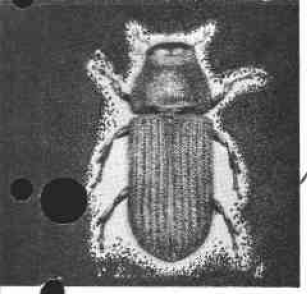

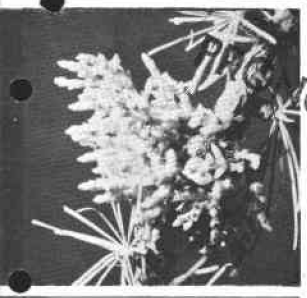

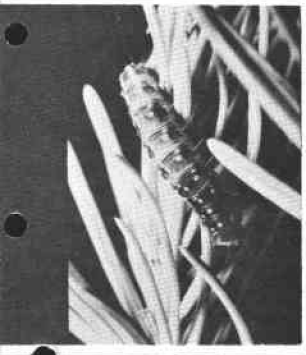

FOREST INSECT & DISEASE MANAGEMENT

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STATUS OF MOUNTAIN PINE BEETLE INFESTATION, GALLATIN NATIONAL FOREST - 1976

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ABSTRACT

Mountain pine beetle developed to epidemic level in lodgepole pine stands in 1969 on the Gallatin District and in 1970 on the Hebgen Lake District. Epidemic infestation occurs on 53,437 hectares. Infestations will intensify in most areas currently infested and develop in uninfested stands, and in excess of 2 million trees could be killed in 1977. Salvage logging to remove brood trees and silvicultural management to reduce average stand diameter below 20.3 cm d.b.h. are recommended to manage the infestation.

INTRODUCTION

Mountain pine beetle (*Dendroctonus ponderosae* Hopk.) developed to epidemic level in lodgepole pine (*Pinus contorta* var. *latifolia* Engelm.) stands directly west of Squaw Creek Ranger Station, Gallatin District, Gallatin National Forest, in 1969. A significant increase in number of newly attacked trees has occurred in susceptible stands since 1969 on the Gallatin and Hebgen Lake Districts. Surveys showed approximately 463,212 trees were killed containing 249,245 cubic meters on the Gallatin District through 1975 (McGregor et al. 1976).

During this infestation, buildup ratio of old to newly attacked trees has exceeded 1:1 annually. Significant increases in acres

infested and number of newly attacked trees occurred from Spanish Creek and Cottonwood Creek drainages on the north end of the District to Buck and Buffalo Horn Creek drainages in the south end of the District. Tree mortality is continuing at a high level in susceptible stands in the West Fork drainage.

The infestation on the Hebgen District was detected in 1970 (Ciesla 1971; McGregor and Tunnock 1971). Extensive infestation occurs from Moose Creek Plateau on the south end of the District north to Targhee Pass, thence northeast to Johnson Lake. New infestation loci occur in the Cherry Creek, Rumbaugh-Spring Creek drainages on the west side of Hebgen Lake and at the mouth of Beaver Creek between Hebgen and Quake Lakes. Infestations are assumed to have developed from inplace buildup of beetle populations and also from beetles migrating from the massive infestation in Yellowstone National Park.

Surveys through 1976 showed that infestation occurred on 29,461 hectares on the Gallatin District (figure 1) and 23,976 hectares on the Hebgen Lake District (figure 2). To provide management direction and maintain estimates of number of infested trees, volume loss data, and infestation spread and trend, the Gallatin District was surveyed every other year from 1970 through 1975. The Hebgen District has not been surveyed other than mapping infested areas during the annual aerial insect and disease detection surveys.

Because yearly operational surveys are not feasible, plots were established during 1976 in various drainages to obtain estimates of number of infested trees and buildup ratios.

METHODS

Estimates of infested trees/hectare and buildup ratios were based on 40 0.10-ha plots located on lines at 100-m intervals in five infested drainages. A hypsometer was used to determine trees to be tallied within plots. Each green and infested tree 13 cm d.b.h. (diameter at breast height) and larger was recorded by d.b.h. to the nearest centimeter, species, and categorized into one of the following classes:

0 = Green, uninfested

1 = 1976 attack; green or partially faded foliage, brood in cambium, blue stain present

2 = 1975 attack; red foliage, brood emerged

3 = 1974 or prior attack; majority of needles dropped

4 = Unsuccessful attack or pitchout; green foliage, pitch tubes present, brood and blue stain absent

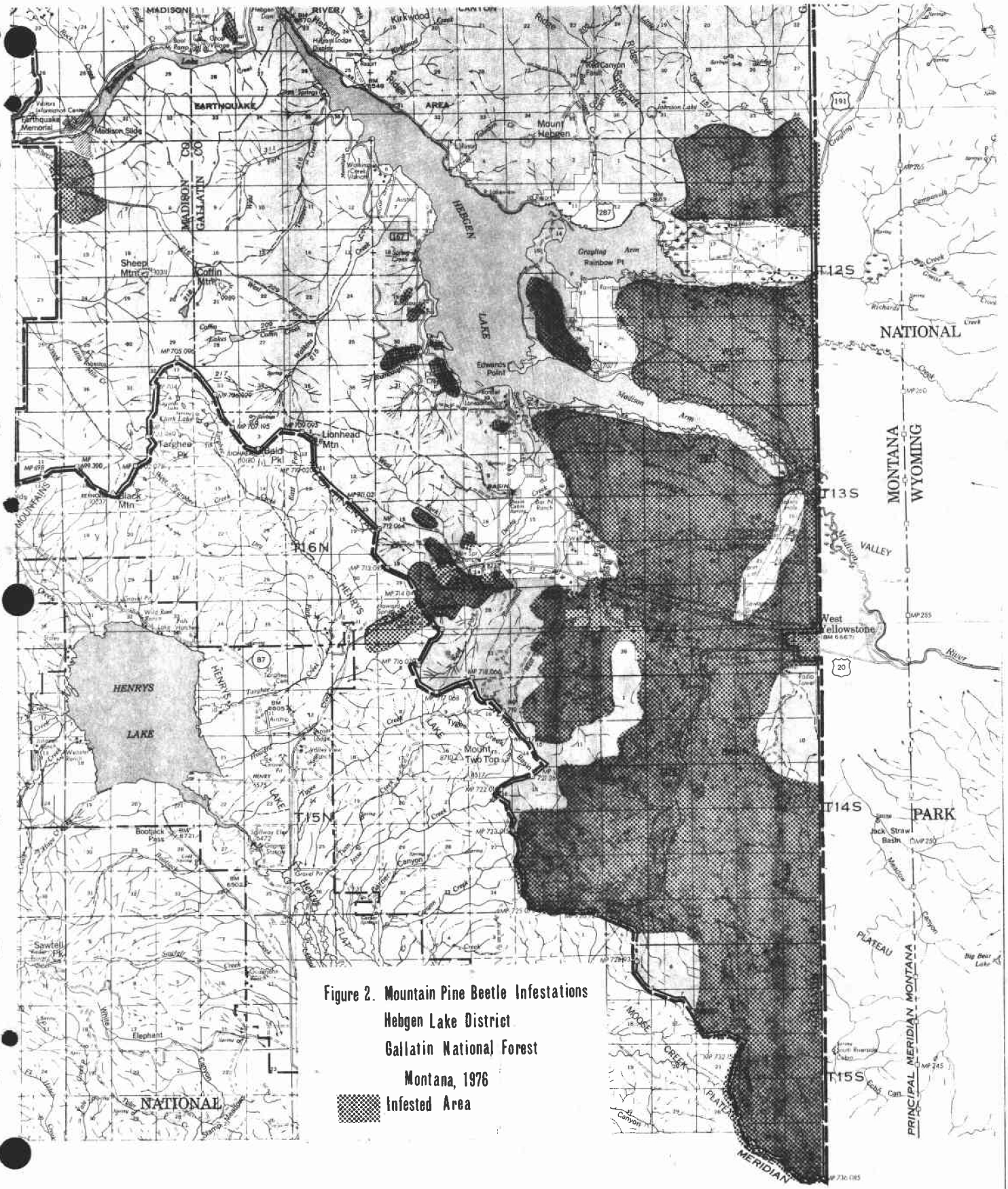

Figure 2. Mountain Pine Beetle Infestations
Hebgen Lake District
Gallatin National Forest
Montana, 1976
Infested Area

Data were used for predicting additional tree mortality that will probably occur in 1977.

RESULTS

Coniferous stands surveyed are mixed species with lodgepole pine comprising the major component with the exception of the Squaw Creek drainage (table 1). Habitat type ranges from AF/Libo - DF/Syal at low elevations (1,630 m) to AF/Vasc - AF/Libo at higher elevations (2,499 m) (Pfister et al. 1974).

Infestation Intensity - Infestation intensity by year in areas surveyed is presented in table 2. Numbers of infested trees in 1976 ranged from a low of 16.8/ha in Spanish Creek to a high of 150.2/ha in Tamphrey Creek. Mean d.b.h. ranged from 18 to 26.1 cm in 1976. Buildup ratio of old to newly infested trees was 1:0.6 in Spanish Creek; 1:0.3 in Squaw Creek; 1:1.3 in Cascade-Lava Lake area; 1:1.5 at Karst; and 1:19 at Tamphrey. Average buildup ratio was 1:1.3.

There is an average of 87.9 infested trees/ha on approximately 29,461 ha on the Gallatin District. Based on these estimates, 2,589,621 trees are infested. Of the 26,461 hectares infested, 14,063 ha of the infested area is on State and private lands.

Using an average of 20.5 infested trees/ha (Hamel et al. 1977), it is estimated that 491,508 newly infested trees occur on 23,976 ha on the Hebgen District.

Table 1.--Green stand data in areas surveyed, Gallatin District, Gallatin National Forest, 1976.

Area	Tree species	Percent of stand	Trees/ha
Spanish Creek	LPP	72.2	148
	DF	24.1	49
	S	2.4	5
	SAF	1.2	2
Squaw Creek	LPP	16.4	37
	DF	83.5	188
Cascade Creek	LPP	90.2	568
	DF	9.0	57
	S	0.7	5
Karst	LPP	90.9	173
	DF	9.0	17
Tamphrey Creek	LPP	82.5	163
	DF	11.2	22
	S	6.2	12

*LPP = lodgepole pine; DF = Douglas-fir; S = Engelmann spruce; SAF = subalpine fir.

Table 2.--Summary of infested stands surveyed, Gallatin District, Gallatin National Forest, 1977

Area	Infested trees/ha			Mean d.b.h. of attacked trees (in cm)			Buildup ratio	
	1974	1975	1976	1974	1975	1976	1974-75	1975-76
Spanish Creek	22.7	27.6	16.8	27.9	28.4	25.1	1:1.2	1:0.6
Squaw Creek	53.3	228.3	69.1	25.1	23.6	18.0	1:4.2	1:0.3
Cascade-Lava Lake	13.8	20.7	74.1	23.3	26.1	26.1	1:1.5	1:1.3
Karst	12.8	70.1	105.7	26.9	27.4	24.6	1:5.4	1:1.5
Tamphrey Creek	1.9	7.9	150.2	22.8	26.1	24.6	1:4.0	1:19.0

DISCUSSION

Mountain pine beetle developed to epidemic level in 1969 on the Gallatin District and in 1970 on the Hebgen Lake District. Beetle populations have continued to develop in large diameter susceptible trees and spread to additional susceptible stands.

The Gallatin Forest hazard-rated lodgepole pine stands in 1976 and prepared a hazard map based on age, density, elevation, and tree diameter (McGregor et al. 1976). Infestation mapped from aerial surveys was plotted on this map and shows that in 1977, 23 percent of the stands rated high hazard; 21 percent of those rated moderately susceptible; and 19 percent of those rated low susceptibility have become infested (table 3). Based on these data, sufficient susceptible type is available to maintain the infestation at epidemic level for several years.

Based on buildup ratios from 1975 to 1976 and on the formula $Y' = y+bx$ (Baker 1968) where:

Y' = The potential cumulative number of trees killed predicted through 1977

y = Cumulative number of trees killed through 1976

x = Number of trees killed in 1976

x_1 = Number of trees killed in 1975

$b = \frac{x}{x_1}$

it is predicted that 2,264,903 trees could be infested in 1977, bringing the cumulative kill to 8,577,787 through 1977. A 1:1.3 average buildup ratio of old to newly infested trees occurred in 1976 in the West Gallatin River drainage. If the buildup ratio is only 1:1 in 1977, over 2 million trees could be killed in the West Gallatin River drainage, and about 500,000 on the Hebgen Lake District in 1977.

Amman et al. (In Press) developed a hazard rating system for mountain pine beetle in unmanaged lodgepole pine stands which includes factors such as (1) age; (2) elevation; and (3) average d.b.h. for the stand. Generally, stands must be $\geq$ 80 years of age, located at an elevation where climate is favorable for brood development, and average d.b.h. of the stand for trees $\geq$ 12.7 cm must exceed 20.3 cm. These factors were used in hazard rating areas evaluated in 1976. By multiplying the following factors, 1 = low, 2 = moderate, and 3 = high, for age, elevation, and average d.b.h., susceptibility classification of the stand is obtained (table 4).

Table 3.--Percent of stands infested from 1975 to 1976, according to hazard rating, Gallatin District, Gallatin National Forest.

Priority rating	1975		1976	
	Infested hectares	Percent infested	Infested hectares	Percent infested
High	1488	6.0	5747	23
Moderate	1093	3.9	5747	21
Low	423	2.3	3904	19

Table 4.--Hazard rating for lodgepole pine stands surveyed, Gallatin District, Gallatin National Forest, 1976.

Area	Av. age LPP	(Rating)	Elevation	(Rating)	Av. d.b.h. in cm's	(Rating)	Overall (Rating)	Hazard
Spanish Creek	80+	3	6200-8000	3	25.1	3	27	High
Squaw Creek	60-80	2	5600-8400	3	18.0	3	18	Mod.
Cascade-Lava	60-80	2	5600-8400	3	26.1	3	18	Mod.
Karst	80+	3	5800-8400	3	24.6	3	27	High
Tamphrey	80+	3	5800-7600	3	24.6	3	27	High

Although only five areas were surveyed to obtain estimates of tree mortality and buildup ratio, they probably represent the mortality occurring throughout the West Gallatin River drainage.

Besides tree mortality, some additional negative effects that may occur in areas where the infestation has continued for nearly 10 years are: some dead trees may fall of natural causes across roads, trails, fences, powerlines, and recreational facilities; falling trees may pose an additional potential danger to hikers, campers, and others using the Forest; downfall may become a limiting access factor to both wild and domesticated animals; and increased fuel loads could result in hotter, more destructive fires when fires do occur (Amman et al., In Press). As beetle-caused tree mortality increases, movement of big game may be limited, particularly in some canyon bottoms being used for winter range.

In areas where considerable lodgepole have been killed/hectare, and where these trees go down from natural factors, Lyons (1975)[1/] in surveying clearcuts and adjacent stands in Montana, found that within any acceptable opening, slash in excess of 0.61 meter will reduce deer use by 50 percent. Lyons also found that dead and down timber exceeding 0.61 meter in uncut stands will so limit deer distribution that presence of clearcuts is probably irrelevant to deer populations.

RECOMMENDATIONS

Stands where loss is predicted to continue at a high level can be managed in several ways, depending upon land use objectives (Amman et al., In Press).

1. Recognizing that the beetle concentrates heavily on large diameter older trees (80 years +), continuous forests can be broken up by small clearcuts; that will result in different age and size classes, and reduce the area likely to be infested at any one time. When specific stands approach or mature to high risk conditions, those stands could be harvested.

2. Because the beetle shows preference for large diameter trees, selective cutting will greatly reduce infestation potential. Removal of trees $\geq$ 20.3 cm will "beetle-proof" most stands. When partial cuts are prescribed, the residual stand should be numerically adequate and physically vigorous to maintain stocking and stand productivity.

Partial cutting may not be the best method of managing beetle populations in understocked or in overstocked stands, particularly if trees are on highly productive sites and growing well. In such stands, a high proportion of trees in diameter classes $\leq$ 20.3 cm may have thick phloem. Beetle production may continue to be high enough in these trees to maintain the infestation at epidemic level. Clearcutting and regenerating these stands may be the best method of management.

3. Another management alternative for particularly susceptible stands is to favor nonhost trees such as Douglas-fir (*Pseudotsuga menziesii* var. *glauca* (Beissn.) Franco). In mixed species forests, nonhost trees will result in greater residual stocking should an outbreak develop to epidemic level. Data show that the beetle infests lodgepole pine in mixed species forests as readily as in pure forests (Amman and Baker 1972; Hamel and Oakes 1977). Conversion to another species (Douglas-fir, spruce, or subalpine fir) may result in depredations by the Douglas-fir beetle (*Dendroctonus pseudotsugae* Hopk.), spruce beetle (*Dendroctonus rufipennis* (Kirby), or the western balsam bark beetle (*Dryocoetes confusus* Swaine).

Potential losses from the mountain pine beetle can be minimized through an accelerated program of (1) logging infested trees, and (2) silvicultural treatment to reduce the inventory of large diameter, thick-phloemed, highly susceptible trees. This should be directed to those stands rated as

1/ 2360 letter to Forest Supervisors and Staff Directors from Edward Schneegas, July 1975. The publication was a product of the Elk-Logging Study and will be included in the 1975 Annual Progress Report.

moderate and high hazard as to susceptibility to beetle attack. Beetle populations are expected to remain at epidemic level until the average tree diameter of the stand is reduced < 20.3 cm.

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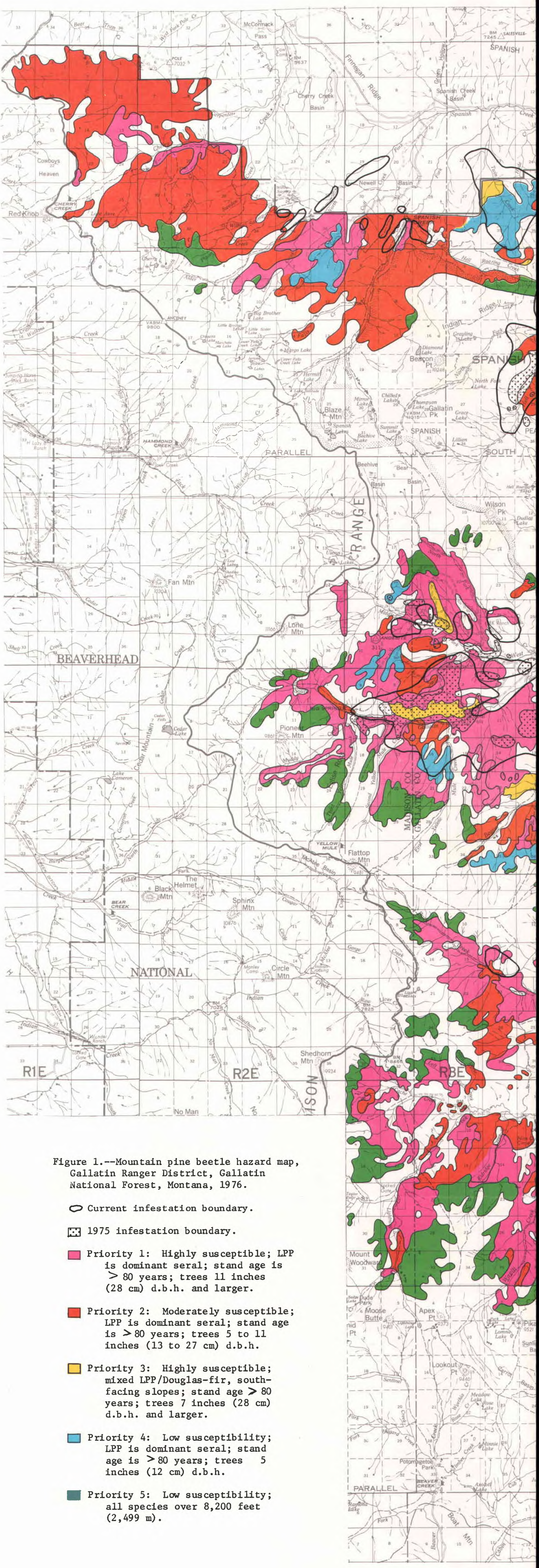


Figure 1.--Mountain pine beetle hazard map, Gallatin Ranger District, Gallatin National Forest, Montana, 1976.

Current infestation boundary.

1975 infestation boundary.

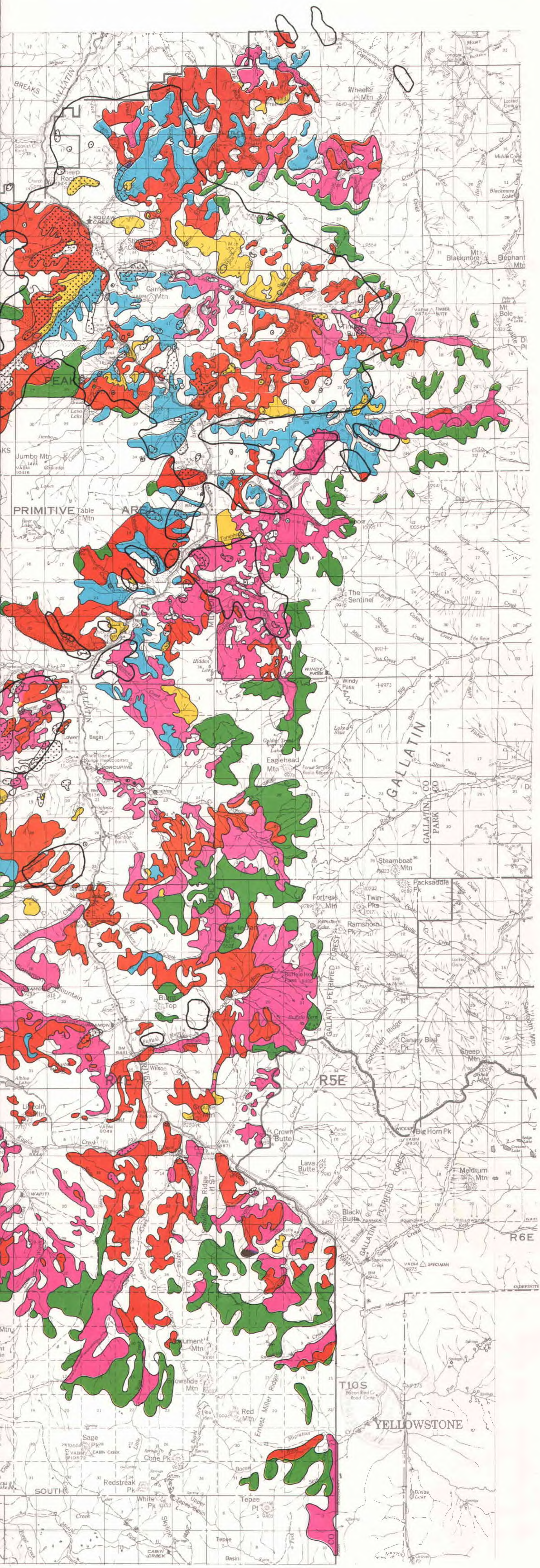
Priority 1: Highly susceptible; LPP is dominant seral; stand age is > 80 years; trees 11 inches (28 cm) d.b.h. and larger.

Priority 2: Moderately susceptible; LPP is dominant seral; stand age is > 80 years; trees 5 to 11 inches (13 to 27 cm) d.b.h.

Priority 3: Highly susceptible; mixed LPP/Douglas-fir, south-facing slopes; stand age > 80 years; trees 7 inches (28 cm) d.b.h. and larger.

Priority 4: Low susceptibility; LPP is dominant seral; stand age is > 80 years; trees 5 inches (12 cm) d.b.h.

Priority 5: Low susceptibility; all species over 8,200 feet (2,499 m).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GALLATIN
Wheeler Mtn
Sheep Rock
SQUAW CREEK
Garnet Mtn
Mica
Timber Butte
TIMBER BUTTE
Mt Blackmore
Elephant Mtn
Blackmore Lake
Mt Bole
Hyalite
Longone Springs
Middle Creek Dam
PEAKS
Lava Lake
Jumbo Mtn
PRIMITIVE
Table Mtn
AREA
The Sentinel
Windy Pass
WINDY PASS
Lake Elsie
Eaglehead Mtn
Forest Service Radio Repeater
GALLATIN
GALLATIN CO
PARK CO
Steamboat Mtn
Packsaddle Pk
Fortress Mtn
Twin Pks
Ramshorn Pk
Ramshorn Lake
Lower Basin
PORCUPINE
Lone Indian
Buffalo Horn Pass
Burnt Top
CINNAMON
Wilson
RIVER
Lincoln Mtn
Albino Lake
Grouse Mtn
Crown Butte
Lava Butte
Black Butte
Big Horn Pk
Meldrum Mtn
Canary Bird Pk
Speciman Ridge
Sheep Mtn
Sawtooth Mtn
R5E
R6E
GALLATIN PETRIFIED FOREST
VABM SPECIMAN
WAPITI
Ridge
Monument Mtn
Snowslide Mtn
Red Mtn
Ernest Miller Ridge
Sage Pk
CABIN CREEK
Cone Pk
Redstreak Pk
White Pk
Upper Tepee Basin
Skyline
Tepee Pt
Tepee Basin
SOUTH
T10S
Bacon Rind Cr Road Camp
YELLOWSTONE
Divide Lake
MP275
MP270