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How To Reduce Injuries to Residual Trees During Stand Management Activities

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Abstract

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Losses of trees and tree volume that result from decay initiated by mechanical injuries during stand management activities in the western United States are substantial. They can be reduced through improved logging methods and careful planning of other forest management activities.

Keywords: Logging damage, tree injury, decay (wood), forest damage/protection, intensive management.

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Introduction

Intensive forest management, requiring frequent entries into stands, increases the probability that residual trees will be wounded. Logging during commercial thinning causes many injuries, but recreational activity in forests, which is increasing, also leads to wounding of trees, particularly around campgrounds. This report illustrates the types of wounds, damage, and decay losses found in residual trees on intensively managed forest areas of the western United States and recommends methods to lessen these impacts.

Types of Damage

The most significant type of damage is direct mortality of residual trees (fig. 1). This occurs when harvested trees are felled against leave trees.

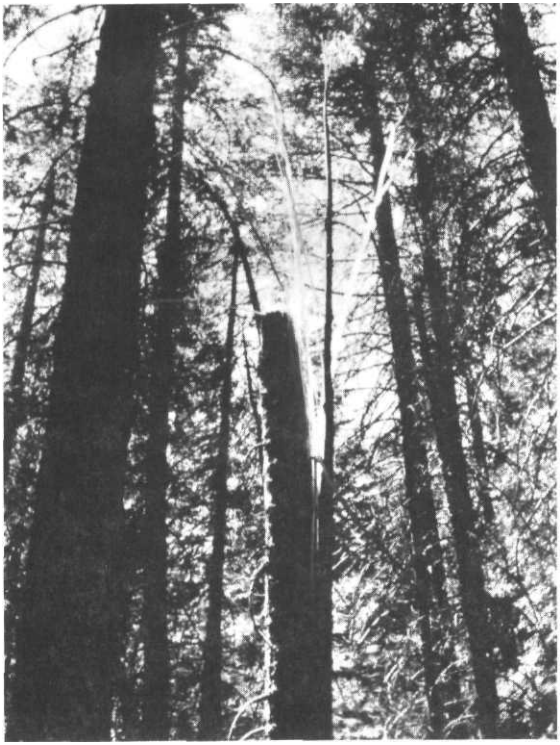

Figure 1.—A white fir killed when struck by a felled tree during a thinning operation.

Significant secondary volume losses occur from decay that follows wounding (fig. 2), including broken tops (fig. 3), caused by felled trees and mechanical equipment.

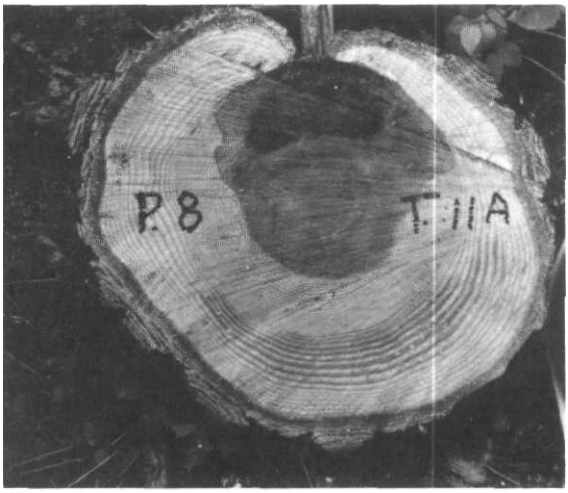

Figure2.—Cross-section through a wound in white fir. Dark area indicates decay.

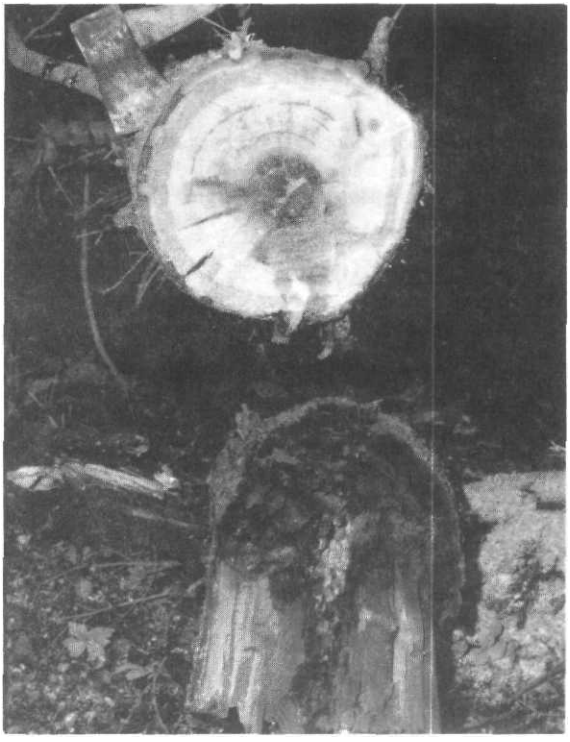

Figure3.—Cross-section of white fir just below a broken top exposing decay associated with a logging injury.

Losses from decay are caused by fungi that invade wounds and stumps. Losses are increased when decay spreads through root contacts to neighboring trees (fig. 4).

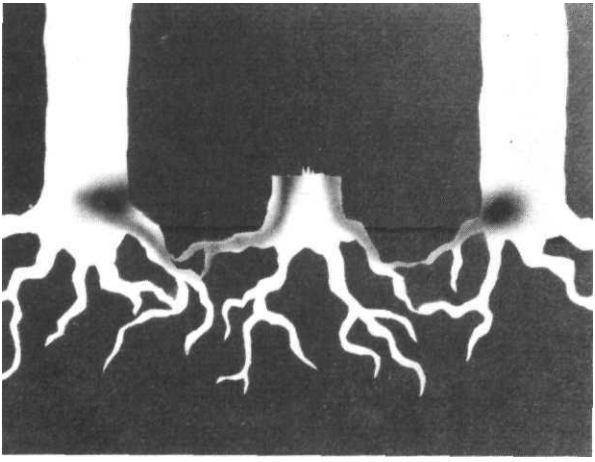

Figure 4.—Root rot spreads from stumps of infected trees to neighboring trees through root contacts.

In true firs and hemlocks, significant losses are caused by frost cracks and shake (fig. 5) that begin with wounds and by decay caused by the Indian paint fungus which is reactivated by wounding (fig. 6).

Another, less obvious loss results when volume growth is reduced because residual trees are unable to respond to release because of severe wounding or soil compaction.

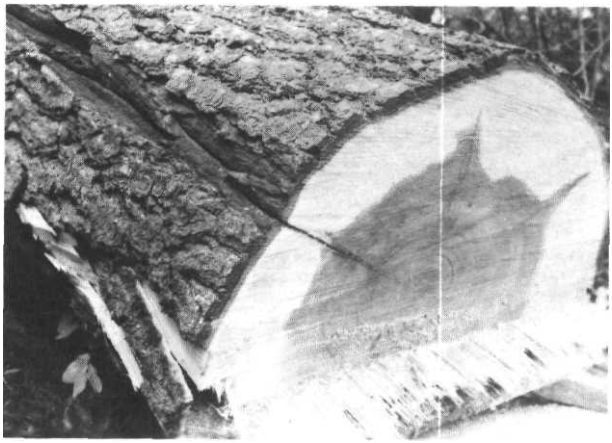

Figure 5.—Cross-section of a grand fir showing wound-initiated frost cracks, wetwood, and shake.

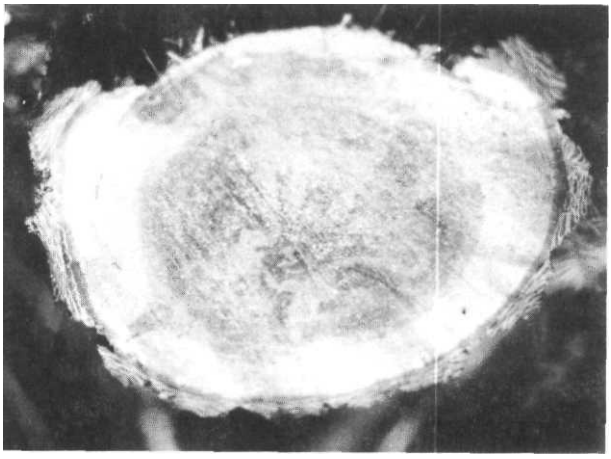

Figure 6.—Decay caused by Indian paint fungus associated with a logging wound. Injuries activate semi-dormant infections of this fungus, which may be present in certain tree species before they are wounded.

In recreation areas, wounding and subsequent decay may so weaken trees that they are hazardous to people and property (fig. 7).

Figure 7.—Damage to recreation facilities caused by a windthrown tree. Decay associated with an injury had weakened the tree.

Factors That Determine Amount of Damage

Many factors, including environmental conditions, influence the incidence and extent of decay that follows wounding. The most important factors are tree species, size and type of wound, condition of wood exposed by the wound, and location of the wound.

Species:

Most species with nonresinous wood, such as true firs and hemlocks, are more readily infected by decay fungi than are species with resinous wood, such as Douglas-fir and the pines. There are exceptions, however; spruces have resinous wood but are very susceptible to infection by decay fungi when wounded.

Size and type of wound:

Large wounds are more likely to become infected than small wounds, and more decay is usually associated with large wounds than with small wounds (fig. 8).

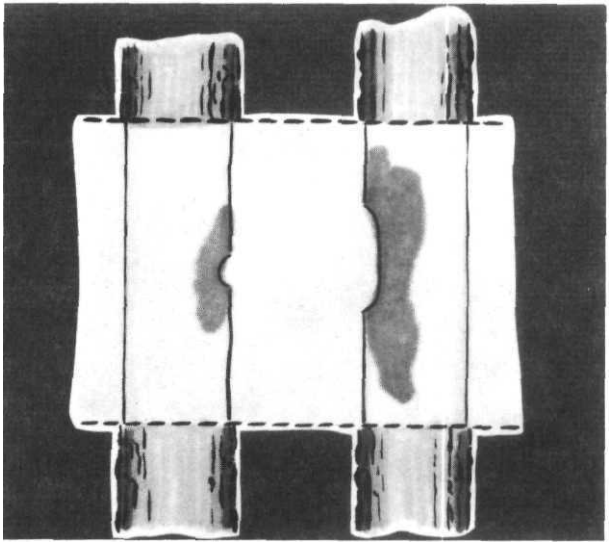

Figure 8.—Large wounds increase the likelihood of infection by decay fungi and increase the amount of decay.

Wounds in which the sapwood is gouged and splintered are more likely to be infected and have more decay than wounds that remove only the bark (fig. 9). If the wound surface is rough, it takes longer for new wood to grow over it.

Figure 9.—Gouge wounds (above) are more likely to become infected and have more decay than smooth wounds (below).

Location of wound:

The closer a wound is to the ground the more likely it is to become infected and the more severe the infection. Wounds of roots or the base of the bole nearly always become infected, and the decay progresses more rapidly than in wounds higher above the ground (fig. 10).

Figure 10.—Basal or ground-contact wounds (above) nearly always become infected, and the rot usually progresses more rapidly than in wounds above the ground (below).

Examples of Damage

Data from a recent study indicate that serious volume losses result when trees are wounded from operation of equipment. Table 1 shows high percentages of residual crop trees damaged during conventional logging. Many trees were damaged so badly they were no longer suitable for crop trees.

Table l — Logging damage to young-growth white fir and Douglas-fir residual trees in northern California stands thinned by conventional logging methods [1]

Species	Logging method	Residual trees	
		Wounded	Destroyed
		--- Percent ---	
White fir	Skidder	22	[illegible]
Douglas-fir	Tractor	35	15
White fir	Skidder	33	[2]
Douglas-fir	Cable	46	8
White fir	Grapple skidder	50	15

[1] Aho and others 1983.
[2] No data taken.

Table 2 shows data collected in two white fir stands that were thinned with rubber-tired skidders. The figures for basal wounds are particularly significant.

Table 2—Percent of residual trees wounded and the location of injuries in 2 northern California white fir stands thinned by conventional logging methods[1/]

Species	Logging method	Trees damaged	Location of wounds		
			Basal	Bole	Crown
		Percent			
White fir	Skidder	22	74	15	11
White fir	Skidder	33	72	16	12

1/ Aho and others 1983.

Table 3 shows what logging damage means in terms of volume loss caused by decay. In the stands we examined, board-foot decay losses in wounded firs already amount to 14 percent for white fir and nearly 7 percent for red fir. Losses will become much larger as decay progresses until the trees are harvested.

Table 3—Decay losses associated with wounds in white and red fir trees sampled in 13 thinned stands in the Lassen National Forest, California[1/]

Species	Trees wounded	Wounds	Wounds infected	Loss expressed in—	
				Cubic feet	Board feet
	Number		*Percent*		
White fir	186	231	100	4.5	14.0
Red fir	39	44	100	1.9	6.8

1/ Aho and others 1983.

How To Prevent Wounds

The best way to reduce decay and the resulting growth losses in residual trees is to prevent wounding during stand entries. **A** study in which logging was done using techniques designed to reduce injuries indicates that residual trees can be protected by action taken both during the planning process and during logging.

Action to take during timber sale planning:

1. Restrict the logging season. Do not allow logging of thin-barked species such as true firs and hemlocks during spring and early summer when the sap is flowing and the bark is not tight.

2. Match the size and type of logging equipment to topography, tree size, and soil type and condition. On gentle terrain, use track-laying or rubber-tired vehicles no larger than necessary (fig. 11). On slopes steeper than 35 percent or on fragile soils, use cable systems (fig. 12).

Figure 11.—Using small skidders reduces injury to residual trees in young stands. Equipment suitable for old-growth stands is not suitable for young-growth stands, although it is often used for thinning.

Figure 12.—Small cable systems are suitable for logging young stands on steep slopes or fragile soils.

3. Mark "leave" trees rather than "cut" trees. This simple change calls attention to the residual trees and has significantly decreased damage to them.

4. Lay out skid trails before logging begins. Use straight-line trails only slightly wider than the skidding vehicle.

5. Designate "rub" trees, to be removed last, or leave cull logs along the edges of skid trails to protect residual trees.

6. Match maximum log length to spacing of the residual stand. Close spacing calls for relatively short logs, whereas wider spacing allows skidding of longer logs with minimal damage to residual trees. Cut trees into logs before skidding. Moving whole tree lengths increases damage to residual trees.

Action to take during logging:

1. Most important is to gain the cooperation of the logger, who must be convinced that most damage to residual trees is unnecessary and will not be tolerated.

2. Log skid trails first. Cut stumps as low as possible so they will not shunt the skidding vehicle or logs sideways into residual trees.

3. Require directional felling. Trees should be felled about 45 degrees toward or away from skid trails (fig. **13).**

Figure **13.—A** thinned white fir stand in which the harvested trees have been directionally felled to reduce damage to residual trees when they are skidded.

4. Limb and top trees prior to skidding. Limb flush to the bole.

5. In some locations, especially in California, stumps of pines, true firs, and hemlock need protection against *Heterobasidion* [*Fomes annosus*] *annosum*. Treatment is particularly important in recreation areas where standing, but unsound, trees may become hazards to people and property.

The effectiveness of these practices was demonstrated in four northern California stands (table 4), where their application reduced damage to residual trees considerably compared with damage in table 1.

Table 4—Logging damage in 4 stands in northern California thinned carefully to reduce injuries to residual trees 1/

Species	Logging Method	Residual trees wounded
		Percent
Ponderosa pine	Skidder	5
White fir	Tractor	11
White fir	Tractor	11
White fir	Tractor	14

1/ Aho and others 1983.

Preventing wounding during stand entries also insures that stands (fig. 14) will be capable of responding favorably to the management treatments applied.

Figure 14.—Stand thinned using recommended logging methods.

Information in this report is also available in a slide talk of the same title prepared by the authors. It may be obtained from:

Forestry Media Center
School of Forestry
Oregon State University
Corvallis, OR 97331

Literature Cited

Aho, Paul E.; Fiddler, Gary; Srago, Mike. Logging damage in thinned young-growth true fir stands in California and recommendations for prevention. Res. Pap. PNW-304. Portland, OR: U.S. Department of Agriculture, Forest Service, Pacific Northwest Forest and Range Experiment Station; 1983. 8 p.

Metric Equivalents

1 cubic foot = 0.028 cubic meter
1 board foot = 0.002 cubic meter

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The **Forest Service** of the U.S. Department of Agriculture is dedicated to the principle of multiple use management of the Nation's forest resources for sustained yields of wood, water, forage, wildlife, and recreation. Through forestry research, cooperation with the States and private forest owners, and management of the National Forests and National Grasslands, it strives — as directed by Congress — to provide increasingly greater service to a growing Nation.

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