

Table 4.—Trees killed per acre by cutting block, year, cause, and diameter

Treatment	Year of kill	Cause of death	Diameter of tree killed (inches)											Total trees killed	Trees killed per acre		
			6	7	8	9	10	11	12	13	14	15	16			>17	
7-inch cut	1979	MPB ¹	2	3	3	3	7	4	1	1						24	0.72
		Pity's ²	1		1	1										3	.09
		Total		3	3	4	4	7	4	1	1					27	.81
	1980	MPB		2	3	5	1	2	3	1						17	.51
		Pity's			1	1										2	.06
		Comandra	1													1	.03
	Total	1	2	4	6	1	2	3	1						20	.60	
	1981	MPB									1			1	1	3	.09
		Total									1			1	1	3	.09
		All years	4	5	8	10	8	6	4	3			1	1		50	1.51
10-inch cut	1979	MPB	1	2	2	10	2	2								21	.35
		<i>lps</i> spp.	1	3	2											6	.10
		Pity's	6	8	3	5										22	.36
		Comandra		1	1											2	.03
	Total	8	15	9	15	2	2								51	.84	
	1980	MPB	1	6	12	9	4	3	2	1	1				1	40	.66
		Pity's	4	3	4	1										12	.20
		Comandra		2	2	1										5	.08
	Total	5	11	18	11	4	3	2	1	1				1	57	.94	
	1981	MPB			1	1	1							1		4	.07
		Total			1	1	1							1		4	.07
	All years	13	26	28	27	7	5	2	1	1			1	1	112	1.78	
	12-inch cut	1979	MPB												1	1	.19
Comandra			2		1		1							1	4	.77	
Total			2		1		1							1	5	.96	
1980		MPB	1	1	4	5	5	7	3							26	5.00
		Pity's					1									1	.19
		Comandra		1									1			1	.19
Total		1	2	4	5	6	7	3							28	5.38	
1981		MPB		1	2			3								6	1.15
		Total		1	2			3								6	1.15
All years		3	3	7	5	7	10	3						1	39	7.50	
100-leave tree cut	1979	MPB	1		1										2	.20	
		<i>lps</i> spp.	1			1		1							3	.30	
		Total	2		1	1		1							5	.50	
	1980	MPB		1											1	.10	
		<i>lps</i> spp.	1	1											2	.20	
	Total	1	2											3	.30		
	1981	MPB	1												1	.10	
		Total	1												1	.10	
All years	4	2	1	1			1							9	.90		
Check area	1979	MPB		4		9	5	9	1	5	1	1			36	2.53	
		Pity's		3											3	.21	
		Total		4	3	9	5	9	1	5	1	1			39	2.74	
	1980	MPB	1	1	4	11	14	18	10	8	6	1	2	6	82	5.77	
		Pity's				1									1	.07	
		Comandra					1								1	.07	
	Total	1	1	4	12	15	18	10	8	6	1	2	6	84	5.91		
	1981	MPB			6	5	9	11	13	6	5		4	1	60	4.23	
		Total			6	5	9	11	13	6	5		4	1	60	4.23	
	All years	1	5	13	26	29	38	24	19	12	2	6	7	183	12.88		

¹MPB = Mountain pine beetle.

²*Pityophthorus*, *Pityogenes*, and *Pityokteines*.

Adding the loss due to the mountain pine beetle, secondary insects, and comandra rust to the trees cut per acre gives the gross number of trees removed and thus the residual trees per acre (table 5). All cutting blocks now contain almost the same number of trees per acre, which is about one-half the number per acre now in the check area, although the average stand diameter is different.

Residual basal area followed the level of cut as would be expected (fig. 2). Using the check blocks as a base, then 66 percent of the basal area was removed in the 7-inch (17.78-cm) blocks; 55 percent in the 10-inch (25.40-cm) blocks; 45 percent in the 12-inch (30.48-cm) blocks; and 63 percent in the 100-leave-tree blocks.

There was an apparent and slightly greater radial growth, of those residual trees measured, in the 12-inch (30.48-cm), 100-leave-tree, and check blocks as compared to the 7-inch (17.78-cm) and 10-inch (25.40-cm) blocks (fig. 3). This does not necessarily reflect release by cutting, because only 1 to 2 years of growth occurred since cutting was started.

Table 5.—Net effects to the stands from cutting levels and mortality factors

Treatment	Trees per acre		Trees Killed by				Residual
	Before cut	Number cut					
			MPB ¹	<i>Ips</i> spp.	<i>Pity's</i> ²	Comandra	
7-inch cut	163.3	76.9	1.32	0	0.15	0.03	84.90
10-inch cut	215.7	113.2	11.08	0.10	.56	.11	90.76
12-inch cut	343.0	229.0	6.34	0	.19	.96	88.66
100-leave-tree cut	214.0	114.0	.30	.60	50	0	99.70
Check area	196.0	0	12.53	0	.28	.07	183.12

¹MPB = Mountain pine beetle.

²*Pityophthorus*, *Pityogenes*, and *Pityokteines*.

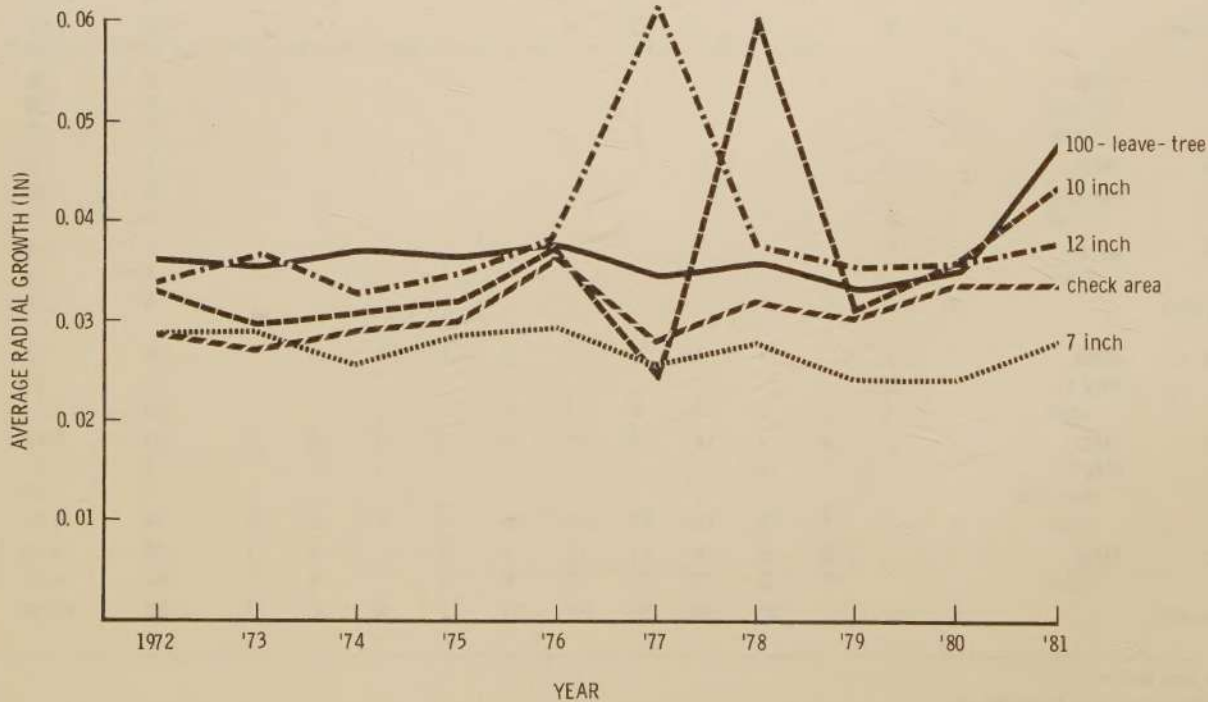


Figure 3.—Average radial growth of stand per year for last 10 years by cutting block.

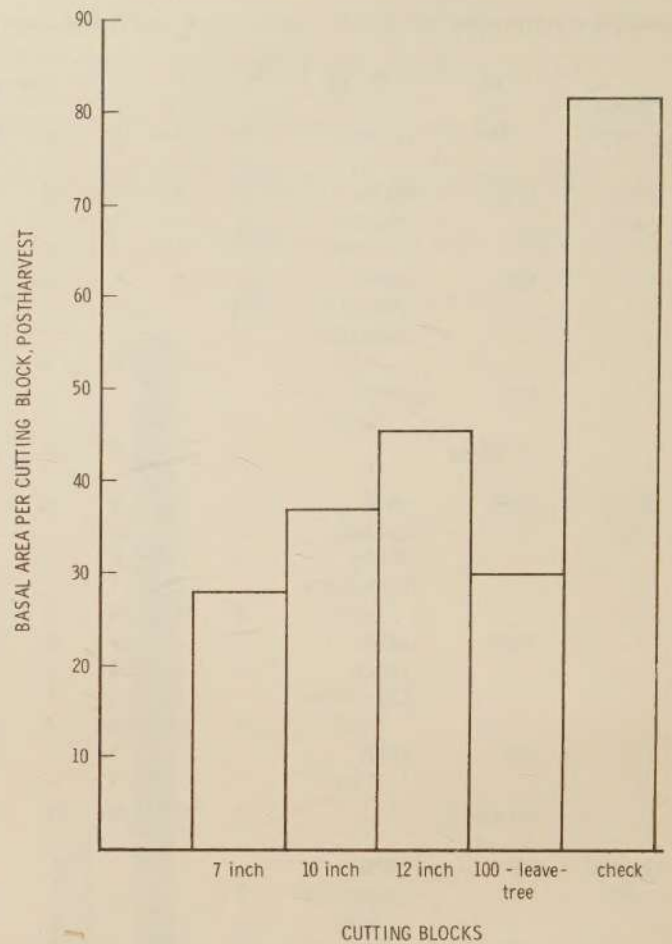


Figure 2.—Residual basal area of cutting blocks.

DISCUSSION

Having seen the immediate results of the cutting levels, the question now is of the future of these stands, with respect to the activity of the beetle and stand development. The harvest levels reduced the current level of loss somewhat proportionally, but will the beetle resume killing trees at the same ratio as before treatment or has a change been induced in the course of the infestation? To project an answer to this question, these mortality trend data were used in the Rate of Loss Model (Cole and McGregor, in press) to predict the rate of future tree loss and number of years of such an infestation (fig. 4).

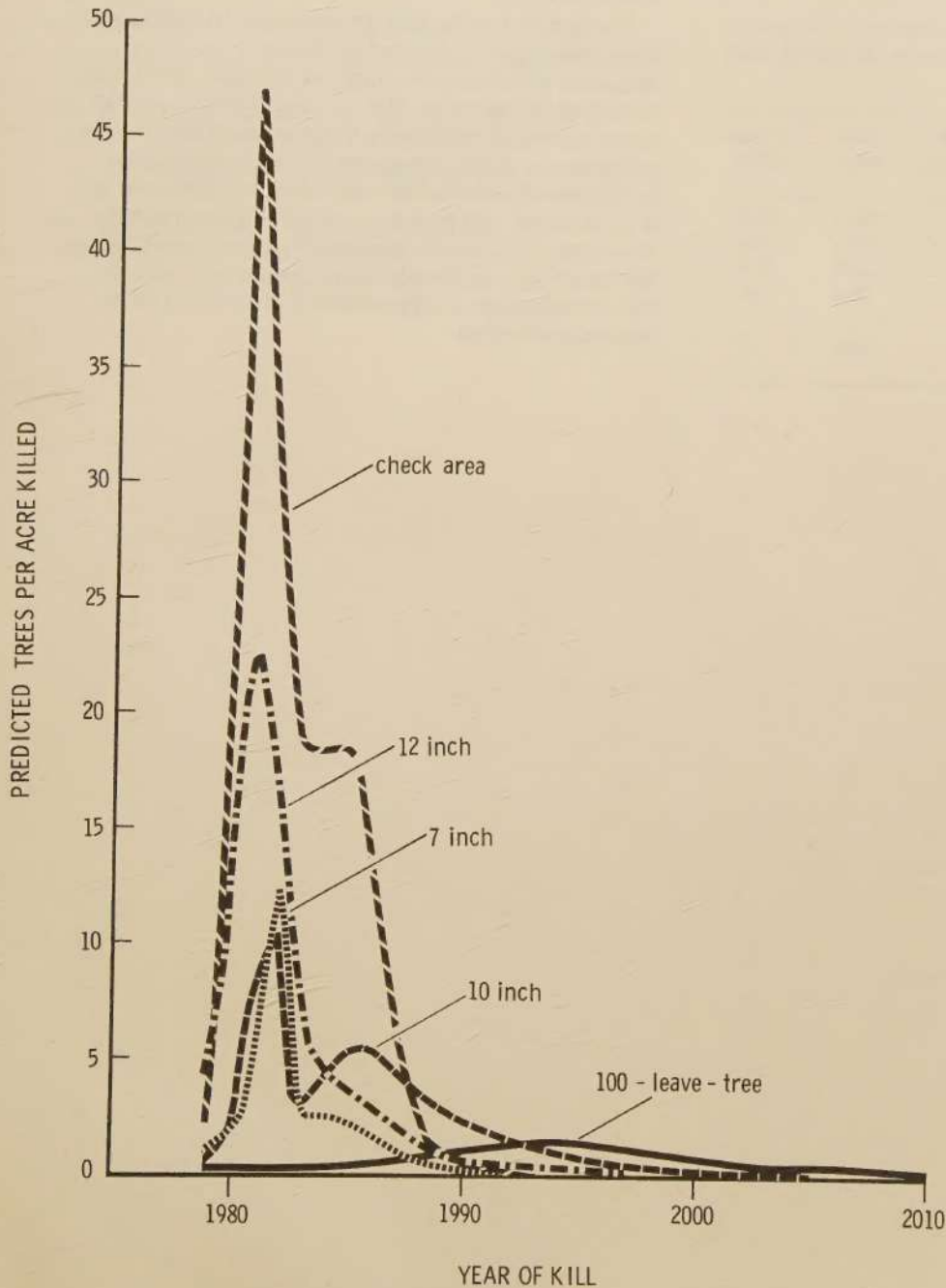


Figure 4.—Predicted trees per acre killed by mountain pine beetle, postharvest by cutting levels.

This projection showed that the infestation within the check area should peak in 1981, with 46.9 trees killed per acre (19 per ha), and subside to 1.1 trees per acre (0.44 per ha) by 1989, tailing to 0.02 tree per acre (0.008 per ha) by 1993. The diameter-limit cuts reduced the peak loss rather proportionally to the extent of cutting; for example, peak kill was greater in the 12-inch (30.48-cm) cuts than in the 7-inch (17.78-cm) cuts. The expected length of infestation changed accordingly, with the longest period of outbreak expected for the 7-inch (17.78-cm) cut. The exception was the 100-leave-tree cut. This cut extended the predicted life of the infestation to the year 2012, with peak tree loss of only 1.5 trees per acre (0.61 per ha) in the year 1993 (table 6).

Table 6.—Predicted peak loss, length of infestation, and annual drain from the mountain pine beetle by cutting level (trees per acre)

Treatment	Peak loss	Peak year	Years of infestation	Total loss	Annual drain
Check area	46.9	1981	14	180.5	12.9
12-inch cut	22.1	1981	18	80.1	4.4
10-inch cut	10.3	1982	26	62.5	2.4
7-inch cut	12.3	1982	13	32.8	2.5
100-leave-tree cut	1.5	1993	33	23.6	.7

The 100-leave-tree cut, according to these predictions, would reduce tree loss from the mountain pine beetle to a low amount. This cut would also be advantageous in reducing or minimizing dwarf mistletoe occurrence (Wicker 1967; Wicker and Shaw 1967). Once the area is reseeded and the regeneration height exceeds snow depth, the leave trees should be removed. The small target area of the regeneration, the washing action of the snow in removing dwarf mistletoe seeds, and the young stand being immune to the mountain pine beetle may well be the keys to producing a healthy new stand of lodgepole pine.

SUMMARY

The demonstration area on which diameter-limit and leave-tree cuts were applied to reduce or minimize lodgepole pine losses to the mountain pine beetle was evaluated the first year after cutting. First-year losses were reduced proportionally to the intensity of cut. Projected losses and continuation of the mountain pine beetle infestation were derived from the predictive Rate of Loss Model. The best deterrent of recurring infestation—amount of losses and length of time—was the 100-leave-tree cut. The 100-leave-tree cut also was the best in encouraging regeneration and reducing dwarf mistletoe infection.

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