United States
Department of
Agriculture

Forest Service

**Northeastern Forest
Experiment Station**

Research Paper NE-692

Closure of Logging Wounds After 10 Years

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Abstract

Closure of logging wounds on 96 sample trees was evaluated after 2, 5, and 10 years for Appalachian hardwood trees in north-central West Virginia. For yellow-poplar, northern red oak, black cherry, and white oak, many small wounds, 1 to 50 square inches in size, closed between 5 and 10 years after logging. For larger wounds, 50 to 200 square inches, it appears that many of these wounds may not close for at least 15 or perhaps 20 years after logging. Recommendations are provided to minimize logging wounds on residual trees in partially cut stands.

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Manuscript received for publication 24 March 1994

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September 1994

Introduction

Damage to residual trees during thinning operations and partial regeneration cuts is a major concern of forest managers. Residual trees are damaged by felling trees and by winching and skidding trees to a log landing. Trees with extensive damage such as severely broken tops or trees that have been uprooted likely will be salvaged when the damage occurs. Less severe damage such as bark removal that exposes sapwood also is frequent. Sapwood wounds pose no immediate threat to the tree but increase the likelihood of attack by insects or diseases.

In this paper we discuss the time required for closure of bark-related (exposed sapwood) wounds incurred during logging. This information can be used by forest managers to estimate the time required for a logging wound to close. Knowing how long it takes for a wound to close (callus over) will aid in deciding whether to salvage a damaged tree or leave it in the stand until the next entry period.

Nyland and Gabriel (1971) indicated that about 80 percent of skidding injuries to residual trees entail bark removal or abrasion to the butt log. In this New York study, major injuries from felling were about twice those from winching/ skidding even though about 70 percent of the standing trees adjacent to a skidroad were damaged from tree-length skidding.

Size of the exposed sapwood wound is important as it relates to decay and closure. Residual trees are damaged primarily during felling or skidding. Damage is largely confined to saplings and poles, though sawtimber trees also are wounded (Lamson and Miller 1983). Research has shown that exposed sapwood wounds of more than 100 square inches are likely to develop decay (Hesterberg 1957; Lavallee and Lortie 1968). Lamson and Miller (1983) reported results from stands of pole- and small sawtimber-size trees logged with a rubber-tired skidder on relatively gentle to flat slopes. Logging damage to the residual stand increased with intensity of thinning. About 7, 13, and 22 percent of the residual dominant-codominant trees had exposed sapwood wounds of at least 100 square inches when the area was logged to a residual stocking of 75, 60, and 45 percent, respectively.

Butin and Shigo (1981) indicated another concern related to shakes and logging wounds. Shakes can result from logging wounds and pruning of branches or stump sprouts. In many cases, if the trees are not injured during logging or branch stubs are not present, stress factors that cause shakes, such as fast growth, vigor, and frost, have little or no influence on the development of the crack.

Study Location

The study areas were on the Fernow Experimental Forest and the Monongahela National Forest in north-central West Virginia near Parsons, West Virginia. Trees were selected on good sites with a site index of 70 and above for northern red oaks. Cove hardwoods were the major species on these sites, including northern red oak, yellow-poplar, black cherry, white oak, sugar maple, beech, and basswood. Study trees were second-growth Appalachian hardwoods in the codominant crown class. These trees were 75 to 80 years old at time of logging and were released to a free-to-grow crown position (released on all four sides of the crown). Annual precipitation on the study area averaged 55 to 60 inches; there are 120 to 140 frost-free days during the growing season. Soils were primarily of sandstone origin with a depth to bedrock of 4 to 5 feet. Soil pH was near 5.0. Topography was mixed, with steep (slopes of 50 to 60 percent), moderate (20 to 25 percent), and flat (0 to 10 percent) sites.

Methods

All trees were harvested with conventional ground-skidding equipment (rubber-tired skidder or crawler tractor with an arch). Skidroads were spaced 150 to 250 feet apart depending on the steepness of the topography. Trees were skidded tree length to a log landing.

Exposed sapwood (skins) was identified and measured on mature sawtimber-size trees periodically at 2, 5, and 10 years after logging. The surface area of logging wounds was calculated based on rectangles. Wound length and width was measured to the nearest inch; these measurements always were rounded to provide conservative estimates of wound size.

Species selected for samples were trees damaged during logging (no effort was made to deliberately damage a tree). Samples were available primarily from northern red oak, white oak, and yellow-poplar. A few samples were available from black cherry, basswood, and sugar maple. Often, a single tree had wounds of more than one size so there is a difference in number of wounds per trees sampled. In all, 96 damaged trees were sampled 2 years after log wounding occurred. These same trees were reexamined at the 5- and 10-year measurement periods. Due to the small number of samples per species, the information presented here is preliminary.

Results

The number of study trees with exposed sapwood wounds at different periods is summarized by species in Table 1. Information on wound closure by size is shown in Tables 2 and 3 (Figs. 1-2). Data were recorded at the 2-, 5-, and 10-year periods. Some logging wounds are not visible immediately after logging. For example, some trees were bumped with logs during winching or skidding but the bark was not removed. However, after 2 years, much of the bark fell off "hidden" wounds, allowing a better estimate of logging damage. None of these wounds observed immediately after logging had closed during the subsequent 2-year period.

For northern red oak, 30 trees were examined initially; 28 white oak and 22 yellow-poplar were examined. The number of trees with wounds that did not close or callus over is indicated at the 5- and 10-year period after logging (Table 1). No northern red oak trees had closed wounds

Figure 1.--Exposed northern red oak sapwood wound due to damage from log skidding.

Figure 2.—Sapwood wound in northern red oak that closed during the 10-year period.

after 2 years, 5 trees had closed wounds after 5 years, and 18 trees had closed wounds after 10 years. Yellow-poplar had the greatest proportion of trees with closed wounds--18 of 22 wounds were closed after 10 years.

Table 1.--Number of sample trees with open exposed sapwood wounds due to logging[a]

Species	Years after wounding occurred		
	Two	Five	Ten
	Number of trees		
N. red oak	30	25	12
White oak	28	25	18
Yellow-poplar	22	14	4
Black cherry	8	6	5
Chestnut oak	5	4	4
Basswood	3	2	0
Total	96	76	43

[a]Because several trees had more than one wound, tree-wound data not additive.

Of the 45 wounds that were 1 to 50 square inches, 26 closed during the 5-year period after logging (Table 2). Yellow-poplar had the most closed wounds with 10 while red oak had 7. One wound (yellow-poplar) in the 51- to 100-square-inch class closed during the 5-year interval. Between 6 and 10 years after logging, 17 additional wounds in the 1- to 50-square-inch category closed. Thus, for the species and conditions evaluated in this study, one could expect most of the wounds that were 1 to 50 square inches to close after 10 years (Table 2). When wounds of all sizes are considered, 59 percent (58 of 99) had closed after 10 years. Most of the closed wounds (43) were in the 1- to 50-square-inch size class (Table 2). For wounds larger than 50 square inches, 28 percent (15 of 54) had closed 10 years after logging damage.

At the end of the 10-year period, the exposed sapwood wounds that did not close were summarized (Table 3). Percent closure was indicated for each wound size class. Of the original 96 trees that were wounded during logging, 43 still had open wounds after 10 years. However, only one species (black cherry) had two open wounds in the 1- to 50-square-inch category that did not close. These wounds were not expected to close for several years since each averaged only 32 percent closure after 10 years. In general, for the 51- to 200-square-inch class, most of the wounds (21) averaged 74 percent closure for red oak, white oak, yellow-poplar, black cherry, and chestnut oak. If this trend continues, several of these wounds should close during the next 5-year period. Of the wounds larger than 200 square inches, 21 averaged slightly more than 50 percent closure.

Discussion and Summary

Logging damage resulting in exposed sapwood is a key factor in lower butt-log quality. These wounds provide a source of entry for insects and diseases and also are a source of ring shakes and cracks. Although sampling for the presence of rot in a closed wound was not done, superficial rot characteristics (fungal fruiting bodies) were not present on any of the closed wounds. However, wood discoloration and perhaps decay will occur, and volume might be reduced. This discoloration will not result in a reduction of tree grade, but there will be some value loss due to lower lumber grade.

The results of this study show that small wounds of 1 to 50 square inches should close 5 to 10 years after logging. It appears that most of the wounds of 50 to 200 square inches will close 15 to 20 years after logging. Currently, average closure of these wounds is 75 percent or more. Study trees were large, maturing codominant stems that were released to a free-to-grow crown position. These large trees were growing between 2.5 and 3.5 inches in d.b.h. per decade and averaged 17 inches at the time of initial logging (Smith and Miller 1991). Based on species d.b.h. growth, faster growing species such as yellow-poplar and northern red oak have the most rapid closure of small wounds. Many small sapwood wounds on red oak, white oak, and yellow-poplar closed within 10 years after logging. Within the first 10 years, 18 (100 percent) red oak wounds and 13 (100 percent) yellow-poplar wounds in the 1- to 50-square-inch class had closed.

When forest stands receive partial cuts, a major effort should be taken to minimize logging damage to the residual stand. The key to reducing exposed sapwood during logging is effective communication among the tree feller, equipment operator, and choker setter. They must be aware of the problems that could result from "barking" the trees. In general, small exposed sapwood wounds at or below the base of the butt log will not create major problems with respect to tree or log grade or quality. However, larger wounds extending into the base of the butt log could develop rot. This could mean a loss in value for wood products or a gain in "value" if development of cavity trees for wildlife is an objective. If dollar values are important to the landowner, a short cutting cycle, every 10 to 20 years on productive sites, is advisable. Short cutting cycles allow the landowner to select trees at risk of dying or about to have a major loss in value. The landowner could improve the stand aesthetically, too. Conversely, with more frequent cutting cycles, there is a higher possibility for increased damage to residual trees.

Wood-rotting fungi do not always develop when trees are damaged during logging. Baxter and Hesterberg (1958) reported that fungi associated with decay in logging wounds were increasing in 10- and 20-year-old sugar maple logging scars. Hesterberg (1957) indicated that exposed sapwood wounds of at least 150 square inches in sugar maple have an even chance (50 percent) of developing decay within 20 years. There was an overlap for these data as there is an 80-percent chance that wounds of 130 to 200 square inches will develop decay within 20 years. Lavallee and Lortie (1968) observed similar effects with the removal of only 90 square inches of bark from yellow birch trees.

Table 2.--Exposed sapwood logging wounds that callused (closed) 5 to 10 years after logging

Species	Number of wounds	Number closed at 5 years	Number closed at 10 years
		1 to 50 in²	
N. red oak	18	7 (39)[a]	18 (100)
White oak	6	4 (67)	6 (100)
Yellow-poplar	13	10 (77)	13 (100)
Black cherry	4	2 (50)	2 (50)
Chestnut oak	1	1(100)	1(100)
Basswood	3	2 (67)	3 (100)
Total	45	26 (58)	43 (96)
		51 to 100 in²	
N. red oak	3	0	1 (33)
White oak	3	0	1 (33)
Yellow-poplar	5	1 (20)	3 (60)
Black cherry	0	--	--
Chestnut oak	1	0	0
Basswood	0	--	--
Total	12	1 (8)	5 (42)
		101 to 150 in²	
N. red oak	2	0	2 (100)
White oak	5	0	2 (40)
Yellow-poplar	4	0	2 (50)
Black cherry	3	0	1 (33)
Chestnut oak	1	0	1 (100)
Basswood	--	--	--
Total	15	0	8 (53)
		151+ in²	
N. red oak	10	0	1 (10)
White oak	14	0	1 (7)
Yellow-poplar	0	--	--
Black cherry	1	0	0 (0)
Chestnut oak	2	0	0 (0)
Basswood	--	--	--
Total	27	0	2 (7)

[a]Percent in parentheses.

Table 3.—Number of exposed sapwood logging wounds that *did not* callus over (close) during the 10-year period after logging

	Square inches of exposed sapwood				
Species	1-50	51-100	101-150	151-200	201+
N. red oak	--	3 (74)[a]	--	1 (86)	8 (44)
White oak	--	2 (84)	3 (91)	2 (85)	11 (62)
Yellow-poplar	--	2 (71)	2 (95)	--	--
Black cherry	2 (32)	1 (88)	2 (88)	--	--
Chestnut oak	--	1 (75)	1 (83)	--	2 (48)
Basswood	--	--	--	--	--
Total	2 (32)	9 (77)	8 (72)	3 (85)	21 (54)

[a]Average percent reduction in size of wounds in parentheses.

The following are some suggestions to reduce logging damage:

- Plan and lay out skidroads and log landings carefully for the most efficient access with minimum disturbance to the residual stand and turning of the log load.

- Consider a maximum winching or skidding tree length, for example, 33 feet.

- Leave "fender trees" or topped trees along the skidroad to keep the log load in the skidroad or to provide a pivot or turning point for logs.

- When the opportunity is available, mark trees to leave rather than trees to cut. Aho and others (1983) showed that this marking technique can reduce logging wounds because loggers are more aware of the location of the crop trees.

- Protect crop trees from skidding wounds by leaving some poles or small sawlog trees near crop trees to serve as bumper trees.

- When there is a choice, avoid logging during spring when the sap is up and the bark is easier to remove from the tree (Deitschman and Herrick 1957).

- When damage is impossible to prevent during winching or skidding, consider damaging a less desirable versus more desirable species (following landowner objectives).

- When possible, use smaller logging equipment during partial cuts. Also, there is less damage (wounding) from crawler tractors than from skidders during skidding operations (Nyland and Gabriel 1972).

- Use directional felling and winching to minimize logging damage. Anticipate when damage might occur and try to avoid it. Fell trees away from more desirable trees and position trees for more effective winching and skidding with a minimum of turning (Nyland 1986).

- Increase supervision of logging crew to minimize damage. Communicate concerns related to numbers and types of logging damage and the potential value that could be lost. Discuss the significance (value) of the butt log (which incurs the majority of logging damage).

- Provide training in log grading for members of the logging crew, particularly the feller and bucker.

- Provide incentives for the logger to reduce damage and impose penalties for unacceptable damage to the residual stand.

- Remove forks and large branches from felled trees before winching or skidding.

- Remove previously damaged trees during subsequent thinnings. If trees are harvested within 10 years after wounding, losses should be minimal--see Ohman (1970) for sugar maple and yellow birch and Lamson et al. (1984) for black cherry and red maple.

As the value of the timber stand increases, so does the importance of minimizing logging damage to the residual stand. The landowner also needs to be aware there is a cost associated with "logging carefully" and that he or she must share this cost. The company or logger that offers the highest price for a timber sale is not always the best "environmental logger." Likewise, prospective timber buyers need to know both the legal requirements and the landowner's requirements with respect to the residual stand. A contract is recommended. Foresters need to inform the logger and landowner of the need to minimize damage to residual trees in Appalachian hardwood stands or any other forest stand.

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Keywords: logging wounds, sapwood, wound closure, butt log, quality

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