Montana Forest Insect and Disease Conditions and Program Highlights

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Trees killed by bark beetles

Assessing decay in fire-killed western larch

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Trees killed by bark beetles, courtesy of Ken Gibson, USDA Forest Service.

Assessing decay in fire-killed larch, courtesy of Marcus Jackson, USDA Forest Service.

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ABBREVIATIONS

The following abbreviations are used throughout:

Beetles	DFB	=	Douglas-fir beetle, *Dendroctonus pseudotsugae* Hopkins
	ESB	=	Spruce beetle, *D. rufipennis* (Kirby)
	IPS	=	Pine engraver, *Ips pini* (Say)
	MPB	=	Mountain pine beetle, *D. ponderosae* Hopkins
	WPB	=	Western pine beetle, *D. brevicomis* LeConte
	FE	=	Fir engraver, *Scolytus ventralis* LeConte
	WBBB	=	Western balsam bark beetle, *Dryocoetes confuses* Swaine
	RTB	=	Red turpentine beetle, *D. valens* LeConte
Defoliators	WSBW	=	Western spruce budworm (*Choristoneura occidentalis* Freeman)
	LCB	=	Larch casebearer (*Coleophora laricella* Hübner)
	DFTM	=	Douglas-fir tussock moth (*Orygia pseudotsugata* McDunnough)
	PTM	=	Pine tussock moth (*Dasychira pinicola*)
Hosts	LPP	=	Lodgepole pine
	PP	=	Ponderosa pine
	WWP	=	Western white pine
	WBP	=	Whitebark pine
	DF	=	Douglas-fir
	WL	=	Western larch
	GF	=	Grand fir
	SAF	=	Subalpine fir
	ES	=	Engelmann spruce
Other	NF	=	National Forest
	RD	=	Ranger District
	IR	=	Indian Reservation
	NP	=	National Park
	BLM	=	Bureau of Land Management
	FIA	=	Forest Inventory and Analysis

INTRODUCTION

This report summarizes the major forest insect and disease conditions in Montana during 2006 and was jointly prepared by the Montana Department of Natural Resources and Conservation, Forestry Division and USDA Forest Service (FS), Forest Health Protection (FHP), State and Private Forestry, Northern Region. Information for the report was derived from ground and aerial surveys within Reporting Areas across parts of Montana. A Reporting Area includes all federal, state, and private land ownerships within a particular geographic boundary (Figure 1).

SUMMARY OF CONDITIONS

Bark Beetles

For the past couple of years, western Montana and northern Idaho have received essentially “normal” amounts of precipitation. Climatologists have suggested that for most of the Region—with the possible exception of southeastern Montana—the long-standing drought is now over. That has been demonstrated in improved growing conditions for most bark beetle hosts over the past couple of years, and resultant reductions in population levels, and associated damage, of several

bark beetle species. Still, long-term drought affects are not easily overcome. Some bark beetle species remained at high levels and showed only slight response to improved host conditions in 2006. As a result of at least somewhat-improved conditions, but also unfortunately due to our inability to survey all infested areas, infestation levels recorded for most bark beetle species—with the exception of mountain pine beetle—declined in 2006. Because of a combination of weather, fire, and personnel shortages, only about 70% of the forested portions of the 19 reporting areas were flown in 2006. For most of Montana, where we could obtain it, ground-collected data showed decreasing bark beetle populations. Again, the exception was mountain pine beetle; however, even there, beetle-related damage has declined in some areas due to host depletion.

Mountain pine beetle-infested areas increased in a few locations, and populations expanded into some previously uninfested areas. However, in some stands, intensity of those out breaks has declined markedly because of the number of trees already killed. Decreases, at least in intensity, were recorded in infested areas on the Bitterroot, Beaverhead, Flathead, and Lolo National Forests (NF). There was about a 60,000-acre increase on the Deerlodge NF; however, some of that may have been a result of the difficulty in distinguishing year-of-kill from the air. In total, fewer infested acres were recorded in 2006 than in 2005, but that was as much a function of how much area was flown as it was how extensive the remaining outbreaks are. A significant amount of the total infested area was once again recorded in whitebark pine stands, but outbreaks in that forest type declined somewhat overall. Because we did not get as much of the total infested areas surveyed this year, in some cases we are relying on 2005 surveys and supplementing that with what ground-collected data we were able to obtain.

Douglas-fir beetle-infested acres decreased in western Montana, and are now lower than they have been since 1998. At a few locations in southwestern and central Montana, populations remained at higher-than-normal levels; however, even in those few locations, they have declined substantially. Overall, infested acres decreased in 2006 to about one-third the area recorded in 2005. A small sampling of ground surveys indicated beetle activity is nearly endemic in most areas.

GF mortality attributable to fir engraver decreased significantly once again—down to less than one-sixth the area recorded last year. Western balsam bark beetle-killed SAF was mapped on considerably fewer acres than in 2005; but fewer infested areas were surveyed. Still, notable beetle-caused mortality was found in some areas. Pine engraver and western pine beetle populations were both recorded at virtually endemic levels.

As we anticipate the field season of 2007, we are hopeful of continuing the recovery from the nearly 7-year drought, the effects of which have been less pronounced in the past couple of years. With a continuation of near-normal weather, we believe bark beetle populations will continue to decrease in both intensity and extent. That may not be the case with the on-going mountain pine beetle outbreaks, however. Mountain pine beetle populations are more a function of host conditions than weather. In general, mountain pine beetles are much less weather-dependent than most other bark beetle species. A departure from normal amounts of moisture, and particularly an unusually dry spring, could signal a resurgence of bark beetle activity in the coming year.

Defoliators

Acres of defoliation are continuing to increase across many reporting areas in Montana, particularly those in south central Montana. Western spruce budworm continues to be the primary insect responsible for the vast majority of the defoliation in Montana**.** Current forest stand conditions and climate in western

Montana are especially favorable to WSBW. Number of acres defoliated by WSBW increased more than two-fold again between 2005 and 2006. In 2005, a total of 453,739 acres were mapped in as defoliated by WSBW. In 2006, acres that were flown and mapped with defoliation was about 1,158,619 was from SBW. Larch casebearer defoliated 2,247 acres in northwest Montana. Aerial survey recorded 168 acres of defoliation in the Custer reporting area by pine tussock moth. No other defoliator damage was recorded in Montana in 2006.

Root Diseases

Mortality and growth losses from root disease continue to be high throughout the state. Root disease-caused mortality is more common west of the Continental Divide, causing mortality on over one million acres. Large areas of root disease can be found east of the Divide but they tend to be found in more discreet patches, rather than being ubiquitous throughout an area. Also, root diseases are commonly found in riparian areas east of the Continental Divide, often in spruce and SAF.

Root diseases are the most significant disease agents of mortality and growth loss in Montana, mostly west of the Continental Divide. Because root diseases are diseases of the site, we see very little changes occurring from one year to the next. The most significant root diseases in Montana are Armillaria root disease (*Armillaria ostoyae* (Romagn.) Herink), laminated root disease (*Phellinus weirii* (Murr.) Gilb.), annosus root disease (*Heterobasidion annosum (*Fr.) Bref.), and brown cubical root and butt decay (*Phaeolus schweintizii* (Fr.) Pat.). The most susceptible tree species in Montana is Douglas-fir, with grand fir and subalpine fir taking a close second. The most tolerant species are western larch, pines and western red cedar, with the remaining species falling somewhere along the gradient between susceptible and tolerant.

Annosus root disease of ponderosa pine is less evident than the above root diseases, but very important in local areas. The disease cycle includes infection of fresh cut stumps. Once a stump has been infected and colonized, then it spreads via root to root contact, like the above root diseases. Annosus root disease has been found causing mortality in ponderosa pine plantations in various locations on the Darby RD, Bitterroot National Forest, private lands west of Kalispell, and continues to be a significant agent on the Flathead Indian Reservation.

Although root diseases cause significant amounts of mortality and growth loss, they are also a major agent influencing both structure and species composition across landscapes. Root diseases have greatly influenced succession of vegetation in our forests. This is especially evident in the absence of natural fire cycles.

Foliage Diseases

Aerial detection surveys identified larch needle disease on 67,229 acres in western Montana on federal, state, tribal, and privately-owned land. Both *Hypodermella laricis* and *Meria laricis*-caused needle disease are included in these acres reported.

Dwarf Mistletoes

Forest Inventory and Analysis (FIA) data were queried to provide an estimate of dwarf mistletoe infections in Montana National Forests. The R1-FIA Summary Database was used to conduct this query. For additional information about FIA and the R1-FIA Summary Database see "Estimates of Old Growth for the Northern Region and National Forests" by Bush and others, 2006 (Region One Vegetation Classification, Mapping, Inventory, and Analysis Report 06-03 v1.2). These estimates probably under represent actual infection incidences since dwarf mistletoe infections can be overlooked during surveys. Two hundred twenty-nine (1% of 23,285 inventoried) Douglas-fir, 800 lodgepole pine (3.2% of

24,983), 14 whitebark pine (0.2% of 7,155 inventoried), 1 limber pine (0.1% of 1, 032 inventoried), and 183 western larch (3.9% of 4,634 inventoried) were reported to be infected with dwarf mistletoe in the National Forests of Montana.

White Pine Blister Rust

Forest Health Protection, in cooperation with partners, provides annual training pertaining to pruning of WWP and management of rust-resistant WWP in the Inland Empire. In addition, a range-wide database to compile limber pine and whitebark pine survey results is under development.

For this report FIA data were queried to provide an estimate of WPBR infections in Montana National Forests. The R1-FIA Summary Database was used to conduct this query. For additional information about FIA and the R1-FIA Summary Database see "Estimates of Old Growth for the Northern Region and National Forests" by Bush and others, 2006 (Region One Vegetation Classification, Mapping, Inventory, and Analysis Report 06-03 v1.2).

ANNUAL AERIAL SURVEY

The annual aerial detection survey in Montana was conducted from June 22 thru October 6, 2006. The survey covered approximately 19 million acres of mixed ownership forestlands, excluding most wilderness areas (Figure 2). Four FHP sketch mappers, using three different airplanes, conducted the 2006 aerial survey.

Much of the data summarized in this report is a product of the aerial survey, as well as ground surveys and biological evaluations. Along with the data summaries, aerial survey maps are available from the Missoula FHP Field Office, in both paper and digitized GIS format.

The annual aerial detection survey is an overview survey designed to cover large areas in relatively short periods. Aerially detected signatures include tree mortality, defoliation and windthrow. If forest disturbance activities are low, secondary disturbances such as diseases, needle casts, high-water damage and previous fire damage are sketch mapped. The intent of the survey is to cover each area once a year during which time the observer sketch maps as many disturbances and damage as possible. The survey is conducted using single-engine, high-wing airplanes, flying at speeds of approximately 90 to 130 mph, at an average altitude of approximately 1,000 to 2,000 feet above ground level.

The aerial survey data are estimates made from airplanes and though not as many areas were ground checked as we would like, enough were checked to lend confidence to the areas for which we only have aerial survey data. Together, aerial and ground surveys provide information relative to bark-beetle-caused mortality, as well as other damage agents pertinent to land managers charged with the responsibility of maintaining forest health.

Reporting Area summaries follow. To the extent possible, we have indicated areas affected, an estimate of impacts, and insect or disease population trends. Though reporting areas are typically designated by names of National Forests, Indian Reservations, or National Parks; there may be within those reporting areas, lands of various ownerships—federal, state and private.

BARK BEETLE CONDITIONS BY REPORTING AREA IN BRIEF

Mountain Pine Beetle (MPB). The infested area mapped in 2006 decreased significantly in most of the Region. Both the Kaniksu and Clearwater NF showed significant decreases, however, the majority of those Forests were not flown. In western Montana, with only a few exceptions, most areas also showed a decrease in infested acres. Lolo NF reporting area showed a slight increase as infestations moved into previously uninfested areas. On the Deerlodge NF, beetle-affected areas increased significantly as populations inhabited not-yet-damaged stands. Still, beetle populations declined in some of the most severely impacted areas, and some of the apparent increase could be the result of mapping trees actually killed in 2004. Acres on which beetle-caused mortality was recorded, in all species and on all ownerships, decreased considerably, to slightly more than 881,000 acres—down considerably from the more than one million acres recorded in 2005. Total infested area is still higher than the 675,000 acres that had been recorded in 2004. On those infested acres, more than 2.4 million trees were killed in 2005—recorded as faders in 2006. A bit more than 83% of those were LPP. Although beetle populations have declined in some host stands, they continued to expand in a few areas. In some infested areas, for which ground-collected data were obtained, as many as 295 trees (LPP) per acre have been killed within the past 2-3 years.

A substantial decrease in beetle-caused mortality was noted in whitebark pine stands, but is still quite high—especially on the Gallatin, Helena, and Beaverhead NF and in Yellowstone National Park (NP). In the Park, aerial surveys did not record as much beetle activity as in past years; however, not all of the Park was flown. Ground surveys in some of those stands showed 96% of the whitebark pine has been killed within the past few years. Infestations in some whitebark pine stands continued to expand.

Many susceptible lodgepole, whitebark, and ponderosa pine stands remain in the region. Unless weather patterns change to ones more favorable to their host and less conducive to beetle survival and population expansion, or management activities reduce availability of susceptible hosts, MPB populations and resultant tree mortality will continue until few susceptible hosts remain in many stands.

Douglas-fir Beetle (DFB). In western Montana, every area surveyed showed a marked decline in infested stands. In a few areas, especially the Bitterroot, Beaverhead, Flathead, Helena, and Lolo NF, beetle populations and resultant beetle-killed trees remain at higher-than-normal levels. But on every one of those Forests, infested areas declined in 2006. In many areas, beetle-killed trees were still noticeable, but seldom did we find higher numbers of new attacks in 2006. Stands surveyed in and around areas affected by 2000 and 2003 fires, on parts of Bitterroot and Helena NF, showed populations declining dramatically. Few areas had more new attacks in 2006 than in 2005. Infested area recorded on aerial detection surveys declined on the Helena NF, from 5,550 acres in 2005 to slightly less than 5,300 acres in 2006. On the Bitterroot NF, where beetles have infested stands not affected by fire, infested area decreased from 69,300 acres in 2005 to just over 27,000 acres in 2006. That was still the most heavily impacted in the Region. Ground surveys

and observations on the Forest showed fewer areas with currently infested trees, so we believe the infestation has declined markedly. Surveys conducted elsewhere in the state were similar. We may begin to see more beetle activity in WSBW-affected areas; but that has not been manifested as yet.

Region-wide, the infested area mapped decreased to just less than 62,800 acre acres, down from more than 177,000 acres in 2005. Approximately 121,800 beetle-killed DF were recorded on those infested acres. In most areas, we believe populations are or soon will be still declining. In some areas, high populations may be more perceived than real. It is often difficult to separate year of kill from the air.

More than 2 million acres of DF, older than 100 years, exist in the Region. Weather and stand disturbances—fire, defoliation, or wind throw—increase the likelihood of DFB outbreaks in susceptible stands. Preventive management is the key to reducing outbreak potential.

Fir Engraver (FE). Grand fir stands, in which FE-caused mortality was recorded, increased to an all-time high in 2004 (more than 298,650 acres). Improved weather over the past few years has resulted in significant decreases in infested area in 2005 and again in 2006. Most mixed-species stands in which GF was a component showed significantly lower levels of infestation this year. Total infested area in 2005, was reduced to 95,900, and dropped considerably again in 2006, to just over 15,180 acres. Nearly 18,000 GF were estimated to have been killed in 2005 (recorded as faders in 2006). We believe these dramatic decreases in FE-caused mortality were a result of better precipitation in the several years. Should we continue on this nearly-normal trend, populations should continue their decline in 2007.

Western Balsam Bark Beetle (WBBB). The number of acres on which SAF mortality, attributed to WBBB, were recorded also decreased in 2006, but those recorded acres are influenced by not all infested areas being flown. Several Forests—especially the Beaverhead, Gallatin and Kaniksu, where beetle populations have recently been high—were not flown in their entirety in 2006. In the areas surveyed, in 2005, more than 250,400 infested acres were reported. That figure decreased to 158,500 acres in 2006. An estimated 186,000 SAF were killed. The Beaverhead NF, in southwestern Montana, harbored the most widespread outbreaks where more than 54,000 infested acres were reported. Still, the entire Forest was not flown. That infested area in 2005 had exceeded 81,000 acres. In many areas, populations appeared to be decreasing, and should continue to respond to improved weather conditions.

Pine Engraver Beetle (IPS). Populations, and associated tree mortality decreased substantially once again in ponderosa pine stands in the Region, but at least some of those decreases resulted from beetle-killed trees in the eastern part of Montana being attributed to MPB rather than IPS. Likely, some of those trees were killed by both—either singly or in combination. Whereas 12,800 acres had been recorded in 2005, less that 1,600 acres were mapped in 2006. We believe throughout the Region, populations were static or have declined significantly within the past couple of years. Only about 3,000 ponderosa pines were killed by IPS last year.

Spruce Beetle (ESB). Populations remained at endemic levels throughout Montana and in Yellowstone NP. Only the Lolo NF had as many as 50 acres infested by ESB in 2006. The outbreak recorded east of Yellowstone Lake in Yellowstone NP, mapped at more than 8,700 acres in 2003 was not surveyed in 2006, but we believe that outbreak has declined to endemic levels.

Western Pine Beetle (WPB). WPB-caused mortality declined once again in 2006, having been recorded on slightly less than

1,000 acres. Just over 3,600 acres had been reported in 2005. About one-third of the infested acres (300), were mapped on the Lolo NF this year. Where observed, mortality was very lightly scattered, totaling fewer than 1,350 trees. We anticipate continued declining trends if precipitation patterns remain at near-normal conditions. The outbreak recorded east of Yellowstone Lake in Yellowstone NP, mapped at more than 8,700 acres in 2003, declined significantly and now covers less that 2,000 acres. Western pine beetle caused mortality, still relatively low for stand conditions, increased in 2005, to about 1,700 acres. About 400 acres had been reported in 2004. Almost half of those acres were reported on the Pintler RD of the Deerlodge NF, but mortality was very lightly scattered throughout. An estimated 250 PP were killed. We anticipate continuing declines if precipitation patterns approach normal conditions.

DEFOLIATOR CONDITIONS BY REPORTING AREA IN BRIEF

Western Spruce Budworm (WSBW). Number of acres defoliated by WSBW in 2006 not only increased in extent, but also in intensity. In 2005-06, we recorded very heavy defoliation on Douglas-fir on the Helena and Gallatin NF. On the Gallatin NF, defoliation from WSBW increased by almost two-fold from 124,487 in 2005 to 208,787 acres in 2006. Acres defoliated by WSBW increased by almost three-fold on the Helena NF between 2005 and 2006. 413,384 acres were defoliated by WSBW in 2006 as compared to 145,039 acres in 2005. Both the intensity and extent of WSBW defoliation increased on many parts of the Helena NF in 2006. In 2007, we are planning on monitoring potential tree mortality from WSBW in these areas via ground surveys.

Very few acres were defoliated on the Lolo and Bitterroot NF—two forests west of the divide—although the number of acres defoliated by WSBW increased from 160 in 2005 to 10,415 acres in 2006 in the Lolo reporting area. Portions of the Lolo reporting area were not flown in 2005 and this may account for some of the difference in number of acres reported as defoliated. These areas have historically had significant defoliation during previous outbreaks. During the outbreak in the 1980's, 2.6 million acres in the Region were defoliated by WSBW, with almost 200,000 acres defoliated each on the Bitterroot and Lolo NF. Wildfires in the WSBW host type have occurred in several areas on these forests that were historically defoliated by WSBW. This may be the reason in part for the decline in defoliation on the Lolo and Bitterroot NF. Number of acres defoliated on the Kootenai NF increased more than 3-fold between 2005 and 2006, although the entire Kootenai reporting area was not flown in 2006. 64,117 acres were defoliated in 2006 as compared to only 16,785 acres in 2005. In 2005, some defoliation occurred on the Kootenai in primarily mature western hemlock on the Cabinet RD. Some defoliation of hemlock may have continued in 2006. However, historically, defoliation episodes from WSBW on the Kootenai have been short-lived and are not very expansive in acres. Across the Region, outbreaks from WSBW historically have lasted up to 20 years or more.

The largest increase in number of acres defoliated by WSBW in the Region occurred in the Lewis and Clark reporting area. In 2006, 106,751 acres were defoliated as compared to only 28,214 acres in 2005. However the Beaverhead and Deerlodge Reporting areas also had significant increases. Defoliation from WSBW increased in 2006 almost 2.5 times the amount in 2005 in the Beaverhead reporting area. In 2006, number of acres defoliated by WSBW was 150,199 versus 60,818 in 2005. On the Deerlodge reporting area the number of acres defoliated by WSBW increased by about 3.5 times between 2005 and 2006. 174,852 acres were reported as defoliated in 2006 as compared to 52,561 in 2005.

Yellowstone National Park was not flown in 2006, but land managers have reported significant defoliation from WSBW in the northern portion of the park over the past few years. In 2005, we recorded 1,332 acres of defoliation caused by WSBW in Yellowstone National Park.

Larch Casebearer (LCB). Aerial survey detected 2,247 acres in several small patches within the Kootenai and Flathead reporting areas. This is an increase from 2005 when no larch casebearer were observed.

Douglas-fir Tussock Moth. No pheromone traps were set in Montana for Douglas-fir tussock moth detection, and no tussock moth defoliation was noted from aerial survey of federal lands in 2006.

Gypsy Moth. Cooperative detection monitoring continued for the gypsy moth in 2006 with Animal and Plant Health Inspection Service (APHIS), State Department of Agriculture(MDA), and State Departments of Natural Resources and Conservation (DNRC). A network of strategically located pheromone-baited traps was placed throughout Montana, Idaho, and North Dakota. There was one gypsy moth caught on Federal land in Yellowstone National Park. No moths were caught in Montana or North Dakota in 2006.

DISEASE CONDITIONS BY REPORTING AREA IN BRIEF

Root Disease. Root diseases are common and are major agents of change on the forest. The pathogens most commonly found on the Bitterroot and Lolo NF include *Armillaria ostoyae, Phellinus weirii*, *Heterobasidion annosum* (both s- and p-types), and *Phaeolus schweinitzii*. *Inonotus tomentosus* is found sporadically. A stump survey done in ponderosa pine stands in 2003 found an incident rate for *H. annosum* fruiting bodies of 71% on the Bitterroot NF and 25% on the Lolo NF.

We spent time in 2006 looking for root disease in Douglas-fir stands proposed for treatment in and around the Big Hole in the Beaverhead reporting area. We found only *Phaeolus schweinitzii* causing minor amounts of damage. Root disease in spruce and subalpine fir in the higher elevations is quite likely, but has not been confirmed. Please contact Forest Health Protection- Missoula Field Office if you think you have root disease-caused mortality on this forest. Root disease is not a major agent of change on the Deerlodge NF. *Phaeolus schweinitzii* is common in Douglas-fir, but causing decay in the butt logs and not acting as an aggressive root pathogen. In 2006, *P. schweinitzii* was noted in Douglas-fir in areas north of Butte.

The pathogens most commonly found on the Kootenai NF include *Armillaria ostoyae, Phellinus weirii*, and *Phaeolus schweinitzii*. Other root disease pathogens are found sporadically and include *Heterobasidion annosum* and *Inonotus tomentosus*. Root diseases are more significant on the west side of the forest, but are present on east side.

The pathogens most commonly found on the Flathead NF include *Armillaria ostoyae, Phellinus weirii*, *Heterobasidion annosum* (s-type), and *Phaeolus schweinitzii*. These root pathogens often occur together in an area and are especially severe in mixed conifer stands. *Inonotus tomentosus* is found sporadically, affecting both spruce and Douglas-fir. P-type annosus root disease in pine is likely present, but has not been confirmed.

On the Lewis and Clark NF, Tomentosus root disease (*Inonotus tomentosus*) is known to be a significant agent in campgrounds in moist drainages. Armillaria root disease (*Armillaria ostoyae*) is present on the forest and causes very distinct pockets of mortality in Douglas-fir. Tomentosus root disease (*Inonotus tomentosus*) is known to be significant in some campgrounds on the Gallatin NF as well. Black stain root disease

(*Leptographium wageneri* var. *pseudotsugae*; confirmed by T. Harrington) has been positively identified from declining Douglas-fir on the Gallatin NF (Bozeman RD). Black stain root disease can be a significant disease in other parts of the country, but it is considered an infrequent and minor disease in Montana.

Armillaria root disease can be found on the Helena NF. Brown cubical root and butt rot (*Phaeolus schweinitzii*) is quite common in various parts of the Helena NF- especially causing significant decay in the butt logs of larger, older Douglas-firs.

The Custer NF has minimal amounts of root disease. We spent time looking at ponderosa pine mortality in the early 1990's, but found no conclusive root disease agent. Although p-type annosus (*Heterobasidion annosum* (Fr.:Fr.) Bref.) has not been identified on the forest, there is no reason it couldn't exist. We encourage people to contact our office if they believe they are seeing root disease in ponderosa pine.

Stem Decay. Multiple studies of fire-killed trees on the Flathead NF in recent years have resulted in isolations of several decay fungi in western larch on the forest. *Stereum sanguinolentum*, *Phellinus chrysoloma*, *Sistotrema brinkmannii*, *Antrodia serialis*, *Fomitopsis cajanderi*, and *Echinodontium tinctorium* have all been isolated from heartwood decay and *Fomitopsis pinicola*, *Cryptoporus volvatus*, *Trichaptum abietinum*, and *Gleophyllum sepiarium* have been associated with sapwood decay in the fire-killed western larch. In recent years, *Phellinus pini* and *Stereum sanguinolentum* have been isolated from Engelmann spruce stems and *Phaeolus schweinitzii* was isolated from an Engelmann spruce stump in the Lewis and Clark reporting area.

Foliage Disease. Aerial detection surveys identified larch needle disease on 22,332 acres of the Flathead NF and 7,715 acres on state and private lands in the Flathead reporting area and on 560 acres of tribal lands and eight acres of private lands on the Flathead Indian Reservation.

Aerial detection surveys identified larch needle disease on 14,942 acres of the Kootenai NF and 3,001 acres on state and private lands in the Kootenai reporting area. Larch needle disease was also recorded on 16,382 acres of the Lolo National Forest and 2,289 acres on state and private lands in the Lolo reporting area.

Dwarf Mistletoe. FIA data were queried to provide an estimate of dwarf mistletoe infections in each reporting area. Data are presented as percentages of all trees inventoried for the given area. The conditions provided here for dwarf mistletoe are all provided by the FIA database.

Since the Beaverhead NF and Deerlodge NF are combined in the FIA database, the following information is combined data for the Beaverhead and Deerlodge NF. One limber pine (0.4% of the 248 inventoried), eight whitebark pine (0.4% of the 2,133 inventoried), eight Douglas-fir (0.4% of the 2, 048 inventoried), and 525 lodgepole pine (9.8% of the 5,367 inventoried) were reported to be infected.

On the Bitterroot NF 93 Douglas-fir (5.4% of the 1,727 inventoried), 28 lodgepole pine (2.7% of the 1,019 inventoried), and five western larch (13% of the 40 inventoried) were reported to be infected with dwarf mistletoe on the Bitterroot NF. On the Lolo NF 37 Douglas-fir (1.5% of 2,516 inventoried), 37 lodgepole pine (2.2% of 1,715 inventoried), and 36 western larch (5.8% of 620 inventoried) were reported to be infected with dwarf mistletoe.

On the Flathead NF six whitebark pine (0.7% of 910 inventoried), 44 Douglas-fir (2.5% of the 1,749 inventoried), 35 lodgepole pine (1.7% of 2,032 inventoried), and 18 western larch (2.6% of 698 inventoried) were reported to be infected with dwarf mistletoe. On the Kootenai NF no Douglas-fir (0% of 2,863 inventoried), 13 lodgepole pine (0.7% of 1,767 inventoried),

and 103 western larch (7.7% of 1,346 inventoried) were reported to be infected with dwarf mistletoe.

On the Gallatin NF one Douglas-fir (0.1% of 1,046 inventoried) and thirty-one lodgepole pine (2.3% of 1,351 inventoried) were reported to be infected with dwarf mistletoe. On the Helena NF one Douglas-fir (0.1% of 1,045 inventoried) and 46 lodgepole pine (3.5% of 1,312 inventoried) were reported to be infected with dwarf mistletoe. On the Lewis & Clark NF one Douglas-fir (0.1% of 1,759 inventoried) and 48 lodgepole pine (2.4% of 1,972 inventoried) were reported to be infected with dwarf mistletoe. On the Custer NF five lodgepole pine (1.8% of the 283 inventoried) were reported to be infected with dwarf mistletoe.

INSECT AND DISEASE CONDITIONS BY REPORTING AREA

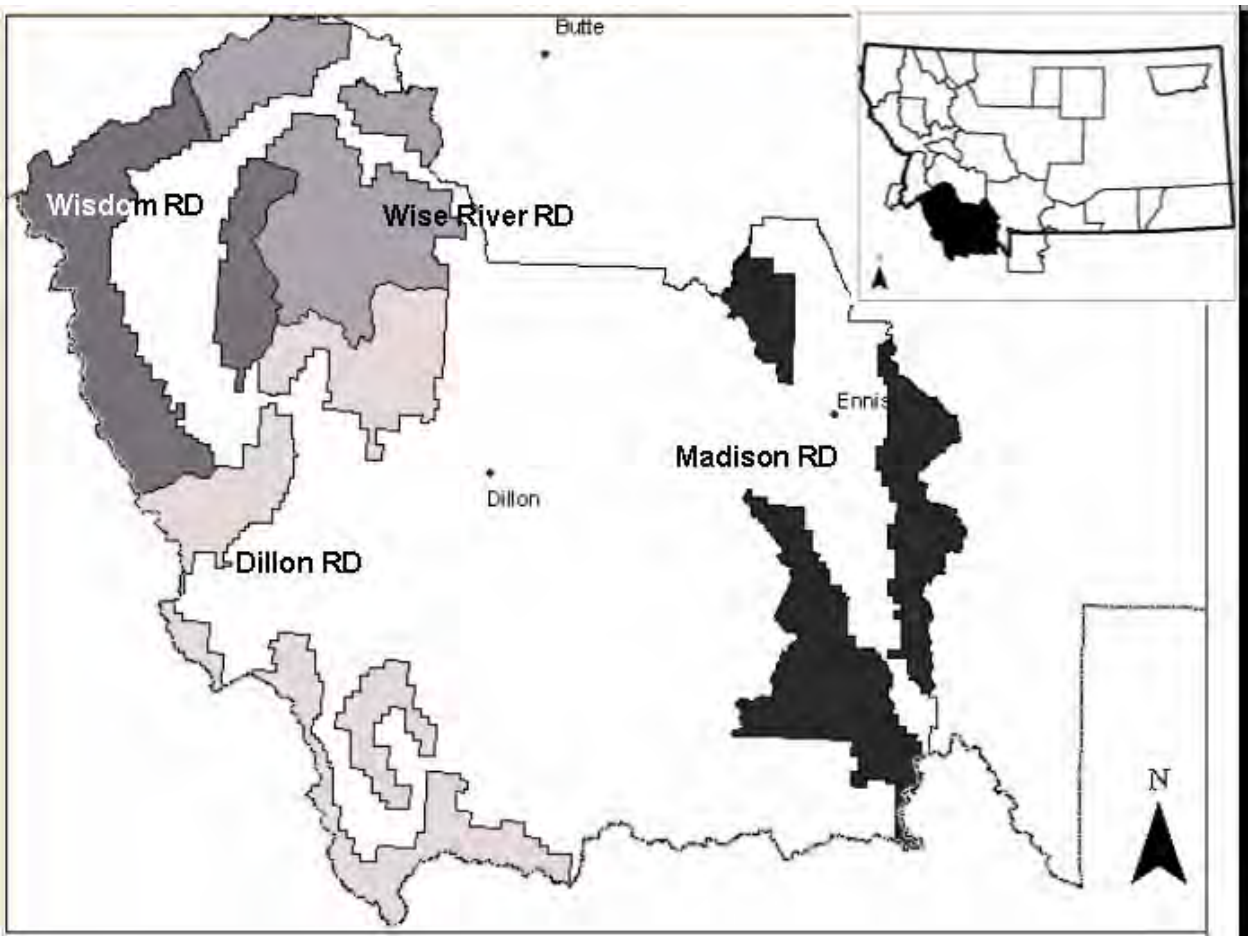

Figure 1. Beaverhead Reporting Area and Beaverhead National Forest Ranger Districts.

Beaverhead Reporting Area

Dillon RD. Noticeable amounts of MPB-killed WBP and LPP in were recorded in the southern portion of Snowcrest Range; more in WBP than LPP. Large groups of WBBB-killed SAF were also noted. A few DF, killed by DFB, were noted in that same general area; however significant amounts of DF defoliated by WSBW suggest DFB activity could increase within the next few years. Lesser amounts of each were more generally scattered in the Blacktail Mountains south of Dillon.

The western portion of the District was not flown in 2006, but in 2005 the following report was noted: To the south, in the Tendoy Mountains, widely scattered groups of WBBB and MPB-killed LPP were observed. South and west of Dillon, from Lemhi Pass to Bannock Pass, scattered groups SAF, were infested by WBBB. In a more general pattern, from Jeff Davis Peak, south to Morrison Lake, scattered WBBB-killed SAF and minor amounts of DFB-killed DF were noted. There were, in that same

area, a few small groups of MPB-infested LPP and WBP recorded.

District-wide in 2005; 4,000 DFB-killed DF were recorded on about 1,800 acres; MPB-killed 6,100 LPP on almost 3,400 acres and 1,200 WBP on nearly 600 acres; and almost 10,000 SAF were killed by WBBB on 4,700 acres.

FIA data were queried to provide an estimate of WPBR infections. Twenty of the 421 (4.8%) WBP sampled on the Dillon RD were infected with WPBR.

Wise River RD. The District was not flown in 2006. The following is the report for 2005. Conditions likely have not greatly changed. Small and lightly scattered groups of MPB-killed LPP were recorded in East Pioneer Mountains. Most were located south of Big Hole River. North of Big Hole River, from about Patton Spring to Fleecer Ridge, large groups of DFB-killed DF were also noted. In that same area, DF stands have also been heavily infested by WSBW. Defoliation coupled with abnormally dry weather could result in increased DFB activity.

For the areas surveyed, DFB-caused mortality was observed on almost 6,600 acres, where 7,100 DF were killed; 7,000 SAF were killed by WBBB on nearly 4,700 acres; and 5,300 LPP were killed on 3,900 acres by MPB. Lesser amounts of mortality were recorded on adjacent State and private lands.

WSBW was negligible in 2006 and only two acres were recorded.

FIA data were queried to provide an estimate of WPBR infections. One of the 434 (0.2%) WBP sampled on the Wise River RD were infected with WPBR.

Wisdom RD. Wisdom RD was also not flown in 2006. In 2005, there was much widely scattered beetle activity recorded throughout the Pioneer Mountains. Small groups of DFB-killed DF were concentrated in the north, with largest groups northwest of Wise River, and south towards Table Mountain. Significant amounts of WBBB-caused mortality and MPB-infested LPP were scattered throughout the District.

In the Beaverhead Mountains, west of Wisdom, many widely scattered, but generally smaller groups of SAF killed by WBBB and LPP infested by MPB were noted. DFB activity was also occasionally observed there, but that was down from the past several years. In the Anaconda Range to the north, larger groups of WBBB-killed SAF and MPB-killed LPP were mapped. Some of the larger groups of the former were near Mud Lake; the latter in the LaMarche Creek drainage.

Notable concentrations of WBBB activity, within the past few years mapped in the Ruby Creek drainage, west of Wisdom; and in the Beaver Creek and Thompson Creek drainages in the Anaconda Range to the north seems to have declined somewhat.

Area-wide, almost 13,000 DF were killed by DFB on 5,750 acres; 4,700 LPP by MPB on 2,900 acres; and WBBB killed just over 8,000 SAF on 4,800 acres.

Madison RD. Widely dispersed small groups, intermixed with a few larger ones, of WBBB-infested SAF were noted in the Madison Range in 2005. That portion of the District was not flown in 2006. In that same area, small and very lightly scattered groups of MPB-killed LPP and WBP were also observed. Small amounts DFB-killed DF were mapped in a few DF stands.

Throughout the Tobacco Root Mountains, large numbers of SAF, killed by WBBB, were found. Some groups were quite large—up to several trees per acre, covering hundreds of acres each—generally in the vicinity of Missouri Mine, northwest to Lava Mountain. Considerable amounts of MPB-killed LPP were observed in the northeastern part of the Tobacco Roots, from Cataract Lake north to Carmichael Creek. MPB has also affected numerous

WBP stands, throughout the Tobacco Roots. Noticeable expansion of WSBW activity could result in increases of DFB populations. Those populations increased significantly in 2006.

In the Gravelly Range to the south, still large amounts of WBBB-killed SAF were observed; from about Pacific Mine, south to Landon Ridge. Also throughout the Range, MPB activity in LPP and WBP stands increased significantly. Especially noticeable were groups of beetle-killed LPP from Cave Mountain, south and east towards Wade and Cliff Lakes. WBP mortality, often in conjunction with white pine blister rust (WPBR), was recorded extensively throughout the Range. Some of those groups covered several thousand acres each.

In the Snowcrest Mountains southwest of Ennis, many large groups of WBBB-killed SAF, and MPB-infested LPP and WBP were mapped. WBP was also being affected by WPBR. In addition, smaller amounts of MPB-killed WBP and LPP were noted in the Ruby Mountains, east of Dillon.

In the past couple of years, SAF mortality attributed to WBBB had reached extremely high levels throughout the District. Some stands were more heavily impacted than others, but it appeared there were few SAF stands on the District not affected to some extent. Relatively small groups—up to 100 trees each—were reported in the Tobacco Root Mountains to the north. To the south, throughout the Gravelly Range, extremely large groups of faders—covering as much as several thousand acres each, and averaging an estimated 3-5 trees per acre—were mapped within the past couple of years. That activity remained relatively static.

WSBW activity increased markedly in 2006, throughout the District. In future years, DFB populations may build to damaging levels in defoliation- and drought-weakened stands of DF.

In the past few years, the largest concentrations of WBBB-killed trees were mapped south and west of Ennis in the Ruby Range, throughout the Snowcrest Range, and southern end of the Gravelly Range. Total affected area on the District in 2006 was estimated at 10,700 acres on which an estimated 20,200 trees were killed. In 2005, those aerial survey estimates totaled more than 10,700 SAF killed on 9,700 acres. More than 55,300 WBP and another 21,300 LPP were killed by MPB on 29,400 acres and 12,000 acres, respectively. In 2005, comparable figures had been 58,000 acres of WBP and 13,000 acres LPP. DFB killed about two trees per acre on 113 acres.

To the south, in the Centennial Range, on lands administered mostly by BLM, large amounts of SAF, killed by WBBB, were still present, but decreased from 2004 levels. In that same general area, significant amounts of LPP killed by MPB were recorded, with lesser amounts of WBP having been infested by MPB. Larger groups of SAF faders were noted west of Nemesis Mountain, then west of Baldy Mountain. WBBB killed about 20,200 SAF on 10,900 acres (13,800 trees on 8,900 acres in 2005).

Although not all infested areas were flown, total aerial survey estimates for the Beaverhead reporting area, on lands of all ownerships, were recorded nearly at 9,000 acres (23,500 acres in 2005) infested by DFB; 87, 900 acres infested by MPB (all hosts) (92,000 acres in 2005); and just over 54,000 acres infested by WBBB (82,000 acres in 2005). Approximately 261,000 trees were killed by bark beetles throughout the area in 2005, recorded as faders in 2006. In addition, nearly 151,200 acres showed some level of WSBW defoliation. Dependent upon weather over the next few years, many of those damaged trees could be killed by DFB.

WSBW defoliation was recorded on 92,552 acres of the Madison RD. Defoliation was concentrated in the western portion of the

district and around forest boundaries. State and BLM land around the Ruby Range also had substantial defoliation.

FIA data were queried to provide an estimate of WPBR infections. Five of 509 (1%) WBP and five of 136 (3.7%) of the limber pine sampled on the Madison RD were infected with WPBR.

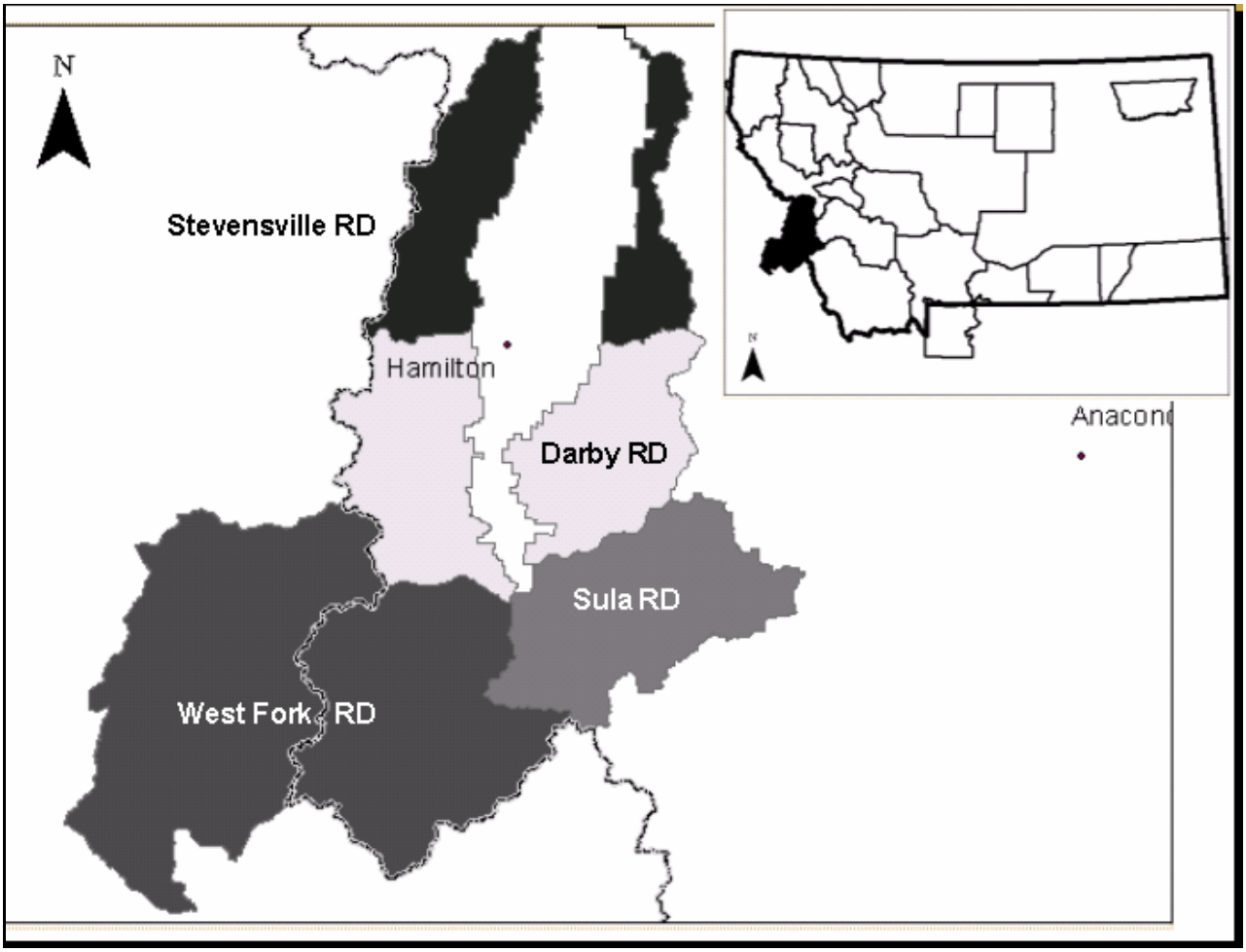

Figure 2. Bitterroot Reporting Area and Bitterroot National Forest Ranger Districts

Bitterroot Reporting Area

Stevensville RD. Considerable MPB-caused damage was mapped in LPP stands northeast of Stevensville, near Three-Mile State Wildlife Management Area. The largest continuous damage is just east of Three-Mile Point, but smaller areas were noted both to the north and south. In the same vicinity, but at lower elevations several small areas of DFB-killed DF were observed and even smaller areas of MPB-damaged PP. There were many more—but much smaller and widely scattered spots of MPB in LPP and DFB-impacted stands throughout the Sapphire Mountains.

On the west side of the Bitterroot Valley, observers found many small spots of MPB-killed trees in both LPP and PP stands throughout that portion of the District. None were or significance, although they could be building. Slightly more was recorded in 2006 than in 2005.

District totals, generally down from those mapped in 2005 showed about 1,400 acres of DFB-infested DF (1,800 in 2006); and a

marked decrease in MPB-caused mortality—6,300 LPP on approximately 2,100 acres (14,000 LPP on 7,000 acres in 2005); another 2,400 WBP on 2,400 acres (3,000 WBP on 3,700 acres last year). WBBB activity declined dramatically. Where more than 6,300 acres were affected and 11,100 SAF were killed in 2005; comparable figures for 2006 were 1,400 trees on 780 acres.

FIA data were queried to provide an estimate of WPBR infections. Four of 239 (1.7%) WBP sampled on the Stevensville RD were infected with WPBR.

Darby RD. Relatively large tracts of MPB-killed WBP, and SAF killed by WBBB were mapped east of Hamilton. Many groups of DFB-affected DF were found in and near Skalkaho Creek drainage, and were more prevalent in that area than in DF type farther north. We found several small groups of WBBB-killed SAF, and LPP killed by MPB, southward towards Darby.

To the west side, only very small fader groups of LPP and PP, killed by MPB, were noted.

District-wide, DFB-infested acres decreased significantly in 2006, to fewer than 3,100 acres, on which 5,300 DF had been killed (compared to 12,700 acres and 28,000 trees last year). MPB activity also decreased: 1,300 LPP were killed on 500 acres (3,200 acres and 4,500 trees in 2005); and 1,600 WBP on 600 acres (3,400 acres, 5,700 WBP in 2005). Slightly more than 1,300 SAF were killed on 1,060 acres (10,200 SAF on 6,800 acres last year). Minor amounts of other bark beetle-related mortality were occasionally observed.

FIA data were queried to provide an estimate of WPBR infections. One of 46 (2.2%) WBP sampled on the Darby RD were infected with WPBR.

Sula RD. There were several large areas of DFB-killed DF mapped along both sides of the East Fork Bitteroot River, beginning about two miles east of Sula and extending to the border of the Pintler RD on the Deerlodge NF. Approximately four miles southwest of Sula, surveyors observed more and larger groups of DFB-infested DF. In addition, small groups of WBBB-killed SAF were found at the northeastern edge of the District. The DFB outbreak of the past few years has finally been reduced to near-epidemic conditions.

The only noticeable amounts of MPB activity on the District were three small groups of beetle killed LPP, located about three miles east of Sula.

On the western side of the District, from Saddle Mountain, north to West Fork Bitterroot River, numerous large groups of DFB-killed faders were reported. In that part of the District, a few smaller groups of MPB-killed LPP and WBBB-killed SAF were also noted.

Total area infested by DFB decreased to slightly more than 15,500 acres (26,000 acres in 2005). Approximately 32,000 DF were killed on those infested acres, compared to 60,000 last year.

Also on the District several groups of LPP, killed by MPB and totaling 20 acres (700 acres in 2005), were recorded. At higher elevations, SAF stands generally contained a few larger groups of WBBB-killed trees; totaling about 800 trees on 720 acres—figures had been 8,100 trees on 5,400 acres in 2005.

West Fork RD. A few scattered groups (one of approximately 100 acres) of MPB-killed PP were mapped on the north side of East Piquett creek. Farther south and west, few small areas of MPB activity in LPP were noted near the head of Sheephead Creek. Several small groups of WBBB and a few small groups of ESB activity were noted in a widely scattered pattern in Blue Joint Creek drainage.

There were still a few large areas of DFB-caused tree mortality, but it is reduced from

past years. Fader groups were noted throughout West Fork Bitterroot River, with much more damage on the east side than the west. A few smaller groups were found on the south side of Straight Creek.

Along the District's southern boundary, still within the West Fork Bitterroot drainage, several small groups of WBBB-killed SAF were mapped. Burned-over areas in that general area of the District—in tributaries of Hughes Creek, Johnson Creek, and Beaver Creek—could harbor increases in bark beetle activity in the future.

District-wide, DFB infested slightly less than 6,900 acres and killed almost 9,600 DF. Those figures can be contrasted to 49,000 DF on 28,000 acres in 2005. MPB accounted for about 150 trees on 55 acres (all species). In 2005 MPB had killed 2,300 LPP alone on 1,300 acres. WBBB killed approximately 11,000 SAF on 7,500 acres in 2005; and 2,900 trees on 1,600 acres in 2006.

DFB populations, extremely high following the fires of 2000 and again in 2003 have finally begun to return to more normal levels. Surveys conducted in fire-affected and adjacent stands in 2005 and 2006, showed generally declining numbers of new attacks. In some areas, host depletion has been responsible for beetle population reductions.

Bitterroot reporting area totals for 2006 showed 27,100 acres infested by DFB, on which nearly 49,500 DF were killed. In 2005, 143,000 DF were killed on 69,300 acres. Slightly more than 2,700 acres LPP; 3,000 acres WBP; and about 330 acres PP contained varying amounts of MPB-caused mortality. Comparable figures for 2005 had been: 12,700 acres LPP; 7,200 acres WBP; and 500 acres PP. About 13,000 MPB hosts were killed. Just over 4,100 acres of SAF stands were infested by WBBB (26,000 last year), on which 4,200 SAF were killed (40,400 in 2005). Mortality attributed to other bark beetles was much less significant.

FIA data were queried to provide an estimate of WPBR infections. Nine of 354 (2.5%) WBP sampled on the West Fork RD were infected with WPBR.

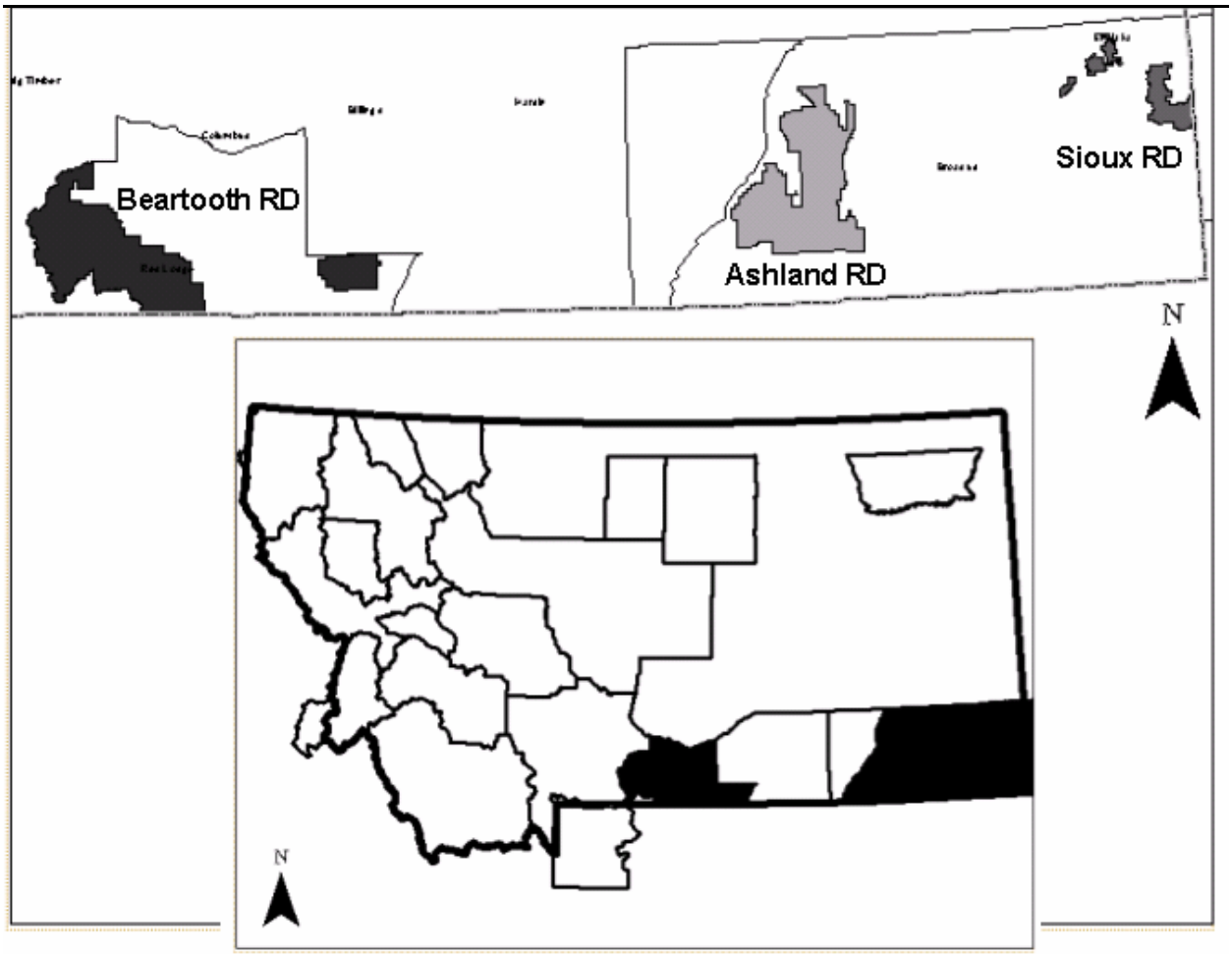

Figure 3. Custer Reporting Area and Custer National Forest Ranger Districts

Custer Reporting Area

Beartooth RD. Much of the District was not flown in 2006 due to fire activity. Last year, in the Pryor Mountains a few large groups DFB-killed DF were mapped, especially near Mystery Cave and along Commissary Ridge. Small amounts MPB-killed LP, plus significant amounts SAF, infested by WBBB, were lightly scattered throughout the area surveyed. In 2006, there was much more MPB activity recorded in LP stands throughout the Pryor Mountains. WBBB-killed trees were also widely scattered throughout the area. In 2005, west of Red Lodge, and north of Cooke City, several large groups of WBBB-killed SAF were mapped in upper reaches of Castle Creek, Picket Pin Creek, and Iron Creek.

Significant amounts of MPB-caused mortality in LP stands were mapped generally west of Red Pryor Mountain, in 2005. Infested stands were also noted on lands administered by BLM in that area. In 2006, large amounts of MPB-killed WBP were mapped south of Red Lodge, in the Beartooth Mountains, concentrated on and near Lime Creek Plateau. North of there, above Silver Run Creek, several groups of WBBB-killed SAF were observed. Others were noted about West Fishtail Creek, south of Nye.

In 2005, more than 2,100 acres DF; 3,400 acres SAF; 1,100 acres WBP, and 730 acres LPP contained measurable amounts of bark beetle-caused mortality, District-wide. Nearly 12,000 trees were killed. In 2006, for the part of the District surveyed; MPB killed about 50 PP on 10 acres,

another 1,550 WBP on about 180 acres, and 770 LP on 80 acres. WBBB was credited with killing approximately one tree per acre on 680 acres.

Defoliation by pine tussock was noticed and reported by landowners on private land (which is not flown in our aerial survey) near Billings, southeast of Columbus. The defoliated area covered 100-200 acres. Defoliation was noted as very heavy.

FIA data were queried to provide an estimate of WPBR infections. One of 26 (3.8%) limber pine and four of the 390 (1%) WBP sampled on the Beartooth RD were infected with WPBR.

Sioux RD. In 2005, minor amounts of MPB- and IPS-killed trees were very widely distributed in PP stands in the North and South Cave Hills, east of Camp Crook; and in the Slim Buttes, east of Buffalo, SD. Southeast of Camp Crook, minor amounts of mostly IPS-killed PP were found in the Short Pine Hills. In 2006, groups were still small and widely scattered, but most was recorded as MPB-related mortality instead of IPS. More widely scattered, but still mostly small groups of MPB-killed PP were mapped throughout Chalk Buttes, Ekalaka Hills, and Long Pines. MPB activity increased markedly in 2006 in the Long Pines.

MPB killed an approximate 70 PP and IPS another 1,100 trees on a combined 1,300 acres, District-wide in 2005.

Ashland RD. Very sparsely scattered, small groups of IPS- and MPB-killed PP were noted east of Ashland, in 2005. In 2006, groups were still small and very scattered, but recorded as MPB-caused damage exclusively. No significantly large groups were reported, but some of the larger ones were found north and west of Sayler, in 2005.

Throughout the District, beetles killed about 12,000 PP on a combined 5,300 acres. Only 2,600 infested acres were reported in 2004.

The 2005 report noted that Custer reporting area-wide, reported bark beetle-caused mortality totaled 3,900 DF killed by DFB on 4,300 acres. MPB was attributed with killing 500 LP on 320 acres; 400 PP on 600 acres, 760 LPP on 740 acres; and 1,340 WBP on 1,100 acres. And an estimated 8,300 WBBB-killed SAF on were reported on 4,300 acres. Most of those were increases over 2004 levels. Those totals, results of an abbreviated survey in 2006 showed: nearly 2,800 trees killed by MPB (most were WBP) and 650 SAF killed on 1,125 acres.

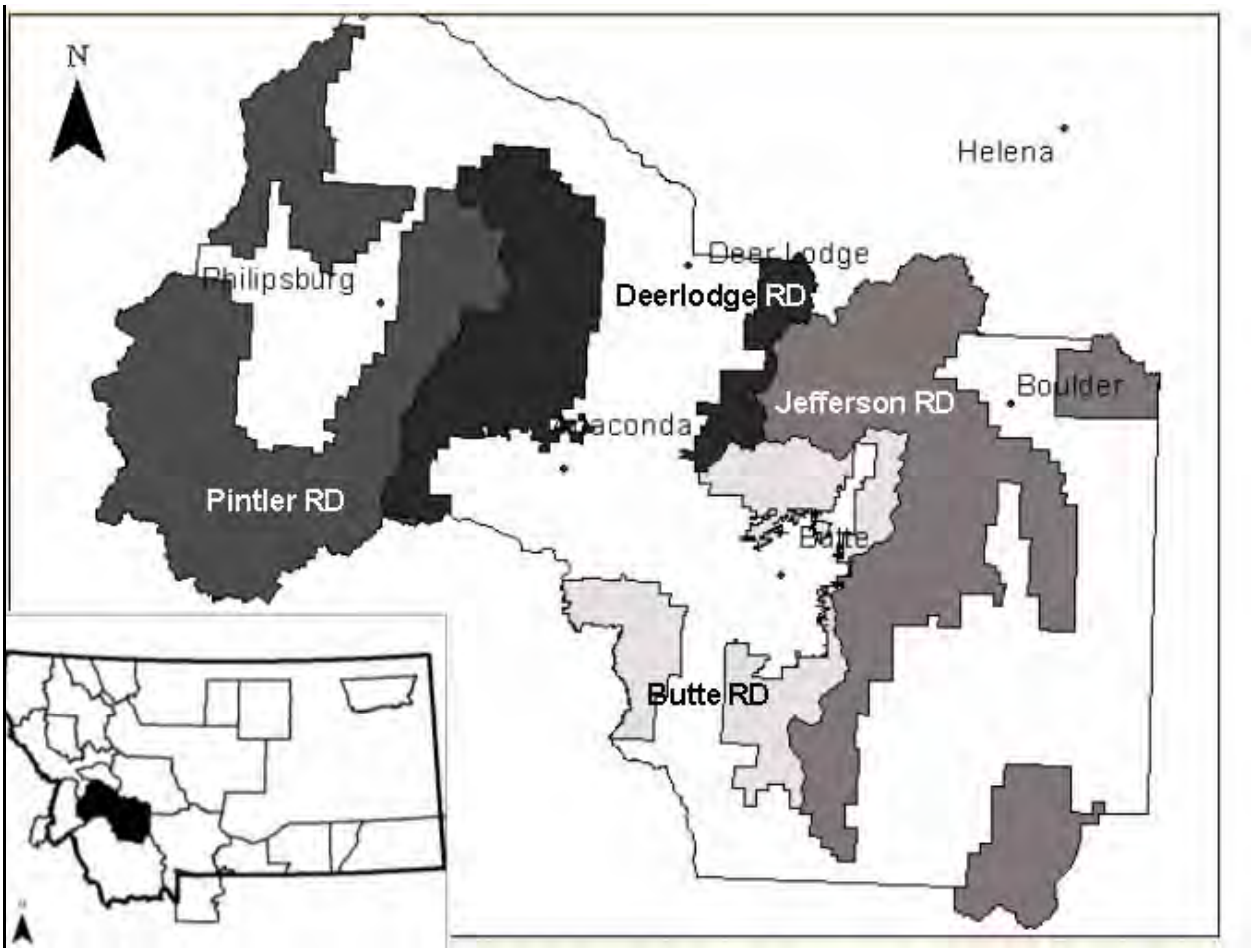

Figure 4. Deerlodge Reporting Area and Deerlodge National Forest Ranger Districts

Deerlodge Reporting Area

Butte RD. Throughout the District, large tracts of LPP stands were still heavily infested by MPB. While populations in some stands are finally subsiding due to host depletion, many areas contain high amounts of MPB-killed trees—some dead for a few years, some killed in 2006. Ground surveys in Lime Kiln basin to the south and in American Gulch to the northwest of Butte showed still-active beetle populations.

Southwest of Butte, along the Deerlodge/Beaverhead NF boundary, there were also a few small groups of MPB-killed WBP noted. In that same general area, in high-elevation SAF stands along the Continental Divide, near South Fork of North Fork Divide Creek, several small groups of WBBB-killed trees were observed. Most DF-dominated stands on the District have significant amounts of WSBW-caused defoliation, and within many of these stands, small groups of DFB-killed trees were noted. While DFB populations at this time are not high, increases in WSBW activity may well result in increased susceptibility to beetles and a significant increase in DFB activity over the next few years.

Ground surveys conducted there in 2005 showed the infestation on the District was still quite active although decreasing in some areas due to host depletion. In the Lime Kiln area, new attacks for one 10-plot area averaged 42 per acre in 2004. That had increased to 72 per acre in 2005. Additional data collected in 2006 showed a total for that area of more than 124 trees per acre killed over the past three years. In Basin Creek, ten plots revealed very few

new attacks, averaging only 16 per acre; but a total of 130 total dead trees per acre—killed during the past 3-4 years. In the American Gulch area, where outbreaks were fairly recent, an average 72 trees per acre have been killed in 2005. Data obtained in 2006 indicated in one area there were 274 beetle-killed trees per acre; in another 195 trees per acre.

District-wide, an estimated 276,000 LPP were killed on approximately 87,200 acres in 2006. Those estimates represent moderate increases from 2005 when more than 264,000 LPP were killed on about 69,800 acres. Some outbreaks became less intensive as a result of host depletion.

DFB-killed DF was noted in decreasing amounts throughout the DF type on the District. District-wide, DFB-caused mortality totaled 1,100 trees on 450 acres in 2005; whereas only 110 trees on 45 acres were recorded in 2006.

WSBW defoliated trees on 12,054 acres of the Butte RD in 2006. Most of the defoliation was west of interstate 15 along the Forest Service boundary. Some defoliation was east of interstate 15 on the southern tip of the RD and on BLM to the south. In addition, defoliation was observed northeast of Butte, MT on Forest Service and private land.

Jefferson RD. Like Butte RD, LPP stands on the Jefferson RD were still heavily infested by MPB. Notable, highly impacted stands of LPP were located in higher elevations throughout Whitetail Deer Creek drainage. MPB-caused damage was almost continuous from a few miles south of Boulder to Little Pipestone Creek, more than 10 miles southeast of Butte. Stands to the northwest, towards Delmoe Lake, were still being severely affected.

Throughout the District, WSBW-caused defoliation increased significantly. The highest concentrations were noted around Boulder. In those stands, small groups of DFB-killed trees were mapped and we believe DFB activity could increase substantially within the next few years. DFB populations have decreased in recent years, but that trend could be reversed within the next several.

North of the Boulder River, near the border with the Pintler RD, a few very small groups of MPB-killed trees were found in WBP stands. In the southern part of the District, additional groups of MPB-killed WBP were also noted. Similar conditions were found in WBP stands to the west. In some of those high-elevation stands we also noted small groups of SAF, killed by WBBB. Similar conditions were found in the area northwest of Boulder, between Jack and Cataract Creeks.

Infestations on the District were the most extensive on the Forest, increasing significantly in 2006. Infested area on the District was recorded as 119,600 acres 75,000 acres in 2006—only 75,000 in 2005. An estimated 216,000 LPP were killed in 2005, but that number increased to almost 371,500 in 2006. WBBB activity declined some, from about 1,900 SAF killed on 950 acres in 2005; to 1,500 trees killed on 500 acres in 2006.

North of Boulder, on lands administered by both BLM and FS, MPB had killed numerous groups of PP and a few groups of LPP. Beetle populations there did not increase significantly.

The Jefferson RD had 66,344 acres of defoliation by the WSBW. One heavy concentration was around Basin, MT, north and south of the Boulder River on Forest Service and BLM land. Others were across the landscape around Elkhorn, MT, on the east and west foothills of the Bull mountain range, and in a triangular area between Delmoe Lake, Bald Mountain, and Goodwin Mountain.

Deer Lodge RD. MPB activity in LPP stands increased east of Deerlodge, especially near Sugarloaf Mountain, Black Mountain, and Orofino Mountain. West of

Deerlodge, significant MPB-caused mortality in LPP stands was noted from Cup Lake, south nearly to Anaconda. Minor amounts of DFB-killed DF were noted in that general area as well.

MPB outbreaks on the District totaled about 12,400 acres in 2005, up to 15,000 acres in 2006. Approximately 22,000 LPP were killed last year, 42,400 in 2006. DFB- and WBBB-caused mortality was much less significant—found on about 170 and 40 acres, respectively.

Aerial survey recorded 13,644 acres of WSBW defoliation on the Deer Lodge RD, primarily in two areas: east of interstate 90 between Deerlodge, MT and Warm Springs, MT, and in the northwest corner of the RD, both along the border of Forest Service and private land.

Pintler RD. On the east side of the District, in Powell and Deerlodge Counties, several large areas of MPB-infested LPP were mapped within Dempsy Creek, Racetrack Creek, Lost Creek and Tin Cup Joe Creek, drainages and some of their tributaries. Only small amounts of DFB activity were noted, some just north of Anaconda; however, increased WSBW defoliation could easily result in increased DFB activity.

The southern portion of the District had only small spots of DFB and WBBB activity. Most of that was found in East Fork Rock Creek and Rock Creek drainages. To the west, there were once again, many small groups of DFB-killed trees located near Stony Creek. There were a few small areas where WBBB had killed a few SAF along Little Stony Creek and elsewhere in that general vicinity.

East of the Clark Fork River, areas heavily defoliated by WSBW were mapped. Those stands are likely to become more susceptible to DFB in the future. There were a few small groups of DFB-killed DF in that area. Throughout that area there were widely scattered, mostly small groups of LPP killed by MPB.

DFB killed about 32,000 DF on almost 15,000 acres in 2005; however, those figures were reduced dramatically in 2006, to 4,200 DF on 1,180 acres. MPB accounted for 1,500 dead LPP (5,100 in 2005) and another 100 PP (370 last year) on a combined 1,100 acres (3,700 in 2005). WPB activity was noted on about 15 acres.

For Deerlodge reporting area, MPB-infested LPP stands increased substantially in 2006. Found on slightly more than 182,200 acres in 2005, that figure increased to 246,130 acres in 2006. More than half a million LPP were killed last year, but increased to nearly 720,000 in 2006. Most infested LPP stands were on FS-administered lands. MPB also killed a reported 4,900 WBP on 2,500 acres. DFB infested another 2,100 acres (20,400 acres in 2005) and WBBB was recorded on 700 acres (6,300 in 2005).

526 acres of the Pintler RD were defoliated by the WSBW, all on Forest Service and private land on the north end of the Flint Creek Range.

A service visit in the Barton Spring area (Lolo NF- administered by Pintler RD, Deerlodge NF) revealed suspicious decay in ponderosa pine indicative of annosus root disease (*Heterobasidion annosum*). Although it was not positively identified, enough evidence was present to alert the district to take precautions, such as treating large ponderosa pine stumps for the prevention of annosus root disease during any entries.

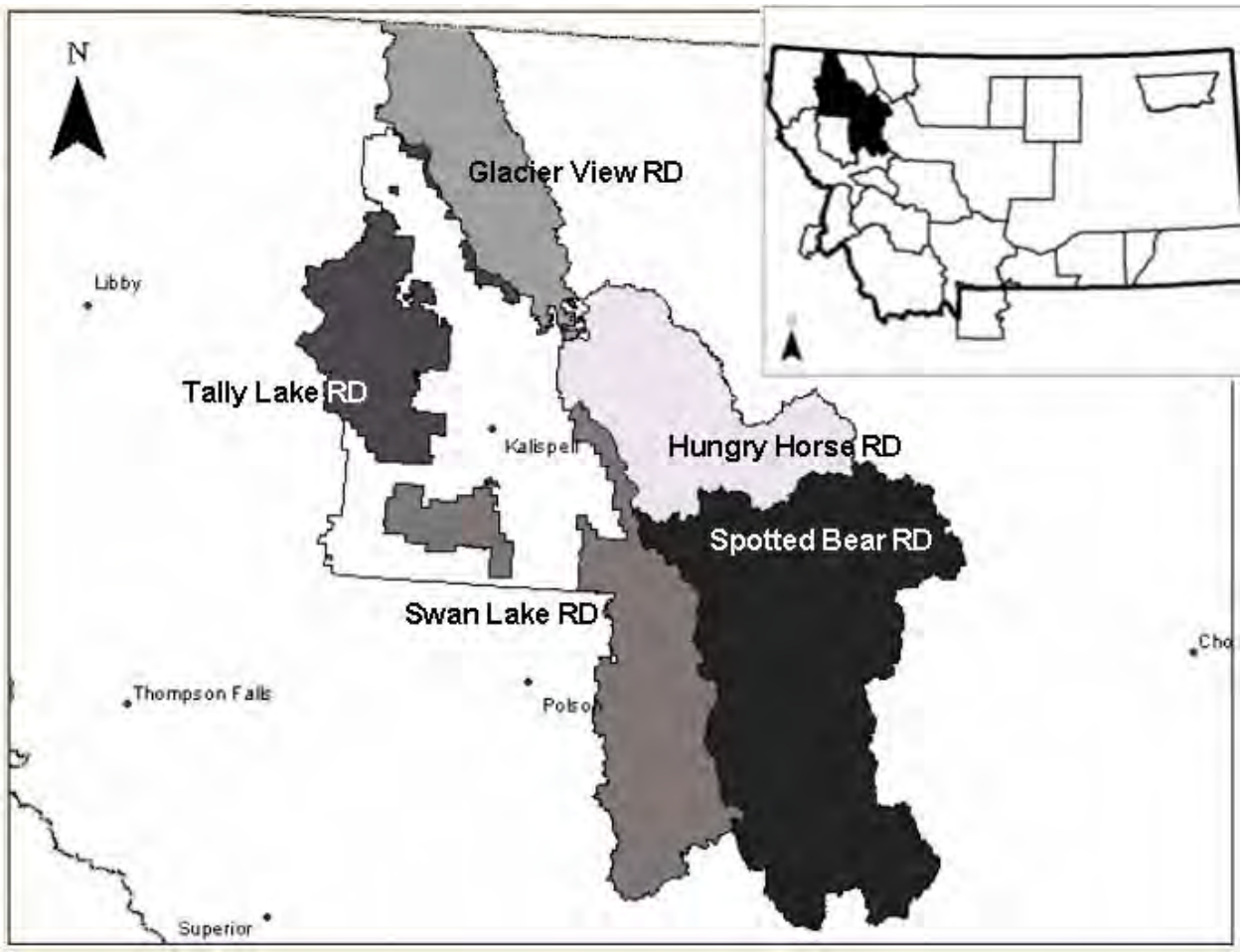

Figure 5. Flathead Reporting Area and Flathead National Forest Ranger Districts

Flathead Reporting Area

Swan Lake RD. General decreases in MPB-killed LPP were noted throughout the Swan Valley. Still, there were notably large groups mapped both east and west of Swan Lake and south of Swan Lake on Swan River SF. Some of the largest groups were observed near Sixmile Mountain, above Porcupine Creek, and from North Fork Elk Creek south to Lindbergh Lake.

To the east, in the Swan Range, MPB-killed trees were common in LPP and WBP stands from Goat Creek on the north to Pierce Lake on the south. Largest groups were once again mapped south of Lion Creek and just south of Holland Lake.

FE activity in mixed-species stands has declined considerably and is now only found in small and widely scattered groups north and east of Swan Lake. Very few groups were found, especially when compared to the massive outbreaks of but a few years ago. Several small groups were widely distributed south of Swan Lake. DFB-killed trees were more frequently encountered in 2006; however, groups of beetle-killed DF were still small and very much scattered on the west slopes of the Swan Range. Small groups were more numerous south of Lion Creek.

In the “Island Unit,” significant increases in MPB-infested LPP were again recorded near Blacktail Mountain. FE activity has declined markedly and beetle-killed GF were only occasionally encountered. Generally, throughout that part of the District, there has been a marked increase in MPB activity, while incidence of DFB-

killed DF and WBBB-infested SAF declined considerably and were rarely recorded.

The once widespread FE outbreak of a few years ago has subsided to nearly endemic levels. In 2005, more than 16,000 GF were killed on 7,500 acres. Comparable figures for 2006 showed 1,700 trees killed on less than 1,000 acres. MPB activity in LPP is still noticeable throughout the District, but has decreased from the 31,000 acres on which 63,000 trees were killed in 2005; to 56,200 dead trees on 22,400 acres. Throughout the District, DFB activity also declined, to 5,000 dead DF (7,400 in 2005) on about 2,200 acres (3,400 acres last year). WBBB-caused mortality also declined from more than 7,500 SAF killed on 4,400 acres in 2005 to 3,400 trees on less than 1,100 acres this year.

285 acres were defoliated by WSBW on the Swan Lake RD. This defoliation was located along the North Fork of Elk Creek above the junction with the South Fork of Elk Creek.

Aerial detection surveys identified larch needle disease on about 5,000 acres scattered across the district on both sides of Flathead Lake. The survey also recorded about 15 acres on the Swan River National Wildlife Refuge and 12 forested acres of state and privately-owned land damaged by high water south of Swan Lake.

FIA data were queried to provide an estimate of WPBR infections. Eleven of 80 (13.8%) WBP sampled on the Swan Lake RD were infected with WPBR.

Spotted Bear RD. A few large groups MPB-killed LPP remained at some locations, but were much reduced from the past few years, both in extent and intensity. Large groups were mapped near Kah Mountain, above Soldier Creek, near Stony Hill, Crossover Mountain and Big Bull Mountain. Most of those groups averaged only about 2-3 trees per acre killed in 2005 (recorded as faders in 2006). Fewer groups of WBBB-killed SAF were noted in high-elevation stands throughout the District; and the ones noted were small and widely scattered. A few similar groups were also mapped east of the Reservoir, along Elk Ridge. DFB activity was only lightly scattered throughout the reporting area.

A set of 30, variable-radius plots that have been monitored yearly for the past 26 years, in the Cedar Creek area, south of Spotted Bear, showed an average 63 LPP per acre have been killed by MPB—mostly within the past 6-8 years.

District-wide, MPB infested LPP stands totaled 10,250 acres, on which almost nearly 25,000 trees were killed. In 2005, those figures were 11,100 acres and 18,000 trees. DFB-affected stands on the District remained about static, totaling just over 1,100 acres, whereas 1,000 acres had been recorded in 2005. Slightly more than 2,700 DF were killed, compared to 1,700 last year. Other bark beetle-related activity was light.

Aerial detection surveys identified larch needle disease on about 900 acres scattered across the portion of the district flown for the surveys.

FIA data were queried to provide an estimate of WPBR infections. 54 of 470 (11.5%) WBP sampled on the Spotted Bear RD were infected with WPBR.

Hungry Horse/Glacier View RD. A variety of bark beetle activity—trees killed by MPB, DFB, FE—was noted in a generally lightly scattered pattern west of Hungry Horse Reservoir. None appeared to be of major significance; however, a few of the largest groups were mapped a few miles south of Hungry Horse. A few larger groups of SAF, killed by WBBB, were observed near Baldhead and Slippery Bill Mountains. North and east of the Reservoir, bark beetle activity was more prevalent. DFB remained active on Coram Experimental Forest near Martin City, though at levels reduced from previous years. WBBB-killed trees were very widely scattered throughout the

Flathead Range, south to the District boundary.

MPB-infested LPP were found in larger, though lightly infested groups in the southeastern portion of the District (Great Bear Wilderness). Largest of those groups were found northwest of Nimrod and throughout Middle Fork Flathead River drainage and its tributaries, south of John F. Stevens Canyon. Some of the largest groups were mapped along Patrol Ridge. Elsewhere, MPB-killed LPP was found in small groups generally scattered throughout the reporting area.

In 2005, MPB killed a reported 13,100 LPP on 12,200 acres—both figures down from 2004. Infested acres declined again in 2006 to 7,600; however, more trees were killed—almost 19,000. Another 500 WBP were killed on 200 acres. District-wide, on lands of all ownerships, WBBB infested acres also declined, from almost 5,400 acres last year, to 750 in 2006; and FE-infested acres declined from 2,300 acres to fewer than 30.

A general scattering of WBBB- and DFB-killed trees were mapped on the Stillwater SF in the Whitefish Mountain Range. A few very larger groups were recorded east of Bull Lake, but overall were much reduced from 2005. Almost no MPB activity was recorded in 2006.

On Forest Service-administered lands, in the North Fork Flathead River drainage (Glacier View RD), WBBB and DFB activity was very widely mapped throughout the District. Largest of the DFB groups were noted in upper reaches of Hay Creek and Whale Creek drainages, while most noticeable WBBB-killed groups of trees were noted along Coal Ridge. MPB-affected LPP was lightly scattered in host type throughout the District, with the more notable groups of MPB-killed LPP were mapped near Cleft Rock Mountain.

District-wide, MPB has infested fewer than 650 acres (1,200 acres last year), DFB actually increased to almost 1,600 acres, on which 3,400 DF were killed; and WBBB activity decreased to less than 2,200 infested acres—down from nearly 5,000 acres in 2005.

A small-scale outbreak of *Pityogenes* sp. occurred on private lands adjacent to the Red Meadow Creek near Polebridge. The outbreak coincided with hazard fuel reduction treatment and was limited to the treated area.

Only 11 acres of the Hungry Horse/Glacier View RD were defoliated by WSBW. These 11 acres were on the southern tip of the RD south of Crystal Creek.

1,020 acres of larch casebearer defoliation was recorded on the Stillwater State Forest along the Stillwater River, in Lonepine State Park, and on the Glacier View RD in the upper Spruce Creek drainage.

Aerial detection surveys identified larch needle disease on about 7,900 acres scattered across the Glacier View section of the district and on about 1,500 acres scattered across the north and far western areas of the Hungry Horse section of the district. Aerial detection survey also identified about 15 forested acres damaged by an avalanche near Grizzly Creek about 6 miles east and one mile south of the southern-most boundary of Glacier National Park.

Multiple studies of fire-killed trees on the Flathead NF in recent years have resulted in isolations of several decay fungi in western larch on the Forest. *Stereum sanguinolentum*, *Phellinus chrysoloma*, *Sistotrema brinkmannii*, *Antrodia serialis*, *Fomitopsis cajanderi*, and *Echinodontium tinctorium* have all been isolated from heartwood decay and *Fomitopsis pinicola*, *Cryptoporus volvatus*, *Trichaptum abietinum*, and *Gleophyllum sepiarium* have been associated with sapwood decay in the fire-killed western larch.

FIA data were queried to provide an estimate of WPBR infections. Sixteen of 345

(4.6%) WBP sampled on the Hungry Horse RD were infected with WPBR.

Tally Lake RD. A significant decrease in all bark beetle activity was noted on the District in 2006. Several small and scattered groups of DFB-killed DF were noted throughout the Logan Creek drainage, and near Tally Lake. They were considerably fewer and less intensely infested than in 2005. Minor amounts of WBBB-killed SAF were noted near Sheppard Mountain, Elk Mountain, and above Bowen Creek drainage. MPB activity was observed in a lightly scattered pattern in a few LPP stands.

On District and adjacent lands, 670 acres (compared to 4,600 acres in 2005) showed some level of DFB-caused mortality; about 600 acres (1,600 acres in 2005) had MPB-killed LPP; only about 30 acres (150 acres last year) of FE-related activity; and less than 550 acres (4,000 acres in 2005) of WBBB-infested SAF. All were significant reductions from previous levels.

Throughout the Flathead reporting area, and on lands of all ownerships, nearly 44,000 acres have been infested by MPB (compared to 62,500 acres in 2005); 1,500 acres by FE (22,400 acres in 2005); 8,000 acres by DFB (13,500 acres last year); and 5,000 acres by WBBB (22,200 acres reported in 2005). Forest-wide, slightly more than 143,000 bark beetle-killed trees were recorded in 2006. Those were substantial decreases from 2005 levels, when 216,000 trees had been killed.

WSBW defoliated 172 acres on the Tally Lake RD, all on the south side of Hellroaring Creek.

Aerial detection surveys identified larch needle disease on about 9,500 acres scattered across the district.

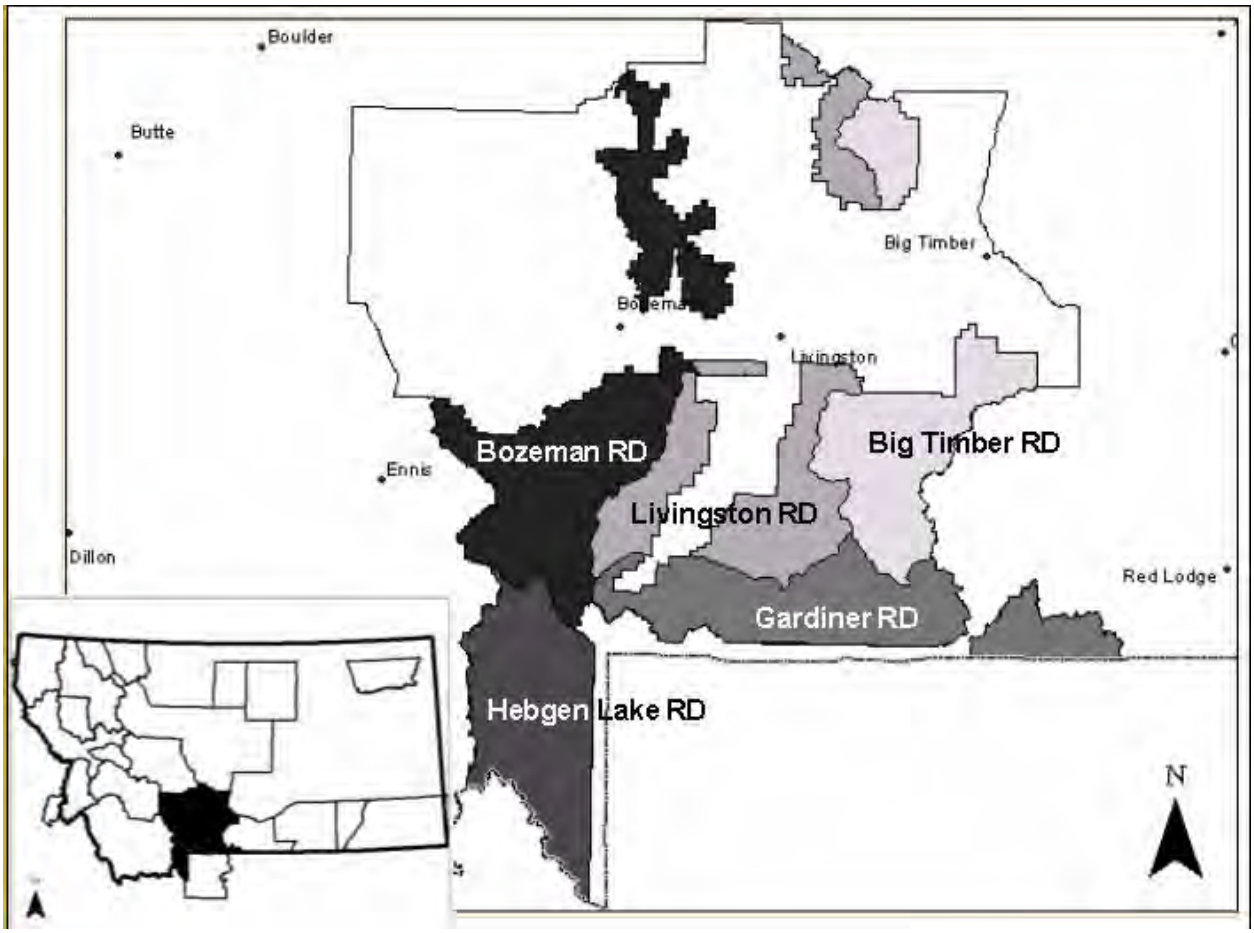

Figure 6. Gallatin Reporting Area and Gallatin National Forest Ranger Districts

Gallatin Reporting Area

Big Timber RD. DFB populations were at mostly low levels in Big Timber Creek drainage in the southern portion of the Crazy Mountains, but one larger group of beetle-killed DF was mapped near Upper Big Timber Falls. However, WSBW populations have continued to increase in that area and DFB populations could likewise become more expansive. Also noted in the Crazies were areas of MPB activity in WBP and WBBB-killed SAF. Much of that was the upper Sweet Grass Creek drainage.

To the south, in the Boulder River drainage, little bark beetle-caused damage was observed. In the West Fork Upper Deer Creek drainage, areas of WSBW defoliation and small groups of DFB activity could coalesce within the not-too-distant future. In the Lower Deer Creek drainage, WBBB activity was observed. A few small groups of PP, killed by MPB, were seen in low-elevation stands along West Bridger Creek. There were also several small groups of MPB-killed WBP and WBBB-infested SAF located in the upper reaches of East Boulder River drainage. Throughout the drainage, MPB activity in LPP, and a few small groups of DFB-killed DF were widely scattered. There was increasing WSBW defoliation as well.

DFB-infested stands declined significantly throughout the District. Where they totaled about 2,450 acres—most in the Boulder River drainage—in 2005; in 2006 only 40 acres were recorded. Where almost 1,900 DF had been killed, last year, a mere 90 were reported in 2006. MPB had killed 4,900 WBP on 1,640 acres in 2005; those figures were reduced to 1,100 trees on

1,200 acres in 2006. In 2005, 4,200 SAF were affected by WBBB on nearly 1,600 acres—declined to 2,300 trees on 1,400 acres in 2006. All of those figures were decreases from 2005 levels. MPB activity, District-wide, increased somewhat in 2006—440 trees were killed on 210 acres.

786 acres were defoliated by WSBW. One area with defoliation was west of Grouse Ridge and Evergreen Mountain. Another concentration of defoliation was on Forest Service and private land west of the West Boulder Divide. A third area was on Forest Service and private land along the Middle Fork of Sweet Grass Creek.

FIA data were queried to provide an estimate of WPBR infections. Five of 229 (2.2%) WBP and three of the 31 (9.7%) limber pine sampled on the Big Timber RD were infected with WPBR.

Livingston RD. Damage attributed to DFB has decreased throughout the District, but widespread and heavy defoliation caused by WSBW could change that situation within the near future. WSBW-caused defoliation was heavy in the northern portion of the District—especially near Bald Ridge and surrounding Billie Butte. Little DFB activity was recorded in that area in 2006, but that could change within the next few years.

There were several groups of MPB-killed LPP in the vicinity of Bald Ridge and to the east, in high-elevation WBP stands, MPB activity was also noted. Southward from Bald Ridge, a few small groups of WBBB-impacted trees were mapped close to the border shared with Big Timber RD. In that general area, observers also mapped a few small areas in which MPB has killed both LPP and WBP.

West of Livingston, only a portion of the District was flown. In the part that was, a few stands of LPP near Dry Creek harbored MPB activity. To the east, near North Fork Sixmile Creek, small groups of MPB-killed LPP and WBP were noted. Farther east, damage attributed to WBBB in SAF stands and additional groups of WBP killed by MPB were found. MPB activity in LPP stands occurred occasionally throughout Mill Creek drainage, as did a few small spots of DFB-killed trees. Elsewhere throughout the Yellowstone River drainage, WBBB- and MPB-caused mortality was light and widely scattered.

In the Crazy Mountains, much of which was not flown in 2006, scattered small groups of WBBB-, DFB-, and MPB-killed trees were observed in 2005. MPB activity was confined to WBP stands. The largest groups of MPB-affected WBP were noticed near Davey Butte. WSBW population increases in the Crazy Mountains could lead to resurgence of DFB activity.

DFB infestations on the District had increased to almost 2,400 acres in 2005, but declined dramatically in 2006 to just over 40 acres. Approximately 7,000 beetle-killed DF had been recorded last year—but 80 this year. MPB activity in WBP stands increased somewhat—from 1,200 dead trees on 1,350 acres in 2005; to 1,750 trees on 2,900 acres in 2006. And, while little MPB activity in other hosts was recorded on the District in 2005; in 2006, 4,700 LPP were mapped on almost 4,000 acres. WBBB activity in SAF stands also declined; from 11,000 trees on 4,600 acres last year; to 5,300 trees on 4,200 acres in 2006.

WSBW defoliated 13,564 acres in the Livingston RD. One small patch of defoliation was east of Carvella, MT. Most of the rest was on Forest Service and private land southeast and southwest of Livingston, MT.

Tomentosus root disease (*Inonotus tomentosus*) is known to be a significant agent in spruce trees in some campgrounds on the forest. It has been positively identified in spruce from Snowbank and Pine Creek Campgrounds south of Livingston (July 1996 Service Visit).

FIA data were queried to provide an estimate of WPBR infections. Seven of 322

(2.2%) WBP sampled on the Livingston RD were infected with WPBR.

Gardiner RD. To the northwest, in the Yellowstone River drainage, we mapped several small groups of DFB-killed trees, a few MPB-killed LPP and other areas where MPB had killed groups of WBP. Just north of Gardiner, WSBW activity was high. It will be of interest to see if DFB populations move into those weakened stands. Near the head of both Eagle Creek and Bear Creek were found larger areas in which MPB had killed WBP. At lower elevations in the same vicinity, MPB had infested a few small areas of LPP. Widely scattered through the area were a few small areas of WBBB-killed trees and a few DF stands impacted by DFB. To the east, mostly small but one larger group of WBBB-killed SAF; and a bigger group of WBP killed by MPB, were mapped near Fisher Creek.

White pine blister rust was reported as the most significantly damaging agent in WBP stands at several locations on the District; however, MPB and secondary bark beetles may also be affecting those trees.

Throughout the District, about 850 acres of DFB-infested stands were noted in 2005 and declined to 35 acres in 2006. Approximately 700 acres SAF were found to contain noticeable amounts of WBBB-caused mortality in 2005, however, those figures increased significantly in 2006, to 2,000 trees on 2,800 acres. MPB-killed WBP decreased as well. Where 3,800 WBP had been killed on 1,600 acres in 2005, only 1,130 trees were killed on about 2,000 acres in 2006. White pine blister rust is still known to infect many of the WBP stands in that area. Quite likely, many also contained MPB-caused mortality.

In the southwest corner of the Gardiner RD, north of Gardiner, MT, there were 795 acres of WSBW defoliation.

FIA data were queried to provide an estimate of WPBR infections. Three of 357 (0.8%) WBP sampled on the Gardiner RD were infected with WPBR.

Bozeman RD. While some bark beetle activity was noted, District-wide, the most significant insect activity on the District remained the heavily defoliated DF stands harboring high populations of WSBW. The most significant of that activity was noted northeast of Bozeman in the Bridger Creek drainage. To the south, there was less WSBW-caused defoliation, but some areas in the Gallatin Canyon have been seriously impacted. DFB-caused mortality, low at present in most of those areas, may increase substantially within the next few years.

North of Bozeman, in the Bridger Mountain Range, small groups of WBBB- and MPB-caused damage was located in their respective hosts. To the south and east, WBBB activity has increased in SAF stands. To the south, closer to the Hebgen Lake RD, around the Buffalo Horn Creek drainage, several groups of MPB-killed LPP were observed. Above some of those MPB infestations in LPP, there were a few areas found where MPB has killed WBP. Larger groups of MPB-killed WBP were found west of Pioneer Mountain—from Lone Mountain on the north, to the Lee-Metcalf Wilderness on the south.

In total, MPB and white pine blister rust in WBP stands increased substantially in 2006. In 2005, 4,100 acres of WBP had been recorded as infested by MPB and another 1,100 acres infected by white pine blister rust. While white pine blister rust was not recorded in 2006, it is certainly a factor in the 3,800 dead WBP recorded on 18,000 acres in 2006. Acres of WBBB-affected SAF stands also increased—from 11,800 acres in 2005 to nearly 27,000 acres in 2006. Beetle-caused mortality on those acres increased slightly—from 24,000 to 27,000 trees. DFB activity was noted on almost 800 acres (3,100 dead trees) in 2005; but declined to 125 trees on 50 acres this year. However, WSBW defoliation was reported on almost 119,000 acres in the

Bridger Mountains. Many of those trees could attract DFB within the next few years.

118,572 acres of the Bozeman RD were defoliated by WSBW. A large section of private land east of Bozeman, MT had defoliation as did Forest Service and private land south of Bozeman. Defoliation also occurred north of Bozeman, throughout the Bridger Range, and north onto private land and into the Helena NF. Another large area of defoliation occurred south of Bozeman along the forest boundary and south along Gallatin Canyon to Cinnamon Mountain. The Lee Metcalf Wilderness Area was not flown but likely contains some defoliation as well.

Tomentosus root disease (*Inonotus tomentosus*) is known to be a significant agent in spruce trees in some campgrounds on the forest. It has been positively identified in subalpine fir from the area around Fairy Lake Campground north of Bozeman (2005 Insect and Disease Training Session). Black stain root disease (*Leptographium wageneri* var. *pseudotsugae*; confirmed by T. Harrington) has been positively identified from declining Douglas-fir north of Bozeman in the Bridger Range and southeast of Bozeman in the Bear Canyon area.. Black stain root disease can be a significant disease in other parts of the country, but it is considered an infrequent and minor disease in Montana. An as yet-to-be-identified root disease appears to be involved with significant blow down of Douglas-fir in 2006 near Battle Ridge Campground north of Bozeman.

Blowdown of several Douglas-fir trees in Battle Ridge campground occurred in December 2006. Although an assessment is not yet complete, twenty-eight wind-damaged trees were observed in the campground. Eighteen of the trees failed at the stem and ten failed at the roots. Of the stem failures, five showed no defects, five showed signs and/or symptoms of decay (*Phellinus pini* and an unidentified brown rot-causing fungus), and eight were associated with co-dominant tops. Of the root failures, three showed no evidence of root decay, two showed evidence of a brown cubical root rot-causing fungus, and four showed evidence of a white rot-causing fungus. The decay fungi in the roots have not been identified yet; however, we strongly suspect the brown cubical rot was caused by *Phaeolus schweinitzii*.

Hebgen Lake RD. In the northern part of the District, south of Buck Creek, observers mapped a large area of MPB-killed WBP; and a much smaller group of SAF killed by WBBB. To the north, WBBB-infested stands were more prevalent.

To the east, north of Cinnamon Creek, another significant group of WBBB-killed trees was found. In that area, a few small groups of DFB-killed DF, and many larger patches of MPB-killed LPP was located. WSBW is also active in that area and may lead to increased activity by DFB. DFB populations have recently decreased throughout t the District, but activity remaining in close proximity to increasing WSBW defoliation may well increase as well.

In the central part of the District, between Wapiti and Kirkwood Creeks, many small groups of bark beetle activity was observed. DFB has killed DF in noticeable numbers; MPB was recorded in both WBP and LPP stands; and WBBB-caused mortality was observed in high-elevation SAF stands. WBBB, and MPB in both WBP and LPP were more concentrated to the east; while DFB activity was evidenced more to the west.

Further south, higher concentrations of all insect damage were in the upper elevations in the Madison Range, and south towards the Centennial Mountains. There, DFB activity was more noticeable, as was WSBW defoliation in Trapper and Sheep Creeks drainages. Larger areas of DFB-caused damage were particularly evident along Watkins Creek. Sheep and Watkins Creek drainages also exhibited large areas of WBBB-caused mortality. MPB activity

was also widely distributed in both WBP and LPP stands throughout that part of the District. Throughout the Madison Range, WSBW activity was prevalent; and while DFB-caused damage in light at present, that may not be the case in the near future.

District-wide, in addition to an estimated 28,400 WBP killed on approximately 24,500 acres in 2004; and 24,100 trees on 11,600 acres in 2005; another 5,700 trees were killed on 7,200 acres in 2006. Mortality of that magnitude is having a drastic effect on those stands; and those estimates may be conservative. Data collected on ten variable-radius plots near Lightning Lake in 2004 showed, for the area surveyed, more than 160 trees per acre had been killed in the past 2-3 years. MPB beetle-killed LPP also increased in 2006. More than 8,700 trees were reported on 7,500 acres. DFB activity declined to just less than 900 acres (1,800 acres reported in 2005), on which only 620 dead DF were recorded (compared to 4,400 in 2005). WBBB killed an estimated 12,200 SAF on nearly 11,000 acres. Both those figures were increases over 2005 estimates: 11,000 trees on 7,800 acres.

For the entire Gallatin reporting area about 1,100 acres of DFB-infested DF stands were observed, compared to 9,520 in 2005. Another 18,100 acres of MPB-infested LPP were mapped—up markedly from only 200 recorded in 2005. More than 31,200 acres of MPB-killed WBP—an increase from 21,000 acres last year—was noted (almost 14,000 WBP were killed); and about 46,000 acres on which WBBB-killed SAF was found were mapped. Nearly 26,600 acres of WBBB-caused mortality had been recorded in 2005. WSBW once again increased significantly, to almost 209,000 acres. That level of defoliation could influence DFB activity in the near future.

WSBW defoliated 6,480 acres in the Hebgen Lake RD in the Taylor Creek drainage and all along the southern and southwestern side of Hebgen Lake to the Forest Service boundary.

FIA data were queried to provide an estimate of WPBR infections. Two of 145 (1.4%) WBP sampled on the Hebgen Lake RD were infected with WPBR.

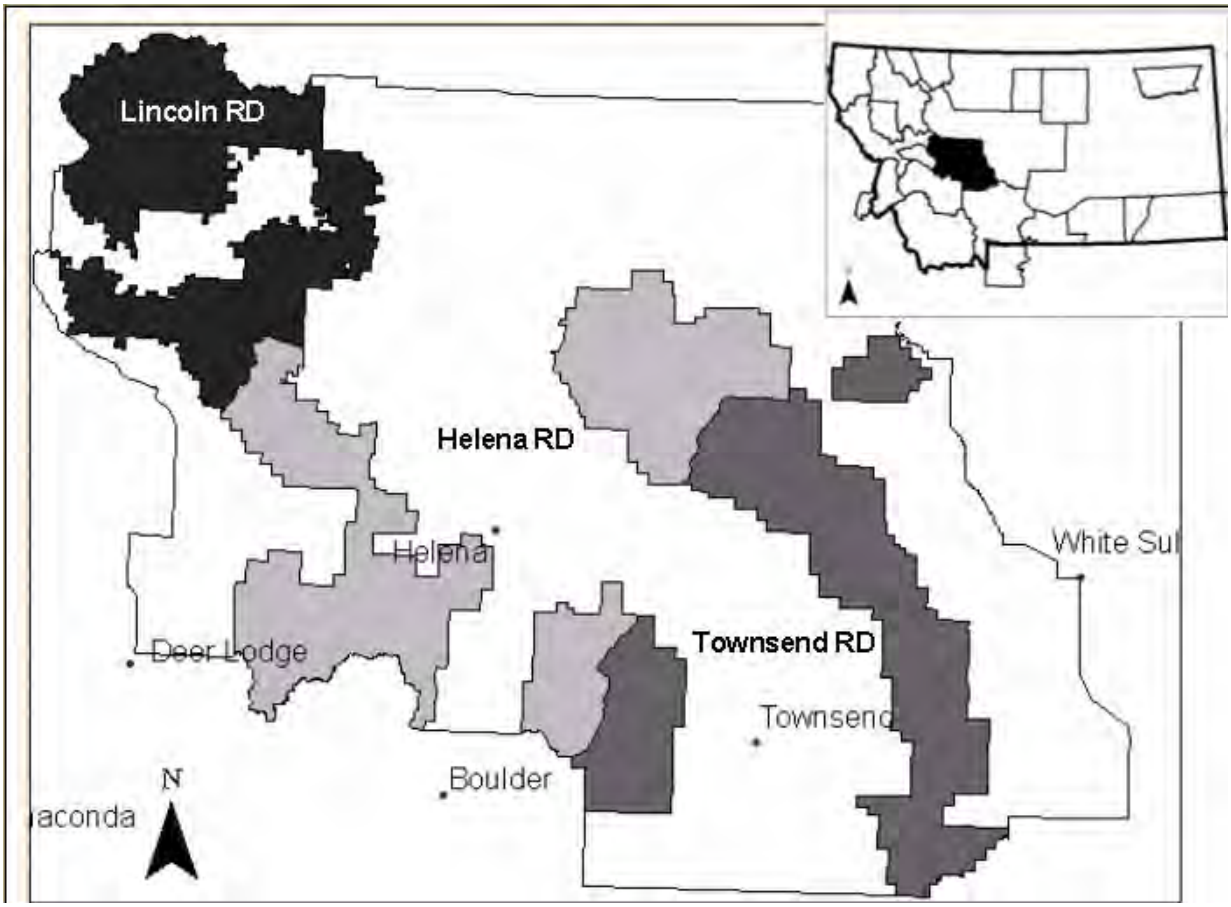

Figure 7. Helena Reporting Area and Helena National Forest Ranger Districts

Helena Reporting Area

Townsend RD. DFB populations have nearly returned to endemic conditions following several years of outbreak levels. Small and very widely scattered groups of DFB-killed trees were mapped throughout the Big Belt Mountains, east of Townsend; but no large groups were recorded. Overall, the previously affected areas have been much reduced. Extensive amounts of defoliation caused by WSBW on nearly 52,000 acres in that same general area could result in increasing DFB populations if weather conditions further weaken affected trees.

MPB populations in both LPP and WBP stands continued to expand significantly throughout their respective hosts in the Big Belts. Groups of beetle-killed trees ranging in size from 5 to several thousand trees each were mapped from the upper reaches of Beaver Creek southward to Mount Edith. WBP stands near Boulder Mountain, Mount Baldy and Mount Edith, have experienced extreme amounts of MPB-caused mortality, and it continued in 2006. Ground-collected data in the vicinity of Mount Edith showed in some areas nearly 70% of the WBP over 5" d.b.h. (more than 200 trees per acre) has been killed in the last three years. White pine blister rust was also prevalent in those stands.

Numerous small groups of WBBB-killed trees were noted throughout the Big Belts in stands high enough and moist enough to support SAF. West of Townsend, beetle-killed groups are small and very widely scattered in DF, PP, and LPP types.

District-wide, DFB-infested trees were observed on almost 900 acres (down from 2,300 last year); MPB-killed LPP on 10,500 acres (up significantly from 8,700 acres in

2005), and beetle-impacted PP on fewer than 10 acres. MPB-caused mortality in WBP stands was reported as totaling 19,700 trees on 6,200 acres—not substantially different from the 18,300 trees on 7,800 acres recorded in 2005, nor the 16,000 trees on 6,760 acres recorded in 2004. Many of those trees were also infected by white pine blister rust. WBBB-caused mortality was recorded on about 300 acres—virtually the same level recorded in 2005.

94,130 acres of the Townsend RD were defoliated by WSBW. Almost every part of the district was affected with the exception of the higher elevations in the Elkhorn Mountains.

Significant pockets of mortality are known to occur west of Canyon Ferry Reservoir. In this area, Armillaria is killing Douglas-fir and quaking aspen and causing large and very discrete pockets of mortality across the hillsides. The species responsible for this extensive mortality has not been identified, but is thought to be *Armillaria ostoyae*.

FIA data were queried to provide an estimate of WPBR infections. Twenty-three of 91 (25.3%) WBP and two of the 43 (4.7%) limber pine sampled on the Townsend RD were infected with WPBR.

Helena RD. MPB-caused mortality was mapped in a very widely scattered pattern throughout PP stands north and south of Helena. Most groups were small, from 1 to 20 trees each. Highest concentrations were mapped south of Helena in the western slopes of the Elkhorn Mountains. Some of the larger groups were near Strawberry Butte. In those same areas, at higher elevations, MPB-killed LPP was also noted; however, most of those groups were small as well.

West of Helena, in the Tenmile Creek and Sweeney Creek drainages—and from there up towards McDonald Pass—MPB-infested LPP stands appeared to be increasing, although groups were still relatively small. DFB populations were still found affecting their hosts in small and widely scattered groups throughout DF type. That is another area, however, where extreme amounts of WSBW-caused defoliation could result in increasing DFB populations over the next few years.

Total DFB-infested area was about 1,500 acres—a very slight increase from 1,200 acres last year. However, WSBW outbreaks on 84,000 acres could lead to DFB increased activity. MPB-killed trees were observed on 3,800 acres in LPP stands (1,500 acres last year), 1,800 acres in PP stands (930 acres in 2005), and 200 acres in WBP stands. MPB killed a total 14,800 trees in 2005 (2006 faders) in all hosts. WBBB killed SAF on another 260 acres, also reduced from 550 acres in 2005.

Almost the entire Helena RD experienced defoliation by WSBW for a total of 84,047 acres. Only the higher elevations in the southwest corner escaped defoliation.

Lincoln RD. A very general scattering of small groups of DFB-killed DF, MPB-killed LPP and WBBB-killed SAF were mapped in host stands throughout that part of the District south of Highway 200. Most groups of beetle-killed trees were smaller than 50 trees each. Large areas of DF defoliated by WSBW (totaling 19,000 acres) could lead to increases in DFB populations. WSBW populations were particularly high along the Continental Divide.

North and east of Lincoln, MPB populations continued to build in LPP stands in the Beaver and Copper Creek drainages. DFB-killed trees and a few groups of WBBB-killed SAF were once again mapped in the Arastra Creek drainage and eastward towards Red Mountain, just north of Lewis and Clark Pass. In the Alice Mountains, north of Alice Creek, several groups of MPB-killed WBP were noted. A few, small groups of DFB-killed trees were found in the Wolf Creek drainage east of Rogers Pass. That whole part of the Forest was another

where WSBW populations and resulting defoliation were extreme.

District-wide, about 1,400 acres were infested by DFB; 6,000 acres of LPP, 260 acres of PP, and 670 acres of WBP showed some level of MPB-caused mortality; and about 500 acres were mapped with SAF mortality attributed to WBBB.

Throughout the Helena Reporting Area, and especially northwest of Helena, WSBW populations are increasing significantly. Defoliation, coupled with prolonged drought, could result in increased amounts of DFB activity within the next few years. Area-wide survey estimates for bark beetle-caused mortality for areas flown totaled: DFB 5,300 acres—compared to 5,600 acres last year; MPB 34,300 acres (24,800 acres in 2005), of which 22,100 acres were LPP, 5,100 PP, and 7,100 WBP (almost 98,000 trees, of all species were killed); and WBBB about 1,300 acres—down from 3,400 acres last year.

Almost all of the Lincoln RD experienced defoliation by WSBW. 49,569 acres total were defoliated although the Scapegoat Wilderness was not flown and likely also experienced defoliation.

FIA data were queried to provide an estimate of WPBR infections. Nine of 205 (4.4%) WBP and two of the eleven (18.2%) limber pine sampled on the Lincoln RD were infected with WPBR.

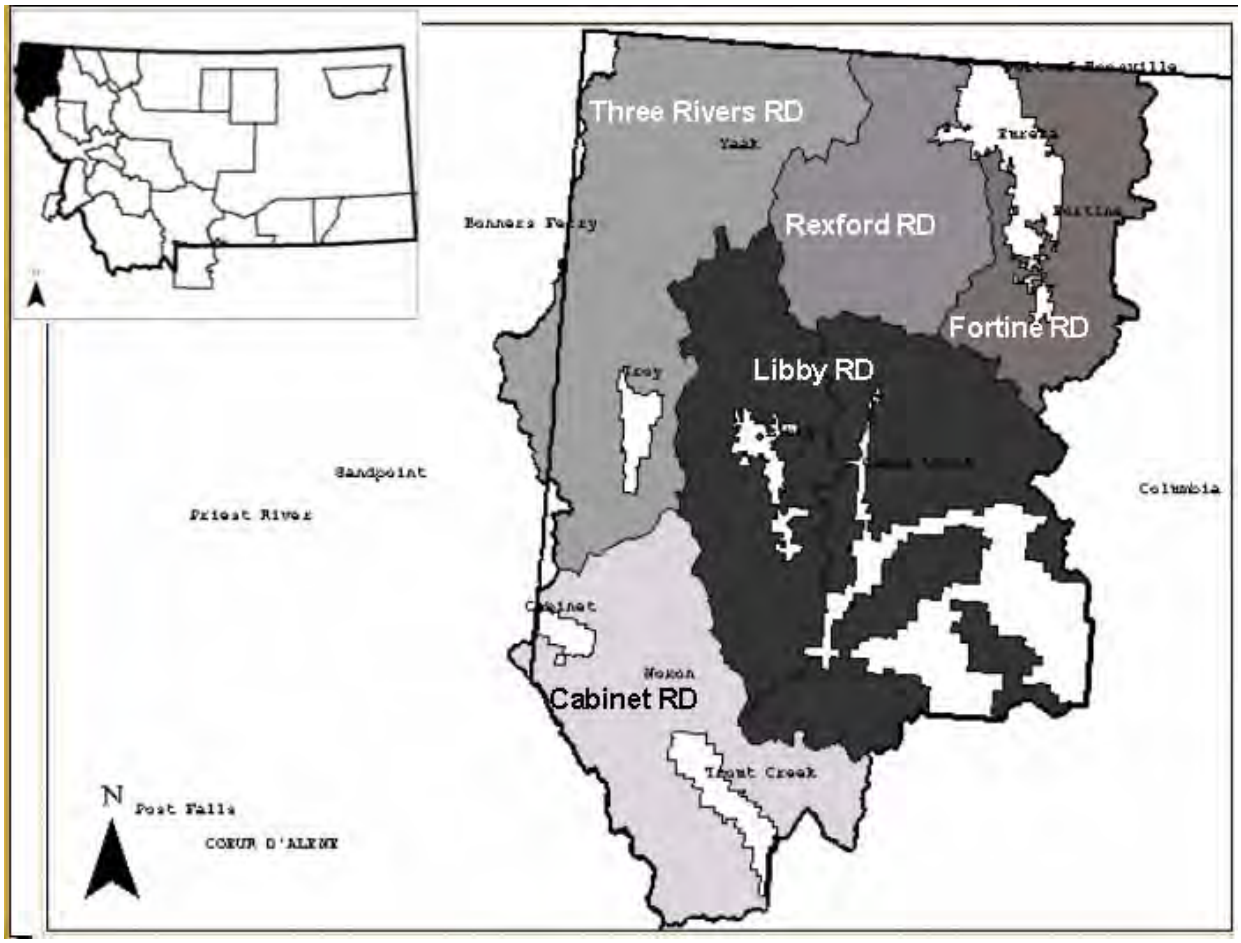

Figure 8. Kootenai Reporting Area and Kootenai National Forest Ranger Districts

Kootenai Reporting Area

Only the southern portion of the Forest—Cabinet RD and southern part of Libby RD—was flown in 2006. Reports for the other Districts are reproduced from the 2005 conditions report. Bark beetle conditions likely have not changed dramatically in the past year.

Rexford RD. DFB populations have returned to near-endemic levels throughout the District. Very small and very widely scattered groups were found at a few locations in DF or mixed-conifer stands. A few larger groups remained in the Pinkham Creek drainage and especially near Virginia Hill, but most are 20- to 30-tree groups, or smaller. WBBB-infested SAF were also found in mostly small groups. A few larger ones were located near McGuire and Ellsworth Mountains to the east and Boulder Mountain to the west. Some small groups FE-killed GF were mapped at a few somewhat isolated locations. A small number of fairly large groups of MPB-killed WBP were observed near Robinson Mountain.

Fortine RD. DFB activity declined on the District once again in 2005. Beetle-killed groups were few, small, and widely scattered. Some of the larger groups were mapped in Sunday Creek drainage and its tributaries, south of Fortine. North of Fortine, in the Galton Range, DFB populations also declined markedly. Several large groups of WBBB-impacted SAF were mapped near Stahl Peak and Krag Peak. MPB-caused mortality in WBP increased near Kasanka Peak, north of Stahl Peak, and surrounding Mount Wam. Another group was located to the south near Mount Petery.

Totals for the District showed about 1,500 acres of DFB-killed DF (approximately 2 trees per acre); 700 acres of MPB-impacted LPP and another 900 WBP (average one tree per acre, each); and 2,200 SAF were killed by WBBB on 1,800 acres.

A very active and severe pocket of *P. weirii* was observed on the Fortine RD in 2006 (MFO TR-06-13). This particular pocket of activity was causing intensive damage and mortality in Douglas-fir and western larch.

Aerial detection surveys identified larch needle disease on 16 acres of the district. Many additional acres would have likely been detected if more of the district had been flown for the surveys; given larch needle disease was widespread across northwestern Montana in 2006.

Three Rivers RD. DFB activity declined throughout the District in 2005. Beetle-caused mortality was still noticeable in small and scattered groups in DF type; but at a much reduced level from recent years. FE-killed GF was frequently encountered, although not in extreme amounts. A few of those larger groups were noted near and east of Yaak Mountain.

Most prevalent bark beetle activity on the District was attributed to WBBB. Larger beetle-killed groups of SAF were mapped near Marmot Mountain, Rock Candy Mountain, and Pink Mountain.

MPB-caused mortality in both WWP and WBP was also noted in significant-sized groups throughout the Yaak River drainage. Notable groups in WWP were mapped near Grizzly Point and Garver Mountain. WBP damage was more prevalent near Cross Mountain and Tepee Mountain. White pine blister rust infections, common in the WWP type, were also associated with MPB activity. South of Troy, only very light and widely scattered bark beetle activity was observed.

District wide, about 900 DF were killed by DFB on 300 acres—down from 4,400 trees on 1,300 acres in 2004; WBBB killed 4,600 SAF on 5,700 acres—up markedly from 2,400 acres and 1,900 trees last year; and 1,200 FE-killed GF on were noted on 700 acres—both slight increases. MPB-killed trees were recorded on 1,200 acres of LPP stands; 1,700 acres of WBP; and another

1,000 acres of WWP. More than 9,100 WBP; 2,800 LPP; and 350 WWP were killed.

WSBW defoliated 12,252 acres of the area flown on the Three Rivers RD. This defoliation was scattered throughout the southern third of the district, south of North Callahan Creek. At Spar Lake, western hemlock was defoliated, presumably by WSBW. In the Porcupine and Stanley Creek drainages, defoliation by WSBW was observed on western hemlock and GF.

Larch casebearer defoliated WL on 85 acres in the lower Porcupine Creek drainage.

Aerial detection surveys identified larch needle disease on about 4,650 acres of the district. Foliar damage was widespread across the area flown in 2006 (southern end of the district). Additional acres of damage would have likely been detected if more of the district had been surveyed.

Off-site (some referenced as Lolo stock) PP in the Rocky Pine Fuels Reduction Watershed area north of Troy was extensively defoliated in recent years. A January 2007 site visit showed that some trees had lost all foliage other than that put on in 2006. Extensive red transverse banding (classic symptom of "red band needle disease" caused by *Dothistroma septospora*) was observed on foliage of several trees. However, no pathogen had yet been identified as the cause of the defoliation at the time this report was printed.

Libby RD. Bark beetle activity of all species, in their respective hosts, was greatly reduced throughout the District in 2005 and again in 2006. In 2006, very small and widely scattered groups of MPB-killed LPP and DF, killed by DFB, were reported south and west of Libby. Nearly endemic amounts of DFB activity were recorded both north and south of Libby (in 2005)—totaling but 1,200 acres. FE activity was a little more common in 2005, but reduced from 2004 levels—4,600 acres compared to 7,800 acres. Those figures were reduced once again 2006, for the part of the District surveyed. Notable concentrations were mapped south of Libby in the Cameron Creek drainage, and to the north in Quartz Creek and Bobtail Creek drainages in 2005. Minor amounts of MPB-killed trees were noted at a few isolated locations in WPB, WWP, and LPP stands.

Beetle-infested stands on the District totaled: DFB, 1,200 acres—3,000 dead DF; FE, 4,600 acres—7,300 beetle-killed GF; MPB (all hosts, but mostly LPP), fewer than 300 acres; and minor amounts of WBBB- and WPB-caused mortality in both 2005 and 2006.

WSBW defoliated 16,268 acres all along the southwestern boundary of the Forest Service, east of Flaval Ridge, south to Fisher Creek and in the Parmenter Creek drainage. Defoliation was also scattered over all of the southwestern corner of the old Fisher River RD on Forest Service and Plum Creek land.

125 acres of WL defoliated by the larch casebearer was observed west of Little Hoodoo Mountain.

Aerial detection surveys identified larch needle disease on about 6,100 acres of the district. Foliar damage was widespread across the area flown in 2006 (southern end of the district). Additional acres of damage would have likely been detected if more of the district had been surveyed.

Cabinet RD. As DFB populations, and associated damage returned to near-normal levels in 2005; MPB-killed LPP was increasing in parts of the District. Small amounts of DFB-killed trees were noted in Stevens Creek and Pilgrim Creek drainages and to the north in Rock Creek drainage and near Government Mountain last year, but those infestations have been reduced to small, scattered groups in 2006. Most DFB activity was recorded to the north and south of Noxon Reservoir, but no groups were

larger than about 10 trees. Significant, however, were large groups of MPB-infested LPP mapped in Little Beaver Creek and White Pine Creek drainages south of the Clark Fork River, and throughout the Vermilion River and its tributaries to the north in 2005. Those infested areas had increased markedly just within the past few years. In 2006, MPB activity in LPP stands on the District was recorded as more widely scattered, but in much smaller groups. Notable activity was reported throughout the Vermillion River drainage, and the Silver Butte River drainage to the north (actually on Libby RD); but most groups were small. Few were larger than about 50 trees. South of Noxon Reservoir, small fader groups were also found scattered throughout LPP stands in the Beaver Creek and White Pine Creek drainages.

FE activity was still noted in a few GF or mixed-species stands, with a few of the larger groups mapped in the upper Trout Creek drainage. WSBW activity on the District, not recorded in the past quarter century prior to 2005, has increased and significant amounts of defoliation was recorded in many DF and mixed-species stands. Heavy defoliation, coupled with drier-than-normal conditions, could lead to an increase in DFB activity within the next few years.

District-wide, DFB-killed DF was found on 400 acres (220 acres in 2005); MPB infested 40,500 LPP (30,300 last year) on 13,000 acres (9,400 acres in 2005) and another 200 PP on 260 acres; FE killed 115 GF on 130 acres (1,300 trees on 2,000 acres in 2005); and WBBB activity was minor—recorded on less than 200 acres.

Total mortality attributed to bark beetles in the Kootenai reporting area in 2005 was: 12,000 DF killed by DFB on 5,400 acres (21,000 trees on 9,100 acres in 2004); 11,000 GF killed by FE on 7,700 acres (8,500 trees and 9,100 acres in 2004); 34,200 LPP killed by MPB on 11,500 acres (10,400 trees on 1,500 acres last year); 16,500 WBP and 1,700 WWP killed by MPB on a combined 17,200 acres; and 13,000 SAF killed by WBBB on 12,400 acres (5,700 acres in 2004). Minor amounts of mortality attributed to IPS were also recorded in 2005. Forest-wide totals were not obtained in 2006; however, we believe most bark beetle activity declined, except for MPB in LPP.

35,597 acres of the area flown in 2006 were defoliated by WSBW. This included all of the southern half of the district and an area on the north side of the Bull River basin.

Larch casebearer defoliation was observed on 1,003 acres. Defoliated was detected along the north edge of Noxon Reservoir, in the Rock Creek drainage northeast of Noxon, MT, northwest of Berray Mountain, in the Snake Creek drainage and along the north side of Bull River.

Extensive Armillaria root disease and laminated root disease in the Marten Creek drainage of the Cabinet RD was also observed in 2006 (MFO TR-07-01). The species being most affected were Douglas-fir and grand fir.

Aerial detection surveys identified larch needle disease on about 8,800 acres of the district. Many additional acres would have likely been detected if more of the district had been flown for the surveys; given larch needle disease was widespread across northwestern Montana in 2006.

Elytroderma needle disease (caused by *Elytroderma deformans*) – in combination with drought and limited bark beetle activity – was associated with significant mortality in an 80-year-old ponderosa pine plantation near Marten Creek on the Cabinet RD in 2005. This plantation was planted to stock produced from seed that had been collected on the Bitterroot NF.

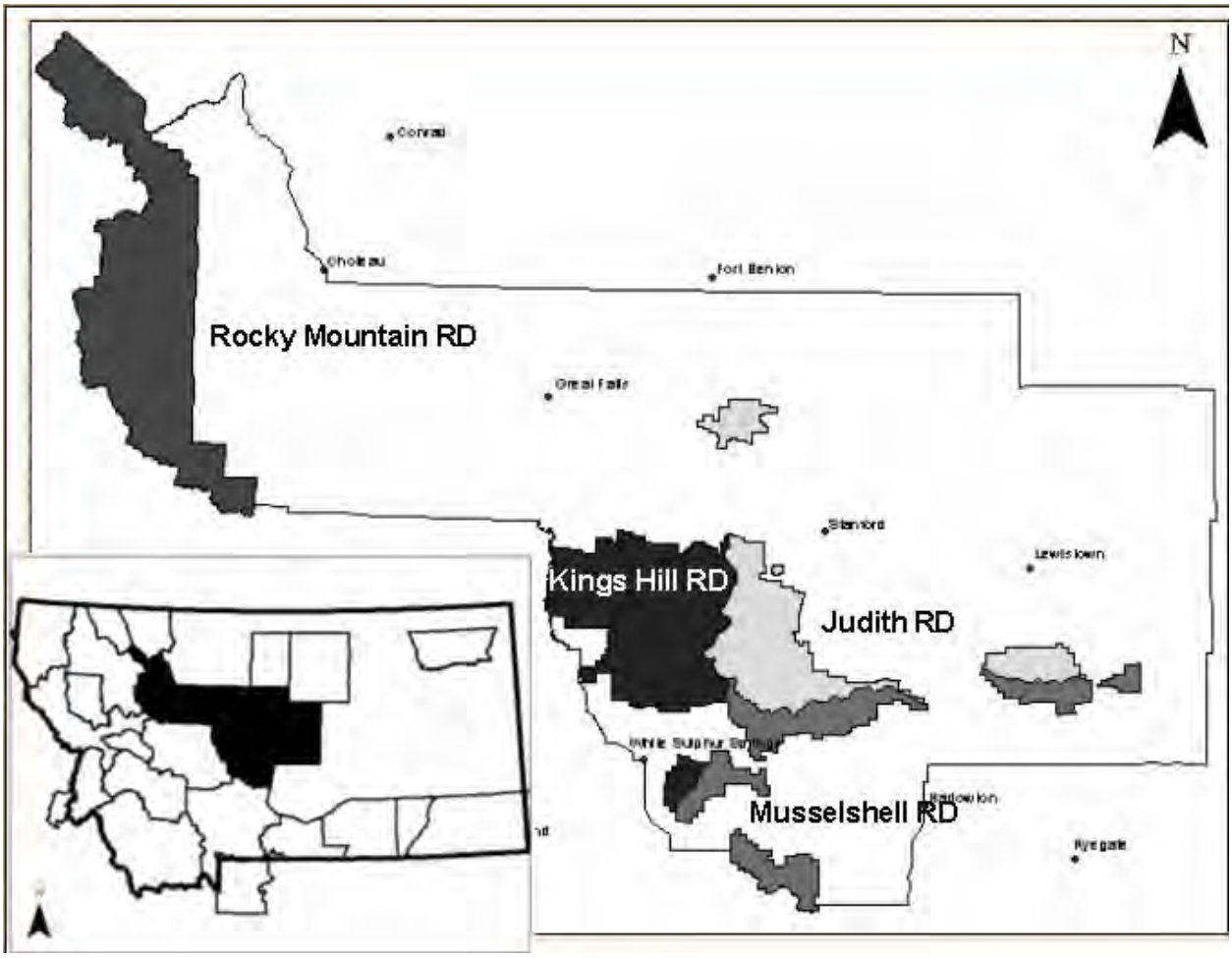

Figure 9. Lewis and Clark Reporting Area and Lewis and Clark National Forest Ranger Districts

Lewis & Clark Reporting Area

Rocky Mountain RD. District was not flown in 2006 nor has it been for the past several years. We have no current record of any insect of disease activity on the District.

FIA data were queried to provide an estimate of WPBR infections. Twenty-two of 302 (7.3%) WBP and eleven of the 119 (9.2%) limber pine sampled on the Rocky Mountain RD were infected with WPBR.

Judith RD. Bark beetle activity was noted in a widely scattered pattern of mostly small groups throughout the District in 2006, similar to what had been observed in 2005. Most activity was recorded as MPB-killed PP, found in small groups north and east of the Little Belt Mountains; however, in that same general area, widespread beetle-caused mortality was also found in WBP, SAF, and LPP stands. Largest of the MPB-infested PP stands were mapped in the Dry Wolf Creek and North Fork Wolf Creek drainages, and on the east-facing slopes of Ettien Ridge, southeast of Tollgate.

Significant groups of MPB-infested WBP were found in the central portion of the District—especially near Yogo Peak, Tepee Butte, and Big Bald Mountain. WBBB activity was recorded near Big Bald Mountain, Yogo Peak, Tepee Butte, and Grendah Mountain and a few other high-elevation sites.

The Highwood Mountains were not flown, but in 2005, very light and widely scattered

groups of DFB-killed DF and MPB-impacted LPP were noted in that area. Numerous groups of MPB-infested PP were recorded in the Big Snowy Mountains, especially noticeable in South Fork Judith River drainage.

BLM-administered land north of Lewistown was not flown. In 2005, we observed very widely scattered MPB-caused mortality in a few PP stands in the Judith and North and South Mocassin Mountains. Most were small groups; a few were as large as 150 trees, but most were less than 100.

District-wide, DFB was found on less than 200 acres (240 acres last year); MPB on slightly more than 5,900 acres—on all hosts, but most was PP (3,100 acres), next most prevalent being WBP 2,700 acres. MPB killed a total 5,600 trees, most were PP. WBBB-killed SAF was mapped on nearly 4,200 acres—1,250 acres in 2005.

829 acres of the Judith RD were defoliated by WSBW in the Tree Creek drainage and southwest of The Arch.

Both *I. tomentosus* in spruce and *Phaeolus schweinitzii* in Douglas-fir were found causing decline in Dry Wolf Campground southwest of Stanford (MFO TR-02-18).

FIA data were queried to provide an estimate of WPBR infections. Six of 215 (2.8%) limber pine sampled on the Judith RD were infected with WPBR.

Musselshell RD. Widely scattered small groups of trees killed by several bark beetle species were recorded in the Little Belt and Castle Mountains. Most were MPB-killed PP and LPP. Several groups of WBBB-killed SAF were also noted at a few high-elevation sites. DFB activity recorded in 2005 has declined significantly.

MPB-caused mortality in PP and LPP stands was common in the Little Belt Mountains from the Musselshell River east to Stevens Butte, where the largest groups were mapped. MPB-killed WBP was prevalent in higher-elevation stands to the west—especially large groups were mapped near Hoover Mountain in the Little Belts, and near Wapiti Peak in the Castle Mountains. MPB-infested LPP stands were also common in some larger groups in the southern Castle Mountains. Significant WSBW activity throughout the area could lead to increases in DFB populations.

In the Crazy Mountains, widely scattered small groups of WBBB-infested SAF and MPB-impacted WBP were observed. Almost no DFB activity was noted. MPB activity in WBP stands was concentrated near Box Canyon and south of Mount Elmo, with the largest group mapped northeast of Bald Ridge. Numerous small groups of WBBB-killed trees were found near Loco Mountain. Small amounts of MPB-killed trees were noted in LPP type.

Throughout the District, about 1,450 PP were killed by MPB (1,600 in 2005) on roughly 2,500 acres (1,400 acres last year). MPB and white pine blister rust affected WBP and LP on more than 3,850 acres (2,600 acres in 2005); and MPB alone on 4,500 acres of LPP—up from the 1,000 acres recorded last year. Total MPB-caused mortality, all hosts, exceeded 12,000 trees. DFB killed 300 trees on 200 acres—reduced from 770 acres and 2,050 trees last year. WBBB killed 1,600 trees on 1,950 acres—about the same as last year's 2,200 trees on 1,200 acres.

The entire southwestern part of the Musselshell RD in the foothills of the Castle and Crazy Mountains experienced WSBW defoliation. Total acres of defoliation recorded were 31,585.

FIA data were queried to provide an estimate of WPBR infections. Five of 139 (3.6%) limber pine sampled on the Musselshell RD were infected with WPBR.

Kings Hill RD. Widely dispersed and mostly small groups of DFB-infested DF, WBBB-affected SAF, and MPB-killed LPP and PP were noted throughout the reporting area. Notably large groups of MPB-killed WBP were located near Kings Hill, south of Mizpah Peak, and in higher-elevation stands south of Forest Green. White pine blister rust was also prevalent in those stands. Largest groups of MPB-infested PP were also noted to the north, near Logging Creek, in the Sawmill Gulch and Logging Creek drainages, and near Monarch Mountain.

MPB was also active in PP stands to the west, in Tenderfoot Creek drainage. MPB activity in LPP stands was mapped as small groups to the south, near Miller Gulch, Charcoal Gulch, and in the northern Castle Mountains. WSBW activity, common in southern Little Belts, could precipitate increased DFB populations.

Totals for the District were about 5,300 SAF killed on more than 5,100 acres (fewer trees, more acres than last year); 2,800 PP and 14,350 LPP killed by MPB on 1,700 acres and 6,900 acres, respectively (approximately the same for PP, considerably more for LPP); MPB and white pine blister rust have affected 8,600 WBP on more than 6,200 acres—up considerably from 3,900 acres in 2005; and DFB killed 350 trees on 560 acres—down from 2,400 DF and 1,400 acres in 2005.

Area-wide mortality attributed to bark beetles in the Lewis & Clark reporting area totaled almost 1,000 DF on 1,200 acres (considerably reduced from 5,700 trees and 2,600 acres in 2005); and 47,500 MPB-killed trees on 33,400 acres—of all hosts, roughly one-third each of LPP, PP, and WBP. All figures were up from the 41,100 trees and 20,300 acres reported in 2005. Another 12,600 SAF were killed on 11,400 acres (4,500 acres in 2005; however tree mortality at about the same level).

40,810 acres were defoliated by WSBW in the Kings Hill RD. This defoliation was concentrated on the north and south ends of the district and extending into private lands, especially around White Sulpher Springs, MT.

FIA data were queried to provide an estimate of WPBR infections. One of 135 (0.7%) WBP sampled on the Kings Hill RD were infected with WPBR.

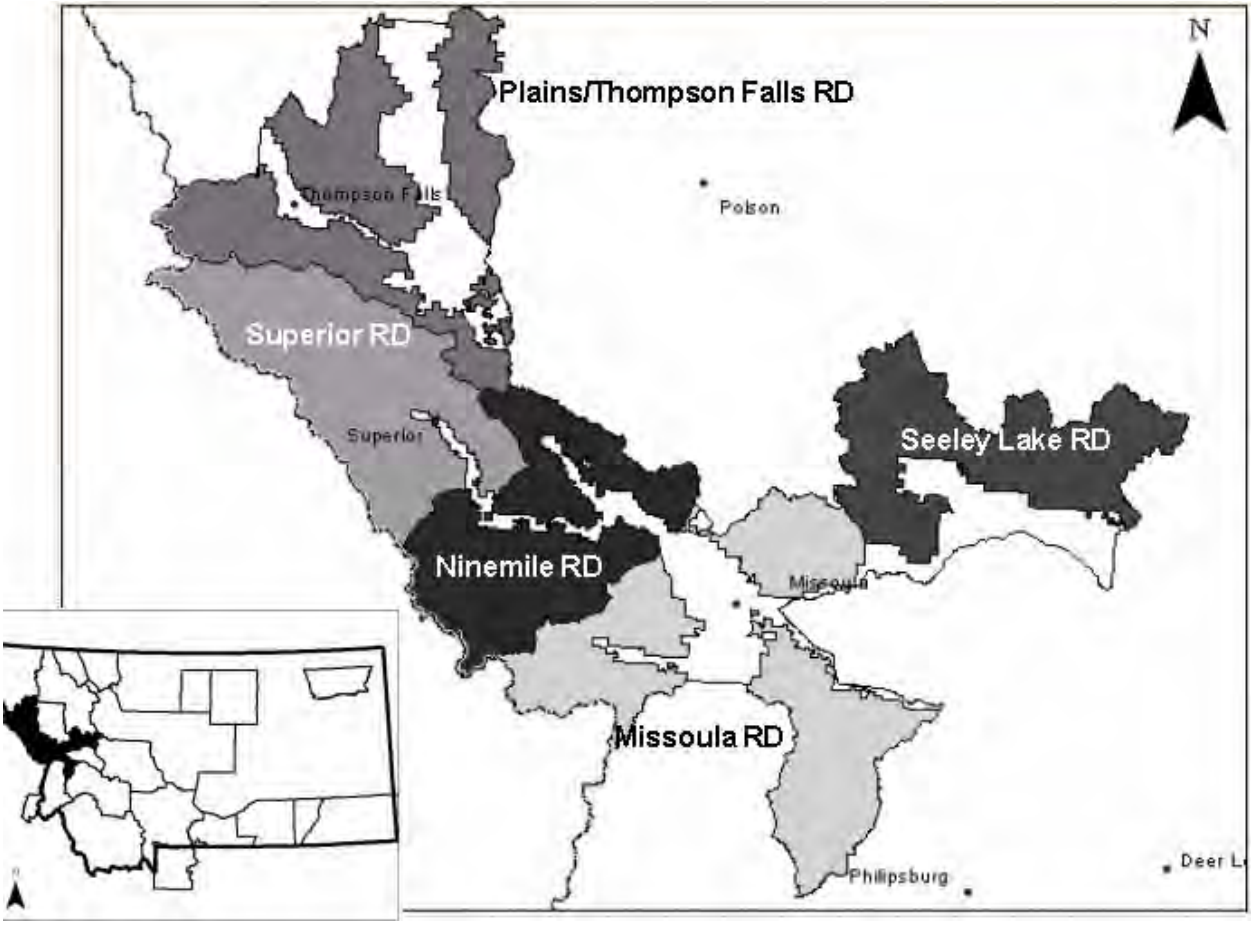

Figure 10. Lolo Reporting Area and Lolo National Forest Ranger Districts

Lolo Reporting Area

Missoula RD. DFB-killed DF were still quite prevalent throughout Rock Creek drainage, but groups were much smaller and more widely scattered than in the past few years—only a few groups exceeded 50 trees. Largest groups were recorded in upper Butte Cabin Creek drainage, and above Solomon Creek. Although small fader groups were numerous throughout the Rock Creek drainage, we found fewer currently infested trees in most areas in 2006 than in previous years. Throughout the District, on lands of all ownerships, a reported 20,600 DF were killed on 6,700 acres in 2005. In 2006, those figures had been reduced to 8,000 trees on just under 1,850 acres.

In the northern end of the Sapphire Mountains, especially in the upper Miller Creek and Allen Creek drainages, southeast of Missoula, MPB-killed LPP increased once again. Numerous groups were mapped in that area, many covering several hundred acres and averaging 2-3 beetle-killed trees per acre in each.

North of Missoula, in the Rattlesnake Creek drainage, MPB-infested LPP was also quite prevalent, and increased notably from 2005 levels. Largest groups were observed near Sheep Mountain, Mineral Peak, Stuart Peak, and east of Boulder Lake. To the west of Missoula, in the Grave Creek Range, MPB activity in LPP stands increased once again in 2006. Particularly large groups of faders were noted in the upper O'Brien Creek drainage and from there northward to Telephone Butte. A few groups of faders extended to a few thousand acres each and averaged 2-3 beetle-killed trees per acre.

District totals in 2005 included 15,800 acres of MPB-killed trees (mostly LPP). Those infested acres increased in 2006 to 35,300 (LPP) and 1,300 (PP); on which more than 105,000 trees were killed. Minor amounts of MPB in WBP, IPS and WPB in PP, and WBBB in SAF were reported in 2006.

The Missoula RD had only 92 acres of recorded WSBW defoliation. This defoliation was located on Forest Service land south of Beavertail Hill.

Aerial detection surveys identified larch needle disease on 23 acres of the district. The damaged larch were all in a small area in the northwestern corner of the district about one mile from the Ninemile RD and one mile from the Flathead IR.

Ninemile RD. MPB activity in LPP stands declined significantly from levels mapped in 2005—especially in the Ninemile Creek drainage. A few larger groups of faders were mapped along the Reservation Divide, near Squaw Peak and Blackrock Mountain; and south of Ninemile Creek around Lookout and Stark Mountains. But the once-massive outbreaks recorded in the past 2-3 years in that area have subsided. The outbreak has run its course near Siegel Pass, where only a few small groups of infested trees were noted. In that area, there were also found a few very small groups of DFB-killed DF. Ground-collected data, for a 10-plot area near Siegel Pass, in 2005, showed an average 187 trees per acre had been killed by MPB over the past several years.

Elsewhere throughout the Ninemile Creek drainage, minor amounts of DFB-infested DF, and MPB-caused mortality in both PP and WPB stands were observed. No significant outbreaks of those were noted, however.

South of the Clark Fork River, in Albert Creek, Petty Creek, Fish Creek, Rock Creek, and Trout Creek drainages, significant groups of MPB-killed LPP were recorded. Largest groups were once again mapped in Fish Creek, Rock Creek, and Trout Creek drainages near Petty Mountain, Garden Point, Cedar Peak, Needle Peak, St. Patrick Peak and Sunrise Mountain. Minor amounts of WBBB, DFB, and MPB (in PP stands) activity were reported south of the Clark Fork River.

In 2005, throughout the District, more than 438,000 LPP were killed by MPB on nearly 50,000 acres. MPB killed another 2,600 PP on 2,500 acres. In 2006, those figures were reduced to 32,000 acres of LPP, but PP-infested acres increased to 6,400. A total of more than 84,000 trees were killed by MPB in 2005 (2006 faders). Last year, 1,300 DF were killed by DFB on 420 acres. In 2006, those figures were reduced to 720 trees on less than 300 acres. WBBB-caused damage was minimal.

Aerial detection surveys identified larch needle disease on about 1,100 acres scattered across the district, except in the southeast corner of the district.

Plains/Thompson Falls RD. A comparison of beetle-infested stands on the District, from 2005 to 2006 show MPB-infestation levels are still very high throughout the District and may have increased in some areas. Largest groups in 2006, however, were mapped north of Plains in the Little Thompson River and upper Thompson River drainages, from about Corona Divide north to the Forest boundary.

Beetle populations have been reduced west of Plains, due to rapidly declining amounts of susceptible hosts. West and south of Thompson Falls, stands are still heavily infested in the Prospect Creek drainage and most of its tributaries. Along CC Divide, both east and west of Knox Pass, current beetle-caused damage has declined markedly. However, hundreds of thousands of beetle-killed LPP remain in many of those stands. Ground-collected data for a 10-plot area near Mount Bushnell, in 2005, showed an average 120 trees per acre killed by MPB during the past 5 years.

Minor amounts of WPB- and MPB-caused damage was found scattered through lower-elevation PP stands throughout the District. A few stands in which small amounts of DFB-killed DF, and WBBB-killed SAF were also mapped. That mortality was very light and scattered.

Totals for the District and adjacent State and private lands in 2005 showed 408,000 MPB-killed trees on more than 64,800 acres—most of which were in LPP stands. Comparable figures for 2006 showed a significant reduction—26,600 acres of LPP infested and another 1,700 acres of PP. In total, about 85,000 trees were killed. DFB activity was also reduced—to 145 acres, down from 750 acres in 2005. WBBB-caused mortality was recorded on but 20 acres (910 acres last year) and about 50 acres were infested by WPB.

9,585 acres were defoliated by WSBW in 2006 and this defoliation was concentrated in the northwest part of the district.

Aerial detection surveys identified larch needle disease on about 7,150 acres scattered across the district.

FIA data were queried to provide an estimate of WPBR infections. One of 48 (2.1%) WBP sampled on the Plains/Thompson Falls RD were infected with WPBR.

Seeley Lake RD. MPB-caused mortality was prevalent in LPP stands throughout the District, and has increased significantly in the past few years. Large groups of beetle-killed trees were noted near Black Mountain and Belmont Point, west of Placid Lake; near Hidden Lake and in Slippery John drainage, north of there; west of West Fork Point and east of Summit Lake to the north; near Richmond Peak and Florence Lake to the east of Seeley Lake; and throughout the Monture Creek drainage farther to the east. WBP has been heavily impacted by MPB, especially near Morrell Mountain, East Spread Mountain, and Conger Point. In most of those locations, beetle populations have declined.

To the west, other groups were once again mapped near Mount Henry and West Fork Point. MPB infestations in LPP intensified considerably in 2006. MPB-affected stands totaled about 9,850 of LPP, where MPB was the sole mortality agent, and another 12,600 acres of WBP with mortality attributed to both MPB and white pine blister rust in 2005. In 2006, comparable data showed 25,100 acres LPP infested, almost 700 acres WBP, and another 200 acres of PP. Total MPB hosts killed exceeded 74,000 trees. It is possible some of the increases in LPP-infested acres and associated decreases in WBP were attributable to areas where those species overlap and the difficulty in distinguishing them from the air.

Elsewhere on the District, DFB-killed trees were more widely scattered and in smaller groups than in 2005. Throughout the DF type, DFB-caused mortality increased was about the same as recorded last year—approximately 1,100 acres, on which 2,600 trees were killed. WBBB-caused mortality was observed on nearly 600 acres (620 acres last year) in a few high elevation SAF stands.

486 acres in the Monture Creek drainage and east of Ovando Point were defoliated by WSBW.

Superior RD. Observable amounts of MPB activity declined somewhat from 2005 to 2006; however, several very large groups of MPB-killed LPP were once again mapped from near Prospect Mountain, southeast of St. Regis, northwestward Lower Stevens Lake, on the Idaho/Montana border. In that general area, south of the Clark Fork and St. Regis Rivers, very large groups of MPB-killed LPP—some totaling hundreds of thousands of trees—were mapped—especially near Sheep Mountain and Wilson Lake on the east; in the McGee Creek drainage, south of Haugan; and near Saltese Mountain and Lookout Pass.

North of the St. Regis River, throughout the Coeur d'Alene Mountains, largest beetle-infested groups were recorded north of DeBorgia, and from there westward to Mullan Pass. The heavy outbreak existing along CC Divide, between St. Regis and Clark Fork drainages, has finally subsided significantly.

District-wide more than 47,200 acres were infested in 2003. We believe most of those outbreaks continued to expand in 2004, but in some of the areas that have been infested for several years, there likely was a decrease in intensity. Ground-collected data for a few sites on the District showed extreme amounts of MPB-caused mortality in LPP stands during the past few years: East Fork Dry Creek, 138 trees per acre; CC Divide, 103 trees per acre; Dry Creek (permanent plots), 143 trees per acre. MPB-caused mortality in LPP stands on the District totaled 453,300 trees on 64,000 acres in 2005; but decreased to about 120,000 trees on 34,500 acres in 2006.

Numerous, small groups of MPB-caused mortality were recorded in PP stands east of Superior, from First Creek northwestward to the Clark Fork River, at a generally heavier level than recorded in 2005. Acres with noticeable amounts of PP mortality increased from about 1,000 acres last year to nearly 2,700 in 2006. At least some of that mortality is thought to be related to lingering drought effects. Ground surveys have shown still-increasing populations in many areas. In some, host depletion has resulted in population declines. In a few areas surveyed in 2004, current-year attacks averaged more than 120 per acre. MPB killed nearly 2,800 PP on the infested acres mapped. Relatively minor amounts of other bark beetle-killed trees were reported.

Throughout the Lolo reporting area—no longer the most heavily impacted in the State—MPB killed LPP more than 1.4 million LPP on 204,400 acres; 9,600 PP killed on 5,400 acres; and nearly 10,800 WBP on 7,800 acres in 2005. Comparable figures recorded in 2006 were: 612,000 LPP on 210,000 acres; 32,300 PP on 15,100 acres; and 1,600 WBP on 730 acres. DFB activity was much reduced. Only 16,400 DF were killed on 5,100 acres—down from about 31,000 DF on 10,400 acres in 2005. WPB killed 230 PP on 300 acres (compared to 120 PP on 135 acres last year); and WBBB accounted for 3,400 dead SAF on 1,200 acres—also reduced from 3,700 trees on 2,600 acres last year. FE activity has returned to nearly endemic levels. In 2005, 2,600 GF were killed on nearly 2,700 acres. In 2006, only 500 trees were killed by FE on 200 acres. IPS killed an additional 1,700 PP on 750 acres.

Aerial detection surveys identified larch needle disease on about 9,600 acres spread across the district with the greatest concentration in the northern half of the district.

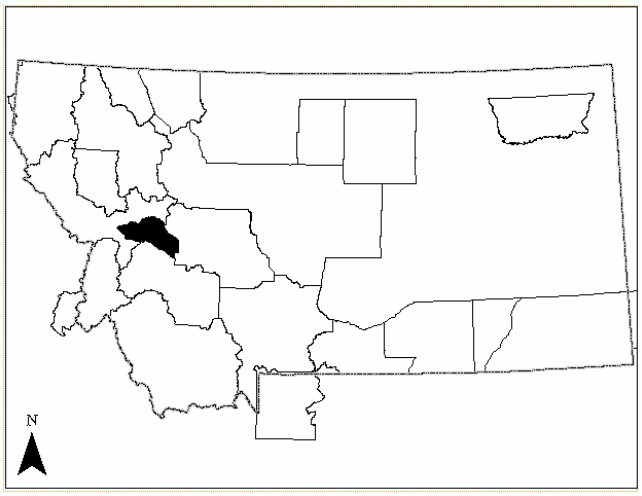

Figure 11. Garnet Reporting Area

Garnet Reporting Area (BLM)

Large amounts of MPB-killed LPP were recorded throughout the reporting area again in 2006, but not as widely spread as in 2005. Largest groups of beetle-killed trees were mapped in the vicinity of Mammoth Mine, Lost Horse Mountain, and Granite Mountain. In the eastern portion of the reporting area, near Hoodoo Mountain, numerous but smaller groups of beetle-killed LPP were noted. In 2005, it appeared

most LPP stands were infested to a greater or lesser degree. That widespread pattern was not as apparent in 2006. To a much lesser extent, and in much smaller groups, MPB-killed PP was also mapped in a widely scattered pattern. DFB-infested DF was also found in many mixed-species stands, but fader groups were small and widely scattered. DFB activity seems to have decreased notably throughout the area. Increasing WSBW populations could exacerbate that situation. WBBB-affected SAF stands were occasionally found in small groups at high-elevation sites.

In total, about 7,800 DF were killed on 3,200 acres in 2005. Those were reduced in 2006 to 2,400 trees on 1,200 acres. MPB killed approximately 18,500 LPP and 930 PP on a combined 12,600 acres last year. In total, for 2006, infested acres decreased for both hosts. Nearly 33,000 LPP were killed on 14,000 acres and 1,600 PP were killed on 825 acres. IPS accounted for an additional 400 dead PP (on 200 acres); and a mere 60 dead SAF were reported on 150 acres (down considerably from 440 acres last year), attributed to WBBB.

Number of acres defoliated by WSBW decreased from 16,785 acres in 2005 to 254 acres in 2006. However, this may be an underestimate because we were not able to fly portions of the Garnet Reporting area. One area of defoliation was north of Beavertail Pond on private land. Another was west of Helmville, MT and north of Douglas Creek.

INDIAN RESERVATIONS

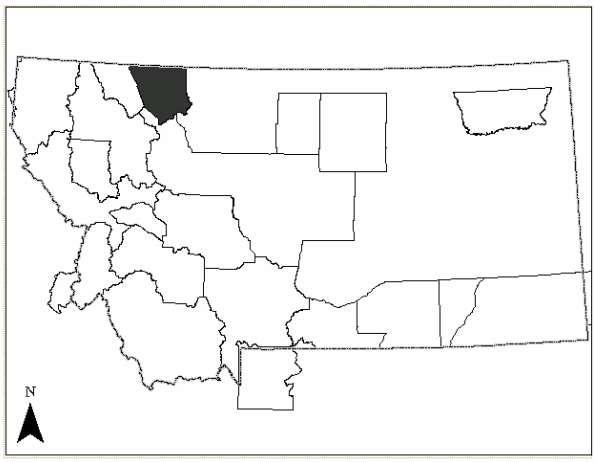

Figure 12. Blackfeet IR

Blackfeet IR

Once again, the Reservation was not flown in 2006. In 2004, the western portion was surveyed along with Glacier NP. In 2004, a few small groups of DFB-killed DF and MPB/IPS-killed LPP were mapped near Lower Saint Mary Lake. The most significant bark beetle-caused damage, however, was several large groups of SAF, killed by WBBB, recorded near Cut Bank Ridge and in upper tributaries of North Fork Cut Bank Creek. On the part of the Reservation flown in 2004, an estimated 4,000 SAF were killed on about 2,600 acres.

We have spent very little time looking for root disease on the Blackfeet Indian Reservation. Please contact Forest Health Protection- Missoula Field Office if you think you have root disease mortality on this reservation.

A Continuous Forest Inventory (CFI) was recently implemented on the Blackfeet IR with data collected over a two year period. CFI data collection is complete, but has not yet been analyzed. Once analyzed, a good assessment of current distribution and severity may be made for lodgepole pine dwarf mistletoe on the Reservation.

Light defoliation by the WSBW was observed on the west edge of the reservation, near the border with Glacier NP and St. Mary's, MT. Moderate WSBW defoliation was observed from several overlooks along highway 89.

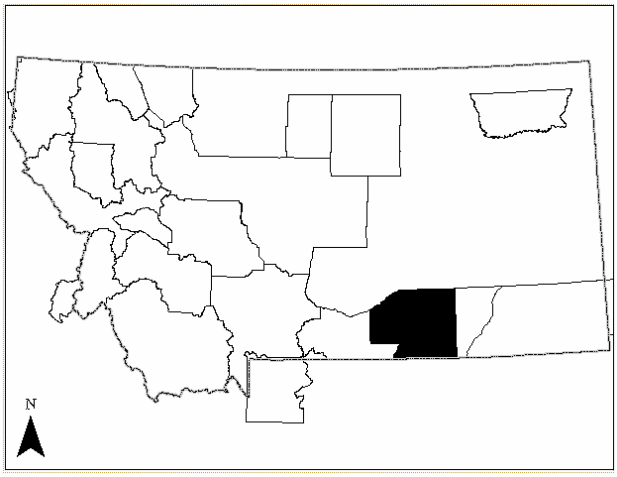

Figure 13. Crow IR

Crow IR

Very small and widely scattered groups IPS-killed PP were observed throughout the Wolf Mountains, east of Lodge Grass. The largest group, of about 400 trees, was mapped north of Shortys Hill in the Corral Creek drainage.

In the Pryor Mountains, to the west, numerous groups of WBBB-killed SAF were mapped in higher-elevation tributaries of Pryor Creek in 2005. Those infested areas remained at about the same level in 2006. In addition, areas not previously flown in the Big Horn Mountains contained significant amounts of SAF, killed by WBBB. Minor amounts of MPB-killed LPP, LP and PP were found at a few locations. IPS-killed PP and DFB-killed DF were recorded at nearly endemic levels.

Throughout the Reservation, 227 PP were reportedly killed by MPB on 140 acres in 2005. Similar figures for 2006 showed only 25 trees on 12 acres. In 2005, 110 LP were killed by MPB on 100 acres in the Pryor Mountains; 235 dead LP were recorded on 40 acres in 2006. No DFB activity was reported in 2006. About 650 SAF were killed by WBBB on about 4,000 acres. Nearly the same number of beetle-killed trees, but on only 330 acres, was reported in 2005.

We have spent very little time looking for root diseases on the Crow Indian Reservation. Please contact Forest Health Protection- Missoula Field Office if you think you have root disease mortality on this reservation.

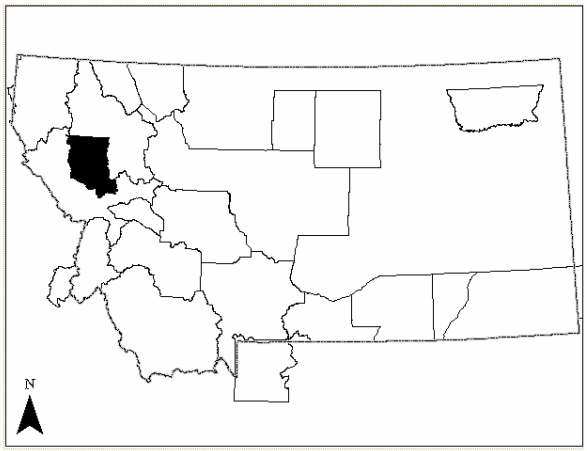

Figure 14. Flathead IR

Flathead IR

MPB-caused mortality decreased remarkably throughout LPP stands on the Reservation. In the Mission Range, east of Flathead Lake, the infested area decreased significantly; however, large groups of beetle-killed trees were once again mapped from Yellow Bay Creek on the north, south to the Reservation boundary at the Rattlesnake Wilderness. Very large groups, some exceeding several thousand acres each were recorded throughout the Jocko River drainage and its tributaries in the southeastern portion of the Reservation. Some larger groups averaged 8-10 trees per acre killed in 2005 (recorded as faders during surveys in 2006).

Outbreaks along Reservation Divide have declined to nearly endemic conditions. A few larger groups were still found near

Three Lakes Peak, Warden Mountain, and Edith Peak.

To the west, only small groups of MPB-killed LPP and PP were recorded in the vicinity of Rainbow Lake, Hot Spring. Northward from there, some of the largest beetle-killed groups were mapped above Mill Creek and near Bassoo Peak.

Elsewhere, MPB-killed PP was found quite generally throughout PP type, though in very small and widely scattered groups. Highest concentrations found to the south in the Hewolf Creek drainage, northward to Sonyok Mountain, Coppedge Gulch and north through the Salish Mountains to just south of Lake Mary Ronan. In all those areas, beetle-killed groups are much smaller than recorded in 2005. Some MPB-infested PP and FE-killed GF were found lightly scattered in foothills of the Mission Mountains, east of Flathead Lake. Very little IPS or WPB activity was recorded anywhere on the Reservation; however, there may have been more than was recorded, either in conjunction with MPB, or recorded as MPB. Minor amounts of WBBB-killed SAF were mapped in a few high-elevation stands to the southeast.

In 2005, total beetle-infested areas on the Reservation included 410 DF killed on 200 acres; 11,400 PP and 230 WBP killed by MPB on 15,100 and 1,300 acres, respectively; 6,200 SAF were killed on 6,000 acres by WBBB; and FE killed almost 6,200 GF on 5,600 acres. The most significant damage recorded, however, was the 214,800 LPP killed by MPB on nearly 90,600 acres. For 2006, comparable figures showed declines in most areas: DFB killed 350 DF on 180 acres; MPB killed a combined 248,800 trees on 45,000 acres of infested LPP, 2,200 acres PP and 20 acres WBP. IPS killed 50 PP on 13 acres, WBBB was attributed with the death of 750 SAF on 280 acres, and FE was still noted on 440 acres, on which 900 GF were killed.

Armillaria root disease (*Armillaria ostoyae*) is a prevalent mortality agent in Douglas-fir and true firs on the reservation. Annosus root disease (p-type *H. annosum*) is a very serious mortality agent in ponderosa pine across the reservation. Presently, the reservation treats all large ponderosa pine stumps created during harvest activities with a registered product to prevent annosus root disease.

Aerial detection surveys identified larch needle disease on 560 acres of tribal lands and eight acres of private lands on the Flathead IR.

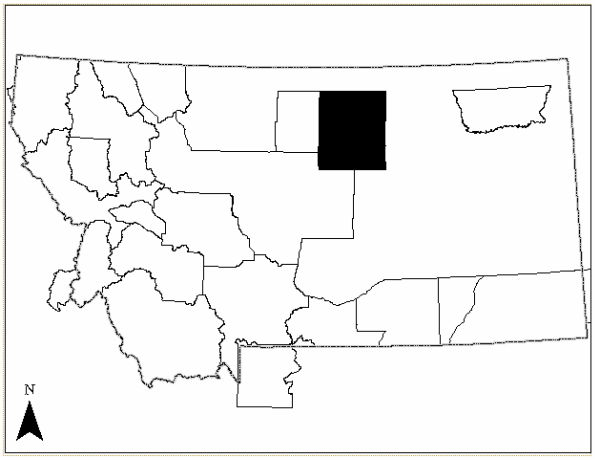

Figure 15. Fort Belknap IR

Fort Belknap IR

The Reservation was not surveyed in 2006; however, conditions were likely little changed from those observed in 2004. Very widely scattered and generally small groups of MPB-killed PP and LPP were mapped across the Reservation in 2004. Groups ranged in size from 1-150 trees, with concentrations noted near Thornhill Butte, Eagle Child Mountain, and near Mission Peak. Most of the latter were small groups of LPP. The largest of those contained an estimated 25 trees. About 530 PP were killed on slightly fewer than 160 acres. Another 125 LPP were killed on about 40 acres. Both of those figures represented nearly static conditions.

We have spent very little time looking for root disease on the Fort Belknap Indian Reservation. Please contact Forest Health

Protection- Missoula Field Office if you think you have root disease mortality on this reservation.

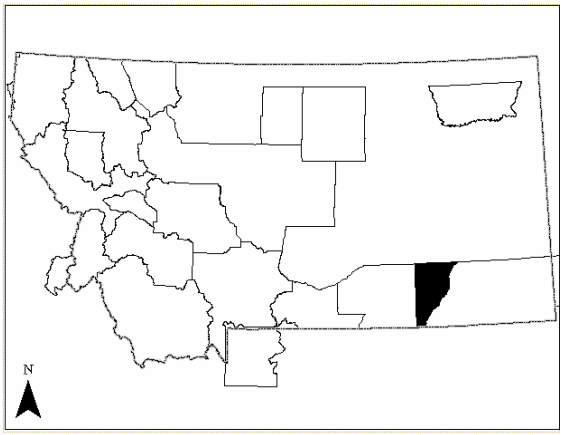

Figure 16. Northern Cheyenne IR

Northern Cheyenne IR

Only a portion of the Reservation was flown in 2006, and only a few small groups of MPB-killed PP were mapped—south of Lame Deer, and west of there in the Trail Creek/Sheep Gulch area. In 2005, minor amounts of IPS-killed PP had been recorded in very small groups widely dispersed throughout the Reservation. Largest groups were found east of Hollowood Creek, and north of Busby. Populations appeared, then, to be at about endemic levels. Those populations have apparently subsided.

ADS data for 2005 showed, Reservation-wide, about 4,400 PP on 2,200 acres were recorded as having been killed by IPS. Another 110 PP on 175 acres were killed by MPB. Those are figures represented decreases in MPB-infested areas, but increases in IPS-infested ones. It is conceivable that there is more interaction between MPB and IPS in PP stands on the Reservation than can be detected from the air. The few figures we obtained for 2006 showed about 50 PP killed by MPB on fewer than 20 acres.

We have spent very little time looking for root disease on the Northern Cheyenne Indian Reservation. Please contact Forest Health Protection- Missoula Field Office if you think you have root disease mortality on this reservation.

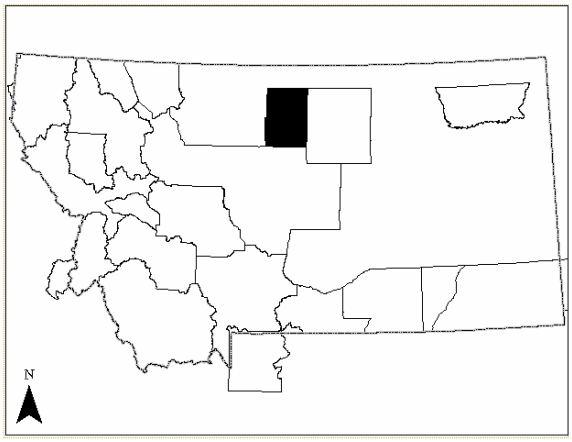

Figure 17. Rocky Boys IR

Rocky Boys IR

The Reservation was not flown in 2006; however, several site visits and ground surveys were conducted on parts of the reporting area. MPB is still a significant management concern on parts of the Reservation. The 2005 report follows. It is still fairly representative of conditions found there in 2006.

A few moderately-sized groups of MPB-killed trees, in both LPP and PP stands, were found south of Tribal headquarters, in stands on Black Mountain, Centennial Mountain, and Sawmill Butte. Largest groups were recorded in LPP stands on Black Mountain—especially in the vicinity of Black Canyon. PP groups were generally much smaller. A few small groups DFB-infested DF were mapped near Lost Canyon. Generally fewer beetle infested groups were noted in 2005 in areas being aggressively managed to reduce the number of beetle-infested trees and threatened stands.

Slightly more than 3,100 beetle-killed LPP were mapped on about 930 acres—a marked increase from the 200 acres

reported in 2004. Another 320 PP were killed on 330 acres, but there may have been more beetle activity in PP stands than reflected in this year's estimates. DFB killed about 400 trees on 160 acres—a slight increase over data recorded last year.

Armillaria root disease (*Armillaria ostoyae*), is present on the reservation, but appears to be uncommon. Butt rot and breakage caused by *Ganoderma applanatum* has been observed in quaking aspen.

NATIONAL PARKS

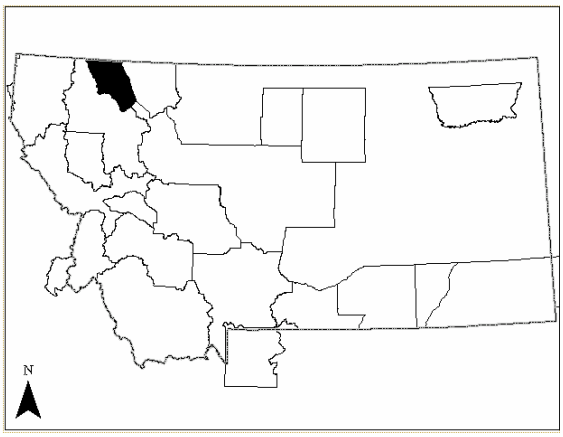

Figure 18. Glacier NP

Glacier NP

Glacier NP was not flown in 2006. The report for 2004, perhaps not changed significantly, is reproduced here.

Within the past 2-3 years, wildfires have affected thousands of acres of forested stands, in the western, central, and southern portions of the Park. Associated with some of those were increasing amounts of DFB-caused mortality—observed in many widely scattered locations, but near many burned stands, particularly near Kintla, Bowman, Quartz, and Logging Lakes. In response to drought-induced damage, FE populations have built in GF stands at several locations in the Park. The largest of those was located in the Pinchot Creek drainage. And MPB-killed LPP was noted in small and very scattered groups throughout LPP type.

Most significant amounts of beetle-caused mortality in the Park were large groups of SAF killed by WBBB. Largest of those was mapped near Logging Mountain; however, several other large groups were observed in high-elevation stands.

Park totals for 2004, included 5,100 DF killed by DFB on 3,300 acres; 4,800 GF killed by FE on 4,050 acres; 720 of various MPB hosts were killed on 850 acres; and WBBB killed 18,300 SAF on just over 8,200 acres. All outbreaks increased over previously recorded figures.

Root disease has been noted in some campgrounds; *Inonotus tomentosus* is known to be one of the causal agents. Other root diseases are likely present in Glacier NP, including armillaria root disease (*Armillaria ostoyae*), brown cubical root and butt rot (*Phaeolus schweinitzii*), and s-type annosus root disease (*Heterobasidion annosum*).

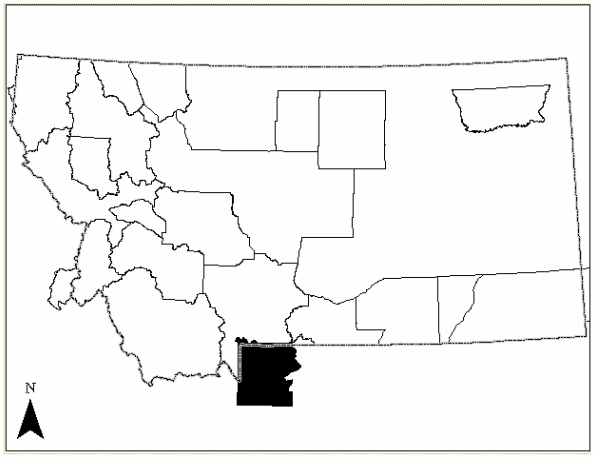

Figure 19. Yellowstone NP

Yellowstone NP

Only a very small part of the Park was flown in 2006. An area immediately east of Yellowstone Lake, from there to the Park's eastern border was surveyed. Large groups of MPB-killed LPP were mapped south of Avalanche Peak, near Grizzly Peak and Top Notch Peak; and from there south to Mount Langford. That is much of the same area

where MPB has killed thousands of WBP within the past 2-3 years. Some MPB activity is increasing in LPP in that area, but it is also difficult to distinguish between WBP and LPP in some areas where they are intermixed. Some of that mortality likely occurred in WBP stands. A few large groups of MPB-infested LPP stands were also recorded south of Yellowstone Lake, along the Two Ocean Plateau. In addition to what was observed, and in a few ground surveys conducted there, we have reproduced the 2005 summary for this report.

In 2005 we recorded remnants of a large ESB outbreak, southeast of Yellowstone Lake, recorded at more than 8,000 acres in 2003 that was reduced to but a few thousand acres by 2005. That area was not surveyed in 2006, but we believe it has continued to decline.

Minor amounts of MPB-killed LPP, DFB-infested DF, and WBBB-affected SAF stands were mapped in a widely scattered pattern at various locations throughout the Park. In contrast, significant outbreaks of MPB in WBP stands were mapped in the southeast portion of the Park, from Lynx Creek north to Avalanche Peak. Largest groups were noted around Colter Peak, Mount Langford, and Sylvan Pass. Other large groups were recorded near Frederick Peak and Mount Washburn. In the northwest part of the Park, other significant groups of MPB-killed WBP, interspersed with WBBB-killed SAF, were noted near Dome Mountain, Bannock Peak, Little Quadrant Mountain, and Meldrum Mountain. Minor amounts of DFB could be exacerbated by increasing populations of WSBW in the vicinity of Mammoth.

In 2004, ground observations detected a very large MPB outbreak in WBP stands in the vicinity of Avalanche Peak. Ground-collected data obtained in both 2004 and 2006 in that area showed in some stands more than 170 WBP per acre (and up to 96% of the stand) have been killed within the past 2-3 years.

Beetle-killed totals for the Park, in 2005, included 860 DF, attributed to DFB on 350 acres; 2,100 ES on 1,800 acres killed by ESB; 1,650 LPP on 1,300 acres killed by MPB; 365,200 WBP killed by MPB on 29,200 acres; and finally, 24,300 SAF were killed by WBBB on 11,690 acres. The biggest increases since 2003, by far, were noted in MPB-killed WBP. Now, LPP stands have become increasingly infested. On the portion of the Park flown in 2006, we noted nearly 17,000 LPP and 830 WBP were killed by MPB, on 6,900 and 290 acres, respectively. About 700 SAF were killed by WBBB on 450 acres. DFB-killed trees were recorded in very minor amounts.

Coniophora putiana has been found causing root decay in mountain pine beetle strip-attacked lodgepole pine in campgrounds. The presence of *C. puteana* is thought to add to the probability of failure of individual trees. *Phaeolus schweinitzii*, is common in butts of older trees in campgrounds, especially lodgepole pine and Douglas-fir. Decay observed in cut stumps of spruce is indicative of *Inonotus tomentosus*, but its presence has not been confirmed.

SPECIAL PROJECTS

1. Evaluating the Effectiveness of Thinning Treatments on DFB-Caused Tree Mortality

In 2005, and in cooperation with Jose Negron (RMRS), a long-term thinning study was initiated in DF stands on the Helena, Lewis & Clark, and Bitterroot NFs to evaluate effectiveness of two thinning treatments on DFB populations and associated beetle-caused mortality. Replicated treatments consist of: (1) basal area reductions, and (2) stand density index (SDI) treatments to maintain or approximate uneven-aged stands. Basal area reduction treatments will be included in ongoing projects on all three Forests; SDI treatments will be evaluated on the Helena and Lewis & Clark NFs only.

Evaluations are in varying stages, dependent upon project status on each Forest. Pre-treatment evaluations were conducted in 2006. Post-treatment evaluations will be conducted beginning in 2007 and annually thereafter, if DFB are active in treatment units. If beetle activity is not found, monitoring will be conducted at 5-year intervals.

For additional information, contact Nancy Sturdevant, MFO.

2. Evaluating Effects of Spring versus Fall Burning on DFB-Caused Tree Mortality

In 2006, a study was initiated on the Beaverhead-Deerlodge (B-D) and Helena NF to compare the effects of spring versus fall burning on DFB activity. Spring and fall burns were completed in several units on the Philipsburg RD, B-D NF. Early-spring and late-spring burns were completed on the Townsend RD, Helena NF. We were not able to include units from the third study area because slash was piled and burned rather than broadcast underburn.

This year, we conducted post-treatment evaluations on the Philipsburg and Townsend RD during which we collected information on vegetation and insect activity in the burned and comparable control units. A report detailing results will be written early in 2007. We hope to add additional study sites within the next few years in an effort to increase our understanding of the effects of spring versus fall burning on DFB activity.

For more information, or to suggest new study sites, contact Nancy Sturdevant, MFO.

3. Testing Efficacy of Verbenone and Hexanol Pouches in Reducing MPB-Caused Mortality in LPP and WBP

A project was established in LPP stands on the Butte RD, Beaverhead-Deerlodge NF, in an attempt to determine the efficacy of a new, experimental, 7.5-gram verbenone pouch in protecting trees from MPB attack. An additional treatment, the addition of hexanol pouches was also be assessed. In a randomly-assigned-treatment test, we selected 150 trees, 50 of each to receive the following treatments: No treatment (controls); one, 7.5-gram pouche (Synergy Semiochemicals, Inc.) per tree; or one, 7.5-gram verbenone pouch and one, 10-gram hexanol pouche per tree. Pouches were stapled to individual trees about 6 feet high and on the north side of the tree. A standard MPB tree bait was hung on an adjacent non-host tree or stake, approximately 5 feet from the treated tree. Treatments were installed in late June and evaluated in late September.

A similar test, identical in all respects except for number of treated trees, was installed in a WBP stand near Mount Edith, Townsend RD, Helena, NF. In that area, we selected 123 trees—41 of each treatment. Treatments were installed in late May and evaluated in mid-September.

Test results were encouraging; but in the LPP stands, not as good as we had hoped for. In the LPP test, 39 of 50 control trees were mass- or stip-attacked (78%); of the verbenone-treated trees, 18 of the 50 treated trees were mass- or strip-attacked (36%); of the verbenone/hexanol-treated trees, 12 were attacked (24%).

In the WBP area, of 41 controls, 32 were attacked (78%); verbenone-treated trees, 10 of 41 were attacked (24%); and exactly the same results for verbenone/hexanol-treated trees—10 of 41 were attacked (24%).

While treatments had more attacks than we had hoped; treatment results were significantly different from controls, in both areas. Results were promising, and hexanol treatments were especially encouraging. We hope to re-do the test in 2007 and add another treatment: two hexanol pouches per tree.

For additional information, contact Ken Gibson, MFO; or Sandy Kegley, CFO.

4. Whitebark/Limber Pines Information System (WLIS)

Pathologists in Region 1 in cooperation with Forest Health Technology Enterprise Team (FHTET), Fort Collins, CO have completed a database of plot information on whitebark and limber pines. This database is not a repository for raw data, but is a compilation of plot summary data from numerous surveys and studies already completed. The database has basic descriptors of plot/study results that can be queried and GIS-linked. The results from this effort include an interactive database; data can be queried to provide a spatial summary of the condition of these two species. A downloadable version can be found on the R1/R4 Forest Health Protection website:
http://www.fs.fed.us/r1-r4/spf/fhp/prog/programs2.html
For additional information, contact Blakey Lockman (406) 329-3189, blockman@fs.fed.us, or Gregg DeNitto (406) 329-3637, gdenitto@fs.fed.us.

5. Elytroderma Needle Disease Thinning and Pruning Project

This project is in the Elk Bed area of the Darby RD, Bitterroot NF. Elytroderma has been moderately severe for a number of years in this area. Twelve ponderosa pine stands were randomly assigned one of five treatments: thinning to 12x12 spacing with and without pruning , thinning to 18x18 spacing with and without pruning, and control (no treatment). Annual monitoring began in 2006. Data is being analyzed and a report is forthcoming. For additional information, contact Blakey Lockman (406) 329-3189, blockman@fs.fed.us.

6. Changes in Fire-Killed Western Larch

Fifth year data were collected in a ten or more-year study investigating changes in fire-killed western larch on the Glacier View Ranger District of the Flathead National Forest. This study includes multiple size classes and provides more information about losses in lumber and fuelwood values than previous studies. Wildlife biologists have shown interest in learning more about how changes in fire-killed larch relate to wildlife use. A Masters Student at the University of Montana is using some of this data to augment her data as she investigates heartwood decay occurrence in

apparently sound western larch for snag retention and management. Others may find this study useful in projecting woody fuel loads on burned larch sites.

The study includes four size classes (8" to 11.9" dbh, 12" to 15.9" dbh, 16" to 19.9" dbh, and 20+" dbh) spread over five locations within the boundaries of the 2001 Moose Fire. Ten trees in each size class will be randomly selected and dissected 1, 2, 3, 5, 7, and 10 years after the fire. Checks, woodborers, wood stain, decay and other factors will be measured after the trees are cut down. Some trees will be left uncut for each size class as "longevity snags" to continue monitoring for conk development and snag longevity.

Fifth year data were collected in September 2006. After five years, no trees had fallen naturally, but 11% of the non-dissected trees had broken tops. *Fomitopsis pinicola* fruiting bodies were found on more than 1/3 of the standing trees. *Trichaptum abietinum* and *Cryptoporus volvatus* conks were observed on less than ten trees each. Although wood borers and checks contribute significantly to loss in merchantable volume, peripheral decay has increasingly become a significant agent of change as time progressed. Additional information about this study can be found in Forest Health Protection Numbered Report 06-12 or by contacting Marcus Jackson at 406-329-3282.

7. Larch Dwarf Mistletoe Remeasurements

Larch dwarf mistletoe plots were established in 1991 and re-measured in 1996, 2003, and 2006 on the Flathead Indian Reservation. The objectives of this study are:

1. Quantify the spread and intensification of dwarf mistletoe in western larch with and without overstory removal and precommercial thinning.
2. Quantify the growth effects due to dwarf mistletoe in infected western larch with and without overstory removal and precommercial thinning.
3. Provide visual demonstration of the treatment effects on stand growth and development.
4. Provide data for the validation of dwarf mistletoe models for stand conditions similar to those found in this study.

A report of the 12-year remeasurements (2003) was printed in April 2006 (Forest Health Protection Numbered Report 06-06). After 12 years the positive effects of overstory removal and thinning on individual crop tree growth, and the negative effects of increased dwarf mistletoe spread and intensification among thinned trees became evident. Results of the 20+ year data should further clarify the impacts of treatments on crop tree growth and spread and intensification of dwarf mistletoe. The 15-year remeasurement (2006) data will be analyzed in 2007 with a report of the results expected in late 2007 or early 2008.

8. The Forester's Toolkit

The "*Forester's Toolkit*", currently in the latter stages of development, is an extensive, comprehensive literature compilation designed for applied use by foresters in Montana and Idaho. It is being provided as a service of the Montana DNRC Forest Pest Management Program, the Idaho Department of Lands Forest Health Program, and USFS Region One Forest Health Protection.

The "*Forester's Toolkit*" will be a non-commercial resource distributed for free to all professional foresters, including those with state and federal agencies, tribes, private industry, and consultants. It will be mass-produced to provide one per forester and is intended to serve as a desktop reference.

The objectives behind development of the "*Forester's Toolkit*" are to:

- promote sound forest-management practices;
- assist foresters in making management decisions;
- assist foresters in composing appropriately-cited, science-based environmental documents;
- return to use older, still-relevant silviculture literature;
- provide historical information on early forest utilization and management;
- provide a mentoring resource for inexperienced foresters or those new to the region;
- provide current literature to help experienced foresters remain up-to-date;
- assist foresters in presenting and discussing forestry topics during public interactions;
- promote efficient and productive interactions among foresters;
- promote efficient and productive interactions between foresters and forest health specialists; and
- promote a proactive, ecologically-based approach to forest insect and disease management.

To be included as part of the "*Forester's Toolkit*" will be a CD of the most-recent revisions of the entire USFS "*Forest Insect & Disease Leaflet*" series, commonly referred to as "FIDL's". FIDL's provide brief yet comprehensive introductions to the identification, biology, hosts, damage, and management of important forest pest organisms. Leaflets will be scanned in their original grayscale or color format and a bibliography will be included for easy navigation. In addition to being included as part of the "*Forester's Toolkit*" this CD will be utilized as a stand-alone resource, distributed as a single-CD package at training sessions and to clients of forest pest specialists.

For additional information, contact Brennan Ferguson (406) 239-7761, brennan@fergusonforestpathology.com.

9. Nursery Disease Projects

Fusarium oxysporum and *F. proliferatum* are the most important and damaging pathogen in many forest nurseries in western North America. In cooperation with the Rocky Mountain Research Station, populations of *F. oxysporum* were genetically defined and characterized. Isolates collected at one forest nursery over several years were extremely diverse, indicating multiple introductions of new genotypes *Fusarium. oxysporum* isolates were successfully separated into highly virulent and non-pathogenic clades using amplified fragment length polymorphism [AFLP] and DNA sequencing techniques. All highly virulent isolates from one forest nursery were classified in a new taxon, *F. commune*. Population diversity within forest nurseries throughout western North America will be characterized in the future and determination made of the extent of F. commune within nursery fungal populations. Genotypes will be compared with pathogenic phenotypes using greenhouse and laboratory inoculation experiments.

Non-pathogenic isolates of *Fusarium oxysporum* were evaluated for potential to control disease incited by highly virulent strains. In initial tests, one non-pathogenic strain gave complete disease control; further tests are planned to confirm the biocontrol efficacy of this strain, particularly on different conifer hosts and other *Fusarium* spp.

Epidemiological investigations about Cylindrocarpon root disease, caused primarily by *Cylindrocarpon destructans*, are being conducted at a container nursery. Infection timing and inoculum sources are being investigated. This disease is especially damaging to 5-needle pine species (western white pine and whitebark pine).

For further information, contact Bob James at rjames@fs.fed.us.

COMMON AND SCIENTIFIC NAMES

Pathogens

Annosus root disease	*Heterobasidion annosum* (Fr.:Fr.) Bref.	Primary hosts: DF, GF, PP, SAF
Armillaria root disease	*Armillaria ostoyae* (Romagn.) Herink	DF, GF, SAF, sapling pines
Black stain root disease	*Leptographium wageneri* (Kendrick) M.J. Wingfield	DF, PP
Brown cubical butt rot	*Phaeolus schweinitzii* (Fr.:Fr.) Pat.	DF
Dothistroma needle cast	*Dothistroma septospora* (Doroguine) Morelet	LP, PP, WWP, LPP, WBP
Dwarf mistletoes	*Arceuthobium* spp.	LPP, LP, DF, WL
Brown Stringy rot	*Echinodontium tinctorium* (Ell. & Ev.) Ell. & Ev.	GF, WH
Elytroderma needle cast	*Elytroderma deformans* (Weir) Darker	PP
Fusarium root rot	*Fusarium oxysporum* Schlechtend.:Fr.	DF (Nursery)
Grey mold	*Botrytis cinerea* Pers. Ex Fr.	WL (Nursery)
Laminated root rot	*Phellinus weirii* (Murrill) R.L. Gilbertson.	DF, GF, WH, SAF
Sirococcus tip blight	*Sirococcus conigenus* (DC.) P. Cannon & Minter	WWP (Nursery)
Sphaeropsis shoot blight	*Sphaeropsis sapinea* (Fr.:Fr.) Dyko & Sutton in Sutton	PP
Western gall rust	*Endocronartium harknessii* (J.P. Moore) Y. Hiratsuka	LPP, PP
White pine blister rust	*Cronartium ribicola* J.C. Fisch.	WWP, WBP, LP

Insects

Douglas-fir beetle	*Dendroctonus pseudotusugae* Hopkins	DF
Douglas-fir tussock moth	*Orygia pseudotsugata (*McDunnough*)*	DF, TF, ES
Gypsy moth	*Lymantria dispar (*Linaeus*)*	Most hardwoods
Mountain pine beetle	*Dendroctonus ponderosa* Hopkins	All pines
Pine engraver beetle	*Ips pini* (Say)	PP, LPP
Spruce beetle	*Dendroctonus rufipennis* Swaine	ES
Western balsam bark beetle	*Dryocoetes confuses* Swaine	SAF
Western spruce budworm	*Choristoneura occidentalis* Freeman	DF, TF, ES, WI
Western pine beetle	*Dendroctonus brevicomis* LeConte	PP
Fir engraver beetle	*Scolytis ventralis* LeConte	GF, SAF
Hemlock looper	*Lambdina fiscellaria lugubrosa* (Hulst)	DF
False hemlock looper	*Nepytia canosaria* (Walker)	DF

DF = Douglas-fir; GF = Grand fir; TF = True fir; SAF = Subalpine fir; PP = Ponderosa pine; LP = Limber pine: LPP = Lodgepole pine; WWP = Western white pine; ES = Engelmann spruce; WH = Western hemlock; WL = Western larch; WBP = Whitebark pine

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Table 1. Acres of Host Type Infested by Bark Beetles, From 2003-2006

	2003[2,3]	2004[2]	2005[3]	2006[2,3]
DFB[1]	75,954	92,307	168,258	60,620
ESB	9,547	309	1,911	116
IPS	4,777	16,285	12,786	1,302
WPB	833	370	1,714	452
FE	20,648	34,312	38,489	2,416
WBBB	75,435	133,844	208,572	130,289
MPB	298,958	451,354	818,981	812,718
Total	486,152	728,781	1,250,712	1,007,913

[1]DFB=Douglas-fir beetle; ESB= Spruce beetle; IPS=Pine engraver; WPB=Western pine beetle; FE=Fir engraver; WBBB=Western balsam bark beetle; MPB=Mountain pine beetle

Not all areas were flown due to fires, inclement weather or seasonal limitations.

Includes Yellowstone NP acres in MT, ID and WY

Table 2. Acres of Douglas-fir Beetle-Caused Mortality in Montana, All Ownerships, From 2003 Through 2006

	2003		2004		2005		2006	
Reporting Area	**Acres**	**Trees**	**Acres**	**Trees**	**Acres**	**Trees**	**Acres**	**Trees**
Beaverhead	6,403*	13,840*	4,677*	10,784*	23,492	34,928	8,929*	2,488*
Bitterroot	34,442	31,989	30,990	61,534	69,342	142,708	27,071	49,444
Custer	27*	45*	64*	234*	4,314*	3,872*	0	0
Deerlodge	6,610	13,249	8,213*	26,078*	20,409	43,591	2,088	6,775
Flathead	5,580	8,552	5,754*	17,447*	13,457	27,719	8,006	18,316
Gallatin	5,649*	7,450*	4,515	12,669	9,520	21,200	1,088*	1,107*
Helena	1,817	3,560	10,810*	19,241*	5,553	8,670	5,279	13,779
Kootenai	10,924	14,134	9,108	21,054	5,403	11,891	701*	949*
Lewis & Clark	1,293	1,585	2,472*	5,473*	2,573*	5,770*	959*	1,162*
Lolo	1,143*	2,627*	8,084*	22,034*	10,439	30,915	5,114	16,356
Garnets	917*	1,637*	2,622	7,228	3,158	7,755	1,196	2,365
Flathead IR	14*	44*	1,718*	2,826*	200	414	177	346
Crow IR	0	0	0	0	49	113	0	0
Glacier NP	★	★	3,280*	5,123*	★	★	★	★
Yellowstone NP	1,135*	3,296*	★	★	349	862	12*	30*
TOTAL	75,954	102,008	92,307	211,725	168,258	340,408	60,620	113,117

★ = Not surveyed * = Partially surveyed

Yellowstone includes acres in MT, ID and WY

Table 3. Acres of Mountain Pine Beetle-Caused Mortality on State and Private Lands in Montana, From 2003 Through 2006

					2004				2005				2006			
Reporting Area	LPP	PP	WBP	WWP	LPP	PP	WBP	WWP	LPP	PP	WBP	WWP	LPP	PP	WBP	WWP
Beaverhead	171*	95*	2,265*	0*	931*	24*	1,178*	0*	2,682	8	1,250	0	1,641*	2*	852*	0*
Bitterroot	0	532	0	0	10	372	0	0	596	87	0	0	113	123	0	0
Custer	0*	20*	0*	0*	23*	387*	34*	0*	9*	63*	0*	0*	0	10	0	0
Deerlodge	4,951	659	89	0	17,053*	55*	385*	0*	25,903	618	68	9	33,933	138	402	0
Flathead	3,735	1,266	236	12	3,891*	651*	801*	10*	9,804	190	0	0	5,262	241	0	0
Gallatin	336*	27*	561*	0*	148	12	6,971	0	42	0	1,354	0	4,612*	14*	8,203*	0*
Helena	1,465	1,522	0	0	1,509*	3,646*	1,163*	0*	2,099	1,237	1,000	0	2,720	2,544	111	0
Kootenai	860	79	0	71	106	14	0	245	164	0	12	0	359*	30*	0*	0*
Lewis & Clark	651*	4,202*	309*	0*	1,108*	3,822*	143*	0*	895*	2,678*	2*	0*	1,260*	1,252*	41*	0*
Lolo	5,305*	1,124*	478*	0*	8,542*	862*	0*	0*	13,761	1,593	75	0	18,909	2,403	0	0
Garnets	196*	377*	2*	0*	3,029	174	0	0	7,527	454	0	0	5,424	814	2	0
Crow IR	0	231	0	0	301	0	2	0	0	28	14	0	0	0	0	0
Fort Belknap IR	0	27	0	0	2	34	0	0	★	★	★	★	★	★	★	★
No. Cheyenne IR	★	★	★	★	0	10	0	0	0	4	0	0	0	0	0	0
Rocky Boys IR	465	51	0	0	60	68	0	0	387	191	0	0	★	★	★	★
Flathead IR	2,023*	923*	0*	0*	3,283*	275*	0*	0*	6,127	3,055	2	17	2,117	244	0	0
TOTAL	20,158	11,135	3,940	83	39,996	10,406	10,677	255	69,996	10,206	3,777	26	76,350	7,815	9,611	0

[1]LPP = Lodgpole pine; PP = ponderosa pine; WBP = whitebark pine; WWP = western white pine

★= Not surveyed * = Partially surveyed

Table 4. Acres of Mountain Pine Beetle-Caused Mortality on All Federal Ownerships in Montana, From 2003 Through 2006

					2004				2005				2006			
Reporting Area	LPP	PP	WBP	WWP	LPP	PP	WBP	WWP	LPP	PP	WBP	WWP	LPP	PP	WBP	WWP
Beaverhead	287*	1,933*	36,626*	0*	12,017*	109*	28,800*	0*	47,786	60	41,191	11	26,178*	0*	59,240	0*
Bitterroot	74	524	78	0	17	592	68	21	12,118	415	7,199	2	2,591	204	3,005	0
Custer	0*	554*	533*	0*	61*	4,645*	1,728*	0*	728*	545*	1,087	0*	0	85	265	0
Deerlodge	24,976	1,207	336	0	89,655*	20*	936*	0*	156,312	1,208	2,007	0	212,195	186	2,083	0
Flathead	17,583	66	1,574	73	32,197*	16*	1,615*	8*	51,766	108	612	0	37,610	181	632	2
Gallatin **2003**	138*	8,452*	0*	0*	266	5	40,873	0	109	0	18,962	0	13,523	16*	23,029	0*
Helena	6,231	2,639	345	0	3,492*	2,894*	6,658*	41*	11,207	793	7,607	0	19,340	2,598	6,943	0
Kootenai	4,000	187	0	903	665	101	1,524	2,769	11,604	2	7,102	1700	13,134*	320*	2*	6*
Lewis & Clark	605*	7,603*	4,389*	19*	4,437*	10,253*	8,289*	0*	4,404*	5,648*	6,539*	0	10,932	7,222	12,736	0*
Lolo	88,755*	4,155*	2,332*	6*	75,338*	2,092*	287*	0*	190,601	3,839	7,710	15	190,890	12,743	726	0
Blackfeet IR	★	★	★	★	16	0	4	0	★	★	★	★	★	★	★	★
Crow IR	0	523	0	0	33	899	9	0	104	115	0	0	0	12	38	0
Fort Belknap IR	53	100	0	0	39	122	0	0	★	★	★	★	★	★	★	★
Flathead IR	26,237*	3,522*	0*	0*	49,485*	3,016*	222*	0*	84,461	12,075	1,293	0	42,563	1,948	19	0
No. Cheyenne IR	★	★	★	★	0	654	0	0	0	171	0	0	0	16	0	0
Rocky Boys IR	0	0	0	0	96	20	0	0	548	141	0	0	★	★	★	★
Garnets	162*	81*	2*	0*	2,276	23	2	0	4,417	124	0	0	8,525	10	0	0
Glacier NP	★	★	★	★	536*	0*	79*	0*	★	★	★	★	★	★	★	★
Yellowstone NP	693*	0*	15,086*	0*	★	★	★	★	1,316	0	29,214	0	6,908*	0*	286*	0*
TOTAL	169,794	31,546	61,301	1,001	270,626	25,461	91,094	2,839	577,481	25,244	130,523	1,728	584,389	25,541	109,004	8

[1]LPP = Lodgepole pine; PP = ponderosa pine; WBP = whitebark pine; WWP = western white pine; ★ = Not surveyed; * = Partially surveyed

Yellowstone includes MT, ID and WY acres

Table 5. Acres of Bark Beetle-Mortality (Other Than Mountain Pine Beetle and Douglas-fir Beetle) in Montana, All Ownerships, From 2003-2006

	Engelmann Spruce Beetle				Pine Engraver Beetle				Western Pine Beetle				Fir Engraver Beetle				Western Balsam Bark Beetle			
Reporting Area	2003	2004	2005	2006	2003	2004	2005	2006	2003	2004	2005	2006	2003	2004	2005	2006	2003	2004	2005	2006
Beaverhead	8*	0*	0	0*	0*	0*	33	0*	14*	0*	0	0*	0*	0*	58	0*	14,437*	21,175	81,888	54,085*
Bitterroot	10	0	55	6	0	85	2,336	4	55	21	0	6	34	40	0	0	873	1,101	26,088	4,141
Custer	2*	0*	0*	0	2,841*	929*	6,168*	0	0*	0*	0*	0	0*	0*	0*	0	3,269*	4,901	4,216*	1,123
Deerlodge	8	14*	0	0	28	0*	272	0	58	8*	1,532	12	41	0*	0	0	4,632	3,929	6,276	692
Flathead	8	73*	31	30	25	36*	790	20	0	10*	0	84	16,109	20,592*	22,439	1,496	13,814	18,680	22,222	4,986
Gallatin	728*	13	6	0*	0*	0	0	2*	0*	0	0	0*	0*	0	0	2*	14,723*	48,091	26,567	46,054*
Helena	29	0*	0	18	22	0*	470	311	32	2*	0	24	6	0*	0	0	6,348	3,281	3,387	1,316
Kootenai	0	0	8	4*	0	252	11	0*	97	173	45	0*	3,008	9,112	7,702	195*	2,628	5,696	12,463	381*
Lewis & Clark	0*	95*	0*	0*	2*	151*	0*	0*	0*	12*	0*	0*	0*	22*	0*	70*	6,690*	9,725	4,518*	11,372*
Lolo	4*	0*	9	58	0*	141*	19	749	534*	69*	135	302	1,444*	39*	2,688	215	1,280*	3,285	2,559	1,177
Garnets	2*	2	0	0	0*	31	108	203	30*	75	2	12	6*	0	0	2	236*	283	444	144
Flathead IR	0*	14*	0	0	1,791*	14,165*	0	13	13*	0*	0	12	0*	287*	5,602	436	10*	2,578	5,933	276
No. Cheyenne IR	★	0	0	0	★	445	2,186	0	★	0	0	0	★	0	0	0	★	0	0	0
Fort Belknap IR	0	0	★	★	0	0	★	★	0	0	★	★	0	0	★	★	0	0	★	★
Rocky Boys IR	0	0	0	★	0	42	0	★	0	0	0	★	0	0	0	★	0	0	2	★
Crow IR	0	0	0	0	68	0	393	0	0	0	0	0	0	0	0	0	101	339	331	4,091
Blackfeet IR	★	2	★	★	★	6	★	★	★	0	★	★	★	2	★	★	★	2,572	★	★
Glacier NP	★	96*	★	★	★	2*	★	★	★	0*	★	★	★	4,218*	★	★	★	8,208	★	★
Yellowstone NP	8,748*	★	1,802*	0*	0*	★	0	0*	0*	★	0	0*	0*	★	0	0*	6,394*	0	11,678	451*
TOTAL	9,547	309	1,911	116	4,777	16,285	12,786	1,302	833	370	1,714	452	20,648	34,312	38,489	2,416	75,435	133,844	208,572	130,289

★ = Not surveyed * = Partially surveyed

Yellowstone includes both MT, ID and WY acres

Figure 20. Reporting Area Boundaries in Montana

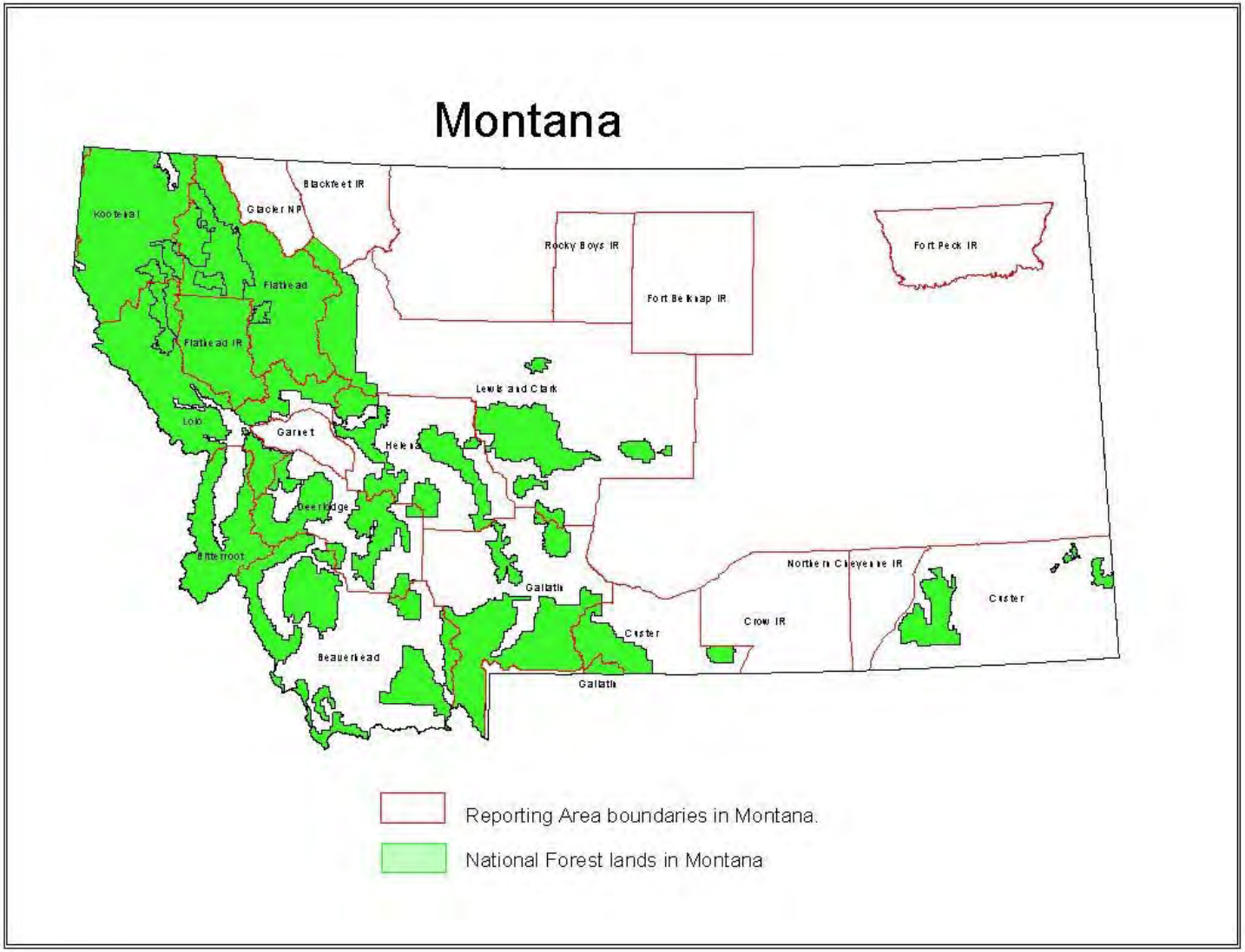

Figure 21. Area Surveyed During the Forest Health Protection Aerial Detection Survey in Montana, 2006

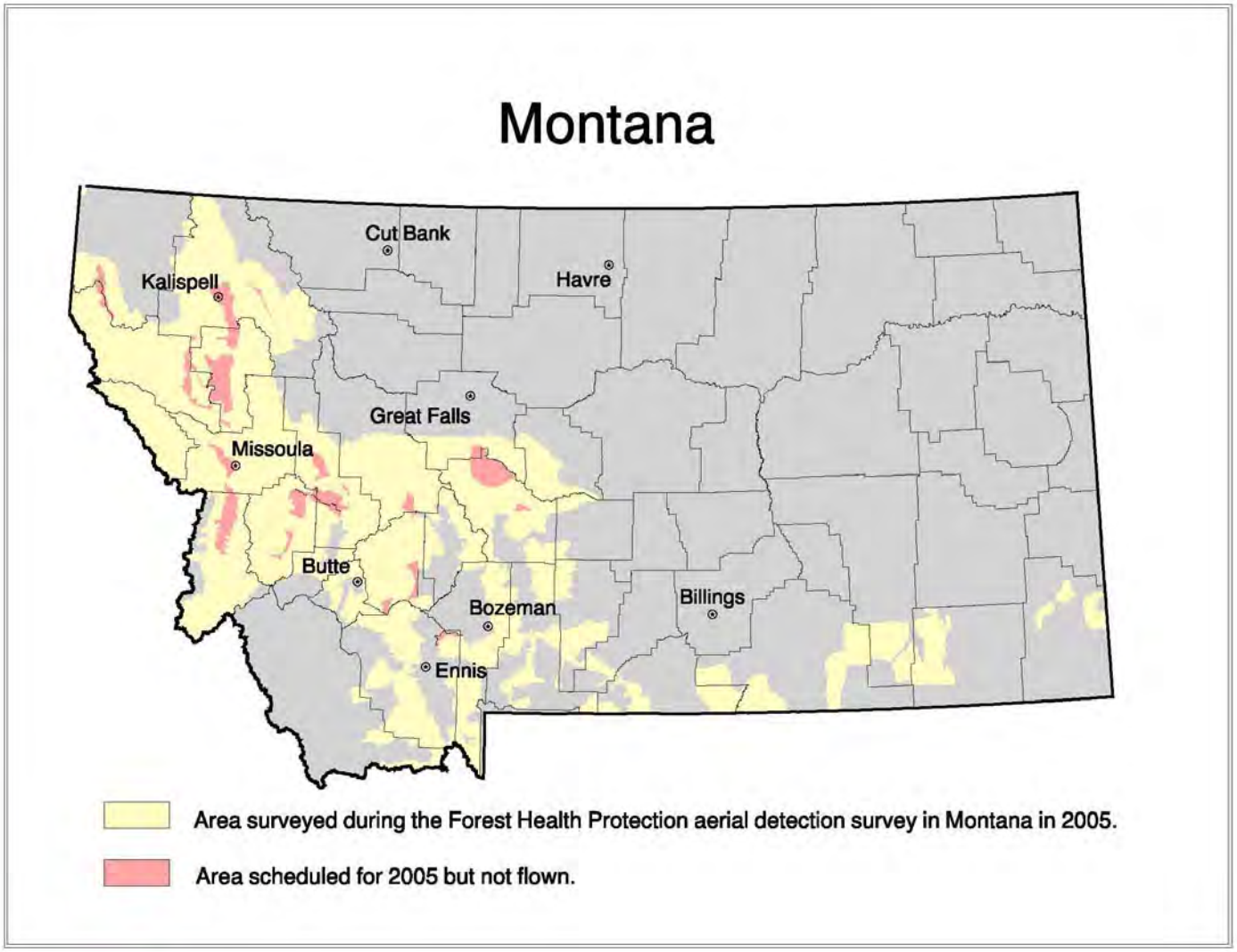

Figure 22. Mountain Pine Beetle Infestations in Montana, 2006

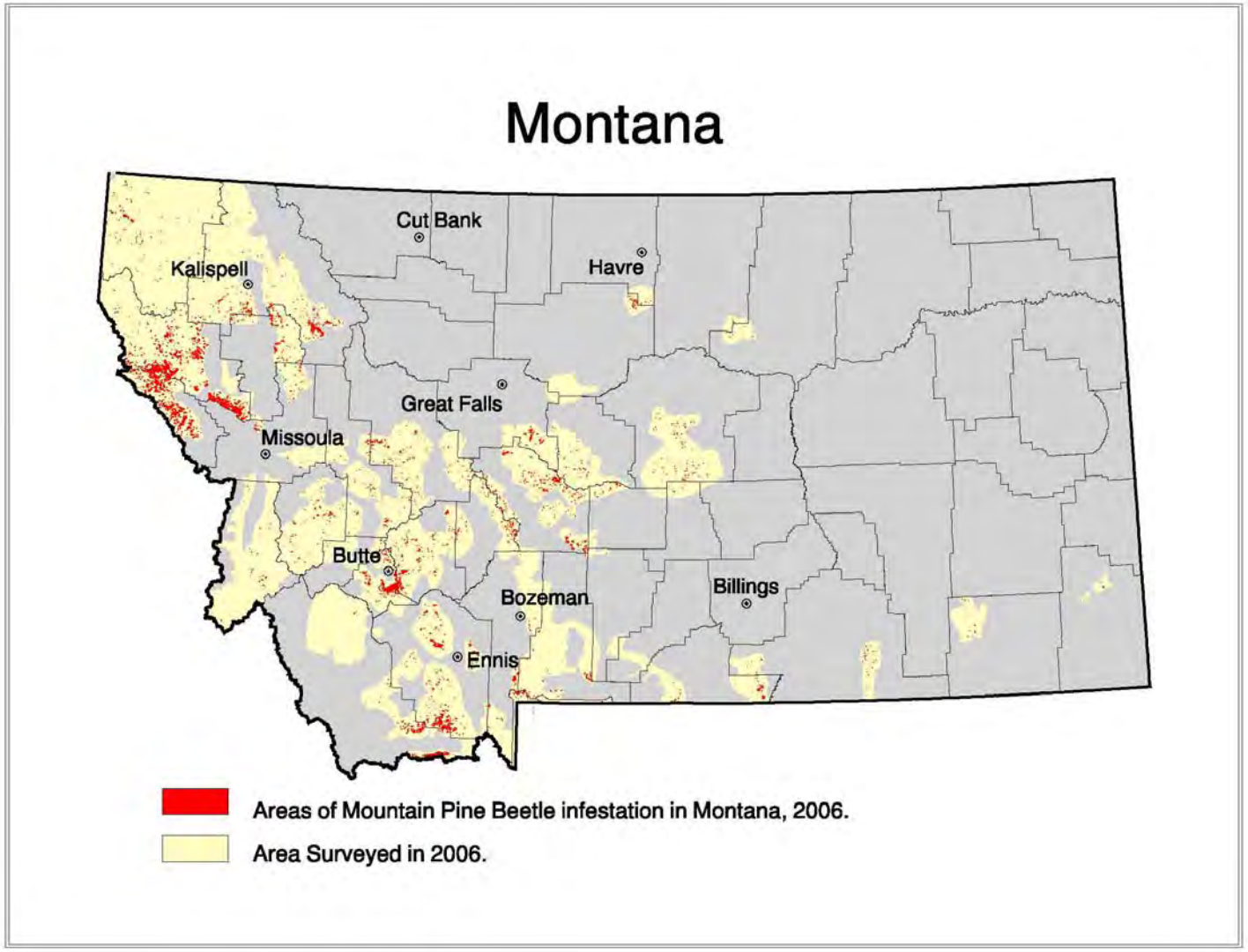

Figure 23. Douglas-fir Beetle Infestations in Montana, 2006

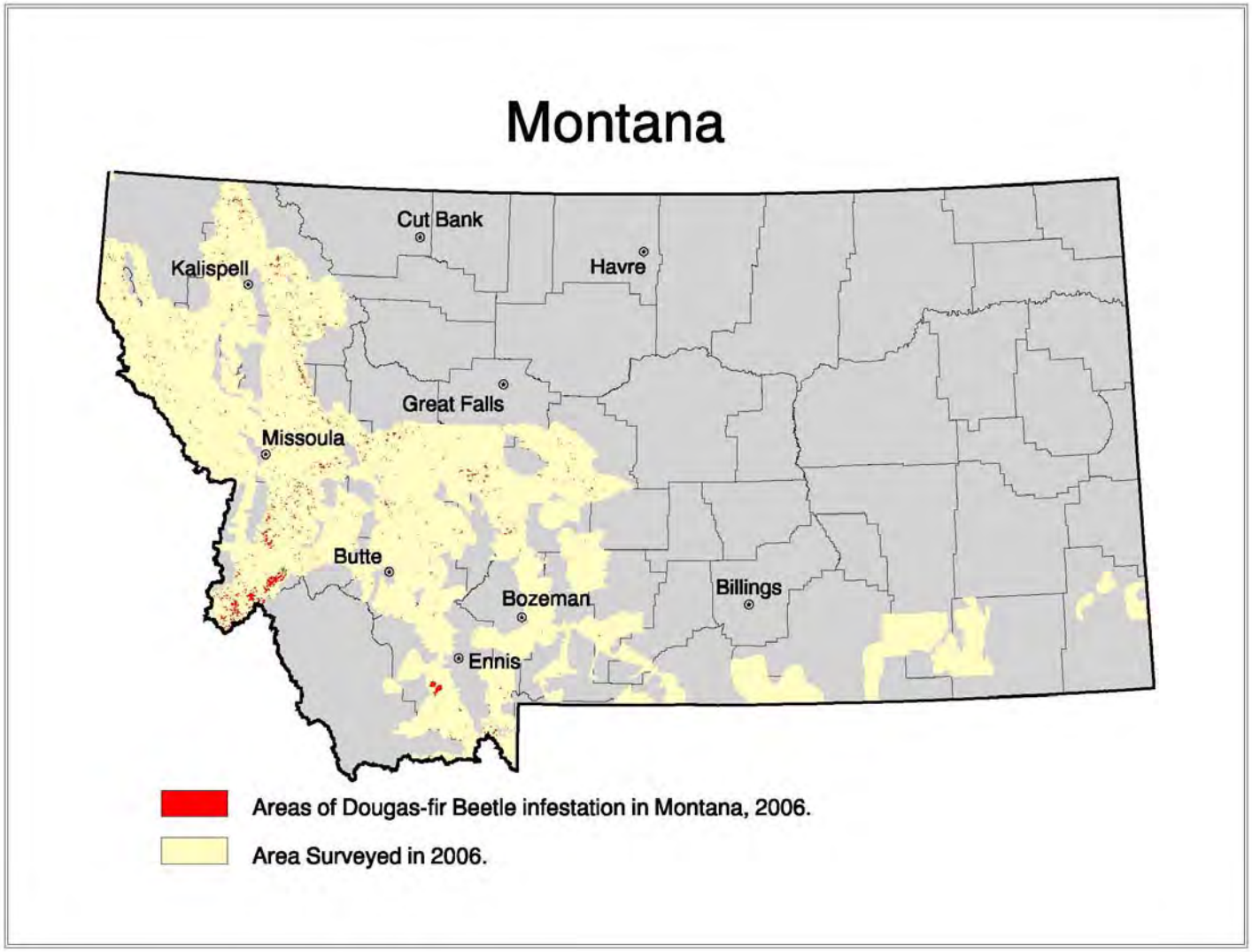

Figure 24. Fir Engraver Infestations in Montana, 2006

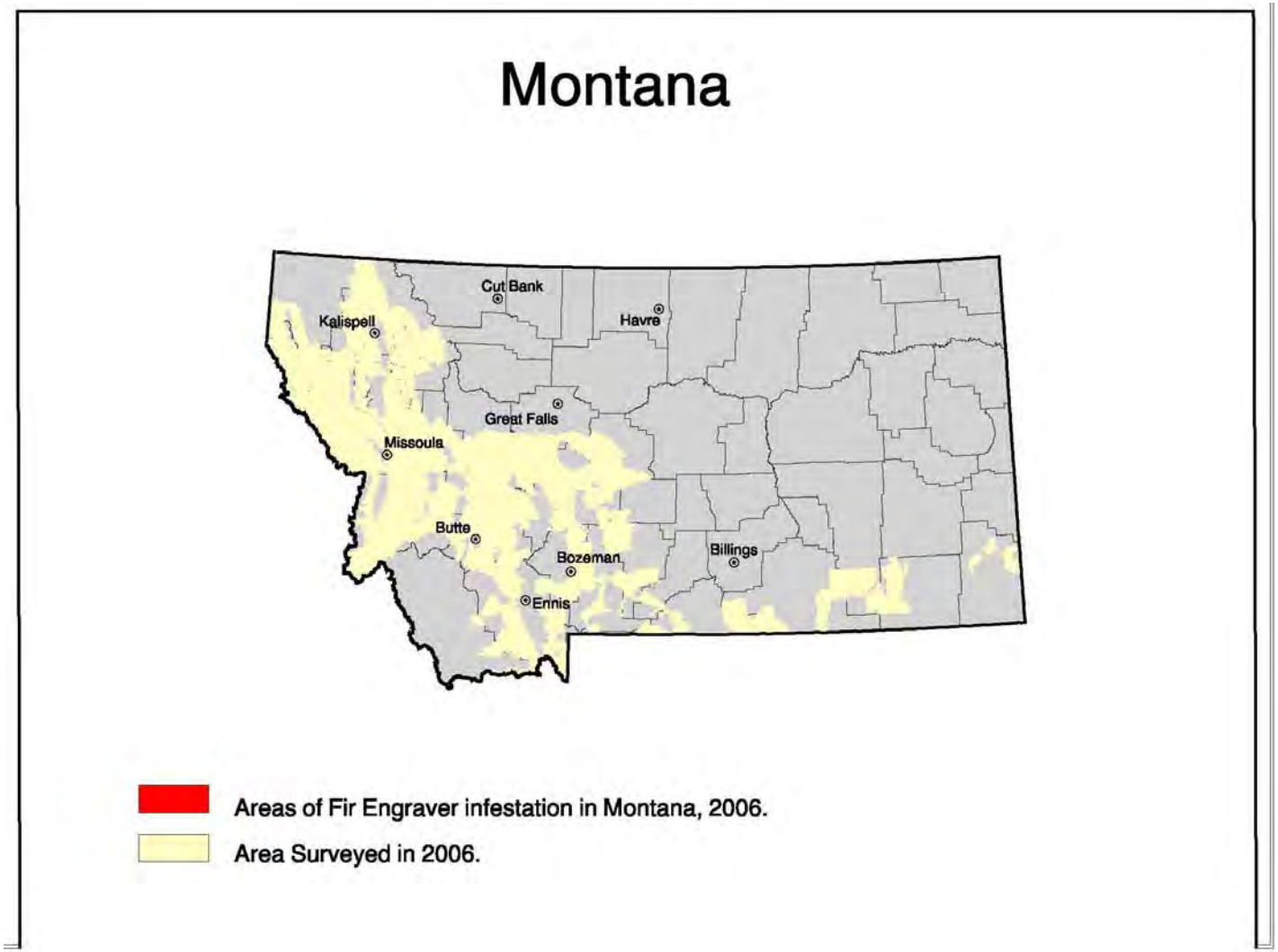

Figure 25. Western Balsam Bark Beetle Infestations in Montana, 2006

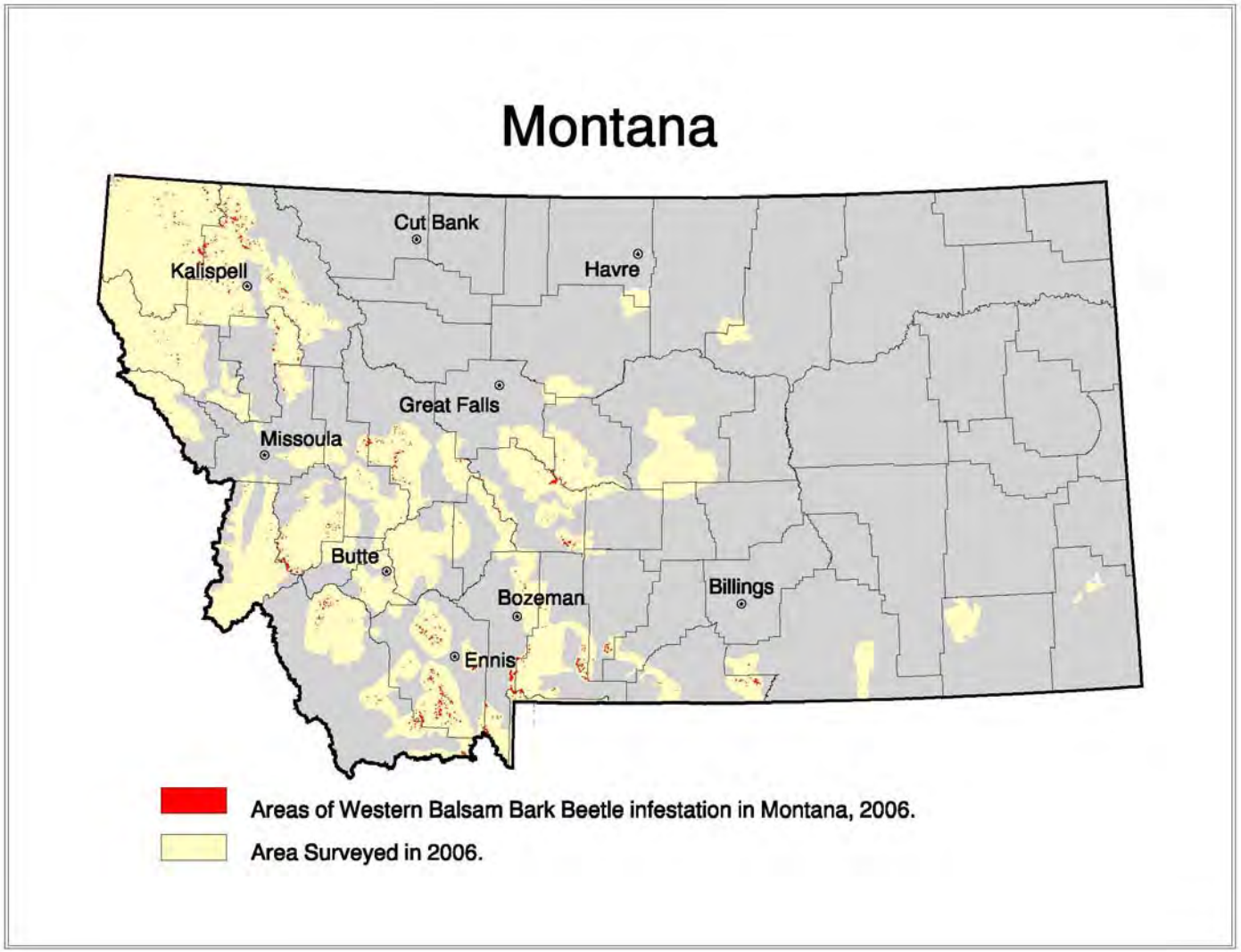
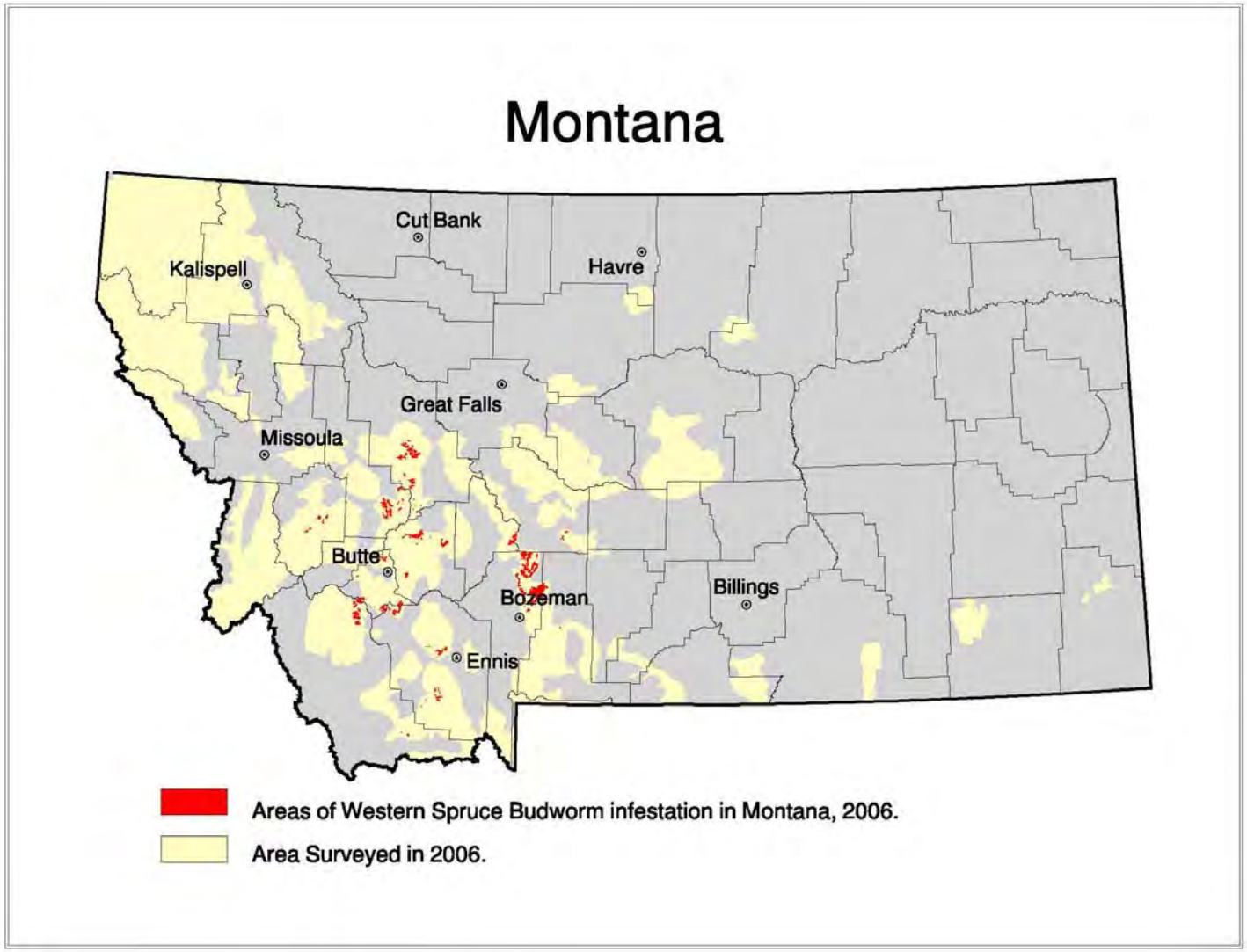
Figure 26. Western Spruce Budworm Infestations in Montana, 2006