THINNING GUIDELINES FOR SOUTHERN BOTTOMLAND HARDWOOD FORESTS

James S. Meadows

Principal Silviculturist, USDA Forest Service, Center for Bottomland Hardwood Research, Stoneville, MS 38776

ABSTRACT

Thinnings, improvement cuttings, and other partial cuttings in southern bottomland hardwood forests are generally designed to enhance the growth and development of those species favored for management objectives. Hardwood tree classes and stocking guides can be used as tools to aid in planning and conducting partial cuttings in hardwood forests. Two disadvantages associated with any partial cutting in hardwood stands are excessive logging damage to boles and/or exposed roots of residual trees and the possible production of epicotmic branches on the boles of residual stems. General guidelines for thinning in mixed-species stands of bottomland hardwoods are presented.

INTRODUCTION

Profitable management of hardwood stands for sawtimber production depends not only on maintenance of satisfactory rates of growth, but also on successful development and maintenance of high-quality logs. Silvicultural practices, such as thinnings and other partial cuttings, can be used to increase growth and, thus, to enhance or improve bole quality (log grade) of individual trees. Unfortunately, those same silvicultural practices, if used improperly, may serve to actually reduce or degrade bole quality.

Partial cuttings in bottomland hardwood forests can be separated into three different categories: (1) improvement cuttings, which are generally applied to previously unmanaged stands to remove low-value, over-mature, damaged, or cull trees, and trees of undesirable species; (2) thinnings, which are used to regulate stand density and to increase growth of residual trees; and (3) other partial cuttings, such as crop-tree release, in which a relatively small number of pre-selected crop trees are freed from competing vegetation.

In practice, some combination of improvement cutting and thinning is used in most mixed-species, bottomland hardwood forests, with these general objectives: (1) to enhance growth and development of individual trees; (2) to improve species composition of the stand; and (3) to improve bole quality of individual trees in the residual stand.

HARDWOOD TREE CLASSES

The first step in preparing for any type of partial cutting in southern bottomland hardwood forests is to be able to identify the types of trees to be left to form the residual stand and the types of trees to be cut. An excellent tool to accomplish this task is the concept of hardwood tree classes. Putnam and others (1960) developed hardwood tree classes as a basis for planning partial cuttings and for developing marking rules. These tree classes, with some modifications, are still in use today.

Putnam recognized four hardwood tree classes, the first and most valuable of which is preferred growing stock (Putnam's "leave" trees). These are trees that (1) are in good condition, (2) are of a desirable species for the site and for management objectives, (3) have dominant or codominant crowns, (4) can be left indefinitely if in good condition, and (5) currently meet or have the potential to eventually meet minimum log grade specifications, which may vary by management and product objectives. Preferred growing stock trees may be thought of as "final crop trees." They are expected to increase in value at a satisfactory rate if left in the stand after some form of partial cutting.

Reserve growing stock (Putnam's "storage" trees) are trees that are in good condition, but do' not meet the qualifications for preferred growing stock trees. They can be safely stored on the stump with little risk of mortality or degrade if left in the stand for one or more cutting cycles. Reserve growing stock trees are not expected to increase in value at a satisfactory rate, but are also not expected to decrease in value if left in the stand after partial cutting.

Cutting stock (Putnam's "cut" trees) must be cut during the next cutting cycle. They may be in poor condition, pose a significant risk of mortality or degrade in merchantability, or be of a species that is unsuitable for the site. Cutting stock trees are expected to decrease in value if left after partial cutting.

Cull stock trees are incapable of meeting the desired product goals. They may be separated into two categories: (1) sound culls which will never produce sawtimber, but which do contain usable fiber; and (2) unsound culls, which do not contain any merchantable fiber.

Tree classes can be used to establish a cutting priority when marking a hardwood stand for partial cutting. In general, for any partial cutting, all cutting stock trees should be cut, and all preferred growing stock trees should be left. The silviculturist may cut none, some, or all of the reserve growing stock trees, according to the planned intensity of the partial cut. Cull stock trees may be left or cut, depending upon management objectives.

STOCKING GUIDES

The next step in planning any partial cutting in hardwood stands is to determine the intensity of the cut. Stocking guides can be used as a tool to determine not only when a stand needs thinning, but also to determine the optimum residual stocking, thereby setting the intensity of the cut.

The only stocking guide available specifically for southern bottomland hardwood forests was developed by Goelz (1995). It is based on hypothetical stocking levels for bottomland hardwood stands before and after thinning, as presented by Putnam and others (1960). Goelz (1995) interpreted stand attributes before thinning to represent 100 percent stocking and Putnam's recommended residual density after thinning to reflect a type of B-line stocking. These data were then used to generate a stocking guide for southern bottomland hardwood forests. Given an estimate of the number of trees per acre and basal area, the stocking guide can be used to provide an estimate of stocking (Goelz 1995). Any stand in which stocking is estimated to be over 100 percent is generally considered to be overstocked, and a partial cutting may be needed.

The silviculturist may use Putnam's B-line to represent the optimum residual stocking level recommended for southern bottomland hardwood stands, or may choose some constant level of stocking, such as 70 percent. However, neither Putnam's recommendations nor any other level of residual stocking have been tested scientifically. Consequently, no definitive guidelines on optimum residual stocking levels for bottomland hardwoods can be given at this time.

PROBLEMS ASSOCIATED WITH PARTIAL CUTTING

Two disadvantages associated with partial cutting in hardwood stands are (1) excessive logging damage to boles and/or exposed roots of residual trees, and (2) possible production of epicormic branches along the boles of residual stems.

Logging Damage--Logging damage, particularly in the form of open wounds to the lower bole, has long been considered a serious problem associated with any type of partial cutting. Logging damage that exposes living sapwood generally leads to decay and/or discoloration of the wood, and may result in a reduction in log grade and potentially a loss of log volume.

Meadows (1993) surveyed the extent of logging damage following partial cutting in a 45-year-old, green ash-sugarberry (*Fraxinrrs pennsylvanica* Marsh.-*Celtis laevigata* Willd.) stand in the Mississippi Delta, and found that 62 percent of residual trees suffered some form of logging damage.

Much of the damage occurred as the logs pulled by the skidder scraped against the lower boles of residual trees. Some degree of logging damage must be expected during any partial cutting operation, but the amount observed in this study is excessive and should not be tolerated. Much of the damage could have been avoided through more careful skidder operation and more supervision by the logging superintendent.

Epicormic Branches--The second serious problem associated with partial cutting in hardwoods is the possible production of epicormic branches on the boles of residual stems. According to USDA Forest Service standard grading rules for hardwood factory logs, most epicormic branches are considered to be defects on all logs (Rast *el* al. 1973). Consequently, epicormic branches are frequent contributors to log grade reduction in partially cut hardwood stands. Furthermore, the defects caused by epicormic branches may greatly reduce the grade and subsequent value of the lumber produced from those logs.

Meadows and Burkhardt ***(in press)*** evaluated the effects of epicormic branches on lumber grade and value in a 50-year-old, predominantly willow oak (*Quercus phellos* L.) stand in central Alabama. A low thinning conducted in the stand about 10 years prior to final harvest had resulted in a proliferation of epicormic branches along the boles of many of the residual trees. By grading the logs in standing trees twice (with epicormic branches counted as defects and without them counted as defects), we were able to accurately assess both the actual and potential grade of each log. In the absence of epicormic branches, 79 percent of the logs were either Grade 1 or 2, whereas with epicormic branches counted as defects, only 44 percent of the logs received one of these higher grades. In fact, roughly half (49 percent) of the logs suffered at least a one-grade reduction due to the presence of epicormic branches.

To assess the effects of epicormic branch defects on lumber grade and value, the stand was harvested and the logs were shipped to a sawmill where they were sawn into lumber and graded. In the absence of epicotmic branch defects, 72 percent of the lumber volume was graded as No. 1 Common or better, whereas with those defects counted, only 54 percent of the volume attained one of these higher grades. More importantly, more than 50 percent of the lumber volume that would have been graded as high-value FAS in the absence of epicormic branch defects had to be downgraded to No. 1 Common or below due to the defects caused by epicormic branches. Economic analysis revealed that the defects caused by epicormic branches resulted in a 13 percent loss in the value of the lumber cut from this particular bottomland tract (Meadows and Burkhardt, ***in press).***

The production of epicormic branches on the boles of hardwood trees is a poorly understood phenomenon that may be responsible for losses of millions of dollars in potential revenue each year across the South. Meadows (1995) listed three major factors that affect the production of epicormic branches in hardwoods: (1) species, (2) stress, and (3) sunlight. Hardwood species vary considerably in their propensity to produce epicormic branches. Meadows (1995) proposed a classification of southern bottomland hardwood species based on their known or suspected susceptibility to epicotmic branching. The second major factor that affects epicormic branching in hardwoods is stress, caused by climatic events, site and stand conditions, suppression, and both stand-level and tree-level disturbances. Any of these stresses may reduce tree vigor and result in the production of epicormic branches. The third major factor, sudden exposure of the bole to direct sunlight, generally occurs after some form of partial cutting, and may trigger the release of those dormant buds that develop into epicormic branches, especially on low-vigor trees of susceptible species. Meadows (1995) proposed that the production of epicormic branches in hardwoods appears to be controlled by the complex interactions among species, tree vigor, and exposure to sunlight and other disturbances. In this context, high-vigor trees, especially of relatively resistant species, are much less likely to produce epicormic branches than are low-vigor trees when subjected to any stimulus that tends to trigger the production of epicormic branches.

Meadows (1995) used this theoretical model to develop some practical guidelines to reduce the risk of epicormic branching in southern bottomland hardwood stands: (1) favor resistant species over susceptible species; (2) discriminate against off-site species; (3) avoid overstocking and stand stagnation; and (4) maintain healthy stands composed of healthy trees.

THINNING GUIDELINES

Partial cuttings can be used to improve species composition, regulate stand density, increase diameter growth of residual trees, and, of equal importance, to maintain healthy stands composed of healthy trees. In most situations, marking for any partial cutting should favor the best trees and discriminate against the worst. Some general guidelines for thinning in southern bottomland hardwood forests (Johnson 1981, Meadows 1995) include:

Begin thinning early in the life of the stand. If economically possible, thin the stand before it becomes extremely overstocked and stagnates. With the recent development of a stable pulpwood market for small hardwood trees, early thinnings have become more economically attractive. However, timing of the first thinning should be delayed until after merchantable height of desirable trees has been set.

Favor the largest trees with well-developed crowns and high-quality boles. Trees with these characteristics will likely be classified as preferred growing stock trees, and should be favored when marking a stand for partial cutting. Crown size, as representative of the amount of total photosynthetic surface, is generally considered to be a good indicator of tree vigor.

Thin from below. Low thinning- is designed to remove trees with inferior crowns. However, most partial cuttings in hardwoods should also remove larger trees that are overmature, damaged, diseased, or of an undesirable species.

Use frequent, light thinnings instead of infrequent, heavy thinnings. The objective is to manage stand density to optimize the value of the stand. Frequency and intensity of thinning involve trade-offs between individual-tree and stand growth, logging damage, and production of epicormic branches. For example, heavy thinnings may allow too much sunlight into the stand and may promote the development of epicormic branches on the boles of residual trees.

Avoid excessive logging damage to residual trees. Some logging damage *is* inevitable following any partial cutting, but it can be minimized through carefully planned and supervised logging practices.

Leave large saplings near residual trees. Whenever possible, large saplings should be left to provide shade on the lower boles of nearby residual trees and, thus, to reduce the risk of epicormic branching. The presence of saplings near residual trees will also serve to protect those trees from logging damage caused by passing skidders.

REFERENCES

Goelz, J.C.G. 1995. A stocking guide for southern bottomland hardwoods. South. J. Appl. For. 19: 103-104.

Johnson, R.L. 1981. Wetland silvicultural systems. *In* Proceedings of the 30th annual forestry symposium. Louisiana State University Press, Baton Rouge, p. 63-79.

Meadows, J.S. 1993. Logging damage to residual trees following partial cutting in a green ash-sugarberry stand in the Mississippi Delta. *In* Proceedings of the 9th central hardwood forest conference, A.R. Gillespie, G.R. Parker, P.E. Pope, and G. Rink (eds.). Gen. Tech. Rep. NC-161. USDA Forest Service, North Central Forest Experiment Station, St. Paul, MN, p. 248-260.

Meadows, J.S. 1995. Epicormic branches and lumber grade of bottomland oak. *In* Proceedings of the 23rd annual hardwood symposium. National Hardwood Lumber Association, Memphis, TN, p. 19-25.

Meadows, J.S., and E.C. Burkhardt. (in press). Epicormic branches and lumber grade and value in willow oak. South. J. Appl. For.

Putnam, J.A., G.M. Fumival, and J.S. McKnight. 1960. Management and inventory of southern hardwoods. Agric. Handb. No. 181. USDA Forest Service, Washington, DC. 102 p.

Rast, E.D., D.L. Sonderman, and G.L. Gammon. 1973. A guide to hardwood log grading. Gen. Tech. Rep. NE-l. USDA Forest Service, Northeastern Forest Experiment Station, Upper Darby, PA. 31 p.