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# Research Note



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## TREE DAMAGE RESULTING FROM THINNING IN YOUNG-GROWTH DOUGLAS-FIR AND WESTERN HEMLOCK

by

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Thinning trials on three cooperative experimental forests<sup>1/</sup> in western Washington have provided an excellent opportunity to evaluate tree damage resulting from typical thinning operations in young-growth timber. The type and degree of damage can, of course, be expected to strongly affect condition and vigor of the residual stand and ultimate success of a thinning regime.

### STUDY AREA

Altogether, 450 acres--representing 40- and 60-year age classes in Douglas-fir and a 65-year age class in western hemlock--have been thinned twice since 1949. Prior to the first thinning, all stands were fully stocked, carrying normal or better volumes. Thinning was carried out either by small contract crews or by independent producers who sold their products on the open market. In the 60-year-old stand of Douglas-fir, a tractor was used for skidding. In the two other stands, logs were skidded with horses. Essential data on stand characteristics and on type and degree of thinning are shown in table 1. Thinnings were light to moderate in intensity, varying from 9 to 25 percent by cubic-foot volume.

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<sup>1/</sup> Cooperating with the Forest Service are St. Regis Paper Co. (Voight Creek and Hemlock Experimental Forests) and Simpson Timber Co. (McCleary Experimental Forest).



## RECORDS

Data on tree injuries resulting from tree felling and log skidding have been systematically recorded during the 12 years these thinning trials have been underway. Type of damage ranged all the way from broken branches and exposed stem wood to the complete loss of the tree. Basal injuries were most numerous, closely followed by root injuries. Crown and bole injuries--largely from felling--were infrequent. Damage information was computed by diameter classes and is presented in terms of both percent of leave trees injured or killed and volume of leave trees injured or killed. The data refer only to the direct physical damage resulting from felling and skidding. The long-term effects of decay incidence and development in thinning wounds are the subject of a forthcoming paper.<sup>2/</sup>

## RESULTS

In terms of leave trees killed, the highest losses occurred in the smallest (2- to 4-inch) diameter class, with a range of 2 to 28 percent (table 2). In contrast, percentage of trees killed in the two larger diameter classes ranged from only 0 to 11 percent and, with one exception, did not exceed 5 percent. The level of losses was somewhat higher in the 60-year-old Douglas-fir stand where logs were skidded by tractor than in the other two stands where horses were used.

In the two larger diameter classes, percentage of trees injured was substantially higher than percentage of trees killed, but in the 2- to 4-inch class it was much lower (table 2). Relative level of injuries was highest in the merchantable size trees (6-inch diameter class and larger) of the 60-year-old Douglas-fir and the 65-year-old western hemlock stands. The least damage in terms of both percentage of trees killed and injured occurred in the 40-year-old Douglas-fir stand where thinning was carried out during the winter season using horses for skidding.

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<sup>2/</sup> Hunt, John, and Krueger, Kenneth W. Decay associated with thinning wounds in young-growth western hemlock and Douglas-fir. 1961. (Manuscript accepted for publication by Jour. Forestry.)

Table 2.--Percentage of leave trees damaged during  
a first and a second thinning

Species, stand age (years), and type of damage	First thinning by diameter class (inches)			Second thinning by diameter class (inches)		
	2-4	6-10	12+	2-4	6-10	12+
----- <u>Percent</u> -----						
Douglas-fir:						
40:						
Injured	7	3	5	1	4	3
Killed	12	1	0	12	( <u>1/</u> )	0
Total	19	4	5	13	4	3
60:						
Injured	3	10	12	0	9	4
Killed	21	5	( <u>1/</u> )	28	11	1
Total	24	15	12	28	20	5
Western hemlock:						
65:						
Injured	2	9	11	6	9	17
Killed	2	2	0	25	1	0
Total	4	11	11	31	10	17

1/ Less than 0.5 percent.

Since the small trees (2- to 4-inch diameter class) in these thinned stands will probably never attain crop-tree status, a more practical measure of thinning damage is the volume of merchantable size trees (6-inch diameter class and larger) that were either killed or injured (table 3). Merchantable volume of killed trees was negligible in all cases. In contrast, merchantable volume of trees injured in a single thinning varied from a low of 151 cubic feet or 724 board feet per acre (in the second thinning in the 40-year-old Douglas-fir stand) to a high of 1,532 cubic feet or 10,162 board feet (in the second thinning in the 65-year-old stand of western hemlock). The high volumes of injured trees in the western hemlock stand are attributed to the thinner bark, wider butt flare, and more numerous exposed surface roots which are characteristic of this species. Injuries to merchantable size trees, though substantial, are not believed to exceed an acceptable level--even in western hemlock--because the injured trees can be readily harvested in later thinnings if the need arises.

Differences in damage between the first and second thinnings were not consistent (tables 2 and 3) and do not indicate that second thinnings are either more or less damaging than first thinnings.

#### SUMMARY

Twelve years of damage records on the three thinning areas can be summarized as follows:

1. Although a large number of small trees were killed during thinning, losses in merchantable size trees (6 inches and larger) were negligible.
2. Nonfatal injuries of various types and degrees were sustained by up to 7 percent of the small trees (2- to 4-inch class) and up to 17 percent of the large trees (12-inch class or larger) during a single thinning.
3. Levels of injury appeared to be higher when tractors were used for skidding than when logs were horse skidded.
4. Western hemlock trees of merchantable size were apparently more susceptible to injury during thinning than Douglas-fir trees of comparable size.

Table 3.--Volume of merchantable leave trees damaged  
during a first and second thinning<sup>1/</sup>

(Acre basis)

Species, stand age (years), and type of damage	First thinning by diameter class (inches)				Second thinning by diameter class (inches)			
	6-10		12+		6-10		12+	
	Cu. ft.	Bd. ft.	Cu. ft.	Bd. ft.	Cu. ft.	Bd. ft.	Cu. ft.	Bd. ft.
<b>Douglas-fir:</b>								
40:								
Injured	88	308	86	499	80	294	71	430
Killed	10	22	0	0	4	0	0	0
Total	98	330	86	499	84	294	71	430
60:								
Injured	126	584	755	5,023	79	433	170	1,099
Killed	81	399	9	55	64	234	21	135
Total	207	983	764	5,078	143	667	191	1,234
<b>Western hemlock:</b>								
65:								
Injured	164	780	966	6,496	112	572	1,420	9,590
Killed	37	168	0	0	8	22	0	0
Total	201	948	966	6,496	120	594	1,420	9,590

<sup>1/</sup> Cubic-foot volume is for trees larger than 4.9 inches d.b.h. to a 4-inch top d.i.b. Board-foot volume (International 1/4-inch rule) is for trees larger than 7.5 inches d.b.h. to a 6-inch top d.i.b.

5. No consistent differences in level of damage between a first and a second thinning were apparent.
6. Although a substantial proportion of merchantable trees was injured in some thinnings, the level of injuries was believed to be acceptable in all cases.