STUDYING THE EFFECTS OF HARDWOOD STAND MODIFICATION, PERIODIC FLOODING, AND FIRE ON INSECT AND DISEASE COMMUNITIES IN THE LOWER MISSISSIPPI RIVER ECOSYSTEM

T. Evan Nebeker, Theodor D. Leininger, and James S. Meadows[1]

Abstract—The relationship between stand modification and pest organisms (insects and diseases) has been noted in general with few specific studies to evaluate this relationship in the southern hardwoods. As a prerequisite to making the best improvement cut prescription, it is essential to have a perspective on thinning impacts that at present can only be gathered from scattered information. The goal of this study is to better understand the impacts of stand modifications on insect and disease populations. A study of practices in southern pines conducted in 1985 by Nebeker and others will serve as a template. We will examine the relationship of pest organisms to stand modifications such as improvement cuts, clear cutting, periodic flooding (e.g., green tree reservoirs) and burning. To our knowledge, this will be the first such study in southern hardwood stands aimed at understanding this relationship.

Our objectives are threefold. We propose to bring together the literature that reports positive and negative impacts of stand modifications in relation to insects and diseases of hardwoods emphasizing the southern hardwood system. We also propose to follow stand modification procedures in order to document changes in insect and disease populations that lead to degrade or mortality of hardwoods. The organisms of interest primarily include insect borers and various wood decays. The study will be conducted in the Delta National Forest near Rolling Fork, MS, where we will survey pest populations before and after an improvement cutting in a bottomland hardwood stand. In addition, pest population surveys will be conducted in stands thinned within the past 5 years on timber company land in Alabama. The envisioned product will be a document containing pest management recommendations for stand modification practices in southern hardwoods. This will be a great asset in summarizing our understanding of pest population responses to management entries into the southern hardwood ecosystem. It should serve as a benchmark for future studies as well.

INTRODUCTION

There are increasing interests in hardwood forests of the Southern United States. These interests are diverse and far-ranging. There are interests in conservation, wetland preservation, ecosystem preservation, ecosystem management, forest health, and restoration, to mention a few. There is also considerable interest in the sustainable productivity of these forests for fuel, fiber, lumber products, and chemicals. As a result of these latter interests, and in connection with broader ecological interests, the impact from harvesting, periodic flooding (including green tree reservoirs), and fire are of concern.

In a report presented by the National Research Council Committee on Forestry Research (1990), focus was given to research needs in forestry, including a mandate for change. One can generally assume that entry into the forest for improvement cuts—imposed disturbance—may result in various levels of damage. A similar assumption can be stated for periodic flooding and prescribed burning. Damage associated with these events may result in a reduction in long-term productivity. The impact (positive and negative) of insects and diseases as a result of entry into the forest for harvesting purposes is of critical interest. Similar interests also exist in relation to the practice of creating green tree reservoirs for recreational purposes such as hunting.

The forestry practice of thinning (improvement cuts) is of particular interest. While thinning is aimed primarily at improving the value of the residual stems and the stand as a whole, there are other benefits currently gaining recognition, such as risk reduction for insect infestations, disease epidemics, and damage due to abiotic agents. Overstocked and overmature stands are generally more susceptible to insects and disease and thus warrant thinning. The mechanics by which thinning reduces these risks are not completely understood. Observations, however, indicate that thinning can cause positive and/or negative effects depending on how, where, when, and why the stand is thinned. The presence of more than one kind of hazard at any given time and place poses some problems in designing an optimum thinning strategy. Further complicating the situation are the species, stage of development, anticipated direct damages to residual stems, site quality, growth rate, and susceptibility to damaging agents, such as insects, disease, and windthrow.

The magnitude of logging damage is due to the following principal variables: (1) silvicultural (system) used, (2) type of equipment and configuration, (3) species, (4) spacing (density), (5) size class (age), (6) season of harvest (soil moisture conditions), and (7) operator carelessness. The type of damage encountered is generally limited to: (1) limb breakage, (2) bole wounding (upper and lower bole), (3) root wounding, and (4) root breaking. Additional damage includes bending and breaking of whole trees (Nyland and Gabriel 1971). Complete uprooting of trees can also occur. Biltonen and others (1976) reported greater crown damage (but little bole damage) when thinning was done with mechanized equipment than without. Hesterberg (1957) found that 80 percent of broken branches 4 inches or

[1] Entomologist, Department of Entomology and Plant Pathology, Box 9775, Mississippi State University, Mississippi State, MS 39762- 9775; Principal Research Plant Pathologist, and Principal Silviculturist, USDA Forest Service, P.O. Box 227, Stoneville, MS 38776-0227 (respectively).

greater in diameter developed defects following thinning. Lavallee and Lortie (1968) claimed that broken branches 2.5 inches or larger in diameter almost always serve as infection courts in yellow birch after a stand disturbance such as thinning. Berry (1977), working with upland oaks, found that 39 percent of the trees studied had decay. Fire scars were the most important entry courts followed by mechanical wounds, top damage, branch stubs, and parent stumps. Shigo (1966) indicated that broken branches in northern hardwoods lead to wood discoloration and serve as infection courts to decay fungi. Tree species also vary in their susceptibility to thinning-related damages such as yellow birch being more susceptible than sugar maple (Benzie and others 1963). Information concerning the impact of insects in hardwood stands following stand modification procedures is much more limited.

The relationship between thinning and pest organisms has been noted in general with few specific studies to evaluate these relationships. This is especially true for insects. As a prerequisite to making the best thinning prescription, it is essential to have a perspective on thinning impacts which at present can be gathered only from scattered information. A study by Nebeker and others (1985) will serve as a template (general protocol and expected output—publication(s)) for this study.

In the proposed study we will address the influence of stand modification on insect and disease populations associated with bottomland hardwood forests of the South. The stand modification procedures of interest are thinning (improvement cuts), clear cutting, periodic flooding (including green tree reservoirs), and prescribed burning.

The objectives of the study are to:

(1) bring together the literature that reports positive and negative impacts of stand modifications in relation to insects and diseases of hardwoods, emphasizing the southern hardwood ecosystem;
(2) follow stand modification procedures and disturbances in order to document changes in insect and disease incidence, primarily insect borers and wood decays, that lead to degrade or mortality of hardwoods; and
(3) produce a document focusing on pest management recommendations associated with thinning guidelines for southern hardwoods.

Study Area

The primary study area is located on the Delta National Forest. Secondary study sites will be on industrial timberlands in Alabama that have already been thinned within the past 5 years. In addition, other areas being commercially thinned will be noted and surveyed. Preliminary information on the impact of regeneration cutting on insect and disease populations will be made on the Delta Experimental Forest near Stoneville, MS. Of special interest are the impacts (positive and negative) on insect and disease populations of prescribed burning and portions of stands left undisturbed for wildlife refuges within the regeneration area.

Methods

The literature review will consist of computer-assisted searches of data bases available through various libraries. A knowledge base will also be obtained by visiting with and surveying (see survey form) individuals and/or companies that have been involved with hardwood stand modifications.

The survey of the stand to be thinned, on the Delta National Forest, will be conducted during the spring of 1997 and will follow typical forest stand inventory methodology. Site and stand data (tree species, basal area, stand density, age, etc.), linked to fixed plots for determining current stand conditions and for monitoring growth over time, will be collected at each sample point. An assessment of insects and diseases will also be made at each sample point. Emphasis will be on the organisms that may potentially cause degrade or mortality. These primarily include insect borers and diseases of various kinds.

Following the stand modification process, surveys will be conducted to determine the extent of new insect and disease activity as a result of stand entry. These general surveys will be conducted within the year following the treatment and again the following year. Trees with limb breakage, upper and lower bole wounding, and root damage as a result of harvesting will be specifically identified. These trees will be numbered and monitored for signs and symptoms of insect and disease activity.

Analysis

Site and stand data, before and after thinning, will be compared graphically (as percentages) to reflect the changes in species composition, stand density, basal area, and size classes. The occurrence of insects and diseases will be compared in a similar manner and in percentage form. The nature of the data will also lend itself to being expressed in relation to various diversity indexes.

Significance

The relationship between thinning and pest organisms will be documented for southern hardwoods for the first time. A better understanding of the impacts of stand modification on insect and disease populations will be gained. The literature will be brought together that reports impacts of stand modifications in relation to insects and diseases of hardwoods. The results of this study will lead to a document we propose to entitle Stand Modification Practices in Southern Hardwoods—With Pest Management Recommendations.

Harvesting operations often cause widespread damage to the residual stand. Often more than 50 percent of the residual stems are damaged. In one survey, Meadows (1993) found logging wounds on 62 percent of the residual stems following a thinning operation in a river front hardwood stand in Mississippi. The most common types of damage include: (1) branches being broken in the residual canopy (2) upper and lower bole wounding and (3) exposure and breakage of roots. Such wounding serves as infection courts for disease organisms and attraction points for various insects that can lead to degrade and potential

mortality of the residual stems. In addition, disease propagules such as fungal spores, bacteria, and viruses may be introduced into trees through wounds created by insects, birds, or mammals. The subsequent reduced vigor of individual trees may also reduce the overall health of the residual stand, making it susceptible to further insect and disease attack.

Changes in stand structure as well as exposure to periodic flooding when water remains standing for various lengths of time can influence ecosystem functions. Food sources, especially nectar, for parasites of hardwood insect pests may be reduced as a result of these events. Insects, especially those that have one or more life stages in the ground or duff, may be affected. This is of concern if it is one of the natural enemies of an insect pest affecting the system. Having such information will further our understanding of this ecosystem and the changes in the system associated with stand intervention and periodic disturbances.

Managers of bottomland and upland hardwood stands typically remove trees with hollow bases, large disfiguring cankers, and/or many scars caused by wood-boring insects. They reason is that by removing these trees they are creating growing space for better quality residual trees, and are reducing the presence of insects and diseases in the stand. On the surface, these assumptions appear biologically sound. Our research is intended to provide the scientific basis for supporting and perhaps modifying these underlying assumptions that are already in practice. This will be a great asset in extending our understanding of entries into and disturbances of the southern hardwood ecosystem.

LITERATURE CITED

Benzie, J.W.; Hesterberg, G.A.; Ohman, J.H. 1963. Pathological effects of logging damage four years after selective cutting in old- growth northern hardwoods. Journal of Forestry. 61(10): 786-792.

Berry, F.H. 1977. Decay in yellow-poplar, maple, black gum, and ash in the central hardwood region. Res. Pap. NE-242. U.S. Department of Agriculture, Forest Service. Northeast Forest Experiment Station. 4 p.

Biltonen, F.E.; Hillstrom, W.A.; Steinhilb, H.M.; Godman, R.M. 1976. Mechanized thinning of northern hardwood pole stands: methods and economics. Res. Pap. NC-137. St. Paul, MN: U.S. Department of Agriculture, Forest Service, North Central Forest Experiment Station. 17 p.

Hesterberg, G.A. 1957. Deterioration of sugar maple following logging damage. Pap. 51. U.S. Department of Agriculture, Forest Service, Lake States Forest Experiment Station. 58 p.

Lavallee, A.; Lortie, M. 1968. Relationships between birch disease and thinning related damage. Forestry Chronicle. 44(2): 5-19.

Meadows, J.S. 1993. Logging damage to residual trees following partial cutting in a green ash-sugarberry stand in the Mississippi Delta. In: Proceedings 9th central hardwood forest conference. Gen. Tech. Rep. NC-161. U.S. Department of Agriculture, Forest Service: 248-260.

National Research Council Committee on Forestry Research. 1990. Forestry research: A mandate for change. National Academy Press. 84 p.

Nebeker, T.E.; Hodges, J.D.; Karr, B.K.; Moehring, D.M. 1985. Thinning practices in southern pines - with pest management recommendations. Tech. Bull. 1703. U.S. Department of Agriculture, Forest Service. Southern Forest Experiment Station. 36 p.

Nyland, R.D.; Gabriel, W.J. 1971. Logging damage to partially cut hardwood stands in New York State. AFRI Res. Rep. 5. Syracuse University, College of Environmental Science and Forestry. 38 p.

Shigo, A.L. 1966. The pattern of decays and discolorations in northern hardwoods. Phytopathology. 55(6): 648-652.

SURVEY

We solicit the assistance of forest managers in providing information, published or unpublished, concerning increases or decreases in insect and/or disease activity associated with the general purpose of this study. We are extremely interested in actual observations concerning insects and/or diseases associated with partial cutting, improvement cutting, logging damage, periodic flooding, or fire in the southern bottomlands.

Name: _____

Address:_____

Phone: _____

Work: _____

FAX: _____

e-mail: _____

Observations:_____

_____

_____

_____

_____

_____

_____

_____

_____

We appreciate your assistance.

Please return to:
T. Evan Nebeker
Department of Entomology and Plant Pathology
Box 9775
Mississippi State University
Mississippi State, MS 39762
Phone: 601-325-2984
FAX: 601-325-8837
e-mail: enebeker@entomology.msstate.edu