Proceedings of the western snow conference; 1986 April 15-17; Phoenix, AZ. Phoenix, AZ: Western Snow Conference; 1986: 168-171.
- Klemmedson, J. O.; Tiedemann, A. R. Long-term effects of mesquite removal on soil characteristics: II. Nutrient availability. Soil Science Society of America Journal. 50(2): 476-480; 1986.
- Lawson, Edwin, R.; Rogerson, Thomas L.; Hileman, Leslie H. Water quality of storm flows from hardwood forested catchments in the Boston Mountains. In: Fifth central hardwood forest conference; 1985 April 15-17; Urbana-Champaign, IL. SAF Publ. 85-05. Urbana-Champaign, IL: University of Illinois, Department of Forestry; 1985: 215-221.
- Leopold, Donald J.; Parker, George R. Vegetation patterns on a southern Appalachian watershed after successive clearcuts. Castanea. 50: 164-186; 1985.
- Likens, G. E.; Bormann, F. H.; Pierce, R. S.; Eaton, J. S. The Hubbard Brook valley. In: Likens, G. E., ed. An ecosystem approach to aquatic ecology: Mirror Lake and its environment. New York: Springer-Verlag; 1985: 9-39.
- Likens, G. E.; Eaton, J. S.; Johnson, N. M.; Pierce, R. S. Flux and balance of water and chemicals. In: Likens, G. E., ed. An ecosystem approach to aquatic ecology: Mirror Lake and its environment. New York: Springer-Verlag; 1985: 135-155.
- Likens, Phyllis C., comp. 1986 Publications of the Hubbard Brook ecosystem study. Millbrook, NY: New York Botanical Garden, Cary Arboretum; 1986. 92 p.
- Lopushinsky, W. Seasonal and diurnal trends of heat pulse velocity in Douglas-fir and ponderosa pine. Canadian Journal of Forest Research. 16(4): 814-821; 1986.
- Lyons, Joseph K.; Beschta, Robert L. Land use, floods, and channel changes: upper middle fork Willamette River, Oregon (1936-1980). Water Resources Research. 19(2): 463-471; 1983.
- MacDonald, Lee H. Persistence of soil moisture changes resulting from artificially extended snowmelt. In: Shafer, Bernard A., ed. Proceedings of the western snow conference; 1986 April 15-17; Phoenix, AZ. Fort Collins, CO: Colorado State University; 1986: 146-149.
- Martin, C. Wayne; Noel, Diane S.; Federer, C. Anthony. Clearcutting and the biogeochemistry of streamwater in New England. Journal of Forestry. 83(11): 686-689; 1985.
- Martin, C. Wayne; Pierce, Robert S.; Likens, Gene E.; Bormann, F. Herbert. Clearcutting effects stream chemistry in the White Mountains of New Hampshire. Res. Pap. NE-579. Broomall, PA: U.S. Department of Agriculture, Forest Service, Northeastern Forest Experiment Station; 1986. 12 p.
- McDowell, W. H. Kinetics and mechanisms of dissolved organic carbon retention in a headwater stream. Biogeochemistry. 1: 329-352; 1985.
- McGurk, Bruce J. Precipitation and snow water equivalent sensors: an evaluation. In: Shafer, Bernard A., ed. Proceedings of the western snow conference; 1986 April 15-17; Phoenix, AZ. Fort Collins, CO: Colorado State University; 1986: 71-80.
- McGurk, Bruce J.; Kattelmann, Richard C. Water flow rates, porosity, and permeability in snowpacks in the Central Sierra Nevada. In: Kane, D. L., ed. Symposium cold regions hydrology; 1986 July 22-25; Fairbanks, AK. Bethesda, MD: American Water Resources Association; 1986: 359-366.
- McNabb, D. H.; Cromack, K.; Fredriksen, R. L. Variability of nitrogen and carbon in surface soils of six forest types in the Oregon Cascades. Soil Science Society of America Journal. 50: 1037-1041; 1986.
- Megahan, Walter F. Evaluating effects of land use on sedimentation-- a case for sediment budgeting. Hydrological Sciences and Technology: Short Papers. 1(1): 13-16; 1985.
- Megahan, Walter, F.; Clayton, James L. Saturated hydraulic conductivities of granitic materials of the Idaho Batholith. Journal of Hydrology. 84: 167-180; 1986.
- Megahan, Walter F.; Seyedbagheri, Kathleen A.; Mosko, Timothy L.; Ketcheson, Gary L. Construction phase sediment budget for forest roads on granitic slopes in Idaho. In: Hadley, Richard F., ed. Drainage basin sediment delivery: Proceedings; 1986 August 4-8; Albuquerque, NM. IAHS Publ. 159. Wallingford, UK; 1986: International Academy of Hydrological Sciences; 1986: 31-39.

- Miles, Carl J.; Wallace, Louis R.; Moye, Anson H. Determination of glyphosate herbicide and (aminomethyl)phosphoric acid in natural waters by liquid chromatography using pre-column fluorogenic labeling with 9-fluorenylmethyl chloroformate. *Journal of the Association of Official Analytical Chemists*. 69(3): 458-461; 1986.
- Montagnini, Florencia; Haines, Bruce; Boring, Lindsay; Swank, Wayne. Nitrification potentials in early successional black locust and in mixed hardwood forest stands in the southern Appalachians, USA. *Biogeochemistry*. 2: 197-210; 1986.
- Neary, D. G.; Bush, P. B.; Douglass, J. E.; Todd, R. L. Picloram movement in an Appalachian hardwood forest watershed. *Journal of Environmental Quality*. 14(4): 585-592; 1985.
- Neary, D. G.; Bush, P. B.; Grant, M. A. Water quality of ephemeral forest streams after site preparation with herbicide hexazinone. *Forest Ecology and Management*. 14: 23-40; 1986.
- Neary, D. G.; Bush, P. B.; Michael, J. L. Herbicides in southern forestry--improving water quality. In: *Weed science and risk assessment: Proceedings, 39th annual meeting of Southern Weed Science Society*; 1986 January 20-22; Nashville, TN. SWSPBE 39: 1-1616. [Place of publication unknown]; Southern Weed Science Society; 1986: 335-341.
- Neary, D. G.; LaFayette, R. A.; Callahan, M. A.; Bush, P. B. CCA and PCP in contaminated forest stream sediments. In: *Proceedings of the 4th Federal interagency sedimentation conference*, 1986. Vol 2.; 1986 March 24-27; Las Vegas, NV. [Place of publication unknown]; Interagency Advisory Committee on Water Data, Subcommittee on Sedimentation; 1986: 8-27 - 8-36.
- Neary, D. G.; Michael, J. L.; Wells, M. J. M. Fate of hexazinone and picloram after herbicide site preparation in a cutover northern hardwood forest. In: Mroz, Glenn D.; Trettin, Carl C., eds. *Forest soils: a resource for intensive forest management. Proceedings: 1984 Lake States forest soils conference*; 1984 September 26-28; Alberta, MI. Misc. Publ. 85-1. Houghton, MI: Michigan Technological University, School of Forestry and Wood Products; 1985: 55-72.
- Neary, D. G.; Swift, L. W., Jr.; Manning, D. M.; Burns, R. G. Debris avalanching in the southern Appalachians: an influence on forest soil formation. *Soil Science Society of America Journal*. 50(2): 465-471; 1986.
- Neary, Daniel G. Fate of pesticides in Florida's forests: an overview of potential impacts on water quality. In: *Fate and transport of agrochemicals in Florida*; 1984 October 23-25; Jacksonville Beach, FL. *Proceedings* 44. [Place of publication unknown]; Soil and Crop Science Society of Florida; 1985: 18-23.
- Neary, Daniel G.; Bush, Parshall B.; Nutter, Wade L.; Taylor, John W., Jr. Insecticide use in a seed orchard: effect on fish in an adjacent lake. *For. Bull.* R8-FB/P29. Atlanta: U.S. Department of Agriculture, Forest Service, Forest Pest Management; 1986. 2 p.
- Neary, Daniel G.; Bush, Parshall B.; Taylor, John W., Jr. Fate of herbicides in southern forest watersheds: picloram and 2,4-D. *For. Bull.* R8-FB/P27. Atlanta: U.S. Department of Agriculture, Forest Service, Forest Pest Management; 1986. 2 p.
- Nodvin, Stephen C.; Driscoll, Charles T.; Likens, Gene E. Simple partitioning of anions and dissolved organic carbon in a forest soil. *Soil Science*. 142(1): 27-35; 1986.
- Noel, Diane S.; Martin, C. Wayne; Federer, C. Anthony. Effects of forest clearcutting in New England on stream macroinvertebrates and periphyton. *Environmental Management*. 10(5): 661-670; 1986.
- Norris, Logan A. Accuracy and precision of analyses for 2,4-D and picloram in streamwater by ten contract laboratories. *Weed Science*. 34: 485-489; 1986.
- Peterson, David L.; Hammer, R. David. Soil nutrient flux: a component of nutrient cycling in temperate forest ecosystems. *Forest Science*. 32: 318-324; 1986.
- Peterson, David L.; Rolfe, Gary L. Temporal variation in nutrient status of a floodplain forest soil. *Forest Ecology and Management*. 12: 73-82; 1985.
- Potts, Donald F.; Peterson, David L.; Zuuring, Hans R. Watershed modeling for fire management planning in the northern Rocky Mountains. *Res. Pap.* PSW-177. Berkeley, CA: U.S. Department of Agriculture, Forest Service, Pacific Southwest Forest and Range Experiment Station; 1985. 11 p.
- Rice, R. M. Social, technological, and research responses to potential erosion and sediment disasters in the Western United States, with examples from California. In: *International symposium on erosion, debris flow, and disaster prevention*; 1985 September 3-5; Tsukuba, JA. Tokyo, JA: The Erosion-Control Engineering Society; 1985: 1-12.
- Rice, R. M.; Lewis, J. Identifying unstable sites on logging roads. In: *Forest environment and silviculture, proceedings of the 18th IUFRO World Congress, Div. 1, Vol. 1*; 1986 September 7-21; Ljubljana, YU. Vienna, AU: Yugoslav IUFRO World Congress Organizing Committee; 1986: 239-247.
- Rice, R. M.; McCashion, J. D. Site conditions related to erosion on logging roads. In: *International symposium on erosion, debris flow, and disaster prevention*; 1985 September 3-5; Tsukuba, JA. Tokyo, JA: The Erosion-Control Engineering Society; 1985: 69-74.

- Rice, Raymond M.; Pillsbury, Norman H.; Schmidt, Kurt W. A risk analysis approach for using discriminant functions to manage logging-related landslides on granitic terrain. *Forest Science*. 31(3): 772-784; 1985.
- Rice, Raymond M.; Thomas, Robert B. Cumulative sedimentation effects of forest management activities: how might they occur? In: Papers presented at the American Geophysical Union meeting on cumulative effects. NCASI Tech. Bull. 490. New York: National Council of the Paper Industry for Air Stream Improvement, Inc.; 1986: 1-11.
- Ricks, Cynthia L. Flood history and sedimentation at the mouth of Redwood Creek, Humboldt County, California. Tech. Rep. 15. Arcata, CA: U.S. Department of the Interior, Redwood National Park; 1985. 154 p.
- Riekerk, H. Lysimetric measurement of pine evapotranspiration for water balances. In: *Advances in evapotranspiration: Proceedings of the national conference on advances in evapotranspiration*; 1985 December 16-17; Chicago. ASAE publ. 14-85. St. Joseph, MI: American Society of Agricultural Engineers; 1985: 276-281.
- Rogerson, Thomas L. Hydrologic responses to silvicultural practices in pine hardwood stands in the Ouachita Mountains. In: *Fifth central hardwood forest conference*; 1985 April 15-17; Urbana-Champaign, IL. SAF Publ. 85-05. Urbana-Champaign, IL: University of Illinois, Department of Forestry; 1985: 209-214.
- Schmidt, R. A. Snow surface strength and the efficiency of relocation by wind. In: Kane, Douglas, L., ed. *Proceedings of a symposium: cold regions hydrology*; 1986 July 22-25; Fairbanks, AK. TPS-86-1. Bethesda, MD: American Water Resources Association; 1986: 355-358.
- Schmidt, R. A. Transport rate of drifting snow and the mean wind speed profile. *Boundary-Layer Meteorology*. 34: 213-241; 1986.
- Sedell, James R.; Swanson, Frederick J. Ecological characteristics of streams in old-growth forests of the Pacific Northwest. In: Meehan, W. R.; Merrill, T. R., Jr.; Hanley, T. A., eds. *Fish and wildlife relationships in old-growth forests: Proceedings of a symposium*; 1982 April 12-15; Juneau, AK. Moorehead, NC: American Institute of Fisheries Research Biology; 1984: 9-16.
- Shewbridge, Scott; Sitar, Nicholas. The influence of fiber properties on the deformation characteristics of fiber-soil composites. Rep. UCB/GT/85-02. Berkeley, CA: University of California; 1985. 100 p.
- Slaughter, C. W. Soil movement associated with the Rosie Creek fire. In: Juday, Glenn P.; Dyrness, C. Theodore. *Early results of the Rosie Creek fire research project 1984*. Misc. Publ. 85-2. Fairbanks, AK: University of Alaska, Agricultural and Forestry Experiment Station; 1986: 5-6.
- Slaughter, C. W.; Benson, C. S. Seasonal snow and aufeis in Alaska's taiga. In: *Proceedings of a symposium: cold regions hydrology*; 1986 July 28-31; Fairbanks, AK. Tech. Publ. Ser. ES TPS-86-1. Bethesda, MD: American Water Resources Association; 1986: 101-109.
- Slaughter, C. W.; Viereck, L. A. Climatic characteristics of the taiga in interior Alaska. In: Van Cleve, K.; Chapin, F. S., III; Flanagan, P. W.; Viereck, L. A.; Dyrness, C. E., eds. *Forest ecosystems in the Alaskan taiga. A synthesis of structure and function*. Ecol. Stud. 57. New York: Springer-Verlag; 1986: 9-21.
- Smith, Gary A.; Smith, Richard D. Specific gravity characteristics of recent volcanoclastic sediment: implications for sorting and grain size analysis. *Journal of Geology*. 93: 619-622; 1985.
- Strayer, D. L.; Likens, G. E. An energy budget for the zoobenthos of Mirror Lake, New Hampshire. *Ecology*. 67(2): 303-313; 1986.
- Sturges, David L. Precipitation measured by dual gages, Wyoming-shielded gages, and in a forest opening. In: Kane, Douglas L., ed. *Proceedings, cold regions hydrology symposium*; 1986 July 22-25; Fairbanks, AK. TPS-86-1. Bethesda, MD: American Water Resources Association; 1986: 387-396.
- Sturges, David L. Responses of vegetation and ground cover to spraying a high elevation, big sagebrush watershed with 2,4-D. *Journal of Range Management*. 39(2): 141-146; 1986.
- Sturges, David L. Snow fencing to increase streamflow: preliminary results. In: *Proceedings, 54th annual western snow conference*; 1986 April 15-17; Phoenix, AZ. Seattle, WA: Western Snow Conference; 1986: 18-29.
- Swank, Wayne T. Biological control of solute losses from forest ecosystems. In: Trudgill, S. T., ed. *Solute processes*. Chichester, EN: John Wiley & Sons Ltd.; 1986: 85-139.
- Swanson, F. J.; Graham, R. L.; Grant, G. E. Some effects of slope movements on river channels. In: *Proceedings, 1985 international symposium on erosion, debris flow and disaster prevention*; 1985 September 3-5; Tsukuba, JA. Tsukuba, JA: National Research Center for Disaster Prevention; 1985: 273-278.
- Swanson, F. J.; Lienkaemper, G. W. Geologic zoning of slope movements in western Oregon, U.S.A. In: *Proceedings, 4th international conference and field workshop on landslides*; 1985 August 23-31; Tokyo, JA. Tokyo, JA: Japanese Landslide Society; 1985: 41-46.
- Swanson, Frederick J.; Dipert, Duane D.; Roach, Christopher J. The study of the use of leave areas to control in-unit landslides. In: *Industry, State, and Federal programs designed to assess and protect water quality associated with managed western forests*; 1985 May; Portland, OR: Tech. Bull. 466. New York: National Council of the Paper Industry for Air and Stream Improvement; 1985: 29-36.

- Swanson, Frederick J.; Oyagi, Norio; Tominaga, Masaki. Landslide dams in Japan. In: Proceedings, Landslide dams: processes, risk, and mitigation; 1986 April 7; Seattle, WA. New York, NY: American Society of Civil Engineers; 1986: 131-145.
- Swift, Lloyd W., Jr. Filter strip widths for forest roads in the southern Appalachians. *Southern Journal of Applied Forestry*. 10(1): 27-34; 1986.
- Tabler, Ronald D.; Sturges, David L. Watershed test of a snow fence to increase streamflow: preliminary results. In: Kane, Douglas L., ed. Proceedings of a symposium: cold regions hydrology; 1986 July 22-25; Fairbanks, AK. TPS-86-1. Bethesda, MD: American Water Resources Association; 1986: 53-61.
- Thomas, Robert B. Calibrating SALT: a sampling scheme to improve estimates of suspended sediment yield. In: Monitoring to detect changes in water quality series; 1986 July 2-10; Budapest, HU. IAHS Publ. 157. Wallingford, UK: International Association of Hydrological Sciences; 1986: 79-88.
- Thomas, Robert B. Estimating total suspended sediment yield with probability sampling. *Water Resources Research*. 21(9): 1381-1388; 1985.
- Tiedemann, A. R.; Klemmedson, J. O. Long-term effects of mesquite removal on soil characteristics. 1: Nutrients and bulk density. *Soil Science Society of America Journal*. 50(2): 472-475; 1986.
- Troendle, C. A.; King, R. M. The effect of timber harvest on the Fool Creek watershed, 30 years later. *Water Resources Research*. 21: 1915-1922; 1985.
- Troendle, C. A.; Meiman, J. R. The effect of patch clearcutting on the water balance of a subalpine forest slope. In: 54th annual meeting of the western snow conference; 1986 April 15-17; Phoenix, AZ. Fort Collins, CO: Colorado State University; 1986: 93-100.
- Troendle, Charles A. The effect of timber harvest on the water balance of the subalpine forests. In: Foresters: leaders, or followers? Proceedings of the 1985 convention; 1985 July 28-31; Fort Collins, CO. Washington, DC: Society of American Foresters; 1985: 148-152.
- Ursic, S. J. Sediment and forestry practices in the South. In: Proceedings of the 4th Federal interagency sedimentation conference, vol. 1; 1986 March 24-27; Las Vegas, NV. Washington, DC: Interagency Advisory Committee on Water Data, Subcommittee on Sedimentation; 1986: 8-28 - 8-37.
- Ursic, S. J.; Duffy, P. D. Hydrologic effects of forestry practices in Mississippi. In: Proceedings, 16th Mississippi water resource conference; 1986 February 12-13; Jackson, MS. Mississippi State, MS: Water Resources Research Institute; 1986: 85-88.
- Velbel, Michael Anthony. Geochemical mass balances and weathering rates in forested watersheds of the southern Blue Ridge. *American Journal of Science*. 285: 904-930; 1985.
- Verry, Elon S. Forest harvesting and water--the Lake States experience. In: Martin, A. Jeff, ed. Timber harvesting the link between management and utilization: Proceedings, 3d SAF Region 5 technical conference; 1985 September 25-27; Madison, WI. SAF Publ. 85-09. [Bethesda], MD: [Society of American Foresters]; 1985: 71-89.
- Wells, Wade G., II. The influence of fire on erosion rates in California chaparral. In: Proceedings of the chaparral ecosystems research conference; 1985 May 16-17; Santa Barbara, CA. Rep. 62. Davis, CA: California Water Resources Center; 1986: 57-62.
- Winter, Thomas C. Geohydrologic setting of Mirror Lake, West Thornton, New Hampshire. *Wat. Res. Inv. Rep.* 84-4266. Lakewood, CO: U.S. Geological Survey; 1984. 61 p.
- Wohlge-muth, Peter M. Spatial and temporal distribution of surface sediment transport in southern California steep-lands. In: Proceedings of the chaparral ecosystems research conference; 1985 May 16-17; Santa Barbara, CA. Rep. 62. Davis, CA: California Water Resources Center; 1986: 29-32.
- Woo, S. L.; Berg, N. H. Snowmelt hydrograph separation: chemical and graphical methods compared. In: Schafer, Bernard A., ed. Proceedings of the western snow conference; 1986 April 15-17; Phoenix, AZ. Phoenix, AZ: Western Snow Conference; 1986: 158-161.
- Woo, Sheri; Berg, Neil. Factors influencing the quality of snow precipitation and snow throughfall at a Sierra Nevada site. In: Kane, D. L., ed. Proceedings of a symposium: cold regions hydrology; 1986 July 22-25; Fairbanks, AK. Bethesda, MD: American Water Resources Association; 1986: 201-212.

Wildlife Habitat

- Agnew, William; Uresk, Daniel W.; Hansen, Richard M. Flora and fauna associated with prairie dog colonies and adjacent ungrazed mixed-grass prairie in western South Dakota. *Journal of Range Management*. 19(2): 135-139; 1986.
- Alexander, Gaylord R.; Hansen, Edward A. Sand bed load in a brook trout stream. *North American Journal of Fisheries Management*. 6: 9-23; 1986.
- Allen, Charles E.; Dickson, James G. Development and impact of an industrial wildlife program. In: Proceedings of the 37th annual conference, Southeastern Association of Fish and Wildlife Agencies; 1983 November 6-9; Asheville, NC. Asheville, NC: Southeastern Association of Fish and Wildlife Agencies; 1983: 8-13.

- Allen, Harriet; Brewer, Larry W. A review of current northern spotted owl (Strix occidentalis caurina) research in Washington State. In: Gutierrez, Ralph J.; Carey, Andrew B., tech. eds. Ecology and management of the spotted owl in the Pacific Northwest. Gen. Tech. Rep. PNW-185. Portland, OR: U.S. Department of Agriculture, Forest Service, Pacific Northwest Forest and Range Experiment Station; 1985: 55-57.
- Andersen, Douglas C.; MacMahon, James A. An assessment of ground-nest depredation in a catastrophically disturbed region, Mount St. Helens, Washington. The Auk. 103(3): 622-626; 1986.
- Andersen, Douglas C.; MacMahon, James A. The effects of catastrophic ecosystem disturbance: the residual mammals at Mount St. Helens. Journal of Mammalogy. 66(3): 581-589; 1985.
- Anderson, Mary E.; Conner, Richard N. Northern cardinal song in three forest habitats in eastern Texas. Wilson Bulletin. 97(4): 436-449; 1985.
- Arendt, Wayne J.; Arendt, Angela I. Bill deformity in a pearly-eyed thrasher from Montserrat, West Indies. North American Bird Bander. 11(2): 51-52; 1986.
- Arno, Stephen F. Whitebark pine cone crops--a diminishing source of wildlife food? Western Journal of Applied Forestry. 1(3): 92-94; 1986.
- Becker, Dale M. Early nesting records of merlins in Montana and North Dakota. Raptor Research. 19(2/3): 102; 1986.
- Becker, Dale M.; Sieg, Carolyn Hull. Breeding chronology and reproductive success of Richardson's merlins in southeastern Montana. Raptor Research. 19(2/3): 52-55; 1986.
- Beckwith, Roy C.; Bull, Evelyn L. SCAT analysis of the arthropod component of pileated woodpecker diet. The Murrelet. 66: 90-92; 1985.
- Brand, Gary J.; Shifley, Stephen R.; Ohmann, Lewis F. Linking wildlife and vegetation models to forecast the effects of management. In: Verner, Jared; Morrison, Michael L.; Ralph, C. John, eds. Wildlife 2000: modeling habitat relationships of terrestrial vertebrates; 1984 October 7-11; Fallen Leaf, CA. Madison, WI: The University of Wisconsin Press; 1986: 383-387.
- Bromley, Marianne. Wildlife management implications of petroleum exploration and development in wildland environments. Gen. Tech. Rep. INT-191. Ogden, UT: U.S. Department of Agriculture, Forest Service, Intermountain Forest and Range Experiment Station; 1985. 42 p.
- Brooks, R. T.; Birch, T. W. Opportunities and constraints for wildlife habitat management on private forests of the Northeast. Northern Journal of Applied Forestry. 3(3): 109-113; 1986.
- Buech, Richard R. Methodologies for observing beavers (Castor canadensis) during the activity period. In: Brooks, Robert P., ed. Nocturnal mammals: techniques for study: Proceedings of a workshop; 1985 August; Edmonton, AB. Resour. Res. Pap. 48. University Park, PA: The Pennsylvania State University, School of Forest Resources; 1985: 29-34.
- Bull, Evelyn; Akenson, Holly A. Common barn owl diet in northeastern Oregon. The Murrelet. 66: 65-68; 1985.
- Bull, Evelyn L. Ecological value of dead trees to cavity nesting birds in northeastern Oregon. Oregon Birds. 12(2): 91-99; 1986.
- Bull, Evelyn L.; Partridge, Arthur D. Methods of killing trees for use by cavity nesters. Wildlife Society Bulletin. 14(2): 142-146; 1986.
- Bull, Evelyn L.; Peterson, Steven R.; Thomas, Jack Ward. Resource partitioning among woodpeckers in northeastern Oregon. Res. Note PNW-444. Portland, OR: U.S. Department of Agriculture, Forest Service, Pacific Northwest Forest and Range Experiment Station; 1986. 19 p.
- Bull, Evelyn L.; Thomas, Jack Ward; Horn, Kirk. Snag management on national forests in the Pacific Northwest--1984. Western Journal of Applied Forestry. 1(2): 41-43; 1986.
- Call, Mayo W.; Maser, Chris. Wildlife habitats in managed rangelands--the Great Basin of southeastern Oregon: sage grouse. Gen. Tech. Rep. PNW-187. Portland, OR: U.S. Department of Agriculture, Forest Service, Pacific Northwest Forest and Range Experiment Station; 1985. 30 p.
- Canfield, Jodie E.; Lyon, L. Jack; Hillis, J. Michael. The influence of viewing angle on elk hiding cover in young timber stands. Res. Pap. INT-371. Ogden, UT: U.S. Department of Agriculture, Forest Service, Intermountain Forest and Range Experiment Station; 1986. 6 p.
- Carey, A. B. A summary of the scientific basis for spotted owl management. In: Gutierrez, Ralph J.; Carey, Andrew B., tech. eds. Ecology and management of the spotted owl in the Pacific Northwest. Gen. Tech. Rep. PNW-185. Portland, OR: U.S. Department of Agriculture, Forest Service, Pacific Northwest Forest and Range Experiment Station; 1985: 100-114.
- Carey, A. B.; Ruggiero, L. F. Spotted owl management: meeting NFMA requirements through monitoring. In: Gutierrez, Ralph J.; Carey, Andrew B., tech. eds. Ecology and management of the spotted owl in the Pacific Northwest. Gen. Tech. Rep. PNW-185. Portland, OR: U.S. Department of Agriculture, Forest Service, Pacific Northwest Forest and Range Experiment Station; 1985: 34-38.
- Carey, Andrew B. A critical look at the issue of species-habitat dependency. In: New forests for a changing world: Proceedings of the 1983 SAF national convention; 1983 October 16-20; Portland, OR. Bethesda, MD: Society of American Foresters; 1984: 346-351.

- Casper, Howard H.; Mount, Michael E.; Marsh, Rex E.; Schmidt, Robert H. Fluoroacetate residues in ground squirrel and coyote tissues due to primary or secondary 1080 poisoning. *Journal of the Association of Official Analytic Chemists*. 69(3): 441-442; 1986.
- Conner, Richard N. Vocalizations of common ravens in Virginia. *The Condor*. 87: 379-388; 1985.
- Conner, Richard N.; Anderson, Mary E.; Dickson, James G. Relationships among territory size, habitat, song, and nesting success of northern cardinals. *The Auk*. 103: 23-31; 1986.
- Conner, Richard N.; O'Halloran, Kathleen A. A comparison of the MacArthur foliage density estimate with actual leaf surface area and biomass. *The Southwestern Naturalist*. 31(2): 270-273; 1986.
- Contreras, Glen P.; Evans, Keith E., comps. Proceedings--grizzly bear habitat symposium; 1985 April 30-May 2; Missoula, MT. Gen. Tech. Rep. INT-207. Ogden, UT: U.S. Department of Agriculture, Forest Service, Intermountain Forest and Range Experiment Station; 1986. 252 p.
- Corn, P. S.; Bury, R. B. Habitat use and terrestrial activity by red tree voles (*Arborimus longicaudus*) in Oregon. *Journal of Mammalogy*. 67(2): 404-406; 1986.
- Crawford, Hewlette S.; Frank, Robert M. Is good forestry good wildlife management?--some examples. In: Is good forestry good wildlife management?; 1985 January 6-8; Portland, ME. Misc. Publ. 689. Orono, ME: University of Maine; 1986: 17-22.
- Crawford, Hewlette S.; Jennings, Daniel T. Effects of bird predation on spruce budworm: a pilot study. In: Recent advances in spruce budworms research: Proceedings of the CANUSA spruce budworms research symposium; 1984 September 16-20; Bangor, ME. Ottawa, ON: Canadian Forestry Service and U.S. Department of Agriculture, Forest Service; 1985: 98-99.
- Crouch, Glenn L. Effects of thinning pole-sized lodgepole pine on understory vegetation and large herbivore activity in central Colorado. Res. Pap. RM-268. Fort Collins, CO: U.S. Department of Agriculture, Forest Service, Rocky Mountain Forest and Range Experiment Station; 1986. 10 p.
- Crouch, Glenn L. Pocket gopher damage to conifers in western forests: a historical and current perspective of the problem. In: Salman, T. P., ed. Twelfth vertebrate pest conference; 1986 March 4-6; San Diego, CA. Davis, CA: University of California; 1986: 196-198.
- Dawson, William R.; Ligon, J. David; Murphy, Joseph R.; Myers, J. P.; Simberloff, Daniel; Verner, Jared. Report of the advisory panel on the spotted owl. Audubon Conserv. Rep. 7. New York: National Audubon Society; 1986: 47 p.
- Dealy, J. Edward; Edgerton, Paul J.; Williams, Wayne G. Use of curleaf mountain-mahogany by mule deer on a transition range. Res. Note PNW-439. Portland, OR: U.S. Department of Agriculture, Forest Service, Pacific Northwest Forest and Range Experiment Station; 1986. 5 p.
- DeByle, Norbert V. Wildlife. In: DeByle, Norbert V.; Winokur, Robert P., eds. Aspen: ecology and management in the Western United States. Gen. Tech. Rep. RM-119. Fort Collins, CO: U.S. Department of Agriculture, Forest Service, Rocky Mountain Forest and Range Experiment Station; 1985: 135-152.
- DeGraaf, Richard M. Breeding bird assemblages in New England northern hardwoods. In: The impact of timber management practices on nongame birds in Vermont; 1982 August 7; Johnson, VT. Montpelier, VT: Vermont Fish and Wildlife Department; 1985: 5-22.
- DeGraaf, Richard M.; Rudis, Deborah D. New England wildlife: habitat, natural history, and distribution. Gen. Tech. Rep. NE-108. Broomall, PA: Northeastern Forest Experiment Station; 1986. 491 p.
- DeGraaf, Richard M.; Tilghman, Nancy G.; Anderson, Stanley H. Foraging guilds of North American birds. *Environmental Management*. 9(6): 493-536; 1985.
- DeGraaf, Richard M.; Wentworth, James M. Avian guild structure and habitat associations in suburban bird communities. *Urban Ecology*. 9: 399-412; 1986.
- Dickson, James G. U.S. Department of Agriculture, Forest Service: management, research, and cooperative forestry for multiple benefits. In: Transactions North American wildlife and natural resources conference 50; 1985 March 15-20; Washington, DC. Washington, DC: The Wildlife Management Institute; 1985: 215-220.
- Dickson, James G.; Huntley, Jimmy C. Streamside management zones and wildlife in the southern coastal plain. In: Proceedings, North American riparian conference: riparian ecosystems and their management: reconciling conflicting uses; 1985 April 16-18; Tucson, AZ. Gen. Tech. Rep. RM-120. Fort Collins, CO: U.S. Department of Agriculture, Forest Service, Rocky Mountain Forest and Range Experiment Station; 1985: 263-264.
- Driver, B. L. Specifying what is produced by management of wildlife by public agencies. *Leisure Sciences*. 7(3): 281-295; 1985.
- Ehrhart, Richard L.; Conner, Richard N. Habitat selection by the northern cardinal in three eastern Texas forest stands. *The Southwestern Naturalist*. 31(2): 191-199; 1986.
- Faaborg, John R.; Arendt, Wayne J. Wildlife assessments in the Caribbean. Rio Piedras, PR: U.S. Department of Agriculture, Forest Service, Southern Forest Experiment Station, Institute of Tropical Forestry; 1985. 220 p.
- Finch, Deborah M. Multivariate analysis of early and late nest sites of Abert's towhees. *Southwestern Naturalist*. 30(3): 427-432; 1985.

- Fox, Barry J.; Quinn, Ronald D.; Breytenbach, G. J. A comparison of small-mammal succession following fire in shrublands of Australia, California, and South Africa. *Proceedings Ecological Society of Australia*. 14: 179-197; 1986.
- Fritts, Steven H.; Paul, William J.; Mech, L. David. Can relocated wolves survive? *Wildlife Society Bulletin*. 13: 459-463; 1985.
- Goldstein, Edward L.; Gross, Meir; DeGraaf, Richard M. Breeding birds and vegetation: a quantitative assessment. *Urban Ecology*. 9: 377-385; 1986.
- Gowaty, Patricia Adair; Lennartz, Michael R. Sex ratios of nestling and fledgling red-cockaded woodpeckers (*Picoides borealis*) favor males. *American Naturalist*. 126(3): 347-353; 1985.
- Grubb, Teryl G.; Eakle, Wade L.; Tuggle, Benjamin N. *Haematosiphon inodorus* (Hemiptera: Cimicidae) in a nest of a bald eagle (*Haliaeetus leucocephalus*). *Journal of Wildlife Disease*. 22(1): 125-127; 1986.
- Gruell, George E. Post-1900 mule deer irruptions in the Intermountain West: principal cause and influences. *Gen. Tech. Rep. INT-206*. Ogden, UT: U.S. Department of Agriculture, Forest Service, Intermountain Forest and Range Experiment Station; 1986. 37 p.
- Gutierrez, R. J. An overview of recent research on the spotted owl. In: Gutierrez, Ralph J.; Carey, Andrew B., tech. eds. *Ecology and management of the spotted owl in the Pacific Northwest*. Gen. Tech. Rep. PNW-185. Portland, OR: U.S. Department of Agriculture, Forest Service, Pacific Northwest Forest and Range Experiment Station; 1985: 39-49.
- Gutierrez, R. J. Information and research needs for spotted owl management. In: Gutierrez, Ralph J.; Carey, Andrew B., tech. eds. *Ecology and management of the spotted owl in the Pacific Northwest*. Gen. Tech. Rep. PNW-185. Portland, OR: U.S. Department of Agriculture, Forest Service, Pacific Northwest Forest and Range Experiment Station; 1985: 115-118.
- Gutierrez, R. J.; Franklin, Alan B.; Lahaye, William; Meretsky, Vicky J.; Ward, J. Patrick. Juvenile spotted owl dispersal in northwestern California: preliminary results. In: Gutierrez, Ralph J.; Carey, Andrew B., tech. eds. *Ecology and management of the spotted owl in the Pacific Northwest*. Gen. Tech. Rep. PNW-185. Portland, OR: U.S. Department of Agriculture, Forest Service, Pacific Northwest Forest and Range Experiment Station; 1985: 60-65.
- Gutierrez, R. J.; Solis, David Munoz; Sisco, Charles. Habitat ecology of the spotted owl in northwestern California: implications for management. In: *New forests for a changing world: Proceedings of the 1983 SAF national convention*; 1983 October 16-20; Portland, OR. Bethesda, MD: Society of American Foresters; 1983: 50-55.
- Gutierrez, Ralph J.; Carey, Andrew B., eds. *Ecology and management of the spotted owl in the Pacific Northwest*; 1984 June 19-23; Arcata, CA. Gen. Tech. Rep. PNW-185. Portland, OR: U.S. Department of Agriculture, Forest Service, Pacific Northwest Forest and Range Experiment Station; 1985. 120 p.
- Gutzwiller, Kevin J.; Anderson, Stanley H. Use of abandoned cliff swallow nests by breeding house wrens. *Prairie Naturalist*. 18(1): 53-54; 1986.
- Hamel, Paul B.; Cost, Noel D.; Sheffield, Raymond M. The consistent characteristics of habitats: a question of scale. In: Jared, Verner; Morrison, Michael; Ralph, C. John, eds. *Wildlife 2000: modeling habitat relationships of terrestrial vertebrates*; 1984 October 7-11; Fallen Leaf, CA. Madison, WI: University of Wisconsin Press; 1986: 121-128.
- Hatch, Jeremy J. Lateral asymmetry of the bill of *Loxops coccineus* (Drepanidinae). *Condor*. 87(3): 546-547; 1985.
- Hatch, Jeremy J. The white tern may be unable to hover in still air. *Journal of Field Ornithology*. 56(4): 427-428; 1986.
- Hayes, Jack P.; Probst, John R.; Rakstad, Don. Effect of mating status and time of day on Kirtland's warbler song rates. *The Condor [Short Communication]*. 88: 386-388; 1986.
- Hejl, Sallie J.; Beedy, Edward C. Weather-induced variation in the abundance of birds. In: Verner, Jared; Morrison, Michael L.; Ralph, C. John, eds. *Wildlife 2000: modeling habitat relationships of terrestrial vertebrates*; 1984 October 7-11; Fallen Leaf Lake, CA. Madison, WI: University of Wisconsin Press; 1986: 241-244.
- Hopkins, Rick B.; Cassel, J. Frank; Bjurgstad, Ardell J. Relationships between breeding birds and vegetation in four woodland types of the Little Missouri National Grasslands. *Res. Pap. RM-270*. Fort Collins, CO: U.S. Department of Agriculture, Forest Service, Rocky Mountain Forest and Range Experiment Station; 1986. 12 p.
- Hovis, Julie A.; Labisky, Ronald F. Vegetative associations of red-cockaded woodpecker colonies in Florida. *Wildlife Society Bulletin*. 13: 307-314; 1985.
- Jones, Lawrence L. C. *Ambystoma gracile gracile* (brown salamander): winter activity. *Herp Review*. 16(1): 26; 1985.
- Jones, Lawrence L. C.; Aubry, Keith B. *Dicamptodon copei* (Cope's giant salamander). *Herp Review*. 15(4): 114; 1984.
- Jones, Lawrence L. C.; Aubry, Keith B. *Ensatina eschscholizii oregonensis* (Oregon ensatina): reproduction. *Herp Review*. 16(1): 26; 1985.
- Jones, Lawrence L. C.; Bury, R. Bruce. *Dicamptodon ensatus* (Pacific giant salamander): coloration. *Herp Review*. 16(1): 26; 1985.

- Juday, Glenn Patrick; Zasada, John C. Structure and development of an old-growth white spruce forest on an interior Alaska floodplain. In: Meehan, William R.; Merrel, Theodore, R., Jr.; Hanley, Thomas A., eds. Fish and wildlife relationships in old-growth forests; 1982 April 12-15; Juneau, AK. Morehead City, NC: American Institute of Fishery Research Biologists; 1984: 227-234.
- Kania, G. S.; Smith, H. R. Observations of agonistic interactions between a pair of feral mute swans and nesting waterfowl. The Connecticut Warbler. Fairfield, CT: Connecticut Ornithological Association; 1986; 6(3): 35-37.
- Kie, John G.; White, Marshall. Tooth failure is not an important mortality factor in a white-tailed deer herd in Texas. Southwestern Naturalist. 31(2): 266-267; 1986.
- Kuehn, David W.; Fuller, Todd K.; Mech, L. David; Paul, William J.; Fritts, Steven H.; Berg, William E. Trap-related injuries to gray wolves in Minnesota. Journal of Wildlife Management. 50(1): 90-91; 1986.
- Larson, Fredrick L.; Ffolliott, Peter F.; Clary, Warren P. Managing wildlife habitat. Journal of Forestry. 84(3): 40-42; 1986.
- Laymon, Stephen A. General habitats and movements of spotted owls in the Sierra Nevada. In: Gutierrez, Ralph J.; Carey, Andrew B., tech. eds. Ecology and management of the spotted owl in the Pacific Northwest. Gen. Tech. Rep. PNW-185. Portland, OR: U.S. Department of Agriculture, Forest Service, Pacific Northwest Forest and Range Experiment Station; 1985: 66-68.
- Laymon, Stephen A.; Barrett, Reginald H. Developing and testing habitat-capability models: pitfalls and recommendations. In: Verner, Jared; Morrison, Michael L.; Ralph, C. John, eds. Wildlife 2000: modeling habitat relationships of terrestrial vertebrates; 1984 October 7-11; Fallen Leaf Lake, CA. Madison, WI: University of Wisconsin Press; 1986: 87-91.
- Laymon, Stephen A.; Reid, Janice A. Effects of grid-cell size on tests of a spotted owl HSI model. In: Verner, Jared; Morrison, Michael L.; Ralph, C. John, eds. Wildlife 2000: modeling habitat relationships of terrestrial vertebrates; 1984 October 7-11; Fallen Leaf Lake, CA. Madison, WI: University of Wisconsin Press; 1986: 93-96.
- Leckenby, Donavin A.; Adams, Arthur W. A weather severity index on a mule deer winter range. Journal of Range Management. 39(3): 244-248; 1986.
- Li, C. Y.; Maser, Chris. New and modified techniques for studying nitrogen-fixing bacteria in small mammal droppings. Res. Note PNW-441. Portland, OR: U.S. Department of Agriculture, Forest Service, Pacific Northwest Forest and Range Experiment Station; 1986. 4 p.
- Lucas, Robert C. Applying our knowledge to the "Bob." In: Lucas, Robert C., comp. Proceedings--national wilderness research conference: current research; 1985 July 23-26; Fort Collins, CO. Gen. Tech. Rep. INT-212. Ogden, UT: U.S. Department of Agriculture, Forest Service, Intermountain Forest and Range Experiment Station; 1986: 523.
- MacCracken, James G.; Uresk, Daniel W.; Hansen, Richard M. Rodent-vegetation relationships in southeastern Montana. Northwest Science. 59(4): 272-278; 1985.
- Mannan, R. William. Habitat use by Hammond's flycatchers in old-growth forests, northeastern Oregon. The Murrelet. 65: 84-86; 1984.
- McCullough, Charles R.; Fritzell, Erik K. Ecological observations of eastern spotted skunks on the Ozark Plateau. Transactions, Missouri Academy of Science. 18: 25-32; 1984.
- Mech, L. David. Wolf population in the central Superior National Forest, 1967-1985. Res. Pap. NC-270. St. Paul, MN: U.S. Department of Agriculture, Forest Service, North Central Forest Experiment Station; 1986. 6 p.
- Mech, L. David; Del Guidice, Glenn D.; Karns, Patrick D.; Seal, Ulysses S. Yohimbine hydrochloride as an antagonist to xylazine hydrochloride-ketamine hydrochloride immobilization of white-tailed deer. Journal of Wildlife Diseases. 21(4): 405-410; 1985.
- Mech, L. David; Goyal, Sagar M.; Bota, Chrissie N.; Seal, Ulysses S. Canine parvovirus infection in wolves (*Canis lupus*) from Minnesota. Journal of Wildlife Diseases. 22(1): 104-106; 1986.
- Mech, L. David; Thiel, Richard P.; Fritts, S. H.; Berg, W. E. Presence and effects of the dog louse *Trichodectes canis* (Mallophaga, Trichodectidae) on wolves and coyotes from Minnesota and Wisconsin. American Midland Naturalist. 114(2): 404-405; 1985.
- Medin, Dean E. Breeding bird responses to diameter-cut logging in west-central Idaho. Res. Pap. INT-355. Ogden, UT: U.S. Department of Agriculture, Forest Service, Intermountain Forest and Range Experiment Station; 1985. 12 p.
- Medin, Dean E. The impact of logging on red squirrels in an Idaho conifer forest. Western Journal of Applied Forestry. 1(3): 73-76; 1986.
- Medina, Alvin L.; Smith, H. Dwain. Designs for an antenna boom and masts for telemetry applications. Wildland Society Bulletin. 14(3): 291-297; 1986.
- Miller, G. S.; Meslow, E. D. Dispersal data for juvenile spotted owls: the problem of small sample size. In: Gutierrez, Ralph J.; Carey, Andrew B., tech. eds. Ecology and management of the spotted owl in the Pacific Northwest. Gen. Tech. Rep. PNW-185. Portland, OR: U.S. Department of Agriculture, Forest Service, Pacific Northwest Forest and Range Experiment Station; 1985: 69-73.
- Miller, Gary S.; Nelson, Kim; Wright, Will C. Two-year-old female spotted owl breeds successfully. Western Birds. 16: 93-94; 1985.

- Miquelle, D. G.; Van Ballenberghe, V. The moose bell: a visual or olfactory communicator. *Alces*. 21: 191-213; 1985.
- Morrison, Michael L.; Dedon, Mark F.; Raphael, Martin G.; Yoder-Williams, Michael P. Snag requirements of cavity-nesting birds: are U.S. Department of Agriculture, Forest Service guidelines being met? *Western Journal of Applied Forestry*. 1(2): 38-40; 1986.
- Mowrey, Robert A.; Zasada, John C. Den tree use and movements of northern flying squirrels in interior Alaska and implications for forest management. In: Meehan, William R.; Merrell, Theodore R., Jr.; Hanley, Thomas A. Fish and wildlife relationships in old-growth forests; 1982 April 12-15; Juneau, AK. [Place of publication unknown]: American Institute of Fishery Research Biologists; 1984: 351-356. [Available from John W. Reintjes, Rt. 4, Box 85, Morehead City, NC 28557.]
- Neal, Donald L. The effect of mountain lion predation on the North Kings deer herd in California. In: Proceedings of the 2d mountain lion workshop; 1984 November 27-29; Zion National Park, UT. Logan, UT: Utah Division of Wildlife Research, Utah Cooperative Wildlife Research Unit; 1985: 138-140.
- Nelson, Michael E.; Mech, L. David. Deer population in the central Superior National Forest, 1967-1985. Res. Pap. NC-271. St. Paul, MN: U.S. Department of Agriculture, Forest Service, North Central Forest Experiment Station; 1986. 8 p.
- Nelson, Michael E.; Mech, L. David. Relationship between snow depth and gray wolf predation on white-tailed deer. *Journal of Wildlife Management*. 50(3): 471-474; 1986.
- Paton, Peter W. C.; Fellows, David P.; Tomich, P. Quentin. Distribution of cattle egret roosts in Hawaii with notes on the problems egrets to airports. *Elepaio*. 46(13): 143-147; 1986.
- Paton, Peter W. C.; Pank, Larry. A technique to mark incubating birds. *Journal of Field Ornithology*. 57(3): 232-233; 1986.
- Paton, Peter W. C.; Scott, J. Michael; Burr, Timothy A. American coot and black-necked stilt on the island of Hawaii. *Western Birds*. 16(4): 175-181; 1986.
- Patton, David R.; Vahle, Robert J. Cache and nest characteristics of the red squirrel in an Arizona mixed-conifer forest. *Western Journal of Applied Forestry*. 1(2): 48-51; 1986.
- Peek, J. M.; Van Ballenberghe, V.; Miquelle, D. G. Intensity of interactions between rutting bull moose in central Alaska. *Journal of Mammalogy*. 67(2): 423-426; 1986.
- Probst, John R. A review of factors limiting the Kirtland's warbler on its breeding grounds. *American Midland Naturalist*. 116(1): 87-100; 1986.
- Probst, John R. Summer records and management implications of Kirtland's warbler in Michigan's Upper Peninsula. *Jack-Pine Warbler*. 63(1): [not paged]; 1985.
- Ralph, C. John. Habitat association patterns of forest and steppe birds of northern Patagonia, Argentina. *Condor*. 87(3): 471-483; 1985.
- Ralph, C. John; van Riper, Charles, III. Historical and current factors affecting Hawaiian native birds. In: Temple, Stanley A., ed. *Bird Conservation 2*. Madison, WI: The University of Wisconsin Press; 1985: 43-70.
- Raphael, Martin G.; Marcot, Bruce G. Validation of a wildlife-habitat-relationships model: vertebrates in a Douglas-fir sere. In: Verner, Jared; Morrison, Michael L.; Ralph, C. John, eds. *Wildlife 2000: modeling habitat relationships of terrestrial vertebrates*; 1984 October 7-13; Fallen Leaf Lake, CA. Madison, WI: The University of Wisconsin Press; 1986: 129-138.
- Raphael, Martin G.; Taylor, Cathy A.; Barrett, Reginald H. Smoked aluminum track stations record flying squirrel occurrence. Res. Note PSW-384. Berkeley, CA: U.S. Department of Agriculture, Forest Service, Pacific Southwest Forest and Range Experiment Station; 1986. 3 p.
- Repenning, Robert W.; Labisky, Ronald F. Effects of even-age timber management on bird communities of the longleaf pine forest in northern Florida. *Journal of Wildlife Management*. 49(4): 1088-1098; 1985.
- Rogers, Lynn L. Aiding the wild survival of orphaned bear cubs. In: Beaver, Paul, ed. *Proceedings of the 4th annual symposium of the National Wildlife Rehabilitators' Association*; 1985 March 21-24; St. Paul, MN. [Brighton], IL: National Wildlife Rehabilitators' Association; 1985: 104-111.
- Rogers, Lynn L. Effects of translocation distance on frequency of return by adult black bears. *Wildlife Society Bulletin*. 14(1): 76-80; 1986.
- Rogers, Lynn L. Long-term survival of adopted black bear cubs in suboptimal habitat. *Wildlife Society Bulletin*. 14(1): 81-83; 1986.
- Rosenberg, Kenneth V.; Raphael, Martin G. Effects of forest fragmentation on vertebrates in Douglas-fir forests. In: Verner, Jared; Morrison, Michael L.; Ralph, C. John, eds. *Wildlife 2000: modeling habitat relationships of terrestrial vertebrates*; 1984 October 7-11; Fallen Leaf Lake, CA. Madison, WI: The University of Wisconsin Press; 1986: 263-272.
- Rothstein, Stephen I.; Yokel, David A.; Fleischer, Robert C. Social dominance, mating and spacing systems, female fecundity, and vocal dialects in captive and free-ranging brown-headed cowbirds. In: Johnston, Richard F., ed. *Current ornithology*, Vol. 3. New York: Plenum Press; 1986: 127-185.

- Ruggiero, Leonard F.; Carey, Andrew B. A programmatic approach to the study of old-growth forest-wildlife relationships. In: New forests for a changing world: Proceedings, SAF national convention; 1983 October 16-20; Portland, OR. Bethesda, MD: Society of American Foresters; 1984: 340-345.
- Sakai, Howard F.; Ralph, C. John; Jenkins, C. D. Foraging ecology of the Hawaiian crow, an endangered genera list. *Condor*. 88(2): 211-219; 1986.
- Salwasser, Hal; Samson, Fred B. Cumulative effects analysis: an advance in wildlife planning and management. In: Transactions North American Wildlife and Natural Resources Conference 50; 1985 March 15-20; Washington, DC. Washington, DC: The Wildlife Management Institute; 1985: 313-321.
- Samson, Fred B.; Perez-Trezo, Francisco; Salwasser, Hal; Ruggiero, Leonard F.; Shaffer, Mark L. On determining and managing minimum population size. *Wildlife Society Bulletin*. 13: 425-433; 1985.
- Schenbeck, Greg L.; Myhre, Richard J. Aerial photography for assessment of black-tailed prairie dog management on the Buffalo Gap National Grassland, South Dakota. Rep. 86-7. Fort Collins, CO: U.S. Department of Agriculture, Forest Service, Forest Pest Management, Methods Application Group; 1986. 15 p.
- Schuster, Ervin G.; Frissell, Sidney S.; Baker, Eldon E.; Loveless, Robert S., Jr. The Delphi method: application to elk habitat quality. Res. Pap. INT-353. Ogden, UT: U.S. Department of Agriculture, Forest Service, Intermountain Forest and Range Experiment Station; 1985. 32 p.
- Severson, Kieth E. Small mammals in modified pinyon-juniper woodlands. *Journal of Range Management*. 39(1): 31-34; 1986.
- Shifley, Stephen R.; Brand, Gary J.; Ohmann, Lewis F. Timber and squirrels: forecasting and evaluating the options. *Northern Journal of Applied Forestry*. 3(2): 46-49; 1986.
- Singer, Francis, J.; Doherty, Jonathon L. Managing mountain goats at a highway crossing. *Wildlife Society Bulletin*. 13(4): 469-477; 1985.
- Stormer, Fred A.; Johnson, Douglas H. Introduction: biometric approaches to modeling. In: Verner, Jared; Morrison, Michael L.; Ralph, C. John, eds. *Wildlife 2000: modeling habitat relationships of terrestrial vertebrates*; 1984 October 7-11; Fallen Leaf Lake, CA. Madison, WI: The University of Wisconsin Press; 1986: 159-160.
- Sweeney, James M. Refinement of DYNAST's forest structure simulation. In: Verner, Jared; Morrison, Michael L.; Ralph, C. John, eds. *Wildlife 2000: modeling habitat relationships of terrestrial vertebrates*; 1984 October 7-11; Fallen Leaf Lake, CA. Madison, WI: The University of Wisconsin Press; 1986: 357-360.
- Sweeney, James M. Summary: linking wildlife models with models of vegetation succession--the researcher's viewpoint. In: Verner, Jared; Morrison, Michael L.; Ralph, C. John, eds. *Wildlife 2000: modeling habitat relationships of terrestrial vertebrates*; 1984 October 7-11; Fallen Leaf Lake, CA. Madison, WI: University of Wisconsin Press; 1986: 415-416.
- Szaro, Robert C. Guild management: an evaluation of avian guilds as a predictive tool. *Environmental Management*. 10(5): 681-688; 1986.
- Szaro, Robert C.; Balda, Russell P. Relationships among weather, habitat structure, and ponderosa pine forest birds. *Journal of Wildlife Management*. 50(2): 253-260; 1986.
- Thomas, Donald W.; West, Stephen D. On the use of ultrasonic detectors for bat species identification and the calibration of QMC Mini Bat Detectors. *Canadian Journal of Zoology*. 62: 2677-2679; 1984.
- Thomas, Jack W. Toward the managed forest: going places that we've never been. *Renewable Resources Journal*. 3(3): 12-16; 1985.
- Thomas, Jack Ward. Professionalism--commitment beyond employment. In: CAL-NEVA wildlife transactions 1985: Proceedings, meeting of the western section, The Wildlife Society, and the California-Nevada chapter, American Fisheries Society; 1985 January 25-26; Monterey, CA. Portland, OR: [Publisher unknown]; 1985: 1-10.
- Thomas, Jack Ward. Wildlife in managed forests--a matter of commitment. In: Proceedings, Canada's forests: a commitment to the future; 1986 April 9-10; Ottawa, ON. Portland, OR: National Forest Congress; 1986: E65-E70.
- Tilghman, Nancy G. Managing urban woodlands for a variety of birds. NE-INF-63-85. Broomall, PA: U.S. Department of Agriculture, Forest Service, Northeastern Forest Experiment Station; 1985. 8 p.
- Tilghman, Nancy G.; Evans, Keith E. A framework for nongame management in midwestern forests. In: Management of nongame wildlife in the Midwest: a developing art. 47th Midwest fish and wildlife conference; 1985 December 17; Grand Rapids, MI. Madison, WI: North Central Section of The Wildlife Society; 1986: 97-115.
- Toweill, Dale E.; Maser, Chris; Johnson, Murray L.; Bryant, Larry D. Size and reproductive characteristics of western Oregon cougars. In: Proceedings, 2d mountain lion workshop; 1984 November 27-29; Salt Lake City, UT. Portland, OR: Utah Division of Wildlife Resources; 1984: 176-184.
- Uhazy, Leslie S.; Arendt, Wayne J. Pathogenesis associated with *Philornid myiasis* (Diptera: Muscidae) on nestling pearly-eyed thrashers (Aves: Mimidae) in the Luquillo Rain Forest, Puerto Rico. *Journal of Wildlife Diseases*. 22(2): 224-237; 1986.

- Uresk, Daniel W.; King, Rudy M.; Apa, Anthony D.; Linder, Raymond. Efficacy of zinc phosphide and strychnine for black-tailed prairie dog control. *Journal of Range Management*. 39(2): 113-116; 1986.
- Verner, Jared. Summary: Predicting effects of habitat patchiness and fragmentation--the researcher's viewpoint. In: Verner, Jared; Morrison, Michael L.; Ralph, C. John, eds. *Wildlife 2000: modeling habitat relationships of terrestrial vertebrates*; 1984 October 7-11; Fallen Leaf Lake, CA. Madison, WI: University of Wisconsin Press; 1986: 327-330.
- Verner, Jared; Morrison, Michael L.; Ralph, C. John, eds. *Wildlife 2000: modeling habitat relationships of terrestrial vertebrates*; 1984 October 7-11; Fallen Leaf Lake, CA. Madison, WI: The University of Wisconsin Press; 1986. 470 p.
- Verner, Jared; Pastorok, Robert; O'Connor, Joel; Severinghaus, William; Glass, Norman; Swindel, Bence. Ecological community structure analyses in the formulation, implementation, and enforcement of law and policy. *The American Statistician*. 39(4): 393-402; 1985.
- Verner, Jared; Ritter, Lyman V. Hourly variation in morning point counts of birds. *The Auk*. 103: 117-124; 1986.
- Welsh, Hartwell. Natural history note: Dicamptodon ensatus. *Herp Review*. 17(1): 19; 1986.
- Welsh, Hartwell; Reynolds, Richard. Natural history notes: Ascapus truei. *Herp Review*. 17(1): 19; 1986.
- West, S. D. Differential capture between old and new models of the museum snap-trap. *Journal of Mammalogy*. 66(4): 798-800; 1985.
- Wisdom, Michael J.; Bright, Larry R.; Carey, Christopher G.; Hines, William W.; Pedersen, Richard J.; Smithey, Douglas A.; Thomas, Jack Ward, Witmer, Gary W. A model to evaluate elk habitat in western Oregon. Publ. R6-F&WL-216-1986. Portland, OR: U.S. Department of Agriculture, Forest Service, Pacific Northwest Region; 1986. 36 p.
- Whitaker, John O., Jr.; Smith, Martha A.; Maser, Chris. Mites and lice from the genus Peromyscus from Oregon. *Northwest Science*. 59(4): 319-322; 1985.
- Wigley, T. Bently; Sweeney, James M.; Garner, Michael E.; Melchoirs, M. Anthony. Effects of forest characteristics on wild turkey habitat use in the Ouachita Mountains. *Bull.* 887. Fayetteville, AR: Arkansas Agricultural Experiment Station; 1986. 24 p.
- Wiley, J. W. Bird conservation in the United States. In: Temple, S. A., ed. *Bird conservation 2*. Madison, WI: The University of Wisconsin Press; 1985: 107-159.
- Wiley, J. W. Status and conservation of forest raptors in the West Indies. In: Chancellor, R.; Newton, I., eds. *Conservation studies on raptors*. Tech. Publ. 5. Cambridge, EN: International Council for Bird Preservation; 1985: 199-204.
- Wiley, J. W. The captive programme for the endangered Puerto Rican parrot Amazona vittata. *Avicultural Magazine*. 91(2): 110-116; 1985.
- Wirtz, William O., II. Postfire rodent and bird communities in the chaparral of southern California. In: Medecos IV proceedings of the 4th international conference on Mediterranean ecosystems; 1984 August 13-17; Perth, Western Australia. Nedlands, Western Australia: University of Western Australia; 1984: 165-168.
- Youngblood, Andrew P.; Mauk, Ronald L. Coniferous forest habitat types of central and southern Utah. Gen. Tech. Rep. INT-187. Ogden, UT: U.S. Department of Agriculture, Forest Service, Intermountain Forest and Range Experiment Station; 1985. 89 p.
- Zeedyk, William D.; Dickson, James G. Fifth National wild turkey symposium summary. In: *Proceedings 5th national wild turkey symposium*; 1985 June 17-21; Des Moines, IA. Edgefield, SC: National Wild Turkey Federation; 1985: 333-339.

Range

- Anderson, Loran C. An overview of the genus Chrysothamnus (Asteraceae). In: McArthur, E. Durant; Welch, Bruce L., comps. *Proceedings--symposium on the biology of Artemisia and Chrysothamnus*; 1984 July 9-13; Provo, UT. Gen. Tech. Rep. INT-200. Ogden, UT: U.S. Department of Agriculture, Forest Service, Intermountain Forest and Range Experiment Station; 1986: 29-45.
- Anderson, Loran C. Cytogeography of Chrysothamnus viscidiflorus. In: McArthur, E. Durant; Welch, Bruce L., comps. *Proceedings--symposium on the biology of Artemisia and Chrysothamnus*; 1984 July 9-13; Provo, UT. Gen. Tech. Rep. INT-200. Ogden, UT: U.S. Department of Agriculture, Forest Service, Intermountain Forest and Range Experiment Station; 1986: 93-97.
- Anderson, Loran C. Sympatric subspecies in Chrysothamnus nauseosus. In: McArthur, E. Durant; Welch, Bruce L., comps. *Proceedings--symposium on the biology of Artemisia and Chrysothamnus*; 1984 July 9-13; Provo, UT. Gen. Tech. Rep. INT-200. Ogden, UT: U.S. Department of Agriculture, Forest Service, Intermountain Forest and Range Experiment Station; 1986: 98-103.

- Arno, Stephen F.; Gruell, George E. Douglas-fir encroachment into mountain grasslands in southwestern Montana. *Journal of Range Management*. 39(3): 272-275; 1986.
- Behan, Barbara; Welch, Bruce L. Winter nutritive content of black sagebrush (*Artemisia nova*) grown in a uniform garden. *Great Basin Naturalist*. 46(1): 161-165; 1986.
- Bonham, Charles D.; Coleman, Sandra S.; Lewis, Clifford E.; Tanner, George W., comps. Statistical analyses and modeling of grazing systems: Symposium proceedings; 1986 February 13; Kissimmee, FL. Denver, CO: Society for Range Management; 1986: 73 p.
- Bryant, Larry D. Livestock management in the riparian ecosystem. In: *Riparian ecosystems and their management: reconciling conflicting uses: Proceedings, 1st North American riparian conference*; 1985 April 16-18; Tucson, AZ. Gen. Tech. Rep. RM-120. Fort Collins, CO: U.S. Department of Agriculture, Forest Service, Rocky Mountain Forest and Range Experiment Station; 1985: 285-289.
- Byrd, Nathan A.; Lewis, Clifford E.; Pearson, Henry A. Tips outlined on managing native forage. *Stockman Magazine*. 42(1): 13-15; 1985.
- Cimon, Norman; Quigley, Thomas. Evolution of a geographic information system: integration into the Oregon range evaluation computing facility. In: *Proceedings of geographic information systems workshop*; 1986 April 1-4; Atlanta, GA. Portland, OR: American Society for Photogrammetry and Remote Sensing; 1986: 99-109.
- Clary, Warren P. Black sagebrush response to grazing in the east-central Great Basin. In: *McArthur, E. Durant; Welch, Bruce L., comps. Proceedings--symposium on the biology of Artemisia and Chrysothamnus*; 1984 July 9-13; Provo, UT. Gen. Tech. Rep. INT-200. Ogden, UT: U.S. Department of Agriculture, Forest Service, Intermountain Forest and Range Experiment Station; 1986: 181-185.
- Clary, Warren P.; Tiedemann, Arthur R. Distribution of biomass within small tree and shrub form *Quercus gambelii* stands. *Forest Science*. 32(1): 234-242; 1986.
- Coe, Priscilla Kolb; Quigley, Thomas. Application of a geographic information system for the Oregon range evaluation project. In: *Proceedings of a geographic information systems workshop*; 1986 April 1-4; Atlanta, GA. Portland, OR: American Society for Photogrammetry and Remote Sensing; 1986: 89-98.
- Davis, James N.; Stevens, Richard. Comparison of production in 27 accessions of 4 sagebrush taxa. In: *McArthur, E. Durant; Welch, Bruce L., comps. Proceedings--symposium on the biology of Artemisia and Chrysothamnus*; 1984 July 9-13; Provo, UT. Gen. Tech. Rep. INT-200. Ogden, UT: U.S. Department of Agriculture, Forest Service, Intermountain Forest and Range Experiment Station; 1986: 336-341.
- Davis, James N.; Welch, Bruce L. Winter preference, nutritive value, and other range use characteristics of *Kochia prostrata* (L.) Schrad. *Great Basin Naturalist*. 45(4): 778-783; 1985.
- DeByle, Norbert V. Animal impacts. In: *DeByle, Norbert V.; Winokur, Robert P., eds. Aspen: ecology and management in the Western United States*. Gen. Tech. Rep. RM-119. Fort Collins, CO: U.S. Department of Agriculture, Forest Service, Rocky Mountain Forest and Range Experiment Station; 1985: 115-123.
- DeByle, Norbert V. Management for esthetics and recreation, forage, water, and wildlife. In: *DeByle, Norbert V.; Winokur, Robert P., eds. Aspen: ecology and management in the Western United States*. Gen. Tech. Rep. RM-119. Fort Collins, CO: U.S. Department of Agriculture, Forest Service, Rocky Mountain Forest and Range Experiment Station; 1985: 223-232.
- Duncan, Don A.; Coon, Susan L. Publications from the San Joaquin Experimental Range, 1935-1985. CATI/850902. Fresno, CA: California Agricultural Technology Institute, California State University; 1985. 101 p.
- Elderkin, R. L., Jr.; Dietz, D. R.; Welch, B. L.; Ralphs, P. M.; Czarnecki, J. K. Irrigation by mine discharge water and fertilization of big sagebrush: effects of nutritional composition production, and mule deer use. In: *McArthur, E. Durant; Welch, Bruce L., comps. Proceedings--symposium on the biology of Artemisia and Chrysothamnus*; 1984 July 9-13; Provo, UT. Gen. Tech. Rep. INT-200. Ogden, UT: U.S. Department of Agriculture, Forest Service, Intermountain Forest and Range Experiment Station; 1986: 140-145.
- Everett, Richard; Clary, Warren. Fire effects and revegetation on juniper-pinyon woodlands. In: *Sanders, Ken; Durham, Jack; [and others], eds. Rangeland fire effects: a symposium: Proceedings*; 1984 November 27-29; Boise, ID. Boise, ID: U.S. Department of the Interior, Bureau of Land Management, Idaho State Office; 1985: 33-37.
- Frank, Carolyn T.; Smith, Bruce N.; Welch, Bruce L. Photosynthesis, growth, transpiration, and 13C relationships among three subspecies of big sagebrush. (*Artemisia tridentata* Nutt.). In: *McArthur, E. Durant; Welch, Bruce L., comps. Proceedings--symposium on the biology of Artemisia and Chrysothamnus*; 1984 July 9-13; Provo, UT. Gen. Tech. Rep. INT-200. Ogden, UT: U.S. Department of Agriculture, Forest Service, Intermountain Forest and Range Experiment Station; 1986: 332-335.
- Goodrich, Sherel. Utah flora: Apiaceae (Umbelliferae). *Great Basin Naturalist*. 46(1): 66-106; 1986.
- Greene, Sarah E. New rangeland research areas in Oregon. *Rangelands*. 7(4): 165-166; 1985.

- Hall, Frederick, C. Wildlife habitats in managed rangelands--the Great Basin of southeastern Oregon: management practices and options. Gen. Tech. Rep. PNW-189. Portland, OR: U.S. Department of Agriculture, Forest Service, Pacific Northwest Forest and Range Experiment Station; 1985. 17 p.
- Hebert, Jeanne R.; Meyer, Ronald W. Lichens of the San Joaquin Experimental Range, California. The Bryologist. 87(3): 251-254; 1984.
- Hobbs, N. Thompson; Welch, Bruce L.; Remington, Thomas E. Effects of big sagebrush on in vitro digestion of grass cell wall. In: McArthur, E. Durant; Welch, Bruce L., comps. Proceedings--symposium on the biology of *Artemisia* and *Chrysothamnus*; 1984 July 9-13; Provo, UT. Gen. Tech. Rep. INT-200. Ogden, UT: U.S. Department of Agriculture, Forest Service, Intermountain Forest and Range Experiment Station; 1986: 186-189.
- Johnson, M. K.; Pearson, H. A.; Ribbeck, K. F.; Davis, L. G. Management of subclover in pine forests. Louisiana Agriculture. 29(1): 3-4, 24; 1985.
- Johnson, Mark K. Estimating ratios of live and dead plant material in clipped plots. Journal of Range Management. 39(1): 90; 1986.
- Johnson, Mark K.; Davis, Lee G.; Ribbeck, Kenneth F.; Render, Jeffrey H.; Pearson, Henry A. Management of subterranean clover in pine forested range. Journal of Range Management. 39(5): 454-457; 1986.
- Jones, John R.; DeByle, Norbert V. Other physical factors. In: DeByle, Norbert V.; Winokur, Robert P., eds. Aspen: ecology and management in the Western United States. Gen. Tech. Rep. RM-119. Fort Collins, CO: U.S. Department of Agriculture, Forest Service, Rocky Mountain Forest and Range Experiment Station; 1985: 83-106.
- Kalmbacher, Robert S.; Coleman, Sandra S.; Lewis, Clifford E.; Tanner, George W., comps. Tropical American lowland range symposium proceedings; 1986 February 13; Kissimmee, FL. Denver, CO: Society for Range Management; 1986 34 p.
- Kie, John G. Production of deerbrush and mountain whitethorn related to shrub volume and overstory crown closure. Res. Note PSW-377. Berkeley, CA: U.S. Department of Agriculture, Forest Service, Pacific Southwest Forest and Range Experiment Station; 1985. 4 p.
- Klemmedson, J. O.; Tiedemann, A. R. Long-term effects of mesquite removal on soil characteristics. 1. Nutrients and bulk density. Soil Science Society of America Journal. 50(2): 472-475; 1986.
- Klemmedson, J. O.; Tiedemann, A. R. Long-term effects of mesquite removal on soil characteristics. 2. Nutrient availability. Soil Science Society of America Journal. 50(2): 476-480; 1986.
- Knipe, O. D. Predator deterrent electric fence for rough terrain. Rangelands. 7(4): 148-153; 1985.
- Knipe, Oren D. Effects of reducing shrub cover on moisture stress in mountain mahogany. Journal of Soil and Water Conservation. 40(5): 445-447; 1985.
- Komarek, Edwin V.; Coleman, Sandra S.; Lewis, Clifford E.; Tanner, George W., comps. Prescribed fire and smoke management symposium proceedings; 1986 February 13; Kissimmee, FL. Denver, CO: Society for Range Management; 1986. 21 p.
- Koniak, Susan. Succession in pinyon-juniper woodlands following wildfire in the Great Basin. Great Basin Naturalist. 45(3): 556-566; 1986.
- Koniak, Susan. Tree densities on pinyon-juniper woodland sites in Nevada and California. Great Basin Naturalist. 46(1): 179-184; 1986.
- Lewis, Clifford E.; Monson, Warren G.; Bonyata, Richard J. Pensacola bahiagrass can be used to improve the forage resource when regenerating southern pines. Southern Journal of Applied Forestry. 9(10): 254-259; 1985.
- Loft, Eric R.; Menke, John W.; Kie, John G. Interaction of cattle and deer on mountain rangeland. California Agriculture. 40(1-2): 6-9; 1986.
- McArthur, E. Durant. Specificity of galls on *Chrysothamnus nauseosus* subspecies. In: McArthur, E. Durant; Welch, Bruce L., comps. Proceedings--symposium on the biology of *Artemisia* and *Chrysothamnus*; 1984 July 9-13; Provo, UT. Gen. Tech. Rep. INT-200. Ogden, UT: U.S. Department of Agriculture, Forest Service, Intermountain Forest and Range Experiment Station; 1986: 205-210.
- McArthur, E. Durant; Goodrich, Sherel K. *Artemisia tridentata* ssp. *spiciformis*: distribution and taxonomic placement. In: McArthur, E. Durant; Welch, Bruce L., comps. Proceedings--symposium on the biology of *Artemisia* and *Chrysothamnus*; 1984 July 9-13; Provo, UT. Gen. Tech. Rep. INT-200. Ogden, UT: U.S. Department of Agriculture, Forest Service, Intermountain Forest and Range Experiment Station; 1986: 55-57.
- McArthur, E. Durant; Sanderson, Stewart C.; Freeman, D. Carl. Isozymes of an autopolyploid shrub, *Atriplex canescens* (Chenopodiaceae). Great Basin Naturalist. 46(1): 157-160; 1986.
- McArthur, E. Durant; Welch, Bruce L. Introduction: *Artemisia* and *Chrysothamnus*. In: McArthur, E. Durant; Welch, Bruce L., comps. Proceedings--symposium on the biology of *Artemisia* and *Chrysothamnus*; 1984 July 9-13; Provo, UT. Gen. Tech. Rep. INT-200. Ogden, UT: U.S. Department of Agriculture, Forest Service, Intermountain Forest and Range Experiment Station; 1986: 2-5.

- McArthur, E. Durant; Welch, Bruce L., comps. Proceedings--symposium on the biology of Artemisia and Chrysothamnus; 1984 July 9-13; Provo, UT. Gen. Tech. Rep. INT-200. Ogden, UT: U.S. Department of Agriculture, Forest Service, Intermountain Forest and Range Experiment Station; 1986. 398 p.
- McInnis, Michael L.; Quigley, Thomas M.; Vavra, Martin. Using computer simulation to estimate grazing capacity and beef production. Spec. Rep. 773. Corvallis, OR: Oregon State University, Agricultural Experiment Station; 1986: 25-31.
- Mitchell, John E. Assessment of habitat factors. In: Cook, C. W.; Stubbendieck, J. Journal of range research: basic problems and techniques. Denver, CO: Society of Range Management; 1986: 19-44.
- Mitchell, John E.; Joyce, Linda A. Use of a generalized linear model to evaluate range forage production estimates. Environmental Management. 10(3): 403-411; 1986.
- Monsen, Stephen B.; Stevens, Richard; Jorgensen, Kent R. Seed harvesters--an evaluation of existing machines and projected needs. In: Vegetative rehabilitation and equipment workshop: 39th annual report; 1985 February 10-11; Salt Lake City, UT. Missoula, MT: U.S. Department of Agriculture, Forest Service, Equipment Development Center; 1985: 37-39.
- Mueggler, W. F. Aspen communities in the interior West. In: Proceedings of the 1985 Society of American Foresters national convention; 1985 July 28-31; Fort Collins, CO. Bethesda, MD: Society of American Foresters; 1985: 106-111.
- Mueggler, W. F. Forage. In: DeByle, Norbert V.; Winokur, Robert P., eds. Aspen: ecology and management in the Western United States. Gen. Tech. Rep. RM-119. Fort Collins, CO: U.S. Department of Agriculture, Forest Service, Rocky Mountain Forest and Range Experiment Station; 1985: 129-134.
- Mueggler, Walter F.; Campbell, Robert B., Jr. Aspen community types of Utah. Res. Pap. INT-362. Ogden, UT: U.S. Department of Agriculture, Forest Service, Intermountain Forest and Range Experiment Station; 1986. 69 p.
- Neel, J. P.; Kiesling, H. E.; Donart, G. B.; Holechek, J. L.; Goodman, T. D.; Manzanares, D. Nutritive value of forage collected by esophageal fistulated cows in riparian and upland areas on forest land. In: Proceedings, western section, American Society of Animal Science, vol. 36; 1985 July 17-19; Moscow, ID. Moscow, ID: American Society of Animal Science; 1986: 304-306.
- Neville, Walter M.; McArthur, E. Durant. Preliminary report on tissue culture propagation of big sagebrush (Artemisia tridentata). In: McArthur, E. Durant; Welch, Bruce L., comps. Proceedings--symposium on the biology of Artemisia and Chrysothamnus; 1984 July 9-13; Provo, UT. Gen. Tech. Rep. INT-200. Ogden, UT: U.S. Department of Agriculture, Forest Service, Intermountain Forest and Range Experiment Station; 1986: 397-398.
- Nielsen, Darwin B.; Wagstaff, Fred J.; Lytle, Denny. Big-game animals on private range. Rangelands. 8(1): 36-38; 1986.
- Noller, Gary L.; McArthur, E. Durant. Establishment and initial results from a sagebrush (Artemisia tridentata) [Nutt.] mass selection garden. In: McArthur, E. Durant; Welch, Bruce L., comps. Proceedings--symposium on the biology of Artemisia and Chrysothamnus; 1984 July 9-13; Provo, UT. Gen. Tech. Rep. INT-200. Ogden, UT: U.S. Department of Agriculture, Forest Service, Intermountain Forest and Range Experiment Station; 1986: 104-107.
- Pearson, Henry A. Agroforestry. In: Merkle, Dan; Carter, Roy; Artz, John L., eds. Southeastern regional conference grazing lands and people; 1984 December 10-12; Atlanta, GA. Athens, GA: University of Georgia; 1984: 72-79.
- Pearson, Henry A.; Rollins, Douglas A. Supplemental winter pasture for southern pine native range. In: Forages: the grassroots of agriculture; 1986 April 15-17; Athens, GA. Lexington, KY: American Forage and Grassland Council; 1986: 258-263.
- Platts, William S. Riparian-stream management. In: National range conference proceedings; 1985 November 6-8; Oklahoma City, OK. Washington, DC: U.S. Department of Agriculture; 1986: 70-74.
- Platts, William S.; Nelson, Rodger Loren. Impacts of rest-rotation grazing on stream banks in forested watersheds in Idaho. North American Journal of Fisheries Management. 5: 547-556; 1985.
- Ratliff, Raymond D. Meadows in the Sierra Nevada of California: state of knowledge. Gen. Tech. Rep. PSW-84. Berkeley, CA: U.S. Department of Agriculture, Forest Service, Pacific Southwest Forest and Range Experiment Station; 1985. 52 p.
- Risser, Paul G.; Mankin, J. B. Simplified simulation model of the plant producer function in shortgrass steppe. American Midland Naturalist. 115: 348-360; 1986.
- Severson, Kieth E. Woody plant reestablishment in modified pinyon-juniper woodlands, New Mexico. Journal of Range Management. 39(5): 438-442; 1986.
- Shaw, Nancy; Monsen, Stephen B. 'Lassen' antelope bitterbrush: a browse plant for game and livestock ranges. Rangelands. 8(3): 122-124; 1986.

- Smith, E. Lamar; Coleman, Sandra S.; Lewis, Clifford E.; Tanner, George W., comps. Use of cover, soils and weather data in rangeland monitoring: Symposium proceedings; 1986 February 12; Kissimmee, FL. Denver, CO: Society for Range Management; 1986. 46 p.
- Stevens, R.; Jorgensen, K. R.; Davis, J. N.; Monsen, S. B. Seed pappus and placement influences on white rubber rabbitbrush establishment. In: McArthur, E. Durant; Welch, Bruce L., comps. Proceedings--symposium on the biology of *Artemisia* and *Chrysothamnus*; 1984 July 9-13; Provo, UT. Gen. Tech. Rep. INT-200. Ogden, UT: U.S. Department of Agriculture, Forest Service, Intermountain Forest and Range Experiment Station; 1986: 353-357.
- Stevens, Richard. Population dynamics of two sagebrush species and rubber rabbitbrush over 22 years of grazing use by three animal classes. In: McArthur, E. Durant; Welch, Bruce L., comps. Proceedings--symposium on the biology of *Artemisia* and *Chrysothamnus*; 1984 July 9-13; Provo, UT. Gen. Tech. Rep. INT-200. Ogden, UT: U.S. Department of Agriculture, Forest Service, Intermountain Forest and Range Experiment Station; 1986: 278-285.
- Stevens, Richard; Monsen, Stephen B. Recent plant releases for western wildlands. In: Vegetation rehabilitation and equipment workshop: 39th annual report; 1985 February 10-11; Salt Lake City, UT. Missoula, MT: U.S. Department of Agriculture, Forest Service, Equipment Development Center; 1985: 34-36.
- Stickney, Peter F. Data base for early postfire succession on the Sundance burn, northern Idaho. Gen. Tech. Rep. INT-189. Ogden, UT: U.S. Department of Agriculture, Forest Service, Intermountain Forest and Range Experiment Station; 1985. 121 p.
- Stickney, Peter F. First decade plant succession following the Sundance forest fire, northern Idaho. Gen. Tech. Rep. INT-197. Ogden, UT: U.S. Department of Agriculture, Forest Service, Intermountain Forest and Range Experiment Station; 1986. 26 p.
- Svejcar, Tony; Vavra, Martin. Seasonal forage production and quality on four native and improved plant communities in eastern Oregon. Tech. Bull. 149. Corvallis, OR: Agricultural Experiment Station, Oregon State University; 1985. 24 p.
- Svejcar, Tony; Vavra, Martin. The influence of several range improvements on estimated carrying capacity and potential beef production. Journal of Range Management. 38(5): 395-399; 1985.
- Sweeney, James M.; Wolters, Gale L. Techniques for future decisionmaking in range, wildlife and fisheries management. In: Crowley, John, ed. Research for tomorrow: 1986 yearbook of agriculture. Washington, DC: U.S. Department of Agriculture; 1986: 209-212.
- Tanner, G. W.; Lewis, C. E. Alternative tree spacings for wood and forage production in Florida. Fact Sheet FRC-36. Gainesville, FL: Florida Cooperative Extension Service, University of Florida; 1986. 2 p.
- Thilenius, John F.; Smith, Dixie R. Vegetation and soils of an alpine range in the Absaroka Mountains, Wyoming. Gen. Tech. Rep. RM-121. Fort Collins, CO: U.S. Department of Agriculture, Forest Service, Rocky Mountain Forest and Range Experiment Station; 1985. 18 p.
- Thill, Ronald E. Cattle and deer compatibility on southern forest range. In: Baker, Frank H.; Jones, R. Katherine, ed. Proceedings of a conference on multi-species grazing; 1985 June 25-28; Morrilton, AR. Morrilton, AR: Winrock Institute for Agricultural Development; 1985: 159-177.
- Upadhyaya, Abha; Sankhla, Narendra; Davis, Tim D.; Weber, D. J.; Smith, B. N. In vitro propagation of a rubber-producing desert shrub. HortScience. 20(5): 864-865; 1985.
- Weber, D. J.; Davis, T. D.; McArthur, E. D.; Sankhla, N. *Chrysothamnus nauseosus* (rubber rabbitbrush): multiple-use shrub of the desert. Desert Plants. 7(4): 172-180; 1985.
- Welch, Bruce L.; McArthur, E. Durant. Growth rate of big sagebrush as influenced by accessions, sites, subspecies, and years. In: McArthur, E. Durant; Welch, Bruce L., comps. Proceedings--symposium on the biology of *Artemisia* and *Chrysothamnus*; 1984 July 9-13; Provo, UT. Gen. Tech. Rep. INT-200. Ogden, UT: U.S. Department of Agriculture, Forest Service, Intermountain Forest and Range Experiment Station; 1986: 342-346.
- Winward, A. H.; McArthur, E. D.; Kaffer, D. A.; Plummer, C. A.; Brackley, G. K. Another sagebrush in Nevada. Tech. Notes TN-Range NV-44. Reno, NV: U.S. Department of Agriculture, Soil Conservation Service; 1986. 2 p.
- Winward, Alma H.; Anderson, Loran C. Field tour--the biology of *Artemisia* and *Chrysothamnus*. In: McArthur, E. Durant; Welch, Bruce L., comps. Proceedings--symposium on the biology of *Artemisia* and *Chrysothamnus*; 1984 July 9-13; Provo, UT. Gen. Tech. Rep. INT-200. Ogden, UT: U.S. Department of Agriculture, Forest Service, Intermountain Forest and Range Experiment Station; 1986: 6-11.
- Wolters, Gale L.; Eberlein, Gary P. Sulfur or sulfur plus nitrogen increases beef production on California annual range. Journal of Range Management. 39(2): 125-129; 1986.

Wood, Benjamin W.; Brotherson, Jack D. Ecological adaptation and grazing response of budsage (*Artemisia spinescens*) in southwestern Utah. In: McArthur, E. Durant; Welch, Bruce L., comps. Proceedings-- symposium on the biology of *Artemisia* and *Chrysothamnus*; 1984 July 9-13; Provo, UT. Gen. Tech. Rep. INT-200. Ogden, UT: U.S. Department of Agriculture, Forest Service, Intermountain Forest and Range Experiment Station; 1986: 75-92.

Wood, John M.; Tanner, George W. Browse quality response to forest fertilization and soils in Florida. *Journal of Range Management*. 38(5): 432-435; 1985.

Fisheries Habitat

Brusven, M. W.; Meehan, W. R.; Ward, J. F. Summer use of simulated undercut banks by juvenile chinook salmon in an artificial Idaho Channel. *North American Journal of Fish Management*. 6: 36-37; 1986.

Bryant, M. D. Changes 30 years after logging in large woody debris, and its use by salmonids. In: Johnson, R. Roy; Ziebell, Charles D.; Patton, David R.; Ffolliott, Peter F.; Hamre, R. H., tech. coords. Riparian ecosystems and their management; reconciling conflicting uses: Proceedings, 1st North American riparian conference; 1985 April 16-18; Tucson, AZ: Tech. Rep. RM-120. Fort Collins, CO: U.S. Department of Agriculture, Forest Service, Rocky Mountain Forest and Range Experiment Station; 1985: 329-33.

Cuplin, Paul; Platts, William S.; Casey, Osborne; Masinton, Roy. A comparison of riparian area ground data with large scale airphoto interpretation. In: Johnson, R. Roy; Ziebell, Charles D.; Patton, David R.; Ffolliott, Peter F.; Hamre, R. H., tech. coords. Riparian ecosystems and their management: reconciling conflicting uses: Proceedings, 1st North American riparian conference; 1985 April 16-18; Tucson, AZ. Gen. Tech. Rep. RM-120. Fort Collins, CO: U.S. Department of Agriculture, Forest Service, Rocky Mountain Forest and Range Experiment Station; 1985: 67-68.

Duncan, W. F.; Brusven, M. A. Benthic macroinvertebrates in logged and unlogged low-order Southeast Alaska streams. *Freshwater Invertebrate Biology*. 4(3): 125-132; 1985.

Duncan, W. F.; Brusven, M. A. Energy dynamics of three low-order Southeast Alaskan streams: allochthonous production. *Journal of Freshwater Ecology*. 3(2): 233-248; 1985.

Duncan, W. R.; Brusven, M. A. Energy dynamics of three low-order Southeast Alaskan streams: autochthonous production. *Journal of Freshwater Ecology*. 3(2): 155-166; 1985.

Estep, Margaret A.; Beschta, Robert L. Transport of bedload sediment and channel morphology of a southeast Alaska stream. Res. Note PNW-430. Portland, OR: U.S. Department of Agriculture, Forest Service, Pacific Northwest Forest and Range Experiment Station; 1985. 15 p.

Hankin, D. G. Sampling designs for estimating the total number of fish in small streams. Res. Pap. PNW-360. Portland, OR: U.S. Department of Agriculture, Forest Service, Pacific Northwest Forest and Range Experiment Station; 1986. 33 p.

Harmon, M. E.; Franklin, J. F.; Swanson, F. J.; Sollins, P.; Gregory, S. V.; Lattin, J. D.; Anderson, N. H.; Cline, S. P.; Aumen, N. G.; Sedell, J. R. Lienkaemper, G. W.; Cromack, K. Jr.; Cummins, K. W. Ecology of coarse woody debris in temperate ecosystems. *Advances in Ecological Research*. 15: 133-302; 1986.

Heede, B. H. The evolution of salmonid systems. In: Wild trout III: Proceedings of the symposium, Yellowstone National Park, Wyoming, 1984; 1984 September 24-25; Yellowstone, WY. Vienna, VA: Wild Trout; 1985: 33-37.

Lisle, Thomas E. Stabilization of a gravel channel by large streamside obstructions and bedrock bends, Jacoby Creek, California. *Geological Society of America Bulletin*. 97: 999-1011; 1986.

Loomis, John; Sorg, Cindy F.; Donnelly, Dennis M. Economic losses to recreational fisheries due to small-head hydro-power development: a case study. *Journal of Environmental Management*. 22: 85-94; 1986.

Loudenslager, Eric J.; Rinne, John N.; Gall, G. A. E.; David, Robert E. Biochemical genetic studies of native Arizona and New Mexico trout. *The Southwestern Naturalist*. 31(2): 221-234; 1986.

Maurer, M. A.; Brusven, M. A. Insect abundance and colonization rate in *Fontinalis neo-mexicana* (Bryophyta) in an Idaho Batholith stream, U.S.A. *Hydrobiologia*. 98: 9-15; 1983.

Minkley, W. L.; Rinne, J. N. Large woody debris in hot-desert streams: an historical review. *Desert Plants*. 7(3): 142-153; 1985.

Modde, Timothy; Drewes, Henry G.; Rumble, Mark A. Effects of watershed alternation on the brook trout populations of a small Black Hills stream. *Great Basin Naturalist*. 46(1): 39-45; 1986.

- Platts, William S.; Gebhardt, Karl A.; Jackson, William L. The effects of large storm events on basin-range riparian stream habitats. In: Johnson, R. Roy; Ziebell, Charles D.; Patton, David Ffolliott, Peter F.; Hamre, R. H., tech. coords. Riparian ecosystems and their management: reconciling conflicting uses: Proceedings, 1st American riparian conference; 1985 April 16-18; Tucson, AZ. Gen. Tech. Rep. RM-120. Fort Collins, CO: U.S. Department of Agriculture, Forest Service, Rocky Mountain Forest and Range Experiment Station; 1985: 30-34.
- Reeves, G. H. Evaluation of streams for salmonid enhancement projects. In: Report of the 3d California salmon and steelhead restoration conference; 1985 February 23-24; Ukiah, CA: [Place of publication unknown]: [Publisher unknown]; 1985: 3-4.
- Richardson, Frank; Hamre, R. H., tech. eds. Wild trout III: Proceedings of the symposium; 1984 September 24-25; Yellowstone National Park, WY. Vienna, VA: Trout Unlimited; 1985: 192 p.
- Rinne, John N. Endangered and nongame fish programs in the West: their role in the conservation of native fishes. In: Western proceedings: 64th annual conference of the Western Association of Fish and Wildlife Agencies; 1984 July 16-19; Victoria, BC. Sacramento, CA: Western Association of Fish and Wildlife Agencies; 1985: 456-469.
- Rinne, John N. Notes on collecting and photographing of fishes in northern Mexico, June 1981. In: Proceedings of Desert Fishes Council; 1981 November 19-21; Furnace Creek, CA. Bishop, CA: Desert Fishes Council; 1985: 8-15 - 22-28.
- Rinne, John N.; Belfit, Scott C. Notes on collecting and photographing of fishes in Sonora and Chihuahua, Mexico, June 1982. In: Proceedings of the Desert Fishes Council; 1982 November 18-20; Tempe, AZ. Bishop, CA: Desert Fishes Council; 1985: 8-15-A138-150.
- Sedell, J. R.; Duval, W. S. Water transportation and storage of logs. Gen. Tech. Rep. PNW-186. Portland, OR: U.S. Department of Agriculture, Forest Service, Pacific Northwest Forest and Range Experiment Station; 1985. 68 p.
- Sedell, James R.; Everest, Fred H.; Benda, Lee E.; Leone, Frank N.; Wolfe, John R.; Heller, David A. Effects of boulder berms on the fish habitat structure in a fifth order stream basin. In: Western proceedings: 64th annual conference of the Western Association of Fish and Wildlife Agencies; 1984 July 16-19; Victoria, BC. Sacramento, CA: Western Association of Fish and Wildlife Agencies; 1985: 435-445.
- Van Deventer, John S.; Platts, William S. A computer software system for entering, managing, and analyzing fish capture data from streams. Res. Note INT-352. Ogden, UT: U.S. Department of Agriculture, Forest Service, Intermountain Forest and Range Experiment Station; 1985. 12 p.
- Wilzback, M. A. Relative roles of food abundance and cover in determining the habitat distribution of stream-dwelling cutthroat trout (*Salm. clarki*). Canadian Journal of Fish and Aquatic Sciences. 42: 1669-1672; 1985.
- ### Forest Recreation
- Anderson, Dorothy H.; Manfredo, Michael J. Visitor preferences for management actions. In: Lucas, Robert C., comp. Proceedings, national wilderness research conference: current research; 1985 July 23-26; Fort Collins, CO. Gen. Tech. Rep. INT-212. Ogden, UT: U.S. Department of Agriculture, Forest Service, Intermountain Forest and Range Experiment Station; Station; 1986: 314-319.
- Anderson, Dorothy H.; Morck, Victoria L. Factors affecting information utilization and change: the case of recreation research and river management in the public sector. Journal of Technology Transfer. 10(2): 53-70; 1986.
- Anderson, Dorothy H.; Morck, Victoria L. The state of Federal river recreation management. In: Popadic, Joseph S.; Butterfield, Dorothy I.; Anderson, Dorothy H.; Popadic, Mary R., eds. 1984 national river recreation symposium proceedings; 1984 October 31-November 3; Baton Rouge, LA. [Baton Rouge], LA: [Louisiana State University, School of Landscape Architecture]; 1986: 466-473.
- Berryman, Karen W.; Cordell, H. Ken; English, Donald B. K. Conceptualization of a geobased recreation resources supply assessment system. In: Watson, Alan E., ed. Proceedings: Southeastern recreation research conference; 1985 February 28-March 1; Myrtle Beach, SC. Statesboro, GA: Georgia Southern College, Department of Recreation and Leisure Services; 1985: 77-84.
- Brown, Thomas C.; Daniel, Terry C. Predicting scenic beauty of timber stands. Forest Science. 32(2): 471-487; 1986.
- Bruns, Don. How to initiate a program of management-oriented research. In: Popadic, Joseph S.; Butterfield, Dorothy I.; Anderson, Dorothy H.; Popadic, Mary R., eds. 1984 national river recreation symposium proceedings; 1984 October 31-November 3; Baton Rouge, LA. [Baton Rouge], LA: [Louisiana State University, School of Landscape Architecture]; 1986: 388-400.
- Bruns, Don. Rivers in a regional context: an overview. In: Popadic, Joseph S.; Butterfield, Dorothy I.; Anderson, Dorothy H.; Popadic, Mary R., eds. 1984 national river recreation symposium proceedings; 1984 October 31-November 3; Baton Rouge, LA. [Baton Rouge], LA: [Louisiana State University, School of Landscape Architecture]; 1986: 68-89.
- Christensen, James E. "Interpretational confounding" and canonical correlation in leisure research. Leisure Sciences. 7(2): 189-203; 1985.

- Christensen, James E. Multiple comparison tests for cross classified recreation data. *Journal of Leisure Research*. 17(4): 296-304; 1985.
- Clark, Roger N. Use and user characteristics: improved knowledge is vital. In: Proceedings--national wilderness research conference: current research; 1985 July 23-26; Fort Collins, CO. Gen. Tech. Rep. INT-212. Ogden, UT: U.S. Department of Agriculture, Forest Service, Intermountain Forest and Range Experiment Station; 1986: 251-252.
- Clark, Roger N.; Stankey, George H. Site attributes--a key to managing wilderness and dispersed recreation. In: Proceedings--national wilderness research conference: current research; 1985 July 23-26; Fort Collins, CO. Gen. Tech. Rep. INT-212. Ogden, UT: U.S. Department of Agriculture, Forest Service, Intermountain Forest and Range Experiment Station; 1986: 509-515.
- Cole, David N. Campsite inventory. In: Lucas, Robert C., comp. Proceedings--national wilderness research conference: current research; 1985 July 23-26; Fort Collins, CO. Gen. Tech. Rep. INT-212. Ogden, UT: U.S. Department of Agriculture, Forest Service, Intermountain Forest and Range Experiment Station; 1986: 531-534.
- Cole, David N. Ecological changes on campsites in the Eagle Cap Wilderness, 1979 to 1984. Res. Pap. INT-368. Ogden, UT: U.S. Department of Agriculture, Forest Service, Intermountain Forest and Range Experiment Station; 1986. 15 p.
- Cole, David N. Recreational trampling effects on six habitat types in western Montana. Res. Pap. INT-350. Ogden, UT: U.S. Department of Agriculture, Forest Service, Intermountain Forest and Range Experiment Station; 1985. 43 p.
- Cole, David N.; Marion, Jeffrey L. Wilderness campsite impacts: changes over time. In: Lucas, Robert C., comp. Proceedings--national wilderness research conference: current research; 1985 July 23-26; Fort Collins, CO. Gen. Tech. Rep. INT-212. Ogden, UT: U.S. Department of Agriculture, Forest Service, Intermountain Forest and Range Experiment Station; 1986: 144-151.
- Driver, B. L.; Bossi, James E.; Cordell, H. Ken. Trends in user fees at Federal outdoor recreation areas. In: Proceedings, 1985 national outdoor recreation trends symposium 2; 1985 February 24-27; Myrtle Beach, SC. Clemson, SC: Clemson University, Department of Parks, Recreation and Tourism Management; 1985: 222-242.
- Dwyer, John F.; Schroeder, Herbert W.; Buck, Richard L. Patterns of use in an urban forest recreation area. In: Proceedings, 1985 national outdoor recreation trends symposium 2; 1985 February 24-27; Myrtle Beach, SC. Clemson, SC: Clemson University, Department of Parks, Recreation and Tourism Management; 1985: 81-89.
- Echelberger, H. E. Commercial facility X-C skiers: a profile. *Ski Area Management*. 24(5): 29-32; 1985.
- Echelberger, Herbert E. American campground industry 1983 economic analysis. Washington, DC: National Campground Owners Association; 1986. 21 p.
- Echelberger, Herbert E. Nascent trends in the private campground industry. In: Proceedings, 1985 national outdoor recreation trends symposium, 2; 1985 February 25-27; Myrtle Beach, SC. Clemson, SC: Clemson University, Department of Parks, Recreation and Tourism Management; 1985: 185-192.
- Echelberger, Herbert E.; Plumley, Harriet J. Anatomy of backcountry management costs. Res. Pap. NE-575. Broomall, PA: U.S. Department of Agriculture, Forest Service, Northeastern Forest Experiment Station; 1986. 8 p.
- English, Donald B. K.; Cordell, H. Ken. A cohort-centric analysis of outdoor recreation participation changes. In: Watson, Alan E., ed. Proceedings: southeastern recreation research conference; 1985 February 28-March 1; Myrtle Beach, SC. Statesboro, GA: Georgia Southern College, Department of Recreation and Leisure Services; 1985: 93-110.
- Heywood, John L. Toward a river recreation group typology. In: Popadic, Joseph S.; Butterfield, Dorothy I.; Anderson, Dorothy H.; Popadic, Mary R., eds. 1984 national river recreation symposium proceedings; 1984 October 31-November 3; Baton Rouge, LA. [Baton Rouge], LA: [Louisiana State University, School of Landscape Architecture]; 1986: 523-533.
- Klemperer, W. David; Buhyoff, Gregory J.; Verbyla, Paul S.; Joyner, Linda D. Valuing white-water river recreation by the travel cost method. In: Popadic, Joseph S.; Butterfield, Dorothy I.; Anderson, Dorothy H.; Popadic, Mary R., eds. 1984 national river recreation symposium proceedings; 1984 October 31-November 3; Baton Rouge, LA. [Baton Rouge], LA: [Louisiana State University, School of Landscape Architecture]; 1985: 709-719.
- Knopf, Richard C. Wilderness attitudes and behavior research--from here to where? In: Lucas, Robert C., comp. Proceedings, national wilderness research conference: current research; 1985 July 23-26; Fort Collins, CO. Gen. Tech. Rep. INT-212. Ogden, UT: U.S. Department of Agriculture, Forest Service, Intermountain Forest and Range Experiment Station; 1986: 305-307.
- Knopf, Richard C.; Harvey, Milton E. A methodology for analyzing relations among higher order concepts in forest recreation models. *Forest Science*. 31(4): 1018-1034; 1985.
- Lieber, S. R.; Fesenmaier, D. R. Physical and social conditions affecting recreation site preferences. *Environment and Planning A*. 17: 1613-1625; 1985.

- Lime, David W. Who uses rivers for recreation and what of the future? In: Popadic, Joseph S.; Butterfield, Dorothy I.; Anderson, Dorothy H.; Popadic, Mary R., eds. 1984 national river recreation symposium proceedings; 1984 October 31-November 3; Baton Rouge, LA. [Baton Rouge], LA: [Louisiana State University, School of Landscape Architecture]; 1986: 15-26.
- Lime, David W.; Koch, Niels Elers; Heytze (Hans), J. C. River recreation use and visitors: a cross-cultural analysis. In: Strand, Lars, div. coord., 18th IUFRO World Congress: division 6; 1986 September 7-21; Ljubljana, YU. Ljubljana, YU: Yugoslav IUFRO World Congress; 1986: 78-89.
- Lucas, Robert C. Influence of visitor experience on wilderness recreation trends. In: Lucas, Robert C., comp. Proceedings--national wilderness research conference: current research; 1985 July 23-26; Fort Collins, CO. Gen. Tech. Rep. INT-212. Ogden, UT: U.S. Department of Agriculture, Forest Service, Intermountain Forest and Range Experiment Station; 1986: 261-268.
- Lucas, Robert C. Visitor trend survey data in relation to the LAC process. In: Lucas, Robert C., comp. Proceedings--national wilderness research conference: current research; 1985 July 23-26; Fort Collins, CO. Gen. Tech. Rep. INT-212. Ogden, UT: U.S. Department of Agriculture, Forest Service, Intermountain Forest and Range Experiment Station; 1986: 535-537.
- Lucas, Robert C., comp. Proceedings--national wilderness research conference: current research; 1985 July 23-26; Fort Collins, CO. Gen. Tech. Rep. 212. Ogden, UT: U.S. Department of Agriculture, Forest Service, Intermountain Forest and Range Experiment Station; 1986: 553 p.
- Lucas, Robert C.; Stankey, George H. Role of research in applying the limits of acceptable change system. In: Watson, Alan E., ed. Proceedings: southeastern recreation research conference; 1985 February 28-March 1; Myrtle Beach, SC. Statesboro, GA: Georgia Southern College, Department of Recreation and Leisure Sciences; 1985: 1-15.
- Manfredo, Michael J.; Allen, Deborah J.; Anderson, Dorothy H. Recreation manager's attitudes toward increasing use of microcomputers as management tools. In: Popadic, Joseph S.; Butterfield, Dorothy I.; Anderson, Dorothy H.; Popadic, Mary R., eds. 1984 national river recreation symposium proceedings; 1984 October 31-November 3; Baton Rouge, LA. [Baton Rouge], LA: [Louisiana State University, School of Landscape Architecture]; 1986: 401-408.
- Manfredo, Michael J.; Anderson, Dorothy H.; Harris, Charles C. What influences recreation opportunity substitutability?. In: Popadic, Joseph S.; Butterfield, Dorothy I.; Anderson, Dorothy H.; Popadic, Mary R., eds. 1984 national river recreation symposium proceedings; 1984 October 31-November 3; Baton Rouge, LA. [Baton Rouge], LA: [Louisiana State University, School of Landscape Architecture]; 1986: 720-730.
- Marion, Jeffrey L. Campsite impact assessment systems: application, evaluation, and development. In: Popadic, Joseph S.; Butterfield, Dorothy I.; Anderson, Dorothy H.; Popadic, Mary R., eds. 1984 national river recreation symposium proceedings; 1984 October 31-November 3; Baton Rouge, LA. [Baton Rouge], LA: [Louisiana State University, School of Landscape Architecture]; 1986: 561-573.
- Marion, Jeffrey L.; Cole, David N.; Bratton, Susan P. Exotic vegetation in wilderness areas. In: Lucas, Robert C., comp. Proceedings--national wilderness research conference: current research; 1985 July 23-26; Fort Collins, CO. Gen. Tech. Rep. INT-212. Ogden, UT: U.S. Department of Agriculture, Forest Service, Intermountain Forest and Range Experiment Station; 1986: 114-120.
- McCool, Stephen F.; Benson, Robert S.; Ashor, Joseph L. How the public perceives the visual effects of timber harvesting: an evaluation of interest group preferences. *Environmental Management*. 10(3): 385-391; 1986.
- McCool, Stephen F.; Stankey, George H. Visitor attitudes toward wilderness fire management policy--1971-84. Res. Pap. INT-357. Ogden, UT: U.S. Department of Agriculture, Forest Service, Intermountain Forest and Range Experiment Station; 1986: 7 p.
- More, Thomas A.; Echelberger, Herbert E. Recreation education in U.S. forestry schools. In: Canadian Institute of Forestry and the Society of American Foresters joint convention; 1984 August 6-8; Quebec City, PQ. Bethesda, MD: Society of American Foresters; 1985: 185-187.
- Peterson, George L.; Loomis, John B.; Sorg, Cindy F. Trends in the value of outdoor recreation. In: Proceedings, 1985 national outdoor recreation trends symposium 2; 1985 February 24-27; Myrtle Beach, SC. Clemson, SC: Clemson University, Department of Parks, Recreation and Tourism Management; 1985: 243-256.
- Popadic, Joseph S.; Butterfield, Dorothy I.; Anderson, Dorothy H.; Popadic, Mary R., eds. 1984 national river recreation symposium proceedings; 1984 October 31-November 3; Baton Rouge, LA. [Baton Rouge], LA: [Louisiana State University, School of Landscape Architecture]; 1986: 740 p.
- Propst, Dennis B.; Gavrillis, Dimitris G.; Cordell, H. Ken; Hansen, William J. Assessing the secondary economic impacts of recreation and tourism: work team recommendations. In: Propst, Dennis B., comp. Assessing the economic impacts of recreation and tourism; 1984 May 14-16; East Lansing, MI. Asheville, NC: U.S. Department of Agriculture, Forest Service, Southeastern Forest Experiment Station; 1985: 52-63.

Environment

- Reiling, S. D.; Echelberger, H. E.; Cook, C. M. Trends in the costs of providing public outdoor recreation opportunities. In: Outdoor recreation trends symposium 2; 1985 February 25-27; Myrtle Beach, SC. Clemson, SC: Clemson University, Department of Parks, Recreation and Tourism Management; 1985: 257-270.
- Reiling, Stephen D.; Anderson, Mark W. Equity and efficiency in public provision of forest based recreation opportunities. *Journal of Environmental Management*. 20: 149-169; 1985.
- Rosenthal, Donald H.; Cordell, H. Ken. Pricing river recreation: some issues and concerns. In: Popadic, Joseph S.; Butterfield, Dorothy I.; Anderson, Dorothy H.; Popadic, Mary R., eds. 1984 national river recreation symposium proceedings; 1984 October 31-November 3; Baton Rouge, LA. [Baton Rouge], LA: [Louisiana State University, School of Landscape Architecture]; 1986: 272-284.
- Rosenthal, Donald H.; Walsh, Richard G. Hiking values and the recreation opportunity spectrum. *Forest Science*. 32(2): 405-415; 1986.
- Sale, Elizabeth P.; Cordell, H. Ken; Howe, Christine Z. Evaluation and synthesis of research on outdoor recreation users for national planning application. In: Watson, Alan E., ed. Proceedings: southeastern recreation research conference; 1985 February 28-March 1; Myrtle Beach, SC. Statesboro, GA: Georgia Southern College, Department of Recreation and Leisure Services; 1985: 85-92.
- Schabel, Hans G. Forest recreation management in West Germany. In: Miller, Robert S., ed. Proceedings, 17th annual meeting, Society of Municipal Arborists; 1981 September 27-30; Milwaukee, WI. Milwaukee, WI: [Publisher unknown]; 1982: 35-41.
- Schomaker, John H. Writing quantifiable river recreation management objectives. In: Popadic, Joseph S.; Butterfield, Dorothy I.; Anderson, Dorothy H.; Popadic, Mary R., eds. 1984 national river recreation symposium proceedings; 1984 October 31-November 3; Baton Rouge, LA. [Baton Rouge], LA: [Louisiana State University, School of Landscape Architecture]; 1986: 249-253.
- Schomaker, John H.; Lime, David W. Wilderness information specialists at portals: information disseminators and gatherers. In: Lucas, Robert C., comp. Proceedings, national wilderness research conference: current research; 1985 July 23-26; Fort Collins, CO. Gen. Tech. Rep. INT-212. Ogden, UT: U.S. Department of Agriculture, Forest Service, Intermountain Forest and Range Experiment Station; 1986: 489-493.
- Shelby, Bo; Harris, Rick. User standards for ecological impacts at wilderness campsites. In: Lucas, Robert C., comp. Proceedings--national wilderness research conference: current research; 1985 July 23-26; Fort Collins, CO. Gen. Tech. Rep. INT-212. Ogden, UT: U.S. Department of Agriculture, Forest Service, Intermountain Forest and Range Experiment Station; 1986: 166-171.
- Stankey, George H. Dispersed recreation use and users in Kosciusko National Park, Australia: a profile and comparison with the United States. In: Lucas, Robert C., comp. Proceedings--national wilderness research conference: current research; 1985 July 23-26; Fort Collins, CO. Ogden, UT: U.S. Department of Agriculture, Forest Service, Intermountain Forest and Range Experiment Station; 1986: 287-296.
- Strauss, Charles H. Scheduling whitewater boating usage on the Lehigh River. In: Popadic, Joseph S.; Butterfield, Dorothy I.; Anderson, Dorothy H.; Popadic, Mary R., eds. 1984 national river recreation symposium proceedings; 1984 October 31-November 3; Baton Rouge, LA. [Baton Rouge], LA: [Louisiana State University, School of Landscape Architecture]; 1986: 316-326.
- Ward, Frank A. Optimally managing wild rivers for instream benefits. In: Popadic, Joseph S.; Butterfield, Dorothy I.; Anderson, Dorothy H.; Popadic, Mary R., eds. 1984 national river recreation symposium proceedings; 1984 October 31-November 3; Baton Rouge, LA. [Baton Rouge], LA: [Louisiana State University, School of Landscape Architecture]; 1986: 285-300.
- Weisel, J.; Echelberger, H. E.; Deeg, B. F.; Shepard, B. National cross-country ski area operations survey, winter 1984-85. Jackson Hole, WY: National Nordic Consultants of Jackson Hole, WY; 1986. 78 p.
- Wollmuth, Duane C.; Schomaker, John H.; Merriam, Lawrence C., Jr. River recreation experience opportunities in two recreation opportunity spectrum (ROS) classes. *Water Resources Bulletin*. 21(5): 851-857; 1985.

Urban and Community Forestry

- Allen, P. G.; Stevens, T.; More, T. Measuring the economic value of urban parks: a caution. *Leisure Science*. 8(4): 467-477; 1985.
- Anderson, L. M.; Eaton, Thomas A. Liability for damage caused by hazardous trees. *Journal of Arboriculture*. 12(8): 189-195; 1986.
- Barker, Philip A. Urban foresters and tree improvement. In: Foresters' future: leaders or followers? Proceedings of the 1985 Society of American Foresters national convention; 1985 July 28-31; Fort Collins, CO. Washington, DC: Society of American Foresters; 1985: 409-411.
- Buhyoff, Gregory J.; Hull, R. Bruce, IV; Lien, John N.; Cordell, H. Ken. Prediction of scenic quality for southern pine stands. *Forest Science*. 32(3): 769-778; 1986.

- Cook, Walter L.; Anderson, L. M.; English, Donald B. K. Top-logging after thinning southern pine: effects on visual quality. In: Watson, Alan E., ed. Proceedings: southeastern recreation research conference; 1985 February 28-March 1; Myrtle Beach, SC. Statesboro, GA: Georgia Southern College, Department of Recreation and Leisure Services; 1985: 57-66.
- Dawson, Jeffrey O.; Khawaja, Mushtaq A. Change in street-tree composition of two Urbana, Illinois neighborhoods after 50 years: 1932-1982. *Journal of Arboriculture*. 11(11): 344-348; 1985.
- Duggin, M. J.; Rowntree, R. A.; Emmons, M.; Hubbard, N.; Odell, A. W.; Sakhavat, H.; Lindsay, J. Short communication: the use of multirate multichannel radiance data in urban feature analysis. *Remote Sensing of Environment*. 20: 95-105; 1986.
- Dwyer, John F. Research and management for leadership in urban forestry. In: Foresters' future: leaders or followers? Proceedings, 1985 Society of American Foresters national convention; 1985 July 28-31; Fort Collins, CO. SAF Publ. 85-13. Bethesda, MD: Society of American Foresters; 1985: 404-408.
- Dwyer, John F. The economic value of urban plants. In: Karnosky, David F.; Karnosky, Sheryl L., eds. Improving the quality of urban life with plants: Proceedings, international symposium on urban horticulture; 1983 June 21-23; New York, NY. Publ. 2. New York: New York Botanical Garden, Institute of Urban Horticulture; 1985: 15-27.
- Dwyer, John F. What we can learn from the Chicago experience. In: Popadic, Joseph S.; Butterfield, Dorothy I.; Anderson, Dorothy H.; Popadic, Mary R., eds. 1984 national river recreation symposium proceedings; 1984 October 31-November 3; Baton Rouge, LA. [Baton Rouge], LA: [Louisiana State University, School of Landscape Architecture]; 1986: 116-118.
- Dwyer, John F.; Strong, Ann L. Urban-rural forestry in the Netherlands: can we learn from the intensity of Dutch landscape management? *Journal of Forestry*. 84(2): 57-59; 1986.
- Grant, Richard H. The influence of the sky radiance distribution on the flux density in the shadow of a tree crown. *Agricultural and Forest Meteorology*. 35: 59-70; 1985.
- Halverson, Howard A.; Rowntree, Rowan A. Correlations between urban tree crown cover and total population in 8 U.S. cities. *Landscape and Urban Planning*. 13: 219-223; 1986.
- Halverson, Howard G.; Gleason, Stephen B.; Heisler, Gordon M. Leaf duration and the sequence of leaf development and abscission in northeastern urban hardwood trees. *Urban Ecology*. 9: 323-335; 1986.
- Halverson, Howard G.; Weber, Frederick P. Hardwood crown cover over impervious urban surfaces. In: Remote sensing in forest and range resource management: 10th William T. Pecora memorial remote sensing symposium; 1985 August 20-22; Fort Collins, Co. Falls Church, VA: American Society for Photogrammetry and Remote Sensing; 1985: 426-427.
- Heisler, Gordon M. Effects of individual trees on the solar radiation climate of small buildings. *Urban Ecology*. 9: 337-359; 1986.
- Heisler, Gordon M. Energy savings with trees. *Journal of Arboriculture*. 12(5): 113-125; 1986.
- Heisler, Gordon M. Managing trees for saving heating and cooling costs in houses. *Northbound*. March-April: 12-14; 1986.
- Heisler, Gordon M.; DeWalle, David R. Effects of windbreak structure on wind flow. In: Hintz, David L.; Brandle, James R., eds. Proceedings of international symposium on windbreak technology; 1986 June 23-27; Lincoln, NE. Publ. 117. Lincoln, NE: Great Plains Agricultural Council; 1986: 41-43.
- Henson, Steven L.; Rowntree, Rowan A. Influence of urban forest cover on radiation, temperature, and runoff in the Salt Lake Basin, Utah. In: Proceedings of Society of American Foresters 1985 National Convention; 1985 July 28-31; Fort Collins, CO. Bethesda, MD: Society of American Foresters; 1985: 412-416.
- Hill, D. B. Forest fragmentation and its implications in central New York. *Forest Ecology and Management*. 12: 113-128; 1985.
- Kaplan, Rachel. Human response to plants and landscapes. In: Karnosky, David F.; Karnosky, Sheryl L., eds. Improving the quality of urban life with plants: Proceedings, international symposium on urban horticulture; 1983 June 21-23; New York, NY. Publ. 2. New York: New York Botanical Garden, Institute of Urban Horticulture; 1985: 45-60.
- Kaplan, Rachel. Nature at the doorstep: residential satisfaction and the nearby environment. *Journal of Architectural and Planning Research*. 2: 115-127; 1985.
- Kaplan, Rachel. The analysis of perception via preference: a strategy for studying how the environment is experienced. *Landscape Planning*. 12: 161-176; 1985.
- Litton, R. Burton, Jr. Visual fluctuations in river landscape quality. In: Popadic, Joseph S.; Butterfield, Dorothy I.; Anderson, Dorothy H.; Popadic, Mary R., eds. 1984 national river recreation symposium proceedings; 1984 October 31-November 3; Baton Rouge, LA. [Baton Rouge], LA: [Louisiana State University, School of Landscape Architecture]; 1986: 369-383.
- Magill, Arthur W.; Litton, R. Burton, Jr. A color measuring system for landscape assessment. *Landscape Journal*. 5(1): 45-54; 1986.
- McPherson, E. G.; Rowntree, R. A. Computers: tree shade. *Landscape Architecture Magazine*. 76(3): 88-91; 1986.

- McPherson, E. G.; Rowntree, R. A.; Brown, R. Simulating tree shadow patterns for building energy analysis. In: Wilson, A. T.; Glennie, W., eds. Solar 85 conference proceedings; 1985 October 16-20; Raleigh, NC. Boulder, CO: American Solar Energy Society; 1985: 378-382.
- More, Thomas A. Evaluating and interpreting use data in urban park settings. In: Outdoor recreation trends symposium 2; 1985 February 25-27; Myrtle Beach, SC. Clemson, SC: Clemson University, Department of Parks, Recreation and Tourism Management; 1985: 103-108.
- Nyland, R. D.; Zipperer, W. C.; Hill, D. B. The development of forest islands in exurban central New York State. *Landscape and Urban Planning*. 13: 111-123; 1986.
- Profous, G. V.; Loeb, R. E. New York City woodlands and the special natural area districts. *Arboricultural Journal*. 10(2): 131-150; 1986.
- Rowntree, R. A. Ecology of the urban forest--introduction to part 2. *Urban Ecology*. 9: 229-243; 1986.
- Sanders, R. A. Urban vegetation impacts on the hydrology of Dayton, Ohio. *Urban Ecology*. 9: 361-376; 1986.
- Schroeder, Herbert W. Introduction to urban river recreation. In: Popadic, Joseph S.; Butterfield, Dorothy I.; Anderson, Dorothy H.; Popadic, Mary R., eds. 1984 national river recreation symposium proceedings; 1984 October 31-November 3; Baton Rouge, LA. [Baton Rouge, LA: [Louisiana State University, School of Landscape Architecture]; 1986: 119-121.
- Schroeder, Herbert W.; Green, Thomas L. Public preference for tree density in municipal parks. *Journal of Arboriculture*. 11(9): 272-277; 1985.
- Spotts, Daniel M.; Stynes, Daniel J. Measuring the public's familiarity with recreation areas. *Journal of Leisure Research*. 17(4): 253-265; 1985.
- Stevens, J. C.; Richards, N. A. Village and street tree resources: a comparison of structure. *Arboricultural Journal*. 10(1): 45-52; 1986.
- Talarchek, G. M. The New Orleans urban forest: structure and management. New Orleans, LA: Xavier University of Louisiana; 1985. 104 p.
- Wagar, J. Alan. Computer-assisted placement of shade trees reduces home heating and cooling costs. *Western Journal of Applied Forestry*. 1(2): 51-54; 1986.
- Wagar, J. Alan. Communications for urban forestry. *Journal of Arboriculture*. 11(10): 296-300; 1985.
- Wagar, J. Alan. Reducing surface rooting of trees with control planters and wells. *Journal of Arboriculture*. 11(6): 165-171; 1985.
- Wagar, J. Alan. Trees for solar control. In: Foresters' future: leaders or followers? Proceedings of the 1985 Society of American Foresters national convention; 1985 July 28-31; Fort Collins, CO. Bethesda, MD: Society of American Foresters; 1985: 399-403.
- Wagar, J. Alan; Heisler, Gordon M. Rating winter crown density of deciduous trees: a photographic procedure. *Landscape Journal*. 5(1): 9-18; 1986.
- Westover, Theresa N. Perceptions of crime and safety in three midwestern parks. *Professional Geographer*. 37(4): 410-420; 1985.
- Westover, Theresa N. Perceptions of rule compliance and law enforcement in urban and suburban parks. *Recreation Research Review*. 12(2): 22-29; 1985.
- Beckjord, P. R.; Melhuish, J. H., Jr.; Kundt, J. F. Survival and growth of paulownia seedlings are enhanced through weed control. *Journal of Environmental Horticulture*. 3(3): 115-117; 1985.
- Beckjord, Peter R.; Melhuish, John H., Jr.; McIntosh, Marla S. Effects of nitrogen and phosphorus on growth and formation of ectomycorrhizae of *Quercus alba* and *Q. rubra* seedlings by *Pisolithus tinctorius* and *Scleroderma auranteum*. *Canadian Journal of Botany*. 63(10): 1677-1680; 1985.
- Berry, Charles R. Reclamation of severely devastated sites with dried sewage sludge in the Southeast. In: Cole, Dale W.; Henry, Charles L.; Nutter, Wade L., eds. The forest alternative for treatment and utilization of municipal and industrial wastes: Proceedings of the forest land applications symposium; 1985 June 25-28; Seattle. Seattle, WA: University of Washington Press; 1986: 497-507.
- Davidson, Walter H. Selecting hybrids and superior trees for reclamation planting. In: New horizons for mined land reclamation: 1986 national meeting of the American society for surface mining and reclamation; 1986 March 17-20; Jackson, MS. Princeton, WV: American Society for Surface Mining and Reclamation; 1986: 165-168.
- Dyer, Kenneth L. Seasonal acid mine drainage from a surface-mined watershed in eastern Kentucky. In: New horizons for mined land reclamation: 1986 national meeting of the American society for surface mining and reclamation; 1986 March 17-20; Jackson, MS. Princeton, WV: American Society for Surface Mining and Reclamation; 1986: 131-139.
- Dyer, Kenneth L.; Crews, Jerry T. Evaluation of bentonite for the control of acid drainage from surface-mined lands, Part 2. In: Proceedings, 7th annual West Virginia Surface Mine Drainage Task Force symposium; 1986 April 1-2; Morgantown, WV. Morgantown, WV: West Virginia Mining and Reclamation Association; 1986: [Pagination unknown].

- Dyer, Kenneth L.; Sencindiver, John C. Bark mulch promotes establishment of vegetation on minesoils with south and west exposures. In: 1985 symposium on surface mining, hydrology, sedimentology, and reclamation; 1985 December 9-13; Lexington, KY. Lexington, KY: University of Kentucky; 1985: 151-156.
- Ferguson, Robert B.; Frischknecht, Neil C. Reclamation on Utah's Emery and Alton coal fields: techniques and plant materials. Res. Pap. INT-335. Ogden, UT: U.S. Department of Agriculture, Forest Service, Intermountain Forest and Range Experiment Station; 1985. 78 p.
- Medcraft, J. Richard; Clark, William R. Big game habitat use and diets on a surface mine in northeastern Wyoming. *Journal of Wildlife Management*. 50(1): 135-142; 1986.
- Melhuish, J. H., Jr.; Wade, G. L. Effect of soil phenolic compounds on growth and fatty acid composition of *Pisolithus tinctorius*. *Transactions of the Kentucky Academy of Sciences*. 46(3-4): 129-133; 1985.
- Monsen, Stephen B.; Shaw, Nancy. Response of an alkali sagebrush/fescue site to restoration treatments. In: McArthur, E. Durant; Welch, Bruce L., comps. Proceedings--symposium on the biology of *Artemisia* and *Chrysothamnus*; 1984 July 9-13; Provo, UT. Gen. Tech. Rep. INT-200. Ogden, UT: U.S. Department of Agriculture, Forest Service, Intermountain Forest and Range Experiment Station; 1986: 126-133.
- Richardson, Bland Z. Reclamation in the intermountain Rocky Mountain region. In: McCarter, M. K., ed. Design of non-impounding mine waste dumps. New York: American Institute of Mining, Metallurgical, and Petroleum Engineers, Inc., Society of Mining Engineers; 1985: 177-192.
- Richardson, Bland Z.; Monsen, Stephen B.; Bowers, Diane M. Interseeding selected shrubs and herbs on mine disturbances in southeastern Idaho. In: McArthur, E. Durant; Welch, Bruce L., comps. Proceedings--symposium on the biology of *Artemisia* and *Chrysothamnus*; 1984 July 9-13; Provo, UT. Gen. Tech. Rep. INT-200. Ogden, UT: U.S. Department of Agriculture, Forest Service, Intermountain Forest and Range Experiment Station; 1986: 134-139.
- Rumble, Mark A. Radiation dosimetry on revegetated uranium mill tailings in western South Dakota. *Northwest Science*. 60(3): 145-149; 1986.
- Rumble, Mark A.; Bjugstad, Ardell J. Uranium and radium concentrations in plants growing on uranium mill tailings in South Dakota. *Revegetation Research*. 4: 271-277; 1986.
- Sieg, Carolyn Hull; Uresk, Daniel W. Seasonal diets of deer mice on bentonite mine spoils and sagebrush grasslands in southeastern Montana. *Northwest Science*. 60(2): 81-89; 1986.
- Skujins, John J.; Richardson, Bland Z. Humic matter enrichment in reclaimed soils under semi-arid conditions. *Geomicrobiology Journal*. 4(4): 101-106; 1985.
- Sorensen, Darwin L.; McLean, Joan E.; Farmer, Eugene E. Development of a bioassay for acid producing potential in mine spoils and overburden. In: Second annual meeting, American Society for Surface Mining and Reclamation: Proceedings; 1985 October 8-10; Denver, CO. Princeton, WV: American Society for Surface Mining and Reclamation; 1985: 61-68.
- Stevens, Richard. Depth of interseeding scalps can affect growth of seeded mountain big sagebrush. In: Vegetative rehabilitation and equipment workshop: 39th annual report; 1985 February 10-11; Salt Lake City, UT. Missoula, MT: U.S. Department of Agriculture, Forest Service, Equipment Development Center; 1985: 25-27.
- Stevens, Richard. Interseeding with a modified Sieco fireplow can result in increased seedling numbers. In: Vegetative rehabilitation and equipment workshop: 39th annual report; 1985 February 10-11; Salt Lake City, UT. Missoula, MT: U.S. Department of Agriculture, Forest Service, Equipment Development Center; 1985: 22-24.
- Stranathan, Sam E.; Monsen, Stephen B. Selection of a cultivar of *Artemisia ludoviciana* for disturbed land plantings. In: McArthur, E. Durant; Welch, Bruce L., comps. Proceedings--symposium on the biology of *Artemisia* and *Chrysothamnus*; 1984 July 9-13; Provo, UT. Gen. Tech. Rep. INT-200. Ogden, UT: U.S. Department of Agriculture, Forest Service, Intermountain Forest and Range Experiment Station; 1986: 108-113.
- Thompson, Ralph L.; Vogel, Willis G.; Wade, Gary L.; Raffail, Barbara L. Development of natural and planted vegetation on surface mines in southeastern Kentucky. In: New horizons for mined land reclamation: 1986 national meeting of the American Society for Surface Mining and Reclamation; 1986 March 17-20; Jackson, MS. Princeton, WV: American Society for Surface Mining and Reclamation; 1986: 145-153.
- Uresk, Daniel W.; Yamamoto, Teruo. Growth of forbs, shrubs, and trees on bentonite mine spoil under greenhouse conditions. *Journal of Range Management*. 39(2): 113-116; 1986.
- Wade, Gary L. Forest topsoil seed banks for introducing native species in eastern surface-mine reclamation. In: New horizons for mined land reclamation: 1986 national meeting of the American Society for Surface Mining and Reclamation; 1986 March 17-20; Jackson, MS. Princeton, WV: American Society for Surface Mining and Reclamation; 1986: 155-164.

Woods, Frank W.; Becker, Charles W.; Curtis, Willie. Haul roads: post-mining management problems. In: New horizons for mined land reclamation: 1986 national meeting of the American Society for Surface Mining and Reclamation; 1986 March 17-20; Jackson, MS. Princeton, WV: American Society for Surface Mining and Reclamation; 1986: 215-219.

Atmospheric Deposition and Air Pollution

Amundson, R. G.; Raba, R. M.; Schoettle, A. W.; Reich, P. B. Response of soybean to low concentrations of ozone. 2: Effects on growth, biomass allocation, and flowering. *Journal of Environmental Quality*. 15: 161-167; 1986.

Baird, Fay; Buso, Donald C.; Hornbeck, James W. Access pipes for multiple sampling under ice. *Limnology and Oceanography*. 30(5): 1129-1130; 1985.

Barnard, Joseph E. A survey to assess the effects of atmospheric deposition on forest vegetation. In: Schmid-Haas, Paul, ed. Inventorying and monitoring endangered forests. IUFRO conference; 1985 August 19-24; Zurich. Birmensdorf, SW: Dr. W. Bosshard; 1986: 197-199.

Barnard, Joseph E. National vegetation survey/forest response program. In: Atmospheric deposition and forest productivity: Proceedings of the 4th regional technical conference at the 56th annual meeting of the Appalachian Society of American Foresters; 1986 January 29-31; Raleigh, NC. SAF 86-06. Blacksburg, VA: Society of American Foresters; 1986: 93-97.

Bowden, William B.; Bormann, F. H. Transport and loss of nitrous oxide in soil water after clearcutting. *Science*. 233: 867-869; 1986.

Bush, P. B.; Neary, D. G.; McMahon, C. K.; Hendricks, H. L. Effect of burning on hexazinone residues in firewood. In: Proceedings, 39th annual meeting of Southern Weed Science Society; 1986 January 20-22; Nashville, TN. SWSPBE 39: 1-616. [Place of publication unknown]; [Publisher unknown]; 1986: 343-353.

Crang, Richard E.; McQuattie, Carolyn J. Effects of acid mist and air pollutants on foliar structure. In: Air pollutants effects on forest ecosystems; 1985 May 8-9; St. Paul, MN. St. Paul, MN: The Acid Rain Foundation; 1985: 385-386.

Crang, Richard E.; McQuattie, Carolyn J. Qualitative and quantitative effect of acid misting and two air pollutants on foliar structures of *Liriodendron tulipifera*. *Canadian Journal of Botany*. 64: 1237-1243; 1986.

Dann, M. S.; Lynch, J. A.; Corbett, E. S. Comparison of methods for estimating sulfate export from a forested watershed. *Journal of Environmental Quality*. 15(2): 140-145; 1986.

de Steiguer, J. Ed. Research targets acid rain for effects on trees. *Forest Farmer*. 45(5): 28-29; 1986.

Dochinger, Leon S.; Jensen, Keith F. Effect of acid mist and air pollutants on yellow poplar seedling height and leaf growth. Res. Pap. NE-572. Broomall, PA: U.S. Department of Agriculture, Forest Service, Northeastern Forest Experiment Station; 1985. 8 p.

Driscoll, C. T.; van Breeman, N.; Mulder, J. Aluminum chemistry in a forested spodosol. *Soil Science Society of America Journal*. 49(2): 437-444; 1985.

Duffy, P. D.; Schreiber, J. D.; McDowell, L. L. Leaching of nitrogen, phosphorus, and total organic carbon from loblolly pine litter by simulated rainfall. *Forest Science*. 31(3): 750-759; 1985.

Eisenreich, Steven J.; Metzner, Nancy A.; Urban, Noel R.; Robbins, John A. Response of atmospheric lead to decreased use of lead in gasoline. *Environmental Science & Technology*. 20(2): 171-174; 1986.

Federer, C. Anthony; Hornbeck, James W. The buffer capacity of forest soils in New England. *Water, Air and Soil Pollution*. 26: 163-173; 1985.

Fitzgerald, J. W.; Watwood, M. E.; Rose, F. A. Forest floor and soil arylsulphatase: hydrolysis of tyrosine sulphate, an environmentally relevant substrate for the enzyme. *Soil Biology & Biochemistry*. 17(6): 885-887; 1985.

Fuller, R. D.; David, M. B.; Driscoll, C. T. Sulfate adsorption relationships in forested spodosols of the northeastern USA. *Soil Science Society of America Journal* 49(4): 1034-1040; 1985.

Haines, Bruce; Chapman, James; Monk, Carl D. Rates of mineral element leaching from leaves of nine plant species from a southern Appalachian forest succession subjected to simulated acid rain. *Bulletin of the Torrey Botanical Club*. 112(3): 258-264; 1985.

Hall, R. J.; Driscoll, C. T.; Likens, G. E.; Pratt, J. M. Physical, chemical, and biological consequences of episodic aluminum additions to a stream. *Limnology and Oceanography*. 30(1): 212-220; 1985.

Hooper, R. P.; Shoemaker, C. Aluminum mobilization in an acidic headwater stream: temporal variation and mineral dissolution disequilibria. *Science*. 229: 463-465; 1985.

Hornbeck, James W. Modelling the accumulation and effects of chemicals in snow. In: Modelling snowmelt-induced processes (Proceedings of the Budapest symposium, July 1986); 1986 July; Budapest. IAHS Publ. 155. [Place of publication unknown]; International Association of Hydrological Sciences; 1986: 325-333.

- Hornbeck, James W.; Federer, C. Anthony. Estimating the buffer capacity of forest soils. *Journal of Forestry*. 83(11): 690-691; 1985.
- Hornbeck, James W.; Smith, Robert B. Documentation of red spruce growth decline. *Canadian Journal of Forest Research*. 15: 1199-1201; 1985.
- Jensen, K. F.; Roberts, B. R. Changes in yellow poplar stomatal resistance with SO₂ and O₃ fumigation. *Environmental Pollution*. 41: 235-245; 1986.
- Jensen, Keith F. Summary and evaluation of research on native vegetation. In: Lee, Si Duk, ed. Evaluation of the scientific basis for ozone/oxidants standards; 1984 November; Houston, TX. Pittsburgh, PA: Air Pollution Control Association; 1985: 127-131.
- Johnson, Dale W.; Kelly, J. M.; Swank, W. T.; Cole, Dale W.; Hornbeck, James W.; Pierce, Robert S.; Van Lear, David. A comparative evaluation of the effects of acid precipitation, natural acid production, and harvesting on cation removal from forests. *Environ. Sciences Div. Publ.* 2508. Oak Ridge, TN: Oak Ridge National Laboratory; 1985. 107 p.
- Lawrence, G. B.; Fuller, R. D.; Driscoll, C. T. Spatial relationships of chemistry in the streams of the Hubbard Brook Experimental Forest, New Hampshire. *Biogeochemistry*. 2(2): 115-135; 1986.
- Lynch, James A.; Corbett, Edward S.; Rishel, Gregg B. Atmospheric deposition: spatial and temporal variation in Pennsylvania 1984. LW8505A. University Park, PA: The Pennsylvania State University, Institute for Research on Land and Water Resources; 1985. 236 p.
- Lynch, James A.; Hanna, C. Mark; Corbett, Edward S. Predicting pH, alkalinity, and total acidity in stream water during episodic events. *Water Resources Research*. 22(6): 905-912; 1986.
- Marx, Donald H. The southern commercial forest research cooperative. In: Atmospheric deposition and forest productivity: Proceedings of the 4th regional technical conference at the 65th annual meeting of the Appalachian Society of American Foresters; 1986 January 29-31; Raleigh, NC. Blacksburg, VA: Society of American Foresters; 1986: 98-110.
- McBride, Joe R.; Miller, Paul R.; Laven, Richard D. Effects of oxidant air pollutants on forest succession in the mixed conifer forest type of southern California. In: Air pollutants effects on forest ecosystems; 1985 May 8-9; St. Paul, MN. St. Paul, MN: The Acid Rain Foundation; 1985: 157-167.
- McMahon, C. K.; Clements, H. B.; Bush, P. B.; Neary, D. G.; Taylor, J. W. Pesticides released from burning treated wood. In: Proceedings of the 8th conference on fire and forest meteorology; 1985 April 29-May 2; Detroit, MI. [Place of publication unknown]: [Publisher unknown]; 1985: 145-152.
- Miller, Paul R.; Taylor, O. Clifton; Poe, Minn P. Spatial variation of summer ozone concentrations in the San Bernardino Mountains. In: 79th annual meeting of the Air Pollution Control Association; 1986 June 22-27; Minneapolis, MN. Minneapolis, MN: Air Pollution Control Association; 1986: 86-39: 1-14.
- Patton, Roy L.; Garraway, Michael O. Ozone-induced necrosis and increased peroxidase activity in hybrid poplar (*Populus* sp.) leaves. *Environmental and Experimental Botany*. 26(2): 137-141; 1986.
- Pechak, David G.; Noble Reginald D.; Dochinger, Leon S. Ozone and sulfur dioxide effects on the ultrastructure of the chloroplasts of hybrid poplar leaves. *Bulletin of Environmental Contamination and Toxicology*. 36: 421-428; 1986.
- Philpot, Charles W.; Radloff, David L. Air quality impact on forests. In: TAPPI proceedings: 1986 annual meeting; [Date of meeting unknown]; [Place of meeting unknown]. Atlanta, GA: Technical Association of the Pulp and Paper Industry; 1986: 23-24.
- Poth, Mark; La Favre, J. S.; Focht, D. D. Quantification by direct ¹⁵N dilution of fixed N₂ incorporation into soil by *Cajanus cajan* (pigeon pea). *Soil Biology and Biochemistry*. 18(1): 125-127; 1986.
- Rabinowitz, J.; Miller, P.; Greppin, H. Les oxydants photochimiques. *Medecine et Hygiene*. 43(4519): 3466-3478; 1985.
- Radloff, David L. Determining the effects of atmospheric deposition. In: Crowley, John, ed. Research for tomorrow: 1986 yearbook of agriculture. Washington, DC: U.S. Department of Agriculture; 1986: 242-246.
- Rapaport, R. A.; Urban, N. R.; Capel, P. D.; Baker, J. E.; Looney, B. B.; Eisenreich, S. J.; Gorham, E. "New" DDT inputs to North America: atmospheric deposition. *Chemosphere*. 14(9): 1167-1173; 1985.
- Reich, P. B.; Schoettle, A. W.; Amundson, R. G. Effect of low concentrations of O₃, leaf age and water stress on leaf diffusive conductance and water use efficiency in soybean. *Physiologia Plantarum*. 63: 58-64; 1985.
- Reich, P. B.; Schoettle, A. W.; Amundson, R. G. Effects of O₃ and acidic rain on photosynthesis and growth in sugar maple and northern red oak. *Environmental Pollution*. 40: 1-16; 1985.
- Reich, P. B.; Schoettle, A. W.; Raba, R. M.; Amundson, R. G. Response of soybean to low concentrations of ozone. I. Reductions in leaf and whole plant net photosynthesis and leaf chlorophyll. *Journal of Environmental Quality*. 15: 31-36; 1986.

- Reich, P. B.; Schoettle, A. W.; Stroo, H. F.; Troiano, J.; Amundson, R. G. Effects of O_3 , SO_2 , and acidic rain on mycorrhizal infection in northern red oak seedlings. *Canadian Journal of Botany*. 63: 2049-2055; 1985.
- Reich, P. B.; Stroo, H. F.; Schoettle, A. W.; Amundson, R. G. Acid rain and ozone influence mycorrhizal infection in tree seedlings. *Journal of the Air Pollution Control Association*. 36: 724-726; 1986.
- Schier, George A. Seedling growth and nutrient relationships in New Jersey pine barrens soil treated with "acid rain." *Canadian Journal of Forest Research*. 16: 136-142; 1986.
- Schindler, S. C.; Mitchell, M. J.; Scott, T. J.; Fuller, R. D.; Driscoll, C. T. Incorporation of ^{35}S -sulfate into inorganic and organic constituents of two forest soils. *Soil Science Society of America Journal*. 50: 457-462; 1986.
- Sommerfeld, R. A.; Lamb, D. Preliminary measurements of SO_2 adsorbed on ice. *Geophysical Research Letters*. 13(4): 349-351; 1986.
- Strickland, Timothy C.; Fitzgerald, John W. Incorporation of sulphate-sulphur into organic matter extracts of litter and soil: involvement of ATP sulphurylase. *Soil Biology and Biochemistry*. 17 (6): 779-784; 1985.
- Strickland, Timothy C.; Fitzgerald, John W.; Swank, Wayne T. In situ measurements of sulfate incorporation into forest floor and soil organic matter. *Canadian Journal of Forest Research*. 16: 549-553; 1986.
- van Breeman, N.; Driscoll, C. T.; Mulder, J. Acidification of soil and water. *Nature*. 313 (5997): 73; 1985.
- Velbel, Michael Anthony. Hydrogeochemical constraints on mass balances in forested watersheds of the southern Appalachians. In: Drever, J. I., ed. *The chemistry of weathering*. [Place of publication unknown]: D. Reidel Publishing Company; 1985: 231-247.
- Winer, William E.; Leininger, Theodor D.; McLaughlin, Samuel B. Forest responses to deposition of air-borne chemicals. In: *Proceedings of the 4th regional technical conference at the 65th annual meeting of the Appalachian Society of American Foresters*; 1986 January 29-31; Raleigh, NC. SAF 86-06. Blacksburg, VA: Society of American Foresters; 1986: 22-44.

Insects and Disease

Insect Detection and Evaluation

- Allen, Douglas C.; Abrahamson, Lawrence C.; Jobin, Luc; Souto, Dennis, J.; Sanders, Chris J. Use of pheromone traps to monitor spruce budworm populations. Ottawa, ON: Canadian Forestry Service; 1986. 16 p.
- Amman, Gene D.; McGregor, Mark D.; Dolph, Robert E., Jr. Mountain pine beetle. For. Ins. Dis. Leaflet 2. Washington, DC: U.S. Department of Agriculture, Forest Service; 1985. 11 p.
- Beckwith, R. C. Destruction and consumption of host foliage by the western budworm. In: Sanders, C. J.; and others, eds. Recent advances in spruce budworms research: Proceedings of the CANUSA spruce budworms research symposium; 1984 September 16-20; Bangor, ME. Ottawa, ON: Canadian Forestry Service and U.S. Department of Agriculture, Forest Service; 1985: 474-475.
- Berisford, C. Wayne; Mizell, Russell F., III; Kudon, Louis H.; Ware, Kenneth D. Line intersect sampling technique for estimating Ips populations in logging residue. In: Branham, Susan J.; Thatcher, Robert C., eds. Integrated pest management research symposium: The proceedings; 1985 April 15-18; Asheville, NC. Gen. Tech. Rep. SO-56. New Orleans, LA: U.S. Department of Agriculture, Forest Service, Southern Forest Experiment Station; 1985: 13-25.
- Blake, Elizabeth A.; Wagner, Michael R.; Koerber, Thomas W. Insects destructive to ponderosa pine cone crops in northern Arizona. In: Conifer tree seed in the inland mountain West symposium; 1985 August 5-9; Missoula, MT. Gen. Tech. Rep. INT-203. Ogden, UT: U.S. Department of Agriculture, Forest Service, Intermountain Forest and Range Experiment Station; 1986: 238-242.
- Brann, Thomas B.; Reams, Gregory A.; Solomon, Dale S. Spruce budworm growth impact study--1982 Report. Misc. Rep. 302. Orono, ME: Maine Agricultural Experiment Station, University of Maine; 1984. 53 p.
- Carlson, Clinton E. Rating stand hazard to western spruce budworm: introduction. In: Brookes, Martha H.; Colbert, J. J.; Mitchell, Russel G.; Stark, R. W., tech. coords. Managing trees and stands susceptible to western spruce budworm. Tech. Bull. 1695. Washington, DC: U.S. Department of Agriculture; 1985: 42.
- Corneil, Jeffery A.; Wilson, Louis F. Impact of feeding by adult pales weevil (Coleoptera: Curculionidae) on Christmas tree stands in southeastern Michigan. Journal of Economic Entomology. 79(1): 192-196; 1986.
- Daterman, Gary E.; Miller, Jeffrey C.; Hanson, Paul E. Potential for gypsy moth problems in southwest Oregon. In: Helgersson, O. T., ed. Forest pest management in southwest Oregon: Proceedings of a workshop; 1985 August 19-20; Grants Pass, OR. Corvallis, OR: Oregon State University; 1986: 37-40.
- DeMars, C. J. Applying RIDPOLY to rate forest stand hazard for tree mortality. In: Proceedings, geographic information systems workshop; 1986 April 1-4; Atlanta, GA. Washington, DC: American Society of Photogrammetry and Remote Sensing; 1986: 284-292.
- Dillery, D. Scott. On the optimal partitioning of a seasonal distribution. Raleigh, NC: North Carolina State University; 1985. 45 p. M.S. thesis.
- Donley, David E.; Feicht, David L. Oak sawtimber losses in stands defoliated by gypsy moth. In: Dawson, J. O.; Majerus, K. A., eds. Proceedings of the 5th central hardwood forest conference; 1985 April 15-17; Urbana-Champaign, IL. Urban-Champaign, IL: University of Illinois; 1985: 275-297.
- Eav, B. B.; Colbert, J. J.; Stipe, L. E. Performance evaluation of the spruce budworm egg mass counter: prototype 2. Rep. 86-6. Fort Collins, CO: U.S. Department of Agriculture, Forest Service, Forest Pest Management, Methods Application Group; 1986. 27 p.
- Egan, T. H. Sampling hibernating western spruce budworm and estimating survival during the early instars. In: Sanders, C. J.; and others, eds. Recent advances in spruce budworms research: Proceedings of the CANUSA spruce budworms research symposium; 1984 September 16-20; Bangor, ME. Ottawa, ON: Canadian Forestry Service and U.S. Department of Agriculture, Forest Service; 1985: 475.
- Fellin, D. G. Sampling larvae of the western spruce budworm. In: Sanders, C. J.; and others, eds. Recent advances in spruce budworms research: Proceedings of the CANUSA spruce budworms research symposium; 1984 September 16-20; Bangor, ME. Ottawa, ON: Canadian Forestry Service and U.S. Department of Agriculture, Forest Service; 1985: 235-236.
- Ferguson, D. E. Quantifying impacts on forest growth and yield--Western United States. In: Sanders, C. J.; and others, eds. Recent advances in spruce budworms research: Proceedings of the CANUSA spruce budworms research symposium; 1984 September 16-20; Bangor, ME. Ottawa, ON: Canadian Forestry Service and U.S. Department of Agriculture; 1985: 249-250.
- Foltz, John L.; Torgersen, Torolf R. Accuracy of direct visual counts of western spruce budworm larvae (Lepidoptera: Tortricidae) on Douglas-fir and grand fir branches. Journal of Economic Entomology. 78: 1056-1058; 1985.
- Fosbroke, David E.; Crow, Gerald R.; Hicks, Raymond R., Jr. Hardwood mortality following spring insect defoliation. In: Proceedings: 1985 national gypsy moth review; 1986 November 18-21; Columbus, OH. Columbus, OH: National Gypsy Moth Management Board; 1986: 76-86.

- Galford, Jimmy R. Primary infestation of sprouting chestnut, red, *Blastobasidae*. Entomological News. 97(3): 109-112; 1986.
- Galford, Jimmy R. The weevil *Barypeithes pellucidus* (Coleoptera: Curculionidae) feeds on northern red oak, *Quercus rubra*, seedlings. Entomological News. 97(3): 113-114; 1986.
- Gansner, David A. Tree defoliation and mortality in new infestations. In: Follow-up to the workshop "Gypsy moth influence on stand management--how to cope"; 1986 April 10; West Boylston, MA. Broomall, PA: U.S. Department of Agriculture, Forest Service, Northeastern Area, State and Private Forestry; 1986. [Unpaginated.]
- Gansner, David A.; Herrick, Owen W. Impact of gypsy moth on a new frontier. In: Proceedings: 1985 national gypsy moth review; 1985 November 18-21; Columbus, OH. Columbus, OH: National Gypsy Moth Management Board; 1986: 73-75.
- Gibson, Lester P. A catalog of the Coleoptera of America north of Mexico, Family: Curculionidae, Subfamily: Curculioninae. Agric. Handb. 529-143b. Washington, DC: U.S. Department of Agriculture, Agricultural Research Service; 1985. 13 p.
- Hard, John S. Spruce beetles attack slowly growing spruce. Forest Science. 31(4): 839-850; 1985.
- Hardy, Yvan; Mainville, Michael; Schmitt, Daniel M. An atlas of spruce budworm defoliation in eastern North America, 1938-80. Misc. Publ. 1449. Washington, DC: U.S. Department of Agriculture; 1986. 52 p.
- Hedden, R. L.; Lorio, P. L., Jr. Rating stand susceptibility to southern pine beetle attack on national forests in the gulf coastal plain. Res. Pap. SO-221. New Orleans, LA: U.S. Department of Agriculture, Forest Service, Southern Forest Experiment Station; 1985. 5 p.
- Hedden, Roy L.; Belanger, Roger P. Predicting susceptibility to southern pine beetle attack in the coastal plain, Piedmont, and southern Appalachians. In: Branham, Susan J.; Thatcher, Robert C., eds. Integrated pest management research symposium: The proceedings; 1985 April 15-18; Asheville, NC. Gen. Tech. Rep. SO-56. New Orleans, LA: U.S. Department of Agriculture, Forest Service, Southern Forest Experiment Station; 1985: 233-238.
- Herrick, Owen W.; Gansner, David A. Rating forest stands for gypsy moth defoliation. Res. Pap. NE-583. Broomall, PA: U.S. Department of Agriculture, Forest Service, Northeastern Forest Experiment Station; 1986. 4 p.
- Houston, David R.; Valentine, Harry T. Classifying forest susceptibility to gypsy moth defoliation. Agric. Handb. 542. Washington, DC: U.S. Department of Agriculture; 1986. 19 p.
- Jennings, D. T. Prototype 2 detector-counter for egg masses of spruce budworm. In: Sanders, C. J.; and others, eds. Recent advances in spruce budworms research: Proceedings of the CANUSA spruce budworms research symposium; 1984 September 16-20; Bangor, ME. Ottawa, ON: Canadian Forestry Service and U.S. Department of Agriculture, Forest Service; 1985: 237.
- Kessler, B. L. A remote sensing model to predict forest susceptibility to budworm defoliation. In: Sanders, C. J.; and others, eds. Recent advances in spruce budworms research: Proceedings of the CANUSA spruce budworms research symposium; 1984 September 16-20; Bangor, ME. Ottawa, ON: Canadian Forestry Service and U.S. Department of Agriculture, Forest Service; 1985: 476-477.
- Lightfoot, David C. Invertebrates of the H. J. Andrews Experimental Forest, Western Cascades, Oregon. 3: The Orthoptera (grasshoppers and crickets). Res. Note PNW-443. Portland, OR: U.S. Department of Agriculture, Forest Service, Pacific Northwest Forest and Range Experiment Station; 1986. 23 p.
- Lorio, P. L.; Sommers, R. A. Potential use of soil maps to estimate southern pine beetle risk. In: Branham, Susan J.; Thatcher, Robert C., eds. Integrated pest management research symposium; 1985 April 15-18; Asheville, NC. Gen. Tech. Rep. SO-56. New Orleans, LA: U.S. Department of Agriculture, Forest Service, Southern Forest Experiment Station; 1985: 239-245.
- Markin, George P.; Johnson, David R. Bud destruction by western spruce budworm larvae *Choristoneura occidentalis* (Lepidoptera: Tortricidae) and its effects on population sampling. Journal of the Kansas Entomological Society. 59(1): 194-196; 1986.
- Mason, G. N.; Lorio, P. L.; Belanger, R. P.; Nettleton, W. A. Rating the susceptibility of stands to southern pine beetle attack. Agric. Handb. 645. Washington, DC: U.S. Department of Agriculture, Forest Service; 1985. 31 p.
- Moser, J. C. Estimating timber losses from town ant colonies with aerial photographs. Southern Journal of Applied Forestry. 10: 45-47; 1986.
- Nichols, T. The relation of tree growth losses to levels of defoliation by the western spruce budworm. In: Sanders, C. J.; and others, eds. Recent advances in spruce budworms research: Proceedings of the CANUSA spruce budworms research symposium; 1984 September 16-20; Bangor, ME. Ottawa, ON: Canadian Forestry Service and U.S. Department of Agriculture, Forest Service; 1985: 479.
- O'Connor, B. M.; Moser, J. C. Phylogenetic relationships of the Allogophagidae (Acari: Astigmata), with descriptions of a new subfamily, genus, and species. Annals of the Entomological Society of America. 78: 783-789; 1985.

- Rappaport, N. G.; Volney, W. J. A. Assessing individual species impact on seen yield and community interactions among Douglas-fir cone and seed insects. In: Proceedings of the symposium conifer tree seed in the inland mountain West; 1985 August 5-9; Missoula, MT. Tech. Rep. INT-203. Ogden, UT: U.S. Department of Agriculture, Forest Service, Intermountain Forest and Range Experiment Station; 1986: 279 p.
- Sartwell, C.; Daterman, G. E.; Twardus, D. B. Moth captures in pheromone-baited traps relative to subsequent defoliation of Douglas-fir by western spruce budworm. In: Sanders, C. J.; and others, eds. Recent advances in spruce budworms research: Proceedings of the CANUSA spruce budworms research symposium; 1984 September 16-20; Bangor, ME. Ottawa, ON: Canadian Forestry Service and U.S. Department of Agriculture, Forest Service; 1985: 240.
- Schowalter, T. D. Lepesoma lecontei (Coleoptera: Curculionidae): an agent of conelet abortion in a Douglas-fir seed orchard in western Oregon. Journal of Economic Entomology. 79(3): 843-846; 1986.
- Schowalter, T. D.; Haverty, M. I.; Koerber, T. W. Cone and seed insects in Douglas-fir, Pseudotsuga menziesii (Mirb.) Franco, seed orchards in the Western United States: distribution and relative impact. Canadian Entomologist. 117: 1223-1230; 1985.
- Smiley, R. L.; Moser, J. C. A new species, key to females, and distribution records for Heterotarsonemus (Acari: Tarsonemida). International Journal of Acarology. 11: 247-253; 1985.
- Solomon, D. S. The impact of the spruce budworm on the growth response of trees in the spruce-fir forests of the Eastern United States. In: Sanders, C. J.; and others, eds. Recent advances in spruce budworms research: Proceedings of the CANUSA spruce budworms research symposium; 1984 September 16-20; Bangor, ME. Ottawa, ON: Canadian Forestry Service and U.S. Department of Agriculture, Forest Service; 1985: 246-247.
- Solomon, J. D. Gypsy moth update and implications for southeastern hardwoods. In: Third symposium of southeastern hardwoods; 1985 April 16-17; Dothan, AL. Atlanta, GA: U.S. Department of Agriculture, Forest Service, Southern Region; 1985: 66-75.
- Solomon, J. D. Impact of insects on growth and development of young cottonwood plantations. Res. Pap. SO-217. New Orleans, LA: U.S. Department of Agriculture, Forest Service, Southern Forest Experiment Station; 1985. 6 p.
- Stevens, R. E. Lepidoptera associated with western spruce budworm. In: Sanders, C. J.; and others, eds. Recent advances in spruce budworms research: Proceedings of the CANUSA spruce budworms research symposium; 1984 September 16-20; Bangor, ME. Ottawa, ON: Canadian Forestry Service and U.S. Department of Agriculture, Forest Service; 1985: 498-499.
- Stevens, R. E.; Sartwell, C.; Koerber, T. W.; Powell, J. A.; Daterman, G. E.; Sower, L. L. Forest tortricids trapped using Eucosma and Rhyacionia synthetic sex attractants. Journal of the Lepidopterists' Society. 39(1): 26-32; 1985.
- Stoszek, K. G.; Mike, P. G. Why risk rate sites and stands using multivariate regression models? In: Sanders, C. J.; and others, eds. Recent advances in spruce budworms research: Proceedings of the CANUSA spruce budworms research symposium; 1984 September 16-20; Bangor, ME. Ottawa, ON: Canadian Forestry Service and U.S. Department of Agriculture, Forest Service; 1985: 360-361.
- Swetnam, T. W. Radial growth of Douglas-fir trees defoliated by western spruce budworm in northern New Mexico. In: Sanders, C. J.; and others, eds. Recent advances in spruce budworms research: Proceedings of the CANUSA spruce budworms research symposium; 1984 September 16-20; Bangor, ME. Ottawa, ON: Canadian Forestry Service and U.S. Department of Agriculture, Forest Service; 1985: 501-502.
- Tunnock, Scott; Ryan, Roger B. Larch casebearer in western larch. For. Ins. Dis. Leaflet. 96. Washington, DC: U.S. Department of Agriculture, Forest Service; 1985. 8 p.
- Twardus, D. B.; Carolin, V. M. How to distinguish between old and new egg masses of the western spruce budworm. In: Sanders, C. J.; and others, eds. Recent advances in spruce budworms research: Proceedings of the CANUSA spruce budworms research symposium; 1984 September 16-20; Bangor, ME. Ottawa, ON: Canadian Forestry Service and U.S. Department of Agriculture, Forest Service; 1985: 502-503.
- Weatherby, J. C.; DeBarr, G. L.; Barber, L. R. Monitoring coneworms with pheromone traps: a valuable pest detection procedure for use in southern pine seed orchards. In: Schmidtling, R. C.; Griggs, M. M., eds. Proceedings of the 18th southern forest tree improvement conference; 1985 May 21-23; Long Beach, MS. SFTI Comm. Publ. 40. [Place of publication unknown]: [Publisher unknown]; 1985: 208-220. [Available from from National Technical Information Service, 5285 Port Royal Road, Springfield, VA 22161.]
- Werner, R. Associations of plants and phytophagous insects in taiga forest ecosystems. In: Van Cleve, K.; Chapin, F. S., III; Flanagan, P. W.; Viereck, L. A.; Dyrness, C. T. Forest ecosystems in the alaskan taiga: a synthesis of structure and function. Ecol. Stud. 57. New York: Springer-Verlag; 1986: 205-212.

Wickman, Boyd E. Growth of white fir after Douglas-fir tussock moth outbreak: long-term records in the Sierra Nevada. Res. Note PNW-440. Portland, OR: U.S. Department of Agriculture, Forest Service, Pacific Northwest Forest and Range Experiment Station; 1986. 8 p.

Wulf, N. W. Rating stand susceptibility to western spruce budworm. In: Sanders, C. J.; and others, eds. Recent advances in spruce budworms research: Proceedings of the CANUSA spruce budworms research symposium; 1984 September 16-20; Bangor, ME. Ottawa, ON: Canadian Forestry Service and U.S. Department of Agriculture, Forest Service; 1985: 359-360.

Wulf, N. William; Carlson, Clinton E. Generalized indexing model. In: Brookes, Martha H.; Colbert, J. J.; Mitchell, Russel G.; Stark, R. W., tech. coords. Managing trees and stands susceptible to western spruce budworm. Tech. Bull. 1695. Washington, DC: U.S. Department of Agriculture; 1985: 51-54.

Yates, Harry O., III. Checklist of insect and mite species attacking cones and seeds of world conifers. Journal of Entomological Science. 21(2): 142-168; 1986.

Insect Biology

Amman, Gene D. Dynamics of 1-year and 2-year life cycle populations of mountain pine beetle and related tree losses. In: Mountain pine beetle symposium proceedings; 1985; Smithers, BC. Pest Manage. Rep. 7. Victoria, BC: British Columbia Ministry of Forests; 1986: 37-43.

Amman, Gene D. Population dynamics and ecological impacts of mountain pine beetle. In: Summaries of the proceedings of the 1985 western forestry conference; 1985 December 2-4; Portland, OR. Portland, OR: Western Forestry and Conservation Association; 1986. 11 p.

Amman, Gene D.; Pasek, Judith E. Mountain pine beetle in ponderosa pine: effects of phloem thickness and egg gallery density. Res. Pap. INT-367. Ogden, UT: U.S. Department of Agriculture, Forest Service, Intermountain Research Station; 1986. 7 p.

Askew, G. R.; Hedden, R. L.; DeBarr, G. L. Clonal variation in susceptibility to coneworms (*Dioryctria* spp.) in young loblolly pine seed orchards. Forest Science. 31(3): 794-798; 1985.

Askew, George R.; Hedden, Roy L.; DeBarr, Gary. Selection potential for coneworm and seed bug resistance in loblolly pine seed orchards. In: Schmidtling, R. C.; Griggs, M. M., eds. Proceedings of the 18th southern forest tree improvement conference; 1985 May 21-23; Long Beach, MS. SFTI Comm. Publ. 40. [Place of publication unknown]: [Publisher unknown]; 1985: 221-225. [Available from National Technical Information Service, 5285 Port Royal Road, Springfield, VA 22161.]

Beckwith, R. C. Effects of constant and fluctuating laboratory temperature on the western spruce budworm. In: Sanders, C. J.; and others, eds. Recent advances in spruce budworms research: Proceedings of the spruce budworms research symposium; 1984 September 16-20; Bangor, ME. Ottawa, ON: Canadian Forestry Service and U.S. Department of Agriculture, Forest Service; 1985: 89.

Beckwith, Roy C.; Bull, Evelyn L. SCAT analysis of the arthropod component of pileated woodpecker diet. The Murrelet. 66: 90-92; 1985.

Bedard, William D.; Lindahl, Kenneth Q., Jr.; Tilden, Paul E.; Wood, David L. Behavior of the western pine beetle during host colonization. Journal of Chemical Ecology. 11(9): 1249-1261; 1985.

Benfield, E. F.; Webster, J. R. Shredder abundance and leaf breakdown in an Appalachian Mountain stream. Freshwater Biology. 15: 113-120; 1985.

Blackwell, Meredith; Bridges, J. Robert; Moser, John C.; Perry, Thelma J. Hyperphoretic dispersal of a *Pyxidiophora* anamorph. Science. 232: 993-995; 1986.

Bridges, J. R.; Moser, J. C. Relationship of phoretic mites (Acari: Tarsonemidae) to the bluestaining fungus, *Ceratocystis minor*, in trees infested by southern pine beetle (Coleoptera: Scolytidae). Environmental Entomology. 15: 951-953; 1986.

Bridges, J. R.; Perry, T. J. Effects of mycangial fungi on gallery construction and distribution of bluestain in southern pine beetle-infested pine bolts. Journal of Entomological Science. 20: 271-275; 1985.

Campbell, R. W. Effects of birds and ants on pupae of the spruce budworm. In: Sanders, C. J.; and others, eds. Recent advances in spruce budworms research: Proceedings of the CANUSA spruce budworms research symposium; 1984 September 16-20; Bangor, ME. Ottawa, ON: Canadian Forestry Service and U.S. Department of Agriculture, Forest Service; 1985: 100.

Cannon, William N., Jr. Gallery construction and oviposition of *Scolytus multistriatus* (Coleoptera: Scolytidae) in relation to temperature and adult density. Environmental Entomology. 14: 641-643; 1985.

Cates, R. G. The effect of chemical defenses, nutrition, needle phenology, and physical parameters of Douglas-fir on western spruce budworm success. In: Sanders, C. J.; and others, eds. Recent advances in spruce budworms research: Proceedings of the CANUSA spruce budworms research symposium; 1984 September 16-20; Bangor, ME. Ottawa, ON: Canadian Forestry Service and U.S. Department of Agriculture, Forest Service; 1985: 128.

- Cole, Walter E.; Amman, Gene D.; Jensen, Chester E. Mountain pine beetle dynamics in lodgepole pine forests. Part 3: Sampling and modeling of mountain pine beetle populations. Gen. Tech. Rep. INT-188. Ogden, UT: U.S. Department of Agriculture, Forest Service, Intermountain Forest and Range Experiment Station; 1985. 46 p.
- Crawford, Hewlette S.; Jennings, Daniel T. Effects of birds on spruce budworm populations--a progress report. In: Is forestry good wildlife management?: Proceedings of a joint conference; 1985 March; Portland, ME. Misc. Publ. 689. Orono, ME: University of Maine and Maine Agricultural Experiment Station; 1986: 315-321.
- Daterman, G. E.; Sower, L. L.; Sartwell, C. Courtship disruption of western spruce budworm by aerial application of synthetic pheromone. In: Sanders, C. J.; and others, eds. Recent advances in spruce budworms research: Proceedings of the CANUSA spruce budworms research symposium; 1984 September 16-20; Bangor, ME. Ottawa, ON: Canadian Forestry Service and U.S. Department of Agriculture, Forest Service; 1985: 386-387.
- DeMars, C. J., Jr.; Dahlsten, D. L.; Sharpnack, N. X.; Rowney, D. L. Tree utilization and density of attacking and emerging populations of the western pine beetle (Coleoptera: Scolytidae) and its natural enemies, Bass Lake, California, 1970-1971. Canadian Entomologist. 118(9): 881-900; 1986.
- Dennis, Brian; Kemp, Willima P.; Beckwith, Roy C. Stochastic model of insect phenology: estimating and testing. Environmental Entomologist. 15: 540-546; 1986.
- Dix, Mary Ellen. Lilac seed, an alternate host for the ash seed weevil, Lignyodes bischoffi (Blatchley) (Coleoptera: Curculionidae). Journal of the Kansas Entomological Society. 59(2): 389-390; 1986.
- Doolittle, R. E.; Solomon, J. D. Stereoselective synthesis of (Z,E)-3,5-tetradecadienyl acetate: sex attractant for carpenterworm moth, Prionoxystus robiniae (Peck) (Lepidoptera: Cossidae) and effect of isomers and monounsaturated acetates on its attractiveness. Journal of Chemical Ecology. 12: 619-633; 1985.
- Drooz, A. T.; Ghent, J. H.; Huber, C. M. Insect parasites associated with the introduced pine sawfly, Diprion similis (Hartig) (Hymenoptera: Diprionidae), in North Carolina. Environmental Entomology. 14(4): 401-403; 1985.
- Drooz, A. T.; Huber, C. M.; Ghent, J. H. Nematodes attacking the larch sawfly, Pristiphora erichsonii, in North Carolina. Res. Note SE-339. Asheville, NC: U.S. Department of Agriculture, Forest Service, Southeastern Forest Experiment Station; 1986. 3 p.
- Drooz, A. T.; Smith, T. F.; Doggett, C. A. Outbreak of a rare Lymantriid, Orgyia detrita, in coastal North Carolina. Res. Note SE-340. Asheville, NC: U.S. Department of Agriculture, Forest Service, Southeastern Forest Experiment Station; 1986. 3 p.
- Drooz, Arnold T., ed. Insects of eastern forests. Misc. Publ. 1426. Washington, DC: U.S. Department of Agriculture, Forest Service; 1985. 608 p.
- Edwards, John S. Arthropods as pioneers: recolonization of the blast zone on Mount St. Helens. The Northwest Environmental Journal. 2(1): 63-73; 1986.
- Fellin, D. G. Dispersal of western spruce budworm larvae and adults as related to silvicultural treatments. In: Sanders, C. J.; and others, eds. Recent advances in spruce budworms research: Proceedings of the CANUSA spruce budworms research symposium; 1984 September 16-20; Bangor, ME. Ottawa, ON: Canadian Forestry Service and U.S. Department of Agriculture, Forest Service; 1985: 116-117.
- Fellin, David G. Movement and distribution of Pleocoma larvae in western Oregon coniferous forest soils (Coleoptera: Scarabaeidae). Pan-Pacific Entomologist. 62(1): 58-76; 1986.
- Fellin, David G. Western budworm and its hosts. In: Brookes, Martha H.; Colbert, J. J.; Mitchell, Russel G.; Stark, R. W., tech. coords. Managing trees and stands susceptible to western spruce budworm. Tech. Bull. 1695. Washington, DC: U.S. Department of Agriculture, Forest Service; 1985: 7-14.
- Hairston, Nelson G., Sr. Species packing in Desmognathus salamanders: experimental demonstration of predation and competition. American Naturalist. 127(3): 266-291; 1986.
- Hanula, James L.; DeBarr, Gary L.; Berisford, C. Wayne. Adult activity of Dioryctria amatella (Lepidoptera: Pyralidae) in relation to development of immature stages in loblolly pine cones. Environmental Entomology. 14: 842-845; 1985.
- Hargrove, William W. An annotated species list of insect herbivores commonly associated with black locust, Robinia pseudoacacia, in the southern Appalachians. Entomological News. 97(1): 36-40; 1986.
- Hertel, G. D.; Mason, G. N.; McManus, M. L.; Wallner, W. E. The Northeastern Forest Experiment Station's/university cooperators' Gypsy Moth Research Program. In: Proceedings, 1985 national gypsy moth review; 1985 November 18-21; Columbus, OH. Columbus, OH: National Gypsy Moth Management Board; 1985: 109-118.
- Hurny, Alexander D.; Wallace, J. Bruce. A method for obtaining in situ growth rates of larval Chironomidae (Diptera) and its application to studies of secondary production. Limnology and Oceanography. 31(1): 216-222; 1986.

- Huryn, Alexander D.; Wallace, J. Bruce. Life history and production of Goerita semata Ross (Trichoptera: Limnephilidae) in the southern Appalachian Mountains. Canadian Journal of Zoology. 63: 2604-2611; 1985.
- Jennings, Daniel T.; Crawford, Hewlette S. Predators of the spruce budworm. Agric. Handb. 644. Washington, DC: U.S. Department of Agriculture; 1985. 77 p.
- Jennings, Daniel T.; Houseweart, Mark W.; Francoeur, Andre. Ants (Hymenoptera: Formicidae) associated with strip-clearcut and dense spruce-fir forests of Maine. Canadian Entomologist. 118: 43-50; 1986.
- Jones, John R.; DeByle, Norbert V.; Bowers, Diane M. Insects and other invertebrates. In: DeByle, Norbert V.; Winokur, Robert P., eds. Aspen: ecology and management in the Western United States. Gen. Tech. Rep. RM-119. Fort Collins, CO: U.S. Department of Agriculture, Forest Service, Rocky Mountain Forest and Range Experiment Station; 1985: 107-114.
- Kemp, W. P. Historical western spruce budworm outbreak frequency. In: Sanders, C. J.; and others, eds. Recent advances in spruce budworms research: Proceedings of the CANUSA spruce budworms research symposium; 1984 September 16-20; Bangor, ME. Ottawa, ON: Canadian Forestry Service and U.S. Department of Agriculture, Forest Service; 1985: 133-134.
- Kemp, W. P. Springtime behavior and budworm population dynamics. In: Sanders, C. J.; and others, eds. Recent advances in spruce budworms research: Proceedings of the CANUSA spruce budworms research symposium; 1984 September 16-20; Bangor, ME. Ottawa, ON: Canadian Forestry Service and U.S. Department of Agriculture, Forest Service; 1985: 118.
- Kemp, W. P. Temperature and western spruce budworm development. In: Sanders, C. J.; and others, eds. Recent advances in spruce budworms research: Proceedings of the CANUSA spruce budworms research symposium; 1984 September 16-20; Bangor, ME. Ottawa, ON: Canadian Forestry Service and U.S. Department of Agriculture, Forest Service; 1985: 87-88.
- Kemp, W. P. The relation of climate to frequency of western spruce budworm outbreak. In: Sanders, C. J.; and others, eds. Recent advances in spruce budworms research: Proceedings of the spruce budworms research symposium; 1984 September 16-20; Bangor, ME. Ottawa, ON: Canadian Forestry Service and U.S. Department of Agriculture, Forest Service; 1985: 479.
- Kemp, W. P.; Sheehan, K.; Colbert, J. J.; Crookston, N. L. Western spruce budworm population dynamics model. In: Sanders, C. J.; and others, eds. Recent advances in spruce budworms research: Proceedings of the CANUSA spruce budworms research symposium; 1984 September 16-20; Bangor, ME. Ottawa, ON: Canadian Forestry Service and U.S. Department of Agriculture, Forest Service; 1985: 509-510.
- Kemp, William P.; Dennis, Brian; Beckwith, Roy C. Stochastic phenology model for the western spruce budworm (Lepidoptera: Tortricidae). Environmental Entomologist. 15: 547-554; 1986.
- Kinn, D. N. Studies on the flight capabilities of Dendroctonus frontalis and Ips calligraphus: preliminary findings using tethered beetles. Res. Note SO-324. New Orleans, LA: U.S. Department of Agriculture, Forest Service, Southern Forest Experiment Station; 1986. 3 p.
- Liebhold, A. M., Elkinton, J. S., Wallner, W. E. Effect of burlap bands on between-tree movement of late-instar gypsy moth, Lymantria dispar (Lepidoptera: Lymantriidae). Environmental Entomology. 15(2): 373-379; 1986.
- Logan, J. A.; Amman, G. D. A distribution model for egg development in mountain pine beetle. The Canadian Entomologist. 118: 361-372; 1986.
- Lorio, P. L., Jr. Growth-differentiation balance: a basis for understanding southern pine beetle-tree interactions. Forest Ecology and Management. 14: 259-273; 1986.
- Mattson, W. J. Role of host plants in the population dynamics of the spruce budworm. In: Sanders, C. J.; and others, eds. Recent advances in spruce budworms research: Proceedings of the CANUSA spruce budworms research symposium; 1984 September 16-20; Bangor, ME. Ottawa, ON: Canadian Forestry Service and U.S. Department of Agriculture, Forest Service; 1985: 124-125, 130.
- Mattson, William J. Competition for food between two principal cone insects of red pine, Pinus resinosa. Environmental Entomology. 15(1): 88-92; 1986.
- Mazzone, H. M.; Podgwaite, J. D. Standard and novel functions of insect latent viruses. In: Proceedings, symposium of host-regulated developmental mechanisms in vector arthropods; 1986 February 3-6; Vero Beach, FL. Vero Beach, FL: University of Florida; 1986: 212-216.
- McLean, J. A. The geographic chemoprinting hypothesis as applied to western spruce budworm. In: Sanders, C. J.; and others, eds. Recent advances in spruce budworms research: Proceedings of the CANUSA spruce budworms research symposium; 1984 September 16-20; Bangor, ME. Ottawa, ON: Canadian Forestry Service and U.S. Department of Agriculture, Forest Service; 1985: 477-478.
- McManus, M. L. Weather related gypsy moth mortality. In: Proceedings of the national gypsy moth review; 1985 November 18-21; Columbus, OH. Columbus, OH: National Gypsy Moth Management Board; 1986: 109-118.

- Meyer, Wendy L.; DeBarr, Gary L.; Hanula, James L.; Kovalev, Boris; Cameron, R. Scott; Berisford, C. Wayne; Roelofs, Wendell L. Z-11-hexadecenyl acetate, a sex pheromone component for the southern pine coneworm, *Dioryctria amatella* (Lepidoptera: Pyralidae). *Environmental Entomology*. 15(2): 316-320; 1986.
- Miller, M. C. Survival of within-tree *Ips calligraphus* (Germar): effect of insect associates. *Entomophaga* (Paris). 31(1): 39-48; 1986.
- Miller, M. C. The effect of *Monochamus titillator* (F.) (Col., Cerambycidae) foraging on the emergence of *Ips calligraphus* (Germ.) (Col., Scolytidae) insect associate. *Zeitschrift für angewandte Entomologie*. 100(2): 189-197; 1985.
- Miller, William E.; Epstein, Marc E. Synchronous population fluctuations among moth species (Lepidoptera). *Environmental Entomology [Forum]*. 15(3): 443-447; 1986.
- Montgomery, M. E. Host plant nitrogen dynamics in spruce budworm. In: Sanders, C. J.; and others, eds. Recent advances in spruce budworms research: Proceedings of the CANUSA spruce budworms research symposium; 1984 September 16-20; Bangor, ME. Ottawa, ON: Canadian Forestry Service and U.S. Department of Agriculture, Forest Service; 1985: 120-121.
- Montgomery, M. E. Population dynamics of the gypsy moth in Yugoslavia. In: Gypsy moth host plant relationship and population dynamics; 1986 September 9-16; Ljubljana, YU. Ljubljana, YU: Yugoslav IUFRO World Congress Organizing Committee; 1986: 743-754.
- Moser, J. C.; Bridges, J. R. *Tarsonemus* (Acarina: Tarsonemidae) mites phoretic on the southern pine beetle (Coleoptera: Scolytidae): attachment sites and numbers of bluestain (Ascomycetes: Ophiostomataceae) ascospores carried. *Proceedings of the Entomological Society of Washington*. 88: 297-299; 1986.
- Neel, W. W.; Solomon, J. D. Collection, storage and release of predaceous coccinellids in young cottonwood plantations. *Journal of Agricultural Entomology*. 2: 212-214; 1985.
- Niwa, C. C.; Stark, R. W.; Burnell, D. G.; Johnson Knox, D. M. Annotated bibliography of larch casebearer parasitoids. Bull. 41. Moscow, ID: University of Idaho, Forest, Wildlife and Range Experiment Station; 1986. 135 p.
- O'Dell, T. M. Gypsy moth parasite research. *Gypsy Moth News* #9. Broomall, PA: U.S. Department of Agriculture, Forest Service, Northeastern Forest Experiment Station; 1985: 6-7.
- Podgwaite, J. D. Effects of insect pathogens on the environment. *Fortschritte der Zoologie*. 32: 279-287; 1986.
- Podgwaite, J. D.; Mazzone, H. M. Latency of insect viruses. *Advances in Virus Research*. 31: 293-320; 1986.
- Rappaport, N.; Page, M. Rearing *Glypta fumiferanae* [Hym: Ichneumonidae] on a multivoline laboratory colony of the western spruce budworm (*Choristoneura occidentalis*) [Lep.: Tortricidae]. *Entomophaga*. 30(4): 347-352; 1985.
- Ryan, R. B. A hypothesis for decreasing parasitization of larch casebearer (Lepidoptera: Coleophoridae) on larch foliage by *Agathis pumila*, The Canadian Entomologist. 117(12): 1573-1574; 1985.
- Sanders, C. J.; and others, eds. Recent advances in spruce budworms research: Proceedings of the CANUSA spruce budworms research symposium; 1984 September 16-20; Bangor, ME. Ottawa, ON: Canadian Forestry Service and U.S. Department of Agriculture, Forest Service; 1985. 527 p.
- Sartwell, Charles; Daterman, G. E.; Sower, L. L. A synthetic attractant for male moths of a biotype in the *Cydia piperana* complex (Lepidoptera: Tortricidae). *The Canadian Entomologist*. 117(9): 1151-1152; 1985.
- Schmitz, Richard F. Effect of life cycle duration on factors limiting survival of the mountain pine beetle. In: Mountain pine beetle symposium proceedings; 1985; Smithers, BC. Pest Manage. Rep. 7. Victoria, BC: British Columbia Ministry of Forests; 1986: 25-36.
- Schowalter, T. D.; Hargrove, W. W.; Crossley, D. A., Jr. Herbivory in forested ecosystems. *Annual Review of Entomology*. 31: 177-196; 1986.
- Sheehan, Katharine A.; Dahlsten, Donald L. Bionomics of *Neodiprion* species on white fir in northeastern California. In: Hilgardia. 53(8). Berkeley, CA: University of California; 1985: 1-24.
- Siegfried, Blair D.; Fatzinger, Carl W.; Wilkinson, Robert C.; Nation, James L. In-flight responses of the black turpentine beetle (Coleoptera: Scolytidae) to individual monoterpenes, turpentine, and paraquat-treated slash pines. *Environmental Entomology*. 15(3): 710-714; 1986.
- Sower, Lonnie L.; Daterman, G. E. Premating searching activity of male western spruce budworm moths *Choristoneura occidentalis* (Lepidoptera: Tortricidae). *The Canadian Entomologist*. 117(10): 1273-1274; 1985.
- Sower, Lonnie L.; Shorb, Martin D. Pesticides have little impact on attraction of three species of male moths to sex pheromone. *Journal of Economic Entomology*. 78: 908-912; 1985.
- Stevens, R. E.; Sartwell, C.; Koerber, T. W.; Powell, J. A.; Daterman, G. E.; Sower, L. L. Forest tortricids trapped using *Eucosma* and *Rhyacionia* synthetic sex attractants. *Journal of the Lepidopterists' Society*. 39(1): 26-32; 1985.

- Stoszek, K. J.; Mika, P. G. Interpreting the environment of western budworm outbreak-prone site-stand configurations. In: Sanders, C. J.; and others, eds. Recent advances in spruce budworms research: Proceedings of the CANUSA spruce budworms research symposium; 1984 September 16-20; Bangor, ME. Ottawa, ON: Canadian Forestry Service and U.S. Department of Agriculture, Forest Service; 1985: 131-132.
- Sturgeon, K. B.; Mitton, J. B. Biochemical diversity of ponderosa pine and predation by bark beetles. *Journal of Economic Entomology*. 79: 1064-1068; 1986.
- Tabashnik, Bruce E.; Mattson, William J.; Miller, James R. Host acceptance behavior of the red pine cone beetle (*Conophthorus resinosae*). *Entomologia Experimentalis et Applicata*. 37: 3-7; 1985.
- Tkacz, Borys M.; Schmitz, Richard F. Association of an endemic mountain pine beetle population with lodgepole pine infected by *Armillaria* root disease in Utah. Res. Note INT-353. Ogden, UT: U.S. Department of Agriculture, Forest Service, Intermountain Forest and Range Experiment Station; 1986. 7 p.
- Torgersen, T. R. Parasitoids and western budworm dynamics. In: Sanders, C. J.; and others, eds. Recent advances in spruce budworms research: Proceedings of the CANUSA spruce budworms research symposium; 1984 September 16-20; Bangor, ME. Ottawa, ON: Canadian Forestry Service and U.S. Department of Agriculture, Forest Service; 1985: 104.
- Torgersen, T. R. Role of birds and ants in western spruce budworm dynamics. In: Sanders, C. J.; and others, eds. Recent advances in spruce budworms research: Proceedings of the CANUSA spruce budworms research symposium; 1984 September 16-20; Bangor, ME. Ottawa, ON: Canadian Forestry Service and U.S. Department of Agriculture, Forest Service; 1985: 97.
- Torgersen, Torolf R. A new hyposoter (Hymenoptera: Ichneumonidae) from *Orgyia pseudotsugata* (McD.) (Lepidoptera: Lymantriidae). *The Canadian Entomologist*. 117: 941-947; 1985.
- Trostle, Glen E. Distinguishing mated and unmated mountain pine beetles in alcohol-preserved specimens. Res. Note INT-356. Ogden, UT: U.S. Department of Agriculture, Forest Service, Intermountain Forest and Range Experiment Station; 1986. 3 p.
- Volney, W. J. A. Comparative population biologies of North American spruce budworms. In: Sanders, C. J.; and others, eds. Recent advances in spruce budworms research: Proceedings of the CANUSA spruce budworms research symposium; 1984 September 16-20; Bangor, ME. Ottawa, ON: Canadian Forestry Service and U.S. Department of Agriculture, Forest Service; 1985: 71-84.
- Volney, W. J. A. Temperature effects on development and survival of western spruce budworms. In: Sanders, C. J.; and others, eds. Recent advances in spruce budworms research: Proceedings of the CANUSA spruce budworms research symposium; 1984 September 16-20; Bangor, ME. Ottawa, ON: Canadian Forestry Service and U.S. Department of Agriculture, Forest Service; 1985: 92-93.
- Volney, W. J. A. The historical record and its value in developing chronologies for western spruce budworms. In: Sanders, C. J.; and others, eds. Recent advances in spruce budworms research: Proceedings of the CANUSA spruce budworms research symposium; 1984 September 16-20; Bangor, ME. Ottawa, ON: Canadian Forestry Service and U.S. Department of Agriculture, Forest Service; 1985: 138-139.
- Volney, W. J. A.; Liebhold, A. M.; Waters, W. E. Population quality and the biology of two western budworms in southern Oregon and northern California. In: Sanders, C. J.; and others, eds. Recent advances in spruce budworms research: Proceedings of the CANUSA spruce budworms research symposium; 1984 September 16-20; Bangor, ME. Ottawa, ON: Canadian Forestry Service and U.S. Department of Agriculture, Forest Service; 1985: 500.
- Wagner, M. R.; Tinus, R. W. Mechanism of tree resistance to spruce budworms--is there a terpene connection? In: Sanders, C. J.; and others, eds. Recent advances in spruce budworms research: Proceedings of the CANUSA spruce budworms research symposium; 1984 September 16-20; Bangor, ME. Ottawa, ON: Canadian Forestry Service and U.S. Department of Agriculture, Forest Service; 1985: 121-123.
- Wallace, J. Bruce; Gurtz, Martin E. Response of *Baetis* mayflies (Ephemeroptera) to catchment logging. *American Midland Naturalist*. 115(1): 25-41; 1986.
- Wallner, W. E. Research and management priorities for gypsy moth in North America. In: World Congress of Entomology Proceedings; 1985 September 9-16; Ljubljana, YU. Ljubljana, YU: Yugoslave IUFRO World Congress Organizing Committee; 1986: 755-764.
- Waters, W. E.; Volney, W. J. A.; Liebhold, A. M. Comparative dynamics of sparse and dense western budworm populations. In: Sanders, C. J.; and others, eds. Recent advances in spruce budworms research: Proceedings of the CANUSA spruce budworms research symposium; 1984 September 16-20; Bangor, ME. Ottawa, ON: Canadian Forestry Service and U.S. Department of Agriculture, Forest Service; 1985: 501.
- Weber, B. C.; McPherson, J. E. Relation between attack by *Xylosandrus germanus* (Coleoptera: Scolytidae) and disease symptoms in black walnut. *The Canadian Entomologist*. 117: 1275-1277; 1985.

- Werner, Richard A. The eastern larch beetle in Alaska. Res. Pap. PNW-357. Portland, OR: U.S. Department of Agriculture, Forest Service, Pacific Northwest Forest and Range Experiment Station; 1986. 25 p.
- Whitehead, Armand T. Electroantennogram responses by mountain pine beetles, *Dendroctonus ponderosae* Hopkins, exposed to selected semiochemicals. Journal of Chemical Ecology. 12(7): 1603-1621; 1986.
- Wickman, Boyd E. Comparison of a degree-day computer and a recording thermograph in a forest environment. Res. Note PNW-427. Portland, OR: U.S. Department of Agriculture, Forest Service, Pacific Northwest Forest and Range Experiment Station; 1985. 6 p.
- Youngs, L. C. Ant predators of the western spruce budworms: species composition and patterns of occurrence in eastern Oregon and western Montana. In: Sanders, C. J.; and others, eds. Recent advances in spruce budworms research: Proceedings of the CANUSA spruce budworms research symposium; 1984 September 16-20; Bangor, ME. Ottawa, ON: Canadian Forestry Service and U.S. Department of Agriculture, Forest Service; 1985: 96.
- Youngs, L. C. Ants preying on western spruce budworm. In: Sanders, C. J.; and others, eds. Recent advances in spruce budworms research: Proceedings of the CANUSA spruce budworms research symposium; 1984 September 16-20; Bangor, ME. Ottawa, ON: Canadian Forestry Service and U.S. Department of Agriculture, Forest Service; 1985: 487.
- ### Insect Control and Management Strategies
- Anderson, Walter C.; Guldin, Richard W.; Vasievich, Michael. Risk assessment of investments in loblolly pine plantations threatened by bark beetles. In: Branham, Susan J.; Thatcher, Robert C., eds. Integrated pest management research symposium: The proceedings; 1985 April 15-20; Asheville, NC. Gen. Tech. Rep. SO-56. New Orleans, LA: U.S. Department of Agriculture, Forest Service, Southern Forest Experiment Station; 1985: 328-334.
- Bedard, William D. Integrated pest management systems for insects injurious to regeneration. In: Summaries of the proceedings of the 1985 western forestry conference; 1985 December 2-4; Spokane, WA. Portland, OR: Western Forestry and Conservation Association; 1986: 73.
- Belanger, R. P.; Hedden, R. L.; Tainter, F. H. Managing Piedmont forests to reduce losses from the littleleaf disease-southern pine beetle complex. Agric. Handb. 649. Washington, DC: U.S. Department of Agriculture, Forest Service and Cooperative State Research Service; 1986. 19 p.
- Belanger, Roger P. Integrated pest management in southern forests. In: Proceedings of the national silviculture workshop: successes in silviculture; 1985 May 13-16; Rapid City, SD. Washington, DC: U.S. Department of Agriculture, Forest Service, Timber Management; 1985: 167-172.
- Berisford, C. Wayne; DeBarr, Gary L.; Payne, Thomas L. Utilization of pheromones in forest pest management. In: Goyer, Richard A.; Jones, John P., eds. Thirty-fourth annual forestry symposium: insects and diseases of southern forests; 1985 March 26-27; Baton Rouge, LA. Baton Rouge, LA: Louisiana Agricultural Experiment Station and Louisiana Cooperative Extension Service; 1985: 92-96.
- Bible, T. D. Economic considerations for spruce budworm management in North America. In: Sanders, C. J.; and others, eds. Recent advances in spruce budworms research: Proceedings of the CANUSA spruce budworms research symposium; 1984 September 16-20; Bangor, ME. Ottawa, ON: Canadian Forestry Service and U.S. Department of Agriculture, Forest Service; 1985: 176-187.
- Blum, Barton M.; McLean, David A. Potential silvicultural, harvesting and salvage practice in eastern North America. In: Sanders, C. J.; and others, eds. Recent advances in spruce budworm research: Proceedings of the CANUSA spruce budworms research symposium; 1984 September 16-20; Bangor, ME. Ottawa, ON: Canadian Forestry Service and U.S. Department of Agriculture, Forest Service; 1985: 264-280.
- Buffam, P. E. Spraying for control of the western spruce budworm in the Pacific Northwest. In: Sanders, C. J.; and others, eds. Recent advances in spruce budworms research: Proceedings of the CANUSA spruce budworms research symposium; 1984 September 16-20; Bangor, ME. Ottawa, ON: Canadian Forestry Service and U.S. Department of Agriculture, Forest Service; 1985: 379.
- Carlson, C. E.; Schmidt, W. C.; Fellin, D. G.; Wulf, N. W. Silvicultural approaches to western spruce budworm management in the northern U.S. Rocky Mountains. In: Sanders, C. J.; and others, eds. Recent advances in spruce budworms research: Proceedings of the CANUSA spruce budworms research symposium; 1984 September 16-20; Bangor, ME. Ottawa, ON: Canadian Forestry Service and U.S. Department of Agriculture, Forest Service; 1985: 281-300.

- Carlson, Clinton E.; Schmidt, Wyman C.; Wulf, N. William. Silvicultural treatment. In: Brookes, Martha H.; Colbert, J. J.; Mitchell, Russel G.; Stark, R. W., tech. coords. Managing trees and stands susceptible to western spruce budworm. Tech. Bull. 1695. Washington, DC: U.S. Department of Agriculture; 1985: 64-69.
- Chang, Ming Tu. Biotechnology for the Forest Service--a new frontier. In: Proceedings of the 1985 national gypsy moth review; 1985 November 18-21; Columbus, OH. Columbus, OH: National Gypsy Moth Management Board; 1986: 180.
- Crawford, H. S.; Jennings, D. T. Effects of bird predation on spruce budworm: a pilot study. In: Sanders, C. J.; and others, eds. Recent advances in spruce budworms research: Proceedings of the CANUSA spruce budworms research symposium; 1984 September 16-20; Bangor, ME. Ottawa, ON: Canadian Forestry Service and U.S. Department of Agriculture, Forest Service; 1985: 98-99.
- DeBarr, Gary L.; Matthews, Fred R. Insecticide applications during the pollination period do not adversely affect seed yields of loblolly pine. Southern Journal of Applied Forestry. 9(10): 240-243; 1985.
- Dix, Mary Ellen. Effectiveness of carbaryl and acephate in reducing damage by *Petrova metallica* (Busck) (Lepidoptera: Tortricidae) in ponderosa pine windbreaks. Res. Note RM-458. Fort Collins, CO: U.S. Department of Agriculture, Forest Service, Rocky Mountain Forest and Range Experiment Station; 1985: 3 p.
- Dubois, N. D. Field use of *Bacillus thuringiensis* to control the gypsy moth. In: Proceedings of symposium: understanding the gypsy moth threat: control options with *Bacillus thuringiensis*; 1985 November 5-6; Vancouver, BC. Vancouver, BC: Agriculture Canada; 1985: 5-6.
- Dubois, N. D. Synergism between B-exotoxin and *Bacillus thuringiensis* subspecies *Kurstaki* (HD-1) in gypsy moth, *Lymantria dispar*, larvae. Journal of Invertebrate Pathology. 48: 146-151; 1986.
- Feicht, David L.; Acciavatti, Robert. Pilot test of red oak borer silvicultural control in commercial forest stands. In: Dawson, J. O.; Majerus, K. A., eds. Fifth central hardwood forest conference; 1985 April 15-17; Urbana-Champaign, IL. SAF Publ. 85-05. Urbana-Champaign, IL: University of Illinois, Department of Forestry; 1985: 280-284.
- Fellin, David G. Tactics for managing trees and stands. In: Brookes, Martha H.; Colbert, J. J.; Mitchell, Russel G.; Stark, R. W., tech. coords. Managing trees and stands susceptible to western spruce budworm. Tech. Bull. 1695. Washington, DC: U.S. Department of Agriculture; 1985: 57-70.
- Fellin, David G.; Shea, Patrick J. Biological agents. In: Brookes, Martha H.; Colbert, J. J.; Mitchell, Russel G.; Stark, R. W., tech. coords. Managing trees and stands susceptible to western spruce budworm. Tech. Bull. 1695. Washington, DC: U.S. Department of Agriculture; 1985: 62-64.
- Fellin, David G.; Shea, Patrick J. Integrated pest management. In: Brookes, Martha H.; Colbert, J. J.; Mitchell, Russel G.; Stark, R. W., tech. coords. Managing trees and stands susceptible to western spruce budworm. Tech. Bull. 1695. Washington, DC: U.S. Department of Agriculture; 1985: 69-70.
- Frank, R. M. Building new spruce-fir stands--a long-term localized strategy for reducing spruce budworm impact. In: Sanders, C. J.; and others, eds. Recent advances in spruce budworms research: Proceedings of the CANUSA spruce budworms research symposium; 1984 September 16-20; Bangor, ME. Ottawa, ON: Canadian Forestry Service and U.S. Department of Agriculture, Forest Service; 1985: 365-366.
- Frank, R. M. The shelterwood simulator. In: Sanders, C. J.; and others, eds. Recent advances in spruce budworms research: Proceedings of the CANUSA spruce budworms research symposium; 1984 September 16-20; Bangor, ME. Ottawa, ON: Canadian Forestry Service and U.S. Department of Agriculture, Forest Service; 1985: 503.
- Galford, Jimmy R. Effects of dimilin on red oak borer fertility, 1981. Insecticide and Acaricide Tests. 11: 413; 1986.
- Garton, E. O.; Takekawa, J. Y.; Langelier, L. A. Enhancing habitat of avian predators. In: Sanders, C. J.; and others, eds. Recent advances in spruce budworms research: Proceedings of the CANUSA spruce budworms research symposium; 1984 September 16-20; Bangor, ME. Ottawa, ON: Canadian Forestry Service and U.S. Department of Agriculture, Forest Service; 1985: 474.
- Garton, E. O.; Langelier, L. A.; Takekawa, J. Y.; Lawless, M. M. Managing forest birds to prevent western spruce budworm outbreak. In: Sanders, C. J.; and others, eds. Recent advances in spruce budworms research: Proceedings of the CANUSA spruce budworms research symposium; 1984 September 16-20; Bangor, ME. Ottawa, ON: Canadian Forestry Service and U.S. Department of Agriculture, Forest Service; 1985: 474.
- Gottschalk, Kurt W. Managing Appalachian hardwood stands to minimize gypsy moth impacts. In: Smith, H. C.; Eye, M. C., eds. Proceedings: managing immature Appalachian hardwood stands; 1986 May 28-30; Morgantown, WV. SAF Publ. 86-02. Morgantown, WV: West Virginia University; 1986: 181-207.
- Hard, John S.; Holsten, Edward H. Managing white and Lutz spruce stands in south-central Alaska for increased resistance to spruce beetles. Gen. Tech. Rep. PNW-188. Portland, OR: U.S. Department of Agriculture, Forest Service, Pacific Northwest Forest and Range Experiment Station; 1985: 21 p.
- Harrell, Mark O. Control of combined populations of *Dioryctria ponderosae* and *D. tumicolella*, two phloem borers of pine. Insecticide and Acaricide Tests. 11: 425; 1986.
- Harrell, Mark O. Control of *Dioryctria tumicolella*, a phloem borer of pine. Insecticide and Acaricide Tests. 11: 425-426; 1986.

- Haverty, Michael I.; Shea, Patrick J. Protection of blister rust-resistant western white pine cones from insect damage with permethrin and fenvalerate. In: Conifer tree seed in the inland mountain West symposium; 1985 August 5-6; Missoula, MT. Gen. Tech. Rep. INT-2038. Ogden, UT: U.S. Department of Agriculture, Forest Service, Intermountain Forest and Range Experiment Station; 1986: 246-250.
- Haverty, Michael I.; Shea, Patrick J.; Stipe, Lawrence E. Single and multiple applications of fenvalerate to protect western white pine cones from *Dioryctria abietivorella* (Lepidoptera: Pyralidae). *Journal of Economic Entomology*. 79(1): 158-161; 1986.
- Holsten, E. H.; Hennon, P. E.; Werner, R. A. Insects and diseases of Alaskan forests. Alaska Reg. Rep. 181. Juneau, AK: U.S. Department of Agriculture, Forest Service, Region 10; 1985. 271 p.
- Holsten, Edward H.; Werner, Richard A. Evaluation of a controlled release formulation of methylcyclohexanone (MCH) in preventing spruce beetle attacks in Alaska. Tech. Rep. R10-12. Anchorage, AK: U.S. Department of Agriculture, Forest Service, Alaska Region, Forest Pest Management; 1985. 9 p.
- Houseweart, M. W. *Trichogramma* vs. the spruce budworm. In: Sanders, C. J.; and others, eds. Recent advances in spruce budworms research: Proceedings of the CANUSA spruce budworms research symposium; 1984 September 16-20; Bangor, ME. Ottawa, ON: Canadian Forestry Service and U.S. Department of Agriculture, Forest Service; 1985: 395-396.
- Jennings, D. T.; Houseweart, M. W.; Dimond, J. B. Strip clearcutting contributes to dispersal losses of early-instar spruce budworm larvae. In: Sanders, C. J.; and others, eds. Recent advances in spruce budworms research: Proceedings of the CANUSA spruce budworms research symposium; 1984 September 16-20; Bangor, ME. Ottawa, ON: Canadian Forestry Service and U.S. Department of Agriculture, Forest Service; 1985: 115.
- Jennings, Daniel T., mod. Future of predators in forest pest management. In: Predator workshop 2: Proceedings of the 18th annual northeastern forest insect work conference; 1985 March 14-15; Portland, ME. Syracuse, NY: State University of New York, College of Environmental Science and Forestry; 1985: 59-65.
- Jennings, Daniel T.; Houseweart, Mark W. Helicopter propwash dislodges few spruce budworms. Res. Note NE-333. Broomall, PA: U.S. Department of Agriculture, Forest Service, Northeastern Forest Experiment Station; 1986. 7 p.
- Jennings, Daniel T.; Jones, Richard L. Field tests of kairomones to increase parasitism of spruce budworm (Lepidoptera: Tortricidae) eggs by *Trichogramma* spp. (Hymenoptera: Trichogrammatidae). *Great Lakes Entomologist*. 19: 185-189; 1986.
- Kronrad, Gary D. Insect pest control: economic theoretical models, costs and benefits, and a review of the forestry literature. Res. Notes Ser. 39. Raleigh, NC: North Carolina State University; 1984. 56 p.
- Livingston, R. Ladd. History of chemical treatment of the western spruce budworm in Idaho. In: Sanders, C. J.; and others, eds. Recent advances in spruce budworms research: Proceedings of the CANUSA spruce budworms research symposium; 1984 September 16-20; Bangor, ME. Ottawa, ON: Canadian Forestry Service and U.S. Department of Agriculture, Forest Service; 1985: 380-383.
- Markin, George P.; Johnson, David R. Aerial field tests of five insecticides on western spruce budworm in Idaho and Montana, 1978-1980. Res. Note PSW-385. Berkeley, CA: U.S. Department of Agriculture, Forest Service, Pacific Southwest Forest and Range Experiment Station; 1986. 5 p.
- Martignoni, Mauro E.; Iwai, Paul J. Laboratory evaluation of new ultraviolet absorbers for protection of Douglas-fir tussock moth (Lepidoptera: Lymantriidae) *Baculovirus*. *Journal of Economic Entomology*. 78: 982-987; 1985.
- Martignoni, Mauro E.; Iwai, Paul J. Propagation of multicapsid nuclear polyhedrosis virus of *Orgyia pseudotsugata* in larvae of *Trichoplusia ni*. *Journal of Invertebrate Pathology*. 47(1): 32-41; 1986.
- Mastro, V. C.; Schwalbe, C. P.; O'Dell, T. M. An operationally feasible sterile insect technique. Gypsy Moth News #10. Broomall, PA: U.S. Department of Agriculture, Forest Service; 1985: 13-15.
- Murphy, C. F. Effects on woodland ants of the carbaryl treatment of the western spruce budworm in Oregon. In: Sanders, C. J.; and others, eds. Recent advances in spruce budworms research: Proceedings of the CANUSA spruce budworms research symposium; 1984 September 16-20; Bangor, ME. Ottawa, ON: Canadian Forestry Service and U.S. Department of Agriculture, Forest Service; 1985: 478.
- Nakamoto, R. J.; Page, M. Simplified determination of carbaryl in rainbow trout liver tissue. *Bulletin of Environmental Contamination and Toxicology*. 37(3): 415-420; 1986.
- Nord, John C.; Jones, Alice S.; Hastings, Felton L. Field tests of insecticides for control of black turpentine beetle. In: Branham, Susan J.; Thatcher, Robert C., eds. Integrated pest management research symposium: The proceedings; 1985 April 15-18; Asheville, NC. Gen. Tech. Rep. SO-56. New Orleans, LA: U.S. Department of Agriculture, Forest Service, Southern Forest Experiment Station; 1985: 272-280.

- Oregon State University Extension Service. The gypsy moth in Oregon: potential effects and management options. Corvallis, OR: Oregon State University Extension Service; 1986. 16 p.
- Podgwaite, J. D.; Shapiro, M. Evaluation of sunlight protectants for gypsy moth, *Lymantria dispar* L., nucleopolyhedrosis virus. In: Samson, R. A.; Vlask, J. M.; Peters, D; eds. Fundamentals and applied aspects of invertebrate pathology; 1986 August 17-22; Looijen, Netherlands. Looijen, Netherlands: Ponson and Looijen; 1986: 154.
- Reardon, R. C.; Barrett, L. J.; Koerber, T. W.; Stipe, L. E.; Dewey, J. E. Implantation and injection of systemics to suppress seed and cone insects in Douglas-fir in Montana. The Canadian Entomologist. 117: 961-969; 1985.
- Reardon, R. C.; Kaya, H. A.; Fusco, R. A.; Lewis, F. B. Evaluation of *Steinernema feltiae* and *S. bibionis* (Rhabditida: Steinernematidae) for suppression of *Lymantria dispar* (Lepidoptera: Lymantriidae) in Pennsylvania, U.S.A. Agriculture, Ecosystems and Environment. 15(1): 1-10; 1986.
- Reeves, Robert G.; McDaniel, C. A.; Ford, Joseph H. Organic and inorganic bromide residues in spices fumigated with methyl bromide. Journal of Agriculture and Food Chemistry. 33: 780-783; 1985.
- Richmond, C. E. Effectiveness of Norpine-65 for protection of lodgepole pines from mountain pine beetle for two years. Insecticide and Acaricide Tests, vol. 11. College Park, MD: Entomological Society of America; 1986: 424-425.
- Richmond, C. E. Effectiveness of two pine oils for protecting lodgepole pine from attack by mountain pine beetle (Coleoptera: Scolytidae). The Canadian Entomologist. 117: 1445-1446; 1985.
- Robertson, J. L.; Stock, M. W. Computer prediction of insecticide efficacy for western spruce budworm and Douglas-fir tussock moth. Tech. Rep. PSW-89. Berkeley, CA: U.S. Department of Agriculture, Forest Service, Pacific Southwest Forest and Range Experiment Station; 1986. 11 p.
- Robertson, J. L.; Richmond, C. E.; Preisler, H. K. Lethal and sublethal effects of evermectin B1 on the western spruce budworm (Lepidoptera: Tortricidae). Journal of Economic Entomology. 78: 1129-1123; 1985.
- Robertson, Jacqueline L.; McLean, John A. Correspondence on the LC₅₀ for arsenic trioxide in a diet-incorporation experiment with the quantity of arsenic ingested as measured by X-ray, energy-dispersive spectrometry. Journal of Economic Entomology. 78: 1035-1036; 1985.
- Robertson, Jacqueline L.; Preisler, Haigounous K. WRD-473 (An experimental benzoylphenylurea): rates and optimal time of application to western spruce budworm. Journal of Entomological Sciences. 21(1): 16-20; 1986.
- Sartwell, Charles; Daterman, Gary. Control of forest insects with synthetic pheromones: status and prospects in western North America. In: Summaries of the proceedings of the 1985 western forestry conference; 1985 December 1-4; Spokane, WA. Portland, OR: Western Forestry and Conservation Association; 1986: 69.
- Schmid, J. M. Percentage of parasitism of the western spruce budworm: in tree crowns and following a suppression project. In: Sanders, C. J.; and others, eds. Recent advances in spruce budworm research: Proceedings of the CANUSA spruce budworms research symposium; 1984 September 16-20; Bangor, ME. Ottawa, ON: Canadian Forestry Service and U.S. Department of Agriculture, Forest Service; 1985: 103.
- Schmidt, C. D.; Robertson, J. L. Effects of the treatment techniques on response of horn flies (Diptera: Muscidae) to permethrin at different temperatures. Journal of Economic Entomology. 79: 684-687; 1986.
- Schmidt, W. C. Silviculture--solution to budworm problems in the inland mountain West. In: Sanders, C. J.; and others, eds. Recent advances in spruce budworm research: Proceedings of the CANUSA spruce budworms research symposium; 1984 September 16-20; Bangor, ME. Ottawa, ON: Canadian Forestry Service and U.S. Department of Agriculture, Forest Service; 1985: 367.
- Schmidt, Wyman C. Historical considerations. In: Brookes, Martha H.; Colbert, J. J.; Mitchell, Russel G.; Stark, R. W., tech. coords. Managing trees and stands susceptible to western spruce budworm. Tech. Bull. 1695. Washington, DC: U.S. Department of Agriculture; 1985: 1-5.
- Shea, Patrick J.; Fellin, David G. Chemical insecticides. In: Brookes, Martha H.; Colbert, J. J.; Mitchell, Russel G.; Stark, R. W., tech. coords. Managing trees and stands susceptible to western spruce budworm. Tech. Bull. 1695. Washington, DC: U.S. Department of Agriculture; 1985: 58-61.
- Smith, K. C.; Robertson, J. L.; Savin, N. E. Maximum likelihood vs. minimum chi-square. Response. Biometrics. 41: 781-783; 1985.
- Smith, R. H. Trapping western pine beetles with baited toxic trees. Res. Note PSW-382. Berkeley, CA: U.S. Department of Agriculture, Forest Service, Pacific Southwest Forest and Range Experiment Station; 1986. 9 p.
- Stage, A. R. Integration of forest and pest management: implications for forest management--the western view. In: Sanders, C. J.; and others, eds. Recent advances in spruce budworms research: Proceedings of the CANUSA spruce budworms research symposium; 1984 September 16-20; Bangor, ME. Ottawa, ON: Canadian Forestry Service and U.S. Department of Agriculture, Forest Service; 1985: 465-469.

- Stage, Albert R.; Johnson, Ralph; Colbert, J. J. Selecting management tactics. In: Brookes, Martha H.; Colbert, J. J.; Mitchell, Russel G.; Stark, R. W., tech. coords. Managing trees and stands susceptible to western spruce budworm. Tech. Bull. 1695. Washington, DC: U.S. Department of Agriculture; 1985: 71-80.
- Stairs, G. R. Adaptation of wax moth baculovirus to the western spruce budworm. In: Sanders, C. J.; and others, eds. Recent advances in spruce budworms research: Proceedings of the CANUSA spruce budworms research symposium; 1984 September 16-20; Bangor, ME. Ottawa, ON: Canadian Forestry Service and U.S. Department of Agriculture, Forest Service; 1985: 388-389.
- Stelzer, M. J.; Scott, D. W. Evaluation of hydraulically applied baculovirus preparations to control western spruce budworm (Lepidoptera: Tortricidae) on grand fir. Journal of Economic Entomology. 78: 1105-1108; 1985.
- Stipe, L. E. Budworm management in Montana. In: Sanders, C. J.; and others, eds. Recent advances in spruce budworms research: Proceedings of the CANUSA spruce budworms research symposium; 1984 September 16-20; Bangor, ME. Ottawa, ON: Canadian Forestry Service and U.S. Department of Agriculture, Forest Service; 1985: 377-378.
- Stipe, L. E. Reducing Douglas-fir seed and cone damage. In: Sanders, C. J.; and others, eds. Recent advances in spruce budworms research: Proceedings of the CANUSA spruce budworms research symposium; 1984 September 16-20; Bangor, ME. Ottawa, ON: Canadian Forestry Service and U.S. Department of Agriculture, Forest Service; 1985: 489-490.
- Stock, M. W. Predicting response of western spruce budworm to insecticides. In: Sanders, C. J.; and others, eds. Recent advances in spruce budworms research: Proceedings of the CANUSA spruce budworms research symposium; 1984 September 16-20; Bangor, ME. Ottawa, ON: Canadian Forestry Service and U.S. Department of Agriculture, Forest Service; 1985: 374-375.
- Stoszek, K. J. Considerations for design of silviculture measures to reduce western spruce budworm hazard. In: Sanders, C. J.; and others, eds. Recent advances in spruce budworms research: Proceedings of the CANUSA spruce budworms research symposium; 1984 September 16-20; Bangor, ME. Ottawa, ON: Canadian Forestry Service and U.S. Department of Agriculture, Forest Service; 1985: 363-364.
- Thatcher, R. C.; Mason, G. N.; Hertel, G. D. Integrated pest management in southern pine forests. Agric. Handb. 650. Washington, DC: U.S. Department of Agriculture; 1986. 38 p.
- Valentine, Harry T.; Dubois, Normand R.; Podgwaite, John D. Optimizing the timing of applications on Bt to control the gypsy moth: a modeling analysis. In: Fundamental and applied aspects of invertebrate pathology; 1986 August 18-22; Veldhoven, Netherlands. Wageningen, Netherlands: Foundation of the Fourth International Colloquium of Invertebrate Pathology; 1986: 580-583.
- Werner, Richard A.; Hastings, Felton L.; Holsten, Edward H.; Jones, Alice S. Carbaryl and lindane protect white spruce from attack by spruce beetles (Coleoptera: Scolytidae) for three growing seasons. Journal of Economic Entomology. 79(4): 1121-1124; 1986.
- Williams, Carroll B., Jr.; Sharpnack, David A.; Maxwell, Liz; Shea, Patrick J.; McGregor, Mark D. Guide to testing insecticides on coniferous forest defoliators. Gen. Tech. Rep. PSW-85. Berkeley, CA: U.S. Department of Agriculture, Forest Service, Pacific Southwest Forest and Range Experiment Station; 1985. 38 p.
- Wilson, Louis F.; Moore, Lincoln M. Preference for some nursery-grown hybrid *Populus* trees by the spotted poplar aphid and its suppression by insecticidal soaps (Homoptera: Aphididae). The Great Lakes Entomologist. 19(1): 21-26; 1986.
- ### Disease Detection and Evaluation
- Anderson, Robert L.; Cost, Noel D.; McClure, Joe P.; Ryan, George. Predicting severity of fusiform rust in young loblolly and slash pine stands in Florida, Georgia, and the Carolinas. Southern Journal of Applied Forestry. 10(1): 38-41; 1986.
- Anderson, Robert L.; McClure, Joe P.; Cost, Noel D.; Huber, Cindy M. Disease losses in North Carolina: forests. In: 1985 estimates of crop losses in North Carolina due to plant diseases and nematodes. Spec. Publ. 5. Raleigh, NC: North Carolina State University, Department of Plant Pathology; 1986: 175-183.
- Barrows-Broadbudd, Jane; Dwinell, L. D. Branch dieback and cone and seed infection caused by *Fusarium moniliforme* var. *subglutinans* in a loblolly pine seed orchard in South Carolina. Phytopathology. 75(10): 1104-1108; 1985.
- Berry, Frederick H. Anthracnose diseases of eastern hardwoods. For. Ins. Dis. Leaflet 133. Washington: U.S. Department of Agriculture, Forest Service; 1985. 8 p.
- Blackwell, M.; Perry, T. J.; Bridges, J. R.; Moser, J. C. A new species of *Pyxidiophora* and its *Thaxteriola* anamorph. Mycologia. 78: 605-612; 1986.
- Cannon, William N., Jr.; Barger, Jack H.; Groth, Laurie L. Seasonal detection of visible Dutch elm disease symptoms. Journal of Arboriculture. 11(8): 233, 235; 1985.
- Edmonds, R. L.; Hinshaw, R. W.; Leslie, K. B. A 24-hour deposition sampler for spores of *Heterobasidion annosum*. Phytopathology. 74: 1032-1034; 1984.
- Filip, Gregory M. Symptom expression of root-diseased trees in mixed-conifer stands in central Washington. Western Journal of Applied Forestry. 1(2): 46-48; 1986.

- Francis, John K.; McCracken, Francis I. The decline and mortality of cottonwood clone Stoneville 124 on a clay soil. Res. Note SO-318. New Orleans, LA: U.S. Department of Agriculture, Forest Service, Southern Forest Experiment Station; 1985. 3 p.
- Froelich, R. C.; Snow, G. A. Predicting site hazard to fusiform rust. Forest Science. 35(1): 31-35; 1986.
- Gardner, D. E.; Hodges, C. S. Distinctive spore morphology of Hawaiian Acacia rusts. Mycologia. 77: 575-586; 1985.
- Gardner, D. E.; Hodges, C. S. Hawaiian forest fungi. 7: A new species of Elsinoe on native Vaccinium. Mycologia. 78: 506-508; 1986.
- Gregory, Robert A.; Wargo, Philip M. Timing of defoliation and its effect on bud development, starch reserves, and sap sugar concentration in sugar maple. Canadian Journal of Forest Research. 16: 10-17; 1986.
- Griggs, Margene M.; Schmidt, Robert A. Disease progress of Scirrhia acicola in single and mixed family plantings of resistant and susceptible longleaf pine. In: Research on conifer needle diseases conference; 1984 October 14-18; Gulfport, MS. Gen. Tech. Rep. WO-50. Washington, DC: U.S. Department of Agriculture, Forest Service; 1985: 5-10.
- Hawksworth, F. G.; Scharpf, R. F. Spread of European mistletoe (Viscum album) in California. U.S.A. European Journal of Forest Pathology. 16: 1-5; 1986.
- Hinds, T. E.; Shepperd, W. D. Dothiora polyspora on aspen. Disease Notes, Plant Disease. 69: 1100; 1986.
- Hodges, C. S. Diseases of eastern white pine. In: Funk, David T., comp. Eastern white pine: today and tomorrow: Symposium proceedings; 1985 June 12-14; Durham, NH. Gen. Tech. Rep. WO-51. Washington, DC: U.S. Department of Agriculture, Forest Service; 1986: 93-98.
- Hodges, Charles S., Jr. Hawaiian forest fungi, vol. 6: a new species of Brasiliomyces on Sapindus oahuensis. Mycologia. 77(6): 977-981; 1985.
- Hoff, R. J. Susceptibility of pine populations to western gall rust--central Idaho. Res. Note INT-354. Ogden, UT: U.S. Department of Agriculture, Forest Service, Intermountain Forest and Range Experiment Station; 1986. 7 p.
- Huber, Cindy M.; McClure, Joe P.; Cost, Noel D. Incidence and impact of damage to North Carolina's timber, 1984. Resour. Bull. SE-82. Asheville, NC: U.S. Department of Agriculture, Forest Service, Southeastern Forest Experiment Station; 1985. 27 p.
- Hutchins, Anita Stiebrs; Fay, Harlan; Kuntuson, Don. A selective medium for Phellinus weirii. Canadian Journal of Forest Research. 15: 746-748; 1985.
- Johnson, David W.; Riffle, Jerry W. Wetwood (slime flux) of elm, cottonwood, and mulberry. In: Riffle, Jerry W.; Peterson, Glenn W., tech. coords. Diseases of trees in the Great Plains. Gen. Tech. Rep. RM-129. Fort Collins, CO: U.S. Department of Agriculture, Forest Service, Rocky Mountain Forest and Range Experiment Station; 1986: 64-65.
- Kais, Albert G.; Peterson, Glenn W. Brown spot needle blight of pines. In: Riffle, Jerry W.; Peterson, Glenn W., tech. coords. Diseases of trees in the great plains. Gen. Tech. Rep. RM-129. Fort Collins, CO: U.S. Department of Agriculture, Forest Service, Rocky Mountain Forest and Range Experiment Station; 1986: 118-119.
- Knutson, Donald; Tinnin, Robert. Effects of dwarf mistletoe on the response of young Douglas-fir to thinning. Canadian Journal of Forest Research. 16: 30-35; 1986.
- Kuhlman, E. G. Impact of annosus root rot minimal 22 years after planting pines on root rot infested sites. Southern Journal of Applied Forestry. 10(2): 96-98; 1986.
- Larsen, Michael J.; Lombard, Frances F.; Hodges, Charles S., Jr. Hawaiian forest fungi, vol. 5: a new species of Phellinus (Hymenochaetaceae) causing decay of casuarina and acacia. Mycologia. 77(3): 345-352; 1985.
- McCracken, F. I. Oak decline and mortality in the Southeast. In: Third symposium of southeastern hardwoods; 1985 April 16-17; Dothan, AL. Atlanta, GA: U.S. Department of Agriculture, Forest Service, Southern Region; 1985: 77-81.
- McCracken, F. I. Observations on the decline and death of southern magnolia. Journal of Arboriculture. 11(9): 253-256; 1985.
- Mielke, Manfred E.; Houston, Daniel B.; Houston, David R. First report of Cryptococcus fagisuga, initiator of beech bark disease, in Virginia and Ohio. Plant Disease. 69: 905; 1985.
- Miller, Donald J.; Knutson, Donald M.; Tocher, Richard D. Chemical brown staining of Douglas-fir sapwood. Forest Products Journal. 33(4): 44-48; 1983.
- Nelson, E. E.; Thies, W. G., Li, C. Y. Are seed and cone pathogens causing significant losses in Pacific Northwest seed orchards? Res. Note PNW-436. Portland, OR: U.S. Department of Agriculture, Forest Service, Pacific Northwest Forest and Range Experiment Station; 1986. 5 p.
- Oren, Ram; Thies, Walter G.; Waring, Richard H. Tree vigor and stand growth of Douglas-fir as influenced by laminated root rot. Canadian Journal of Forest Research. 15: 985-988; 1985.

- Ostrofsky, Andrea; Peterson, Glenn W. Kabatina tip blight of junipers. In: Riffle, Jerry W.; Peterson, Glenn W., tech. coords. Diseases of trees in the Great Plains. Gen. Tech. Rep. RM-129. Fort Collins, CO: U.S. Department of Agriculture, Forest Service, Rocky Mountain Forest and Range Experiment Station; 1986. 116-117.
- Peterson, Glenn W. Phomopsis blight of junipers. In: Riffle, Jerry W.; Peterson, Glenn W., tech. coords. Diseases of trees in the Great Plains. Gen. Tech. Rep. RM-129. Fort Collins, CO: U.S. Department of Agriculture, Forest Service, Rocky Mountain Forest and Range Experiment Station; 1986: 112-113.
- Peterson, Glenn W.; Johnson, David W. Diplodia blight of pines. In: Riffle, Jerry W.; Peterson, Glenn W., tech. coords. Diseases of trees in the Great Plains. Gen. Tech. Rep. RM-129. Fort Collins, CO: U.S. Department of Agriculture, Forest Service, Rocky Mountain Forest and Range Experiment Station; 1986: 128-129.
- Peterson, Glenn W.; Johnson, David W. Western X-disease of chokecherry. In: Riffle, Jerry W.; Peterson, Glenn W., tech. coords. Diseases of trees in the Great Plains. Gen. Tech. Rep. RM-129. Fort Collins, CO: U.S. Department of Agriculture, Forest Service, Rocky Mountain Forest and Range Experiment Station; 1986. 24-25.
- Peterson, Glenn W.; Maier, Charles. Phymatotrichum root rot. In: Riffle, Jerry W.; Peterson, Glenn W., tech. coords. Diseases of trees in the Great Plains. Gen. Tech. Rep. RM-129. Fort Collins, CO: U.S. Department of Agriculture, Forest Service, Rocky Mountain Forest and Range Experiment Station; 1986. 106-107.
- Peterson, Glenn W.; Morton, Harrison L. Botryodiplodia disease of Russian-olive. In: Riffle, Jerry W.; Peterson, Glenn W., tech. coords. Diseases of trees in the Great Plains. Gen. Tech. Rep. RM-129. Fort Collins, CO: U.S. Department of Agriculture, Forest Service, Rocky Mountain Forest and Range Experiment Station; 1986: 42-43.
- Peterson, Glenn W.; Riffle, Jerry W. Cylindrosporium leaf spot of buffaloberry and skunkbush sumac. In: Riffle, Jerry W.; Peterson, Glenn W., tech. coords. Diseases of trees in the Great Plains. Gen. Tech. Rep. RM-129. Fort Collins, CO: U.S. Department of Agriculture, Forest Service, Rocky Mountain Forest and Range Experiment Station; 1986: 32.
- Peterson, Glenn W.; Riffle, Jerry W. Root lesion nematodes in junipers and pines. In: Riffle, Jerry W.; Peterson, Glenn W., tech. coords. Diseases of trees in the Great Plains. Gen. Tech. Rep. RM-129. Fort Collins, CO: U.S. Department of Agriculture, Forest Service, Rocky Mountain Forest and Range Experiment Station; 1986. 140-141.
- Peterson, Glenn W.; Stack, Robert W. Melampsora leaf rust of cottonwood and willow. In: Riffle, Jerry W.; Peterson, Glenn W., tech. coords. Diseases of trees in the Great Plains. Gen. Tech. Rep. RM-129. Fort Collins, CO: U.S. Department of Agriculture, Forest Service, Rocky Mountain Forest and Range Experiment Station; 1986: 4-5.
- Peterson, Glenn W.; Walla, James A. Naemacyclus (Cyclaneusma) needle cast of pines. In: Riffle, Jerry W.; Peterson, Glenn W., tech. coords. Diseases of trees in the Great Plains. Gen. Tech. Rep. RM-129. Fort Collins, CO: U.S. Department of Agriculture, Forest Service, Rocky Mountain Forest and Range Experiment Station; 1986. 122-123.
- Peterson, Glenn W.; Walla, James A. Western gall rust of pines. In: Riffle, Jerry W.; Peterson, Glenn W., tech. coords. Diseases of trees in the Great Plains. Gen. Tech. Rep. RM-129. Fort Collins, CO: U.S. Department of Agriculture, Forest Service, Rocky Mountain Forest and Range Experiment Station; 1986. 126-127.
- Peterson, Glenn W.; Wysong, David S. Cercospora blight of junipers. In: Riffle, Jerry W.; Peterson, Glenn W., tech. coords. Diseases of trees in the Great Plains. Gen. Tech. Rep. RM-129. Fort Collins, CO: U.S. Department of Agriculture, Forest Service, Rocky Mountain Forest and Range Experiment Station; 1986: 114-115.
- Peterson, Glenn W.; Wysong, David S. Dothistroma blight of pines. In: Riffle, Jerry W.; Peterson, Glenn W., tech. coords. Diseases of trees in the Great Plains. Gen. Tech. Rep. RM-129. Fort Collins, CO: U.S. Department of Agriculture, Forest Service, Rocky Mountain Forest and Range Experiment Station; 1986: 120-121.
- Powers, H. R., Jr. Rusts of pines in North America. In: Ko, Je-Ho; La, Yong-Joon, comps., eds. Proceedings of the joint conference of IUFRO working parties on forest gall midges and rusts of pines, working parties S2. 07-08 & S2. 06-10; 1985 September 16-21; Seoul, KO. Suweon, KO: Korean Forestry Society, c/o College of Agriculture, Seoul National University; 1985: 1-12.
- Powers, H. R., Jr.; Stone, D. M. Incidence of fusiform rust infection on loblolly pine related to tip moth damage. In: Ko, Je-Ho; La, Yong-Joon; comps., eds. Proceedings of the joint conference of IUFRO working parties on forest gall midges and rusts of pines, working parties S2. 07-08 & S2. 06-10; 1985 September 16-21; Seoul, KO. Suweon, KO: Korean Forestry Society, c/o College of Agriculture, Seoul National University; 1985: 129-134.

- Riffle, Jerry W.; Conway, Kenneth E. Phellinus stem decays of hardwoods. In: Riffle, Jerry W.; Peterson, Glenn W., tech. coords. Diseases of trees in the Great Plains. Gen. Tech. Rep. RM-129. Fort Collins, CO: U.S. Department of Agriculture, Forest Service, Rocky Mountain Forest and Range Experiment Station; 1986: 83-85.
- Riffle, Jerry W.; Crowe, Frederick J. Pine wilt disease. In: Riffle, Jerry W.; Peterson, Glenn W., tech. coords. Diseases of trees in the Great Plains. Gen. Tech. Rep. RM-129. Fort Collins, CO: U.S. Department of Agriculture, Forest Service, Rocky Mountain Forest and Range Experiment Station; 1986: 138-139.
- Riffle, Jerry W.; Krupinsky, Joseph M. Botryodiplodia canker of elms. In: Riffle, Jerry W.; Peterson, Glenn W., tech. coords. Diseases of trees in the Great Plains. Gen. Tech. Rep. RM-129. Fort Collins, CO: U.S. Department of Agriculture, Forest Service, Rocky Mountain Forest and Range Experiment Station; 1986: 38-39.
- Riffle, Jerry W.; Krupinsky, Joseph M. Nematodes of broadleaf trees. In: Riffle, Jerry W.; Peterson, Glenn W., tech. coords. Diseases of trees in the Great Plains. Gen. Tech. Rep. RM-129. Fort Collins, CO: U.S. Department of Agriculture, Forest Service, Rocky Mountain Forest and Range Experiment Station; 1986: 110-111.
- Riffle, Jerry W.; Peterson, Glenn W., tech. coords. Diseases of trees in the Great Plains. Gen. Tech. Rep. RM-129. Fort Collins, CO: U.S. Department of Agriculture, Forest Service, Rocky Mountain Forest and Range Experiment Station; 1986: 149 p.
- Riffle, Jerry W.; Walla, James A. Perennial woodrotting fungi that cause stem decays of hardwoods. In: Riffle, Jerry W.; Peterson, Glenn W., tech. coords. Diseases of trees in the Great Plains. Gen. Tech. Rep. RM-129. Fort Collins, CO: U.S. Department of Agriculture, Forest Service, Rocky Mountain Forest and Range Experiment Station; 1986: 80-82.
- Riffle, Jerry W.; Watkins, John E. Honeysuckle leaf blight. In: Riffle, Jerry W.; Peterson, Glenn W., tech. coords. Diseases of trees in the Great Plains. Gen. Tech. Rep. RM-129. Fort Collins, CO: U.S. Department of Agriculture, Forest Service, Rocky Mountain Forest and Range Experiment Station; 1986: 26-29.
- Riffle, Jerry W.; Wysong, David S. Septoria canker of cottonwood and hybrid poplars. In: Riffle, Jerry W.; Peterson, Glenn W., tech. coords. Diseases of trees in the Great Plains. Gen. Tech. Rep. RM-129. Fort Collins, CO: U.S. Department of Agriculture, Forest Service, Rocky Mountain Forest and Range Experiment Station; 1986: 50-51.
- Scharpf, R. F.; Hawksworth, F. G. Exotic pines infected by two dwarf mistletoes in southern California. Plant Disease. 70(2): 173; 1986.
- Scharpf, Robert F. Effect of a foliage disease caused by Lirula abietis-concoloris on growth of white fir in California. Plant Disease. 70(1): 13-14; 1986.
- Scharpf, Robert F.; Vogler, Detlev. Western dwarf mistletoe infects understory Jeffrey pine seedlings on Cleveland National Forest, California. Res. Note PSW-386. Berkeley, CA: U.S. Department of Agriculture, Forest Service, Pacific Southwest Forest and Range Experiment Station; 1986: 2 p.
- Sharon, Edward M.; Riffle, Jerry W. Antrrodia stem decay of eastern redcedar. In: Riffle, Jerry W.; Peterson, Glenn W., tech. coords. Diseases of trees in the Great Plains. Gen. Tech. Rep. RM-129. Fort Collins, CO: U.S. Department of Agriculture, Forest Service, Rocky Mountain Forest and Range Experiment Station; 1986: 134-135.
- Sharon, Edward M.; Riffle, Jerry W. Tar spot of maple. In: Riffle, Jerry W.; Peterson, Glenn W., tech. coords. Diseases of trees in the Great Plains. Gen. Tech. Rep. RM-129. Fort Collins, CO: U.S. Department of Agriculture, Forest Service, Rocky Mountain Forest and Range Experiment Station; 1986: 12-13.
- Shaw, Charles G., III; Stage, Albert R.; Webb, Timothy M. Development of a root disease subroutine for use with stand growth models of western forests. In: Thies, Walter G., comp. Proceedings, 33d annual international forest disease work conference; 1985 September 24-27; Olympia, WA. Corvallis, OR: Oregon State University, Department of Printing; 1986: 48-54.
- Shea, Patrick J. Impact of insects on cone/seed production in three blister rust-resistant western white pine seed orchards. In: Conifer tree seed in the inland mountain West symposium; 1985 August 5-9; Missoula, MT. Ogden, UT: U.S. Department of Agriculture, Forest Service, Intermountain Forest and Range Experiment Station; 1986: 256-259.
- Shigo, A. L.; Shortle, W. C. Shigometry: a reference guide. Agric. Handb. 646. Washington, DC: U.S. Department of Agriculture, Forest Service; 1985: 48 p.
- Shortle, W. C. Pathological losses. In: Proceedings of the 1985 Penn State forest resources issues conference; 1985 March 19-20; University Park, PA. University Park, PA: Cooperative Extension Service, The Pennsylvania State University; 1985: 117-123.
- Snow, G. A. A needle blight of slash and loblolly pines in south Mississippi. In: Recent research on conifer needle diseases; 1984 October 14-18; Gulfport, MS. Gen. Tech. Rep. WO-50. Washington, DC: U.S. Department of Agriculture, Forest Service; 1985: 20-21.
- Snow, G. A.; Wells, O. O.; Switzer, G. L. Fusiform rust gradient in a loblolly pine plantation. Forest Science. 32(2): 372-376; 1986.

- Stack, Robert W.; Riffle, Jerry W. *Mycosphaerella* leaf spots of ash. In: Riffle, Jerry W.; Peterson, Glenn W., tech. coords. Diseases of trees in the Great Plains. Gen. Tech. Rep. RM-129. Fort Collins, CO: U.S. Department of Agriculture, Forest Service, Rocky Mountain Forest and Range Experiment Station; 1986: 14-15.
- Thies, Walter G., comp. Proceedings of the 33d annual western international forest disease work conference; 1985 September 24-27; Olympia, WA. Corvallis, OR: Oregon State University; 1985. 160 p.
- Walla, James A.; Riffle, Jerry W. Gymnosporangium rusts on junipers. In: Riffle, Jerry W.; Peterson, Glenn W., tech. coords. Diseases of trees in the Great Plains. Gen. Tech. Rep. RM-129. Fort Collins, CO: U.S. Department of Agriculture, Forest Service, Rocky Mountain Forest and Range Experiment Station; 1986: 136-137.
- Williams, R. E.; Shaw, C. G. III; Wargo, P. M.; Sites, W. H. Armillaria root disease. For. Ins. Dis. Leaflet 78. Washington, DC: U.S. Department of Agriculture, Forest Service; 1986. 8 p.
- Disease Biology**
- Anderson, R. L.; Walkinshaw, C. H. Susceptibility of longleaf pine seedlings to *Cronartium quercuum* f. sp. *fusiforme*. Plant Disease. 70(1): 50-51; 1986.
- Broshot, Nancy E.; Tinnin, Robert O. The effect of dwarf mistletoe on starch concentrations in the twigs and needles of lodgepole pine. Canadian Journal of Forest Research. 16: 658-660; 1986.
- Cheng-Guo, Wang; Blanchette, Robert A.; Jackson, William A.; Palmer, Marguerita A. Differences in conidial morphology among isolates of *Sphaeropsis sapinea*. Plant Disease. 69(10): 838-841; 1985.
- Entry, James A.; Martin, Neal [Neil] E.; Cromack, Kermit, Jr.; Stafford, Susan G. Light and nutrient limitation in *Pinus monticola*: seedling susceptibility to *Armillaria* infection. In: Thies, Walter G., comp. Proceedings, 33d annual western international forest disease work conference; 1985 September 24-27; Olympia, WA. Corvallis, OR: Oregon State University, Department of Printing; 1986: 83-88.
- Ettinger, Terry L.; Read, Paul E.; Hackett, Wesley P.; Ostry, Michael E.; Skilling, Darroll D. Development of resistance in *Populus* to *Septoria musiva* utilizing somaclonal variation. In: Caron, F.; Corriveau, A. G.; Boyle, I. J. B., eds. Proceedings, 20th meeting of the Canadian Tree Improvement Association. Part 2: Symposium on new ways in forest genetics; 1985 August 19-22; Quebec City, PQ. Ottawa, ON: Canadian Forestry Service; 1986: 83-90.
- Graves, C. H. MacGown, M. W.; Hedin, P. A.; Filer, T. H. Histochemical localization of juglone and related constituents of pecan. Phytopathology. 76(2): 205-208; 1986.
- Hess, Wilford M.; Nelson, David L.; Sturges, David L. Morphology and ultrastructure of a snowmold fungus on sagebrush (*Artemisia tridentata*). Mycologia. 77(4): 637-645; 1985.
- Hodges, Charles S., Jr.; Alfenas, Acelino C.; Ferreira, Francisco A. The conspecificity of *Cryphonectria cubensis* and *Endothia eugeniae*. Mycologia. 78(3): 343-350; 1986.
- Hodges, Charles S.; Adee, Ken T.; Stein, John D.; Wood, Hulton B.; Doty, Robert D. Decline of ohia (*Metrosideros polymorpha*) in Hawaii: a review. Gen. Tech. Rep. PSW-86. Berkeley, CA: U.S. Department of Agriculture, Forest Service, Pacific Southwest Forest and Range Experiment Station; 1986: 22 p.
- James, R. L.; Militante, E. P.; Wood, J. Y.; Gilligan, C. J. Pathogenicity of *Fusarium* from forest seedling nurseries on Douglas-fir and ponderosa pine seedlings. Rep. 86-8. Missoula, MT: U.S. Department of Agriculture, Forest Service, Northern Region; 1986. 12 p.
- Kessler, Kenneth J., Jr. *Mycosphaerella* leaf spot of black walnut. Plant Disease. 69(12): 1092-1094; 1985.
- Knutson, Donald M. Physiology of mistletoe parasitism and disease responses in the host. In: Calder, Malcolm; Bernhardt, Peter, eds. The biology of mistletoes. Sydney and New York: Academic Press; 1983: 295-316.
- Lewis, R., Jr. Sapwood inhabiting canker fungi in healthy and oak wilt-infected *Quercus* spp. Journal of the Mississippi Academy of Sciences. 30: 93-97; 1985.
- McDonald, G. I. Ecological genetics of *Armillaria*-conifer interactions. In: Thies, Walter T., comp. Proceedings, 33d annual western international forest disease work conference; 1985 September 24-27; Olympia, WA. Corvallis, OR: Oregon State University, Department of Printing; 1986: 29-31.
- Nelson, E. E.; Fay, H. A. Maintaining cultures of wood-rotting fungi. Res. Note PNW-428. Portland, OR: U.S. Department of Agriculture, Forest Service, Pacific Northwest Forest and Range Experiment Station; 1985. 3 p.
- Nicholls, Thomas H.; Palmer, Marguerita A.; Ostry, Michael E. *Mycosphaerella laricina* needlecast of *Larix decidua* in the United States. In: Peterson, Glenn W., tech. coord. Recent research on conifer needle diseases: Conference proceedings; 1984 October 14-18; Gulfport, MS. Gen. Tech. Rep. WO-50. Washington, DC: U.S. Department of Agriculture, Forest Service; 1986: 60-61.
- Niyo, K. A.; McNabb, H. S., Jr.; Tiffany, L. H. Ultrastructure of the ascocarps, asci, and ascospores of *Mycosphaerella populorum*. Mycologia. 78(2): 202-212; 1986.

- Ossenbruggen, S. J.; Peters, M. A.; Shigo, A. L. Potential failure of a decayed tree under wind loading. *Wood and Fiber Science*. 18(1): 168-186; 1986.
- Ostry, Michael E. Association of *Parkerella populii* with declining hybrid aspen in Wisconsin. *Canadian Journal of Botany*. 64(8): 1834-1835; 1986.
- Ostry, Michael E.; McNabb, Harold S., Jr. *Populus* species and hybrid clones resistant to *Melampsora*, *Marssonina*, and *Septoria*. Res. Pap. NC-272. St. Paul, MN: U.S. Department of Agriculture, Forest Service, North Central Forest Experiment Station; 1986. 7 p.
- Ostry, Michael E.; McNabb, Harold S., Jr. Susceptibility of *Populus* species and hybrids to disease in the North Central United States. *Plant Disease*. 69(9): 755-757; 1985.
- Otrosina, William J. Isozyme polymorphism in *Fomes annosus* [*Heterobasidion annosum*]. In: *Proceedings: 33d annual western international forest disease work conference*; 1985 September 24-27; Olympia, WA. Olympia, WA: Oregon State University; 1985: 97-99.
- Palmer, M. A.; Nicholls, T. H. Shoot blight and collar rot of *Pinus resinosa* caused by *Sphaeropsis sapinea* in forest tree nurseries. *Plant Disease*. 69(9): 739-740; 1985.
- Peters, M.; Ossenbruggen, S.; Shigo, A. Cracking and failure behavior models of defective balsam fir trees. *Holzforschung*. 39(3): 125-135; 1985.
- Peterson, Glenn W. Resistance to *Phomopsis juniperovora* in geographic seed sources of *Juniperus virginiana*. In: Peterson, Glenn W., tech. coord. Recent research on conifer needle diseases: Proceedings, International Union of Forestry Research Organizations working party on needle diseases conference; 1984 October 14-18; Gulfport, MS. Gen. Tech. Rep. WO-50. Washington, DC: U.S. Department of Agriculture, Forest Service; 1986: 65-69.
- Peterson, Glenn W., tech. coord. Recent research on conifer needle diseases: Proceedings, International Union of Forestry Research Organizations working party on needle diseases conference; 1984 October 14-18; Gulfport, MS. Gen. Tech. Rep. WO-50. Washington, DC: U.S. Department of Agriculture, Forest Service; 1986: 106 p.
- Riffle, Jerry W.; Peterson, Glenn W. *Thyronectria* canker of honeylocust: influence of temperature and wound age on disease development. *Phytopathology*. 76: 313-316; 1986.
- Robbins, Kathryn; Sharon, Edward M. Sirococcus shoot blight of spruce. In: Riffle, Jerry W.; Peterson, Glenn W., tech. coords. Diseases of trees in the Great Plains. Gen. Tech. Rep. RM-129. Fort Collins, CO: U.S. Department of Agriculture, Forest Service, Rocky Mountain Forest and Range Experiment Station; 1986: 130-131.
- Scharpf, Robert F. Dwarf mistletoe as a host for brown felt blight in California. *Plant Disease*. 70(8): 798-799; 1986.
- Scharpf, Robert F.; Koerber, Thomas W. Destruction of shoots, flowers, and fruit of dwarf mistletoe by grasshoppers in California. *Canadian Journal of Forestry*. 16: 166-168; 1986.
- Schmidt, Robert A.; Holley, Renee C.; Klapproth, Michael C.; Miller, Thomas. Temporal and spatial patterns of fusiform rust epidemics in young plantations of susceptible and resistant slash and loblolly pines. *Plant Disease*. 70: 661-666; 1986.
- Schreiber, L. R.; Conaway, E. E.; Peacock, J. W. Aggressiveness, competitiveness, and stability of tolerance of benzimidazole-tolerant strains of *Ceratocystis ulmi*. *Plant Disease*. 70(2): 154-158; 1986.
- Shevenell, B. J.; Shortle, W. C. An ion profile of wounded red maple. *Phytopathology*. 76(2): 132-135; 1986.
- Shigo, A. L. How trees survive after injury and infection. In: Wilson, Charles L.; Scorza, Ralph, work. coords. 1984 stone fruit tree decline workshop proceedings; 1984 October 30-November 1; Kearneysville, WV. [Washington, DC]: U.S. Department of Agriculture, Agricultural Research Service; 1985: 29-40.
- Shigo, A. L. Wounded forests, starving trees. *Journal of Forestry*. 83(11): 668-673; 1985.
- Shigo, A. L.; Dudzik, K. R. Response of uninjured cambium to xylem injury. *Wood Science and Technology*. 19(3): 195-200; 1985.
- Shigo, A. L.; Gregory, G. F.; Campana, R. J.; Dudzik, K. R.; Zimel, D. M. Patterns of starch reserves in healthy and diseased American elms. *Canadian Journal of Forest Research*. 16(2): 204-210; 1986.
- Skilling, Darroll D.; Ostry, Michael E. Biotechnologies--the potential role of somaclonal variation in forestry. In: Burns, Denver P., comp. IUFRO proceedings, evaluation and planning of forestry research S6. 06-S6. 06. 01; 1985 July 25-26; Fort Collins, CO. Gen. Tech. Rep. NE-111. Broomall, PA: U.S. Department of Agriculture, Forest Service, Northeastern Forest Experiment Station; 1986: 17-19.
- Skilling, Darroll D.; Walla, James A. Rhizosphaera needle cast of spruce. In: Riffle, Jerry W.; Peterson, Glenn W., tech. coords. Diseases of trees in the Great Plains. Gen. Tech. Rep. RM-129. Fort Collins, CO: U.S. Department of Agriculture, Forest Service, Rocky Mountain Forest and Range Experiment Station; 1986: 124-125.
- Sluder, Earl R.; Powers, Harry R., Jr. Further comparisons between infection of loblolly and slash pines by fusiform rust after artificial inoculation or planting. Res. Note SE-342. Asheville, NC: U.S. Department of Agriculture, Forest Service, Southeastern Forest Experiment Station; 1986. 3 p.

- Strobel, Gary A.; Sugawara, Fumio. The pathogenicity of *Ceratocystis montia* to lodgepole pine. Canadian Journal of Botany. 64: 113-116; 1986.
- Sturges, David L.; Nelson, David L. Snow depth and incidence of a snowmold disease on mountain big sagebrush. In: McArthur, E. Durant; Welch, Bruce L., comps. Proceedings--symposium on the biology of *Artemisia* and *Chrysothamnus*; 1984 July 9-13; Provo, UT. Gen. Tech. Rep. INT-200. Ogden, UT: U.S. Department of Agriculture, Forest Service, Intermountain Forest and Range Experiment Station; 1986: 215-221.
- Wargo, Philip M.; Shaw, Charles G. III. *Armillaria* root rot: the puzzle is being solved. Plant Disease. 69(10): 826-832; 1985.
- Disease Control and Management Strategies**
- Affeltranger, C. E.; Filer, T. H. Seed treatments and foliar fungicides used to control yellow-poplar anthracnose in a forest nursery. Fungicide and Nematicide Tests. 41: 178; 1985.
- Barrows-Broadbent, Jane; Dwinell, L. D.; Kerr, T. J. Evaluation of *Arthrobacter* sp. for biological control of the pitch canker fungus (*Fusarium moniliforme* var. *subglutinans*) on slash pines. Canadian Journal of Microbiology. 31: 888-892; 1985.
- Belanger, Roger P. Salvage cutting: a means of reducing losses from fusiform rust in southern pine plantations. In: Thinning southern pine plantations workshop manual; 1984 October 30-November 1; Long Beach, MS. Washington, DC: American Pulpwood Association, Inc; 1985: 21-27.
- Berry, Frederick H. Reducing decay losses in high-value hardwoods--a guide for woodland owners and managers. Agric. Handb. 595. Washington, DC: U.S. Department of Agriculture, Forest Service; 1985. 23 p.
- Cannon, William N., Jr. Time and materials needed to survey, inject systemic fungicides, and install root graft barriers for Dutch elm disease management. Res. Pap. NE-585. Broomall, PA: U.S. Department of Agriculture, Forest Service, Northeastern Forest Experiment Station; 1986. 8 p.
- Cordell, Charles E.; Filer, T. H. Integrated nursery pest management. In: Lantz, Clark W. Southern pine nursery handbook, chap. 13. Atlanta, GA: U.S. Department of Agriculture, Forest Service; 1984.
- Fenn, M. E.; Coffey, M. D. Further evidence for the direct mode of action of fosetyl-al and phosphorous acid. Phytopathology. 75(9): 1064-1068; 1985.
- Filer, T. H., Jr. Evaluation of systemic fungicides for oak wilt control in Texas live oaks, 1984-85. Fungicide and Nematicide Tests. 41: 174; 1985.
- Garrett, Peter W.; Trew, I. Frederick. Resistance of pitch x loblolly pine hybrids to fusiform rust (*Cronartium quercuum* f. sp. *fusiforme*). Plant Disease. 70(6): 564-565; 1986.
- Goldfarb, Barry; Nelson, Earl; Hansen, Everett. *Trichoderma* spp.: distribution in *Phellinus weirii*-infested stumps and roots and antagonism in vitro. In: Thies, Walter G., comp. Proceedings, 33d annual western international forest disease work conference; 1985 September 24-27; Olympia, WA. Corvallis, OR: Oregon State University; 1985: 100-103.
- Kais, A. G.; Cordell, C. E.; Affeltranger, C. E. Benomyl root treatment controls brown-spot disease on longleaf pine in the Southern United States. Forest Science. 32(2): 506-511; 1986.
- Kais, Albert G. Recent advances in control of brown spot in longleaf pine. In: Proceedings, insects and diseases of southern forests; 1985 March 26-27; Baton Rouge, LA. Baton Rouge, LA: Louisiana Agricultural Experiment Station; 1985: 83-90.
- Kais, Albert G.; Cordell, Charles E.; Affeltranger, Charles E. Nursery application of benomyl fungicide for field control of brown-spot needle blight (*Scirrhia acicola* (Dearn.) Sigg.) on longleaf pine (*Pinus palustris* Mill.). Tree Planters' Notes. 37(1): 5; 1986.
- Kais, Albert G.; Griggs, Margene M. Control of brown spot needle blight infection on longleaf pine through benomyl treatment and breeding. In: Recent research on conifer needle diseases conference; 1984 October 14-18; Gulfport, MS. Gen. Tech. Rep. WO-50. Washington, DC: U.S. Department of Agriculture, Forest Service; 1986: 15-19.
- Kessler, Kenneth J., Jr. Companion planting of black walnut with autumn olive to control *Mycosphaerella* leaf spot of walnut. In: Dawson, Jeffrey O.; Majerus, Kimberly A., eds. Proceedings, 5th central hardwood forest conference; 1985 April 15-17; Urbana-Champaign, IL. SAF Publ. 85-05. Urbana-Champaign, IL: University of Illinois, Department of Forestry; 1985: 285-288.
- Kessler, Kenneth J., Jr.; Swanson, Linda B. H. How to identify and control black walnut *Mycosphaerella* leaf spot. HT-65. St. Paul, MN: U.S. Department of Agriculture, Forest Service, North Central Forest Experiment Station; 1986. 6 p.
- Mazzone, H. M.; Peacock, J. W. Prospects for control of Dutch elm disease--biological considerations. Journal of Arboriculture. 11(10): 285-292; 1985.
- Nance, Warren L. Making management decisions before establishing slash pine plantations in areas where fusiform rust is a hazard. In: Insects and diseases of southern forests: 34th annual forestry symposium; 1985 March 26-27; Baton Rouge, LA. Baton Rouge, LA: Louisiana Agricultural Experiment Station; 1985: 120-135.

Nelson, E. E.; Thies, W. G. Colonization of Phellinus weirii-infested stumps by Trichoderma viride. 2: Effects of season of inoculation and stage of wood decay. *European Journal of Forest Pathology*. 16: 56-60; 1986.

Nelson, E. E.; Thies, W. G. Trichoderma viride--a potential biological control for laminated root rot. In: Thies, Walter G., comp. Proceedings, 33d annual western international forest disease work conference; 1985 September 24-27; Olympia, WA: Corvallis, OR: Oregon State University; 1985: 107.

Nelson, Earl E.; Thies, W. G. Colonization of Phellinus weirii-infested stumps by Trichoderma viride. 1: Effect of isolate and inoculum base. *European Journal of Forest Pathology*. 15: 425-431; 1985.

Palmer, M. A.; Nicholls, T. H.; Croghan, C. F. Fungicidal control of shoot blight caused by Sphaeropsis sapinea on red pine nursery seedlings. *Plant Disease*. 70(3): 194-196; 1986.

Powers, H. R., Jr. Performance of Livingston Parish loblolly pine in the Georgia Piedmont. *Southern Journal of Applied Forestry*. 10(2): 84-87; 1986.

Powers, H. R., Jr. Selecting and breeding pines resistant to fusiform rust. In: Ko, Je-Ho; La, Yong-Joon, comps., eds. Proceedings of the joint conference of IUFRO working parties on forest gall midges and rusts of pines, working parties S2. 07-08 & S2. 06-10; 1985 September 16-21; Seoul, KO. Suwon, KO: Korean Forestry Society, c/o College of Agriculture, Seoul National University; 1985: 115-128.

Rowan, S. J. Triadimefon controls fusiform rust in young slash pine plantations. *Southern Journal of Applied Forestry*. 10(2): 112-114; 1986.

Snow, Glenn A. A view of resistance to fusiform rust in loblolly pine. In: Proceedings, insects and diseases of southern forests; 1985 March 26-27; Baton Rouge, LA. Baton Rouge, LA: Louisiana Agricultural Experiment Station; 1985: 47-51.

Thies, Walter G.; Hansen, Everett M. Bulldozing to control laminated root rot--another consideration. In: Thies, Walter G., comp. Proceedings, 33d annual western international forest disease work conference; 1985 September 24-27; Olympia, WA: Corvallis, OR: Oregon State University; 1985: 104-105.

Mycorrhizae

Berch, Shannon M.; Castellano, Michael A. Sporulation of Endogone pisiformis in axenic and monoxenic culture. *Mycologia*. 78(2): 292-295; 1986.

Castellano, Michael A.; Trappe, James M. Ectomycorrhizal formation and plantation performance of Douglas-fir nursery stock inoculated with Rhizopogon spores. *Canadian Journal of Forest Research*. 15: 613-617; 1985.

Castellano, Michael A.; Trappe, James M.; Molina, Randy. Inoculation of container-grown Douglas-fir seedlings with basidiospores of Rhizopogon vinicolor and R. colossus: effects of fertility on spore application rate. *Canadian Journal of Forest Research*. 15: 10-13; 1985.

Cordell, Charles E.; Marx, Donald H. Benefits and application of ectomycorrhizae in southern forest tree nurseries. In: South, David B., ed. Proceedings of the international symposium on nursery management practices for the southern pines; 1985 August 4-9; Montgomery, AL. Auburn, AL: Auburn University; 1986: 244-250.

Daughtridge, Ann Todd; Pallardy, Stephen G.; Garrett, H. Gene; Sander, Ivan L. Growth analysis of mycorrhizal and nonmycorrhizal black oak (Quercus velutina Lam.) seedlings. *New Phytologist*. 103: 473-480; 1986.

Fogel, Robert; Trappe, James M. Destuntzia, a new genus in the Hymenogastraceae (Basidiomycotina). *Mycologia*. 77(5): 732-742; 1985.

Homola, R. L.; Czapowskyj, M. M.; Blum, B. M. Ectomycorrhizae of Maine. In: A listing of Hygrophorus with the associated hosts (with additional information on edibility). *Bull.* 810. Orono, ME: Maine Agricultural Experiment Station, University of Maine; 1985. 19 p.

Hung, Ling-Ling; Molina, Randy. Temperature and time in storage influence the efficacy of selected isolates of fungi in commercially produced ectomycorrhizal inoculum. *Forest Science*. 32(2): 534-545; 1986.

Hung, Ling-Ling; Molina, Randy. Use of the ectomycorrhizal fungus Laccaria laccata in forestry. 3: Effects of commercially produced inoculum on container-grown Douglas-fir and ponderosa pine seedlings. *Canadian Journal of Forest Research*. 16: 802-806; 1986.

Kormanik, Paul P. Development of vesicular-arbuscular mycorrhizae in a young sweetgum plantation. *Canadian Journal of Forest Research*. 15: 1061-1064; 1985.

Kormanik, Paul P. Effects of phosphorus and vesicular-arbuscular mycorrhizae on growth and leaf retention of black walnut seedlings. *Canadian Journal of Forest Research*. 15: 688-693; 1985.

Kough, J. L.; Molina, R.; Linderman, R. G. Mycorrhizal responsiveness of Thuja, Calocedrus, Sequoia, and Sequoiadendron species of western North America. *Canadian Journal of Forest Research*. 16(6): 1049-1054; 1985.

Kropp, Bradley R.; Castellano, Michael A.; Trappe, James M. Performance of outplanted western hemlock (Tsuga heterophylla (Raf.) Sarg.) seedlings inoculated with Cenococcum geophilum. *Tree Planters' Notes*. 36(4): 13-16; 1985.

Marx, D. H.; Cordell, C. E.; France, R. C. Effects of triadimefon on growth and ectomycorrhizal development of loblolly and slash pines in nurseries. *Phytopathology*. 76(8): 824-831; 1986.

Marx, D. H.; Hedin, Arne; Toe, Sieh F. P., IV. Field performance of Pinus caribaea var. hondurensis seedlings with specific ectomycorrhizae and fertilizer after three years on a savanna site in Liberia. Forest Ecology and Management. 13: 1-25; 1985.

Marx, Donald H., Cordell, Charles E. Bayleton (triadimefon) affects ectomycorrhizal development on slash and loblolly pine seedlings in nurseries. In: South, David B., ed. Proceedings of the international symposium on nursery management practices for the southern pines; 1985 August 4-9; Montgomery, AL. Auburn, AL: Auburn University; 1986: 460-475.

Marx, Donald H.; Hatchell, Glyndon E. Root stripping of ectomycorrhizae decreases field performance of loblolly and longleaf pine seedlings. Southern Journal of Applied Forestry. 10: 173-179; 1986.

Riffle, Jerry W. Mushroom collecting and mycorrhizae. In: Mooter, Dave; Locklear, Jim, tech. eds. Trees for food and fun: 9th annual trees for Nebraska conference; 1986 February 14-15; Lincoln, NE. Lincoln, NE: University of Nebraska; 1986: 149-153.

Rowan, S. J.; Kelley, W. D. Survival and growth of outplanted pine seedlings after mycorrhizae were inhibited by use of triadimefon in the nursery. Southern Journal of Applied Forestry. 10(1): 21-23; 1986.

Stewart, Elwin L.; Trappe, James M. The new genus Austrogautieria (Basidiomycotina), segregate from Gautieria. Mycologia. 77(5): 674-687; 1985.

Trappe, J. M.; Molina, R. Taxonomy and genetics of mycorrhizal fungi: their interactions and relevance. In: Mycorrhizae: physiology and genetics; 1985 July 1-5; Dijon, FR. Paris: INRA; 1986: 133-146.

Wood Products Organisms

Beal, Raymond H. Field testing of soil insecticides as termiticides. In: Proceedings, 17th annual meeting of the international research group on wood preservation--working group 1B: biological problems; 1986 May 26-30; Avignon, FR. IRG/WP/1294. Stockholm: IRG Secretariat; 1986. 9 p.

Chen, George C.; Esenther, Glenn R.; Rowell, Roger M. Termite resistance of wood treated with copper (II) compounds derived from tri- and dialkylamine-boric acid complexes. Forest Products Journal. 36(5): 18-20; 1986.

Eslyn, Wallace E. Utility pole decay. Part 4: Growth-temperature relations and decay capabilities of eleven major utility pole decay fungi. Holzforschung. 40(2): 69-77; 1986.

Highley, Terry L. Long-term effectiveness of fumigants in controlling decay in Douglas-fir waterfront timbers. In: The international research group on wood preservation; 1986 May 26-30; Avignon, FR. IRG/WP/3364. Stockholm: IRG Secretariat; 1986: 1-31.

Highley, Terry L.; Eslyn, Wallace E. Efficacy of fumigants in the eradication of decay fungi implanted in southern pine timbers. In: The international research group on wood preservation; 1986 May 26-30; Avignon, FR. IRG/WP/3365. Stockholm: IRG Secretariat; 1986: 26-30.

Highley, Terry L.; Murmanis, Lidija L. Determination of hydrogen peroxide production in Coriolus versicolor and Poria placenta during wood degradation. Material und Organismen. 20(4): 241-252; 1985.

Jones, Susan C. Laboratory evaluation of chemicals as termiticides. In: Proceedings, 17th annual meeting of the international research group on wood preservation--working group 1B: biological problems; 1986 May 26-30; Avignon, FR. IRG/WP/1294. Stockholm: IRG Secretariat; 1986. 4 p.

Kinn, D. N. Heat-treating wood chips: a possible solution to pine wood nematode contamination. Tappi. 69(1): 97-98; 1986.

Kinn, D. N.; Springer, E. L. Using sodium N-methyldithiocarbamate to exterminate the pine wood nematode in wood chip. Tappi. 68(12): 88; 1985.

Kropp, Bradley R.; Nakasone, Karen K. Redisposition of Radulum concentricum (Aphyllporales: Corticiaceae). Mycotaxon. 24: 423-429; 1985.

Larsen, Michael J.; Lombard, Frances F. New combinations in the genus Postia Fr. (Polyporaceae). Mycotaxon. 26 (July-September): 271-273; 1986.

Mauldin, Joe K. Economic importance and control of termites in the United States. In: S. Bradleigh Vinson, ed., Economic impact and control of social insects. New York: Praeger; 1986: 130-143.

Murmanis, L.; Palmer, J. G.; Highley, T. L. Electron-dense particles in wood decayed by Ganoderma applanatum. Wood Science Technology. 19: 313-321; 1985.

Pellerin, Roy F.; De Groot, Rodney C.; Esenther, Glenn R. Non-destructive stress wave measurement of decay and termite attack in experimental wood units. In: The international research group on wood preservation; 1986 May 26-30; Avignon, FR. IRG/WP/2256. Stockholm: IRG Secretariat; 1986: 1-31.

Su, Nan-Yao; Tamachiro, Minoru. Wood-consumption rate and survival of the formosan subterranean termite (Isoptera: Rhinotermitidae) when fed one of six woods used commercially in Hawaii. Proceedings of the Hawaiian Entomological Society. 26: 109-113; 1986.

Su, Nan-Yao; Tamashiro, Minoru; Haverty, Michael I. Effects of three insect growth regulators, feeding substrates, and colony origin on survival and presoldier production of the Formosan subterranean termite (Isoptera: Rhinotermitidae). *Journal of Economic Entomology*. 78(6): 1259-1263; 1985.

Williams, Lonnie H. Part 1: The basis for developing beetle preventive measures for use by hardwood industries. In: Integrated protection against lyctid beetle infestations. [Unnumbered leaflet.] New Orleans, LA: U.S. Department of Agriculture, Forest Service, Southern Forest Experiment Station; 1985. 12 p.

Williams, Lonnie H.; Mauldin, Joe K. Part 2: Laboratory dip-diffusion treatment of unseasoned banak (*Virola* spp.) lumber with boron compounds. In: Integrated protection against lyctid beetle infestations. Res. Note SO-313. New Orleans, LA: U.S. Department of Agriculture, Forest Service, Southern Forest Experiment Station; 1985. 8 p.

Fire and Atmospheric Sciences

Fire Physics, Chemistry, and Behavior

- Andrews, Patricia L. BEHAVE: Fire behavior prediction and fuel modeling system--BURN subsystem, Part 1. Gen. Tech. Rep. INT-194. Ogden, UT: U.S. Department of Agriculture, Forest Service, Intermountain Forest and Range Experiment Station; 1986. 130 p.
- Andrews, Patricia L. Methods for predicting fire behavior--you do have a choice. Fire Management Notes. 47(2): 6-10; 1986.
- Blakely, Aylmer D. Combustion recovery: a measurement of fire retardant extinguishment capability. Res. Pap. INT-352. Ogden, UT: U.S. Department of Agriculture, Forest Service, Intermountain Forest and Range Experiment Station; 1985. 6 p.
- Burgan, Robert E.; Susott, Ronald A. Fire danger computations with the Hewlett-Packard HP-71B calculator. Gen. Tech. Rep. INT-199. Ogden, UT: U.S. Department of Agriculture, Forest Service, Intermountain Forest and Range Experiment Station; 1986. 16 p.
- Burgan, Robert E.; Susott, Ronald A. HP-71 replaces TI-59 for fire calculations in the field. Fire Management Notes. 47(2): 11-13; 1986.
- Clark, Robert G.; Wright, Henry A.; Roberts, Fred H. Threshold requirements for fire spread in grassland fuels. In: Proceedings, rangeland fire effects: a symposium; 1984 November 27-29; Boise, ID. Boise, ID: U.S. Department of the Interior, Bureau of Land Management; 1985: 27-32.
- Cohen, Jack D. Estimating fire behavior with FIRECAST: user's manual. Gen. Tech. Rep. PSW-90. Berkeley, CA: U.S. Department of Agriculture, Forest Service, Pacific Southwest Forest and Range Experiment Station; 1986. 11 p.
- Eubanks, Roger L.; Bradshaw, Roger L.; Andrews, Patricia L. Current status of BEHAVE system. Fire Management Notes. 47(2): 29-31; 1986.
- Frandsen, William H.; Ryan, Kevin C. Soil moisture reduces below-ground heat flux and soil temperatures under a burning fuel pile. Canadian Journal of Forestry Research. 16: 244-248; 1986.
- McMahon, Charles K.; Adkins, Carl W.; Rodgers, Steven L. A video image analysis system for measuring fire behavior. Fire Management Notes. 47(1): 10-15; 1986.
- Nelson, R. M., Jr. Diffusion of bound water in wood. Part I: The driving force. Wood Science and Technology. 20: 125-135; 1986.
- Paananen, Donna M.; Haines, Donald A. The crown fire puzzle. The Minnesota Volunteer. 49(286): 21-26; 1986.
- Rogers, Janice M.; Susott, Ronald A.; Kelsey, Rick G. Chemical composition of forest fuels affecting their thermal behavior. Canadian Journal of Forest Research. 16(4): 721-726; 1986.
- Rothermel, Richard C.; Mutch, Robert W. Behavior of the life-threatening Butte Fire: August 27-29, 1985. Fire Management Notes. 47(2): 14-24; 1986.
- Rothermel, Richard C.; Wilson, Ralph A., Jr.; Morris, Glen A.; Sackett, Stephen S. Modeling moisture content of fine dead wildland fuels: input to the BEHAVE fire prediction system. Res. Pap. INT-359. Ogden, UT: U.S. Department of Agriculture, Forest Service, Intermountain Forest and Range Experiment Research Station; 1986. 61 p.
- Salazar, Lucy A. Sensitivity of fire behavior simulations to fuel model variations. Res. Pap. PSW-178. Berkeley, CA: U.S. Department of Agriculture, Forest Service, Pacific Southwest Forest and Range Experiment Station; 1985. 11 p.
- Smith, M. C.; Haines, D. A. An experimental study of mixed, forced, and free convection heat transfer from a horizontal flat plate to air. Journal of Heat Transfer [Discussion]. 107: 738-739; 1985.
- Smith, Mahlon C.; Haines, Donald A.; Main, William A. Some characteristics of longitudinal vortices produced by line-source heating in a low-speed wind tunnel. International Journal of Heat Mass Transfer. 29(1): 59-68; 1986.
- Susott, Ronald A.; Burgan, Robert E. Fire behavior computations with the Hewlett-Packard HP-71B calculator. Gen. Tech. Rep. INT-202. Ogden, UT: U.S. Department of Agriculture, Forest Service, Intermountain Forest and Range Experiment Station; 1986. 80 p.

Fire Management, Economics, and Prevention

- Anderson, Earl B.; Hales, R. Stanton. Critical path method applied to research project planning: fire economic evaluation system (FEES). Gen. Tech. Rep. PSW-93. Berkeley, CA: U.S. Department of Agriculture, Forest Service, Pacific Southwest Forest and Range Experiment Station; 1986. 12 p.
- Brown, James K. A process for designing fire prescriptions. In: Mutch, Robert W., tech. coord. Prescribed fire by aerial ignition: Proceedings; 1984 October 30-November 1; Missoula, MT. Missoula, MT: Intermountain Fire Council; 1986: 17-30.

- Brown, James K.; Simmerman, Dennis G. Appraising fuels and flammability in western aspen: prescribed fire guide. Gen. Tech. Rep. INT-205. Ogden, UT: U.S. Department of Agriculture, Forest Service, Intermountain Forest and Range Experiment Station; 1986. 48 p.
- Cleaves, David A. Net value changes in fire management: issues and application problems. In: Long, James N., ed. Fire management, the challenge of protection and use: Proceedings of a symposium; 1985 April 17-19; Logan, UT. Logan, UT: Utah State University; 1986: 43-61.
- Davis, James B. Protecting forest resources from fire. In: Crowley, John J., ed. Research for tomorrow: 1986 yearbook of agriculture. Washington, DC: U.S. Department of Agriculture; 1986: 228-232.
- Davis, James B. The USDA Forest Service wildfire program. Fire Management Notes. 46(4): 31-33; 1986.
- Donoghue, Linda R. The role of law enforcement in wildfire prevention. In: The Northeastern Forest Fire Protection Commission: annual training meeting--1985; 1985 February 5-7; Concord, NH. [Concord], NH: [Forest Fire Protection Commission]; 1985: 11-16.
- Donoghue, Linda R. Wildfire prevention: new perspectives on an old problem. In: Wildfire prevention seminar; 1985 October 21-24; Chalk River, ON. Chalk River, ON: Canadian Committee on Forest Fire Management; 1986: 59-65.
- Donoghue, Linda R.; Sutton, Arthur J. Training fire sleuths of the forest. Fire Management Notes. 47(1): 3-5; 1986.
- Flowers, Patrick J.; Shinkle, Patricia B.; Cain, Daria A.; Mills, Thomas J. Timber net value and physical output changes following wildfire in the northern Rocky Mountains: estimates for specific fire situations. Res. Pap. PSW-179. Berkeley, CA: U.S. Department of Agriculture, Forest Service, Pacific Southwest Forest and Range Experiment Station; 1985. 25 p.
- Food and Agriculture Organization of the United Nations. Wildland fire management terminology 1985. FAO For. Pap. 70. Rome: Food and Agriculture Organization of the United Nations; 1986. 257 p.
- Gardner, Philip D.; Anderson, Earl B.; Huddleston, May E. Evaluating structural damage from wildland fires. Fire Management Notes. 46(4): 15-18; 1986.
- Gardner, Philip D.; Cortner, Hanna ; Bridges, JoAnne. Wildfire: managing the hazard in urbanizing areas. Journal of Soil and Water Conservation. 40(4): 319-321; 1986.
- Gardner, Philip D.; Cortner, Hanna J. Public risk perceptions and policy response toward wildland fire hazards in the urban/rural interface. In: Long, James N., ed. Fire management, the challenge of protection and use; 1985 April 17-19; Logan, UT. Logan, UT: Utah State University; 1985: 153-171.
- Gardner, Philip D.; Cortner, Hanna J. Wildland-urban fires in semi-arid environments: a southern California study of homeowner perceptions and public policy preferences. In: Templer, Otis W., ed. Proceedings of forum of the Association for Arid Lands Studies; 1985 April 24-27; Fort Worth, TX. Lubbock, TX: Texas Technical University; 1986: 129-133.
- Gehring, George A.; George, Charles W. Guidelines for preventing fire retardant corrosion. Gen. Tech. Rep. INT-210. Ogden, UT: U.S. Department of Agriculture, Forest Service, Intermountain Forest and Range Experiment Station; 1986. 23 p.
- George, Charles W.; Johnson, Cecilia W. Determining fire retardant quality in the field. Gen. Tech. Rep. INT-201. Ogden, UT: U.S. Department of Agriculture, Forest Service, Intermountain Forest and Range Experiment Station; 1986. 42 p.
- Gonzales C., Armando. Analisis de costos de los programas de manejo de fuegos forestales: tecnicas y problemas. In: Jelvez C., Arnaldo; McKetta, Charles W. eds. Proceedings: simposio economia forestal en Chile; 1986 May 29-30; Concepcion, CH. Concepcion, CH: Universidad del Biobio; 1986: 57-72.
- Gonzales C., Armando. Evaluacion economica de programas alternos de manejo de incendios forestales. In: Jelvez C., Arnaldo; McKetta, Charles W., eds. Proceedings: simposio de economia forestal en Chile; 1986 May 29-30; Concepcion, CH. Concepcion, CH: Universidad del Biobio; 1986: 43-56.
- Gonzalez-Caban, Armando. A technique for estimating fire suppression forces costs. In: Long, James N., ed. Fire management, the challenge of protection and use; 1985 April 17-19; Logan, UT. Logan, UT: Utah State University; 1986: 153-171.
- Gonzalez-Caban, Armando. El uso de modelos de simulacion en la evaluacion economica de programas de proteccion contra incendios forestales: la experiencia norteamericana. Revista Interamericana de Planificacion. 20(78): 149-164; 1986.
- Gonzales-Caban, Armando; Shinkle, Patricia B.; Mills, Thomas J. Developing fire management mixes for fire program planning. Gen. Tech. Rep. PSW-88. Berkeley, CA: U.S. Department of Agriculture, Forest Service, Pacific Southwest Forest and Range Experiment Station; 1986. 8 p.
- Gruell, George E.; Brown, James K.; Bushey, Charles L. Prescribed fire opportunities in grasslands invaded by Douglas-fir: state-of-the-art guidelines. Gen. Tech. Rep. INT-198. Ogden, UT: U.S. Department of Agriculture, Forest Service, Intermountain Forest and Range Experiment Station; 1986. 19 p.

- Haines, Donald A.; Main, William A.; Simard, Albert J. Fire-danger rating and observed wildfire behavior in the Northeastern United States. Res. Pap. NC-274. St. Paul, MN: U.S. Department of Agriculture, Forest Service, North Central Forest Experiment Station; 1986. 23 p.
- Haines, Donald A.; Main, William A.; Simard, Albert J. Operational validation of the national fire-danger rating system in the Northeast. In: Eighth conference on fire and forest meteorology: Proceedings; 1985 April 29-May 2; Detroit, MI. [Bethesda], MD: [Society of American Foresters]; 1985: 169-177.
- Hill, Paul; George, Charles W.; Johnson, Cecilia W. Field operational evaluation: long-term fire retardants Fire-Trol LCA and LCS. 5100-Fire. San Dimas, CA: U.S. Department of Agriculture, Forest Service, San Dimas Equipment Development Center; 1986. 49 p.
- Joseph, Chris A.; Gardner, Philip D.; Mills, Thomas J.; Hunter, T. Parkin. Gaming aids for resource managers. *Journal of Forestry*. 83(10): 624-626; 1985.
- Lyon, C. Bentley. Forest, brush, and grass fires. In: Cote, Arthur E., ed. *Fire protection handbook*, 16th ed. Quincy, MA: National Fire Protection Association; 1986: 12-61 - 12-65.
- McRae, Stephen; Cleaves, David. Incorporating strategic data-planning and decision analysis techniques in geographic information system design. In: *Geographic information systems workshop*; 1986 April 1-4; Atlanta, GA. Falls Church, VA: American Society for Photogrammetry and Remote Sensing; 1986: 76-86.
- Mees, Romain M. Simulating initial attack with two fire containment models. Res. Note PSW-378. Berkeley, CA: U.S. Department of Agriculture, Forest Service, Pacific Southwest Forest and Range Experiment Station; 1985. 7 p.
- Mills, T. J.; Flowers, P. J. Estimating fire-induced net value change in resource outputs. In: Dube, D. E., comp. *Proceedings of the Intermountain Fire Council 1983 fire management workshop*; 1983 October 25-27; Banff, AB. Infor. Rep. NOR-X-271. Edmonton, AB: Canadian Forestry Service, Northern Forest Research Centre; 1985: 5-12.
- Mills, Thomas J. Criteria for evaluating the economic efficiency of fire management programs in park and wilderness areas. In: *Wilderness fire symposium*; 1983 November 15-18; Missoula, MT. Gen. Tech. Rep. INT-182. Ogden, UT: U.S. Department of Agriculture, Forest Service, Intermountain Forest and Range Experiment Station; 1986: 182-190.
- Mills, Thomas J.; Flowers, Patrick J. Fire-induced changes in net value of timber: a sensitivity analysis. *Canadian Journal of Forest Research*. 15: 973-981; 1985.
- Mutch, Robert W.; Rothermel, Richard C. 73 fire fighters survive in shelters. *Fire Command*. March: 30-31, 48; 1986.
- Potts, Donald F.; Ryan, Kevin C.; Zuuring, Hans R. Stratified sampling for determining duff moisture in mountainous terrain. *Western Journal of Applied Forestry*. 1(1): 29-30; 1986.
- Salazar, Lucy A.; Bradshaw, Larry S. Display and interpretation of fire behavior probabilities for long-term planning. *Environmental Management*. 10(3): 393-402; 1986.
- Smith, Eric L. Calculating economic efficiency with cost plus net value change using fire simulation models. In: Long, James N., ed. *Fire management, the challenge of protection and use: Proceedings of a symposium*; 1985 April 17-19; Logan, UT. Logan, UT: Utah State University; 1986: 99-113.
- Smith, Eric L. Sensitivity of fire size to fireline construction rates in a simulation model. *Fire Technology*. 22(2): 136-147; 1986.
- Stockstad, Dwight S.; Kurth, Troy W.; Barney, Richard J. Fireline explosives--a second look. *Fire Management Notes*. 47(1): 18-21; 1986.

Fire Ecology and Effects

- Arno, Stephen F.; Wilson, Andrew E. Dating past fires in curleaf mountain-mahogany communities. *Journal of Range Management*. 39(3): 241-243; 1986.
- Brown, James K. Role and use of fire in aspen. In: *Foresters' future: leaders or followers?*: Proceedings of the 1985 Society of American Foresters national convention; 1985 July 28-31; Fort Collins, CO. SAF Publ. 85-13. Bethesda, MD: Society of American Foresters; 1985: 101-105.
- Covington, W. W.; Sackett, S. S. Effect of periodic burning on soil nitrogen concentrations in ponderosa pine. *Soil Science Society of America Journal*. 50: 452-457; 1986.
- Dunn, Paul H.; Barro, Susan C.; Poth, Mark. Soil moisture affects survival of microorganisms in heated chaparral soil. *Soil Biology and Biochemistry*. 17(2): 143-148; 1985.
- Everett, Richard L.; Clary, Warren. Fire effects and revegetation on juniper-pinyon woodlands. In: Sanders, Ken; [and others], eds. *Rangeland fire effects: a symposium: Proceedings*; 1984 November 27-29; Boise, ID. Boise, ID: U.S. Department of the Interior, Bureau of Land Management, Idaho State Office; 1985: 33-37.
- Foote, M. Joan; Viereck, Leslie A. Burn severity: its impact on the natural revegetation process following the Rosie Creek Fire. In: Juday, Glenn P.; Dyrness, C. Theodore. *Early results of the Rosie Creek Fire research project 1984*. Misc. Publ. 85-2. Fairbanks, AK: University of Alaska, Agricultural and Forestry Experiment Station; 1986: 22-29.

- Grissom, James Edwin. Effect of crown scorch on water status and growth of slash pine trees. Gainesville, FL: University of Florida; 1985. 50 p. M.S. thesis.
- Haase, Sally M. Effect of prescribed burning on soil moisture and germination of southwestern ponderosa pine seed on basaltic soils. Res. Note RM-462. Fort Collins, CO: U.S. Department of Agriculture, Forest Service, Rocky Mountain Forest and Range Experiment Station; 1986. 6 p.
- Harrington, Michael G. Comparison of forest floor depth to loading relationships from several Arizona ponderosa pine stands. Res. Note RM-463. Fort Collins, CO: U.S. Department of Agriculture, Forest Service, Rocky Mountain Forest and Range Experiment Station; 1986. 5 p.
- Johansen, R. W.; Wade, D. D. Response of slash pine to severe crown scorch. In: Long, James N., ed. Fire management, the challenge of protection and use: Proceedings of symposium; 1985 April 17-19; Logan, UT. Logan, UT: Utah State University; 1985: 31-34.
- Jones, John R.; DeByle, Norbert V. Fire. In: DeByle, Norbert V.; Winokur, Robert P., eds. Aspen: ecology and management in the Western United States. Gen. Tech. Rep. RM-119. Fort Collins, CO: U.S. Department of Agriculture, Forest Service, Rocky Mountain Forest and Range Experiment Station; 1985: 77-81.
- Juday, Glenn P.; Dyrness, Theodore C. Early results of the Rosie Creek Fire research project, 1984. Misc. Publ. 85-2. Fairbanks, AK: University of Alaska, Agricultural and Forestry Experiment Station; 1986. 46 p.
- Kilgore, Bruce M. Evaluating direct response to understory burning in a pine-fir-larch forest in Glacier National Park. In: Lucas, Robert C., comp. Proceedings: national wilderness research conference: current research; 1985 July 23-26; Fort Collins, CO. Gen. Tech. Rep. INT-212. Ogden, UT: U.S. Department of Agriculture, Forest Service, Intermountain Forest and Range Experiment Station; 1986: 26-34.
- Nadkarni, Nalini M. Effects of seeding an exotic grass (*Lolium multiflorum*) on native seedling regeneration following fire in a chaparral community. In: Proceedings of the chaparral ecosystems research conference; 1985 May 16-17; Santa Barbara, CA. Rep. 62. Davis, CA: California Water Resources Center; 1986: 115-121.
- Oechel, W. C.; Hastings, S. J. The effects of fire on photosynthesis in chaparral resprouts. In: Kruger, F. J.; Mitchell, D. T.; Jarvis, J. U. M., eds. Ecological studies, vol. 43. Berlin/Heidelberg/New York: Springer-Verlag; 1983: 274-277.
- Pafford, Daniel. An investigation into ground surface heating during a prescribed burn. Los Angeles, CA: University of California; 1986. 105 p. M.S. thesis.
- Peterson, David L. Evaluating the effects of air pollution and fire on tree growth by tree ring analysis. In: Proceedings of the 8th conference on fire and forest meteorology; 1985 April 29-May 2; Detroit, MI. Bethesda, MD: Society of American Foresters; 1985: 124-131.
- Rouse, Cary. Fire effects in northeastern forests: aspen. Gen. Tech. Rep. NC-102. St. Paul, MN: U.S. Department of Agriculture, Forest Service, North Central Forest Experiment Station; 1986. 8 p.
- Rouse, Cary. Fire effects in northeastern forests: jack pine. Gen. Tech. Rep. NC-106. St. Paul, MN: U.S. Department of Agriculture, Forest Service, North Central Forest Experiment Station; 1986. 8 p.
- Rouse, Cary. Fire effects in northeastern forests: oak. Gen. Tech. Rep. NC-105. St. Paul, MN: U.S. Department of Agriculture, Forest Service, North Central Forest Experiment Station; 1986. 7 p.
- Sanders, Diane L. Low-intensity prescribed fire in mixed pine-hardwood stands--effects on small mammal habitat and hardwood stem quality. Clemson, SC: Clemson University; 1985. 58 p. M.S. thesis.
- Simard, Albert J.; Baumgartner, David C. Predicting hardwood mortality following wildfires in the Lake States. Michigan Academician. 18(1): 17-30; 1986.
- Steele, Robert; Arno, Stephen F.; Geier-Hayes, Kathleen. Wildfire patterns change in central Idaho's ponderosa pine-Douglas-fir forest. Western Journal of Applied Forestry. 1(1): 16-18; 1986.
- Van Cleve, Keith; Dyrness, C. T. The effect of the Rosie Creek Fire on soil fertility. In: Juday, Glenn P.; Dyrness, C. Theodore. Early results of the Rosie Creek Fire research project, 1984. Misc. Publ. 85-2. Fairbanks, AK: University of Alaska, Agricultural and Forestry Experiment Station; 1986: 7-11.
- Viereck, Leslie A.; Foote, M. Joan. Effects of the Rosie Creek Fire on selected environmental factors in the Bonanza Creek Experimental Forest. In: Juday, Glenn P.; Dyrness, C. Theodore. Early results of the Rosie Creek Fire research project, 1984. Misc. Publ. 85-2. Fairbanks, AK: University of Alaska, Agricultural and Forestry Experiment Station; 1986: 1-4.
- Wade, Dale D.; Johansen, R. W. Effects of fire on southern pine: observations and recommendations. Gen. Tech. Rep. SE-41. Asheville, NC: U.S. Department of Agriculture, Forest Service, Southeastern Forest Experiment Station; 1986. 14 p.
- Zasada, John; Norum, Rodney. Prescribed burning white spruce slash in interior Alaska. Northern Journal of Applied Forestry. 3(1): 16-18; 1986.

Meteorology and Climatology

- Bergen, James D. Preliminary canopy structure estimates for the forest site of the Program WIND study. FPM-86-3. Davis, CA: U.S. Department of Agriculture, Forest Service, Forest Pest Management; 1986. 22 p.
- Bradshaw, Larry S.; Salazar, Lucy A. On using a Fourier series model for estimating diurnal temperatures at mountainous locations in the Western United States. *Journal of Climate and Applied Meteorology*. 24(10): 1104-1106; 1985.
- Donoghue, Linda R.; Martin, Robert E., eds. Weather--the drive train connecting the solar engine to forest ecosystems: Proceedings, 8th conference on fire and forest meteorology; 1985 April 29-May 2; Detroit, MI. Bethesda, MD: Society of American Foresters; 1985. 304 p.
- Finklin, Arnold I. A climatic handbook for Glacier National Park, Montana--with data for Waterton Lakes National Park. Gen. Tech. Rep. INT-204. Ogden, UT: U.S. Department of Agriculture, Forest Service, Intermountain Forest and Range Experiment Station; 1986. 124 p.
- Fosberg, Michael A. KRISSY: user's guide to modeling three-dimensional wind flow in complex terrain. Gen. Tech. Rep. PSW-92. Berkeley, CA: U.S. Department of Agriculture, Forest Service, Pacific Southwest Forest and Range Experiment Station; 1986. 7 p.
- Fosberg, Michael A. Windthrown trees on the Kings River Ranger District, Sierra National Forest: meteorological aspects. Res. Note PSW-381. Berkeley, CA: U.S. Department of Agriculture, Forest Service, Pacific Southwest Forest and Range Experiment Station; 1986. 4 p.
- Fosberg, Michael A.; Pronos, John. An evaluation of wind damage in true fir stands on the Kings River Ranger District, Sierra National Forest. For. Pest. Manage. Rep. 86-6. San Francisco, CA: U.S. Department of Agriculture, Forest Service, Pacific Southwest Region; 1986. 11 p.
- Fujioka, Francis M. A method for designing a fire weather network. *Journal of Atmospheric and Oceanic Technology*. 3(9): 564-570; 1986.
- Fujioka, Francis M. Spatial analysis of fire weather data. In: Geographic information systems workshop; 1986 April 1-4; Atlanta, GA. Falls Church, VA: American Society for Photogrammetry and Remote Sensing; 1986: 313-319.
- Haines, Donald A.; Frost, John S. Fire-weather station observations and records--how good are they? *National Weather Digest*. 10(4): 39-44; 1985.
- Jones, John R.; DeByle, Norbert V. Climates. In: DeByle, Norbert V.; Winokur, Robert P., eds. Aspen: ecology and management in the Western United States. Gen. Tech. Rep. RM-119. Fort Collins, CO: U.S. Department of Agriculture, Forest Service, Rocky Mountain Forest and Range Experiment Station; 1985. 57-64.
- Latham, Don J. Anode column behavior of long vertical air arcs at atmospheric pressure. *IEEE Transactions on Plasma Science*. PS-14(3): 220-227; 1986.
- Ryan, Bill. Estimating surface wind velocities on an isolated mountain by extrapolation and interpolation. *National Weather Digest*. 10(3): 5-9; 1985.
- Simard, Albert J.; Haines, Donald A.; Main, William A. El Nino and wildland fire: an exploratory study. In: Eighth conference on fire and forest meteorology: Proceedings; 1985 April 29-May 2; Detroit, MI. [Bethesda], MD: [Society of American Foresters]; 1985: 88-95.
- Simard, Albert J.; Haines, Donald A.; Main, William A. Relations between El Nino/southern oscillation anomalies and wildland fire activity in the United States. *Agricultural and Forest Meteorology*. 36: 93-104; 1985.
- Tsou, Tai-Houn; Fujioka, Francis M. Box-Jenkins analysis of a fire weather index. In: Ninth conference on probability and statistics in atmospheric sciences; 1985 October 9-11; Virginia Beach, VA. Boston, MA: American Meteorological Society; 1985: 484-486.

Air Resource Management

- Bush, P. B.; Neary, D. G.; McMahon, C. K.; Hendricks, H. L. Effect of burning on hexazinone residues in firewood. In: Weed science and risk management: Proceedings, 39th annual meeting of Southern Weed Science Society; 1986 January 20-22; Nashville, TN. SWSPBE 39. [Place of publication unknown]: Southern Weed Science Society; 1986: 343-353.
- Fox, Douglas G. Establishing a baseline/protocols for measuring air quality effects in wilderness. In: Lucas, Robert C., ed. National wilderness research conference: current research; 1985 July 23-26; Fort Collins, CO. Gen. Tech. Rep. INT-212. Ogden, UT: U.S. Department of Agriculture, Forest Service, Intermountain Forest and Range Experiment Station; 1986: 85-91.
- McMahon, Charles K.; Bush, Parshall B. Emissions from burning herbicide treated forest fuels--a laboratory approach. In: Proceedings, 79th annual meeting of the Air Pollution Control Association; 1986 June 22-27; Minneapolis, MN. Pap. 86-94P.8. Pittsburgh, PA: Air Pollution Control Association; 1986: 8-9.
- McMahon, Charles; Botti, Stephen; Sniegowski, Walter. Smoke monitoring and evaluation. In: Smoke management guide, 420-1. NFES 1279. Washington, DC: NWFCG; U.S. Department of Agriculture, and National Association of State Foresters; 1985: 18-27.

- Neary, D. G.; McMahon, C. K.; Bush, P. B.; Taylor, J. W., Jr. Herbicides and insecticides released from burning treated firewood. For. Bull. R8-FB/P 23. Atlanta: U.S. Department of Agriculture, Forest Service, Southern Region; 1986. 2 p.
- Patterson, E. M.; McMahon, C. K.; Ward, D. E. Absorption properties and graphitic carbon emission factors of forest fire aerosols. Geophysical Research Letters. 13(1): 129-132; 1986.
- Petersen, William B.; Lavdas, Leonidas G. INPUFF 2.0--a multiple source Gaussian puff dispersion algorithm: user's guide. Research Triangle Park, NC: U.S. Environmental Protection Agency; 1986. 105 p.
- Riebau, A. R.; Fox, Douglas G.; Dietrich, David L.; Mussard, Donald E.; Marlatt, W. E. Regional risk identification analysis applicable to resource development of H₂S-contaminated natural gas fields in southwest Wyoming. In: Proceedings of geographic information systems; 1986 April 1-4; Atlanta, GA. ISBN 0-937294-74-8. Falls Church, VA: American Society for Photogrammetry and Remote Sensing; 1986: 345-356.
- U.S. Environmental Protection Agency. Developing long-term strategies for regional haze: findings and recommendations of the Visibility Task Force. Research Triangle Park, NC: U.S. Environmental Protection Agency; 1985. 25 p.
- Ward, D. E. Particulate matter emissions from forest fires--a comparison of methods and results. In: Proceedings of large-scale fire phenomenology; 1984 September 10-13; Gaithersburg, MD. Gaithersburg, MD: Defense Nuclear Agency; 1986.
- Woolson, E. A. Burning cacodylic acid-treated oak trees: how safe? Forest Products Journal. 36(5): 49-52; 1986.

Timber Management

Forest Biology

- Acevedo-Rodriguez, Pedro; Woodbury, Roy O. Los bejucos de Puerto Rico. Gen. Tech. Rep. SO-58. New Orleans, LA: U.S. Department of Agriculture, Forest Service, Southern Forest Experiment Station; 1985. 331 p.
- Alban, David H. Seasonal changes in nutrient concentration and content of aspen suckers in Minnesota. Forest Science. 31(3): 785-794; 1985.
- Alden, John N. Early survival and growth of white spruce on natural sites. In: Juday, Glenn P.; Dyrness, C. Theodore. Early results of the Rosie Creek Fire research project, 1984. Misc. Publ. 85-2. Fairbanks, AK: University of Alaska, Agricultural and Forestry Experiment Station; 1986: 40-43.
- Alexander, Robert R. Classification of forest vegetation of Wyoming. Res. Note RM-466. Fort Collins, CO: U.S. Department of Agriculture, Forest Service, Rocky Mountain Forest and Range Experiment Station; 1986. 10 p.
- Alexander, Robert R. Major habitat types, community types, and plant communities in the Rocky Mountains. Gen. Tech. Rep. RM-123. Fort Collins, CO: U.S. Department of Agriculture, Forest Service, Rocky Mountain Forest and Range Experiment Station; 1985. 105 p.
- Alexander, Robert R.; Hoffman, George R.; Wirsing, John M. Forest vegetation of the Medicine Bow National Forest in southwestern Wyoming. Res. Pap. RM-271. Fort Collins, CO: U.S. Department of Agriculture, Forest Service, Rocky Mountain Forest and Range Experiment Station; 1986. 39 p.
- Andersen, Douglas C.; MacMahon, James A. Plant succession following the Mount St. Helens volcanic eruption: facilitation by a burrowing rodent, *Thomomys talpoides*. The American Midland Naturalist. 114(1): 62-69; 1985.
- Antos, Joseph A.; Zobel, Donald B. Recovery of forest understories buried by tephra from Mount St. Helens. Vegetation. 64: 103-111; 1985.
- Antos, Joseph A.; Zobel, Donald B. Seedling establishment in forests affected by tephra from Mount St. Helens. American Journal of Botany. 73(4): 495-499; 1986.
- Arno, Stephen F.; Simmerman, Dennis G.; Keane, Robert E. Characterizing succession within a forest habitat type--an approach designed for resource managers. Res. Note INT-357. Ogden, UT: U.S. Department of Agriculture, Forest Service, Intermountain Forest and Range Experiment Station; 1986. 8 p.
- Binkley, Dan; Graham, Robin Lambert. Biomass, production, and nutrient cycling of mosses in an old-growth Douglas-fir forest. Ecology. 62(5): 1387-1389; 1981.
- Birdsey, Richard A.; Weaver, Peter L.; Nicholls, Calvin F. The forest resources of St. Vincent. In: Lugo, Ariel E., ed. Development, forestry, and environmental quality in the eastern Caribbean. Rio Piedras, PR: U.S. Department of Agriculture, Forest Service, Southern Forest Experiment Station, Institute of Tropical Forestry; 1985: 35-102.
- Boese, Steven R.; George, Milton F.; Mitchell, Robert J.; Martin, Unja; McQuilkin, Robert A. Physical aspects of freezing in black oak acorns. In: Dawson, Jeffrey O.; Majerus, Kimberly A., eds. Proceedings, 5th central hardwood forest conference; 1985 April 15-17; Urbana-Champaign, IL. SAF Publ. 85-05. Urbana-Champaign, IL: University of Illinois, Department of Forestry; 1985: 222-227.
- Bonner, F. T. Measurement of seed vigor for loblolly and slash pines. Forest Science. 32(1): 170-178; 1986.
- Brown, Sandra; Lugo, Ariel E.; Chapman, Jonathan. Biomass of tropical tree plantations and its implications for the global carbon budget. Canadian Journal of Forest Research. 16(2): 390-394; 1986.
- Burton, James D.; Tiarks, Allan E. Available nutrients and early growth of woody plants vary with overburden material in lignite minesoils of Louisiana. In: New horizons got mined land reclamation: Proceedings of the 1986 national meeting of the American Society for Surface Mining and Reclamation; 1986 March 170-20; Jackson, MS. Princeton, WV: American Society for Surface Mining and Reclamation; 1986: 79-85.
- Carbonneau, Lee. Old-growth forests. Forest Notes. 1(163) (December): 2-5, 7; 1986.
- Christy, E. Jennifer. Effect of root competition and shading growth of suppressed western hemlock (*Tsuga heterophylla*). Vegetation. 65: 21-28; 1986.
- Cintron, Gilberto; Lugo, Ariel E.; Martinez, Ramon. Structural and functional properties of mangrove forests. In: D'Arcy, William G.; Correa, Mireya D., eds. The botany and natural history of Panama. St. Louis, MO: Missouri Botanical Garden; 1985: 53-66.
- Comerford, Nicholas B.; Neary, Daniel G., comps. Forestry and soils: the contributions of Dr. Earl L. Stone to forest soil science. Gainesville, FL: Institute of Food and Agricultural Science, University of Florida; 1985. 228 p.
- Conard, Susan G.; Jaramillo, Annabelle E.; Cromack, Kermit, Jr.; Rose, Sharon, comps. The role of the genus *Ceanothus* in western forest ecosystems. Gen. Tech. Rep. PNW-182. Berkeley, CA: U.S. Department of Agriculture, Forest Service, Pacific Northwest Forest and Range Experiment Station; 1985. 72 p.

- Cooper, Stephen V.; Pfister, Robert D. Ecology of Douglas-fir and grand fir in the interior West. In: Baumgartner, David M.; Mitchell, Russ, eds. Silvicultural management strategies for pests of the interior Douglas-fir and grand fir forest types: proceedings of a symposium; 1984 February 14-16; Spokane, WA. Pullman, WA: Washington State University, Office of Conferences and Institutes; 1984: 11-24.
- Critchfield, William B. Internode or stem unit: a problem of terminology. *Forest Science*. 31(4): 911-912; 1985.
- Critchfield, William B. The late quaternary history of lodgepole and jack pines. *Canadian Journal of Forest Research*. 15: 749-772; 1985.
- Crow, T. R. Ecophysiology of oak regeneration. In: Johnson, James E., ed. Proceedings, challenges in oak management and utilization; 1985 March 28-29; Madison, WI. Madison, WI: University of Wisconsin-Extension, Cooperative Extension Service; 1985: 26-28.
- Curtis, Alan B. Upper Elk Meadows Research Natural Area, supplement 18. RNA Guideb. Supp. 18. Portland, OR: U.S. Department of Agriculture, Forest Service, Pacific Northwest Forest and Range Experiment Station; 1986. 19 p.
- Czapowskyj, M. M.; Rourke, R. V.; Grant, W. J. Growth and nutrient status of black spruce seedlings as affected by water table depth. Res. Pap. 591. Broomall, PA: U.S. Department of Agriculture, Forest Service, Northeastern Forest Experiment Station; 1986. 9 p.
- Dale, Virginia H.; Hemstrom, Miles; Franklin, Jerry. Modeling the long-term effects of disturbances on forest succession, Olympic Peninsula, Washington. *Canadian Journal of Forest Research*. 16: 56-57; 1986.
- Del Moral, Roger; Clappitt, Christopher A. Growth of native plant species on recent volcanic substrates from Mount St. Helens. *The American Midland Naturalist*. 114(2): 374-383; 1985.
- DeVelice, Robert L.; Ludwig, John A.; Moir, William H.; Ronco, Frank, Jr. A classification of forest habitat types of northern New Mexico and southern Colorado. Gen. Tech. Rep. RM-131. Fort Collins, CO: U.S. Department of Agriculture, Forest Service, Rocky Mountain Forest and Range Experiment Station; 1986. 59 p.
- Dickson, Richard E. Carbon fixation and distribution in young *Populus* trees. In: Fujimori, T.; Whitehead, D., eds. Crown and canopy structure in relation to productivity; [1985 October 14-20]; [Tsukuba], JA. Ibaraki, JA: Forestry and Forest Products Institute; 1986: 409-426.
- Dyrness, C. T.; Viereck, L. A.; Van Cleve, K. Fire in taiga communities of interior Alaska. In: Van Cleve, K.; Chapin, F. S., III; Flanagan, P. W.; Viereck, L. A.; Dyrness, C. T., eds. Forest ecosystems in the Alaskan taiga: a synthesis of structure and function. *Ecol. Stud.* 57. New York: Springer-Verlag; 1986: 74-88.
- Eggleston, Kent L.; Sharp, Ruth Crownover. Fertilizer trials on containerized red pine. In: Landis, Thomas D.; Fischer, James W., tech. coords. Proceedings, Intermountain Nurseryman's Association meeting; 1985 August 13-15; Fort Collins, CO. Gen. Tech. Rep. RM-125. Fort Collins, CO: U.S. Department of Agriculture, Forest Service, Rocky Mountain Forest and Range Experiment Station; 1985: 38-42.
- Enge, Kevin M.; Marion, Wayne R. Effects of clearcutting and site preparation on herpetofauna of a north Florida flatwoods. *Forest Ecology and Management*. 14: 177-192; 1986.
- Everett, Richard L.; Koniak, Susan; Budy, Jerry D. Pinyon seedling distribution among soil surface microsites. Res. Pap. INT-363. Ogden, UT: U.S. Department of Agriculture, Forest Service, Intermountain Forest and Range Experiment Station; 1986. 3 p.
- Fernandez, I. J.; Czapowskyj, M. M. Selected relationships for trace metals in Maine low elevation spruce-fir forest floors. *Bull.* 119. Orono, ME: Maine Agricultural Experiment Station; 1986. 23 p.
- Fitzgerald, J. W.; Andrew, T. L. Metabolism of methionine in forest floor layers and soil: influence of sterilization and antibiotics. *Soil Biology & Biochemistry*. 17(6): 881-883; 1985.
- Frangi, Jorge L.; Lugo, Ariel E. Ecosystem dynamics of a subtropical floodplain forest. *Ecological Monographs*. 55(3): 351-369; 1985.
- [Franklin, J. F.; Hall, F.; Laudenslayer, W.; and others.] Interim definitions for old-growth Douglas-fir and mixed conifer forests in the Pacific Northwest and California. Res. Note PNW-447. Portland, OR: U.S. Department of Agriculture, Forest Service, Pacific Northwest Forest and Range Experiment Station; 1986. 7 p.
- Franklin, J. F.; Ralph, C. J.; and others. Interim definitions for old-growth Douglas-fir and mixed conifer forests in the Pacific Northwest and California. Res. Note PNW-447. Portland, OR: U.S. Department of Agriculture, Forest Service, Pacific Northwest Forest and Range Experiment Station; 1986. 7 p.
- Franklin, Jerry; Halpern, Charles; Smith, Brad; Thomas, Ted. The importance of *Ceanothus* species in U.S. forest ecosystems. In: The role of the genus *Ceanothus* in western forest ecosystems. Gen. Tech. Rep. PNW-182. Portland, OR: U.S. Department of Agriculture, Forest Service, Pacific Northwest Forest and Range Experiment Station; 1985: 2-15.

- Franklin, Jerry F. Design of natural area preserves in Hawaii. In: Stone, Charles P.; Scott, J. Michael, eds. Hawaii's terrestrial ecosystem: preservation and management; 1984 June 5-6; Honolulu, HI: University of Hawaii; 1985: 459-474.
- Franklin, Jerry F. Objectives and nature of scientific programs in biosphere reserves. In: Conference on the management of biosphere reserves; 1984 November 27-29; Gatlinburg, TN: Gatlinburg, TN: Upland Field Research Lab, Great Smoky Mountains National Park Biosphere Reserve; 1985: 57-66.
- Franklin, Jerry F.; Spies, Thomas A. The ecology of old-growth Douglas-fir forests. Oregon Birds. 12(2): 79-90; 1986.
- Frenkel, Robert E.; Moir, William H.; Christy, John A. Vegetation of Torrey Lake Mire, Central Cascade Range, Oregon. Madrono. 33(1): 24-39; 1986.
- Gibson, Mark D.; McMillin, Charles W.; Shoulders, E. Moisture content and specific gravity of the four major southern pines under the same age and site conditions. Wood and Fiber Science. 18(3): 428-435; 1986.
- Gottfried, Gerald J.; Heidmann, L. J. Effects of cold stratification and seed coat sterilization on pinyon (*Pinus edulis*) germination. In: Shearer, Raymond C., comp. Proceedings--conifer tree seed in the inland mountain West symposium; 1985 August 5-6; Missoula, MT. Gen. Tech. Rep. INT-203. Ogden, UT: U.S. Department of Agriculture, Forest Service, Intermountain Forest and Range Experiment Station; 1986: 38-43.
- Graber, R. E.; Brewer, L. G. Changes in the population of the rare and endangered plant *Potentilla robbinsiana* Oakes during the period 1973 to 1983. Rhodora--Journal of the New England Botanical Club. 87(852): 449-457; 1985.
- Graham, Russell T. Effect of nitrogen fertilizer and girdling on cone and seed production of western larch. In: Shearer, Raymond C., comp. Proceedings--conifer tree seed in the inland mountain West symposium; 1985 August 5-6; Missoula, MT. Gen. Tech. Rep. INT-203. Ogden, UT: U.S. Department of Agriculture, Forest Service, Intermountain Forest and Range Experiment Station; 1986: 166-170.
- Graney, David L.; Rogerson, Thomas L. Growth of oak, ash and cherry reproduction following overstory thinning of upland hardwood stands in the Boston Mountains of Arkansas. In: Fifth central hardwood forest conference; 1985 April 15-17; Urbana-Champaign, IL. SAF Publ. 85-05. Urbana-Champaign, IL: University of Illinois, Department of Forestry; 1985: 4-10.
- Greene, Sarah E.; Klopsch, Mark. Soil and air temperatures for different habitats in Mount Rainier National Park. Res. Pap. PNW-342. Portland, OR: U.S. Department of Agriculture, Forest Service, Pacific Northwest Forest and Range Experiment Station; 1985. 50 p.
- Gregory, R. A.; Wargo, P. M. Timing of defoliation and its effect on bud development, starch reserves, and sap sugar concentration in sugar maple. Canadian Journal of Forest Research. 16: 10-17; 1985.
- Grigal, D. F.; Buttleman, C. G.; Kernik, L. K. Biomass and productivity of the woody strata of forested bogs in northern Minnesota. Canadian Journal of Botany. 63(12): 2416-2424; 1985.
- Halpern, Charles B. Montane meadow plant associations of Sequoia National Park, California. Madrono. 33(1): 1-23; 1986.
- Harcombe, P. A. Stand development in a 130-year-old spruce-hemlock forest based on age structure and 50 years of mortality data. Forest Ecology and Management. 14: 14-58; 1986.
- Haridi, M. B. Effect of osmotic priming with polyethylene glycol on germination of *Pinus elliottii* seeds. Seed Science and Technology. 13(3): 669-674; 1985.
- Harmon, M. E.; Franklin, J. F.; Swanson, F. J.; and others. Ecology of coarse woody debris in temperate ecosystems. In: Advances in ecological research, vol. 15. New York, NY: Academic Press; 1986: 133-302.
- Harper, Kimball T.; Shane, John D.; Jones, John R. Taxonomy. In: DeByle, Norbert V.; Winokur, Robert P., eds. Aspen: ecology and management in the Western United States. Gen. Tech. Rep. RM-119. Fort Collins, CO: U.S. Department of Agriculture, Forest Service, Rocky Mountain Forest and Range Experiment Station; 1985: 7-8.
- Heidmann, L. J. Acetone is unreliable as a solvent for introducing growth regulators into seeds of southwestern ponderosa pine (*Pinus ponderosa* var. *scopulorum*). In: Shearer, Raymond C., comp. Proceedings--conifer tree seed in the inland mountain West symposium; 1985 August 5-6; Missoula, MT. Gen. Tech. Rep. INT-203. Ogden, UT: U.S. Department of Agriculture, Forest Service, Intermountain Forest and Range Experiment Station; 1986: 44-46.
- Heidmann, L. J.; Cornett, Zane J. Effect of various nutrient regimes and ectomycorrhizal inoculations on field survival and growth of ponderosa pine (*Pinus ponderosa* var. *scopulorum* Engelm.) container seedlings in Arizona. Tree Planters' Notes. 37(2): 15-19; 1986.
- Hess, Karl; Alexander, Robert R. Forest vegetation of the Arapaho and Roosevelt National Forests in central Colorado: a habitat type classification. Res. Pap. RM-266. Fort Collins, CO: U.S. Department of Agriculture, Forest Service, Rocky Mountain Forest and Range Experiment Station; 1986. 48 p.

- Hoff, R. J. Effect of stratification time and seed treatment on germination of western white pine seed. In: Shearer, Raymond C., comp. Proceedings--conifer tree seed in the inland mountain West symposium; 1985 August 5-6; Missoula, MT. Gen. Tech. Rep. INT-203. Ogden, UT: U.S. Department of Agriculture, Forest Service, Intermountain Forest and Range Experiment Station; 1986: 112-116.
- Hoff, R. J.; Steinhoff, R. J. Cutting stratified seed of western white pine (*Pinus monticola* Dougl. ex D. Don) to determine viability or to increase germination. Tree Planters' Notes. 37(1): 25-26; 1986.
- Hoffman, George R. Germination of herbaceous plants common to aspen forests of western Colorado. Bulletin of the Torrey Botanical Club. 112(4): 409-413; 1985.
- Horsley, Stephen B. Allelopathy as a stress for urban trees. In: Nineteenth annual meeting, Society of Municipal Arborists; 1983 September 25-28; East Lansing, MI. Dayton, OH: Society of Municipal Arborists; 1985: 73-87.
- Isebrands, J. G.; Crow, T. R. Techniques for rooting juvenile softwood cuttings of northern red oak. In: Dawson, Jeffrey O.; Majerus, Kimberly A., eds. Proceedings, 5th central hardwood forest conference; 1985 April 15-17; Urbana-Champaign, IL. SAF Publ. 85-05. Urbana-Champaign, IL: University of Illinois, Department of Forestry; 1985: 228-233.
- Isebrands, J. G.; Michael, D. A. Effects of leaf morphology and orientation on solar radiation interception and photosynthesis in *Populus*. In: Fujimori, T.; Whitehead, D., eds. Crown and canopy structure in relation to productivity; [1985 October 14-20]; [Tsukuba], JA. Ibaraki, JA: Forestry and Forest Products Research Institute; 1986: 359-381.
- Jokela, J. J.; Sawtelle, R. A. Origin of oak stands on the Springfield Plain: a lesson on oak regeneration. In: Dawson, Jeffrey O.; Majerus, Kimberly A., eds. Proceedings, 5th central hardwood forest conference; 1985 April 15-17; Urbana-Champaign, IL. SAF Publ. 85-05. Urbana-Champaign, IL: University of Illinois, Department of Forestry; 1985: 181-188.
- Jones, John R. Distribution. In: DeByle, Norbert V.; Winokur, Robert P., eds. Aspen: ecology and management in the Western United States. Gen. Tech. Rep. RM-119. Fort Collins, CO: U.S. Department of Agriculture, Forest Service, Rocky Mountain Forest and Range Experiment Station; 1985: 9-10.
- Jones, John R.; DeByle, Norbert V. Morphology. In: DeByle, Norbert V.; Winokur, Robert P., eds. Aspen: ecology and management in the Western United States. Gen. Tech. Rep. RM-119. Fort Collins, CO: U.S. Department of Agriculture, Forest Service, Rocky Mountain Forest and Range Experiment Station; 1985: 11-18.
- Jones, John R.; DeByle, Norbert V. Other physical factors. In: DeByle, Norbert V.; Winokur, Robert P., eds. Aspen: ecology and management in the Western United States. Gen. Tech. Rep. RM-119. Fort Collins, CO: U.S. Department of Agriculture, Forest Service, Rocky Mountain Forest and Range Experiment Station; 1985: 83-86.
- Jorgensen, Jacques R.; Wells, Carol G. Foresters' primer in nutrient cycling. Gen. Tech. Rep. SE-37. Asheville, NC: U.S. Department of Agriculture, Forest Service, Southeastern Forest Experiment Station; 1986: 42 p.
- Juday, Glenn Patrick; Zasada, John C. Structure and development of an old-growth white spruce forest of an interior Alaska floodplain. In: Meehan, William R.; Merrell, Theodore R., Jr.; Hanley, Thomas A. Fish and wildlife relationships in old-growth forest; 1982 April 12-15; Juneau, AK. Juneau, AK: American Institute of Fishery Research Biologists; 1984: 227-234.
- Jurgensen, M. F.; Jones, E. A.; Mroz, G. D. Total tree harvesting effects on soil nitrogen mineralization and nitrogen fixation. In: Mroz, Glenn D.; Trettin, Carl C., eds. Forest soils: a resource for intensive forest management: Proceedings, 1984 Lake States forest soils conference; 1984 September 26-28; Alberta, MI. Misc. Publ. 85-1. Houghton, MI: Michigan Technological University, School of Forestry and Wood Products; 1985: 31-38.
- Kaufmann, Merrill R. Annual transpiration in subalpine forests: large differences among four tree species. Forest Ecology and Management. 13: 235-246; 1985.
- Kaufmann, Merrill R.; Fiscus, Edwin L. Water transport through plants--internal integration of edaphic and atmospheric effects. Acta Horticulture. 171: 83-94; 1985.
- Kingsbury, Louise. The comeback of western white pine. In: The new book of popular science annual, 1986. Danbury, CT: Grolier Enterprises; 1985: 205-209.
- Kormanik, Paul P. Can lateral root characteristics be a major factor in assessing seedling quality? In: Schmidtling, R. C.; Griggs, M. M., eds. Proceedings of the 18th southern forest tree improvement conference; 1985 May 21-23; Long Beach, MS. SFTI Committee publ. 40. [Place of publication unknown]: [Publisher unknown]; 1985: 290-297. [Available from the National Technical Information Service, 5285 Port Royal Road, Springfield, VA 22161.
- Kormanik, Paul P. Lateral root morphology as an expression of sweetgum seedling quality. Forest Science. 32(3): 601-610; 1986.

- Kossuth, S. V. Mode of action of seed orchard and nursery herbicides on forest trees. In: Pywell, Nancy A.; Neary, Daniel; Law, Beverly, comps., eds. Herbicides for southern forestry: Proceedings of the 1985 annual spring symposium; 1985 April 23-24; Gainesville, FL. Gainesville, FL: [Publisher unknown]; 1985: 168-182.
- Krugman, Stanley L. Biosphere reserves of the Man and Biosphere program in support of sustained-yield forest management. In: Peine, John D., ed. Proceedings of the conference on management of biosphere reserves; 1984 November 27-29; Gatlinburg, TN. Washington, DC: U.S. Department of the Interior, National Park Service; 1985: 119-124.
- Krugman, Stanley L. Summary--conifer tree seed in the inland mountain West. In: Shearer, Raymond C., comp. Proceedings, conifer tree seed in the inland mountain West symposium; 1985 August 5-7; Missoula, MT. Res. Pap. INT-203. Ogden, UT: U.S. Department of Agriculture, Forest Service, Intermountain Forest and Range Experiment Station; 1986: 289.
- Krugman, Stanley L.; McDonald, Stephen E. Forest biology research and the 21st century. In: Crowley, John, ed. Research for tomorrow: 1986 yearbook of agriculture. Washington, DC: U.S. Department of Agriculture; 1986: 206-208.
- Kuhns, M. R.; Garrett, H. E.; Teskey, R. O.; Hinckley, T. M. Root growth of black walnut trees related to soil temperature, soil water potential, and leaf water potential. Forest Science. 31(3): 617-629; 1985.
- Larson, Philip R. Rachis vascularization and leaflet venation in developing leaves of *Fraxinus pennsylvanica*. Canadian Journal of Botany. 63: 2383-2392; 1985.
- Larson, Philip R.; Dickson, Richard E. 14C translocation pathways in honeylocust and green ash: woody plants with complex leaf forms. Physiologia Plantarum. 66: 21-30; 1986.
- Lawson, Edwin R. Eastern redcedar: An American wood. FS-260. Washington, DC: U.S. Department of Agriculture, Forest Service; 1985: 1-7.
- Lenz, G. W.; Mroz, G. D. Total-tree harvesting effects on soil macronutrient pools. In: Mroz, Glenn D.; Trettin, Carl C., eds. Forest soils: a resource for intensive forest management: Proceedings, 1984 Lake States forest soils conference; 1984 September 26-28; Alberta, MI. Misc. Publ. 85-1. Houghton, MI: Michigan Technological University, School of Forestry and Wood Products; 1985: 25-30.
- Linit, M. J.; Johnson, P. S.; McKinney, R. A.; Kearby, W. H. Insects and leaf area losses of planted northern red oak seedlings in an Ozark forest. Forest Science. 32(1): 11-20; 1986.
- Loope, Lloyd L.; Scowcroft, Paul G. Vegetation response within exclosures in Hawai'i: a review. In: Stone, Charles P.; Scott, J. Michael, eds. Hawai'i's terrestrial ecosystems: preservation and management; 1984 June 5-6; Hawaii Volcanoes National Park, HI. Honolulu, HI: Cooperative National Park Resources Studies Unit, University of Hawaii; 1985: 377-402.
- Lopushinsky, William; Kaufmann, Merrill R. Effects of cold soil on water relations and spring growth of Douglas-fir seedlings. Forest Science. 30: 228-234; 1984.
- Lugo, Ariel E. Development, forestry and environmental quality in the eastern Caribbean. In: Lugo, Ariel E., ed. Development, forestry, and environmental quality in the eastern Caribbean. Rio Piedras, PR: U.S. Department of Agriculture, Forest Service, Southern Forest Experiment Station, Institute of Tropical Forestry; 1985: 123-165.
- Lugo, Ariel E., ed. Development, forestry, and environmental quality in the eastern Caribbean. Rio Piedras, PR: U.S. Department of Agriculture, Forest Service, Southern Forest Experiment Station, Institute of Tropical Forestry; 1985. 1650 p.
- Lugo, Ariel; Brown, Sandra. Conserving tropical rainforest ecosystems: assessing coverage and assigning priorities. In: Conservation, science and society. Paris: United Nations Educational, Scientific and Cultural Organization; 1984: 37-43.
- McBride, F. D.; Rink, George. A soil moisture control system for greenhouse plant stress studies. Tree Planters' Notes. 37(1): 27-32; 1986.
- McCaughey, Ward W.; Schmidt, Wyman C.; Shearer, Raymond C. Seed-dispersal characteristics of conifers in the inland mountain West. In: Shearer, Raymond C., comp. Proceedings--conifer tree seed in the inland mountain West symposium; 1985 August 5-6; Missoula, MT. Gen. Tech. Rep. INT-203. Ogden, UT: U.S. Department of Agriculture, Forest Service, Intermountain Forest and Range Experiment Station; 1986: 50-62.
- Means, Joseph E.; Cromack, Kermit, Jr.; MacMillan, Paul C. Comparison of decomposition models using wood density of Douglas-fir logs. Canadian Journal of Forest Research. 15: 1092-1098; 1985.

- Mehring, Peter J., Jr. Late-quaternary pollen records from the interior Pacific Northwest and northern Great Basin of the United States. In: Bryant, V. M., Jr.; Holloway, R. G., eds. Pollen records of late-quaternary North American sediments; 1985; Dallas, TX. Dallas, TX: American Association of Stratigraphic Palynologists; 1985: 167-189.
- Minore, Don. Effects of madrone, chinkapin, and tanoak sprouts on light intensity, soil moisture, and soil temperature. Canadian Journal of Forest Research. 16(3): 654-658; 1986.
- Muir, Patricia S.; Lotan, James E. Disturbance history and serotiny of Pinus contorta in western Montana. Ecology. 66(5): 1658-1668; 1985.
- Nagata, Roddy F.; Markin, George P. Status of insects introduced into Hawai'i for the biological control of the wild blackberry Rubus argutus Link. In: Smith, Clifford W., ed. Proceedings of the 6th conference in natural sciences; 1986 June 10-13; Hawaii Volcanoes National Park, HI. Honolulu, HI: Cooperative National Park Resources Studies Unit, University of Hawaii; 1986: 53-64.
- Nelson, Neil D. Photosynthetic life span of attached poplar leaves under favorable controlled environmental conditions. Forest Science. 31(3): 700-705; 1985.
- Ohmann, Lewis F.; Grigal, David F. Biomass distribution of unmanaged upland forests in Minnesota. Forest Ecology and Management. 13: 205-222; 1985.
- O'Meara, Timothy E.; Rowse, Lesley A.; Marion, Wayne R.; Harris, Larry D. Numerical responses of flatwoods avifauna to clearcutting. Florida Scientist. 48(4): 208-219; 1985.
- Page-Dumroese, Deborah S.; Jurgensen, Martin F.; Graham, Russell T.; Harvey, Alan E. Soil physical properties of raised planting beds in a northern Idaho forest. Res. Pap. INT-360. Ogden, UT: U.S. Department of Agriculture, Forest Service, Intermountain Forest and Range Experiment Station; 1986. 6 p.
- Patterson, Patricia A.; Neiman, Kenneth E.; Tonn, Jonalea R. Field guide to forest plants of northern Idaho. Gen. Tech. Rep. INT-180. Ogden, UT: U.S. Department of Agriculture, Forest Service, Intermountain Forest and Range Experiment Station; 1985. 246 p.
- Peterson, David L.; Hammer R. David. Soil nutrient flux: a component of nutrient cycling in temperate forest ecosystems. Forest Science. 32(2): 318-324; 1986.
- Peterson, David L.; Rolfe, Gary L. Temporal variation in nutrient status of a floodplain forest soil. Forest Ecology and Management. 12: 73-82; 1985.
- Potts, Donald F. Water potential of forest duff and its possible relationship to regeneration success in the northern Rocky Mountains. Canadian Journal of Forest Research. 15: 464-468; 1985.
- Radwan, M. A.; Kraft, J. M.; Shumway, J. S. Evaluation of different extractants for phosphorus in western hemlock soils. Soil Science. 140(6): 429-435; 1985.
- Rice, P. M.; Carlson, C. E.; Bromenshenk, J. J.; Gordon, C. C.; Tourangeau, P. C. Basal injury syndrome of Pinus needles. Canadian Journal of Botany. 64: 632-642; 1986.
- Russin, William A.; Evert, Ray F. Studies on the leaf of Populus deltoides (Salicaceae): ultrastructure, plasmodesmatal frequency, and solute concentrations. American Journal of Botany. 72(8): 1232-1247; 1985.
- Schier, George A.; Jones, John R.; Winokur, Robert P. Vegetative regeneration. In: DeByle, Norbert V.; Winokur, Robert P., eds. Aspen: ecology and management in the Western United States. Gen. Tech. Rep. RM-119. Fort Collins, CO: U.S. Department of Agriculture, Forest Service, Rocky Mountain Forest and Range Experiment Station; 1985: 29-33.
- Schmid, J. M.; Mata, S. A.; Mitchell, J. C. Estimating sound seeds in ponderosa pine cones from half-face counts. Res. Note RM-459. Fort Collins, CO: U.S. Department of Agriculture, Forest Service, Rocky Mountain Forest and Range Experiment Station; 1985. 3 p.
- Scowcroft, Paul G. Fine litterfall and leaf decomposition in a montane koa-ohia rain forest. In: Smith, Clifford W., ed. Proceedings of the 6th conference in natural sciences; 1986 June 10-13; Hawaii Volcanoes National Park, HI. Honolulu, HI: Cooperative National Park Resources Studies Unit, University of Hawaii; 1986: 66-82.
- Seidel, K. W. Tolerance of seedlings of ponderosa pine, Douglas-fir, grand fir, and Engelmann spruce for high temperatures. Northwest Science. 60(1): 1-7; 1986.
- Shearer, Raymond C. Cone production on Douglas-fir and western larch in Montana. In: Shearer, Raymond C., comp. Proceedings--conifer tree seed in the inland mountain West symposium; 1985 August 5-6; Missoula, MT. Gen. Tech. Rep. INT-203. Ogden, UT: U.S. Department of Agriculture, Forest Service, Intermountain Forest and Range Experiment Station; 1986: 63-67.
- Shearer, Raymond C., comp. Proceedings--conifer tree seed in the inland mountain West symposium; 1985 August 5-6; Missoula, MT. Gen. Tech. Rep. INT-203. Ogden, UT: U.S. Department of Agriculture, Forest Service, Intermountain Forest and Range Experiment Station; 1986. 289 p.

- Shigo, A. L. How tree branches are attached to trunks. *Canadian Journal of Botany*. 63(8): 1391-1401; 1985.
- Skolmen, R. G. *Acacia* (*Acacia koa* Gray). In: Bajaj, Y. P. S., ed. *Biotechnology in agriculture and forestry*, vol. 1. Berlin: Springer-Verlag; 1986: 375-384.
- Smith, C. T., Jr.; McCormack, M. L., Jr.; Hornbeck, J. W.; Martin, C. W. Nutrient and biomass removals from a red spruce--balsam fir whole-tree harvest. *Canadian Journal of Forest Research*. 16: 381-388; 1986.
- Sorensen, F. C.; Campbell, R. K. Effect of seed weight on height growth of Douglas-fir (*Pseudotsuga menziesii* (Mirb.) Franco var. *Menziesii*) seedlings in a nursery. *Canadian Journal of Forest Research*. 15(6): 1109-1115; 1985.
- Steinhorst, R. K.; Morgan, P.; Neunswander, L. F. A stochastic-deterministic simulation model of shrub succession. *Ecological Modelling*. 29: 35-55; 1985.
- Stewart, Glenn H. Forest development in canopy openings in old-growth *Pseudotsuga* forests of the Western Cascade Range, Oregon. *Canadian Journal of Forest Research*. 16(3): 558-568; 1986.
- Stewart, Glenn H. Population dynamics of a montane conifer forest, Western Cascade Range, Oregon, USA. *Ecology*. 67(2): 534-544; 1986.
- Stransky, John J.; Huntley, Jimmy C.; Wisher, Wanda J. Net community production dynamics in the herb-shrub stratum of a loblolly pine-hardwood forest: effects of clearcutting and site preparation. *Gen. Tech. Rep. S0-61*. New Orleans, LA: U.S. Department of Agriculture, Forest Service, Southern Forest Experiment Station; 1986. 11 p.
- Swindel, Benée F.; Conde, Louis F.; Smith, Joel E. Successional changes in *Pinus elliottii* plantations following two regeneration treatments. *Canadian Journal of Forest Research*. 16: 630-636; 1986.
- Tinnin, Robert O.; Kirkpatrick, Lee Ann. The allelopathic influence of broadleaf trees and shrubs on seedlings of Douglas-fir. *Forest Science*. 31(4): 945-952; 1985.
- Tinus, R. W. In-bed herbaceous windbarrier produced more ponderosa pine seedlings. In: *Proceedings: Intermountain Nurserymen's Association meeting*; 1985 August 13-15; Fort Collins, CO. *Gen. Tech. Rep. RM-125*. Fort Collins, CO: U.S. Department of Agriculture, Forest Service, Rocky Mountain Forest and Range Experiment Station; 1986: 3-6.
- Tomback, Diana F. Post-fire regeneration of Krummholz whitebark pine: a consequence of nutcracker seed caching. *Madrono*. 33: 100-110; 1986.
- Twilley, Robert B.; Lugo, Ariel E.; Patterson-Zucca, Carol. Litter production and turnover in basin mangrove forests in southwest Florida. *Ecology*. 67(3): 670-683; 1986.
- Ustin, S. L.; Woodward, R. A.; Barbour, M. G. Relationships between sunfleck dynamics and red fir seedling distribution. *Ecology*. 65(5): 1420-1428; 1984.
- Van Cleve, K.; Chapin, F. S., III; Flanagan, P. W.; Viereck, L. A.; Dyrness, C. T. Forest ecosystems in the Alaskan taiga: a synthesis of structure and function. *Ecol. Stud.* 57. New York: Springer-Verlag; 1986. 120 p.
- Verner, Jared; Pastorok, Robert; O'Connor, Joel; Severinghaus, William; Glass, Norman; Swindel, Benée. Ecological community structure analyses in the formulation, implementation, and enforcement of law and policy. *American Statistician*. 39(4, Pt. 2): 393-402; 1985.
- Viereck, L. A.; Van Cleve, K.; Dyrness, C. T. Forest ecosystem distribution in the taiga environment. In: Van Cleve, K.; Chapin, F. S., III; Flanagan, P. W.; Viereck, L. A.; Dyrness, C. T. *Forest ecosystems in the Alaskan taiga: a synthesis of structure and function*. *Ecol. Stud.* 57. New York: Springer, Verlag; 1986: 22-43.
- Viereck, Leslie A.; Foote, M. Joan. Shrub, tree, and herbaceous biomass after the 1983 Rosie Creek Fire. *Misc. Publ. 85-2*. Fairbanks, AK: University of Alaska, Agricultural and Forestry Experiment Station; 1986: 30-33.
- Vozzo, J. A.; Bonner, F. T. Using electrical conductivity of seed leachate as a measure of seed quality in southern pines. In: South, David B., ed. *Proceedings, international symposium on nursery management practices for the southern pines*; 1985 August 4-9; Montgomery, AL. Auburn, AL: Alabama Agricultural Experiment Station, Auburn University; 1986: 94-101.
- Wadsworth, Frank. La deforestacion, muerte del Canal de Panama. [The deforestation, death of the Panama Canal]. *Biocenosis*. 1(3): 15-16; 1985.
- Weaver, Peter L.; Medina, E.; Pool, D.; Dugger, K.; Gonzales-Liboy, J.; Cuevas, E. Ecological observations in the dwarf cloud forest of the Luquillo Mountains in Puerto Rico. *Biotropica*. 18(1): 79-85; 1986.
- Wellner, Charles A. Salmo Research Natural Area, supplement 19. Portland, OR: U.S. Department of Agriculture, Forest Service, Pacific Northwest Forest and Range Experiment Station; 1986. 15 p.
- Wells, Martha, J. M. General procedures for the development of adsorption trapping methods used in herbicide residue analysis. In: *Sampling preparation and isolation using bonded silicas: Proceedings, 2d annual international symposium*; 1985 January 14-15; Philadelphia, PA. Harbor City, CA: Analytichem International, Inc.; 1985: 63-68.

Werner, Richard A.; Post, Karen E. Effects of wood-boring insects and bark beetles on survival and growth of burned white spruce. In: Juday, Glenn P.; Dyrness, C. Theodore. Early results of the Rosie Creek Fire research project, 1984. Misc. Publ. 85-2. Fairbanks, AK: University of Alaska, Agricultural and Forestry Experiment Station; 1986: 14-16.

Zasada, John Z. Production, dispersal, and germination of white spruce and paper birch and first-year seedling establishment after the Rosie Creek Fire. In: Early results of the Rosie Creek Fire research project, 1984. Misc. Publ. 85-2. Fairbanks, AK: University of Alaska, Agricultural and Forestry Experiment Station; 1986: 34-37.

Zobel, Donald B.; Antos, Joseph A. Response of conifer shoot elongation to tephra from Mount St. Helens. Forest Ecology and Management. 12: 83-91; 1985.

Zobel, Donald B.; Antos, Joseph A. Survival of prolonged burial by subalpine forest understory plants. The American Midland Naturalist. 115(2): 282-287; 1986.

Zobel, Donald B.; Roth, Lewis F.; Hawk, Glenn M. Ecology, pathology, and management of Port-Orford-cedar (*Chamaecyparis law. oniana*). Gen. Tech. Rep. PNW-184. Portland, OR: U.S. Department of Agriculture, Forest Service, Pacific Northwest Forest and Range Experiment Station; 1985. 161 p.

Silviculture and Management

Alexander, Robert R. Engelmann spruce seed production and dispersal, and seedling establishment in the central Rocky Mountains. Gen. Tech. Rep. RM-134. Fort Collins, CO: U.S. Department of Agriculture, Forest Service, Rocky Mountain Forest and Range Experiment Station; 1986. 9 p.

Alexander, Robert R. Silvicultural systems and cutting methods for old-growth lodgepole pine forests in the central Rocky Mountains. Gen. Tech. Rep. RM-126. Fort Collins, CO: U.S. Department of Agriculture, Forest Service, Rocky Mountain Forest and Range Experiment Station; 1986. 33 p.

Alexander, Robert R. Silvicultural systems and cutting methods for old-growth spruce fir forests in the central and southern Rocky Mountains. Gen. Tech. Rep. RM-127. Fort Collins, CO: U.S. Department of Agriculture, Forest Service, Rocky Mountain Forest and Range Experiment Station; 1986. 31 p.

Alexander, Robert R. Silvicultural systems and cutting methods for ponderosa pine forests in Front Range of the central Rocky Mountains. Gen. Tech. Rep. RM-128. Fort Collins, CO: U.S. Department of Agriculture, Forest Service, Rocky Mountain Forest and Range Experiment Station; 1986. 22 p.

Alexander, Robert R.; Edminster, Carleton B.; Watkins, Ross K. Estimates of Engelmann spruce seed production on the Fraser Experimental Forest, Colorado. Res. Pap. RM-269. Fort Collins, CO: U.S. Department of Agriculture, Forest Service, Rocky Mountain Forest and Range Experiment Station; 1986. 7 p.

Auchmoody, L. R. Evaluating growth responses to fertilization. Canadian Journal of Forest Research. 15(5): 877-880; 1985.

Auchmoody, L. R. Fertilizing Appalachian hardwoods. In: Guidelines for managing immature Appalachian hardwoods; 1986 May 28-30; Morgantown, WV. Morgantown, WV: West Virginia University; 1986: 208-220.

Auchmoody, L. R. Response of young black cherry to thinning and fertilization. In: Proceedings, 5th central hardwood forest conference; 1985 April 15-17; Urbana-Champaign, IL. Urbana-Champaign, IL: University of Illinois; 1985: 53-61.

Baker, James B. Uneven-aged management of the Crossett Experimental Forest. In: Proceedings of the national silvicultural workshop; 1985 May 13-16; Rapid City, SD. Washington, DC: U.S. Department of Agriculture, Forest Service; 1985: 208-212.

Barnett, James P. Techniques for improving the performance of southern pine seeds in nurseries. In: South, David B., ed. Proceedings of the international symposium on nursery management practices for the southern pines; 1985 August 4-9; Montgomery, AL. Auburn, AL: Auburn University; 1985: 102-112.

Barnett, James P.; Brissette, John C. Producing southern pine seedlings in containers. Gen. Tech. Rep. SO-59. New Orleans, LA: U.S. Department of Agriculture, Forest Service, Southern Forest Experiment Station; 1986. 71 p.

Barnett, James P.; Johnson, J. D.; Stumpff, N. J. Effects of ethylene on development and field performance of loblolly pine seedlings. In: Proceedings, Intermountain Nurserymen's Association meeting; 1985 August 13-15; Fort Collins, CO. Gen. Tech. Rep. RM-125. Fort Collins, CO: U.S. Department of Agriculture, Forest Service, Rocky Mountain Forest and Range Experiment Station; 1986: 48-53.

Beck, Donald E. Thinning Appalachian pole and small sawtimber stands. In: In: Smith, H. Clay; Eye, Maxine C., eds. Workshop proceedings: guidelines for managing immature Appalachian hardwood stands; 1986 May 28-30; Morgantown, WV. SAF Publ. 86-02. Bethesda, MD: Society of American Foresters; 1986: 85-98.

Beck, Donald E.; Hooper, Ralph M. Development of a southern Appalachian hardwood stand after clearcutting. Southern Journal of Applied Forestry. 10(3): 168-172; 1986.

Birdsey, Richard A.; Pitcher, J. A. Management options for poorly stocked stands in the South Central United States. Southern Journal of Applied Forestry. 10(2): 73-77; 1986.

- Bjorkbom, John C.; Walters, Russell S. Allegheny hardwood regeneration response to even-age harvesting methods. Res. Pap. NE-581. Broomall, PA: U.S. Department of Agriculture, Forest Service, Northeastern Forest Experiment Station; 1986. 13 p.
- Boyd, Raymond J.; Miller, Daniel L.; Kidd, Frank A.; Ritter, Catherine P. Herbicides for forest weed control in the inland Northwest: a summary of effects on weeds and conifers. Gen. Tech. Rep. INT-195. Ogden, UT: U.S. Department of Agriculture, Forest Service, Intermountain Forest and Range Experiment Station; 1985. 66 p.
- Bramlett, David L. Potential and actual seed yields from a southern pine seed orchard. In: Proceedings: conifer tree seed in the inland mountain West symposium; 1985 August 5-6; Missoula, MT. Gen. Tech. Rep. INT-203. Ogden, UT: U.S. Department of Agriculture, Forest Service, Intermountain Forest and Range Experiment Station; 1986: 162-165.
- Brisbin, Robert L. Quality hardwoods--what a forester needs to know. In: Proceedings of the 1985 Pennsylvania State University forestry resources issues conference; 1985 March 19-20; University Park, PA. University Park, PA: The Pennsylvania State University; 1986: 35-44.
- Buck, Michael G. Hawaiian treefern harvesting affects forest regeneration and plant succession. Res. Note PSW-355. Berkeley, CA: U.S. Department of Agriculture, Forest Service, Pacific Southwest Forest and Range Experiment Station; 1982. 8 p.
- Buckman, Robert E.; Loftus, Nelson S., Jr. Future research in central hardwoods. In: Dawson, Jeffrey O.; Majerus, Kimberly A., eds. Proceedings of the 5th central hardwood forest conference; 1985 April 15-17; Urbana-Champaign, IL. Urbana-Champaign, IL: University of Illinois; 1985: 1-3.
- Burns, Russell M. Philosophy and approach to special management of natural areas on USDA Forest Service land. In: Collins, Ellen I., comp., ed. Proceedings, Wyoming natural area needs workshop; 1985 November 14-15; Riverton, WY. Arlington, VA: The Nature Conservancy; 1985: 11-15.
- Campbell, T. E. Development of direct-seeded and planted loblolly and slash pines through age 20. Southern Journal of Applied Forestry. 9(4): 205-211; 1985.
- Campbell, T. E. Sprouting of slash, loblolly, and shortleaf pines following a simulated precommercial thinning. Res. Note SO-320. New Orleans, LA: U.S. Department of Agriculture, Forest Service, Southern Forest Experiment Station; 1985. 3 p.
- Carlson, Clinton E.; Pfister, Robert D.; Theroux, Leon J.; Fiedler, Carl E. Release of a thinned budworm-infested Douglas-fir/ponderosa pine stand. Res. Pap. INT-349. Ogden, UT: U.S. Department of Agriculture, Forest Service, Intermountain Forest and Range Experiment Station; 1985. 8 p.
- Cochran, P. H.; Brock, Terry. Soil compaction and initial height growth of planted ponderosa pine. Res. Note PNW-434. Portland, OR: U.S. Department of Agriculture, Forest Service, Pacific Northwest Forest and Range Experiment Station; 1985. 4 p.
- Cochran, P. H.; Lopushinsky, W.; McColley, P. D. Effect of operational fertilization on foliar nutrient content and growth of young Douglas-fir and Pacific silver fir. Res. Note PNW-445. Portland, OR: U.S. Department of Agriculture, Forest Service, Pacific Northwest Forest and Range Experiment Station; 1986. 10 p.
- Cole, Dennis M.; Schmidt, Wyman C. Site treatments influence development of a young mixed-species western larch stand. Res. Pap. INT-364. Ogden, UT: U.S. Department of Agriculture, Forest Service, Intermountain Forest and Range Experiment Station; 1986. 6 p.
- Comerford, Nichols B.; Conde, Louis F.; Marion, Wayne R.; Neary, Daniel G.; Riekerk, Hans; Rockwood, Donald L.; Swindel, Bennee F.; Wilkinson, Robert C. IMPAC assesses biological potential of southern pines. SE Adm. Aid 1985-1. Asheville, NC: U.S. Department of Agriculture, Forest Service, Southeastern Forest Experiment Station; 1985. 11 p.
- Conrad, C. Eugene; Roby, George A.; Hunter, Serena C. Chaparral and associated ecosystems management: a 5-year research and development program. Gen. Tech. Rep. PSW-91. Berkeley, CA: U.S. Department of Agriculture, Forest Service, Pacific Southwest Forest and Range Experiment Station; 1986. 15 p.
- Copes, Donald L. Effects of leader topping and branch pruning on efficiency of Douglas-fir cone harvesting with a tree shaker. Res. Note PNW-431. Portland, OR: U.S. Department of Agriculture, Forest Service, Pacific Northwest Forest and Range Experiment Station; 1985. 8 p.
- Countryman, David W.; Donovan, David D.; Coder, Kim D.; Wray, Paul H. Potential harvestable volumes and management implications for three upland timber types in eastern Iowa. Iowa State Journal of Research. 60(1): 25-37; 1985.
- Crouch, Glenn L. Aspen regeneration in 6- to 10-year-old clearcuts in southwestern Colorado. Res. Note RM-467. Fort Collins, CO: U.S. Department of Agriculture, Forest Service, Rocky Mountain Forest and Range Experiment Station; 1986. 4 p.
- Crouch, Glenn L. Survival and growth of ponderosa pine 18 years after planting and atrazine treatment in south-central Oregon. In: Baumgartner, R. Boyd; Brown, D.; Miller, D., eds. Weed control for forest productivity in the interior West; 1985 February 5-7; Spokane, WA. Pullman, WA: Washington Extension Service; 1986: 125-128.

- Crow, Thomas R. Early revegetation and nutrient conservation following whole-tree harvesting. In: Mroz, Glenn D.; Trettin, Carl C., eds. Forest soils: a resource for intensive forest management: Proceedings, 1984 Lake States forest soils conference; 1984 September 26-28; Alberta, MI. Misc. Publ. 85-1. Houghton, MI: Michigan Technological University, School of Forestry and Wood Products; 1985: 39-54.
- Dale, Martin E.; Hilt, Donald E. Thinning pole and small sawtimber mixed oak stands. In: Guidelines for managing immature Appalachian hardwood stands; 1986: May 28-30; Morgantown, WV. Morgantown, WV: West Virginia University, Division of Forestry; 1986: 99-117.
- DeBell, Dean S.; Radwan, M. A.; Reukema, Donald L.; Ager, Alan A. Increasing the productivity of biomass plantations of alder and cottonwood in the Pacific Northwest. Olympia, WA: U.S. Department of Agriculture, Forest Service, Forestry Sciences Laboratory; 1986. 101 p.
- DeByle, Norbert V. Environment of Populus tremuloides. In: Proceedings of the 1985 Society of American Foresters national convention; 1985 July 28-31; Fort Collins, CO. Bethesda, MD: Society of American Foresters; 1985: 87-91.
- Edwards, M. Boyd. Application of herbicide with hand-operated broadcast spreaders. In: Ground application of forestry herbicide; 1986 May 20-23; Forsyth, GA. [Place of publication unknown]: Georgia Forestry Commission; 1986: 65-78.
- Edwards, M. Boyd. Three-year performance of planted loblolly pine seedlings on a lower Piedmont site after six site-preparation treatments. Res. Note SE-337. Asheville, NC: U.S. Department of Agriculture, Forest Service, Southeastern Forest Experiment Station; 1986. 4 p.
- Edwards, M.; Gonzalez, F. Forestry herbicide control of kudzu and Japanese honeysuckle in loblolly pine sites in central Georgia. In: Proceedings, 39th annual meeting of Southern Weed Science Society; 1986 January 20-22; Nashville, TN. SWSPBE 39. [Place of publication unknown]: Southern Weed Science Society; 1986: 272-275.
- Erdmann, Gayne G.; Mattson, James A.; Oberg, Robert A. A 9-year evaluation of mechanized thinning in northern hardwoods. In: Sturos, John A., comp. Hardwood thinning opportunities in the Lake States: Proceedings of a symposium; 1984 April 20; Escanaba, MI. Gen. Tech. Rep. NC-113. St. Paul, MN: U.S. Department of Agriculture, Forest Service, North Central Forest Experiment Station; 1986: 54-68.
- Erdmann, Gayne G.; Peterson, Ralph M., Jr.; Oberg, Robert R. Crown releasing of red maple poles to shorten high-quality sawlog rotations. Canadian Journal of Forest Research. 15: 694-700; 1985.
- Ferguson, Dennis E.; Stage, Albert R.; Boyd, Raymond J. Predicting regeneration in the grand fir-cedar-hemlock ecosystem of the northern Rocky Mountains. For. Sci. Monogr. 26. Bethesda, MD: Society of American Foresters; 1986. 41 p.
- Fiddler, Gary O.; Laacke, Robert J. Overstory removal: an assessment. In: Successes in silviculture: Proceedings of the national silviculture workshop; 1985 May 13-16; Rapid City, SD. Washington, DC: U.S. Department of Agriculture, Forest Service, Timber Management; 1985: 230-237.
- Fiddler, Gary O.; Weatherspoon, C. Phillip. Retrieving residue after overstory removal in true fir, northeastern California. Res. Pap. PSW-383. Berkeley, CA: U.S. Department of Agriculture, Forest Service, Pacific Southwest Forest and Range Experiment Station; 1986. 5 p.
- Francis, John K. Site evaluation for hardwoods. In: Proceedings, 3d symposium on southeastern hardwoods; 1985 April 16-17; Dothan, AL. Atlanta, GA: U.S. Department of Agriculture, Forest Service, Southern Region; 1985: 31-37.
- Francis, John K. The roots of plantation cottonwood: their characteristics and properties. Res. Note SO-314. New Orleans, LA: U.S. Department of Agriculture, Forest Service, Southern Forest Experiment Station; 1985. 4 p.
- Francis, John K.; Bivens, Donald L. Yellow-poplar and black cherry grow well after underplanting and release. Tree Planters' Notes. 36(1): 8-9; 1985.
- Frenzen, Peter M.; Franklin, Jerry F. Establishment of conifers from seed on tephra deposited by the 1980 eruptions of Mount St. Helens, Washington. The American Midland Naturalist. 114(1): 84-97; 1985.
- Funk, David T., comp. Eastern white pine: today and tomorrow: Symposium proceedings; 1985 June 12-14; Durham, NH. Gen. Tech. Rep. WO-51. Washington, DC: U.S. Department of Agriculture, Forest Service; 1986. 122 p.
- Gansner, David A. Silvicultural cutting opportunities in oak-hickory forests. In: Program and abstracts, Midwest Forest Economists, Midwest Forest Mensurationists; 1986 August 13-14; Lake Front Zion, IL. Urbana, IL: University of Illinois, Department of Forestry; 1986: 25.
- Garrett-Kraus, K.; Blanche, C. A.; Elam, W. W. Ethylene production by stored pine seedlings and its relation to root regeneration and survival. In: South, David B., ed. Proceedings of the international symposium on nursery management practices for the southern pines; 1985 August 5-9; Montgomery, AL. Auburn, AL: Auburn University; 1985: 363-371.
- Gent, J. A.; Allen, H. L.; Campbell, Robert G.; Wells, C. G. Magnitude, duration, and economic analysis of loblolly pine growth response following bedding and phosphorus fertilization. Southern Journal of Applied Forestry. 10: 124-128; 1986.

- Godman, Richard M. Silvicultural considerations in thinning. In: Sturos, John A., comp. Hardwood thinning opportunities in the Lake States: Proceedings of a symposium; 1984 April 20; Escanaba, MI. Gen. Tech. Rep. NC-113. St. Paul, MN: U.S. Department of Agriculture, Forest Service, North Central Forest Experiment Station; 1986: 26-30.
- Gottschalk, Kurt W. Effects of shading on growth and development of northern red oak, black oak, black cherry, and red maple seedlings. Vol. 1. Height, diameter, and root/shoot ratio. In: Dawson, J. O.; Majerus, K. A., eds. Proceedings, 5th central hardwood forest conference; 1985 April 15-17; Urbana-Champaign, IL. SAF Publ. 85-05. Urbana-Champaign, IL: University of Illinois; 1985: 189-195.
- Green, Lisle R. An overview of California chaparral and its management. In: Thirty-eighth annual California weed conference; 1986 January 27-30; Fresno, CA. El Macero, CA: California Weed Conference; 1986: 107-113.
- Grelen, H. E.; Pearson, H. A.; Thill, R. E. Establishment and growth of slash pine on grazed cutover range in central Louisiana. Southern Journal of Applied Forestry. 9(4): 232-236; 1985.
- Hansen, E. A.; Madgwick, H. A. I. Short-rotation plantation management technology for coniferous species. In: Mitchell, C. P.; Nilsson, P. O.; Zsuffa, L., eds. Proceedings of the Joint IEA/forestry energy programme and FAO/cooperative network on rural energy forest energy conference and workshops on: research in forestry for energy, vol. 1; 1985 October 28-30; Rungstedgaard, DE. Garpenberg, SW: The Swedish University of Agricultural Sciences, Department of Operational Efficiency; 1985: 212-229.
- Hansen, Edward A. Planting date affects survival and height growth of hybrid poplar. The Forestry Chronicle. 62(3): 164-169; 1986.
- Hansen, Edward A.; Netzer, Daniel A. Weed control using herbicides in short-rotation intensively cultured poplar plantations. Res. Pap. NC-260. St. Paul, MN: U.S. Department of Agriculture, Forest Service, North Central Forest Experiment Station; 1985. 6 p.
- Hansen, Edward A.; Netzer, Daniel A.; Woods, Ruth F. Tillage superior to no-till for establishing hybrid poplar plantations. Tree Planters' Notes. 37(1): 6-10; 1986.
- Hansen, Edward A.; Tolsted, David N. Nitrogen sources and fertilizer rates affect growth of hybrid poplar. In: Dawson, Jeffrey O.; Majerus, Kimberly A., eds. Proceedings, 5th central hardwood forest conference; 1985 April 15-17; Urbana-Champaign, IL. SAF Publ. 85-05. Urbana-Champaign, IL: University of Illinois, Department of Forestry; 1985: 71-77.
- Harrington, Constance A.; Wierman, Charles A. Response of a poor-site western redcedar stand to precommercial thinning and fertilization. Res. Pap. PNW-339. Portland, OR: U.S. Department of Agriculture, Forest Service, Pacific Northwest Forest and Range Experiment Station; 1985. 14 p.
- Hatchell, Glyndon E. Nursery cultural practices affect field performance of longleaf pine. In: South, David B., ed. Proceedings of the international symposium on nursery management practices for the southern pines; 1985 August 4-9; Montgomery, AL. Auburn, AL: Auburn University; 1986: 148-156.
- Haymond, Jacqueline L.; Zahner, Robert. Forestry acre by acre. Bull. 131. Clemson, SC: Clemson University Cooperative Extension Service; 1985. 37 p.
- Haywood, J. D. Herbicides release crop trees. Forest Farmer. 45(8): 16-17; 1986.
- Haywood, J. D. Response of planted *Pinus taeda* L. to brush control in northern Louisiana. Forest Ecology and Management. 15: 129-134; 1986.
- Heidmann, L. J. Ponderosa pine regeneration in the Southwest. In: Foresters' future: leaders or followers? Proceedings of the 1985 Society of American Foresters national convention; 1985 July 28-31; Fort Collins, CO. Bethesda, MD: Society of American Foresters; 1985: 228-232.
- Hines, Franklin, D.; Long, James N. First- and 2d-year survival of containerized Engelmann spruce in relation to initial seedling size. Canadian Journal of Forest Research. 16: 668-670; 1986.
- Hobbs, Stephen D.; Owston, Peyton W. Plant competition associated with Douglas-fir shelterwood management in southwest Oregon. In: Mann, J. W.; Tesch, S. D., eds. Shelterwood management system: Proceedings of a workshop; 1985 May 13-14; Grants Pass, OR: Corvallis, OR: Forest Research Laboratory, Oregon State University; 1985: 17-21.
- Jimenez, Jorge A.; Lugo, Ariel E.; Cintron, Gilberto. Tree mortality in mangrove forests. Biotropica. 17(3): 177-185; 1985.
- Johnson, Craig W.; Brown, Thomas C.; Timmons, Michael L. Esthetics and landscaping. In: Aspen: ecology and management in the Western United States. Gen. Tech. Rep. RM-119. Fort Collins, CO: U.S. Department of Agriculture, Forest Service Rocky Mountain Forest and Range Experiment Station; 1986: 185-188.
- Johnson, Paul S. Regenerating oaks in the Lake States. In: Johnson, James E., ed. Proceedings, 1985 March 28-29; Madison, WI. Madison, WI: University of Wisconsin-Extension, Cooperative Extension Service; 1985: 98-109.
- Johnson, Paul S.; Rogers, Robert. A method for estimating the contribution of planted hardwoods to future stocking. Forest Science. 31(4): 883-891; 1985.
- Johnson, Robert L.; Krinard, Roger M. Oak regeneration by direct seeding. Alabama's Treasured Forests. 4(3): 12-15; 1985.

- Johnson, Robert L.; Krinard, Roger M. Oak seeding on an adverse field site. Res. Note SO-319. New Orleans, LA: U.S. Department of Agriculture, Forest Service, Southern Forest Experiment Station; 1985. 4 p.
- Johnson, Robert L.; Krinard, Roger M. Regeneration of oaks by direct seedlings. In: Proceedings, 3d Symposium on southeastern hardwoods; 1985 April 16-17; Dothan, AL. Atlanta, GA: U.S. Department of Agriculture, Forest Service, Southern Region; 1985: 56-65.
- Jones, John R.; Kaufmann, Merrill R.; Richardson, E. Arlo. Effects of water and temperature. In: DeByle, Norbert V.; Winokur, Robert P., eds. Aspen: ecology and management in the Western United States. Part 2. Ecology. Gen. Tech. Rep. RM-119. Fort Collins, CO: U.S. Department of Agriculture, Forest Service, Rocky Mountain Forest and Range Experiment Station; 1985. 71-76.
- Jones, John R.; Shepperd, Wayne D. Harvesting. In: DeByle, Norbert V.; Winokur, Robert P., eds. Aspen: ecology and management in the Western United States. Part IV. Management. Gen. Tech. Rep. RM-119. Fort Collins, CO: U.S. Department of Agriculture, Forest Service, Rocky Mountain Forest and Range Experiment Station; 1985: 219-222.
- Jones, John R.; Shepperd, Wayne D. Intermediate treatments. In: DeByle, Norbert V.; Winokur, Robert P., eds. Aspen: ecology and management in the Western United States. Gen. Tech. Rep. RM-119. Fort Collins, CO: U.S. Department of Agriculture, Forest Service, Rocky Mountain Forest and Range Experiment Station; 1985. 209-216.
- Jones, John R.; Shepperd, Wayne D. Rotations. In: DeByle, Norbert V.; Winokur, Robert P., eds. Aspen: ecology and management in the Western United States. Part 4. Management. Gen. Tech. Rep. RM-119. Fort Collins, CO: U.S. Department of Agriculture, Forest Service, Rocky Mountain Forest and Range Experiment Station; 1985: 217-218.
- Jones, John R.; Winokur, Robert P.; Shepperd, Wayne D. Management overview. In: DeByle, Norbert V.; Winokur, Robert P., eds. Aspen: ecology and management in the Western United States. Part 4. Management. Gen. Tech. Rep. RM-119. Fort Collins, CO: U.S. Department of Agriculture, Forest Service, Rocky Mountain Forest and Range Experiment Station; 1985: 193-195.
- Jorgensen, J. R.; Wells, C. G. Tree nutrition and fast-growing plantations in developing countries. International Tree Crops Journal. 3: 225-244; 1986.
- Kauffman, J. Boone; Martin, R. E. A preliminary investigation on the feasibility of preharvest prescribed burning for shrub control. In: Sixth annual forest vegetation management conference; 1984 November 1-2; Redding, CA. Redding, CA: Forest Vegetation Management Conference; 1985: 89-114.
- Kaufmann, Merrill R. New silvicultural options for timber and water yield in the Rocky Mountains. In: Foresters: leaders, or followers?: Proceedings of the 1985 Society of American Foresters national convention; 1985 July 28-31; Fort Collins, CO. Bethesda, MD: Society of American Foresters; 1985: 237-242.
- Kays, J. S.; Smith, D. Wm.; Zedaker, S. M. Season of harvest and site quality effects on hardwood regeneration in the Virginia Piedmont. In: Shoulders, Eugene, ed. Proceedings of the 3d biennial southern silvicultural research conference; 1984 November 7-8; Atlanta. Gen. Tech. Rep. SO-54. New Orleans, LA: U.S. Department of Agriculture, Forest Service, Southern Forest Experiment Station; 1985: 137-145.
- Kennedy, Harvey E., Jr. Cultural treatments influence hardwood growth and foliar nutrient concentration on a minor stream bottom site. Res. Pap. SO-215. New Orleans, LA: U.S. Department of Agriculture, Forest Service, Southern Forest Experiment Station; 1985. 6 p.
- Kennedy, Harvey E., Jr.; Krinard, Roger M. Shumard oaks successfully planted on high pH soils. Res. Note SO-321. New Orleans, LA: U.S. Department of Agriculture, Forest Service, Southern Forest Experiment Station; 1985. 3 p.
- Krinard, Roger M. Cottonwood development through 19 years in a Nelder's design. Res. Note SO-322. New Orleans, LA: U.S. Department of Agriculture, Forest Service, Southern Forest Experiment Station; 1985. 4 p.
- Krinard, Roger M. Ten years' growth of pruned and unpruned cottonwood planted at 40- by 40-foot spacing. Res. Note SO-316. New Orleans, LA: U.S. Department of Agriculture, Forest Service, Southern Forest Experiment Station; 1985. 5 p.
- Krinard, Roger M.; Johnson, Robert L. Hardwood regrowth and yields on bottomland clay soil following clearcutting. Res. Note SO-323. New Orleans, LA: U.S. Department of Agriculture, Forest Service, Southern Forest Experiment Station; 1986. 4 p.
- Lamson, Neil I. Thinning increases growth of 60-year-old cherry-maple stands in West Virginia. Res. Pap. NE-571. Broomall, PA: U.S. Department of Agriculture, Forest Service, Northeastern Forest Experiment Station; 1985. 8 p.
- Lamson, Neil I.; Smith, H. Clay; Miller, Gary W. Logging damage using an individual-tree selection practice in Appalachian hardwood stands. Northern Journal of Applied Forestry. 2(4): 117-120; 1985.
- Leary, Rolfe A. Interaction theory in forest ecology and management. [Place of publication unknown]: Martinus Nijhoff Publishers; 1985. 219 p.
- Leopold, Donald J.; Parker, George R.; Swank, Wayne T. Forest development after successive clearcuts in the southern Appalachians. Forest Ecology and Management. 13: 83-120; 1985.

- Lewis, Clifford E. Planting slash pine in a dense pasture sod. *Agroforestry Systems*. 3: 267-274; 1985.
- Liegel, Leon H.; Lugo, Ariel E. Damage and management of hurricane-prone forests in the Caribbean. In: Lugo, Ariel E., ed. *Development, forestry, and environmental quality in the eastern Caribbean*. Rio Piedras, PR: U.S. Department of Agriculture, Forest Service, Southern Forest Experiment Station, Institute of Tropical Forestry; 1985: 103-122.
- Little, Susan N.; Ottmar, Roger D.; Ohman, Janet L. Predicting duff consumption from prescribed burns on conifer clearcuts in western Oregon and western Washington. Res. Pap. PNW-362. Portland, OR: U.S. Department of Agriculture, Forest Service, Pacific Northwest Forest and Range Experiment Station; 1986. 29 p.
- Loftus, Nelson S., Jr. Innovative silvicultural research in the 1980's. Highlights from a slide presentation. In: *Proceedings of the national silviculture workshop*; 1985 May 13-16; Rapid City, SD. Washington, DC: U.S. Department of Agriculture, Forest Service, Timber Management Research; 1985: 98-103.
- Marquis, David A. Thinning Allegheny pole and small sawtimber stands. In: *Guidelines for managing immature Appalachian hardwoods*; 1986 May 28-30; Morgantown, WV. Morgantown, WV: West Virginia University; 1986: 68-84.
- McDonald, Philip M.; Fiddler, Gary O. Release of Douglas-fir seedlings: growth and treatment costs. Res. Pap. PSW-182. Berkeley, CA: U.S. Department of Agriculture, Forest Service, Pacific Southwest Forest and Range Experiment Station; 1986. 9 p.
- McDonald, Philip M.; Fiddler, Gary O. Weed treatment strategies to control losses in ponderosa pine plantations. In: Helgerson, D. T., ed. *Forest pest management in southwest Oregon*; 1985 August 19-20; Grants Pass, OR. Corvallis, OR: Oregon State University, Forest Research Laboratory; 1986: 47-53.
- McDonald, S. E. Irrigation in forest-tree nurseries: monitoring and effects on seedling growth. In: Duryea, Mary L.; Landis, Thomas D., eds. *Forest nursery manual: production of bareroot seedlings*. The Hague; Boston; Lancaster: Martinus Nijhoff/Dr W. Junk Publishers [for the Forest Research Laboratory, Oregon State University, Corvallis, OR]; 1984: 107-121.
- McDonald, Stephen E. At the threshold of scientific reforestation. In: Crowley, John J., ed. *Research for tomorrow: 1986 yearbook of agriculture*. Washington, DC: U.S. Department of Agriculture; 1986: 215-217.
- McDonald, Stephen E.; Krugman, Stanley L. Worldwide planting of southern pines. *Journal of Forestry*. 84(6): 21-24; 1984.
- McDonald, Stephen E.; Krugman, Stanley L. Worldwide planting of southern pines. In: South, David B., ed. *Proceedings of the international symposium on nursery management practices for the southern pines*; 1985 August 4-9; Montgomery, AL. Auburn, AL: Auburn University; 1986: 1-19.
- McGee, C. E.; Beck, D. E.; Sims, D. H. Natural regeneration of upland hardwoods in the South. *Alabama's Treasured Forests*. 5(1): 9-11; 1986.
- McGee, Charles E. Regeneration after shearfelling and chipping of upland hardwoods. Res. Pap. SO-224. New Orleans: U.S. Department of Agriculture, Forest Service, Southern Forest Experiment Station; 1986. 14 p.
- McGee, Charles E. The first decision: to rehabilitate or to regenerate immature low quality hardwoods. In: Smith, H. Clay; Eye, Maxine C. eds. *Proceedings: guidelines for managing immature Appalachian hardwoods*; 1986 May 28; Morgantown, WV. SAF Publ. 86-02. Morgantown, WV: West Virginia University; 1986: 134-139.
- McGee, Charles E.; Loftis, David L. Planted oaks perform poorly in North Carolina and Tennessee. *Northern Journal of Applied Forestry*. 3(3): 114-116; 1986.
- McKay, Neil. A stockability equation for forest land in Siskiyou County, California. Res. Note PNW-435. Portland, OR: U.S. Department of Agriculture, Forest Service, Pacific Northwest Forest and Range Experiment Station; 1985. 6 p.
- McKee, W. H., Jr.; Hatchell, G. E.; Tiarks, A. E. Managing site damage from logging. Gen. Tech. Rep. SE-32. Asheville, NC: U.S. Department of Agriculture, Forest Service, Southeastern Forest Experiment Station; 1985. 21 p.
- McKee, W. H., Jr.; Wilhite, L. P. Loblolly pine response to bedding and fertilization varies by drainage class on lower Atlantic Coastal Plain sites. *Southern Journal of Applied Forestry*. 10: 16-21; 1986.
- McKee, William H., Jr. Forestry and forest management impacts on wetlands. In: Groman, Hazel A.; [and others], eds. *Wetlands of the Chesapeake*; 1985 April 9-11; Easton, MD. Washington, DC: Environmental Law Institute; 1985: 216-224.
- McLaughlin, Richard A.; Pope, Phillip E.; Hansen, Edward A. Nitrogen fertilization and ground cover in a hybrid poplar plantation: effects on nitrate leaching. *Journal of Environmental Quality*. 14(2): 241-245; 1985.
- McLaughlin, Richard A.; Pope, Phillip E.; Hansen, Edward A. Nitrogen management in a biomass plantation. In: Mroz, Glenn D.; Trettin, Carl C., eds. *Forest soils: a resource for intensive forest management: Proceedings, 1984 Lake States forest soils conference*; 1984 September 26-28; Alberta, MI. Misc. Publ. 85-1. Houghton, MI: Michigan Technological University, School of Forestry and Wood Products; 1985: 77-84.
- Megalos, M. A.; Frederick, D. J.; Clark, A., III; Phillips, D. R. Biomass, nutrient and energy content of southern Piedmont hardwood forests. *Hardwood Res. Coop. Ser. 5*. Raleigh, NC: North Carolina State University; 1986. 34 p.

- Megalos, M. A.; Horton, L.; Frederick, D. J.; Clark, A.; Phillips, D. Energy and biomass of Piedmont hardwoods. In: Palz, W.; Coombs, J.; Hall, D. O., eds. Energy from biomass: 3d E. C. conference; 1985 March 25-29; Venice, IT. London and New York: Elsevier Applied Science Publishers; 1986: 288-291.
- Michael, Jerry L. Pine regeneration with simultaneous control of kudzu. In: Weed science and risk assessment: Proceedings, 39th annual meeting of the Southern Weed Science Society; 1986 January 20-22; Nashville, TN. Champaign, IL: Southern Weed Science Society; 1986: 282-288.
- Michael, J. L.; Neary, D. G. Response of saw palmetto to three herbicides. In: Pywell, Nancy A.; Neary, Daniel; Law, Beverly, comps., eds. Herbicides for southern forestry: Proceedings, 17th annual spring symposium; 1985 April 23-24; Gainesville, FL. Gainesville, FL: University of Florida, School of Forest Resources and Conservation; 1985: 183-185.
- Miller, James H. Ground applications. In: Proceedings, herbicides in forestry; 1985 December 12-13; Athens, GA. Athens, GA: University of Georgia Center for Continuing Education; 1986: 35-55.
- Miller, James H. Kudzu eradication trials testing 15 herbicides. In: Weed science and risk assessment: Proceedings, 39th annual meeting of the Southern Weed Science Society; 1986 January 20-22; Nashville, TN. Champaign, IL: Southern Weed Science Society; 1986: 39: 276-281.
- Minore, Don. A method for estimating the preharvest potential for seedling height growth on cutover forest land in southwestern Oregon. Res. Note PNW-442. Portland, OR: U.S. Department of Agriculture, Forest Service, Pacific Northwest Forest and Range Experiment Station; 1986. 10 p.
- Minore, Don. Effects of sowing depth on emergence and growth of Douglas-fir, western hemlock, and noble fir seedlings. Canadian Journal of Forest Research. 15: 935-940; 1985.
- Minore, Don. Germination, survival, and early growth of conifer seedlings in two habitat types. Res. Pap. PNW-348. Portland, OR: U.S. Department of Agriculture, Forest Service, Pacific Northwest Forest and Range Experiment Station; 1986. 25 p.
- Mueggler, W. F. Vegetation associations. In: DeByle, Norbert V.; Winokur, Robert P., eds. Aspen: ecology and management in the Western United States. Gen. Tech. Rep. RM-119. Fort Collins, CO: U.S. Department of Agriculture, Forest Service, Rocky Mountain Forest and Range Experiment Station; 1985: 45-55.
- Neary, D. G.; Michael, J. L. Herbicides in Florida's flatwoods--efficacy and opportunity. In: Pywell, Nancy A.; Neary, Daniel; Law, Beverly, comps., eds. Herbicides for southern forestry: Proceedings of the 1985 annual spring symposium; 1985 April 23-24; Gainesville, FL. Gainesville, FL: University of Florida; 1985: 194-201.
- Neary, Daniel G. New and old herbicides for weed control in Florida's forests--an introduction. In: Pywell, Nancy A.; Neary, Daniel; Law, Beverly, comps., eds. Herbicides for southern forestry: Proceedings of the 1985 annual spring symposium; 1985 April 23-24; Gainesville, FL. Gainesville, FL: University of Florida; 1985: 1-15.
- Neary, Daniel G.; Bush, Parshall B.; Michael, Jerry L.; Taylor, John W., Jr. Effectiveness of 2,4-D and picloram as forestry herbicides. For. Bull. R8-FB/P28. Atlanta, GA: U.S. Department of Agriculture, Forest Service, Forest Pest Management; 1986. 2 p.
- Oliver, William W. Growth of California red fir advance regeneration after overstory removal and thinning. Res. Pap. PSW-180. Berkeley, CA: U.S. Department of Agriculture, Forest Service, Pacific Southwest Forest and Range Experiment Station; 1986. 6 p.
- Outcalt, Kenneth W. Sand pine for dry sites. Forest Farmer. 45(9): 34, 37; 1986.
- Owston, Peyton W.; Davis, Valerie A. Monitoring growth of crop trees after release treatments. In: Helgerson, O. T., ed. Forest pest management in southwest Oregon: Proceedings of a workshop; 1985 August 19-20; Grants Pass, OR: Corvallis, OR: Oregon State University, Forest Research Laboratory; 1986: 55-62.
- Palmer, Mark A.; Straka, Thomas J.; Doolittle, M. L. Socioeconomic characteristics, adoption of innovations and nonindustrial private forest regeneration. In: Cubbage, Frederick W., ed. Proceedings, trends in growing and marketing southern timber: 1985 southern forest economics workshop; 1985 March 13-15; Athens, GA. Athens, GA: University of Georgia, School of Forest Resources; 1985: 108-116.
- Perala, Donald A. Managing aspen in the North Central States. In: Proceedings, woodland owners and users conference; 1986 February 1; Grand Rapids, MN. St. Paul, MN: University of Minnesota, Office of Special Programs; 1986: 89-98.
- Phillips, Douglas R.; Steinbeck, Klaus. Piedmont hardwoods--potential for management. In: Proceedings: 3d symposium on southeastern hardwoods; 1985 April 16-17; Dothan, AL. Atlanta, GA: U.S. Department of Agriculture, Forest Service, Southern Region; 1985: 82-89.
- Ponder, Felix, Jr. Soil-water variations and black walnut growth. In: Seventy-sixth annual report of the Northern Nut Growers Association; 1985 August 4-7; Springfield, MO. [Place of publication unknown]: [Northern Nut Growers Association]; 1986: 149-154.
- Ponder, Felix, Jr.; Baines, David M. Growth and nutrition of planted black walnut in response to several cultural treatments. In: Dawson, Jeffrey O.; Majerus, Kimberly A., eds. Proceedings, 5th central hardwood forest conference; 1985 April 15-17; Urbana-Champaign, IL. SAF Publ. 85-05. Urbana-Champaign, IL: University of Illinois, Department of Forestry; 1985: 15-18.

- Ponder, Felix, Jr.; Johnson, Paul. Guide to selecting soils for black walnut planting sites in Iowa. [Des Moines], IA: Iowa Conservation Commission, Forestry Section; 1986. 1-86.
- Powers, Robert F. Ponderosa pine and brush competition: a release model. In: Proceedings, 7th annual forest vegetation management conference; 1985 November 6-7; Eureka, CA. Redding, CA: Forest Vegetation Management Conference; 1985. 100 p.
- Putney, W. E.; Zasada, J. C. Direct seeding techniques to regenerate white spruce in interior Alaska. Canadian Journal of Forest Research. 16: 660-664; 1986.
- Pywell, Nancy A.; Neary, Daniel G.; Law, Beverly. comps., eds. Herbicides for southern forestry: Proceedings of the 1985 annual spring symposium; 1985 April 23-24; Gainesville, FL. Gainesville, FL: University of Florida; 1985. 238 p.
- Radwan, M. A.; Shumway, J. S. Response of Douglas-fir seedlings to nitrogen, sulfur, and phosphorus fertilizers. Res. Pap. PNW-346. Portland, OR: U.S. Department of Agriculture, Forest Service, Pacific Northwest Forest and Range Experiment Station; 1985. 14 p.
- Rogers, Robert; Johnson, Paul S. Rule thinning: a field method for meeting stocking goals in oak stands. In: Dawson, Jeffrey O.; Majerus, Kimberly A., eds. Proceedings, 5th central hardwood forest conference; 1985 April 15-17; Urbana-Champaign, IL. SAF Publ. 85-05. Urbana-Champaign, IL: University of Illinois, Department of Forestry; 1985: 106-110.
- Safford, L. O.; Czapowskyj, M. M. Fertilizer stimulates growth and mortality in a young *Populus-Betula* stand: 10-year results. Canadian Journal of Forest Research. 16: 807-813; 1986.
- Schier, George A.; Shepperd, Wayne D.; Jones, John R. Regeneration. In: DeByle, Norbert V.; Winokur, Robert P., eds. Aspen: ecology and management in the Western United States. Part 4. Management. Gen. Tech. Rep. RM-119. Fort Collins, CO: U.S. Department of Agriculture, Forest Service, Rocky Mountain Forest and Range Experiment Station; 1985: 197-208.
- Schlesinger, Richard C. Pruning Appalachian hardwoods. In: Smith, H. Clay; Eye, Maxine C., eds. Proceedings, guidelines for managing immature Appalachian hardwood stands; 1986 May 28-30; Morgantown, WV. SAF Publ. 86-02. Morgantown, WV: West Virginia University, College of Agriculture and Forestry; 1986: 221-227.
- Schlesinger, Richard C.; Baines, David M. Quality dynamics in young black walnut trees. In: Dawson, Jeffrey O.; Majerus, Kimberly A., eds. Proceedings, 5th central hardwood forest conference; 1985 April 15-17; Urbana-Champaign, IL. SAF Publ. 85-05. Urbana-Champaign, IL: University of Illinois, Department of Forestry; 1985: 94-99.
- Schlesinger, Richard C.; Van Sambeek, Jerome W. Ground cover management can revitalize black walnut trees. Northern Journal of Applied Forestry. 3: 49-51; 1986.
- Scowcroft, Paul G.; Stein, John D. Stimulating growth of stagnated *Acacia koa* by thinning and fertilizing. Res. Note PSW-380. Berkeley, CA: U.S. Department of Agriculture, Forest Service, Pacific Southwest Forest and Range Experiment Station; 1986. 8 p.
- Seidel, K. W. A ponderosa pine-grand fir spacing study in central Oregon: results after 10 years. Res. Note PNW-429. Portland, OR: U.S. Department of Agriculture, Forest Service, Pacific Northwest Forest and Range Experiment Station; 1985. 7 p.
- Seidel, K. W. Growth response of suppressed true fir and mountain hemlock after release. Res. Pap. PNW-344. Portland, OR: U.S. Department of Agriculture, Forest Service, Pacific Northwest Forest and Range Experiment Station; 1985. 22 p.
- Seymour, Robert S.; Grace, James R.; Hannah, Peter R.; Marquis, David A. Silviculture: the next 30 years, the past 30 years. Part 4. The Northeastern Journal of Forestry. 84(7): 31-38; 1986.
- Shaw, Lawrence N.; McReynolds, Robert D. Mechanization of gum naval stores production. In: Transactions of the ASAE. 28(6): 1766-1769; 1985.
- Shepperd, Wayne D. Aspen ecology and management in the central and southern Rocky Mountains. In: Foresters: leaders, or followers?: Proceedings of the 1985 Society of American Foresters national convention; 1985 July 28-31; Fort Collins, CO. Bethesda, MD: Society of American Foresters; 1985: 233-236.
- Shepperd, Wayne D. Silviculture of aspen forests in the Rocky Mountains and Southwest. RM-IT-7. Fort Collins, CO: U.S. Department of Agriculture, Forest Service, Rocky Mountain Forest and Range Experiment Station; 1986. 38 p.
- Shepperd, Wayne D.; Jones, John R. Nurse crop. In: DeByle, Norbert V.; Winokur, Robert P., eds. Aspen: ecology and management in the Western United States. Part 3. Resources and uses. Gen. Tech. Rep. RM-119. Fort Collins, CO: U.S. Department of Agriculture, Forest Service, Rocky Mountain Forest and Range Experiment Station; 1985: 181-184.
- Shifley, Stephen R.; Brand, Gary J.; Ohmann, Lewis F. Timber and squirrels: forecasting and evaluating the options. Northern Journal of Applied Forestry. 3(2): 46-49; 1986.

- Sloan, John P.; Ryker, Russell A. Large scalps improve survival and growth of planted conifers in central Idaho. Res. Pap. INT-366. Ogden, UT: U.S. Department of Agriculture, Forest Service, Intermountain Forest and Range Experiment Station; 1986. 9 p.
- Smalley, Glendon W. Classification and evaluation of forest sites on the northern Cumberland Plateau. Gen. Tech. Rep. SO-60. New Orleans: U.S. Department of Agriculture, Forest Service, Southern Forest Experiment Station; 1986. 74 p.
- Smith, Eric L. Economic development considerations in public timber planning. In: Proceedings of the 1985 Society of American Foresters national convention; 1985 July 29-31; Fort Collins, CO. Bethesda, MD: Society of American Foresters; 1985: 292-296.
- Smith, H. Clay; Eye, Maxine C. Guidelines for managing immature Appalachian hardwood stands; 1986 May 28-30; Morgantown, WV. SAF Publ. 86-02. Morgantown, WV: West Virginia University; 1986. 283 p.
- Smith, H. Clay; Lamson, Neil I. Cultural practices on Appalachian hardwood stands--if done, how to do it. In: Smith, H. Clay; Eye, Maxine C. Guidelines for managing immature Appalachian hardwood stands; 1986 May 28-30; Morgantown, WV. SAF Publ. 86-02. Morgantown, WV: West Virginia University; 1986: 46-61.
- Smith, H. Clay; Lamson, Neil I. Wild grapevines--a special problem in immature Appalachian hardwood stands. In: Smith, H. Clay; Eye, Maxine C., eds. Guidelines for managing immature Appalachian hardwood stands; 1986 May 28-30; Morgantown, WV. SAF Publ. 86-02. Morgantown, WV: West Virginia University; 1986: 228-239.
- Sonderman, David L. Changes in stem quality on young thinned hardwoods. Res. Pap. NE-576. Broomall, PA: U.S. Department of Agriculture, Forest Service, Northeastern Forest Experiment Station; 1986. 9 p.
- Stanturf, John A.; Stone, Earl L., Jr. Measuring fertilizer response in mixed species hardwood stands. In: Dawson, Jeffrey O.; Majerus, Kimberly A., eds. Proceedings, 5th central hardwood forest conference; 1985 April 15-17; Urbana-Champaign, IL. Urbana-Champaign, IL: University of Illinois; 1985: 78-89.
- Stein, William I. Designing preharvest and postharvest stocking surveys. In: Mann, J. W.; Tesch, S. D., eds. Shelterwood management system: Proceedings of a workshop; 1985 May 13-14; Grants Pass, OR. Corvallis, OR: Oregon State University, Forest Research Laboratory; 1985: 79-85.
- Stein, William I. Regeneration outlook on BLM lands in the Siskiyou Mountains. Res. Pap. PNW-349. Portland, OR: U.S. Department of Agriculture, Forest Service, Pacific Northwest Forest and Range Experiment Station; 1986. 104 p.
- Stout, Susan Laurane. Twenty-two-year growth of four planted hardwoods. Northern Journal of Applied Forestry. 16(2): 69-72; 1986.
- Swindel, Benec F.; Conde, Louis F.; Smith, Joel E. Windrowing affects early growth of slash pine. Southern Journal of Applied Forestry. 10(2): 81-84; 1986.
- Tappeiner, J. C., II; Knapp, W. H.; Wierman, C. A.; Atkinson, W. A.; Oliver, C. D.; King, J. E.; Zasada, J. C. Silviculture: the next 30 years, the past 30 years. Part II. The Pacific Coast Journal of Forestry. 84(5): 37-46; 1986.
- Tiarks, Allan E.; Haywood, James D. *Pinus taeda* L. Response to fertilization, herbaceous plant control, and woody plant control. Forest Ecology and Management. 14: 103-112; 1986.
- Trimble, George R., Jr.; Tryon, E. H.; Smith, H. Clay; Hillier, J. D. Age and stem origin of Appalachian hardwood reproduction following a clearcut and herbicide treatment. Res. Pap. NE-589. Broomall, PA: U.S. Department of Agriculture, Forest Service, Northeastern Forest Experiment Station; 1986. 8 p.
- Van Haverbeke, David F. Twenty-year performances of Scotch, European black (Austrian), red, and jack pines in eastern Nebraska. Res. Pap. RM-267. Fort Collins, CO: U.S. Department of Agriculture, Forest Service, Rocky Mountain Forest and Range Experiment Station; 1986. 14 p.
- Van Sambeek, J. W. Intercropping black walnut. In: Seventy-sixth annual report of the Northern Nut Growers Association; 1985 August 4-7; Springfield, MO. [Place of publication unknown]: [Northern Nut Growers Association]; 1986: 157-162.
- Van Sambeek, J. W.; Schlesinger, R. C.; Ponder, Felix, Jr.; Rietveld, W. J. Actinorhizal species as nurse crops for black walnut. In: Dawson, Jeffrey O.; Majerus, Kimberly A., eds. Proceedings, 5th central hardwood forest conference; 1985 April 15-17; Urbana-Champaign, IL. SAF Publ. 85-05. Urbana-Champaign, IL: University of Illinois, Department of Forestry; 1985: 257-263.
- Van Sambeek, J. W.; Taylor, Allan. How to start walnut trees from seed. HT-64. St. Paul, MN: U.S. Department of Agriculture, Forest Service, North Central Forest Experiment Station; 1985. 6 p.
- Venator, Charles. Forest tree nursery production: a new concept. In: Seminar on machines and techniques for forest plant production, vol. 2. IUFRO S4. 06-0. Zurich, SW: United Nations, Food and Agriculture Organization and International Union of Forestry Research Organizations; 1984: 64-79.
- Venator, Charles R. Survival of shortleaf pine (*Pinus echinata* Mill.) seedlings as influenced by nursery handling and storage. Tree Planters' Notes. 36(4): 17-19; 1985.

- Venator, Charles R.; Liegel, Leon H. Manual para el funcionamiento de viveros mecanizados para raices desnudas, y viveros semimecanizados con recipientes de volumen menor (130cc), en el Ecuador. Quito, EC: Ministerio de Agricultura y Ganaderia, Programa Nacional Forestal, Ecuador; 1985. 1420 p.
- Venator, Charles R.; Liegel, Leon H.; Barnett, James P. Bare-root versus container production of pines in the American tropics. In: South, David B., ed. Proceedings of the international symposium on nursery management practices for the southern pines; 1985 August 5-9; Montgomery, AL. Auburn, AL: Auburn University; 1985: 72-82.
- Verme, Louis J.; Johnston, William F. Regeneration of northern white cedar deeryards in upper Michigan. *Journal of Wildlife Management*. 50(2): 307-313; 1986.
- Voorhis, Nancy G. Sugarbush management in young stands: effects of crop tree thinning. *Northern Journal of Applied Forestry*. 3(3): 106-108; 1986.
- Walstad, J. D.; Brodie, J. D.; McGinley, B. C.; Robert, C. A. Silvicultural value of chemical brush control in the management of Douglas-fir. *Western Journal of Applied Forestry*. 1(3): 69-73; 1986.
- Weatherspoon, C. Phillip. Preharvest burning for shrub control in a white fir stand: preliminary observations. In: Sixth annual forest vegetation management conference; 1984 November 1-2; Redding, CA. Redding, CA: Forest Vegetation Management Conference; 1985: 71-88.
- Weaver, Peter L. Hurricane damage and recovery in the montane forests of the Luquillo Mountains of Puerto Rico. *Caribbean Journal of Science*. 22(1-2): 53-70; 1986.
- Weaver, Peter L.; Bauer, Gerald P. Growth of line planted mahogany in the Luquillo Mountains of Puerto Rico. [Crecimiento de caoba sembrada en lineas en la Sierra de Luquillo de Puerto Rico]. In: Tenth symposium on natural resources; 1983 December 7; San Juan, PR. San Juan, PR: Puerto Rico Department of Natural Resources; 1983: 31-39d.
- Wehr, Michael A.; Johnson, Russell W.; Sajdak, Robert L. Calibrating and evaluating boomless spray systems for applying forest herbicides. Res. Note NC-329. St. Paul, MN: U.S. Department of Agriculture, Forest Service, North Central Forest Experiment Station; 1985. 4 p.
- Wells, Carol; Allen, Lee. When and where to apply fertilizer. Gen. Tech. Rep. SE-36. Asheville, NC: U.S. Department of Agriculture, Forest Service, Southeastern Forest Experiment Station; 1985. 23 p.
- Woodall, Steven L.; Geary, Thomas F. Identity of Florida casuarinas. Res. Note SE-332. Asheville, NC: U.S. Department of Agriculture, Forest Service, Southeastern Forest Experiment Station; 1985. 10 p.
- Zasada, J. Natural regeneration of trees and tall shrubs on forest sites in interior Alaska. In: Van Cleve, K.; Chapin, F. S., III; Flanagan, P. W.; Viereck, L. A.; Dyrness, C. T. Forest ecosystems in the Alaskan taiga: a synthesis of structure and function. *Ecol. Stud.* 57. New York: Springer-Verlag; 1986: 44-733.
- Zavitzkovski, J.; Isebrands, J. G. Biomass production and energy accumulation in the world's forests. In: Robertson, Doris, proc. coord. Proceedings, 7th international FPRS industrial wood energy forum '83; 1983 September 19-21; Nashville, TN. Proc. 47337. Madison, WI: Forest Products Research Society; 1985: 1: 12-22.
- Zeide, Boris. How much space does a seedling need? *Forest Ecology and Management*. 11: 225-229; 1985.
- ### Growth and Yield
- Benzie, John W.; Alm, Alvin A.; Curtin, T. W.; Merritt, Clair. Silviculture: the next 30 years, the past 30 years. *Journal of Forestry*. 84(8): 35-42; 1986.
- Bockheim, J. G.; Lee, Soo Wook. Biomass and net primary production equations for thinned red pine plantations in central Wisconsin. For. Res. Note 256. Madison, WI: University of Wisconsin-Madison, Department of Forestry; 1984. 6 p.
- Buchman, Roland G. Mortality assessment: what are the essentials? In: Van Hooser, Dwane D.; Van Pelt, Nicholas, comps. Proceedings, growth and yield and other mensurational tricks: a regional technical conference; 1984 November 6-7; Logan, UT. SAF 84-19 and Gen. Tech. Rep. INT-193. Ogden, UT: U.S. Department of Agriculture, Forest Service, Intermountain Forest and Range Experiment Station; 1985: 21-24.
- Buchman, Roland G. Performance of a tree survival model on national forests. *Northern Journal of Applied Forestry*. 2(4): 114-116; 1985.
- Buchman, Roland G. Tree growth simulation within the forest classroom. In: Massey, Joseph G.; Greber, Brian J.; Cooney, Timothy M., eds. Software solutions: Proceedings of a computer symposium, software fair and 2d annual meeting of the Forest Resources Systems Institute; 1985 April 21-24; Clarksville, IN. Florence, AL: Forest Resources Systems Institute; Madison, WI: Forest Products Research Society; 1985: 44-49.
- Cochran, P. H.; Lopushinsky, W.; McColley, P. D. Effects of operational fertilization on foliar nutrient content and growth in young Douglas-fir and Pacific silver fir. Res. Note PNW-445. Portland, OR: U.S. Department of Agriculture, Forest Service, Pacific Northwest Forest and Range Experiment Station; 1986. 10 p.

- Curtis, R. O.; Hyink, D. M. Data for growth and yield models. In: Proceedings: growth and yield and other mensurational tricks: a regional technical conference. Gen. Tech. Rep. INT-193. Ogden, UT: U.S. Department of Agriculture, Forest Service, Intermountain Forest and Range Experiment Station; 1985: 1-5.
- Curtis, Robert O.; Marshall, D. D. Levels-of-growing-stock cooperative study in Douglas-fir. Report No. 8--The logs study: 20-year results. Gen. Tech. Rep. PNW-356. Portland, OR: U.S. Department of Agriculture, Forest Service, Pacific Northwest Forest and Range Experiment Station; 1986. 113 p.
- Crookston, Nicholas L. User's guide to the event monitor: an addition to the PROGNOSIS model. Gen. Tech. Rep. INT-196. Ogden, UT: U.S. Department of Agriculture, Forest Service, Intermountain Forest and Range Experiment Station; 1985. 36 p.
- Crow, Thomas R. Comparing the performance of two northern hardwood growth projection systems. Northern Journal of Applied Forestry. 3(1): 28-32; 1986.
- Dennis, B.; Brown, B. E.; Stage, A. R.; Burkhardt, H. E.; Clark, S. Problems of modeling growth and yield of renewable resources. In: Proceedings of the 8th symposium on statistics, law, and the environment. The American Statistician. 39(4): 374-383; 1985.
- Edminster, Carleton B.; Mowrer, H. Todd. RMYLD update: new growth and yield relationships. In: Van Hooser, Dwane D., Van Peit, Nicholas, comps. Growth and yield and other mensurational tricks: a regional technical conference; 1984 November 6-7; Logan, UT. Gen. Tech. Rep. INT-193. Ogden, UT: U.S. Department of Agriculture, Forest Service, Intermountain Forest and Range Experiment Station; 1985. 98 p.
- Ek, Alan R.; Randall, Bryan L.; Hahn, Jerold T.; Buchman, Roland G. STEMS model projection capability with plot and tree data aggregation. Northern Journal of Applied Forestry. 2(4): 121-127; 1985.
- Erdmann, Gayne G.; Peterson, Ralph M., Jr.; Oberg, Robert R. Crown releasing of red maple poles to shorten high-quality sawlog rotations. Canadian Journal of Forest Research. 15: 694-700; 1985.
- Farrar, Robert M. Predicting stand and stock tables from a spacing study in naturally regenerated longleaf pine. Res. Pap. SO-219. New Orleans, LA: U.S. Department of Agriculture, Forest Service, Southern Forest Experiment Station; 1985. 28 p.
- Farrar, Robert M. Volume and growth predictions for thinned even-aged natural longleaf pine stands in the west gulf area. Res. Pap. SO-220. New Orleans, LA: U.S. Department of Agriculture, Forest Service, Southern Forest Experiment Station; 1985. 171 p.
- Farrar, Robert M.; Murphy, Paul A.; Matney, Thomas G. Predicting growth and yield in natural southern timber stands. The Compiler. 3(4): 15-25; 1986.
- Feduccia, Donald P. Growth and yield prediction models for southern pine plantations. In: Thinning southern pine plantations workshop; 1984 October 30-November 1; Long Beach, MS. Washington, DC: American Pulpwood Association, Inc.; 1984: 15-19.
- Gregoire, Timothy G.; Valentine, Harry T.; Furnival, George M. Estimation of bole volume by importance sampling. Canadian Journal of Forest Research. 16: 554-557; 1986.
- Gregoire, Timothy G.; Valentine, Harry T.; Furnival, George M. Estimation of volume with a taper function: a sampling approach. In: Use of auxiliary information in natural resource inventories; 1985 October 1-2; Blacksburg, VA. SAF Publ. 86-01. Bethesda, MD: Society of American Foresters; 1986: 164-170.
- Harrington, C. A. A method of site quality evaluation for red alder. Gen. Tech. Rep. PNW-192. Portland, OR: U.S. Department of Agriculture, Forest Service, Pacific Northwest Forest and Range Experiment Station; 1986. 22 p.
- Harrington, Constance A.; Curtis, Robert O. Height growth and site index curves for red alder. Res. Pap. PNW-358. Portland, OR: U.S. Department of Agriculture, Forest Service, Pacific Northwest Forest and Range Experiment Station; 1986. 14 p.
- Harrison, Wade C.; Burk, Thomas E.; Beck, Donald E. Individual tree basal area increment and total height equations for Appalachian mixed hardwoods after thinning. Southern Journal of Applied Forestry. 10(2): 99-104; 1986.
- Harrison, Wade C.; Burkhardt, Harold E.; Burk, Thomas E.; Beck, Donald E. Growth and yield of Appalachian mixed hardwoods after thinning. In: Wiant, Harry V., Jr.; Yandle, David O.; Kidd, William E., eds. Forestry microcomputer software symposium; 1986 June 30-July 2; Morgantown, WV. Morgantown, WV: West Virginia University; 1986: 117-130. [Also published separately, with appendixes, as FWS-1-86. Blacksburg, VA: Virginia Polytechnic Institute and State University; 1986. 48 p.]
- Hilt, Donald E. User's guide to OAKSIM: an individual-tree growth and yield simulator for managed, even-aged upland oak stands. Gen. Tech. Rep. NE-104. Broomall, PA: U.S. Department of Agriculture, Forest Service, Northeastern Forest Experiment Station; 1985. 22 p.
- Holdaway, Margaret R. Adjusting STEMS growth model for Wisconsin forests. Res. Pap. NC-267. St. Paul, MN: U.S. Department of Agriculture, Forest Service, North Central Forest Experiment Station; 1985. 8 p.
- Holdaway, Margaret R.; Brand, Gary J. An evaluation of Lake States STEMS85. Res. Pap. NC-269. St. Paul, MN: U.S. Department of Agriculture, Forest Service, North Central Forest Experiment Station; 1986. 10 p.

- Hoyer, Gerald E. Tree form quotients as variables in volume estimation. Res. Pap. PNW-345. Portland, OR: U.S. Department of Agriculture, Forest Service, Pacific Northwest Forest and Range Experiment Station; 1985. 16 p.
- Johnson, Paul S.; Dale, Charles D.; Davidson, Kenneth R.; Law, Jay R. Planting northern red oak in the Missouri Ozarks: a prescription. Northern Journal of Applied Forestry. 3: 66-68; 1986.
- Jones, John R.; DeByle, Norbert V.; Winokur, Robert P. Wood resource. In: DeByle, Norbert V.; Winokur, Robert P., eds. Aspen: ecology and management in the Western United States. Gen. Tech. Rep. RM-119. Fort Collins, CO: U.S. Department of Agriculture, Forest Service, Rocky Mountain Forest and Range Experiment Station; 1985: 161-167.
- Jones, John R.; Schier, George A. Growth. In: DeByle, Norbert V.; Winokur, Robert, P. eds. Aspen: ecology and management in the Western United States. Gen. Tech. Rep. RM-119. Fort Collins, CO: U.S. Department of Agriculture, Forest Service, Rocky Mountain Forest and Range Experiment Station; 1986: 19-24.
- Knoebel, Bruce R.; Burkhart, Harold E.; Beck, Donald E. A growth and yield model for thinned stands of yellow-poplar. For. Sci. Monogr 27. [Place of publication unknown]: [Publisher unknown]; 1986. 62 p.
- Landau, Emanuel; Swindel, Bennee F.; Thompson, James R.; Van Ryzin, John R. FORAST review report. American Statistician. 39(4,Pt. 1): 250-254; 1985.
- Leak, W. B. Stocking of white pine. In: Eastern white pine: today and tomorrow; 1985 June 12-14; Durham, NH. Gen. Tech. Rep. WO-51. Washington, DC: U.S. Department of Agriculture, Forest Service; 1986: 51-54.
- Lloyd, F. Thomas; Harms, William R. An individual stand growth model for mean plant size based on the rule of self-thinning. Annals of Botany. 57: 681-688; 1986.
- Loftus, Nelson S., Jr. Forest land management decisions. In: Crowley, John J., ed. Research for tomorrow: 1986 yearbook of agriculture. Washington, DC: U.S. Department of Agriculture; 1986: 212-214.
- Lopushinsky, W. Effects of jellyrolling and acclimatization on survival and height growth of conifer seedlings. Res. Note PNW-438. Portland, OR: U.S. Department of Agriculture, Forest Service, Pacific Northwest Forest and Range Experiment Station; 1986. 14 p.
- Matney, Thomas G.; Hodges, John D.; Sullivan, Alfred D.; Ledbetter, Julia R. Tree profile and volume ratio equations for sweetgum and cherrybark oak trees. Southern Journal of Applied Forestry. 9(4): 222-227; 1985.
- McMinn, James W. Derivation of prism factors for quantifying tree crown competition. Res. Note SE-341. Asheville, NC: U.S. Department of Agriculture, Forest Service, Southeastern Forest Experiment Station; 1986. 4 p.
- McNab, W. Henry; Outcalt, Kenneth W.; Brendemuehl, Raymond H. Weight and volume of plantation-grown Choctawhatchee sand pine. Res. Pap. SE-252. Asheville, NC: U.S. Department of Agriculture, Forest Service, Southeastern Forest Experiment Station; 1985. 44 p.
- Means, Joseph E.; Helm, Mary E. Height growth and site index curves for Douglas-fir on dry sites in the Willamette National Forest. Res. Pap. PNW-341. Portland, OR: U.S. Department of Agriculture, Forest Service, Pacific Northwest Forest and Range Experiment Station; 1985. 17 p.
- Moeur, Melinda. COVER: a user's guide to the CANOPY and SHRUBS extension of the stand PROGNOSIS model. Gen. Tech. Rep. INT-190. Ogden, UT: U.S. Department of Agriculture, Forest Service, Intermountain Forest and Range Experiment Station; 1985. 49 p.
- Mowrer, H. Todd. ASPNORM: a normal diameter distribution growth and yield model for aspen in the central Rocky Mountains. Res. Pap. RM-264. Fort Collins, CO: U.S. Department of Agriculture, Forest Service, Rocky Mountain Forest and Range Experiment Station; 1985. 12 p.
- Mowrer, H. Todd. Site productivity estimates for aspen in the central Rocky Mountains. Western Journal of Applied Research. 3: 89-91; 1986.
- Mowrer, H. Todd; Edminster, Carleton B. Estimating past diameters and bark thickness of aspen in the Rocky Mountains. Res. Note RM-456. Fort Collins, CO: U.S. Department of Agriculture, Forest Service, Rocky Mountain Forest and Range Experiment Station; 1984. 2 p.
- Murphy, Paul A.; Farrar, Robert M. Growth and yield of uneven-aged shortleaf pine stands in the interior highlands. Res. Pap. SO-218. New Orleans: U.S. Department of Agriculture, Forest Service, Southern Forest Experiment Station; 1985. 11 p.
- Nance, W. L.; Shoulders, E.; Dell, T. R. Predicting survival and yield of unthinned slash and loblolly pine plantations with different levels of fusiform rust. In: Branham, Susan J.; Thatcher, Robert C., eds. Integrated pest management research symposium: The proceedings; 1985 April 15-18; Asheville, NC. Gen. Tech. Rep. SO-56. New Orleans, LA: U.S. Department of Agriculture, Forest Service, Southern Forest Experiment Station; 1985: 62-72.
- Perala, Donald A. Predicting red pine shoot growth using growing degree days. Forest Science. 31(4): 913-925; 1985.
- Ramm, Carl W.; Miner, Cynthia L. Growth and yield programs used on microcomputers in the North Central region. Northern Journal of Applied Forestry. 3(2): 44-45, 79; 1986.
- Rauscher, H. Michael; Cooney, Timothy M. Using expert-system technology in a forestry application: the CHAMPS experience. Journal of Forestry. 84(3): 14-17; 1986.

- Rauscher, H. Michael; Saha, Hrishi; Robert, Pierre. Computerized habitat analysis and multiple-use prescription system. In: Proceedings, national silvicultural workshop: successes in silviculture; 1985 May 13-16; Rapid City, SD. Washington, DC: U.S. Department of Agriculture, Forest Service, Division of Timber Management; 1985: 238-255.
- Rauscher, Harold M. The microcomputer scientific software series 4: testing prediction accuracy. Gen. Tech. Rep. NC-107. St. Paul, MN: U.S. Department of Agriculture, Forest Service, North Central Forest Experiment Station; 1986. 19 p.
- Riemenschneider, Don E.; Carlson, Mike. Biomass production by jack pine and lodgepole pine. In: Mitchell, C. P.; Nilsson, P. O.; Zuffa, L., eds. Proceedings, joint IEA/forestry energy programme and FAO/cooperative network on rural energy forest energy conference and workshops on: research in forestry for energy, vol. 1; 1985 October 28-30; Rungstedgaard, DE. Garpenberg, SW: Swedish University of Agricultural Sciences, Department of Operational Efficiency; 1985:163-175.
- Ronco, Frank, Jr.; Edminster, Carleton B.; Trujillo, David P. Growth of ponderosa pine thinned to different stocking levels in northern Arizona. Res. Pap. RM-262. Fort Collins, CO: U.S. Department of Agriculture, Forest Service, Rocky Mountain Forest and Range Experiment Station; 1985. 15 p.
- Schlaegel, Bryce, E.; Kennedy, Harvey E., Jr. Deriving biomass estimation equations for seven plantation hardwood species. In: Rockwood, Donald L., ed. Proceedings of the 1985 southern forest biomass workshop: 7th annual meeting of the Southern Forest Biomass Working Group; 1985 June 11-14; Gainesville, FL. Gainesville, FL: University of Florida, Institute of Food and Agricultural Sciences; 1986: 31-39.
- Shifley, Stephen; Lentz, Ellen. Quick estimation of the three-parameter Weibull to describe tree size distributions. Forest Ecology and Management. 13: 195-203; 1985.
- Solomon, D. S. Quantifying impacts on forest growth and yield (summary). In: Sanders, C. J.; and others, eds. Recent advances in spruce budworms research: Proceedings of the CANUSA spruce budworms research symposium; 1984 September 16-20; Bangor, ME. Ottawa, ON: Canadian Forestry Service and U.S. Department of Agriculture; 1985: 254.
- Solomon, Dale S. Annual increment of stressed spruce and fir trees. In: Solomon, D. S.; Brann, T. B., eds. Environmental influences on tree and stand increment; 1985 September 23-27; Durham, NH. Misc. Rep. 691. Orono, ME: Maine Agricultural Experiment Station; 1986: 49-56.
- Solomon, Dale S. SIMSAP/SIMTIM: a forest growth simulator for even-aged northern hardwoods. In: Wiant, H. V.; Yandle, D. O.; Kidd, W. E., eds. Proceedings of the forestry microcomputer software symposium; 1986 June 30-July 2; Morgantown, WV. Morgantown, WV: West Virginia University; 1986: 97-116.
- Solomon, Dale S.; Hayslett, Homer T., Jr. Predicting foliage production on balsam fir trees using a matrix model. In: Solomon, D. S.; Brann, T. B., eds. Environmental influences on tree and stand increment; 1985 September 23-27; Durham, NH. Misc. Rep. 691. Orono, ME: Maine Agricultural Experiment Station; 1986: 138-145.
- Solomon, Dale S.; Hosmer, Richard A. FIBER: a growth model for forest stands in the Northeast. In: Wiant, H. V.; Yandle, D. O.; Kidd, W. E., eds. Proceedings of the forestry microcomputer software symposium; 1986 June 30-July 2; Morgantown, WV. Morgantown, WV: West Virginia University; 1986: 131-145.
- Solomon, Dale S.; Hosmer, Richard A.; Hayslett, Homer T., Jr. A two-stage matrix model for predicting growth of forest stands in the Northeast. Canadian Journal of Forestry Research. 16: 521-529; 1986.
- Solomon, Dale S.; Leak, William B. Simulated yields for managed northern hardwood stands. Res. Pap. NE-578. Broomall, PA: U.S. Department of Agriculture, Forest Service, Northeastern Forest Experiment Station; 1986. 24 p.
- Stage, Albert R.; Crookston, Nicholas L.; Wiitala, Marc R. Procedures for including pest management activities in forest planning using present or simplified planning models. In: Bailey, Robert G., tech. coord. Lessons from using FORPLAN: Proceedings of a planning and implementation workshop; 1986 April 29-May 1; Denver, CO. Washington, DC: U.S. Department of Agriculture, Forest Service, Land Management Planning Systems; 1986: 202-215.
- Steele, Brian M.; Cooper, Stephen F. Predicting site index and height for selected tree species of northern Idaho. Res. Pap. INT-365. Ogden, UT: U.S. Department of Agriculture, Forest Service, Intermountain Forest and Range Experiment Station; 1986. 16 p.
- Stout, Susan Laurane; Nyland, Ralph D. Role of species composition in relative density measurement in Allegheny hardwoods. Canadian Journal of Forest Research. 16: 574-579; 1986.
- Sutter, E. G.; Barker, P. B. (sic). In vitro propagation of mature *Liquidambar styraciflua*. Plant Cell Tissue Organ Culture. 5: 13-21; 1985.
- Valentine, Harry T. Tree-growth models: derivations employing the pipe-model theory. Journal of Theoretical Biology. 117: 579-585; 1985.
- Valentine, Harry T.; Gregoire, Timothy G.; Furnival, George M.; Solomon, Dale S. Unbiased estimation of bole increment. In: Solomon, Dale S.; Brann, Thomas B., eds. Environmental influences on tree and stand increment: Proceedings of an international conference; 1985 September 23-27; Durham, NH. Misc. Publ. 691. Orono, ME: Maine Agricultural Experiment Station, University of Maine; 1986: 67-72.

- Van Deusen, Paul C. Fitting assumed distributions to horizontal points sample diameters. *Forest Science*. 32(1): 146-148; 1986.
- Van Deusen, Paul C.; Dell, Tommy R.; Thomas, Charles E. Volume growth estimation from permanent horizontal points. *Forest Science*. 32(2): 415-422; 1986.
- Van Hooser, Dwane D.; Van Pelt, Nicholas, comps. Proceedings--growth and yield and other mensurational tricks: a regional technical conference. Gen. Tech. Rep. INT-193. Ogden, UT: U.S. Department of Agriculture, Forest Service, Intermountain Forest and Range Experiment Station; 1985. 98 p.
- Van Lear, D. H.; Taras, M. A.; Waide, J. B.; Augspurger, M. K. Comparison of biomass equations for planted vs. natural loblolly pine stands of sawtimber size. *Forest Ecology and Management*. 14: 205-210; 1986.
- Waldrop, T. A.; Buckner, E. R.; Shugart, H. H., Jr.; McGee, C. E. FORCAT: a single tree model of stand development following clearcutting on the Cumberland Plateau. *Forest Science*. 32(2): 297-317; 1986.
- Walters, Nancy R. The transfer of TWIGS. In: *Foresters' future: leaders or followers?*: Proceedings of the 1985 Society of American Foresters national convention; 1985 July 28-31; Fort Collins, CO. SAF Publ. 85-13. Bethesda, MD: Society of American Foresters; 1985: 53-56.
- Walters, Nancy R.; Miner, Cynthia L. TWIGS: a tool for forestry professionals. In: Massey, Joseph G.; Greber, Brian J.; Cooney, Timothy M., eds. *Software solutions: Proceedings of a computer symposium, software fair and 2d annual meeting of the Forest Resources Systems Institute*; 1985 April 21-24; Clarksville, IN. Florence, AL: Forest Resources Systems Institute; Madison, WI: Forest Products Research Society; 1985: 29-32.
- Williston, H. L. Growth and yield of planted loblolly and shortleaf pines in a north Mississippi creek bottom. *Southern Journal of Applied Forestry*. 9(4): 247-249; 1985.
- Wykoff, W. R. Supplement to the user's guide for the stand PROGNOSIS model--version 5.0. Gen. Tech. Rep. INT-208. Ogden, UT: U.S. Department of Agriculture, Forest Service, Intermountain Forest and Range Experiment Station; 1986. 36 p.
- Zutter, B. R.; Oderwald, R. G.; Murphy, P. A.; Farrar, R. M. Characterizing diameter distributions with modified data tapes and forms of the Weibull distribution. *Forest Science*. 32(1): 37-38; 1986.

Genetics and Tree Improvement

- Bramlett, D. L.; Bridgwater, F. E.; Jett, J. B.; Matthews, F. R. Theoretical impact of pollen viability and distribution on the number of strobili to use for controlled pollinations in loblolly pine. In: Schmidtling, R. C.; Griggs, M. M., eds. *Proceedings of the 18th southern forest tree improvement conference*; 1985 May 21-23; Long Beach, MS. SFTI Comm. Publ. 40. [Place of publication unknown]: [Publisher unknown]; 1985: 194-203. [Available from the National Technical Information Service, 5285 Port Royal Road, Springfield, VA 22161.]
- Braun, Carl J.; Sisco, Paul H.; Sederoff, Ronald R.; Levings, Charles S., III. Characterization of inverted repeats from plasmid-like DNA's and the maize mitochondrial genome. *Current Genetics*. 10: 625-630; 1986.
- Bridgwater, F. E.; Franklin, E. C. Forest tree breeding: strategies, achievements and constraints. In: Cannell, M. G. R.; Gordon, J. C., eds. *Attributes of trees as crop plants*. Edinburgh, SC: Wilson and Son, Ltd.; 1985: 36-48.
- Bridgwater, F. E.; Williams, C. G.; Campbell, R. G. Patterns of leader elongation in loblolly pine families. *Forest Science*. 31(4): 933-944; 1985.
- Bridgwater, Floyd E.; Ledig, F. Thomas. Selecting for super trees. *Journal of Forestry*. 84(2): 53-56; 1986.
- Campbell, R. K.; Echois, R. M.; Stonecypher, R. W. Genetic variances and interactions in 9-year-old Douglas-fir grown at narrow spacings. *Silvae Genetica*. 35(1): 24-32; 1986.
- Campbell, R. K.; Sorensen, F. C. Genetic implications of nursery practices. In: Duryea, Mary L.; Landis, Thomas D. *Production of bareroot seedlings. Forest nursery manual*. New York: Dr. W. Junk Publishers; 1984: 183-191.
- Clausen, Knud E. Early growth and flowering of *Alnus glutinosa* provenances in southern Illinois. In: Dawson, Jeffrey O.; Majerus, Kimberly A., eds. *Proceedings, 5th central hardwood forest conference*; 1985 April 15-17; Urbana-Champaign, IL. SAF Publ. 85-05. Urbana-Champaign, IL: University of Illinois, Department of Forestry; 1985: 289-295.
- Conkle, M. Thompson. Decoding tree DNA. *Journal of Forestry*. 84(1): 34-37; 1986.
- Copes, Donald L. Fertility of Douglas-fir pollen after 1 year of storage in liquid nitrogen. *Forest Science*. 31(3): 569-574; 1985.
- Crookston, N. L. Forecasting growth and yield of budworm-infested forests. In: Sanders, C. J.; and others, eds. *Recent advances in spruce budworms research: Proceedings of the CANUSA spruce budworms research symposium*; 1984 September 16-20; Bangor, ME. Ottawa, ON: Canadian Forestry Service and U.S. Department of Agriculture, Forest Service; 1985: 214-230.

- Durzan, D. J. Tissue culture and improvement of woody perennials: an overview. In: Henke, Randolph R.; Hughes, Karen W.; Constantin, Milton J.; Hollaender, Alexander; Wilson, Claire M., eds. Tissue culture in forestry and agriculture. New York and London: Plenum Press; 1986: 233-256.
- Durzan, Don J. Improvement of forest and fruit species. *Intersciencia*. 11(1): 7-8; 1986.
- Eguiluz Piedra, T.; Ledig, F. T.; Yeatman, C. W. Conservation of forest genetic resources in North America. In: North American Forestry Commission, 13th session; 1986 February 3-7; Chetumal, MX. Chetumal, MX: North American Forestry Commission; 1986: 1-14.
- Francis, John K.; McCracken, Francis I. The decline and mortality of cottonwood clone Stoneville 124 on a clay soil. Res. Note SO-318. New Orleans, LA: U.S. Department of Agriculture, Forest Service, Southern Forest Experiment Station; 1985. 3 p.
- Garrett, Peter W. Role of tree improvement in providing pest-resistant eastern white pine (*Pinus strobus* L.). In: Funk, David T., comp. Eastern white pine: today and tomorrow; 1985 June 12-14; Durham, NH. Gen. Tech. Rep. WO-51. Washington, DC: U.S. Department of Agriculture, Forest Service; 1986: 75-88.
- Garrett, Peter W. Tree improvement in Pennsylvania. *Pennsylvania Forests*. 9: 16; 1985.
- Gerhold, Henry D.; Goddard, Ray E.; McDonald, GERALD I. Breeding out disease: can we use resistant trees to reduce forest damage? *Journal of Forestry*. 84(2): 49-53; 1986.
- Gregorius, H.-R.; Namkoong, G. Joint analysis of genotypic and environmental effects. *Theoretical and Applied Genetics*. 72: 413-422; 1986.
- Gregorius, H.-R.; Roberds, J. H. Measurement of genetical differentiation among subpopulations. *Theoretical and Applied Genetics*. 71: 826-834; 1986.
- Gupta, P. K.; Durzan, D. J. Shoot multiplication from mature trees of Douglas-fir (*Pseudotsuga menziesii*) and sugar pine (*Pinus lambertiana*). *Plant Cell Reports*. 4: 177-179; 1985.
- Gupta, Pramod K.; Durzan, Don J. Somatic polyembryogenesis from callus of mature sugar pine embryos. *Bio/Technology*. 4: 643-645; 1986.
- Haissig, Bruce E. Metabolic processes in adventitious rooting of cuttings. In: Jackson, Michael B. New root formation in plants and cuttings. Boston, MA: Martinus Nijhoff Publishers; 1986: 141-189.
- Hautala, E.; Stafford, A.; Corse, J.; Barker, Philip A. Cytokinin variation in the sap of male and female *Gymnocladus dioica*. *Journal of Chromatography*. 351: 560-565; 1986.
- Heile-Sudholt, Catherine; Huetteman, Carl A.; Preece, John E.; Van Sambeek, Jerome W.; Gaffney, Gerald R. In vitro embryonic axis and seedling shoot tip culture of *Juglans nigra* L. *Plant Cell, Tissue and Organ Culture*. 6: 189-197; 1986.
- Jones, John R.; DeByle, Norbert V. Genetics and variation. In: DeByle, Norbert V.; Winokur, Robert P., eds. *Aspen: ecology and management in the Western United States*. Gen. Tech. Rep. RM-119. Fort Collins, CO: U.S. Department of Agriculture, Forest Service, Rocky Mountain Forest and Range Experiment Station; 1985: 35-39.
- Kang, H. Juvenile selection in tree breeding: some mathematical models. *Silvae Genetica*. 34(2-3): 75-84; 1985.
- Knezick, Donald R.; Kuser, John E.; Garrett, Peter W. Supplemental mass pollination of single clone orchards for the production of southern pine hybrids. In: Schmidtling, R. C.; Griggs, M. M., eds. Proceedings of the 18th southern forest tree improvement conference; 1985 May 21-23; Long Beach, MS. Long Beach, MS: Southern Forest Tree Improvement Committee; 1985: 187-193.
- Kossuth, Susan V.; Muse, H. David. Within-tree variation in cortical monoterpenes of slash pine. In: Schmidtling, R. C.; Griggs, M. M., eds. Proceedings of the 18th southern forest tree improvement conference; 1985 May 21-23; Long Beach, MS: Publ. 40. [Place of publication unknown]: Southern Forest Tree Improvement Committee; 1985: 127-135. [Available from the National Technical Information Service, 5285 Port Royal Road, Springfield, VA 22161.]
- Kraus, John F. Disease resistance from hybrids of *Pinus echinata* x *Pinus taeda*. In: Caron, F.; Coriveau, A. G.; Boyle, R. J. B., eds. Proceedings of the 20th meeting of the Canadian Tree Improvement Association. Part 2: Symposium on new ways in forest genetics; 1985 August 19-22; Quebec City, PQ: Ottawa, ON: Canadian Forestry Service; 1986: 166-171.
- Krugman, Stanley L. Forest genetics and foreign policy. *Iowa State Journal of Research*. 59(4): 529-539; 1985.
- Krugman, Stanley L. Forest genetics--the U.S. contribution to international forestry--the Federal role. In: Proceedings, 17th southern forest tree improvement conference; 1983 June 6-9; Athens, GA. Athens, GA: Southern Forest Tree Improvement Committee; 1983: 1-6.
- Krugman, Stanley L. Forest tree improvement strategies in developing countries. In: Proceedings of the 15th reunion del Grupo de Mejoramiento Genetico Forestal ciclo de conferencias; 1984 October 9-12; Durango, MX. Durango, MX: North American Forestry Commission--Mexico; 1985: 125-134.
- Krugman, Stanley L. Policies, strategies and means for genetic conservation in forestry. In: Yeatman, Christopher W.; Kafton, David; Wilkes, Garrison, eds. *Plant genetic resources: a conservation imperative: American Association for the Advancement of Science selected symposium 87*; [Date of meeting unknown]; Boulder, CO. Toronto, ON: Westview Press [for the American Association for the Advancement of Science]; 1984: 71-78.

- Krugman, Stanley L. The ethical question. *Journal of Forestry*. 84(1): 40-41; 1986.
- Krugman, Stanley L. Traditional forest genetics vs. biotechnological and physiological approaches. In: *Proceedings of the 20th meeting of the Canadian Tree Improvement Association*; 1985 August 19-22; Quebec City, PQ. [Place of publication unknown]: Canadian Tree Improvement Association; 1985: 62-67.
- Krugman, Stanley L. U.S. Forest Service view of recent developments and the future of forest biotechnology. In: *Proceedings of the research and development conference*; 1986 September; Raleigh, NC. [Place of publication unknown]: TAPPI; 1986: 79-81.
- Kuser, John E.; Knezick, Donald R. Twenty-year observations on a clonal plantation of pitch pine in the New Jersey pinelands. *Bulletin of the Torrey Botanical Club*. 112(3): 318-323; 1985.
- Ledig, F. Thomas. Applying frontier biotechnologies to tree improvement: opportunities and limitations. In: Burns, Denver P., comp. *Proceedings: IUFRO evaluation and planning of forestry research*; 1985 July 25-26; Fort Collins, CO. Gen. Tech. Rep. NE-111. Broomall, PA: U.S. Department of Agriculture, Forest Service, Northeastern Forest Experiment Station; 1986: 9-15.
- Ledig, F. Thomas. Conservation strategies for forest gene resources. *Forest Ecology and Management*. 14: 77-90; 1986.
- Ledig, F. Thomas. Genetic transformation in forest trees. *Forestry Chronicle*. 61(5): 454-458; 1985.
- Ledig, F. Thomas. Heterozygosity, heterosis, and fitness in outbreeding plants. In: Soule, Michael E., ed. *Conservation biology*. Sunderland, MA: Sinauer Associates, Inc.; 1986: 77-104.
- Ledig, F. Thomas; Sederoff, Ronald R. Genetic engineering in forest trees. In: Eguluz Piedra, Teobaldo, ed. *Proceedings: the state of the art in forest genetics and breeding*; 1985 July 5; Mexico City. Mexico City: North American Forestry Commission, Tree Improvement Study Group; 1985: 107-116.
- Matthews, Fred R.; Bramlett, David L. Pollen quantity and viability affect seed yields from controlled pollinations of loblolly pine. *Southern Journal of Applied Forestry*. 10(2): 78-80; 1986.
- McCutchan, B. G.; Ou, J. X.; Namkoong, G. A comparison of planned unbalanced designs for estimating heritability in perennial crops. *Theoretical and Applied Genetics*. 71: 536-544; 1985.
- Moeur, Melinda. Predicting canopy cover and shrub cover with the PROGNOSIS-COVER model. In: Verner, Jared; Morrison, Michael L.; Ralph, C. John, eds. *Proceedings--wildlife 2000: modeling habitat relationships of terrestrial vertebrates*; 1984 October 7-11; South Lake Tahoe, CA. Madison, WI: University of Wisconsin Press; 1986: 339-345.
- Mohn, C. A.; Hanover, J. W.; Kang, H.; Stine, R. A. Survival and growth of tamarack seed sources in 10 NC-99 tests. In: *Proceedings, 4th north central tree improvement conference*; 1985 August 12-14; East Lansing, MI. [East Lansing], MI: [Michigan State University, Department of Forestry]; 1986: 112-123.
- Monserud, Robert A. Time-series analyses of tree-ring chronologies. *Forest Science*. 32(2): 349-372; 1986.
- Murphy, John D.; Kang, Hyun-Chung. "Paint gun tree improvement" the role of genetic models for silvicultural systems: a proposal. In: *Proceedings, national silviculture workshop: successes in silviculture*; 1985 May 13-16; Rapid City, SD. Washington, DC: U.S. Department of Agriculture, Forest Service, Timber Management; 1985: 289-295.
- Namkoong, G. The influence of composite traits on genotype by environment relations. *Theoretical and Applied Genetics*. 70: 315-317; 1985.
- Namkoong, Gene. Genetics and the forests of the future. *Unasylva*. 38(2): 2-18; 1986.
- Namkoong, Gene. The population genetic basis of breeding theory. In: Gregorius, H.-R., ed. *Population genetics in forestry: Proceedings of IUFRO working party, ecological and population genetics*; 1984 August 21-24; Göttingen, FRG. Lect. Notes in Biomath. 60. Berlin, FRG: Springer-Verlag; 1985: 2-15.
- Namkoong, Gene; Selgrade, James F. Frequency-dependent selection in logistic growth models. *Theoretical Population Biology*. 29: 64-86; 1986.
- Nance, Warren L. Seed-deployment strategies. *Journal of Forestry*. 84(2): 50-51; 1986.
- Nelson, N. D.; Haissig, B. E. Herbicide stress: use of biotechnology to confer herbicide resistance to selected woody plants. In: Hennessey, Thomas C.; Dougherty, Phillip M.; Kossuth, Susan V.; Johnson, Jon D., eds. *Stress physiology and forest productivity: Proceedings, physiology working group technical session, Society of American Foresters national convention*; 1985 July 28-31; Fort Collins, CO. Dordrecht, Boston, Lancaster: Martinus Nijhoff Publishers; 1986: 191-215.
- Nelson, Neil D. North Central Forest Experiment Station biotechnology program-application to tree improvement. In: Schmidtling, R. C.; Griggs, M. M., eds. *Proceedings, 18th southern forest tree improvement conference*; 1985 May 21-23; Long Beach, MS. [Gulf Park], MS: University of Southern Mississippi; 1985: 14-22.
- Overton, Ronald P.; Kang, Hyun. Breeding strategies for north central tree improvement programs. In: *Proceedings, 4th north central tree improvement conference*; 1985 August 12-14; East Lansing, MI. [East Lansing], MI: [Michigan State University, Department of Forestry]; 1986: 51-61.

- Rehfeldt, G. E. Adaptive variation in Pinus ponderosa from Intermountain regions. I. Snake and Salmon River basins. *Forest Science*. 32(1): 79-92; 1986.
- Rehfeldt, G. E. Development and verification of models of freezing tolerance for Douglas-fir populations in the inland Northwest. Res. Pap. INT-369. Ogden, UT: U.S. Department of Agriculture, Forest Service, Intermountain Forest and Range Experiment Station; 1986. 5 p.
- Rehfeldt, G. E. Ecological genetics of Pinus contorta in the lower Snake River Basin of central Idaho. Res. Pap. INT-354. Ogden, UT: U.S. Department of Agriculture, Forest Service, Intermountain Forest and Range Experiment Station; 1985. 9 p.
- Rehfeldt, G. E. Ecological genetics of Pinus contorta in the upper Snake River basin of eastern Idaho and Wyoming. Res. Pap. INT-356. Ogden, UT: U.S. Department of Agriculture, Forest Service, Intermountain Forest and Range Experiment Station; 1986. 9 p.
- Rehfeldt, G. E. Performance of Douglas-fir intervarietal hybrids after 10 years of field testing. Res. Note INT-355. Ogden, UT: U.S. Department of Agriculture, Forest Service, Intermountain Forest and Range Experiment Station; 1986. 2 p.
- Riemenschneider, Don E. Heritability and intertrait correlations in breeding subpopulations of jack pine. In: *Proceedings, 4th north central tree improvement conference*; 1985 August 12-14; East Lansing, MI. [East Lansing], MI: [Michigan State University, Department of Forestry]; 1986: 12-22.
- Rink, George. Challenges and progress in black walnut tree improvement. In: *Seventy-sixth annual report of the Northern Nut Growers Association*; 1985 August 4-7; Springfield, MO. [Place of publication unknown]: [Northern Nut Growers Association]; 1986: 68-73.
- Rink, George; Van Sambeek, J. W. Variation among black walnut seedling families in resistance to competition and allelopathy. *Plant and Soil*. 88: 3-10; 1985.
- Roberds, J. H.; Brotschol, J. V. Linkage disequilibria among allozyme loci in natural populations of Liriodendron tulipifera L. *Silvae Genetica*. 34(4-5): 137-141; 1985.
- Schiller, G.; Conkle, M. T.; Grunwald, C. Local differentiation among Mediterranean populations of Aleppo pine in their isoenzymes. *Silvae Genetica*. 35(1): 11-19; 1986.
- Sederoff, R. Ronald; Stomp, Anne-Marie; Chilton, W. Scott; Moore, Larry W. Gene transfer into loblolly pine by Agrobacterium tumefaciens. *Bio/Technology*. 4(7): 647-649; 1986.
- Sederoff, Ronald R.; Ronald, Pamela; Bedinger, Patricia; Rivin, Carol; Walbot, Virginia; Bland, Molly; Levings, C. S., III. Maize mitochondrial plasmid S-1 sequences share homology with chloroplast gene psbA. *Genetics*. 113: 469-482; 1986.
- Selgrade, James F.; Namkoong, Gene. Examples of the effect of genetic variation on competing species. *Journal of Mathematical Biology*. 24: 193-206; 1986.
- Shepperd, Wayne D.; McElderry, Sue E. Ten-year results of a ponderosa pine progeny test in the Black Hills. *Western Journal of Applied Forestry*. 3: 79-83; 1986.
- Shifley, Stephen R. STEMS, the stand and tree evaluation and modeling system: description, applicability to assess air pollution impacts, and future research needs. St. Paul, MN: U.S. Department of Agriculture, Forest Service, North Central Forest Experiment Station; 1985. 46 p.
- Silen, Roy R.; Randell, William K.; Mandel, Nancy L. Estimates of genetic parameters for deer browsing of Douglas-fir. *Forest Science*. 32(1): 178-184; 1986.
- Silen, Roy R.; Wanek, Jack. The J. E. Schroeder forest tree seed orchard in Oregon. *Journal of Forestry*. 84(3): 31-37; 1986.
- Skolmen, Roger G. Performance of Australian provenances of Eucalyptus grandis and Eucalyptus saligna in Hawaii. Res. Pap. PSW-181. Berkeley, CA: U.S. Department of Agriculture, Forest Service, Pacific Southwest Forest and Range Experiment Station; 1986. 8 p.
- Smith, Geordie D.; Kung, Fan H. A method for selection of seed sources and planting location for black walnut in the Central States. In: Dawson, Jeffrey O.; Majerus, Kimberly A., eds. *Proceedings, 5th central hardwood forest conference*; 1985 April 15-17; Urbana-Champaign, IL. SAF Publ. 85-05. Urbana-Champaign, IL: University of Illinois, Department of Forestry; 1985: 296-299.
- Squillace, A. E.; Powers, Harry R., Jr.; Kossuth, S. V. Monoterpene phenotypes in loblolly pine populations: natural selection trends and implications. In: Schmidtling, R. C.; Griggs, M. M., eds. *Proceedings of the 18th southern forest tree improvement conference*; 1985 May 21-23; Long Beach, MS. Publ. 40. [Place of publication unknown]: Southern Forest Tree Improvement Conference; 1985: 299-308. [Available from the National Technical Information Service, 5285 Port Royal Road, Springfield, VA 22161.
- Squillace, A. E.; Swindel, Benée F. Linkage among genes controlling monoterpene constituent levels in loblolly pine. *Forest Science*. 32(1): 97-112; 1986.
- Stage, Albert R. Modeling methods for silvicultural decisions in stands of mixed species and ages. In: Hagglund, Bjorn; Peterson, Goran, eds. *Broadleaves in boreal silviculture--an obstacle or an asset*. Rapport 14. Umea, SW: Swedish University of Agricultural Sciences, Department of Silviculture; 1985: 223-233.

Strauss, S. H.; Conkle, M. T. Segregation, linkage, and diversity of allozymes in knobcone pine. *Theoretical and Applied Genetics*. 72: 483-493; 1986.

Strauss, Steven H. Heterosis at allozyme loci inbreeding and crossbreeding in Pinus attenuata. *Genetics*. 113: 115-134; 1986.

Van Haverbeke, David F. Genetic variation in ponderosa pine: a 15-year test of provenances in the Great Plains. Res. Pap. RM-265. Fort Collins, CO: U.S. Department of Agriculture, Forest Service, Rocky Mountain Forest and Range Experiment Station; 1986. 16 p.

Van Haverbeke, David F.; Comer, C. W. Effects of treatment and seed source on germination of eastern redcedar seed. Res. Pap. RM-263. Fort Collins, CO: U.S. Department of Agriculture, Forest Service, Rocky Mountain Forest and Range Experiment Station; 1985. 7 p.

Wilkinson, R. C. Site and age differences in family heritability estimates for bole diameter and sugar concentration of sap from open-pollinated progeny tests of sugar maple. In: Thirtieth northeastern forest tree improvement conference; 1986 August 21-24; Orono, ME. Orono, ME: University of Maine; 1986.

Wilkinson, R. C.; Hawley, G. J. How superior are sweet trees? *New England Farmer*. 10(1): B2-B4; 1986.

Wykoff, William R. Introduction to a PROGNOSIS model--version 5.0. In: Van Hooser, Dwane D.; Van Pelt, Nicholas, comps. *Proceedings--growth and yield and other mensurational tricks: a regional technical conference*; 1984 November 6-7; Logan, UT. Gen. Tech. Rep. INT-193. Ogden, UT: U.S. Department of Agriculture, Forest Service, Intermountain Forest and Range Experiment Station; 1985: 44-52.

Resource Economics

Forest Inventory and Analysis

Alig, Ralph J.; Wyant, James G. Projecting regional area changes in forestland cover in the U.S.A. *Ecological Modelling*. 29: 27-34; 1985.

Associates in Rural Development, Inc., preps. Impact of large biomass centers on the forest resource base. Burlington, VT: Associates in Rural Development; 1986. 163 p.

Barnard, Joseph; Myers, Wayne; Pearce, John; Ramsey, Fred; Sissenwine, Michael; Smith, Woolcott. Surveys for monitoring changes and trends in renewable resources: forests and marine fisheries. *American Statistician*. 39(4): 363-373; 1985.

Biggs, P. H.; Wood, G. B.; Schreuder, H. T.; Brink, G. E. Comparison of point-model based sampling and point-Poisson sampling for timber inventory in jarrah forest. *Australian Forest Research*. 15(4): 481-493; 1986.

Birch, Thomas W. Forest inventory and analysis in the North: with emphasis on the hardwood resource. In: *Applications of forest inventory and analysis research to hardwood resource issues*; 1985 October 29-30; Arlington, VA. Washington, DC: National Forest Products Association; 1986: 41-54.

Birdsey, Richard A. Overview of forest survey hardwood assessment in the South. In: *Applications of forest inventory and analysis research to hardwood resource issues*; 1985 October 29-30; Alexandria, VA. Washington, DC: National Forest Products Association; 1985: 2-12.

Birdsey, Richard A.; Diego, Jimenez. The forests of Toro Negro. Res. Pap. SO-222. New Orleans: U.S. Department of Agriculture, Forest Service, Southern Forest Experiment Station; 1985. 29 p.

Birdsey, Richard A.; McWilliams, William H. MidSouth forest area trends. *Resour. Bull.* SO-107. New Orleans: U.S. Department of Agriculture, Forest Service, Southern Forest Experiment Station; 1986. 17 p.

Blyth, James E.; McCurdy, Dwight R.; Burde, John H.; Smith, W. Brad. Fuelwood production and sources from roundwood in Illinois, 1983. *Resour. Bull.* NC-92. St. Paul, MN: U.S. Department of Agriculture, Forest Service, North Central Forest Experiment Station; 1985. 73 p.

Blyth, James E.; Smith, W. Brad. Pulpwood production in the north-central region by county, 1984. *Resour. Bull.* NC-98. St. Paul, MN: U.S. Department of Agriculture, Forest Service, North Central Forest Experiment Station; 1986. 26 p.

Blyth, James E.; Whipple, James W.; Mace, Terry; Smith, W. Brad. Wisconsin timber industry--an assessment of timber output trends. *Resour. Bull.* NC-90. St. Paul, MN: U.S. Department of Agriculture, Forest Service, North Central Forest Experiment Station; 1985. 61 p.

Born, J. David. Visual segmentation for woodland tree volume models in the Rocky Mountain States. In: Van Hooser, Dwane D.; Van Pelt, Nicholas, comps. *Proceedings--growth and yield and other mensurational tricks: a regional technical conference*; 1984 November 6-7; Logan, UT. Gen. Tech. Rep. INT-193. Ogden, UT: U.S. Department of Agriculture, Forest Service, Intermountain Forest and Range Experiment Station; 1985: 68-71.

Brown, Mark J. Forest statistics for the northern mountains of Virginia, 1986. *Resour. Bull.* SE-85. Asheville, NC: U.S. Department of Agriculture, Forest Service, Southeastern Forest Experiment Station; 1986. 56 p.

Brown, Mark J. Forest statistics for the northern Piedmont of Virginia, 1986. *Resour. Bull.* SE-84. Asheville, NC: U.S. Department of Agriculture, Forest Service, Southeastern Forest Experiment Station; 1986. 52 p.

Brown, Mark J. Forest statistics for the southern mountains of Virginia, 1986. *Resour. Bull.* SE-86. Asheville, NC: U.S. Department of Agriculture, Forest Service, Southeastern Forest Experiment Station; 1986. 55 p.

Brown, Mark J. Forest statistics for Virginia, 1986. *Resour. Bull.* SE-87. Asheville, NC: U.S. Department of Agriculture, Forest Service, Southeastern Forest Experiment Station; 1986. 67 p.

Brown, Mark J. Forest statistics for the southern Piedmont of Virginia, 1985. *Resour. Bull.* SE-81. Asheville, NC: U.S. Department of Agriculture, Forest Service, Southeastern Forest Experiment Station; 1985. 55 p.

Buck, Michael B.; Costales, Patrick G.; McDuffie, Katharine. Multiresource forest statistics for Molokai, Hawaii. *Resour. Bull.* PNW-136. Portland, OR: U.S. Department of Agriculture, Forest Service, Pacific Northwest Forest and Range Experiment Station; 1986. 18 p.

Carpenter, Eugene M. Brief history and discussion of biomass estimation for timber tree species. In: Van Hooser, Dwane D.; Van Pelt, Nicholas, comps. *Proceedings, growth and yield and other mensurational tricks: a regional technical conference*; 1984 November 6-7; Logan, UT. SAF Publ. 84-19 and Gen. Tech. Rep. INT-193. Ogden, UT: U.S. Department of Agriculture, Forest Service, Intermountain Forest and Range Experiment Station; 1985: 72-78.

Carpenter, Eugene M. Timber supply and hardwood thinning opportunities on Michigan's nonindustrial private forests. In: Sturos, John A., comp. *Hardwood thinning opportunities in the Lake States: proceedings of a symposium*; 1984 April 20; Escanaba, MI. Gen. Tech. Rep. NC-113. St. Paul, MN: U.S. Department of Agriculture, Forest Service, North Central Forest Experiment Station; 1986: 143-148.

- Catts, G. P. Use of panoramic aerial photographs to estimate forest stand variables and land cover classes in northern California and southwestern Oregon. In: Oderwald, Richard G.; Burkhardt, Harold E.; Burk, Thomas E., eds. Use of auxiliary information in natural resource inventories; 1985 October 1-2; Blacksburg, VA. SAF Publ. 86-01. Bethesda, MD: Society of American Foresters; 1986: 95-113.
- Catts, G. P.; Hiserote, B. Use of high altitude photography (NHAP) color infrared transparencies in stand volume estimation for western Oregon conifer inventory. In: Oderwald, Richard G.; Burkhardt, Harold E.; Burk, Thomas E., eds. Use of auxiliary information in natural resource inventories; 1985 October 1-2; Blacksburg, VA. SAF Publ. 86-01. Bethesda, MD: Society of American Foresters; 1986: 114-123.
- Cleaves, David A.; O'Laughlin, Jay. Forest inventory, plant locations, and firm strategies in the southern plywood industry. In: Cubbage, Frederick W., ed. Trends in growing and marketing southern timber: Proceedings of the southern forest economics workshop; 1985 March 13-15; Athens, GA. Atlanta, GA: Southern Forest Economics Association; 1985: 35-43.
- Colclasure, Perry; Moen, Joel; Bolsinger, Charles L. Timber resource statistics for the northern interior resource area of California. Resour. Bull. PNW-135. Portland, OR: U.S. Department of Agriculture, Forest Service, Pacific Northwest Forest and Range Experiment Station; 1986. 32 p.
- Colclasure, Perry; Moen, Joel; Bolsinger, Charles L. Timber resource statistics for the central coast resource area of California. Resour. Bull. PNW-133. Portland, OR: U.S. Department of Agriculture, Forest Service, Pacific Northwest Forest and Range Experiment Station; 1986. 32 p.
- Czaplewski, R. L.; Cost, N. D. Photointerpretation of wildlife, recreation, and livestock grazing variables on one-acre forest plots in South Carolina. In: Oderwald, Richard G.; Burkhardt, Harold E.; Burk, Thomas E., eds. Use of auxiliary information in natural resource inventories; 1985 October 1-2; Blacksburg, VA. SAF Publ. 86-01. Bethesda, MD: Society of American Foresters; 1986: 24-37.
- Czaplewski, R. L.; Kastner, W. Developing a dichotomous photointerpretation key using ancillary photo-data and a numerical distribution-free classifier. In: Oderwald, Richard G.; Burkhardt, Harold E.; Burk, Thomas E., eds. Use of auxiliary information in natural resource inventories; 1985 October 1-2; Blacksburg, VA. SAF Publ. 86-01. Bethesda, MD: Society of American Foresters; 1986: 124-134.
- DeBald, Paul; Birch, Thomas W. Who owns Ohio's woodlands? The Ohio Farmer. 5: 22; 1985.
- Ek, Alan R.; Randall, Bryan L.; Hahn, Jerold T.; Buchman, Roland G. STEMS model projection capability with plot and tree data aggregation. Northern Journal of Applied Forestry. 2(4): 121-127; 1985.
- Frayer, W. E.; Beltz, Roy C. Loss of bottomland hardwoods in the Mississippi alluvial plain. In: Inventorying and monitoring endangered forests; 1985 August 19-24; Zurich, SW. Birmensdorf, [SW]: International Union of Forestry Research Organizations; 1986: 307-309.
- Frieswyk, Thomas S.; Malley, Anne M. Biomass statistics for New Hampshire--1983. Resour. Bull. NE-92. Broomall, PA: U.S. Department of Agriculture, Forest Service, Northeastern Forest Experiment Station; 1986. 85 p.
- Frieswyk, Thomas S.; Malley, Anne M. Biomass statistics for Vermont--1983. Resour. Bull. NE-91. Broomall, PA: U.S. Department of Agriculture, Forest Service, Northeastern Forest Experiment Station; 1986. 105 p.
- Frieswyk, Thomas S.; Malley, Anne M. Forest statistics for New Hampshire 1973-1983. Resour. Bull. NE-88. Broomall, PA: U.S. Department of Agriculture, Forest Service, Northeastern Forest Experiment Station; 1985. 100 p.
- Frieswyk, Thomas S.; Malley, Anne M. Forest statistics for Vermont 1973-1983. Resour. Bull. NE-87. Broomall, PA: U.S. Department of Agriculture, Forest Service, Northeastern Forest Experiment Station; 1985. 102 p.
- Green, Alan W.; O'Brien, Renee A.; Schaefer, James C. Montana's forests. Resour. Bull. INT-38. Ogden, UT: U.S. Department of Agriculture, Forest Service, Intermountain Forest and Range Experiment Station; 1985. 70 p.
- Hahn, Jerold T. Timber volume in Wisconsin 1983. Res. Note NC-335. St. Paul, MN: U.S. Department of Agriculture, Forest Service, North Central Forest Experiment Station; 1986. 7 p.
- Hansen, Mark H. Line intersect sampling of wooded strips. Forest Science. 31(2): 282-288; 1985.
- Hansen, Mark H.; Burk, Thomas E. Testing the consistency of forest cover type estimates across survey periods. In: Oderwald, Richard G.; Burkhardt, Harold E.; Burk, Thomas E., eds. Use of auxiliary information in natural resource inventories; 1985 October 1-2; Blacksburg, VA. SAF Publ. 86-01. Bethesda, MD: Society of American Foresters; 1986: 62-73.
- Hansen, Mark H.; Mickelson, Allen S. Southern Illinois forest inventory completed. National Woodlands. 9(1): 17-18; 1986.
- Hiserote, Bruce; Moen, Joel; Bolsinger, Charles L. Timber resource statistics for the San Joaquin and southern California resource areas. Resour. Bull. PNW-132. Portland, OR: U.S. Department of Agriculture, Forest Service, Pacific Northwest Forest and Range Experiment Station; 1986. 32 p.

- Howard, James L.; Stone, Robert N.; Skog, Kenneth E. The Forest Products Laboratory wood products production index. Res. Pap. FPL-473. Madison, WI: U.S. Department of Agriculture, Forest Service, Forest Products Laboratory; 1986. 13 p.
- Ince, Peter. Changing technology will increase southern hardwood use in future. Pulp & Paper. February: 59-63; 1986.
- Ince, Peter J. New Potential for increased use of hardwoods in kraft linerboard production. Forest Products Journal. 36(2): 32-36; 1986.
- Keegan, C. E., III; Van Hooser, Dwane D. The forest products industry in the Rocky Mountain States. In: Proceedings--Society of American Foresters national convention; 1985 July 28-31; Fort Collins, CO. Washington, DC: Society of American Foresters; 1985: 417-421.
- Knight, Herbert A. Recent survey findings and growth rates in the Southeast. In: Cabbage, Frederick W., ed. Joint proceedings of the 1985 southern forest economics workshop: trends in growing and marketing southern timber; 1985 March 13-15; Athens, GA. [Place of publication unknown]: [Publisher unknown]; 1985: 44-52. [Available from D. L. Holley, North Carolina State University, P.O. Box 5488, Raleigh, NC 27650.]
- Knight, Herbert A. What can the open market provide Dukewood, Inc.? In: Burak, Steven G., ed. Forestry accounting and control seminar: controlled forestlands, a case study on the question, to buy or not to buy?: Seminar proceedings; 1982 May 12-14; Durham, NC. Durham, NC: Duke University; 1986: 29-39.
- Labau, Vernon J.; Mead, Delbert R.; Herman, David A. Quantification of vegetation edge for the Tanana River basin, Alaska. In: American Society for Photogrammetry and Remote Sensing-American Congress on Mapping, fall convention; 1986 September 29-October 3; Anchorage, AK. Falls Church, VA: American Society for Photogrammetry and Remote Sensing/American Congress on Mapping; 1986: 335-341.
- Larson, Frederic R.; Herman, David A.; Winterberger, Kenneth C. Determining true and magnetic north on aerial photographs. Photogrammetric Engineering and Remote Sensing. 56(6): 829-831; 1986.
- Lloyd, J. D.; Moen, Joel; Bolsinger, Charles L. Timber resource statistics for the Sacramento resource area of California. Resour. Bull. PNW-134. Portland, OR: U.S. Department of Agriculture, Forest Service, Pacific Northwest Forest and Range Experiment Station; 1986. 32 p.
- Lloyd, J. D.; Moen, Joel; Bolsinger, Charles L. Timber resource statistics for the north coast resource area of California. Resour. Bull. PNW-131. Portland, OR: U.S. Department of Agriculture, Forest Service, Pacific Northwest Forest and Range Experiment Station; 1986. 32 p.
- McComb, William C.; Bonney, Stephen A.; Sheffield, Raymond M.; Cost, Noel D. Snag resources in Florida--are they sufficient for average populations of primary cavity-nesters? Wildlife Society Bulletin. 14(1): 40-48; 1986.
- McKeever, David B. Wood products used by U.S. furniture, fixtures and architectural woodwork manufacturers. Furniture Design and Manufacturing. 57(13): 10-18; 1985.
- McWilliams, William H. Primary sources of timber removals information for the Midsouth. In: Oderwald, Richard G.; Burkhart, Harold E.; Burk, Thomas E., eds. Use of auxiliary information in natural resource inventories; 1985 October 1-2; Blacksburg, VA. SAF Publ. 86-01. Bethesda, MD: Society of American Foresters; 1986: 38-44.
- McWilliams, William H.; Bertelson, Daniel E. Forest statistics for northeast Texas counties. Resour. Bull. SO-113. New Orleans: U.S. Department of Agriculture, Forest Service, Southern Forest Experiment Station; 1986. 29 p.
- McWilliams, William H.; Birdsey, Richard A. Midsouth timber statistics. Resour. Bull. SO-108. New Orleans: U.S. Department of Agriculture, Forest Service, Southern Forest Experiment Station; 1986. 42 p.
- Mety, Michael P. Louisiana's forest: opportunity for progress. Baton Rouge, LA: Louisiana Department of Natural Resources, Office of Forestry; 1986. 13 p.
- Myers, John R.; Miller, Gary W.; Wiant, Harry V., Jr.; Barnard, Joseph E. Butt-log grade distributions for five Appalachian hardwood species. Res. Pap. NE-590. Broomall, PA: U.S. Department of Agriculture, Forest Service, Northeastern Forest Experiment Station; 1986. 4 p.
- Nevel, Robert L., Jr.; Engalichev, Nicolas; Gove, William C. The timber industries of New Hampshire and Vermont--a periodic assessment of timber output. Resour. Bull. NE-89. Broomall, PA: U.S. Department of Agriculture, Forest Service, Northeastern Forest Experiment Station; 1986. 56 p.
- Ohmann, Lewis F.; Grigal, David F. Plant species biomass estimates for 13 upland community types of northeastern Minnesota. Resour. Bull. NC-88. St. Paul, MN: U.S. Department of Agriculture, Forest Service, North Central Forest Experiment Station; 1985. 52 p.
- Ostrom, Arnold J. Forest area in Wisconsin, 1983. Res. Note NC-332. St. Paul, MN: U.S. Department of Agriculture, Forest Service, North Central Forest Experiment Station; 1985. 4 p.
- Oswald, Daniel D. Analysis of change in timber volume on non-Federal timberlands in Washington. Resour. Bull. PNW-128. Portland, OR: U.S. Department of Agriculture, Forest Service, Pacific Northwest Forest and Range Experiment Station; 1986. 22 p.
- Prouty, Mike. Forest survey research--projecting what's ahead. Forestry Research West. 1986 March: 5-9.

- Raile, Gerhard K. Nebraska forest statistics, 1983. Resour. Bull. NC-91. St. Paul, MN: U.S. Department of Agriculture, Forest Service, North Central Forest Experiment Station; 1985. 70 p.
- Raile, Gerhard K. The Lake States red pine resource. In: Marty, Robert, ed. Managing red pine: Proceedings, 2d Region 5 technical conference; 1984 October 1-3; Marquette, MI. SAF Publ. 85-02. Bethesda, MD: Society of American Foresters; 1985: 6-20.
- Raile, Gerhard K. Wisconsin forest statistics, 1983. Resour. Bull. NC-94. St. Paul, MN: U.S. Department of Agriculture, Forest Service, North Central Forest Experiment Station; 1985. 113 p.
- Remington, Susan B. Amount and characteristics of logging residue on harvested areas in Vermont. Northern Journal of Applied Forestry. 3(2): 63-65; 1986.
- Rosson, James F., Jr.; Bertelson, Daniel F. Forest statistics for north delta Louisiana parishes. Resour. Bull. SO-105. New Orleans, LA: U.S. Department of Agriculture, Forest Service, Southern Forest Experiment Station; 1986. 31 p.
- Rosson, James F., Jr.; Bertelson, Daniel F. Forest statistics for northwest Louisiana parishes. Resour. Bull. SO-102. New Orleans, LA: U.S. Department of Agriculture, Forest Service, Southern Forest Experiment Station; 1985. 31 p.
- Rosson, James F., Jr.; Bertelson, Daniel F. Forest statistics for southeast Louisiana parishes. Resour. Bull. SO-106. New Orleans, LA: U.S. Department of Agriculture, Forest Service, Southern Forest Experiment Station; 1986. 31 p.
- Rosson, James F., Jr.; Bertelson, Daniel F. Forest statistics for southeast Louisiana parishes. Resour. Bull. SO-104. New Orleans, LA: U.S. Department of Agriculture, Forest Service, Southern Forest Experiment Station; 1986. 31 p.
- Rosson, James F., Jr.; Bertelson, Daniel F. Forest statistics for southwest Louisiana parishes. Resour. Bull. SO-103. New Orleans, LA: U.S. Department of Agriculture, Forest Service, Southern Forest Experiment Station; 1986. 31 p.
- Schreuder, H. T.; Brink, G. E. Model-dependent sampling versus point-Poisson sampling on a Colorado timber sale. Res. Note RM-465. Fort Collins, CO: U.S. Department of Agriculture, Forest Service, Rocky Mountain Forest and Range Experiment Station; 1986. 2 p.
- Schreuder, H. T.; Thomas, C. E. Efficient sampling techniques for timber sale surveys and inventory updates. Forest Science. 31(4): 857-866; 1985.
- Schreuder, H. T.; Wood, G. B. The choice between design-dependent and model-dependent sampling. Canadian Journal of Forest Research. 16(2): 260-265; 1986.
- Scott, Charles T. An evaluation of sampling with partial replacement. In: Oderwald, Richard G.; Burkhardt, Harold E.; Burk, Thomas E., eds. Use of auxiliary information in natural resource inventories; 1985 October 1-2; Blacksburg, VA. Bethesda, MD: Society of American Foresters; 1986: 74-79.
- Scott, Charles T. A test of ocular estimation of merchantable tree heights. In: Program and abstracts, Midwest Forest Economists/Midwest Forest Mensurationists; 1986 August 13-14; Lake Front Zion, IL. Urbana, IL: University of Illinois, Department of Forestry; 1986: 30.
- Scott, Charles T. Proposed northeastern forest survey emphasizing disturbance detection. In: Oderwald, Richard G.; Burkhardt, Harold E.; Burk, Thomas E., eds. Use of auxiliary information in natural resource inventories; 1985 October 1-2; Blacksburg, VA. Bethesda, MD: Society of American Foresters; 1986: 146-151.
- Setzer, Theodore S.; Mead, Delbert R. Aerial photo stand volume tables for southeast Alaska. In: Pecora 10, Remote sensing in forest and range resource management; 1985 August 20-2; Fort Collins, CO. Falls Church, VA: American Society for Photogrammetry and Remote Sensing; 1985: 407-408.
- Sheffield, Raymond M.; Cost, Noel D. Evidence of pine growth loss in Forest Service inventory data. In: Atmospheric deposition and forest productivity: Proceedings, 4th regional technical conference, Appalachian Society of American Foresters; 1986 January 29-31; Raleigh, NC. Blacksburg, VA: Appalachian Society of American Foresters; 1986: 74-85.
- Sheffield, Raymond M.; Cost, Noel D.; Bechtold, William A.; McClure, Joe P. Pine growth reductions in the Southeast. Resour. Bull. SE-83. Asheville, NC: U.S. Department of Agriculture, Forest Service, Southeastern Forest Experiment Station; 1985. 112 p.
- Sheffield, Raymond M.; Knight, Herbert A. North Carolina's forests. Resour. Bull. SE-88. Asheville, NC: U.S. Department of Agriculture, Forest Service, Southeastern Forest Experiment Station; 1986. 97 p.
- Skog, Kenneth E.; Watterson, Irene A. Residential fuelwood use in the United States: 1980-81. Res. Bull. WO-3. Washington, DC: U.S. Department of Agriculture, Forest Service; 1986. 42 p.
- Smith, W. Brad. Factors and equations to estimate forest biomass in the North Central region. Res. Pap. NC-268. St. Paul, MN: U.S. Department of Agriculture, Forest Service, North Central Forest Experiment Station; 1985. 6 p.
- Smith, W. Brad; Spencer, John S., Jr. Forest management opportunities for Michigan, 1981-1990. Res. Pap. NC-264. St. Paul, MN: U.S. Department of Agriculture, Forest Service, North Central Forest Experiment Station; 1985. 31 p.

- Spencer, John S., Jr. The Lake States' hardwood resource. In: Sturos, John A., comp. Hardwood thinning opportunities in the Lake States: Proceedings of a symposium; 1984 April 20; Escanaba, MI. Gen. Tech. Rep. NC-113. St. Paul, MN: U.S. Department of Agriculture, Forest Service, North Central Forest Experiment Station; 1986: 6-25.
- Spencer, John S., Jr.; Hansen, Mark H.; Jakes, Pamela J. A method for estimating operability and location of the timber resource. Res. Pap. NC-273. St. Paul, MN: U.S. Department of Agriculture, Forest Service, North Central Forest Experiment Station; 1986. 52 p.
- Stone, Robert N. Timber supply information: meeting industrial needs. In: Ellefson, Paul V.; Lewis, Bernard J.; Skok, Richard, eds. Industry as a force in economic development: options for Minnesota's future: Proceedings of the governor's conference on forestry; 1984 December; St. Paul, MN. St. Paul, MN: University of Minnesota, Agricultural Experiment Station and College of Forestry; 1985: 18-20.
- Tansey, J. B.; Kellison, R. C. The supply and availability of hardwoods in the southeastern coastal plain. Hardw. Res. Coop. Ser. 4. Raleigh, NC: North Carolina State University, School of Forest Resources; 1985. 52 p.
- Thomas, Charles E. Stein rule estimation of county level inventory statistics. In: Oderwald, Richard G.; Burkhardt, Harold E.; Burk, Thomas E., eds. Use of auxiliary information in natural resource inventories; 1985 October 1-2; Blacksburg, VA. SAF Publ. 86-01. Bethesda, MD: Society of American Foresters; 1986: 45-54.
- Wadsworth, F. H.; Birdsey, R. A. A new look at the forests of Puerto Rico. Turrialba. 35(1): 11-17; 1985.
- Wharton, Eric H.; Powell, Douglas S. Eastern white pine: inventory and dynamics. In: Funk, David T., ed. Eastern white pine: today and tomorrow; 1985 June 12-14; Durham, NH. Gen. Tech. Rep. WO-51. Washington, DC: U.S. Department of Agriculture, Forest Service; 1986: 16-21.
- Widmann, Richard H. Pulpwood production in the Northeast--1984. Resour. Bull. NE-93. Broomall, PA: U.S. Department of Agriculture, Forest Service, Northeastern Forest Experiment Station; 1986. 17 p.
- Widmann, Richard H.; Blyth, James E. Pulpwood production in 1984 sets record: most notable gain in roundwood. The Northern Logger and Timber Processor. 34(8): 20-21; 1986.
- Widmann, Richard H.; Wharton Eric H. The current and changing hardwood resource base in the Northeast, with a close look at Pennsylvania. In: Forest management decisions based on future forest product requirements; 1985 March 19-20; State College, PA. State College, PA: The Pennsylvania State University, School of Forest Resources and Cooperative Extension Service; 1986: 3-12.
- Wilson, C. L.; Catts, G. P. Determining conifer stand stocking percentages by sequential clustering and masking of thematic mapper digital data. In: Oderwald, Richard G.; Burkhardt, Harold E.; Burk, Thomas E., eds. Use of auxiliary information in natural resource inventories; 1985 October 1-2; Blacksburg, VA. SAF Publ. 86-01. Bethesda, MD: Society of American Foresters; 1986: 9-23.
- Wood, G. B.; Schreuder, H. T. Implementing point-Poisson and point-model based sampling in forest inventory. Forest Ecology and Management. 14(2): 141-156; 1986.
- Anderson, R. Bruce; Luppold, William G. An econometric analysis of pallet demand and supply and raw material usage by the pallet industry in southern regions. In: Trends in growing and marketing southern timber: 1985 southern forest economics workshop; 1985 March 13-15; Athens, GA. Raleigh, NC: Southern Forest Economics Workshop; 1985: 142-149.
- Anderson, Walter C.; Hickman, Clifford A. Cost effectiveness of hexazinone vs. mechanical site preparation. In: Weed science and risk assessment: Proceedings, 39th annual meeting of the Southern Weed Science Society; 1986 January 20-22; Nashville, TN. Champaign, IL: Southern Weed Science Society; 1986: 220-227.
- Araman, Philip A. Hardwood exports: a thriving Pacific Rim market. Wood and Wood Products. 91(7): 86, 88-90; 1986.
- Araman, Philip A. Pacific Rim demands for U.S. hardwoods. In: Mathews, Edward E., ed. Proceedings 1986 southern forest economics workshop; 1986 April 16-18; New Orleans. Raleigh, NC: Southern Forest Economics Workshop; 1986: 45-51.
- Araman, Philip A.; Dempsey, Gilbert P. World hardwood lumber demand expected to increase by 28% in 80's and 17% in 90's. Import/Export Wood Purchasing News. 11(2): 1, 11-18; 1984.
- Araman, Philip A.; Hansen, Bruce G. Prospective world demand for hardwoods. In: Proceedings of the 13th annual hardwood symposium of the Hardwood Research Council; 1985 May 22-24; High Point, NC. Asheville, NC: Hardwood Research Council; 1985: 110-125.
- Baird, Andrew W.; Doolittle, Larry; Burroughs, Robert G. Harvesting decisions of nonindustrial private forest owners in Mississippi. Sociol. Res. Rep. 86-2. Starkville, MS: Mississippi Agricultural and Forestry Experiment Station; 1986. 6 p.

Forest Economics

- Baughman, Melvin J.; Ellefson, Paul V. Funding county forests. *Journal of Forestry*. 84(8): 33-34; 1986.
- Bengston, David N. Diffusion of innovations in forestry and forest products: review of the literature. In: Risbrudt, Christopher D.; Jakes, Pamela J., comps. *Forestry research evaluation: current progress, future directions: Proceedings, forestry research evaluation workshop; 1984 August 20-21; St. Paul, MN. Gen. Tech. Rep. NC-104*. St. Paul, MN: U.S. Department of Agriculture, Forest Service, North Central Forest Experiment Station; 1985: 69-77.
- Bengston, David N.; Gregersen, Hans M. Forestry research and income redistribution. In: Burns, Denver P., comp. *IUFRO proceedings, evaluation and planning of forestry research*. S6. 06-S6. 06. 01; 1985 July 25-26; Fort Collins, CO. Gen. Tech. Rep. NE-111. Broomall, PA: U.S. Department of Agriculture, Forest Service, Northeastern Forest Experiment Station; 1986: 117-122.
- Benson, Robert E.; Niccolucci, Michael J. What does it cost to protect nontimber resources during logging? *American Forests*. 92(6): 26-28, 53-54; 1986.
- Birch, Thomas W. The forest-land owners of Maine, 1982. *Resour. Bull. NE-90*. Broomall, PA: U.S. Department of Agriculture, Forest Service, Northeastern Forest Experiment Station; 1986. 83 p.
- Birch, Thomas W. The private forest landowner--measuring change. In: Program and abstracts, *Midwest Forest Economists/Midwest Forest Mensurationists*; 1986 August 13-14; Lake Front Zion, IL. Urbana, IL: University of Illinois, Department of Forestry; 1986: 23.
- Birch, Thomas W.; Pywell, Nancy. Communicating with nonindustrial private forest-land owners: getting programs on target. *Res. Pap. NE-593*. Delaware, OH: U.S. Department of Agriculture, Forest Service, Northeastern Forest Experiment Station; 1986. 11 p.
- Boyd, Roy. Forest taxation: current issues and future research. *Res. Note SE-338*. Asheville, NC: U.S. Department of Agriculture, Forest Service, Southeastern Forest Experiment Station; 1986. 14 p.
- Boyd, Roy; Daniels, Barbara J. Capital gains treatment of timber income: incidence and welfare implications. *Land Economics*. 61(4): 354-362; 1985.
- [Bradley, Dennis P.; Hoganson, Howard M.]. Northeastern Minnesota assessment. In: Site-specific wood residue assessments and their implications for greater resource recovery. Washington, DC: U.S. Department of Agriculture, Forest Service, Forest Resources Economics Research; 1986: 20-29.
- Bradley, Dennis P.; Hoganson, Howard M. Wood for energy: a Minnesota case study. *Southern Lumberman*. 246: 48-50; 1985.
- Bradley, Dennis P.; Hoganson, Howard M.; Kallio, Edwin. Wood energy potential in northeastern Minnesota: enhanced forest productivity, economic growth, and energy cost savings. In: *Alternative energy in the Midwest: research and applications: Conference proceedings, vol. 2*; 1985 February 21-23; Schaumburg, IL. IL ENR/AE-85-04. [Springfield, IL]: Illinois Department of Energy and Natural Resources; 1985: 7-27 - 7-36.
- Buongiorno, Joseph. A model for international trade in pulp and paper. *TIMS Studies in the Management Sciences*. 21: 41-54; 1986.
- Busby, Rodney L. A critical review of the use of regional purchase coefficients for the construction of non-survey regional input-output models. In: Mathews, Edward E., ed. *Proceedings of the 1986 southern forest economics workshop*; 1986 April 16-18; New Orleans, LA. Raleigh, NC: North Carolina State University; 1986: 129-148.
- Carpenter, Eugene M. Ownership change and timber supply on nonindustrial private forest land. *Res. Pap. NC-265*. St. Paul, MN: U.S. Department of Agriculture, Forest Service, North Central Forest Experiment Station; 1985. 14 p.
- Carpenter, Eugene M.; Hansen, Mark H. The private forest landowners of Michigan. *Resour. Bull. NC-93*. St. Paul, MN: U.S. Department of Agriculture, Forest Service, North Central Forest Experiment Station; 1985. 55 p.
- Carpenter, Eugene M.; Hansen, Mark H.; St. John, Dennis M. The private forest landowners of Minnesota--1982. *Resour. Bull. NC-95*. St. Paul, MN: U.S. Department of Agriculture, Forest Service, North Central Forest Experiment Station; 1986. 55 p.
- Chambers, Paul C.; Sinclair, Steven A.; Hassler, Curt C.; Hansen, Bruce G. Forest products investment model: a microcomputer tool for incorporating risk into capital budgeting. *Forest Products Journal*. 36(1): 64-68; 1986.
- Chang, Sun Joseph. An economic analysis of a new growth and yield model for oaks in New England. In: Risbrudt, Christopher D.; Jakes, Pamela J., comps. *Forestry research evaluation: current progress, future directions: Proceedings, forestry research evaluation workshop; 1984 August 20-21; St. Paul, MN. Gen. Tech. Rep. NC-104*. St. Paul, MN: U.S. Department of Agriculture, Forest Service, North Central Forest Experiment Station; 1985: 79-81.
- Cleaves, David A.; O'Laughlin, Jay. Analyzing structure in wood-based industry. Part 1: Identifying competitive strategy. *Forest Products Journal*. 36(4): 9-14; 1986.
- Cleaves, David A.; O'Laughlin, Jay. Analyzing structure in wood-based industry. Part 2: Categorizing strategic diversity. *Forest Products Journal*. 36(5): 11-17; 1986.

- Clements, Stephen E.; Klemperer, W. David; Haney, Harry L., Jr.; Siegel, William C. Current status of timber yield and severance taxes in the United States. *Forest Products Journal*. 36(6): 31-35; 1986.
- Connaughton, Kent P.; Polzin, Paul E.; Schallau, Con. Tests of the economic base model of growth for a timber dependent region. *Forest Science*. 31(3): 717-725; 1985.
- Daniels, Barbara J.; Hyde, William F. Estimation of supply and demand for North Carolina's timber. *Forest Ecology and Management*. 14: 59-67; 1986.
- Davenport, Edgar L. Pulpwood prices in the Southeast, 1984. Res. Note SE-343. Asheville, NC: U.S. Department of Agriculture, Forest Service, Southeastern Forest Experiment Station; 1986. 3 p.
- DeBald, Paul S.; Birch, Thomas W. Who owns Ohio's woodlands? *The Ohio Farmer*. 5: 22; 1985.
- De Borger, Bruno; Buongiorno, Joseph. Productivity growth in the paper and paperboard industries: a variable cost function approach. *Canadian Journal of Forest Research*. 15: 1013-1020; 1985.
- Devine, Hugh A.; Field, Richard C. The gist of GIS. *Journal of Forestry*. 84(8): 17-22; 1986.
- Donnelly, Dennis M.; Nelson, Louis J. Y. Net economic value of deer hunting in Idaho. *Resour. Bull. Rm-13*. Fort Collins, CO: U.S. Department of Agriculture, Forest Service, Rocky Mountain Forest and Range Experiment Station; 1986. 27 p.
- Doolittle, Larry; Baird, A. W.; Burroughs, Robert G. The diversity of nonindustrial private forest landowners. *Tree Talk*. 7(3): 20-22; 1986.
- Durst, Patrick B. Dendrothermal dream threatened in the Philippines. *Journal of Forestry*. 84(8): 45-48; 1986.
- Durst, Patrick B. Energy plantations in the Republic of the Philippines. SCFER Work. Pap. 24. Research Triangle Park, NC: Southeastern Center for Forest Economics Research; 1986. 34 p.
- Durst, Patrick B.; Ingram, C. Denise; Laarman, Jan G. Statistics on forest products trade: are they believable? In: Schreuder, Gerard F., ed. *World trade in forest products*, 2. Proceedings of the 2d international symposium on world trade in forest products; 1985 March 19-21; Seattle, WA. Seattle, WA: University of Washington Press; 1986: 265-273.
- Eckstein, Louis W., Jr. An analysis of organization structures for southern wood departments. In: Cabbage, Frederick W., ed. *Joint proceedings of the 1985 southern forest economics workshop: trends in growing and marketing southern timber*; 1985 March 13-15; Athens, GA. [Place of publication unknown]: [Publisher unknown]; 1985: 21-28. [Available from D. L. Holley, North Carolina State University, P. O. Box 5488, Raleigh, NC 27650.]
- Fege, Anne S. Economic and political factors influencing the development of the short rotation forestry technology. In: Burns, Denver P., comp. *IUFRO proceedings, evaluation and planning of forestry research*, S6. 06-S6. 06. 01; 1985 July 25-26; Fort Collins, CO. Gen. Tech. Rep. NE-111. Broomall, PA: U.S. Department of Agriculture, Forest Service, Northeastern Forest Experiment Station; 1986: 123-135.
- Fege, Anne S. Research evaluation techniques applied to a case study of short-rotation forestry. In: Risbrudt, Christopher D.; Jakes, Pamela J., comps. *Forestry research evaluation: current progress, future directions*: Proceedings, forestry research evaluation workshop; 1984 August 20-21; St. Paul, MN. Gen. Tech. Rep. NC-104. St. Paul, MN: U.S. Department of Agriculture, Forest Service, North Central Forest Experiment Station; 1985: 82-90.
- Flora, Donald F.; Vlosky, Richard P. Potential Pacific Rim demand for construction-grade softwood logs. Res. Pap. PNW-364. Portland, OR: U.S. Department of Agriculture, Forest Service, Pacific Northwest Forest and Range Experiment Station; 1986. 26 p.
- Gatchell, Charles; Hansen, Bruce G. Standard blanks: a good value-added opportunity; the economics of system 6. *Northern Logger & Timber Processor*. 34(10): 26-31, 45; 1986.
- Gilles, J. Keith; Buongiorno, Joseph. Price-endogenous linear programming system for economic modeling. R3329. Madison, WI: University of Wisconsin, College of Agricultural and Life Sciences; 1985. 34 p.
- Gilles, James Keith; Buongiorno, Joseph. Simulation of future trade in wood pulp between Canada and the United States. *The Annals of Regional Science*. 19(2): 47-60; 1985.
- Graham, L. P.; Labadie, J. W.; Hutchison, I. P. G.; Ferguson, K. A. Allocation of augmented water supply under a priority water rights system. *Water Resources Research*. 22(7): 1083-1094; 1986.
- Granskog, James E. Eastern softwood exports. *Southern Lumberman*. 246 (3064): 32-33; 1985.
- Granskog, James E. The South's timber export potential. *Forest Farmer*. 45(9): 14-15; 1986.
- Greber, Brian J. Interpreting measures of forestry investment merit. SCFER Work. Pap. 23. Research Triangle Park, NC: Southeastern Center for Forest Economic Research; 1986. 18 p.
- Hansen, Bruce G.; Araman, Philip A. Hardwood blanks expand export opportunities. *Forest Industries*. 112(11): 33-35; 1985.
- Hardie, Ian. Wood as energy--an overview: wood energy markets. *Agric. Issues Overview* 4. Washington, DC: U.S. Department of Agriculture, National Agricultural Library; 1984. 12 p.

- Harpole, George B.; Rensi, Giuseppe. A computer program for analysis of fuelwood harvesting costs. Gen. Tech. Rep. 46. Madison, WI: U.S. Department of Agriculture, Forest Service, Forest Products Laboratory; 1985. 18 p.
- Haygreen, John; Gregersen, Hans; Holland, Irv; Stone, Robert. The economic impact of timber utilization research. Forest Products Journal. 36(2): 12-20; 1986.
- Haygreen, John; Gregersen, Hans; Hyun, Andrew; Ince, Peter. Innovation and productivity change in the structural panel industry. Forest Products Journal. 35(10): 32-38; 1985.
- Haynes, Richard W. Inventory and value of old-growth in the Douglas-fir region. Res. Note PNW-437. Portland, OR: U.S. Department of Agriculture, Forest Service, Pacific Northwest Forest and Range Experiment Station; 1986. 18 p.
- Hickman, Clifford A. How to evaluate your timberland investment. Forest Farmer. 45(2): 26-28; 1985.
- Hof, John G. A MAXMIN approach to nondeclining yield timber harvest scheduling problems. Forest Science. 32(3): 653-666; 1986.
- Hof, John G.; Lee, Robert D.; Dyer, A. Allen; Kent, Brian M. An analysis of joint costs in a managed forest ecosystem. Journal of Environmental Economics and Management. 12: 338-352; 1985.
- Hof, John G.; Marose, Robin K.; King, David A. Potential pitfalls in renewable resource decision making that utilizes convex combinations of discrete alternatives. Western Journal of Agricultural Economics. 10(2): 391-400; 1985.
- Hof, John G.; Pickens, James B. A multi-level optimization system for large-scale renewable resource planning. Gen. Tech. Rep. RM-130. Fort Collins, CO: U.S. Department of Agriculture, Forest Service, Rocky Mountain Forest and Range Experiment Station; 1986. 24 p.
- Hoganson, Howard; Rose, Dietmar. Assessing regional opportunities and costs for wood energy production. In: Mitchell, C. P.; Nilsson, P. O.; Zsuffa, L., eds. Proceedings, joint IEA/forestry energy programme and FAO/cooperative network on rural energy forest energy conference and workshops on research in forestry for energy; 1985 October 28-30; Rungstedgaard, DK. Garpenberg, SW: Swedish University of Agricultural Sciences, Department of Operational Efficiency; 1986: 2: 348-355.
- Huebner, Anne E.; Hickman, Clifford A.; Kaiser, H. Fred. A tax equivalency study on national forest system lands in the United States. FS-396. Washington, DC: U.S. Department of Agriculture, Forest Service; 1985. 50 p.
- Huyler, Neil K. The cost and returns of the Vermont cable yarder. The Northern Logger and Timber Processor. 35(2): 12-14, 17-18; 1986.
- Huyler, Neil K. The production potential and cost of the Vermont cable yarder. In: Industrial wood energy forum '83; 1983 September 10-21; Nashville, TN. Madison, WI: Forest Products Research Society; 1985: 84-91.
- Jakes, Pamela J. Variability in researcher productivity. In: Risbrudt, Christopher D.; Jakes, Pamela J., comps. Forestry research evaluation: current progress, future directions: Proceedings, forestry research evaluation workshop; 1984 August 20-21; St. Paul, MN. Gen. Tech. Rep. NC-104. St. Paul, MN: U.S. Department of Agriculture, Forest Service, North Central Forest Experiment Station; 1985: 91-96.
- Jones, J. Greg; Schuster, Ervin G. An analysis of the appropriateness of "below cost" timber sales on national forests. In: Economics of Federal timber sales: hearings before the subcommittee on forests, family farms, and energy of the Committee on Agriculture, House of Representatives, 99th Congress, first session. Serial No. 99-4. Washington, DC: U.S. Government Printing Office; 1985: 42-89.
- Kaltenberg, Michael C.; Buongiorno, Joseph. Growth and decline of the paper industry: an econometric analysis of US regions. Applied Economics. 18: 379-397; 1986.
- Klemperer, W. David. Adjusting timberland lease payments for stumpage price-changes. Northern Journal of Applied Forestry. 3(1): 22-25; 1986.
- Klemperer, W. David. The economics of timber management contracts in the United States. Journal of Forest Planning Study. December: 58-60; 1985.
- Klemperer, W. David; Buhyoff, Gregory J.; Verbyla, Paul S.; Joiner, Linda D. Valuing white-water river recreation by the travel cost method. In: Proceedings 1984 national river recreation symposium; 1984; October 31-November 3; Baton Rouge, LA. Baton Rouge, LA: Louisiana State University; 1986: 709-719.
- Klemperer, W. David; Bullard, Steven H. [Estimating economically optimal thinning regimes in mixed-species timber stands] (In Russian). In: Proceedings: IUFRO world congress; 1985 September 7-15; Moscow, USSR. [Place of publication unknown]: [Publisher unknown]; 1985: 3-13.
- Klemperer, W. David; Greber, Brian J. The buy versus lease decision for timberlands. In: Proceedings of the 1985 southern forest economics workshop; 1985 March 13-15; Athens, GA. Raleigh, NC: Southern Forest Economics Workshop; 1985: 125-132. [Available from D. C. Holley, North Carolina State University, P. O. Box 5488, Raleigh, NC 27650.]
- Kronrad, Gary D. Check your hardwood markets. Forest Farmer. 45(7): 19-20; 1986.
- Kronrad, Gary D.; Hickman, Clifford A. Optional forest yield taxes. Journal of Forestry. 84(7): 27-30; 1986.

- Laarman, Jan G. The economic outlook for forestry in tropical America: a hazardous period for crystal balls. SCFER Work. Pap. 21. Research Triangle Park, NC: Southeastern Center for Forest Economics Research; 1986. 23 p.
- Laarman, Jan G.; Dutrow, George F. A private enterprise strategy for forestry development: principles, mechanisms, and challenges. SCFER Work. Pap. 19. Research Triangle Park, NC: Southeastern Center for Forest Economics Research; 1986. 8 p.
- Ledoux, Chris B.; Fight, Roger D.; Ortman, Tom L. Stump-to-truck cable logging cost equations for young-growth Douglas-fir. Western Journal of Applied Forestry. 1(1): 19-22; 1986.
- Lewis, David K. Summary: an examination of the impacts associated with implementation of new technology by a major new industry in a region. In: Risbrudt, Christopher D.; Jakes, Pamela J., comps. Forestry research evaluation: current progress, future directions: Proceedings, forestry research evaluation workshop; 1984 August 20-21; St. Paul, MN. Gen. Tech. Rep. NC-104. St. Paul, MN: U.S. Department of Agriculture, Forest Service, North Central Forest Experiment Station; 1985: 97-98.
- Loomis, John B.; Donnelly, Dennis M.; Sorg, Cindy F.; Oldenburg, Lloyd. Net economic value of hunting unique species in Idaho: bighorn sheep, mountain goat, moose, and antelope. Resour. Bull. RM-10. Fort Collins, CO: U.S. Department of Agriculture, Forest Service, Rocky Mountain Forest and Range Experiment Station; 1986. 16 p.
- Loomis, John B.; Hof, John G. Comparability of market and nonmarket valuations of forest and rangeland outputs. Res. Note RM-457. Fort Collins, CO: U.S. Department of Agriculture, Forest Service, Rocky Mountain Forest and Range Experiment Station; 1985. 5 p.
- Loomis, John B.; Peterson, George L. Economic information in river recreation management. In: Proceedings 1984 national river recreation symposium; 1984 October 31-November 3; Baton Rouge, LA. Baton Rouge, LA: Louisiana State University; 1986: 260-271.
- Loomis, John B.; Sorg, Cindy F.; Donnelly, Dennis M. Evaluating regional demand models for estimating recreation use and economic benefits: a case study. Water Resources Research. 22(4): 431-438; 1986.
- Lothner, David C. State, county, and municipal forests. Journal of Forestry. 84(8): 31-32; 1986.
- Luppold, William G.; Anderson, R. Bruce. A regional analysis of pallet supply and demand. Res. Pap. NE-580. Broomall, PA: U.S. Department of Agriculture, Forest Service, Northeastern Forest Experiment Station; 1986. 8 p.
- Luppold, William G.; Anderson, R. Bruce. Factors affecting pallet demand. Pallet Enterprise. 5(1): 10-12; 1985.
- Luppold, William G.; Anderson, R. Bruce. Hardwood use in the pallet industry. National Hardwood Magazine. 60(7): 43, 56-58; 1986.
- Lyons, Gerard J.; Vasievich, J. Michael. Economic analysis of short-rotation forests for energy in Ireland. In: Kallio, M.; Anderson, A. E.; Seppala, R.; Morgan, A., eds. Systems Analysis in Forestry and Forest Industries. 21: 311-323; 1986.
- Maki, Wilbur R.; Olson, Douglas; Schallau, Con H. A dynamic simulation model for analyzing the importance of forest resources in Alaska. Res. Note PNW-432. Portland, OR: Pacific Northwest Forest and Range Experiment Station; 1985. 12 p.
- Maki, Wilbur R.; Schallau, Con H.; Foster, Bennett B.; Redmond, Clair H. Alabama's forest products industry: performance and contribution to the State's economy, 1970 to 1980. Res. Pap. PNW-361. Portland, OR: Pacific Northwest Forest and Range Experiment Station; 1986. 22 p.
- Maki, Wilbur R.; Schallau, Con H.; Foster, Bennett B.; Redmond, Clair H. Oklahoma's forest products industry: performance and contribution to the State's economy, 1970 to 1980. Res. Pap. PNW-363. Portland, OR: Pacific Northwest Forest and Range Experiment Station; 1986. 22 p.
- Maki, Wilbur R.; Schallau, Con H.; Foster, Bennett B.; Redmond, Clair H. South Carolina's forest products industry: performance and contribution to the State's economy, 1970 to 1980. Res. Pap. PNW-351. Portland, OR: Pacific Northwest Forest and Range Experiment Station; 1986. 22 p.
- Martens, David G. Reduce dimension costs by using WALNUT. Res. Pap. NE-586. Broomall, PA: U.S. Department of Agriculture, Forest Service, Northeastern Forest Experiment Station; 1986. 10 p.
- May, Dennis M. Midsouth pulpwood prices, 1984. Res. Note SO-325. New Orleans, LA: U.S. Department of Agriculture, Forest Service, Southern Forest Experiment Station; 1986. 2 p.
- McCool, Stephen F.; Benson, Robert E.; Ashor, Joseph L. How the public perceives the visual effects of timber harvesting: an evaluation of interest group preferences. Environmental Management. 10(3): 385-391; 1986.
- McKean, John R.; Hof, John G.; Bartlett, E. T.; Taylor, R. G. Contingent value estimates for existing Federal grazing. Tech. Bull. 86-1. Fort Collins, CO: Colorado State University; 1986. 24 p.
- Merrifield, David E.; Haynes, Richard W. A cost analysis of the lumber and plywood industries in two Pacific Northwest regions. Annals of Regional Science. 14(3): 16-33; 1985.
- Merrifield, David E.; Singleton, William R. A dynamic cost and factor demand analysis for the Pacific Northwest lumber and plywood industries. Forest Science. 32(1): 220-233; 1986.

- Michaels, Joseph A.; Stone, M. Brian; Sendak, Paul E. The economic importance of Vermont's sawtimber. Res. Pap. NE-587. Broomall, PA: U.S. Department of Agriculture, Forest Service, Northeastern Forest Experiment Station; 1986. 12 p.
- Miller, Gary W. Cultural practices in hardwood sapling stands--are they worthwhile? In: Smith, H. Clay; Eye, Maxine C., eds. Guidelines for managing immature Appalachian hardwood stands; 1986 May 28-30; Morgantown, WV. SAF Publ. 86-02. Morgantown, WV: West Virginia University; 1986: 33-45.
- Miller, Gary W.; Sarles, Raymond L. Costs, yields, and revenues associated with thinning and clearcutting 60-year-old cherry-maple stands. Res. Pap. NE-582. Broomall, PA: U.S. Department of Agriculture, Forest Service, Northeastern Forest Experiment Station; 1986. 18 p.
- Montieth, Douglas B.; Ferretti, William M. Motivating landowners, a marketing perspective. The Consultant. April: 28-29; 1986.
- Newman, David H. An econometric analysis of the supply and demand of southern softwood stumpage: 1950-1980. SCFER Work. Pap. 28. Research Triangle Park, NC: Southeastern Center for Forest Economics Research; 1986. [Unpaginated.]
- Newman, David H. Changes in southern softwood productivity: a modified production function analysis. SCFER Work. Pap. 29. Research Triangle Park, NC: Southeastern Center for Forest Economics Research; 1986. 62 p.
- Newman, David H.; Gilbert, Charles B.; Hyde, William F. The optimal forest rotation with evolving prices. Land Economics. 61(4): 347-353; 1985.
- Nielsen, D. B.; Lytle, D. D.; Wagstaff, F. Who gains (or loses) when big-game uses private lands? Utah Science. Summer: 48-51; 1985.
- Obiya, Alex; Chappelle, Daniel E.; Schallau, Con H., comps. Spatial and regional analysis methods in forestry economics: an annotated bibliography. Gen. Tech. Rep. PNW-190. Portland, OR: Pacific Northwest Forest and Range Experiment Station; 1986. 32 p.
- Orr, Blair; Buongiorno, Joseph; Young, Timothy; Lothner, David C.; Kallio, Edwin. Future timber harvest on the Chippewa and Superior National Forests in Minnesota. Resour. Bull. NC-89. St. Paul, MN: U.S. Department of Agriculture, Forest Service, North Central Forest Experiment Station; 1985. 11 p.
- Pacella-Hazelton, Glenn; Devine, Hugh A. Benefit evaluation of visual resources for air quality management. SCFER Work. Pap. 26. Research Triangle Park, NC: Southeastern Center for Forest Economics Research; 1986. 22 p.
- Peterson, George L. Economic growth from forest-based recreation, wildlife and tourism. In: Proceedings of the 15th forestry forum; 1985 April 11-12; Blacksburg, VA. Blacksburg, VA: Virginia Cooperative Extension Service, Virginia Polytechnic Institute and State University; 1985: 109 p.
- Peterson, George L.; Brown, Thomas C. The economic benefits of recreation: common disagreements and informed replies. In: Southeastern recreation research conference; 1985 February 8-March 1; Myrtle Beach, SC. Statesboro, GA: Department of Recreation and Leisure Sciences; 1985: 17-33.
- Peterson, George L.; Brown, Thomas C. Visual impact assessment in benefit cost analysis. Journal of Urban Planning and Development. 112(1): 14; 1986.
- Peterson, George L.; Stynes, Daniel J. Evaluating goodness of fit in nonlinear recreation demand models. Leisure Sciences. 8(2): 131-147; 1986.
- Pitcher, John A.; Risbrudt, Christopher D. Revising the forestry incentives program for the south. Southern Journal of Applied Forestry. 10(1): 6-10, 1986.
- Remington, Susan B.; Dennis, Donald F. New Hampshire's stumpage and roadside prices: characteristics and trends. Res. Note NE-332. Broomall, PA: U.S. Department of Agriculture, Forest Service, Northeastern Forest Experiment Station; 1986. 8 p.
- Reynolds, Hugh W.; Hansen, Bruce G. System 6: a pricing strategy for long blanks. Res. Pap. NE-573. Broomall, PA: U.S. Department of Agriculture, Forest Service, Northeastern Forest Experiment Station; 1986. 14 p.
- Rideout, Doug; Hof, John G. A re-evaluation of the site burden concept when forest land value is maximized. Forest Science. 32(2): 511-516; 1986.
- Risbrudt, Christopher; Pitcher, John A. Financial returns from timber stand improvement investments. Northern Journal of Applied Forestry. 3(2): 52-58; 1986.
- Rosenthal, Donald H.; Donnelly, Dennis M.; Schiffhauer, Marie B.; Brink, Glen E. User's guide to RMTCM: software for travel cost analysis. Gen. Tech. Rep. RM-132. Fort Collins, CO: U.S. Department of Agriculture, Forest Service, Rocky Mountain Forest and Range Experiment Station; 1986. 32 p.
- Royer, Jack P. Tax incentives and cost-sharing: the prospect of inefficiency. SCFER Work. Pap. 22. Research Triangle Park, NC: Southeastern Center for Forest Economics; 1986. 15 p.
- Ruderman, Florence K.; Haynes, Richard W. Volume and average stumpage price of selected species on the national forests of the Pacific Northwest Region, 1973 to 1984. Res. Note PNW-446. Portland, OR: U.S. Department of Agriculture, Forest Service, Pacific Northwest Forest and Range Experiment Station; 1986. 37 p.
- Ruderman, Florence K.; Warren, Debra D. Production, prices, employment, and trade in Northwest forest industries, 1st quarter 1985. Resour. Bull. PNW-126. Portland, OR: U.S. Department of Agriculture, Forest Service, Pacific Northwest Forest and Range Experiment Station; 1986. 49 p.

- Salazar, Debra J.; Schallau, Con H.; Lee, Robert G. The growing importance of retirement income in timber-dependent areas. Res. Pap. PNW-359. Portland, OR: Pacific Northwest Forest and Range Experiment Station; 1986. 10 p.
- Saliba, Bonnie Colby. Irrigated agriculture and groundwater quality--a framework for policy development. American Journal of Agricultural Economics. 67(5): 1231-1237; 1985.
- Sarles, Raymond L. Cost of thinning in Appalachia using a truck-mounted crane. Tech. Pap. Harvest. 4. 235442 (86-P-4). Washington, DC: American Pulpwood Association, Inc.; 1986. 17 p.
- Sarles, Raymond L.; Luppold, William G. Technoeconomic analysis of conventional logging systems operating from stump to landing. Res. Pap. NE-577. Broomall, PA: U.S. Department of Agriculture, Forest Service, Northeastern Forest Experiment Station; 1986. 23 p.
- Schallau, Con H.; Maki, Wilbur R. Economic impacts of interregional competition in the forest products industry during the 1970's: the South and the Pacific Northwest. Res. Pap. PNW-350. Portland, OR: U.S. Department of Agriculture, Forest Service, Pacific Northwest Forest and Range Experiment Station; 1986. 44 p.
- Schallau, Con H.; Maki, Wilbur R. Input/output models and forest resource supply constraints revisited. Forest Science. 32(2): 4; 1986.
- Schallau, Con H.; Maki, Wilbur R.; Foster, Bennett B.; Redmond, Clair H. Kentucky's forest products industry: performance and contribution to the State's economy, 1970 to 1980. Res. Pap. PNW-354. Portland, OR: U.S. Department of Agriculture, Forest Service, Pacific Northwest Forest and Range Experiment Station; 1986. 22 p.
- Schuster, Ervin G.; Zuuring, Hans R. Quantifying the unquantifiable. Journal of Forestry. 84(4): 25-30; 1986.
- Scodari, Paul Francis; Hardie, Ian W. Heating costs and household wood stove acquisition: a discrete choice demand model. Northwest Journal of Agricultural and Resource Economics. April: 65-70; 1985.
- Seldon, Barry J. A nonresidual estimation of welfare gains from public investment in softwood plywood research. Faculty Work. Pap. 85-16. Athens, OH: Ohio University; 1985. 21 p.
- Seldon, Barry J. Factor shares of research and other inputs in the softwood plywood industry. Faculty Work. Pap. 85-14. Athens, OH: Ohio University; 1985. 26 p.
- Seldon, Barry J. The marginal productivity of public research in the softwood plywood industry. Faculty Work. Pap. 85-15. Athens, OH: Ohio University; 1985. 36 p.
- Shaffer, Robert M.; Klemperer, W. David; Meyer, Richard D. Determining the initial annual payment for a long-term timberland lease. Southern Journal of Applied Forestry. 9(4): 250-253; 1985.
- Siegel, William C. Proposed timber changes in the Federal income tax--background and current status. In: Mathews, Edward E., ed. Proceedings of the 1986 southern forest economics workshop; 1986 April 16-18; New Orleans, LA. Raleigh, NC: [Publisher unknown]; 1986: 101-116. [Available from D. L. Holley, North Carolina State University, P. O. Box 5448, Raleigh, NC 27605.]
- Siegel, William C. Recent tax decisions on estate valuation and casualty deductions. Forest Farmer. 45(2): 14-15; 1985.
- Siegel, William C. Woodland how-to: trimming the timberland tax bite. American Forests. 92(2): 20-21, 58-59; 1986.
- Siegel, William C.; Ballou, Wade, Jr. The "Primarily for sale" provisions of sections 1221 and 1231 of the Internal Revenue Code as related to timber transactions. Arkansas Law Review. 39(1): 73-98; 1985.
- Siegel, William C.; Cabbage, Frederick W. Forestry legislative and regulatory trends--potential impacts for the hardwood resource. In: The changing hardwood scene: 13th annual hardwood symposium of the Hardwood Research Council; 1985 May 22-24; High Point, NC. Asheville, NC: Hardwood Research Council; 1985: 14-22.
- Sinclair, Steven A.; Chambers, Paul C.; Hansen, Bruce G. Forest products investment model: investment decisionmaking on the microcomputer. In: Proceedings of the 2d annual computer symposium of the Forest Resources Institute; 1985 April 22-24; Louisville, KY. Florence, AL: Forest Resources Institute; 1985: 188-192.
- Smith, Eric L. Economic development considerations in public timber planning. In: Proceedings of the 1985 Society of American Foresters national convention; 1985 July 28-31; Fort Collins, CO. Bethesda, MD: Society of American Foresters; 1985: 292-296.
- Sorg, Cindy F.; Loomis, John B.; Donnelly, Dennis M.; Peterson, George L.; Nelson, Louis J. Net economic value of cold and warm water fishing in Idaho. Resour. Bull. RM-11. Fort Collins, CO: U.S. Department of Agriculture, Forest Service, Rocky Mountain Forest and Range Experiment Station; 1985. 26 p.
- Sorg, Cindy F.; Nelson, Louis J. Net economic value of elk hunting in Idaho. Resour. Bull. RM-12. Fort Collins, CO: U.S. Department of Agriculture, Forest Service, Rocky Mountain Forest and Range Experiment Station; 1986. 21 p.
- Spelter, Henry. A product diffusion approach to modeling softwood lumber demand. Forest Science. 31(3): 685-700; 1985.
- Spelter, Henry. A profile of the nonresidential, nonbuilding construction market for lumber and plywood. Resour. Bull. FPL-16. Madison, WI: U.S. Department of Agriculture, Forest Service, Forest Products Laboratory; 1985. 6 p.

- Stynes, Daniel J.; Peterson, George L.; Rosenthal, Donald H. Log transformation bias in estimating travel cost models. *Land Economics*. 62(1): 94-103; 1986.
- Tucker, Dean F.; Devine, Hugh A. Opportunity cost of timber on preserved areas on the national forests in North Carolina. SCFER Work. Pap. 25. Research Triangle Park, NC: Center for Forest Economics Research; 1986. 26 p.
- U.S. Department of Agriculture, Forest Service. Can northeastern Minnesota see the forest for the trees? *Biologue*. 2(5): 13-15; 1985.
- Wagstaff, Fred J. Economic considerations in management of sagebrush ranges. In: McArthur, E. Durant; Welch, Bruce L., comps. *Proceedings: symposium on the biology of Artemisia and Chrysothamnus*; 1984 July 9-13; Provo, UT. Gen. Tech. Rep. INT-200. Ogden, UT: U.S. Department of Agriculture, Forest Service, Intermountain Forest and Range Experiment Station; 1986: 146-150.
- Walden, John B.; Haney, Harry L., Jr.; Siegel, William C. Planning can reduce State death taxes. *Forest Farmer*. 45(2): 16-17; 1985.
- Walsh, Richard G.; Sanders, Larry D.; Loomis, John B. Measuring the economic benefits of proposed wild and scenic rivers. In: *Proceedings, 1984 national river recreation symposium*; 1985 October 31-November 3; Baton Rouge, LA. Baton Rouge, LA: Louisiana State University; 1986: 301-315.
- Warren, Debra D. Production, prices, employment, and trade in Northwest forest industries, 4th quarter 1985. *Resour. Bull. PNE-130*. Portland, OR: U.S. Department of Agriculture, Forest Service, Pacific Northwest Forest and Range Experiment Station; 1986. 49 p.
- Warren, Debra D. Production, prices, employment, and trade in Northwest forest industries, 2d quarter 1985. *Resour. Bull. PHNW-127*. Portland, OR: U.S. Department of Agriculture, Forest Service, Pacific Northwest Forest and Range Experiment Station; 1986. 62 p.
- Warren, Debra D. Production, prices, employment, and trade in Northwest forest industries, 3d quarter 1985. *Resour. Bull. PNW-129*. Portland, OR: U.S. Department of Agriculture, Forest Service, Pacific Northwest Forest and Range Experiment Station; 1986. 54 p.
- Westgate, Robert A. Benefits and costs of containerized forest tree seedling research in the United States. In: Burns, Denver P., comp. *IUFRO proceedings, evaluation and planning of forestry research*, S6. 06-S6. 06. 01; 1985 July 25-26; Fort Collins, CO. Gen. Tech. Rep. NE-111. Broomall, PA: U.S. Department of Agriculture, Forest Service, Northeastern Forest Experiment Station; 1986: 143-152.
- Westgate, Robert A. Returns to investment in forestry research: the case of containerized forest tree seedlings. In: Risbrudt, Christopher D.; Jakes, Pamela J., comps. *Forestry research evaluation: current progress, future directions: Proceedings, forestry research evaluation workshop*; 1984 August 20-21; St. Paul, MN. Gen. Tech. Rep. NC-104. St. Paul, MN: U.S. Department of Agriculture, Forest Service, North Central Forest Experiment Station; 1985: 117-118.
- Wisdom, Harold W.; Granskog, James E.; Blatner, Keith A. Caribbean markets for U.S. wood products. *Res. Pap. SO-225*. New Orleans, LA: U.S. Department of Agriculture, Forest Service, Southern Forest Experiment Station; 1986. 13 p.

Products and Harvesting

Forest Engineering Systems

Adams, Edward L. Ignoring short-duration downtimes can be costly. *National Hardwood Magazine*. 60(5): 48-49, 61; 1986. WV. Morgantown, WV: West Virginia University; 1986: 355-366.

Anon. Cable harvesting: an alternative for commercial harvesting of New York State's forests lying on steep slopes. In: *Biomass research bulletin: forest management*. Albany, NY: New York State Energy Research and Development Authority; 1986. 8 p.

Ashmore, Colin; Burt, Eddie C.; Turner, John L. Predicting tractive performance of log-skidder tires. In: 1985 winter meeting American Society of Agricultural Engineers; 1985 December 17-20; Chicago. Pap. 85-1597. St. Joseph, MI: American Society of Agricultural Engineers; 1985. 23 p.

Barger, Roland L. Non-industrial private forest lands. Part 3. Harvesting and utilization considerations for forest landowners. *Montana Extension Forestry Digest*. 5(5): 8-13; 1986.

Baumgras, John E.; LeDoux, Chris B. Costs of harvesting forest biomass on steep slopes with a small cable yarder: results from field trials and simulation. In: Smith, Wayne H., ed., *Proceedings of the 3d southern biomass energy research conference*; 1985 March 12-14; Gainesville, FL. New York: Plenum Publishing Corp.; 1986: 133-142.

Beardsell, Michael G. Decreasing the cost of hauling timber through increased payload. Blacksburg, VA: Virginia Polytechnic Institute and State University; 1986. 132 p. Ph.D. dissertation.

Billor, Cleveland J.; Peters, Penn A. Harvesting hardwoods with a feller-buncher. In: *Forest operations in politically and environmentally sensitive areas: Proceedings of the 8th annual Council on Forest Engineering meeting*; 1985 August 18-22; Tahoe City, CA. Davis, CA: University of California; 1985: 140-145.

Burroughs, E. R., Jr.; Hammond, C. J.; Booth, G. D. Relative stability estimation for potential debris avalanche sites using field data. In: *International symposium on erosion, debris flow and disaster prevention: Proceedings*; 1985 September 3-5; Tsukuba, JA. Kyoto, JA: Kyoto University, Department of Forestry; 1985: 335-339.

Carson, Barry; Mann, Charles N.; Schiess, Peter. An evaluation of cable yarding bunched trees on steep slopes. In: *Forest operations in politically and environmentally sensitive areas: Proceedings of the 8th annual Council on Forest Engineering meeting*; 1985 August 18-22; Tahoe City, CA. Portland, OR: Council on Forest Engineering; 1985: 95-102.

Conway, J. S.; Lanford, B. L.; Stokes, B. J.; Greene, W. D. A generalized plotting program to produce stand maps. *Bull.* 574. Auburn, AL: Auburn University and Alabama Agricultural Experiment Station; 1985. 15 p.

Cubbage, Frederick W.; Siegel, William C.; Raney, Kevin P. Logging, politics, and regulation in the East: status and prospect. In: *Forest operations in politically and environmentally sensitive areas: Proceedings of the 8th annual Council on Forest Engineering meeting*; 1985 August 18-22; Tahoe City, CA. Davis, CA: Council on Forest Engineering; 1985: 7-10.

Cubbage, Frederick W.; Werblow, Dennis A. Trends in forest harvesting equipment costs. In: 1985 winter meeting American Society of Agricultural Engineers; 1985 December 17-20; Chicago. St. Joseph, MI: American Society of Agricultural Engineers; 1985. 16 p.

Eck, Ronald W.; Morgan, Perry J. Economic analysis of broad-based dips vs. aluminum pipe culverts on low-volume roads. In: *Low-volume rural roads. Transport. Res. Rec.* 1055. Washington, DC: Transportation Research Board, National Research Council; 1986: 17-25.

Erdmann, Gayne G.; Mattson, James A.; Oberg, Robert R. A 9-year evaluation of mechanized thinning in northern hardwoods. In: Sturos, John A., comp. *Hardwood thinning opportunities in the Lake States: Proceedings of a symposium*; 1984 April 20; Escanaba, MI. Gen. Tech. Rep. NC-113. St. Paul, MN: U.S. Department of Agriculture, Forest Service, North Central Forest Experiment Station; 1986: 54-68.

Frederick, Douglas J.; Stokes, Bryce J.; Curtin, Dennis T. Field trials of a Canadian biomass feller buncher. In: Rockwood, Donald L., ed. *Proceedings, 1985 southern forest biomass workshop*; 1985 June 11-14; Gainesville, FL. Gainesville, FL: Institute of Food and Agricultural Sciences, University of Florida; 1986: 17-22.

Greene, W. D.; Lanford, B. L. An interactive simulation program to model feller-bunchers. *Bull.* 576. Auburn, AL: Auburn University and Alabama Agricultural Experiment Station; 1986. 24 p.

Hammond, C. J.; Sprenke, K. F.; Hammond, W. R. Ground-penetrating radar field tests in north Idaho. In: *Proceedings of the 22d symposium on engineering geology and soils engineering*; 1986 February 24-26; Boise, ID. Boise, ID: Idaho State Department of Transportation; 1986: 53-68.

Hartsough, Bruce R.; Miles, John A. Comparison of static models for cable logging systems. Pap. 85-1615. St. Joseph, MI: American Society of Agricultural Engineers; 1985. 15 p.

- Hartsough, Bruce R.; Miles, John A.; Darling, Gary W.; Mann, Charles N. Running skyline analysis: should you consider yarder characteristics? In: Forest operations in politically and environmentally sensitive areas: Proceedings of the 8th annual Council on Forest Engineering meeting; 1985 August 18-22; Tahoe City, CA. Portland, OR: Council on Forest Engineering; 1985: 103-107.
- Hartsough, Bruce R.; Miles, John A.; Lambert, Michael B. Airship logging: parameters affecting load factors. Transactions of the ASAE. 28(05): 1363-1366; 1985.
- Hassan, Awatif E.; Sirois, D. L. Traction and rolling resistance of a dual-tired skidder on wetland. Transactions of the ASAE. 28(4): 1038-1042; 1985.
- Hinton, Laura G.; Gibson, H. G., Krutz, G. W. Tractor logging simulation: overcoming terrain obstacle problems. Pap. 85-1606. St. Joseph, MI: American Society of Agricultural Engineers; 1985. 7 p. Hoffman, Benjamin, F., Jr.; Wedge, David C. Use of the PORT-A-LOG^R skully with an all terrain cycle for woodlot logging. Tech. Notes 95. Orono, ME: University of Maine, College of Forest Resources; 1985. 7 p.
- Jackson, David H.; Loveless, Robert. Predicting forest road and bridge construction costs. Western Journal of Applied Forestry. 1(3): 76-79; 1986.
- Jones, J. Greg.; Hyde, James F. C., III.; Meacham, Mary L. Four analytical approaches for integrating land management and transportation planning on forest lands. Res. Pap. INT-361. Ogden, UT: U.S. Department of Agriculture, Forest Service, Intermountain Forest and Range Experiment Station; 1986. 33 p.
- Kellogg, Loren D.; Hargrave, Mike. Harvesting cost and stand damage comparisons of cable thinning techniques: herringbone strip thinning versus conventional thinning. In: Forest operations in politically and environmentally sensitive areas: Proceedings of the 8th annual Council on Forest Engineering meeting; 1985 August 18-22; Tahoe City, CA. Davis, CA: University of California; 1985: 84-90.
- Kellogg, Loren D.; Olsen, Eldon D.; Hargrave, Michael A. Skyline thinning a western hemlock-Sitka spruce stand: harvesting costs and stand damage. Res. Bull. 53. Corvallis, OR: Oregon State University, Forest Research Lab, College of Forestry; 1986. 21 p.
- Koger, Jerry L.; Webster, Dennis B. Maximizing profits of ground-based harvesting systems. Forest Products Journal. 36(2): 25-31; 1986.
- Koten, Donald E.; Peters, Penn A. Cable yarding on environmentally sensitive areas in New York State. In: Forest operations in politically and environmentally sensitive areas: Proceedings of the 8th annual Council on Forest Engineering meeting; 1985 August 18-22; Tahoe City, CA. Davis, CA: University of California; 1985: 79-83.
- Laarman, Jan G.; Vasievich, J. Michael; Durst, Patrick B. Technologies to harvest fast-growing energy plantations in Hawaii and the Philippines. SCFER Work. Pap. 17. Research Triangle Park, NC: Southeastern Center for Forest Economics Research; 1985. 12 p.
- Lanford, B. L.; Stokes, B. J. Techniques for silvicultural thinning. In: Proceedings, thinning southern pine plantations workshop--Forest Industries Training and Educational Council, vol. 1; 1984 October 30-November 1; Long Beach, MS. Washington, DC: American Pulpwood Association; 1985: 65-70.
- Lanford, Bobby L.; Stokes, Bryce J.; Somerville, Mathew. Thinning with the John Deere 743A--a case study. Bull. 573. Auburn, AL: Auburn University and Alabama Agricultural Experiment Station; 1985. 8 p.
- LeDoux, Chris B. Applications of a stump-to-mill computer model to cable logging planning. In: Proceedings of the forestry microcomputer software symposium; 1986 June 30-July 2; Morgantown, WV. Morgantown, WV: West Virginia University Press; 1986: 395-399.
- LeDoux, Chris B. Stump-to-mill timber production cost equations for cable logging eastern hardwoods. Res. Pap. NE-566. Broomall, PA: U.S. Department of Agriculture, Forest Service, Northeastern Forest Experiment Station; 1985. 6 p.
- LeDoux, Chris B.; Fight, Roger D.; Ortman, Tom L. Stump-to-truck cable logging cost equations for young-growth Douglas-fir. Western Journal of Applied Forestry. 1(1): 19-21; 1986.
- LeDoux, Chris B.; Starnes, Lawson W. Cable logging production rate equations for thinning young-growth Douglas-fir. Forest Products Journal. 36(5): 21-24; 1986.
- Little, Susan N.; Waddell, Dale R. Harvesting overstocked stands of small diameter trees. Report 3: Chemical composition and implications for harvest strategy. Portland, OR: U.S. Department of Agriculture, Forest Service, Pacific Northwest Forest and Range Experiment Station; 1986. 47 p.
- Mann, C. N.; Schiess, P.; Miyata, E. S. Increasing productivity of timber harvesting on steep slopes. Pap. 85-1592. St. Joseph, MI: American Society of Agricultural Engineers; 1985. 11 p.
- Markstrom, Donald C.; Windsor, John C. Feasibility of collecting firewood blocks with a small skyline. Res. Note RM-468. Fort Collins, CO: U.S. Department of Agriculture, Forest Service, Rocky Mountain Forest and Range Experiment Station; 1986. 5 p.

- Mattson, James A. Harvest system alternatives: the logger's toolbox. In: Martin, A. Jeff, ed. Timber harvesting the link between management and utilization: 3d SAF Region 5 technical conference; 1985 September 25-27; Madison, WI. SAF Publ. 85-09. [Bethesda], MD: [Society of American Foresters]; 1985: 122-136.
- Miller, D. E.; Watson, W. F.; Straka, T. J.; Matthes, R. K.; Stokes, B. J. Productivity and cost of conventional understory biomass harvesting systems. In: 1985 winter meeting American Society of Agricultural Engineers; 1985 December 17-20; Chicago. Pap. 85-1598. St. Joseph, MI: American Society of Agricultural Engineers; 1985: 19 p.
- Miyata, E. S.; Feves, M. L.; Mann, C. N. Static and dynamic load tests of rockbolt anchorages. Pap. 85-1599. St. Joseph, MI: American Society of Agricultural Engineers; 1985. 8 p.
- Olsen, Eldon D. Computer program for modelling multiple-entry economics. In: Forest operations in politically and environmentally sensitive areas: Proceedings of the 8th annual Council on Forest Engineering meeting; 1985 August 18-22; Tahoe City, CA. Davis, CA: University of California; 1985: 51-53.
- Peters, Penn A. Cost-estimating programs for cable yarding. In: Annual winter meeting American Society of Agricultural Engineers; 1985 December 17-20; Chicago. Pap. 85-1590. St. Joseph, MI: American Society of Agricultural Engineers; 1985: 46 p.
- Peters, Penn A. Estimating average volume per turn for skidding systems. In: Proceedings of the forestry microcomputer software symposium; 1986 June 30-July 2; Morgantown, WV. Morgantown, WV: West Virginia University Press; 1986: 422-439.
- Phillips, Ross A. A temporary bridge to support skidder traffic. Northern Logger and Timber Processor. 34(10): 20-21; 1986.
- Phillips, Ross A.; Perumpral, John V.; Swick, Christopher. Log skidder loading predictions. In: HP-41C users' library software catalog. Prog. 03265. Corvallis, OR: Hewlett-Packard; 1985.
- Phillips, Ross A.; Powell, Douglas. Timber volume relative to slope. In: Forest operations in politically and environmentally sensitive areas: Proceedings of the 8th annual Council on Forest Engineering meeting; 1985 August 18-22; Tahoe City, CA. Davis, CA: University of California; 1985: 41-45.
- Plummer, Glenn M.; Stokes, Bryce J. Petroleum product consumption by engine horsepower and drive trains of on-highway forest transportation vehicles. Rep. 5, 85-A-8. Washington, DC: American Pulpwood Association, Inc., Southwide Energy Committee; 1985. 7 p.
- Plummer, Glenn M.; Stokes, Bryce J. Petroleum product consumption estimates for on-highway forest vehicles. Rep. 6, 85-A-9. Washington, DC: American Pulpwood Association, Inc., Southwide Energy Committee; 1985. 8 p.
- Plummer, Glenn M.; Stokes, Bryce J. Petroleum product consumption of on-highway forest transportation. Rep. 4, 85-A-6. Washington, DC: American Pulpwood Association, Inc., Southwide Energy Committee; 1985. 7 p.
- Pong, W. Y.; Waddell, Dale R. Harvesting overstocked stands of small diameter trees. Report 1: Stem density of western hemlock, Douglas-fir, and western redcedar. Portland, OR: U.S. Department of Agriculture, Forest Service, Pacific Northwest Forest and Range Experiment Station; 1985. 13 p.
- Pong, W. Y.; Waddell, Dale R. Harvesting overstocked stands of small diameter trees. Report 2: Biomass distribution in western hemlock, Douglas-fir, and western redcedar. Portland, OR: U.S. Department of Agriculture, Forest Service, Pacific Northwest Forest and Range Experiment Station; 1986. 54 p.
- Prellwitz, R. W. A complete three-level approach for analyzing landslides on forest lands. In: International symposium on erosion, debris flow and disaster prevention: Proceedings; 1985 September 3-5; Tsukuba, JA. Kyoto, JA: Kyoto University, Department of Forestry; 1985: 475-479.
- Prellwitz, R. W.; Babbitt, R. E. Long-term ground water monitoring in mountainous terrain. Transportation Research Record. 965: 8-15; 1984.
- Prouty, Mike. Road research aims to limit costs and resource damage. Forest Industries. 113(6): 14-15; 1986.
- Quirk, J. T.; Miller, R. B. Vestured pits in the tribe *Cassieae* *bronn* (Leguminosae). IAWA Bulletin. 6(3): 200-212; 1985.
- Reutebuch, S. E.; Twito, R. H. Preliminary route location using a digital terrain model. Pap. 85-1595. St. Joseph, MI: American Society of Agricultural Engineers; 1985. 12 p.
- Reutebuch, Stephen E.; Murphy, Glen E. Using a computer-aided planning package to assess the impact of environmental restrictions on harvesting systems. In: Forest operations in politically and environmentally sensitive areas: Proceedings of the 8th annual Council on Forest Engineering meeting; 1985 August 18-22; Tahoe City, CA. Portland, OR: Council on Forest Engineering; 1985: 16-25.
- Rummer, Robert; Ashmore, Colin. Factors affecting the rolling resistance of rubber-tired skidders. In: 1985 winter meeting American Society of Agricultural Engineers; 1985 December 17-20; Chicago. Pap. 85-1611. St. Joseph, MI: American Society of Agricultural Engineers; 1986: 13 p.
- Schroering, J. D.; Lanford, B. L. Application of the Hewlett-Packard 41CV calculator in elemental time studies. Bull. 569. Auburn, AL: Auburn University and Alabama Agricultural Experiment Station; 1985. 30 p.

- Sirois, D. L.; Hassan, A. E. Performance of the skidder tires in swamps. In: 1985 winter meeting American Society of Agricultural Engineers; 1985 December 17-20; Chicago. Pap. 85-1616. St. Joseph, MI: American Society of Agricultural Engineers; 1985: 18 p.
- Sirois, D. L.; Smith, L. A. Physiological demands of forest harvesting tasks: A case study of skidding operations. *Applied Ergonomics*. 16(3): 167-172; 1985.
- Sirois, Donald L.; Stokes, Bryce J. Helicopter used in swamp logging. Tech. Release 86-R-22. Washington, DC: American Pulpwood Association; 1986. 2 p.
- Sirois, Donald L.; Stokes, Bryce J. Processing energy wood. Tech. Pap. 86-P-1. Washington, DC: American Pulpwood Association; 1986. 16 p.
- Sirois, Donald L.; Stokes, Bryce J.; Ashmore, Colin. Primary transport of wood on sensitive sites in the Southeast. In: Forest operations in politically and environmental sensitive areas: Proceedings of the 8th annual Council on Forest Engineering meeting; 1985 August 18-22; Tahoe City, CA. Davis, CA: University of California; 1986: 122-127.
- Stokes, B. J.; Lanford, Bobby L. Production and costs of manual delimbing, bucking, and piling in thinnings. Res. Pap. SO-223. New Orleans, LA: U.S. Department of Agriculture, Forest Service, Southern Forest Experiment Station; 1986. 8 p.
- Stokes, Bryce J. Flail-delimbing of loblolly pine--a case study. Res. Note SO-315. New Orleans: U.S. Department of Agriculture, Forest Service, Southern Forest Experiment Station; 1985. 7 p.
- Stokes, Bryce J. Reduced vibration with twin-cylinder chainsaw. In: Forest operations in politically and environmental sensitive areas: Proceedings of the 8th annual Council on Forest Engineering meeting; 1985 August 18-22; Tahoe City, CA. Davis, CA: University of California; 1986: 149-153.
- Stokes, Bryce J. Twin-cylinder chain saw reduces vibration levels. *Forest Industries*. 113(5): 46-47; 1986.
- Stokes, Bryce J.; Lanford, Bobby L. Prebunching and skidding functions in thinnings. In: Proceedings, 1985 winter meeting American Society of Agricultural Engineers; 1985 December 17-20; Chicago. Pap. 85-1594. St. Joseph, MI: American Society of Agricultural Engineers; 1985: 9 p.
- Stokes, Bryce J.; Sirois, D. L. Evaluation of chipper-forwarder biomass harvesting concept. In: Rockwood, Donald L., ed. Proceedings, 1985 southern forest biomass workshop; 1985 June 11-14; Gainesville, FL. Gainesville, FL: Institute of Food and Agricultural Sciences, University of Florida; 1986: 23-26.
- Stokes, Bryce J.; Sirois, Donald L. Chipper-forwarder biomass harvesting concept. In: Proceedings, 7th international FPRS industrial wood energy forum '83, vol. 1; 1983 September 19-21; Nashville, TN. Madison, WI: Forest Products Research Society; 1985: 65-68.
- Stokes, Bryce J.; Watson, William F. Integration of biomass harvesting and site preparation. In: Rockwood, Donald L., ed. Proceedings, 1985 southern forest biomass workshop; 1985 June 11-14; Gainesville, FL. Gainesville, FL: Institute of Food and Agricultural Sciences, University of Florida; 1986: 62-67.
- Sturos, John A. New harvest equipment and systems. In: Martin, A. Jeff, ed. Timber harvesting: the link between management and utilization: 3d SAF Region 5 technical conference; 1985 September 25-27; Madison, WI. SAF Publ. 85-09. [Bethesda], MD: [Society of American Foresters]; 1985: 155-174.
- Sturos, John A., comp. Hardwood thinning opportunities in the Lake States: Proceedings of a symposium; 1984 April 20; Escanaba, MI. Gen. Tech. Rep. NC-113. St. Paul, MN: U.S. Department of Agriculture, Forest Service, North Central Forest Experiment Station; 1986. 153 p.
- Sturos, John A.; Thompson, Michael A. Harvesting hardwood thinnings. In: Sturos, John A., comp. Hardwood thinning opportunities in the Lake States: Proceedings of a symposium; 1984 April 20; Escanaba, MI. Gen. Tech. Rep. NC-113. St. Paul, MN: U.S. Department of Agriculture, Forest Service, North Central Forest Experiment Station; 1986: 31-53.
- Taylor, William R.; Gibson, David F. Simulation model for assessing harvesting and handling systems. In: Winter meeting American Society of Agricultural Engineers: Proceedings; 1983 December 13-16; Chicago. Pap. 83-1614. St. Joseph, MI: American Society of Agricultural Engineers; 1986: 1-23.
- Toupin, Richard. Modeling and testing two-stump anchor systems for skyline yarders. *Engineering Field Notes*. 18(3): 5-12; 1986.
- Watson, W. F.; Stokes, B. J.; Savelle, I. W. Comparison of two methods of harvesting biomass for energy. *Forest Products Journal*. 36(4): 63-68; 1986.

Wood Structural Engineering

- Aplin, E. Nicholas; Green, David W.; Evans, James W.; Barrett, J. David. The influence of moisture content on the flexural properties of Douglas-fir dimension lumber. Res. Pap. FPL-475. Madison, WI: U.S. Department of Agriculture, Forest Service, Forest Products Laboratory; 1986. 32 p.
- Aune, Petter; Patton-Mallory, Marcia. Lateral load-bearing capacity of nailed joints based on the yield theory: experimental verification. Res. Pap. FPL-470. Madison, WI: U.S. Department of Agriculture, Forest Service, Forest Products Laboratory; 1986. 29 p.

- Aune, Petter; Patton-Mallory, Marcia. Lateral load-bearing capacity of nailed joints based on the yield theory: theoretical development. Res. Pap. FPL-469. Madison, WI: U.S. Department of Agriculture, Forest Service, Forest Products Laboratory; 1986. 20 p.
- Bender, D. A.; Woeste, F. E.; Schaffer, E. L.; Marx, C. M. Reliability formulation for the strength and fire endurance of glued-laminated beams. Res. Pap. FPL 460. Madison, WI: U.S. Department of Agriculture, Forest Service, Forest Products Laboratory; 1985. 43 p.
- Brenden, John J.; Chamberlain, David L. Heat release rates from wall assemblies: oxygen consumption and other methods compared. Res. Pap. FPL-476. Madison, WI: U.S. Department of Agriculture, Forest Service, Forest Products Laboratory; 1986. 21 p.
- Burke, Edwin J.; Koch, Peter. Crushing strength and modulus of elasticity of unmachined lodgepole pine stem sections compared to machined dowels of the same diameter--kerfed and kerf-free, round and half-round. Forest Products Journal. 36(3): 31-38; 1986.
- Caulfield, D. F. A chemical kinetics approach to the duration-of-load problem in wood. Wood and Fiber Science. 17(4): 504-521; 1985.
- Courville, George; TenWolde, Anton. Moisture measurements in buildings. In: Moisture control in buildings; 1984 September 25-26; Washington, DC. Washington, DC: Building Thermal Envelope Coordinating Council; 1985: 77-87.
- Criswell, M. Design of columns. Journal of Materials Education. 8(3): 400-517; 1986.
- Diekmann, Edward F. Design of wood diaphragms. Journal of Materials Education. 8(1/2): 89-186; 1986.
- Galligan, William L.; Hoyle, Robert J.; Pellerin, Roy R.; Haskell, James H.; Taylor, James R. Characterizing the properties of 2-inch softwood dimension lumber with regressions and probability distributions: project completion report. [Place of publication unknown]: [Publisher unknown]; 1986. 135 p. [Available from National Technical Information Service, 5285 Port Royal Road, Springfield, VA 22161.]
- Gerhards, C. C.; Link, C. L. Effect of loading rate on bending strength of Douglas-fir 2 by 4's. Forest Products Journal. 36(3): 63-66; 1986.
- Gerhards, Charles C. Duration of load research on lumber at the U.S. Forest Products Laboratory. In: International workshop on duration of load in lumber and wood products; 1985 September 12-13; Vancouver, BC. Vancouver, BC: Forintek Canada Corp.; 1986: 14-21.
- Green, David W.; Link, Carol L.; DeBonis, A. Louis; McLain, Thomas E. Predicting the effect of moisture content on the flexural properties of southern pine dimension lumber. Wood and Fiber Science. 18(1): 134-156; 1986.
- Gromala, David S. Determination of modulus of rigidity by ASTM D 198 flexural methods. Journal of Testing and Evaluation. 13(5): 352-355; 1985.
- Gromala, David S. Lateral nail resistance for ten common sheathing materials. Forest Products Journal. 35(9): 61-68; 1985.
- Hamon, D. C.; Woeste, F. E.; Green, D. W. Influence of lumber property correlations on roof truss reliability. Transactions of the American Society of Agricultural Engineers. 28(5): 1618-1625; 1985.
- Hrutfjord, B. F.; Luthi, R.; Hanover, K. F. Color formation in western hemlock. Journal of Wood Chemistry and Technology. 5(4): 451-460; 1985.
- Kline, D. E.; Woeste, F. E.; Bendtsen, B. A. Stochastic model for modulus of elasticity of lumber. Wood and Fiber Science. 18(2): 228-238; 1986.
- Koenigshof, Gerald A. Performance and quality-control standards for composite floor, wall, and truss framing. Gen. Tech. Rep. SE-33. Asheville, NC: U.S. Department of Agriculture, Forest Service, Southeastern Forest Experiment Station; 1985. 20 p.
- Laufenberg, Theodore; LeVan, Susan; Bruci, Vladimir. Prethodna ispitivanja izrade vatrootpornih ploca iverica. [Preliminary investigation of fire-retardant treatments for flakeboards.] Drvna Ind. 36(3-4): 65-70; 1986.
- LeVan, Susan L. Durability of fire-retardant treatments for shingles. Southern Lumberman. December: 70; 1985.
- LeVan, Susan L. Flamespread variability of candidate wood-based reference materials. Journal of Fire Sciences. 3(3): 208-223; 1985.
- LeVan, Susan L.; Brenden, John J. Variability of smoke particulate concentrations in the NBS smoke chamber. Forest Products Journal. 36(5): 29-35; 1986.
- Marx, Catherine M.; Evans, James W. Tensile strength of AITC 302-24 grade tension laminations. Forest Products Journal. 36(1): 71-86; 1986.
- McAlister, Robert H. Effect of fabrication variables on critical buckling stress of composite lumber. Forest Products Journal. 36(7/8): 17-19; 1986.
- McAlister, Robert H. Effect of joints on bending strength and stiffness of composite truss lumber. Forest Products Journal. 35(11/12): 75-78; 1985.
- McAlister, Robert H. Performance of truss plate joints in structural flakeboard and southern pine dimension lumber. Forest Products Journal. 36(3): 41-43; 1986.

- McCutcheon, William J. Stiffness of framing members with partial composite action. *Journal of Structural Engineering*. 112(7): 1623-1637; 1986.
- Murphy, Joseph F. Strength and stiffness reduction of large notched beams. *Journal of Structural Engineering*. 112(9): 1989-2000; 1986.
- Patton-Mallory, Marcia; Wolfe, Ronald W.; Soltis, Lawrence A.; Gutkowski, Richard M. Light-frame shear wall length and opening effects. *Journal of Structural Engineering*. 111(10): 2227-2239; 1985.
- Schaffer, E. L.; Woeste, F. E.; Bender, D. A.; Marx, C. M. Strength and fire endurance of glued-laminated timber beams. In: Anchor, R. D.; Malhotra, H. L.; Purkiss, J. A., eds. *International conference on design of structures against fire*; 1986 April 15-16; Birmingham, UK. New York, NY: Elsevier Applied Science Publishers; 1986: 71-86.
- Schaffer, Erwin L.; Marx, Catherine M.; Bender, Donald A.; Woeste, Frank E. Strength validation and fire endurance of glued-laminated timber beams. Res. Pap. FPL-467. Madison, WI: U.S. Department of Agriculture, Forest Service, Forest Products Laboratory; 1986. 16 p.
- Sherwood, G. E.; Highley, T. L.; Moody, R. C. Inspection of wood beams and trusses. NAVFAC MO-111. 1. Alexandria, VA: Naval Facilities Engineering Command; 1985. 50 p.
- Sherwood, Gerald E. Technology of preserving wood structures. In: David, G., ed. *Proceedings of ASTM symposium on building preservation and rehabilitation*; 1983 October 17; Bal Harbour, FL. Philadelphia, PA: American Society for Testing and Materials; 1986: 121-135.
- Soltis, Lawrence A. Details for durable timber structures. In: Ma, S. Marshall, ed. *Effects of deterioration on safety and reliability of structures*; 1986 April 4-11; Seattle, WA. New York, NY: American Society of Civil Engineers; 1986: 12-21.
- Soltis, Lawrence A. Partially continuous floor joists. Res. Pap. FPL-461. Madison, WI: U.S. Department of Agriculture, Forest Service, Forest Products Laboratory; 1985. 16 p.
- Soltis, Lawrence A.; Hubbard, Finn K.; Wilkinson, Thomas L. Bearing strength of bolted timber joints. *Journal of Structural Engineering*. 112(9): 2141-2154; 1986.
- Soltis, Lawrence A.; Mtenga, Primus V. A. Strength of nailed wood joints subjected to dynamic load. *Forest Products Journal*. 35(11/12): 14-18; 1985.
- Soltis, Lawrence A.; Patton-Mallory, Marcia. Strength and ductility of sheathed walls. In: *Proceedings of the 8th European conference on earthquake engineering*; 1986 September 7-12; Lisbon, PO. Lisbon, PO: Laboratorio Nacional de Engenharia Civil; 1986: 57-63.
- Stern, E. George; Wallin, Walter B. Glossary of terms in the pallet field. Washington, DC: Virginia Polytechnic Institute and State University and National Wooden Pallet and Container Association; 1985. 24 p.
- Stern, E. George; Wallin, Walter B. Model specification for driven fasteners for assembly of pallets and related structures. Tech. Pap. Blacksburg, VA: Virginia Polytechnic Institute and State University; 1985. 20 p.
- Stern, E. George; Wallin, Walter B.; Whitenack, Kenneth R. Evidence shows pallet rigidity to be a major indicator of pallet durability. *Pallet Enterprise*. 6(1): 42-45; 1986.
- Stern, E. George; Wallin, Walter B.; Whitenack, Kenneth R. Pallet rigidity--a major indicator of pallet durability (expanded version). *Pallet & Container Lab. Bull.* 4. Blacksburg, VA: Virginia Polytechnic Institute and State University; 1985. [Unpaginated.]
- Stern, E. George; Wallin, Walter B.; Whitenack, Kenneth R. Pallet rigidity--a major indicator of pallet durability. *Forest Products Journal*. 35(11/12): 83-86; 1985.
- TenWolde, A.; Courville, G. E. Instrumentation for measuring moisture in building envelopes. In: *ASHRAE Transactions* 1985; 1985 June 26; Honolulu, HI. Atlanta, GA: American Society of Heating, Refrigerating and Air-Conditioning Engineers; 1985: 1101-1115.
- Thurmond, Michael B.; Woeste, Frank E.; Green, David W. Floor loads for reliability analysis of lumber properties data. *Wood and Fiber Science*. 18(1): 187-207; 1986.
- Wheat, Dan L.; Gromala, David S.; Moody, Russell C. Static behavior of wood-joint floors at various limit states. *Journal of Structural Engineering*. 112(7): 1677-1691; 1986.
- White, Robert H. Design of fire-resistive coated wood members. In: *Second passive fire protection symposium*; 1985 November 4-6; Alexandria, VA. Alexandria, VA: Naval Sea Systems Command; 1985: 304-322.
- White, Robert H. Reporting of fire incidents in heavy timber structures. Res. Pap. FPL-464. Madison, WI: U.S. Department of Agriculture, Forest Service, Forest Products Laboratory; 1986. 21 p.
- Wilkinson, Thomas Lee. Load distribution among bolts parallel to load. *Journal of Structural Engineering*. 112(4): 835-852; 1986.
- Wilkinson, Thomas Lee. Rotational creep of pallet joint specimens. Res. Note FPL-RN-0253. Madison, WI: U.S. Department of Agriculture, Forest Service, Forest Products Laboratory; 1986. 11 p.
- Wilkinson, Thomas Lee. Wood joints with mechanical fastenings. In: Bever, Michael B., ed. *Encyclopedia of materials science and engineering*. Elmsford, NY: Pergamon Press, Inc.; 1986: 5438-5440.
- Winandy, J. E.; Boone, R. S.; Bendtsen, B. A. Interaction of CCA preservative treatment and redrying: effect on the mechanical properties of southern pine. *Forest Products Journal*. 35(10): 62-68; 1985.

Wolfe, Ronald W. Roof systems research program: full-scale roof systems test. Woodwards. 3(4): 3 p.; 1985.

Wolfe, Ronald W.; Percival, Donald H.; Moody, Russell C. Strength and stiffness of light-frame sloped trusses. Res. Pap. FPL-471. Madison, WI: U S. Department of Agriculture, Forest Service, Forest Products Laboratory; 1986. 16 p.

Zahn, John J. Design of wood members under combined load. Journal of Structural Engineering. 112(9): 2109-2126; 1986.

Chemistry, Fiber, and Fuel Products

Atalla, R. H.; Woitkovich, C. P.; Setterholm, V. C. Raman microprobe studies of fiber transformations during press-drying. Tappi Journal. 68(11): 116-119; 1985.

Caulfield, D. F.; Young, T. L.; Wegner, T. H. How web and press parameters interact to control water removal in the wet press. Tappi Journal. 69(6): 90-93; 1986.

Caulfield, Daniel F.; Young, Teresa L.; Wegner, Theodore H. Wet pressing webs of higher-yield kraft pulp for improved strength. Tappi Journal. 69(4): 115-119; 1986.

Christiansen, A. W.; Gillespie, R. H. Potential of carbohydrates for exterior-type adhesives. Forest Products Journal. 36(7/8): 20-28; 1986.

Christopherson, Nels S.; Barnett, Paul E. Harvesting hardwood top and limb residue for energy. In: Robertson, Doris, proc. coord. The 7th international FPRS industrial wood energy forum '83, vol. 1.; 1983 September 19-21; Nashville, TN. Proc. 47337. Madison, WI: Forest Products Research Society; 1985: 100-108.

Conner, Anthony H.; Libkie, Kimball; Springer, Edward L. Kinetic modeling of hardwood prehydrolysis. Part 2: Xylan removal by dilute hydrochloric acid prehydrolysis. Wood and Fiber Science. 17(4): 540-548; 1985.

Conner, Anthony H.; Lorenz, Linda F. Kinetic modeling of hardwood prehydrolysis. Part 3: Water and dilute acetic acid prehydrolysis of southern red oak. Wood and Fiber Science. 18(2): 248-263; 1986.

Conner, Anthony H.; Wood, Barry F.; Hill, Charles G., Jr.; Harris, John F. Kinetic model for the dilute sulfuric acid saccharification of lignocellulose. Journal of Wood Chemistry and Technology. 5(4): 461-489; 1985.

Conner, Anthony H.; Wood, Barry F.; Hill, Jr., Charles G.; Harris, John F. Kinetic modeling of the saccharification of prehydrolyzed southern red oak. In: Cellulose: structure, modification, and hydrolysis. New York: John Wiley & Sons; 1986: 281-296.

Fronczek, F. R.; Gannuch, G.; Mattice, W. L.; Hemingway, R. W.; Chiari, G.; Tobiason, F. L.; Houglum, K.; Shanafelt, A. Preference for occupancy of axial positions by substituents bonded to the heterocyclic ring in penta-O-acetyl-(+)-catechin in the crystalline state. Journal Chemical Society Perkin Transactions II. 1: 1383-1386; 1985.

Gigante, Barbera; Jones, Ray; Lobo, Ana M.; Marcelo-Curto, M. Joao; Prabhaker, Sundaresan; Rzepa, Henry S.; Williams, David J.; Zinkel, Duane F. The structure of an abietic acid dimer. Journal of the Chemical Society, Chemical Communications. 13: 1038-1039; 1986.

Green, Jesse D. Light-induced bleaching of high-yield pulps. Part 1: Sensitized bleaching of pulp sheets. Journal of Wood Chemistry and Technology. 6(1): 45-71; 1986.

Gregory, Mary; Miller, Regis B. New and notes: Samuel James Record wood and herbarium collections at Forest Products Laboratory. Taxon. 34(1): 178-179; 1985.

Gunderson, Dennis E. Measuring the mechanical behavior of paperboard in a changing humidity environment. In: Proceedings, 1986 international process and materials quality evaluation conference; 1986 September 21-24; Atlanta, GA. Atlanta, GA: Technical Association of the Pulp and Paper Industry; 1986: 246-251.

Harris, John F.; Baker, Andrew J.; Conner, Anthony H.; Jeffries, Thomas W.; Minor, James L.; Pettersen, Roger C.; Scott, Ralph W.; [and others]. Two-stage, dilute sulfuric acid hydrolysis of wood: an investigation of fundamentals. Gen. Tech. Rep. FPL-45. Madison, WI: U.S. Department of Agriculture, Forest Service, Forest Products Laboratory; 1985. 73 p.

Harris, Robert A.; McMinn, James W.; Payne, Fred A. Calculating and reporting changes in net heat of combustion of wood fuel. Forest Products Journal. 36(6): 57-60; 1986.

Harris, Robert A.; Phillips, Douglas R. Density of selected wood fuels. Ga. For. Res. Pap. 61. Macon, GA: Georgia Forestry Commission; 1986. 6 p.

Hemingway, R. W.; Ludlow, T. B.; Koch, P. Exploratory trials of processing southern woods in screw extruders. In: Comminution of wood and bark; 1984 October 1-3; Chicago. Madison, WI: Forest Products Research Society; 1985: 124-133.

Horn, Richard A. Press drying recycled multi-ply boxboard. In: Proceedings of 1986 papermakers conference; 1986 April 14-16; New Orleans, LA. Atlanta, GA: Technical Association of the Pulp and Paper Industry; 1986: 135-142.

Horn, Richard A.; Bormett, David W. Conventional and press drying of high-yield paper birch for use in linerboard and corrugating medium. Tappi Journal. 68(10): 97-101; 1985.

Horn, Richard A.; Bormett, David W. Press drying recycled fiber for use in paperboard. Tappi Journal. 68(12): 78-83; 1985.

- Horn, Richard A.; Bormett, David W.; Setterholm, Vance C. Press drying chemithermomechanical pulp for linerboard and corrugating medium. In: New technologies in web consolidation and drying: Conference papers; 1986 May 19-23; Brighton, UK. Leatherhead, UK: Pira Paper and Board Division; 1986: 18 p.
- Johnson, Leonard R. Wood residue recovery in the Intermountain Region. In: Robertson, Doris, proc. coord. The 7th international FPRS industrial wood energy forum '83. Vol. 1: Growth, collection, and delivery of wood/biomass; preparation, storage, and handling of wood/biomass; 1983 September 19-21; Nashville, TN. Proc. 47337. Madison, WI: Forest Products Research Society; 1986: 73-83.
- [Keegan, Charles E., III; Barger, Roland L.]. The northwestern Montana assessment. In: Site-specific wood residue assessments and their implications for greater resource recovery. Washington, DC: U.S. Department of Agriculture, Forest Service, Forest Resources and Economics Research; 1986: 30-44.
- Keegan, Charles E., III; Jackson, Timothy P. Mill residue availability in the Inland Empire. *Forest Products Journal*. 35(10): 56-61; 1985.
- Koning, John W., Jr. New rapid method for determining edgewise compressive strength of corrugated fiberboard. *Tappi Journal*. 69(1): 74-76; 1986.
- Landucci, Lawrence L. Quantitative ¹³C NMR characterization of lignin. 1. A methodology for high precision. *Holzforschung*. 39(6): 355-359; 1985.
- Liu, Jen Y. Flat-crush failure mechanism of corrugated fiberboard. *Journal of Applied Mechanics*. 53(3): 602-608; 1986.
- Mattson, James A.; Winsauer, Sharon A. The potential for harvesting "puckerbrush" for fuel. Res. Pap. NC-262. St. Paul, MN: U.S. Department of Agriculture, Forest Service, North Central Forest Experiment Station; 1985. 6 p.
- McMinn, James W. Wood energy potential in northwestern South Carolina. Gen. Tech. Rep. SE-38. Asheville, NC: U.S. Department of Agriculture, Forest Service, Southeastern Forest Experiment Station; 1986. 8 p.
- Minor, J. L. Chemical linkage of polysaccharides to residual lignin in loblolly pine kraft pulps. *Journal of Wood Chemistry and Technology*. 6(2): 185-201; 1986.
- Myers, Gary C.; Crist, John B. Feasibility of manufacturing hardboard from short-rotation intensively cultured *Populus*. *Forest Products Journal*. 36(1): 37-44; 1986.
- Myers, George E. Effects of post-manufacture board treatments on formaldehyde emission: a literature review (1960-1984). *Forest Products Journal*. 36(6): 41-51; 1986.
- Myers, George E. Mechanisms of formaldehyde release from bonded wood products. In: Formaldehyde release from wood products. ACS Sympos. 316. Washington, DC: American Chemical Society; 1986: 87-106.
- Nissan, A. H.; Byrd, V. L.; Batten, G. L., Jr.; Ogden, R. W. Paper as an H-bond dominated solid in the elastic and plastic regimes. *Tappi Journal*. 68(9): 118-124; 1985.
- Obst, John R.; Landucci, Lawrence L. The syringyl content of softwood lignin. *Journal of Wood Chemistry and Technology*. 6(3): 311-327; 1986.
- Phelps, J. E.; Isebrands, J. G.; Einspahr, D. W.; Crist, J. B.; Sturos, J. A. Wood and paper properties of vacuum airlift segregated juvenile poplar whole-tree chips. *Wood and Fiber Science*. 17(4): 529-539; 1985.
- Radcliffe, Robert C. Chunkwood for energy. In: Robertson, Doris, proc. coord. The 7th international FPRS industrial wood energy forum '83, vol. 1; 1983 September 19-21; Nashville, TN. Proc. 47337. Madison, WI: Forest Products Research Society; 1985: 109-115.
- Ralph, John; Landucci, Lawrence L. Adducts of anthrahydroquinone and anthranol with lignin model quinone methides. 9,10-¹³C labelled anthranol-lignin adducts; examination of adduct formation and stereochemistry in the polymer. *Journal of Wood Chemistry and Technology*. 6(1): 73-88; 1986.
- River, Bryan H. Strength and durability of alkylresorcinolic adhesives from Estonian oil shale kerogen. *Forest Products Journal*. 36(4): 25-34; 1986.
- Sachs, Irving B. Microscopic observations during longitudinal compression loading of single pulp fibers. *Tappi Journal*. 69(7): 98-102; 1986.
- Setterholm, V. C. Press drying of paper. In: Bever, Michael B., ed. Encyclopedia of materials science and engineering. Elmsford, NY: Pergamon Press, Ltd.; 1986: 3912-3913.
- Smith, W. Ramsay; Woodfin, Richard A., Jr. Fuel characteristics of selected species of beached logs in southeastern Alaska. In: Progress in biomass conversion. Orlando, FL: Academic Press, Inc.; 1984: 203-216.
- Song, Zhan-Qian; Zavarin, Eugene; Zinkel, Duane F. On the palladium-on-charcoal disproportionation of rosin. *Journal of Wood Chemistry and Technology*. 5(4): 535-542; 1985.
- Springer, Allan M.; Dullforce, Jon P.; Wegner, T. H. Mechanisms by which white water system contaminants affect the strength of paper produced from secondary fiber. *Tappi Journal*. 69(4): 106-110; 1986.
- Springer, Allan M.; Dullforce, Jon P.; Wegner, T. H. The effects of closed whitewater system contaminants on strength properties of paper produced from secondary fiber. *Tappi Journal*. 68(4): 78-82; 1985.

- Springer, E. L. Important factors involved in storing bark and bark-free, whole-log, and whole-tree chips. In: The 7th international FPRS industrial wood energy forum '83; 1983 September 19-21; Nashville, TN. Proc. 47337. Madison, WI: Forest Products Research Society; 1985: 189-202.
- Springer, Edward L. Prehydrolysis of hardwoods with dilute sulfuric acid. Industrial and Engineering Chemistry, Product Research and Development. 24: 614-623; 1985.
- Springer, Edward L.; Harris, John F. Procedures for determining the neutralizing capacity of wood during hydrolysis with mineral acid solutions. Industrial and Engineering Chemistry, Product Research and Development. 24: 485-489; 1985.
- Springer, Edward L.; McSweeney, James D. Use of calcium sulfite and air to bleach a delignified aspen kraft pulp. Tappi Journal. 69(4): 129; 1986.
- White, M. S.; Argent, R. M.; Sarles, R. L. Effects of outside storage on the energy potential of hardwood particulate fuels. Part 3: Specific gravity, ash content, and pH of water solubles. Forest Products Journal. 36(4): 69-73; 1986.
- Wood, Barry F.; Conner, Anthony H.; Hill, Jr., Charles G. The effect of precipitation on the molecular weight distribution of cellulose tricarbanilate. Journal of Applied Polymer Science. 32: 3703-3712; 1986.
- Young, Raymond, A.; Rowell, Roger M. Cellulose--structure, modification and hydrolysis. New York, NY: John Wiley & Sons; 1986. 365 p.
- Young, T. L.; Caulfield, D. F. Dehydration conditions can improve formaldehyde crosslinking of linerboard. Tappi Journal. 69(9): 124-128; 1986.
- Young, Teresa L. Kinetic behavior of formaldehyde crosslinking of linerboard. Cellulose Chemistry and Technology. 20: 117-132; 1986.
- Young, Teresa L.; Caulfield, Daniel F. Effect of process variables on formaldehyde crosslinking of corrugated fiberboard. Tappi Journal. 69(2): 90-95; 1986.
- Zinkel, Duane F. Identification of new resin acids in southern pine oleoresins and rosin. Naval Stores Review. 96(3): 18-19; 1986.
- Zinkel, Duane F.; Han, James S. GLC determination of the resin acid composition in rosins and oleoresins: state of the art. Naval Stores Review. 96(2): 14-19; 1986.
- ### Utilization Potential and Processing of Wood
- Adams, Edward L. Computer simulation used for modifying hardwood sawmills. In: Proceedings of the 2d annual computer symposium of the Forest Resources Systems Institute; 1985 April 22-24; Louisville, KY. Florence, AL: Forest Resources Systems Institute; 1985: 193-196.
- Adams, Edward L. SOLVE II on the PC--an analytical tool for the sawmill manager. In: Wiant, Harry V., Jr.; Yandle, David O.; Kidd, William E., eds. Proceedings of forestry microcomputer symposium; 1986 June 29-July 2; Morgantown, WV. Morgantown, WV: West Virginia University; 1986: 355-366.
- Araman, Philip A.; Reynolds, Hugh W. Computer programs for analyzing furniture rough part needs in standard-size blanks. In: Proceedings of the 2d annual computer symposium of the Forest Resources Systems Institute; 1985 April 22-24; Louisville, KY. Florence, AL: Forest Resources Systems Institute; 1985: 204-210.
- Arola, Rodger A. Communiting trees from thinnings into chunkwood--a new alternative. In: Paper for IUFRO interdivisional conference on thinning problems; 1985 September 9-15; USSR. Publ. 42/1985. Garpenberg, SW: Swedish University of Agricultural Sciences, Department of Operational Efficiency; 1985. 20 p.
- Baas, Pieter; Miller, Regis B. Functional and ecological wood anatomy: some introductory comments. IAWA Bulletin. 6(4): 281-282; 1985.
- Barnekov, V. G.; McMillin, C. W.; Huber, H. A. Factors influencing laser cutting of wood. Forest Products Journal. 36(1): 55-58; 1986.
- Barnett, Paul E.; Sirois, Donald L. Roll splitting as an alternative intermediate process for wood fuel. In: Energy Newsletter No. 4. Garpenberg, SW: Forest Energy Secretariat; 1985: 25-26.
- Barnett, Paul E.; Sirois, Donald L.; Ashmore, Colin. Reduction of biomass moisture by crushing/splitting--a concept. In: Rockwood, Donald L., ed. Proceedings, 1985 southern forest biomass workshop; 1985 June 11-14; Gainesville, FL. Gainesville, FL: Institute of Food and Agricultural Sciences, University of Florida; 1986: 13-16.
- Baumgras, John E. APTHIN: a microcomputer program to evaluate multiproduct utilization alternatives for thinnings in Appalachian hardwood stands. In: Proceedings of the forestry microcomputer software symposium; 1986 June 30-July 2; Morgantown, WV. Morgantown, WV: West Virginia University Press; 1986: 402-421.
- Beard, J. N.; Rosen, H. N.; Adesanya, B. A. Temperature distribution in lumber during impingement drying. Wood Science and Technology. 19: 277-286; 1985.
- Bendtsen, B. A.; Senft, John. Mechanical and anatomical properties in individual growth rings of plantation-grown eastern cottonwood and loblolly pine. Wood and Fiber Science. 18(1): 23-38; 1986.
- Boone, R. S.; Winandy, J. E.; Bendtsen B. A. A technique for simulating lumber drying using small clear specimens. Forest Products Journal. 35(11/12): 49-51; 1985.

- Boone, R. Sidney. Combining conventional and high-temperature kiln schedules for hardwoods. In: Proceedings, 28th annual joint meeting of Midwest Wood Seasoning Association and Wisconsin-Michigan Wood Seasoning Association; 1985 May 30; Red Wing, MN. Madison, WI: Midwest Wood Seasoning Association; 1985: 25-31.
- Boone, R. Sidney. High-temperature kiln-drying red maple lumber--some options. *Forest Products Journal*. 36(9): 19-25; 1986.
- Bowyer, Jim L.; Kallio, Edwin; Monson, Carl R.; Nicholls, David L. Standard blanks: a new alternative to hardwood lumber. *Forest Products Journal*. 36(2): 67-73; 1986.
- Briener, Tom A.; Arganbright, Donald G.; Pong, W. Y. Performance of in-line moisture meters. In: Proceedings: Western Dry Kiln Clubs; 1985 May 8-10; Vancouver, BC. Corvallis, OR: Western Dry Kiln Clubs; 1986: 1-17.
- Chambers, Paul C.; Sinclair, Steven A.; Hassler, Curt C.; Hansen, Bruce G. Forest products investment model: a microcomputer tool for incorporating risk into capital budgeting. *Forest Products Journal*. 36(1): 64-68; 1986.
- Chen, Peter Y. S.; Helton, Charles E. Design and tests of a solar kiln with a built-in heat storage unit and a collector cover-reflector. In: Alternative energy in the Midwest: research and applications: Conference proceedings, vol. 1; 1985 February 21-23; Schaumburg, IL. ENR/AE-85-04. [Springfield], IL: Illinois Department of Energy and Natural Resources; 1985: 4-3 - 4-10.
- Chow, P.; Janowiak, J. J.; Price, E. W. The internal bond and shear strength of hardwood veneered particleboard composites. *Wood and Fiber Science*. 18(1): 99-106; 1986.
- Clark, Alexander, III; Phillips, Douglas R.; Frederick, Douglas J. Weight, volume, and physical properties of major hardwood species in the Piedmont. Res. Pap. SE-255. Asheville, NC: U.S. Department of Agriculture, Forest Service, Southeastern Forest Experiment Station; 1986. 78 p.
- Clark, Alexander, III; Saucier, Joseph R.; McNab, W. Henry. Total-tree weight, stem weight, and volume tables for hardwood species in the Southeast. Ga. For. Res. Pap. 60. Macon, GA: Georgia Forestry Commission; 1986. 44 p.
- Clark, Alexander, III; Schroeder, James G. Weight, volume, and physical properties of major hardwood species in the southern Appalachian Mountains. Res. Pap. SE-253. Asheville, NC: U.S. Department of Agriculture, Forest Service, Southeastern Forest Experiment Station; 1986. 63 p.
- Cutter, Bruce E.; Phelps, John E. High-pressure steam drying: effects on permeability. *Forest Products Journal* [Technical Note]. 36(6): 19-20; 1986.
- Danielson, Jeanne; VonSegen, William; Donivan, Tim. Tighten up your mill with veneer improvement program. *Plywood & Panel World*. 27(3): 18-21; 1986.
- Eckelman, Carl A.; Cassens, Daniel L.; Rosen, Howard N. Evaluation of the gluability of pressure steam-dried wood. *Forest Products Journal*. 36(3): 61-66; 1986.
- Ernst, Susan; Plank, Marlin E.; Fahey, Donald J. Sitka spruce and western hemlock beach logs in southeast Alaska: suitability for lumber pulp and energy. Res. Pap. PNW-352. Portland, OR: U.S. Department of Agriculture, Forest Service, Pacific Northwest Forest and Range Experiment Station; 1986. 25 p.
- Fahey, T. D.; Max, Timothy A.; Sachet, Janet K. Ayer. Factors affecting grade change of ponderosa pine lumber in the desert Southwest. *Forest Products Journal*. 36(6): 36-40; 1986.
- Fahey, Thomas D.; Snellgrove, Thomas A.; Plank, Marlin E. Changes in product recovery between live and dead lodgepole pine: a compendium. Res. Pap. PNW-353. Portland, OR: U.S. Department of Agriculture, Forest Service, Pacific Northwest Forest and Range Experiment Station; 1986. 25 p.
- Fu, Y.; Hse, C. Y.; Price, E. W. Flaking techniques of structural flakeboard in North America. *Journal of Beijing Forestry College*. 2: 93-95; 1985.
- Gaby, Louis I. The southern pines: an American Wood. FS-256. Washington, DC: U.S. Department of Agriculture, Forest Service; 1985. 11 p.
- Gatchell, Charles; Hansen, Bruce G. Standard blanks: a good value-added opportunity; the economics of System 6. The Northern Logger and Timber Processor. 34(10): 26-31, 45; 1986.
- Gatchell, Charles J. Savings with rip-first option. *The Hardwood News*. 1986. March 17: 8.
- Gatchell, Charles J.; Olson, James R. Comparison of glue-line quality between gang edging and straight-line ripping. Res. Pap. NE-588. Broomall, PA: U.S. Department of Agriculture, Forest Service, Northeastern Forest Experiment Station; 1986. 7 p.
- Geimer, Robert L. Mechanical property ratios--a measure of flake alignment. Res. Pap. FPL-468. Madison, WI: U.S. Department of Agriculture, Forest Service, Forest Products Laboratory; 1986. 10 p.
- Geimer, Robert L. Properties of structural flakeboard manufactured from 7-year-old intensively cultured poplar, tamarack, and pine. *Forest Products Journal*. 36(4): 42-46; 1986.
- Geimer, Robert L.; Mahoney, Robert J.; Loehnertz, Stephen P.; Meyer, Robert W. Influence of processing-induced damage on strength of flakes and flakeboards. Res. Pap. FPL-463. Madison, WI: U.S. Department of Agriculture, Forest Service, Forest Products Laboratory; 1985. 15 p.

- Gibson, M. D.; McMillin, C. W.; Shoulders, E. Moisture content and specific gravity of the four major southern pines under the same age and site conditions. *Wood and Fiber Science*. 18(3): 428-435; 1986.
- Graham, Mark Alan. Process variables in the production of densified wood fuel with the addition of coal fines. St. Paul, MN: University of Minnesota, Department of Forest Products; 1985. 145 p. M.S. thesis.
- Hassler, Curt C.; Araman, Philip A.; Sinclair, Steven A.; Reynolds, Hugh W. A normative analysis of a System-6 mill. *Forest Products Journal*. 35(11/12): 43-48; 1985.
- Helmer, Wayne A.; Chen, Peter Y. S. Computer simulation of a new method to dry lumber using solar energy and absorption refrigeration. *Wood and Fiber Science*. 17(4): 464-476; 1985.
- Herzberg, Bruce L.; Taylor, Fred W.; Rosen, Howard N. Factors that affect the time required to high-temperature dry pine dimension lumber. *Forest Products Journal*. 35(7/8): 34-36; 1985.
- Hoover, W. L.; Hunt, M. O.; Lattanzi, R. C.; Maloney, T. M.; Youngquist, J. A. Implications of a design approach for mixed hardwood structural flakeboard. In: Maloney, Thomas M., ed. *Proceedings, 19th Washington State University international particleboard/composite materials symposium*; 1985 March 26-28; Pullman, WA. Pullman, WA: Washington State University; 1986: 381-404.
- Howard, James O.; Bulgrin, Julianne K. Estimators and characteristics of logging residue in California. Res. Pap. PNW-355. Portland, OR: U.S. Department of Agriculture, Forest Service, Pacific Northwest Forest and Range Experiment Station; 1986. 81 p.
- Hse, Chung Yun. Effect of resin types and formulation in internal bond strength and dimensional stability of hardwood flakeboard. In: Gillespie, R. H., ed. *Adhesives for wood--research, applications, and needs*. Park Ridge, NJ: Noyes Publications; 1984: 40-49.
- Huber, H. A.; McMillin, C. W.; McKinney, J. P. Lumber defect detection abilities of furniture rough mill employees. *Forest Products Journal*. 35(11/12): 79-82; 1985.
- Hunt, M. O.; Hoover, W. L.; Lattanzi, R. C.; Youngquist, J. A. A design approach for mixed hardwood structural flakeboard. In: Robertson, Doris, coord. *Structural wood composites: meeting today's needs and tomorrow's challenges*; 1984 November 12-14; Minneapolis, MN. Proc. 7339. Madison, WI: Forest Products Research Society; 1985: 164-172.
- James, W. L. Electrical properties of wood. In: Bever, Michael B., ed. *Encyclopedia of materials science and engineering*. Oxford, UK: Pergamon Press; 1986: 1395-1399.
- James, William L. Effect of transverse moisture content gradients on the longitudinal propagation of sound in wood. Res. Pap. FPL-466. Madison, WI: U.S. Department of Agriculture, Forest Service, Forest Products Laboratory; 1986. 8 p.
- James, William L. The interaction of electrode design and moisture gradients in dielectric measurements on wood. *Wood and Fiber Science*. 18(2): 264-275; 1986.
- Johns, William E.; Rammon, Richard M.; Youngquist, John. Chemical effects of mixed hardwood furnish on panel properties. In: Maloney, Thomas M., ed. *Proceedings, 19th Washington State University international particleboard/composite materials symposium*; 1985 March 26-28; Pullman, WA. Pullman, WA: Washington State University; 1986: 363-377.
- Johnson, Robert L. Sweetgum: an American wood. FS-266. Washington, DC: U.S. Department of Agriculture, Forest Service; 1985. 6 p.
- Johnston, William F.; Carpenter, Eugene M. Tamarack: an American wood. FS-268. [Washington, DC]: U.S. Department of Agriculture, Forest Service; 1985. 7 p.
- Jones, John R.; DeByle, Norbert V.; Winokur, Robert P. Wood resource. In: DeByle, Norbert V.; Winokur, Robert P., eds. *Aspen: Ecology and management in the Western United States*. Gen. Tech. Rep. RM-119. Fort Collins, CO: U.S. Department of Agriculture, Forest Service, Rocky Mountain Forest and Range Experiment Station; 1985: 161-167.
- Kallio, Edwin. Existing and future products from hardwood thinnings. In: Sturos, John A., comp. *Hardwood thinning opportunities in the Lake States: Proceedings of a symposium*; 1984 April 20; Escanaba, MI. Gen. Tech. Rep. NC-113. St. Paul, MN: U.S. Department of Agriculture, Forest Service, North Central Forest Experiment Station; 1986: 108-113.
- Keegan, Charles E., III; Jackson, Timothy P. Value of wood to competing users: energy versus product uses in the Inland Empire. *Forest Products Journal*. 36(4): 53-56; 1986.
- Kennedy, Harvey, E., Jr. Cottonwood (*Populus deltoides* Bartr. ex Marsh. and *P. trichocarpa* Torr. & Gray): an American wood leaflet. FS-231. Washington, DC: U.S. Department of Agriculture, Forest Service; 1985. 8 p.
- Kent, Albert C.; Rosen, Howard N.; Higginbotham, James L.; Girod, George. An aspirated humidity and energy meter for high temperature moist air. In: *Moisture and humidity, 1985 measurement and control in science and industry: Proceedings, 1985 international symposium on moisture and humidity*; 1985 April 15-18; Washington, DC. Research Triangle Park, NC: Instrument Society of America; 1985: 989-995.
- Koch, Peter. Utilizing lodgepole pine forests of the 21st century: a research program. In: Nielson, R. W., ed. *Harvesting and processing of beetle-killed timber: Proceedings*; 1985 May 10; Prince George, BC. Spec. Publ. SP 26. Vancouver, BC: Forintek Canada Corporation, Western Region; 1986: 48-53.
- Krinard, Roger M. Black willow: an American wood. FS-271. Washington, DC: U.S. Department of Agriculture, Forest Service; 1985. 6 p.

- Labosky, Peter, Jr. Using the dead tree resource. In: Proceedings: forest management decisions based on future forest product requirements; 1985 March 19-20; University Park, PA. University Park, PA: The Pennsylvania State University; 1985: 106-116.
- Larson, Timothy D.; Erickson, Robert W.; Boone, R. Sidney. Comparison of drying methods for paper birch SDR flitches and studs. Res. Pap. FPL-465. Madison, WI: U.S. Department of Agriculture, Forest Service, Forest Products Laboratory; 1986. 13 p.
- Laufenberg, Theodore L. Optimization of composite wood structural components: processing and design choices. In: Maloney, Thomas M., ed. Proceedings, 19th Washington State University international particleboard/composite materials symposium; 1985 March 26-28; Pullman, WA. Pullman, WA: Washington State University; 1986: 77-94.
- Laufenberg, Theodore L. Using gamma radiation to measure density gradients in reconstituted wood products. Forest Products Journal. 36(2): 59-62; 1986.
- Layton, T. F.; Smith, W. R.; Maeglin, R. R. An evaluation of the saw, dry and rip process to convert red alder into studs. Wood Science and Technology. 20(2): 185-200; 1986.
- Lewis, David W. Best opening face system for sweepy, eccentric logs--a user's guide. Gen. Tech. Rep. FPL-49. Madison, WI: U.S. Department of Agriculture, Forest Service, Forest Products Laboratory; 1985. 13 p.
- Lewis, David W. Sawmill simulation and the best opening face system--a user's guide. Gen. Tech. Rep. FPL-48. Madison, WI: U.S. Department of Agriculture, Forest Service, Forest Products Laboratory; 1985. 29 p.
- Loehnertz, Stephen P.; Zhu, Huanming. Use of veneer in structural flakeboards. Scientia Silvae Sinicae. 21(4): 441-443; 1985.
- Maeglin, R. R. Timbers of Canada and the USA. In: Bever, Michael B., ed. Encyclopedia of materials science and engineering. Elmsford, NY: Pergamon Press, Inc.; 1986: 5020-5025.
- Martens, David G. Increasing rough-mill efficiency. Wood and Wood Products. 91(9): 62-68; 1986.
- Martens, David G.; Whitenack, Kenneth R.; Nevel, Robert L., Jr. Optigrami users manual. Gen. Tech. Rep. NE-109. Broomall, PA: U.S. Department of Agriculture, Forest Service, Northeastern Forest Experiment Station; 1986. 11 p.
- Mattson, James A.; Arola, Rodger A.; Karsky, Richard. Developments in wood chunking technology. In: Robertson, Doris, proc. coord. Communion of wood and bark; 1984 October 1-3; Chicago, IL. Proc. 7336. Madison, WI: Forest Products Research Society; 1985: 169-180.
- Max, Timothy A.; Cahill, James M.; Snellgrove, Thomas A. Validation of a butt log volume estimator for Douglas-fir. Forest Science. 31(3): 643-646; 1985.
- McAlister, Robert H. Species and core joint design affect tensile strength and stiffness of composite truss lumber. Forest Products Journal. 36(2): 55-58; 1986.
- McMinn, James W. Transpirational drying of Piedmont hardwoods. Ga. For. Res. Pap. 63. Macon, GA: Georgia Forestry Commission; 1986. 7 p.
- McMinn, James W. Transpirational drying of red oaks, sweetgum, and yellow-poplar in the upper Piedmont of Georgia. Forest Products Journal. 36(3): 25-27; 1986.
- McMinn, James W.; Stubbs, Jack. In-woods drying of eucalypts in southern Florida. Forest Products Journal. 35(11/12): 65-67; 1985.
- McNab, W. Henry; Outcalt, Kenneth W.; Brendemuehl, Raymond H. Weight and volume of plantation-grown Choctawhatchee sand pine. Res. Pap. SE-252. Asheville, NC: U.S. Department of Agriculture, Forest Service, Southeastern Forest Experiment Station; 1985. 44 p.
- Megalos, M. A.; Frederick, D. J.; Clark, A., III; Phillips, D. R. Biomass, nutrient and energy content of southern Piedmont hardwood forests. Hardwood Res. Coop. Ser. 5. Raleigh, NC: North Carolina State University, School of Forest Resources; 1986. 34 p.
- Miller, Gary W.; Hanks, Leland F.; Wiant, Harry V., Jr. A key for the Forest Service hardwood tree grades. Northern Journal of Applied Forestry. 3(1): 19-22; 1986.
- Miller, R. B. Timbers of Central and South America. In: Bever, Michael B., ed. Encyclopedia of materials science and engineering, vol. 7. Cambridge, MA: The MIT Press and Oxford, EN: Pergamon Press; 1986: 5025-5031.
- Murmanis, Lidija; Myers, Gary C.; Youngquist, John A. Fluorescence microscopy of hardboards. Wood and Fiber Science. 18(2): 212-219; 1986.
- Murmanis, Lidija; River, Bryan H.; Stewart, Harold A. Surface and subsurface characteristics related to abrasive-planing conditions. Wood and Fiber Science. 18(1): 107-117; 1986.
- Murmanis, Lidija; Youngquist, John A.; Myers, Gary C. Electron microscopy study of hardboards. Wood and Fiber Science. 18(3): 369-375; 1986.
- Myers, Gary C. A comparison of hardboards manufactured by semidry-, dry-, and wet-formed processes. Forest Products Journal. 36(7/8): 49-56; 1986.
- Myers, John R.; Miller, Gary W.; Wiant, Harry W., Jr.; Barnard, Joseph E. Butt log grade distribution for five Appalachian hardwood species. Res. Pap. NE-590. Broomall, PA: U.S. Department of Agriculture, Forest Service, Northeastern Forest Experiment Station; 1986. 4 p.

- Plank, Marlin E.; Snellgrove, Thomas A.; Fahey, Thomas D. Volume and value recovery from live and dead lodgepole pine. In: Harvesting and processing of beetle-killed timber; 1985 May 10; Prince George, BC. Spec. Publ. SP-26. Vancouver, BC: Forintek Canada Corp. and COFI, Northern Interior Lumber Sector; 1986: 27-30.
- Pong, W. Y.; Waddell, Dale R.; Lambert, Michael B. Wood density-moisture profiles in old-growth Douglas-fir and western hemlock. Res. Pap. PNW-347. Portland, OR: U.S. Department of Agriculture, Forest Service, Pacific Northwest Forest and Range Experiment Station; 1986. 30 p.
- Perala, Donald A.; Carpenter, Eugene M. Aspen: an American wood. FS-217. [Washington, DC]: U.S. Department of Agriculture, Forest Service; 1985. 8 p.
- Phelps, J. E.; Isebrands, J. G.; Einspahr, D. W.; Crist, J. B.; Sturos, J. A. Wood and paper properties of vacuum airlift segregated juvenile poplar whole-tree chips. Wood and Fiber Science. 17(4): 529-539; 1985.
- Price, E. Flake characteristics and structural wood properties related to flake types and wood species. In: Comminution of wood and bark; 1985 October 1-3; Chicago. Madison, WI: Forest Products Research Society; 1985: 74-84.
- Price, E. W. New hardwood products--a status report. In: Third symposium on southeastern hardwoods; 1985 April 16-17; Dothan, AL. Atlanta, GA: U.S. Department of Agriculture, Forest Service, Southern Region; 1986: 90-93.
- Reynolds, Hugh W. System 6: chips versus blanks program. Gen. Tech. Rep. NE-106. Broomall, PA: U.S. Department of Agriculture, Forest Service, Northeastern Forest Experiment Station; 1985. 12 p.
- Reynolds, Hugh W.; Araman, Philip A. Program BLANKS on the IBM-PC. Gen. Tech. Rep. NE-107. Broomall, PA: U.S. Department of Agriculture, Forest Service, Northeastern Forest Experiment Station; 1986. 28 p.
- Reynolds, Hugh W.; Hansen, Bruce G. Making black cherry blanks from System 6. Res. Pap. NE-574. Broomall, PA: U.S. Department of Agriculture, Forest Service, Northeastern Forest Experiment Station; 1986. 10 p.
- Reynolds, Hugh W.; Hansen, Bruce G. System 6: A pricing strategy for long blanks. Res. Pap. NE-573. Broomall, PA: U.S. Department of Agriculture, Forest Service, Northeastern Forest Experiment Station; 1986. 14 p.
- Reynolds, Hugh W.; Kallio, Edwin. Application of the System 6 process to hardwood thinnings. In: Sturos, John A., comp. Hardwood thinning opportunities in the Lake States: Proceedings of a symposium; 1984 April 20; Escanaba, MI. Gen. Tech. Rep. NC-113. St. Paul, MN: U.S. Department of Agriculture, Forest Service, North Central Forest Experiment Station; 1986: 114-119.
- Rice, William W. System 6 update: a way to maximize the value of all low grade hardwoods. The Northern Logger and Timber Processor. 34(9): 20-21; 1986.
- Rink, George. Black walnut: an American wood. FS-270. [Washington, DC]: U.S. Department of Agriculture, Forest Service; 1985. 7 p.
- Rosen, Howard N.; Martin, Darrell S. How to use hand-held computers to evaluate wood drying. Res. Pap. NC-263. St. Paul, MN: U.S. Department of Agriculture, Forest Service, North Central Forest Experiment Station; 1985. 17 p.
- Rowell, R. M.; Tillman, A.-M.; Zhengtian, Liu. Dimensional stabilization of flakeboard by chemical modification. Wood Science and Technology. 20: 83-95; 1986.
- Rowell, Roger M. Property enhancement of particleboards made from chemically modified chips. In: Lawniczak, M., ed. Wood modification; 1985 March; Posnan, PO. Posnan, PO: Polish Academy of Science; 1985: 358-366.
- Rowell, Roger M.; Banks, W. Bart. Water repellency and dimensional stability of wood. Gen. Tech. Rep. FPL-50. Madison, WI: U.S. Department of Agriculture, Forest Service, Forest Products Laboratory; 1985. 24 p.
- Rowell, Roger M.; Simonson, Rune; Tillman, Anne-Marie. Dimensional stability of particleboard made from vapor phase acetylated pine wood chips. Nordic Pulp and Paper Research Journal. 2: 11-17; 1986.
- Rowlands, R. E.; Van Deweghe, R. P.; Laufenberg, T. L.; Krueger, G. P. Fiber-reinforced wood composites. Wood and Fiber Science. 18(1): 39-57; 1986.
- Sampson, George R.; Ernst, Susan A.; Ruppert, Forrest A. Lumber recovery of live and fire-killed white spruce. In: Early results of the Rosie Creek Fire research project, 1984. Misc. Publ. 85-2. Fairbanks, AK: University of Alaska, School of Agriculture and Land Resources Management and Agriculture and Forest Experiment Station; 1985: 17-20.
- Sander, Ivan L.; Rosen, Howard N. Oak: an American wood. FS-247. [Washington, DC]: U.S. Department of Agriculture, Forest Service; 1985. 11 p.
- Saucier, Joseph R.; Clark, Alexander, III. Tables for estimating total tree and product weight and volume of major southern tree species and species groups. 85-A-11. Washington, DC: American Pulpwood Association, Inc., Southwide Energy Committee; 1985. 59 p.
- Schlieter, Joyce A. Estimation of diameter at breast height from stump diameter for lodgepole pine. Res. Note INT-359. Ogden, UT: U.S. Department of Agriculture, Forest Service, Intermountain Forest and Range Experiment Station; 1986. 4 p.
- Schroeder, James G.; Taras, Michael A. Atlantic white-cedar: an American wood. FS-225. Washington, DC: U.S. Department of Agriculture, Forest Service; 1985. 5 p.

- Senft, John F.; Bendtsen, B. Alan. Measuring microfibrillar angles using light microscopy. *Wood and Fiber Science*. 17(4): 564-567; 1985.
- Steinhagen, H. Peter; Thomas, Richard L.; Rosen, Howard N. Kiln drying of 4/4 red oak and yellow-poplar lumber: capital and energy cost estimates for various drying systems. In: *Proceedings, Western Dry Kiln Clubs*; 1985 May 8-10; [Vancouver, BC]. Corvallis, OR: Oregon State University, School of Forestry; 1986: 42-48.
- Stewart, Harold A. A turning method for monitoring tool wear when machining reconstituted wood products. *Forest Products Journal* [Technical Note]. 35(11/12): 41-42; 1985.
- Stewart, Harold A. Fixed knife-pressure bar system for surfacing dry wood. *Forest Products Journal*. 36(6): 52-56; 1986.
- Stewart, Harold A.; Polak, David J. Relating specific gravity and mechanical properties of hardwoods to machining defects. *Forest Products Journal*. 35(10): 69-72; 1985.
- Stewart, Harold A.; Shatynski, Stephen K.; Harbison, Barry; Rabin, Barry. High-temperature corrosion of tungsten carbide tools from cutting medium-density fiberboard. *Carbide & Tool Journal*. 18(1): 2-7; 1986.
- Sturos, Joseph B. Characterization and air drying of chunkwood and chips. Res. Note NC-308. St. Paul, MN: U.S. Department of Agriculture, Forest Service, North Central Forest Experiment Station; 1984. 6 p.
- Suchsland, O.; Woodson, G. E.; McMillin, C. W. Pressing of three-layer, dry-formed MDF with binderless hardboard faces. *Forest Products Journal*. 36(1): 33-36; 1986.
- Suchsland, Otto; McNatt, J. D. On the warping of laminated wood panels. East Lansing, MI: Michigan State University; 1985. 120 p.
- Tillman, Anne-Marie; Simonson, Rune; Rowell, Roger M. Dimensional stability and biological resistance of particleboard made from acetylated pine wood chips. In: *Lawniczak, M., ed. Wood modification*; 1985 March; Posnan, PO. Posnan, PO: Polish Academy of Science; 1985: 436-446.
- Trofatter, Glenn; Harris, Robert A.; Schroeder, James; Taras, Michael A. Comparison of moisture content variation in red oak lumber dried by a radio-frequency/vacuum process and a conventional kiln. *Forest Products Journal*. 36(5): 25-28; 1986.
- Tschernitz, J. L. Solar energy for wood drying using direct or indirect collection with supplemental heating--a computer analysis. Res. Pap. FPL-477. Madison, WI: U.S. Department of Agriculture, Forest Service, Forest Products Laboratory; 1986. 81 p.
- Vick, C. B. Adhesives in building. In: *Bever, Michael B., ed. Encyclopedia of materials science and engineering*. Oxford, UK: Pergamon Press; 1986: 78-82.
- Vick, Charles B. Lamination of composite framing with melamine-formaldehyde adhesive and radio-frequency curing. Res. Pap. SE-254. Asheville, NC: U.S. Department of Agriculture, Forest Service, Southeastern Forest Experiment Station; 1986. 9 p.
- Vick, Charles B. Yellow-poplar: an American wood. FS-272. Washington, DC: U.S. Department of Agriculture, Forest Service; 1985. 7 p.
- Ward, James C. The effect of wetwood on lumber drying times and rates: an exploratory evaluation with longitudinal gas permeability. *Wood and Fiber Science*. 18(2): 288-307; 1986.
- Ward, James C.; James, William L.; Kozlik, Charles J. Preliminary evaluation of electronic measurements for presorting hem-fir dimension lumber. In: *Proceedings, Western Dry Kiln Clubs*; 1985 May-10; Corvallis, OR. Corvallis, OR: Western Dry Kiln Clubs; 1985: 97-98.
- Wengert, Eugene M.; Donnelly, Dennis M.; Markstrom, Donald C.; Worth, Harold E. Wood utilization. In: *DeByle, Norbert V.; Winokur, Robert P., eds. Aspen: ecology and management in the Western United States*. Gen. Tech. Rep. RM-119. Fort Collins, CO: U.S. Department of Agriculture, Forest Service, Rocky Mountain Forest and Range Experiment Station; 1986: 169-180.
- Winandy, Jerrold E.; River, Bryan H. Evaluation of a method for testing adhesive-preservative compatibility. *Forest Products Journal*. 36(1): 27-32; 1986.
- Worzala, F. J. Potential applications of low expansivity alloys for the machining of wood. In: *Proceedings, 8th wood machining seminar*; 1985 October 7-9; Berkeley, CA. Richmond, CA: University of California; 1985: 245-257.
- Yaussey, Daniel A. Green lumber grade yields from factory grade logs of three oak species. *Forest Products Journal*. 36(5): 53-56; 1986.
- Youngquist, John A.; Krzysik, Andrzej; Rowell, Roger M. Dimensional stability of acetylated aspen flakeboard. *Wood and Fiber Science*. 18(1): 90-98; 1986.

Protection of Wood in Use

- Cassens, Daniel L.; Feist, William C. Durability of exterior wood finishes depends on proper selection and application. *Workbench Magazine*. 42(2): 84-89; 1986.
- Cassens, Daniel L.; Feist, William C. Finishing wood exteriors--selection, application, and maintenance. *Agric. Handb. 647*. Washington, DC: U.S. Department of Agriculture; 1986. 56 p.

- Chen, George C.; Rowell, Roger M. Approaches to the improvement of biological resistance of wood through controlled release technology. In: The 13th international symposium of controlled release of bioactive materials; August 3-5, 1986; Norfolk, VA. Norfolk, VA: The Controlled Release Society, Inc.; 1986: 75-76.
- De Groot, Rodney C. Durability of utility poles in Panama. Res. Pap. FPL-478. Madison, WI: U.S. Department of Agriculture, Forest Service, Forest Products Laboratory; 1986. 12 p.
- De Groot, Rodney C.; Kuster, Thomas A. SEM x-ray microanalysis of tracheid cell walls in southern yellow pine sapwood treated with water-dispersible pentachlorophenol. Wood and Fiber Science. 18(1): 58-67; 1986.
- De Groot, Rodney C.; Lauret, Thomas H. Durability of preservative-treated wood utility poles in Guam. Res. Pap. FPL-472. Madison, WI: U.S. Department of Agriculture, Forest Service, Forest Products Laboratory; 1986. 17 p.
- Feist, W. C. Protective finishes and coatings for wood. In: Bever, Michael B., ed. Encyclopedia of materials science and engineering. Oxford, UK: Pergamon Press; 1986: 3981-3982.
- Feist, William C. Painting and finishing wood for use outdoors (part 1). American Paint & Coatings Journal. 70(8): 44-56; 1985.
- Feist, William C. Painting and finishing wood for use outdoors (part 2). American Paint & Coatings Journal. 70(9): 40-48; 1985.
- Feist, William C.; Little, James K.; Wennesheimer, Jill M. The moisture-excluding effectiveness of finishes on wood surfaces. Res. Pap. FPL-462. Madison, WI: U.S. Department of Agriculture, Forest Service, Forest Products Laboratory; 1985. 38 p.
- Feist, William C.; Little, James K.; Wennesheimer, Jill M. The moisture-excluding effectiveness of finishes on wood surfaces--support data. Madison, WI: U.S. Department of Agriculture, Forest Service, Forest Products Laboratory; 1985. 58 p.
- Fish, P. L.; Johnson, B. R.; Kerr, C. N.; McNamara, W. C.; Webb, D. A. Report of the T3 task force on service life of CCA-treated marine piling. Stevensville, MD: American Wood-Preservers' Association; 1985. 2 p.
- Gibson, David G.; Krahmer, Robert L.; DeGroot, Rodney C. Early detection of brown rot decay in Douglas-fir and southern yellow pine by infrared spectrophotometry. Wood and Fiber Science. 17(4): 522-528; 1985.
- Gjovik, L. R.; Gutzmer, D. I. Comparison of wood preservatives in stake tests (1985 progress report). Res. Note FPL-02. Madison, WI: U.S. Department of Agriculture, Forest Service, Forest Products Laboratory; 1985. 100 p.
- Hon, D. N.-S.; Feist, W. C. Weathering characteristics of hardwood surfaces. Wood Science and Technology. 20(2): 169-183; 1986.
- Hon, David N.-S.; Chang, Shang-Tzen; Feist, William C. Protection of wood surfaces against photooxidation. Journal of Applied Polymer Science. 30(4): 1429-1448; 1985.
- Johnson, Bruce R. Sensitivity of some wood stain and mold fungi to an inhibitor of chitin synthesis. Forest Products Journal. 36(3): 54-56; 1986.
- Kalnins, Martins A.; Erickson, Eric H. Extending the life of beehives with and without preservatives. American Bee Journal. 126(7): 488-491; 1986.
- Laufenberg, Theodore; LeVan, Susan; Bruci, Vladimir. Preliminary investigation of fire-retardant treatments for flakeboards. Drvna Ind. 36(3-4): 65-70; 1986.
- LeVan, Susan, L.; Holmes, Carlton A. Effectiveness of fire-retardant treatments for shingles after 10 years of outdoor weathering. Res. Pap. FPL-474. Madison, WI: U.S. Department of Agriculture, Forest Service, Forest Products Laboratory; 1986. 15 p.
- LeVan, Susan L.; White, Robert H. Performance of fire retardants and fire-resistive coatings on wood. In: Flame retardant coatings: problems and opportunities; 1985 October 27-30; Pinehurst, NC. Lancaster, PA: Fire Retardant Chemicals Association; 1985: 1-28.
- Pellerin, Roy F.; De Groot, Rodney C.; Esenther, Glenn R. Non-destructive stress wave measurement of decay and termite attack in experimental wood units. In: The international research group on wood preservation; 1986 May; Avignon, FR. Doc. IRG/WP/2256. Stockholm, SW: IRG Secretariat; 1986: 1-31.
- Sell, J.; Gjovik, L. R. Pressure treatment of microincised spruce with ammoniacal copper arsenate (ACA) and chromated copper arsenate (CCA). Holz als Roh- und Werkstoff. 43: 482; 1985.
- Sell, Jurgen; Feist, William C. Role of density in the erosion of wood during weathering. Forest Products Journal. 36(3): 57-60; 1986.
- Sell, Jurgen; Feist, William C. U.S. and European finishes for weather-exposed wood--a comparison. Forest Products Journal. 36(4): 37-41; 1986.
- Sell, Jurgen; Feist, William C. Verwitterung von CKB-getranktem Holz bei kunstlicher Wetterbeanspruchung. Holz als Roh- und Werkstoff. 43: 518; 1985.
- Vick, C. B.; Baechler, R. H. Hardwood and pine fenceposts treated by the double-diffusion method--final report. Forest Products Journal. 36(4): 20-24; 1986.
- White, Robert H. An empirical model for predicting performance of fire-resistive coatings in wood construction. Journal of Testing and Evaluation, JTEVA. 14(2): 97-108; 1986.

White, Robert H. Design of fire-resistive coated wood members. In: Spinna, Robert J., Jr., ed. Retrofitting, maintenance and management for fire safety--the role of engineering, education, and enforcement; 1985 June 3; Riverdale, NY. Riverdale, NY: Manhattan College of Fire Engineering Institute; 1985: 107-125.

Williams, R. Sam. Effects of acid rain on painted wood surfaces: importance of the substrate. In: Baboian, Robert, ed. Materials degradation caused by acid rain; 1985 June 17-19; Arlington, VA. ACS Sympos. Ser. 318. Washington, DC: American Chemical Society; 1986: 310-331.

Williams, R. Sam; Spence, John W. Dilute acids and the photochemical degradation of wood and painted wood. In: Materials effects task group 7, peer review summaries; 1986 April; Durham, NC. Durham, NC: North Carolina State University; 1986: 131-138.

Zhongwei, J.; Hse, Chung-Yun. An overview of the wood preservative industry in the United States. Journal Nanjing Institute of Forestry. 2: 93-108; 1985.

General

- Allison, C. W.; Hilgert, J. W. Scale microfossils from the early Cambrian of northwest Canada. *Journal of Paleontology*. 60(5): 973-1015; 1986.
- Arganbright, Donald G.; Koeppen, Robert C. The 1985 USDA Competitive Grants Program in improved utilization of wood and wood fiber: background and results. *Forest Products Journal*. 36(1): 9-12; 1986.
- Bare, B. Bruce; Loveless, Robert. An overview of the regional forest nutrition research project. In: Risbrudt, Christopher D.; Jakes, Pamela J., comps. *Forestry research evaluation: current progress, future directions: Proceedings, forestry research evaluation workshop*; 1984 August 20-21; St. Paul, MN. Gen. Tech. Rep. NC-104. St. Paul, MN: U.S. Department of Agriculture, Forest Service, North Central Forest Experiment Station; 1985: 52-61.
- Batzner, Harold O.; Skilling, Darroll D., comps. *World directory of forest pathologists and entomologists*. St. Paul, MN: U.S. Department of Agriculture, Forest Service, North Central Forest Experiment Station; 1985. 269 p.
- Bengston, David Neil. Research capacity in developing countries: an evaluation of public forestry research institutions. Minneapolis, MN: University of Minnesota; 1986. 205 p. Ph.D. dissertation.
- Fey, Willard R.; Robinson, Vernon L. Interrelationships among the biological, financial, and silvicultural decisions in forestry. In: *Economics of silvicultural investments: Proceedings of the national silviculture workshop*; 1983 May 16-20; Eugene, OR. Washington, DC: U.S. Department of Agriculture; 1983: 86-105.
- Fieber, William; Robson, Thomas. Jennie Springs . . . horse logging as a new enterprise. Infor. Rep. San Francisco, CA: U.S. Department of Agriculture, Forest Service, Pacific Southwest Forest and Range Experiment Station; 1985. 20 p.
- Franklin, Albert L.; Barker, Philip A. An intermittent mist system pressurized by continuous pumping. In: *Combined proceedings, International Plant Propagators' Society*, vol. 35, 1985; 1985 September 21-28; Bellevue, WA. Seattle, WA: International Plant Propagators' Society, University of Washington; 1986: 222-228.
- Golbeck, Amanda L. Evaluating statistical validity of research reports: a guide for managers, planners, and researchers. Gen. Tech. Rep. PSW-87. Berkeley, CA: U.S. Department of Agriculture, Forest Service, Pacific Southwest Forest and Range Experiment Station; 1986. 22 p.
- Greene, Sarah E.; Frenkel, Robert E.; Wellner, Charles A. Pacific Northwest Natural Area program: a successful partnership. *Natural Areas Journal*. 5(4): 14-23; 1985.
- Gregersen, Hans. The University of Minnesota forestry research evaluation program. In: Risbrudt, Christopher D.; Jakes, Pamela J., comps. *Forestry research evaluation: current progress, future directions: Proceedings, forestry research evaluation workshop*; 1984 August 20-21; St. Paul, MN. Gen. Tech. Rep. NC-104. St. Paul, MN: U.S. Department of Agriculture, Forest Service, North Central Forest Experiment Station; 1985: 31-33.
- Hahn, O. J.; Richardson, M. K.; Birkebak, R. C.; Curtis, W. R. Performance analysis of HVAC system fueled by solar energy or a combination of solar, wood or natural gas. In: Farukhi, Nayeem M., ed. *Heat transfer-Denver 1985*: 23d national heat transfer conference; 1985 August 4-7; Denver. New York: American Institute of Chemical Engineers; 1985: 183-189.
- Hoekstra, Thomas W.; Hof, John G. National assessments of wildlife and fish: a technical framework. Gen. Tech. Rep. RM-122. Fort Collins, CO: U.S. Department of Agriculture, Forest Service, Rocky Mountain Forest and Range Experiment Station; 1985. 6 p.
- Ingram, C. Denise; Laarman, Jan G.; Contezac, Michel C. The international clientele served by the Forest Products Laboratory. SCFER Work. Pap. 18. Research Triangle Park, NC: Southeastern Center for Forest Economics Research; 1986. 18 p.
- Institute of Tropical Forestry. Training manual for forestry technicians in the Caribbean. Rio Piedras, PR: U.S. Department of Agriculture, Forest Service, Southern Forest Experiment Station, Institute of Tropical Forestry; 1985. 400 p.
- Jakes, Pamela J.; Fege, Anne S. Co-authorship patterns of U.S. Department of Agriculture, Forest Service research scientists at two regional experiment stations, 1981-1984. In: Burns, Denver P., comp. *IUFRO proceedings, evaluation and planning of forestry research*. S6. 06-S6. 06. 01; 1985 July 25-26; Fort Collins, CO. Gen. Tech. Rep. NE-111. Broomall, PA: U.S. Department of Agriculture, Forest Service, Northeastern Forest Experiment Station; 1986: 103-106.
- Klopsch, M. W.; Stafford, S. G. The status and promise of intersite computer communication. In: Michener, William K., ed. *Research data management in the ecological sciences*. Marine Sci. 16. Columbia, SC: University of South Carolina Press; 1986: 115-123.
- Krugman, S.; Creighton, J. W. Emerging innovations: considerations for implementation. In: Creighton, J. W.; Jolly, J. A.; Haner, Stephen, eds. *Proceedings, technology transfer: a think tank approach to managing innovation in the public sector*; [Date of meeting unknown]; San Luis Obispo, CA. Monterey, CA: Naval Postgraduate School; 1985: 55-61.

- Laarman, Jan G. A perspective on private enterprise and development aid for forestry. SCFER Work. Pap. 16. Research Triangle Park, NC: Southeastern Center for Forest Economics Research; 1986. 13 p.
- Laarman, Jan G.; Muench, John, Jr. The Caribbean Basin initiative: what does it mean for forestry?. SCFER Work. Pap. 20. Research Triangle Park, NC: Southeastern Center for Forest Economics Research; 1986. 21 p.
- Lotan, Jim. Idaho horse logging short course, 1985. *Small Farmer's Journal*. 10(1): 56-58; 1986.
- Lundgren, Allen L. The future direction of forestry research evaluation efforts. In: Risbrudt, Christopher D.; Jakes, Pamela J., comps. Forestry research evaluation: current progress, future directions: Proceedings, forestry research evaluation workshop; 1984 August 20-21; St. Paul, MN. Gen. Tech. Rep. NC-104. St. Paul, MN: U.S. Department of Agriculture, Forest Service, North Central Forest Experiment Station; 1985: 121-123.
- Miranda, Marie Lynn. Forest management in the Third World. SCFER Work. Pap. 27. Research Triangle Park, NC: Center for Forest Economics Research; 1985. 50 p.
- Mitchell, John E.; Pickens, James B. An evaluation of procedures used to predict timber growth and harvest in the range and multiple resource interactions section of the 1989 RPA Assessment. Gen. Tech. Rep. RM-124. Fort Collins, CO: U.S. Department of Agriculture, Forest Service, Rocky Mountain Forest and Range Experiment Station; 1986. 10 p.
- Muth, R. M.; Lee, R. G. Social impact assessment in natural resource decision making: toward a structural par. *Impact Assessment Bulletin*. 4: 3-4; 1986.
- Nelson, Norman S. The AC approach to liquid spill cleanup. *Journal of Chemical Education*. 63(7): A167-A169; 1986.
- Palmer, Rexford; Corbin, Beth Lowe; Woodward, Roy; Barbour, Michael. Floristic checklist for the headwaters basin area of the north fork of the American River, Placer County, California. *Madrono*. 30(4): 52-66; 1983.
- Risbrudt, Chris. A review of current forestry studies. In: Risbrudt, Christopher D.; Jakes, Pamela J., comps. Forestry research evaluation: current progress, future directions: Proceedings, forestry research evaluation workshop; 1984 August 20-21; St. Paul, MN. Gen. Tech. Rep. NC-104. St. Paul, MN: U.S. Department of Agriculture, Forest Service, North Central Forest Experiment Station; 1985: 29-30.
- Risbrudt, Christopher D.; Jakes, Pamela J., comps. Forestry research evaluation: current progress, future directions: Proceedings, forestry research evaluation workshop; 1984 August 20-21; St. Paul, MN. Gen. Tech. Rep. NC-104. St. Paul, MN: U.S. Department of Agriculture, Forest Service, North Central Forest Experiment Station; 1985. 140 p.
- Roberson, J. L. Reporting requirements for statistical analysis. In: Publications policies and guide for authors of the Entomological Society of America. College Park, MD: The Entomology Society of America; 1985. 22 p.
- Stafford, S. G.; Alaback, P. B.; Waddell, K. L.; Slagle, R. L. Data management procedures in ecological research. In: Michener, William K., ed. Research data management in the ecological sciences. *Marine Sci.* 16. Columbia, SC: University of South Carolina Press; 1986: 93-113.
- Stafford, S. G.; Klopsch, M. W.; Waddell, K. L.; [and others]. Optimizing the computational environment environment for ecological research. In: Michener, William K., ed. Research data management in the ecological sciences. *Marine Sci.* 16. Columbia, SC: University of South Carolina Press; 1986: 73-91.
- Stutzman, Warren L.; Crawford, Hewlette S. Estimation of the weight of vegetation using microwave transmission measurements. In: International geoscience and remote sensing symposium; 1985 October 7-9; Amherst, MA. Amherst, MA: The Institute of Electrical and Electronics Engineers, Inc; 1985: 1: 164-167.
- Wadsworth, F. H.; Birdsey, R. A. A new look at the forests of Puerto Rico. *Turrialba*. 35(1): 11-17; 1985.
- Zobel, Donald B. Port-Orford-cedar: a forgotten species. *Journal of Forest History*. 30(1): 29-36; 1986.

Research Headquarters

FPL Forest Products Laboratory
1 Gifford Pinchot Drive
Madison, WI 53705

INT Intermountain Forest and Range
Experiment Station
324 25th Street
Ogden, UT 84401

NC North Central Forest
Experiment Station
1992 Folwell Avenue
St. Paul, MN 55108

NE Northeastern Forest
Experiment Station
370 Reed Road
Broomall, PA 19008

PNW Pacific Northwest Forest and
Range Experiment Station
P.O. Box 3890
Portland, OR 97208

PSW Pacific Southwest Forest and
Range Experiment Station
1960 Addison Street
Berkeley, CA 94704

RM Rocky Mountain Forest and
Range Experiment Station
240 W. Prospect Street
Fort Collins, CO 80526-2098

SE Southeastern Forest
Experiment Station
200 Weaver Boulevard
P.O. Box 2680
Asheville, NC 28802

SO Southern Forest
Experiment Station
U.S. Postal Service Building
701 Loyola Avenue
New Orleans, LA 70113

WO Forest Service
U.S. Department of Agriculture
P.O. Box 96090
Washington, DC 20090-6090

[illegible]

Rio Piedra
Puerto Rico

Virgin Islands