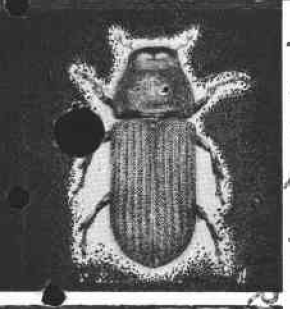

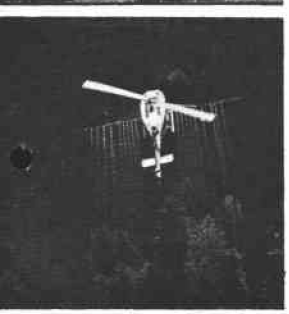

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HARVESTING STRATEGIES FOR MANAGEMENT OF MOUNTAIN PINE BEETLE INFESTATIONS IN LODGEPOLE PINE, GALLATIN NATIONAL FOREST, MONTANA PROGRESS REPORT 1976

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INTRODUCTION

Mountain pine beetle epidemics have been shown to be correlated with large diameter, thick phloem trees (Amman 1972), while decline of epidemics is correlated with loss of these trees. Furthermore, beetle brood production is directly correlated with phloem thickness, which in turn is directly correlated with tree diameter (Amman 1969; 1972).

Recent studies of lodgepole pine stands in Colorado (Cole and Cahill 1976) show that probability of loss from mountain pine beetle attack can be developed from phloem thickness/tree diameter distribution data. They theorized that harvesting strategies to reduce the average d.b.h. could be implemented, based on these probabilities, to eliminate or greatly reduce mountain pine beetle buildup potential.

A cooperative study (Hamel *et al.* 1975) to test this theory was established on the Gallatin National Forest, Montana in 1974.

Presented here are results of the first 2 years of this effort to manage mountain pine beetle populations.

METHODS

Methods are explained in Establishment Report 75-12 and Progress Report 76-3.

Although the study plan called for havesting of trees in blocks prior to emergence of adult beetles in 1975, only two blocks were logged prior to this date--the 7-inch block and major portions of the 12-inch block. As a result of not completing the harvest, resurvey of unlogged blocks was required in fall 1975. Harvest of these blocks was rescheduled prior to beetle flight in 1976. The 10-inch and phloem blocks were harvested by mid-July 1976.

In August 1976, all blocks were resurveyed to determine: current attacked trees per hectare, number of attacked trees classed "pitchouts" (unsuccessful attacks), d.b.h., and phloem thickness of attacked trees. This baseline data will provide the basis for the next 3 years' evaluations to determine efficacy of harvesting strategies.

RESULTS

Descriptions and preharvest data of each study area were presented in Establishment Report 75-12 (Hamel *et al.* 1975). Postharvest results for the 7- and 12-inch blocks, and resurvey data for check blocks are presented in Progress Report 76-3 (Hamel and McGregor 1976). Results of postharvest survey for all cut and check blocks, and a summary of data by year is presented in Table 1.

Table 1.-- Summary of sampling mountain pine beetle study blocks, Gallatin National Forest, Montana, 1974-76

Location	Mean no. of infested trees/hectare			Mean diameter of attacked trees (in cm)		Mean phloem thickness of attacked trees (in cm)		% of phloem samples from attacked trees 0.25 cm or greater		% of attacked trees classed pitchouts	
	1974	1975	1976	1975	1976	1975	1976	1975	1976	1975	1976
Hebgen Lake RD											
7-inch block	* --	0.5	5.2	18.2	14.1	0.27	0.18	83.3	16.0	<1.0	5.9
10-inch block	6	10.4	6.4	31.1	20.4	.24	.18	60.1	17.0	<1.0	21.3
Phloem block	5	10.1	28.1	28.8	24.6	.22	.17	48.8	12.5	<1.0	21.8
Check block (A)	6	6.9	20.5	26.7	24.9	.22	.20	58.4	31.5	<1.0	1.9
Gallatin RD											
12-inch block	10	3.2	4.0	33.8	25.6	.24	.15	60.4	0.1	17.0	28.1
Check block (B)	40	192.7	78.6	22.2	19.1	.22	.18	52.6	19.0	48.4	35.0

* -- initial survey was postharvest

HEBGEN LAKE DISTRICT

A mountain pine beetle infestation developed to epidemic level on the Hebgen Lake District in 1970 (Ciesla 1971; McGregor and Tunnock 1971) and has continued at that level throughout the stand where four of the blocks are located.

7-inch block.--Only six attacked trees were recorded in this block in postharvest sampling in 1975. In 1976, there were 85 attacked trees representing 5.2 trees/ha, or a buildup ratio of 1:14. Mean diameter and phloem thickness of trees attacked in 1976 were 14.1 cm and 0.18 cm respectively. Based on phloem samples taken from attacked trees, 16 percent had a mean phloem thickness $\geq$ 0.25 cm. Nearly 6 percent of the attacked trees were classed pitchouts.

10-inch block.--A total of 281 attacked trees were located in a postharvest survey of this block. This represents 6.4 trees/ha, or a decline in buildup ratio of 1:0.6. Mean diameter and phloem thickness of 1976 attacked trees were 20.4 cm and 0.18 cm respectively. Based on phloem samples taken from attacked trees, 17 percent had mean phloem thickness $\geq$ 0.25 cm. More than 21 percent of attacked trees were classed pitchouts.

Phloem block.--A total of 454 attacked trees were located in a postharvest survey of this block, representing an average 28.1 trees/ha, or a buildup ratio of 1:2.7. Mean diameter and phloem thickness of attacked trees were 24.6 cm and 0.17 cm respectively. Based on phloem samples taken from attacked trees, 12 percent had mean phloem thickness $\geq$ 0.25 cm. More than 21 percent of the attacked trees were classed pitchouts.

Check block (A).--The check block established adjacent to the 7-inch block remained undisturbed with regard to harvesting. Survey of the area was conducted to determine buildup ratio. Mean number of infested trees was 20.5/ha in 1976. This compared to 6.9 trees/ha for 1975 or a buildup ratio of 1:2.9. Mean d.b.h. and phloem thickness of attacked trees were 4.9 cm and 0.20 cm respectively. Based on phloem samples taken from 1976 attacked trees, 31 percent had mean phloem thickness $\geq$ 0.25 cm. Nearly 2 percent of the attacked trees were classed pitchouts.

GALLATIN DISTRICT

The mountain pine beetle infestation on the Gallatin District has continued at epidemic levels since 1969 (McGregor and Dewey 1971; McGregor 1973; McGregor *et al.* 1976). The 12-inch and a check block are within this area of infestation.

12-inch block.--Harvest of all infested trees 30 cm d.b.h. and larger, was completed in this block prior to beetle flight in 1975; however, the remaining "marked" green trees were not removed until spring 1976. In 1976, there were 64 attacked trees in the block or 4/ha, a buildup ratio of 1:1.2. Mean diameter and phloem thickness of 1976 attacked trees were 25.6 cm and 0.15 cm respectively. Based on phloem samples taken from attacked trees, less than 1 percent had mean phloem thickness $\geq$ 0.25 cm. More than 28 percent of the attacked trees were classed pitchouts.

Check block (B).--This block is along Hellroaring Creek in an area of extremely heavy infestation. The block remained undisturbed with regard to harvesting. The block was surveyed and the average number of infested trees was 78.6/ha in 1976. This compared to 192.7 trees/ha in 1975, or a decline in buildup ratio of 1:0.5. This decline can be attributed to food supply depletion as most of the host type has already been killed by the beetle. Mean d.b.h. and phloem thickness of 1976 attacked trees were 19.1 cm and 0.18 cm respectively. Based on phloem samples taken from 1976 attacked trees, 19 percent had mean phloem thickness $\geq$ 0.25 cm. More than 35 percent of the attacked trees were classed pitchouts.

DISCUSSION

To test the theory that certain harvesting strategies can be implemented in lodgepole pine stands to eliminate or at least greatly reduce mountain pine beetle depredations, a series of study blocks were established and given cutting prescriptions in 1974. Harvesting of all blocks was completed by 1976, and a 3-year postharvest evaluation began in 1976 will determine the efficacy of this forest management alternative.

In the 7-inch block, all trees 18 cm d.b.h. and larger were cut regardless of phloem thickness. Since mountain pine beetle prefers large diameter trees and beetle survival is greater in them (Amman 1972), this range of host material was eliminated from this block. It was predicted in the Establishment Report (Hamel *et al.* 1975) that, (a) future infestation levels in the 7-inch block would be minimal, and (b) trees attacked would have thicker than average phloem for their tree diameter class. In a 100 percent cruise of the block in 1975, only six newly infested trees were located. Mean phloem thickness of these trees was 0.27 cm, whereas the mean for this stand in 1974 was 0.16 cm.

One possible explanation for the dramatic increase to 5.2 trees/ha in 1976 is that pole cutters strayed into this block and cut numerous 10- to 15-cm poles leaving piles of slash throughout the area. Terpenes emitted from cutting and subsequent slash accumulations may have attracted mountain pine and other bark beetles which attacked the relatively small diameter trees in the area. Generally trees this small have thin phloem incapable of supporting large broods (Amman 1972). Also, small diameter trees dry out faster than larger trees, subsequently resulting in mortality of developing brood. These two mortality factors may prevent any additional population buildup in the 7-inch block.

Harvest in the 10-inch block was completed in mid-July 1976. Preferably harvest should have been completed before mid-July since many freshly cut stumps and slash were in the area during beetle flight in 1976. The abundance of terpenes emitted from this material may have attracted beetles to the area. Also, as a result of a hurried schedule to remove trees prior to beetle flight, timber harvesters damaged an inordinate number of standing green trees. A total of 281 attacked trees were tallied in the block representing 6.4 trees/ha. It is expected that the number of infested trees will decrease in the future since the majority of susceptible host material has been removed.

The selective harvesting plan for the 12-inch area was to remove all trees 30 cm d.b.h. and larger regardless of phloem thickness. A contract was let to log this area with horses in 1975. Although all 1974 infested trees were removed prior to beetle flight in 1975, the majority of marked green trees 30 cm d.b.h. and larger were not. These trees were, however, removed in spring 1976. A total of 64 attacked trees were recorded in this block in 1976 or 4 trees/ha.

Logging in the phloem block was completed about the same time as in the 10-inch block and problems associated with late harvest and damage to residual trees occurred in both areas. In each area, as much as 12 percent of the current attacks occurred on trees damaged during harvest. A total of 454 attacked trees were recorded in the phloem block representing 28.1 trees/ha. Numbers of infested trees in the future should decline in this block as trees having greater phloem thickness and, therefore, greater brood production capability have been removed.

Future reduction in infestation levels in each block is expected to be proportional to the amount of large diameter or thick phloemed, susceptible timber removed. Beetle populations are expected to continue at epidemic levels and provide the basis for comparison of treatments with check blocks, where harvesting will not occur.

Evaluations will continue through 1979 to determine the feasibility of the proposed phloem thickness-tree diameter harvesting strategies for management of mountain pine beetle infestations.

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