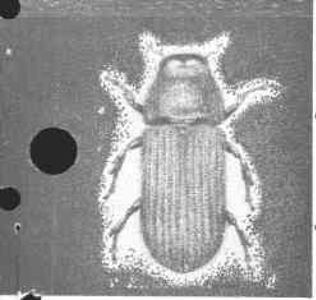
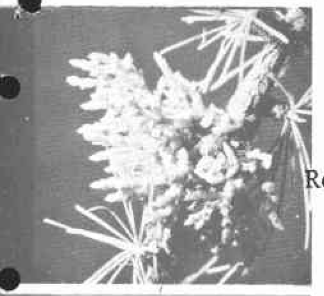

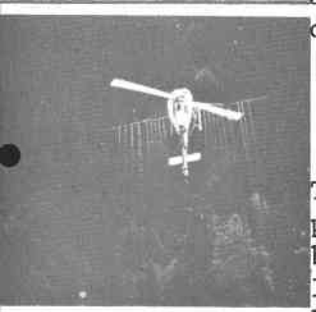

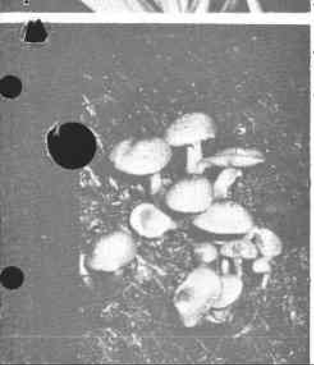



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# A REVIEW OF SELECTED MOUNTAIN PINE BEETLE EPIDEMICS AND THE INFESTATION POTENTIAL FOR THE TALLY LAKE RANGER DISTRICT FLATHEAD NATIONAL FOREST, MONTANA

By

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## ABSTRACT

This report contains a brief history of selected mountain pine beetle infestations and the potential for infestations in high-hazard stands on the Tally Lake Ranger District. Management alternatives to lessen the severity, or reduce the possibility, of infestations are discussed.

## INTRODUCTION

The mountain pine beetle is the most serious pest of lodgepole pine throughout its range in the West. Periodic population buildups have probably occurred for as long as the beetle and lodgepole pine have shared a common habitat. Presence of the beetle has been recorded in ponderosa and lodgepole pine stands in the Region since 1909. Recent infestations developed to epidemic proportions on the Gallatin National Forest, Montana, in 1969. These beetle populations were increasing concurrently with those which swept through Yellowstone National Park beginning in 1966. This outbreak was a continuation of the one on the Targhee National Forest, Idaho (Region 4), where mountain pine beetle populations began increasing in the late 1950's. The Targhee infestation is now subsiding due to host depletion. We believe that populations on the Gallatin National Forest and Yellowstone National Park will soon begin to decline, particularly where infestations have occurred for 5 or more years. These infestations, having existed for a decade or more, have had devastating effects on timber inventories.

A multiphase damage assessment survey conducted on the Targhee National Forest showed that through 1977, on 396,000 acres sampled, beetles accounted for over 21 million standing dead lodgepole pine (Klein, Bennett, and Young 1978). A permanent trend survey on the Targhee National Forest which measured annual mortality for a period of 5 years, showed that on the area surveyed, 69.5 percent of the lodgepole >6 inches d.b.h. were killed between 1973 and 1977 (Gibson and Bennett 1978), and the infestation is continuing. Aerial and ground surveys recently completed in the Northern Region indicate current year lodgepole mortality attributable to mountain pine beetle exceeds 42 million trees (McGregor, Gibson, and Bennett 1979).

Buildup ratios (i.e., newly attacked trees to last year's attacked trees) in many parts of the Region exceed 2:1. Unless natural factors reduce populations, we expect total trees killed in the Region in 1979 may be double the number killed in 1978.

Of the more than 42 million trees killed in 1978, nearly 45 percent were confined to the Yellowstone-Gallatin infestations. The second highest area of tree mortality occurred in northern Montana on the Flathead National Forest and Glacier National Park. This infestation developed to epidemic status in 1972 and has increased rapidly since. Ground surveys conducted this year showed more than 90 new attacks per acre within Glacier Park. The epidemic in the Park increased from 1,180 acres in 1972 to about 164,000 acres in 1978. In 1975, the epidemic spread into the susceptible lodgepole pine stands on the Glacier View Ranger District (McGregor, Hamel, and Kohler 1978). The infestation increased from 80 acres in 1975 to more than 78,000 acres in 1978 (48,500 National Forest land; 30,000 private). This infestation developed from local broods and was augmented by beetles from within the Park. Ground surveys showed more than 79 newly infested trees per acre following the 1978 attack period.

Table 1 lists infestation intensity by year for both the Park and Glacier View Ranger District.

Table 1.--Mountain pine beetle infestations - Glacier National Park and Glacier View Ranger District, Flathead NF, 1972-1978

| | Glacier National Park | | Glacier View RD | |
|---|---|---|---|---|
| Year | Acres | Trees/acre | Acres | Trees/acre |
| 1972 | 1,180 | 4.9 | -- | -- |
| 1973 | 3,600 | 10.9 | -- | -- |
| 1974 | 4,630 | 32.6 | -- | -- |
| 1975 | 13,354 | 19.3 | 80 | 6.1 |
| 1976 | 103,887 | 46.6 | 1,213 | 10.3 |
| 1977 | 142,871 | 76.7 | 27,610 | 55.7 |
| 1978 | 164,492 | 89.8 | 78,500 | 79.3 |

Much has been written concerning the above infestation in terms of volume loss, expected mortality, and predicted infestation trend. Those figures need not be reiterated; rather those quoted will serve as a historical perspective from which to view future epidemics on adjacent Districts.

The North Fork Flathead River infestation (Glacier View RD and Glacier NP) has been used as an example because of its proximity to the Tally Lake Ranger District. However, adjacent areas on the Kootenai and Lolo National Forests are also experiencing widespread tree killing.

The following describes surveys conducted on surrounding Districts.

## SURVEY METHODS

To supplement annual aerial detection surveys, ground plots were established in currently infested stands following beetle flight. These surveys obtain accurate data concerning trees attacked in 1978, previous years' mortality, and the remaining green stand. Buildup ratios, used for predicting future mortality, were determined.

Ten variable plots (BAF 10) were laid out, where practicable, at a 5- by 5-chain spacing in each survey area. On each plot "in" trees were determined using a relaskop or a 10-factor prism. Trees were recorded according to the following criteria: green; current attack; previous year attack; older dead, strip attack; unsuccessful attack; or other mortality. All species were tallied by diameter. Heights of the first two trees of each species were recorded for volume estimations. Data were analyzed using computer program INDIDS (Bousfield 1977).

The number of survey areas established in a given infestation depended on infestation level, available personnel, and time. Four areas surrounding the Tally Lake RD were surveyed in 1978. They were: Flathead NF (Glacier View RD), Kootenai NF (Fisher River, Rexford, and Yaak RD's), Lolo NF (Thompson River drainage), and Glacier National Park (figure 1).

## RESULTS

Our 1978 surveys show 78 newly attacked trees per acre on the Flathead NF, 21 per acre on the Kootenai NF, 23 per acre on the Lolo NF, and 90 per acre in Glacier NP. Tables 2 through 5 summarize data from each area.

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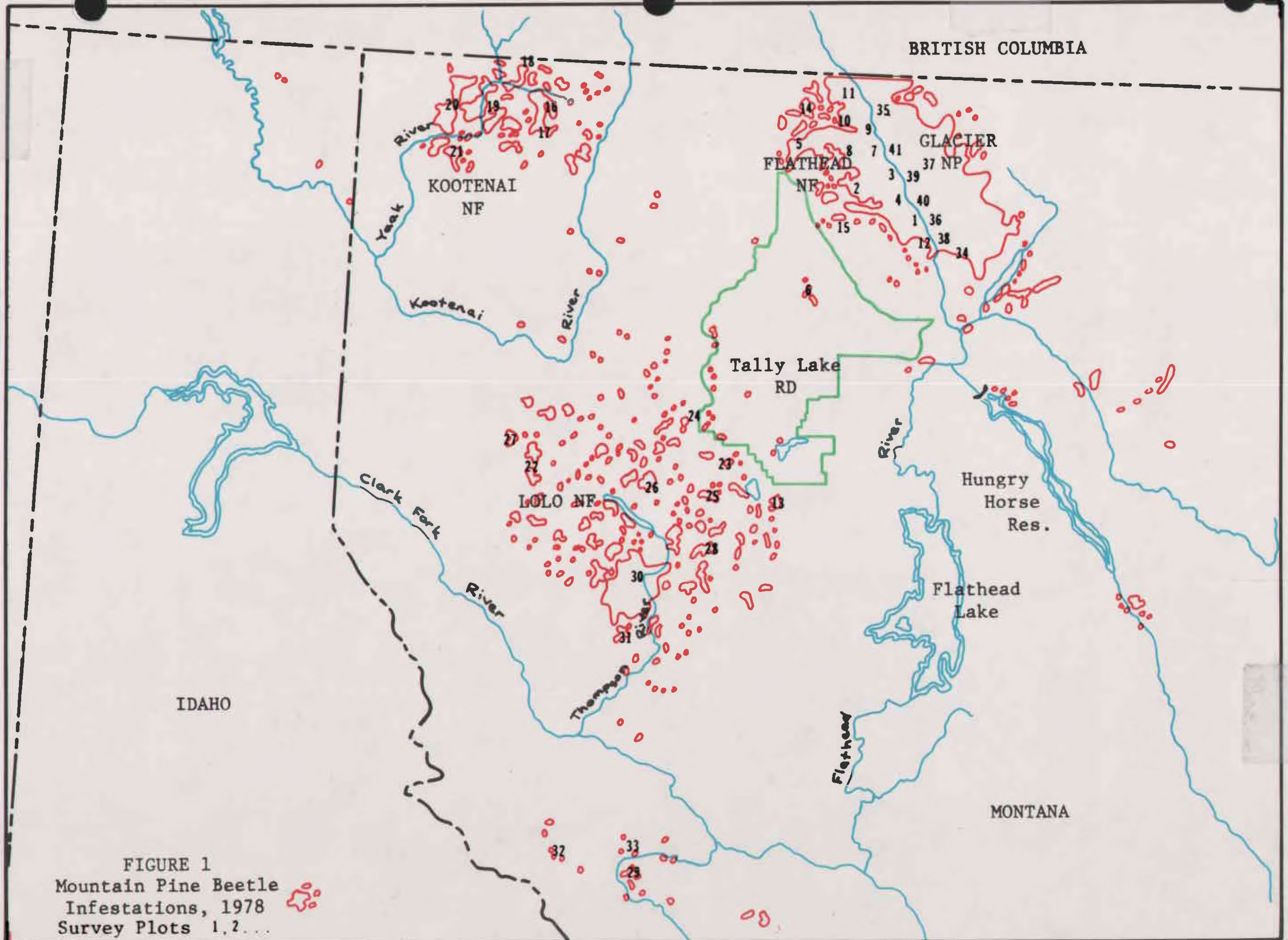


FIGURE 1
Mountain Pine Beetle Infestations, 1978
Survey Plots 1, 2 . . .

Table 2.--Ground survey data, Flathead NF, 1978

| Plot location | 1977 attacks LPP/acre | 1978 attacks LPP/acre |
|---|---|---|
| (1) Coal Creek | 40.8 | 118.9 |
| (2) Upper Red Meadow | 6.1 | 28.9 |
| (3) Red Meadow Creek | -- | 42.5 |
| (4) Spring Creek | 25.6 | 162.0 |
| (5) Whale Creek (2) | 36.7 | 98.3 |
| (6) Olney | 14.6 | 43.4 |
| (7) Center Mountain | 12.3 | 23.9 |
| (8) Whale Creek (1) | 57.3 | 42.2 |
| (9) Trail Creek | 91.9 | 256.8 |
| (10) Upper Trail Creek | 3.7 | 30.9 |
| (11) Upper North Fork | 12.6 | 45.1 |
| (12) Lower Moran | 19.4 | 48.1 |
| (13) Rogers Lake | 26.3 | 128.6 |
| (14) Tuchuck Creek | 8.7 | 17.6 |
| (15) Hay Creek | 10.4 | 80.4 |
| Average | 24.4 | 77.8 |

Buildup ratio = $x/x_1$ = $77.8/24.4$ = 3.16:1

Predicted mortality in 1979 = bx = 245.8 trees/acre

Table 3.--Ground survey data, Kootenai National Forest, 1978

| Plot location | 1977 attacks LPP/acre | 1978 attacks LPP/acre |
|---|---|---|
| (16) Basin Creek (1) | 0.5 | 5.1 |
| (17) Basin Creek (2) | 7.1 | 30.5 |
| (18) Caribou Creek | 4.7 | -- |
| (19) Vinal Creek | 2.7 | 7.5 |
| (20) Slim Creek | 9.6 | 11.7 |
| (21) Cool Creek | 2.9 | 7.9 |
| (22) Tepee Creek | 8.1 | 16.2 |
| (23) Dahl Lake | 8.6 | 3.7 |
| (24) Lynch Lake | 2.9 | 59.6 |
| (25) Pleasant Valley | 22.3 | 29.7 |
| (26) Snell Creek | -- | 42.1 |
| (27) Libby Creek | 53.2 | 6.4 |
| (28) McGregor Lake | 20.5 | 55.5 |
| Average | 11.0 | 21.2 |

Buildup ratio = $x/x_1$ = $21.2/11.0$ = 1.93:1

Predicted mortality in 1979 = bx = 40.9 trees/acre

Table 4.--Ground survey data, Lolo National Forest, 1978

| Plot location | 1977 attacks LPP/acre | 1978 attacks LPP/acre |
|---|---|---|
| (29) North Lolo | -- | 7.7 |
| (30) Bend Campground | 10.1 | 70.7 |
| (31) Fishtrap Creek | 57.1 | 20.8 |
| (32) Mayo Creek | 5.7 | 14.6 |
| (33) Tamarack Creek | -- | 1.8 |
| Average | 14.6 | 23.1 |

Buildup ratio = $x/x_1 = 23.1/14.6 = 1.58:1$

Predicted mortality in 1979 = bx = 36.5 trees/acre

Table 5.--Ground survey data, Glacier National Park, 1978

| Plot location | 1977 attacks LPP/acre | 1978 attacks LPP/acre |
|---|---|---|
| (34) Camas Creek | 1.0 | 95.8 |
| (35) Lower Kintla | 54.9 | 296.5 |
| (36) Quartz Creek | 60.6 | 58.8 |
| (37) Upper Bowman | 34.8 | 154.0 |
| (38) Logging Creek | 33.6 | .8 |
| (39) Lower Bowman | 51.5 | 12.7 |
| (40) Quartz Ridge | 64.2 | 17.7 |
| (41) Mud Creek | 60.1 | 81.9 |
| Average | 45.1 | 89.8 |

Buildup ratio = $x/x_1 = 89.8/45.1 = 1.99:1$

Predicted mortality in 1979 = bx = 178.8 trees/acre

## DISCUSSION

Baker (1968) developed a method by which future mortality may be predicted. This mortality is determined using a buildup ratio which is a ratio of current year to previous year's mortality. His formula for predicted mortality is: $y' = y + bx$

Where: $y'$ = predicted mortality through next year
$y$ = trees killed through current year
$b$ = buildup ratio $(x/x_1)$
$x$ = trees killed current year
$x_1$ = trees killed previous year

Note: All figures are in trees per acre.

Buildup ratios and predicted tree mortality for each of the four areas surveyed is included in tables 2 through 5. In each case, tree mortality in 1979 is expected to increase significantly.

One possible ameliorating factor is the severely cold temperatures experienced during December 1978 and January 1979. Schmid and Frye (1977) cite evidences showing spruce beetle mortality has been high when subjected to temperatures as low as -40°F for 5 consecutive days or more. Temperatures of -31 to -40°F during December 1932-January 1933 caused high mountain pine beetle brood mortality, and a drastic reduction in number of trees killed in 1933 on the Beaverhead National Forest 1/. The effects of cold temperatures experienced this winter on mountain pine beetle populations will be known this spring. The reduction in 1979 attacked trees will be determined after beetle flight in September. The best we can probably expect is a 2- to 3-year respite. As long as highly susceptible lodgepole stands remain, beetle populations will assuredly recover.

Predicted Infestation Trend - Tally Lake Ranger District

Safranyik 2/, doing mountain pine beetle research in British Columbia, has identified six criteria for determining the likelihood of beetle immigration into an uninfested area:

1. Historic evidence of beetle activity in surrounding areas.

2. Recent beetle activity, particularly within the past 3-5 years. Determination of building or declining populations.

3. Tree age, size, and species distribution within the uninfested area. Are trees of a susceptible age and size class and does the stand have a high percentage of host species?

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1/ Unpublished data, Region 1 files.
2/ Safranyik, L. 1979. Personal communication.

4. Large contiguous areas of high-hazard, uninfested trees.

5. Major outbreaks near the uninfested area. There is much evidence to show that beetle populations do migrate into, as well as develop in, a given stand.

6. Relationship of elevation and latitude.

Many of these same criteria have been outlined by Amman, et al. (1977). Their criteria for a high-hazard lodgepole stand are:

1. Average stand age >80 years.

2. Average stand diameter >8 inches.

3. Elevation <6,000 feet (at 48° N latitude).

After measuring several lodgepole pine stands in Colorado, Cole and Cahill (1976) stated that epidemics are not as likely to occur in stands where less than 20 percent of the trees are more than 8 inches d.b.h. and contain phloem 0.11 inch thick or thicker. They concluded that the distribution of phloem thickness over tree diameter classes can be an effective measurement for evaluating infestation potential in a lodgepole pine stand.

According to a recently completed stand examination conducted by personnel on the Tally Lake Ranger District, 319 MMBF of lodgepole pine exist in a high-risk category on the District (figure 2). This volume comprises 72 percent of the volume found in these stands, which encompasses about 38,000 acres. Many stands are nearly pure lodgepole. Other species make up only 123 MMBF of the merchantable volume. Safranyik 2/ maintains that in such an area, with major infestations nearby, the probability exceeds 90 percent that it, too, will soon be infested.

Knowing that much of the lodgepole pine on the Tally Lake District is high-hazard and that beetles exist on nearly every side of the District, we can assume that the District has a high probability of having a serious beetle infestation. The only unknown is time. How long it will take beetle populations to develop to epidemic proportions is not known, but it will probably be within 2 to 3 years. With that knowledge, harvest schedules should include removal of high-hazard lodgepole within that same 2- to 3-year period. In addition to removing the highest hazard trees, this will greatly reduce beetle pressure and subsequent tree mortality in stands rated moderate and low hazard.

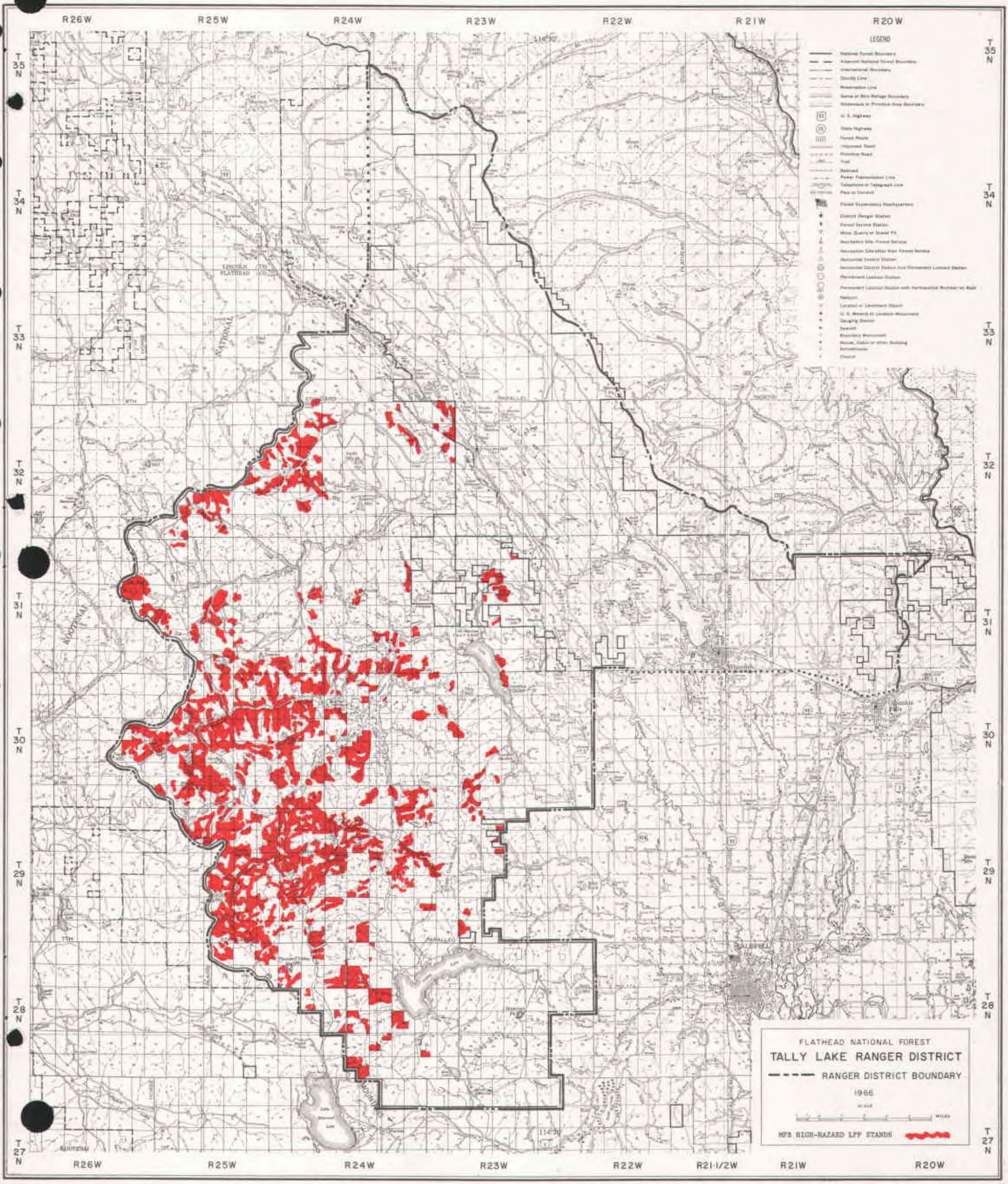
R26W
R25W
R24W
R23W
R22W
R21W
R20W
LEGEND
T 35 N
T 34 N
T 33 N
T 32 N
T 31 N
T 30 N
T 29 N
T 28 N
T 27 N
FLATHEAD NATIONAL FOREST
TALLY LAKE RANGER DISTRICT
RANGER DISTRICT BOUNDARY
1966
MPB HIGH-HAZARD LPP STANDS
R26W
R25W
R24W
R23W
R22W
R21-1/2W
R21W
R20W

FIGURE 2

This page for Figure 2.

Management Strategies, Tally Lake Ranger District

Within the past several years, much valuable information has been obtained concerning manipulation of mountain pine beetle populations through appropriate stand management. Cole (1977) and Amman, et al. (1977) have stated that infested stands and high-risk stands can be managed in several ways depending upon land use objectives and stand composition. Where extensive stands contain larger diameter and older age trees (high risk), such as many of those on the Tally Lake Ranger District, they can be broken up by small organized clearcuts. This will help eliminate those stands which are conducive to large beetle population buildups. Where smaller stands are, or approach, high risk, they should be completely removed.

Where composition is pure lodgepole and form is even-aged, practices should be limited to:

1. Stocking control in young stands.

2. Organized clearcutting in blocks to create age, size, and species mosaics from mature stands.

3. Salvage or partial cuts.

4. Salvage cutting to reduce mortality in stands under attack (Cole 1977).

In uneven-aged pure lodgepole pine and mixed species stands, the preventive practices mentioned for pure, even-aged lodgepole pine stands are also feasible (Cole 1977). In mature mixed species stands with large lodgepole pine in the overstory, block clearcutting is recommended as a preventative to develop a mosaic pattern. If already attacked, mortality can be reduced by salvage cutting. Selective cutting to remove overstory lodgepole pine is recommended provided the residual trees are the desired species, age, and stocking level. If immature, such stands are candidates for stocking control, with species discrimination possible while reducing stand density in mixed species stands.

Discrimination against lodgepole pine is possible in older mixed stands through partial cuts in which only the most susceptible lodgepole pine portion of the main stand is removed (Cole 1977).

Partial cutting has been shown an effective treatment to reduce potential mortality in susceptible stands (Hamel and McGregor 1976; Cole and Cahill 1976; Hamel 1977). Amman (1976) stated, "Because the beetle concentrates heavily on trees of large diameter, continuous lodgepole forests at low elevations could be broken up into small blocks of different age and size classes, thereby reducing the area likely to be infested at any one time."

Cautions have been issued, however, for the use of partial cuts. Where timber values are primary, partial cuts for beetle management may only be appropriate where a small proportion of the trees are high-risk lodgepole and where enough residual trees remain to maintain productivity (Amman 1976). Alexander (1975) has further cautioned that lodgepole stands partially opened may be more susceptible to windthrow, dwarf mistletoe, and logging damage.

Data (unpublished) from the Lolo National Forest shows that selective cutting--removing some large as well as small diameter trees--has prevented and reduced beetle attack along visual areas such as roads, streams, etc. This will also lessen the siltation impact to stream channels which could be created by clearcutting. Partial cutting, whether selectively leaving large and small diameter lodgepole pine, or a straight commercial thinning based on tree diameter regardless of crown, has prevented and/or reduced incidence of beetle attack in stands on the Plains Ranger District, Lolo National Forest.

Finally, partial cutting can be applied as a last resort to after-the-fact salvage of beetle-killed trees. An increased utilization of sound material and a degree of direct control of beetle populations by removing beetle-infested trees would buy time to accomplish preferred block cutting (McGregor, et al. 1978).

One additional management alternative exists for those stands where single-tree esthetic values are primary. In campgrounds, summer home areas, or around administrative sites, high-value trees can be successfully protected from mountain pine beetle attack through the use of preventive sprays. An application of Sevimol-4®, a water-soluble mixture of carbaryl insecticide in a molasses carrier, prior to beetle flight has proven to be a safe, economical, and highly efficient means of protecting individual trees (Gibson 1978).

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