United States
Department of
Agriculture

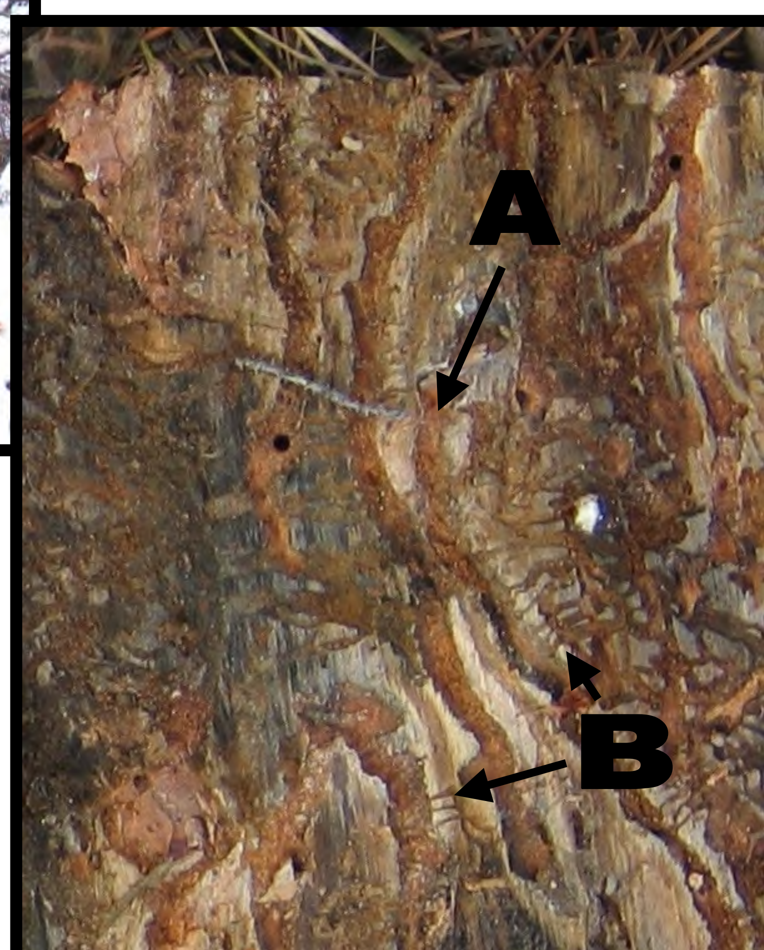
Rocky
Mountain
Region

Renewable
Resources -
Forest Health

FOREST INSECT and DISEASE CONDITIONS in the ROCKY MOUNTAIN REGION

2005

Lodgepole pine beetle, *Dendroctonous murrayanae* killed lodgepole pines on the Medicine Bow National Forest. This beetle is similar to spruce beetle in both physical appearance of the adults and in their gallery construction. Lodgepole pine beetle attacks at the base of the tree.



A. Vertical egg gallery of lodgepole pine beetle.

B. Horizontal larval galleries

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2005

R2-06-07

USDA Forest Service
Rocky Mountain Region
Renewable Resources, Forest Health Management
740 Simms Street
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by

The Rocky Mountain Region Forest Health Management Staff, and State Forest Health Specialists of Colorado, Kansas, Nebraska, South Dakota, and Wyoming

ACKNOWLEDGMENTS

The Forest Health Management (FHM) Staff extends its appreciation to all cooperators who contributed to forest health efforts in the Rocky Mountain Region.

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Data, Aerial Survey, and Map Disclaimers

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Only rough estimates of location, intensity and the resulting trend information for any given damaging agent are provided with aerial survey data. The data presented should only be used as indicators of insect and disease activity, and validated on the ground for actual location and casual agent. Many of the most destructive diseases are not represented in these data because these agents are not detectable from aerial surveys.

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Rocky Mountain Region (R2), Forest Health Management 2005

Forest Health (FH) Management is responsible for the detection, evaluation, and suppression of insects and diseases on forested Federal lands in the Rocky Mountain Region (Figure 1). FH Management also administers financial and technical assistance programs with State Foresters of Colorado, Kansas, Nebraska, South Dakota, and Wyoming for insect and disease detection, evaluation, and suppression. In addition, management for range pests and non-native forest insects and diseases is shared with the Animal and Plant Health Inspection Service (APHIS). Federal and State agencies coordinate and cooperate in forest health management for effective program execution.

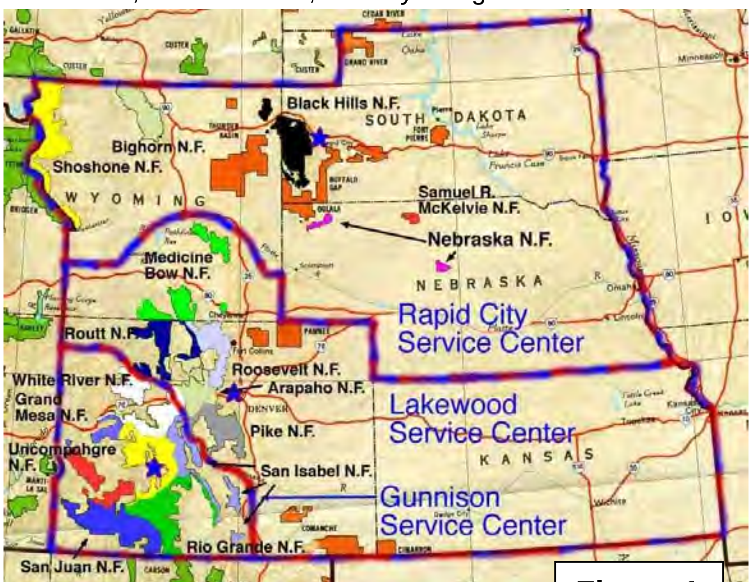

Figure 1

Three Service Centers and the Regional Office address forest health concerns for the Rocky Mountain Region. Questions concerning operations and requests for service can be directed to the Forest Health Management Group Leader in the Regional Office or the respective Service Center Leaders.

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Status of Major Forest Damaging Insects, Diseases, and Other Agents in the Rocky Mountain Region during 2005

Mountain Pine Beetle
Dendroctonus ponderosae

Mountain Pine Beetle again was the most damaging agent in the Region in 2005. Large outbreaks continued to devastate pines in the region from Colorado's San Luis Valley to the Absaroka Mountains in northwest Wyoming and over into the Black Hills in South Dakota.

<u>Colorado</u>

Mountain pine beetle populations remained at epidemic levels in lodgepole pine stands throughout northern Colorado. The following counties were severely impacted: Eagle, Grand, Jackson, Routt and Summit. Large amounts of dead and dying lodgepole pines adjacent to towns prompted efforts by federal, state and local homeowners to manage beetle impacts and fire risk in the wildland-urban interface. These communities included Breckenridge, Silverthorn, Dillon, Frisco, Grand Lake, Granby, Winter Park, and Steamboat Springs.

Mountain pine beetle outbreaks within the Williams Fork and Troublesome Creek watersheds in Colorado depleted lodgepole stands of almost all large diameter trees. These outbreaks and later epidemics began in these watersheds in 1997.

As lodgepole pine trees have been depleted from the Williams Fork area, mountain pine beetles are now concentrating on the few pines remaining that are intermingled with Engelmann spruce in the riparian area along the Williams Fork. Along these riparian areas, the mountain pine beetle is attacking and infesting Engelmann spruce trees along with lodgepole pine trees. Mountain pine beetle larvae are developing in these trees and are reaching late larval instars. Whether these mountain pine beetles will survive to emerge as adults has not been determined.

In an unusual twist, mountain pine beetle-infested Engelmann spruce are being attacked at their base by the spruce beetle, *Dendroctonus rufipennis*. This sort of interaction between these two *Dendroctonus* species may lead to an increasing problem associated with building spruce beetle populations as the mountain pine beetle population collapses due to a depletion of the lodgepole pine resource in the Williams Fork area.

In Colorado, mountain pine beetles successfully completed their lifecycle in a single year at elevations in excess of 9,500 feet, where they were expected to take two years to complete development. As a result, we saw unprecedented high levels of lodgepole pine mortality in these high elevation forests.

Beetle activity in lodgepole pine continued to intensify in proximity to Vail, CO. Beetle activity that once concentrated along the Interstate 70 corridor evidently impacted the Piney River drainage. Salvage, sanitation, thinning and related fuels treatments were planned and implemented near Vail, including WUI, developed recreation sites, the Vail Ski Area and the Piney River drainage.

Mountain pine beetle populations in ponderosa pine were at epidemic levels surrounding the Woodland Park community in El Paso and Teller Counties, Colorado. The beetles also caused high levels of tree mortality in stands of ponderosa pine in the South Park area, near Fairplay, in Park County, Colorado.

Mountain pine beetle activity in ponderosa pine in the Upper Arkansas River Valley was less than that observed during the previous six years. Several thousand acres of forest health management and fuels treatments were implemented in the past few years in the valuable Wildland-Urban-Interface (WUI) setting between Buena Vista and Salida. On the San Carlos Ranger District, San Isabel National Forest, mountain pine beetle continued to spread across the landscape, moving east towards the Front Range and south towards the Wet Mountains.

Mountain pine beetle activity was also evident, though in lesser amounts than previous years, on the Rio Grande National Forest. In the Hermosa, CO area of the San Juan National Forest, mountain pine beetle was found in large diameter ponderosa pine, in association with several other species of bark beetles, Armillaria root disease, and dwarf mistletoes.

South Dakota

Mountain pine beetle populations remained at epidemic levels around much of the Black Hills where. approximately 20,500 acres were infested and 70,000 ponderosa pines killed. Mountain pine beetle increased to outbreak levels around the northern Hills, central Hills, and in the Norbeck - Mt Rushmore area.

Ponderosa pine mortality due to mountain pine beetle was widespread in localized areas of the northern Hills and across the central Hills. Areas with high levels of beetle-caused mortality were mapped in the following general locations:

- southeast and west of Warren Peak in the Bearlodge Mountains,
- west of Highway 85 and extending west to Spearfish Canyon,
- west from Beaver Park and into the vicinity of Hanna,
- west and south of Deerfield Reservoir, on the southwest slopes of Bear Mountain, extending east and south to Highway 16,
- and around Harney Peak.

Of special note were the areas northwest, west and south of Deerfield Reservoir. A multi-stand, landscape-level episode of mountain pine beetle-caused mortality continues across this large area. This beetle epidemic expanded and intensified significantly in the northwest, crossing Highway 85, and also south and east of Bear Mountain.

Although these areas had the highest concentration of beetle-caused mortality, activity again appeared to be elevated across much of the Black Hills. In some locations, what were a few, small, widely separated spots of mountain pine beetle-killed pines in 2004 appeared in 2005 to be more numerous, larger spots closer together --- signs of potential beetle epidemics developing.

Wyoming

High levels of limber and whitebark pine mortality attributed to the mountain pine beetle in concert with other stressors were mapped by aerial surveyors during the 2004 and 2005 field seasons. All known locations containing limber and whitebark pines within Wyoming were mapped during these surveys. Over 1,000,000 of these trees were killed across more than 200,000 acres statewide. Areas proximal to Togwotee Pass, the eastern slopes of the Medicine Bow Mountains, and the central Wyoming mountain ranges were notably affected.

Severe mountain pine beetle activity occurred on the west side of the Bighorns in limber pine and to a lesser extent in lodgepole pine. On the east side of the Bighorns, mountain pine beetle was still at high levels in ponderosa pine.

Large acreages of mountain pine beetle are evident in lodgepole, ponderosa, and limber pine in the Bighorn Mountains. Dry Fork Ridge and southeast of Burgess Junction had extensive areas of mountain pine beetle in lodgepole pine. Roughly 150 lodgepole pines were killed north of Black Canyon in the Ferris Mountains in northwestern Carbon County. There were a few areas of ponderosa pine mortality due to mountain pine beetle in the eastern foothills of the Bighorn Mountains. Concentrated pockets of mortality surrounding Stone Mountain, the southeastern tip of Red Canyon, and the northern edge of Tongue Canyon were observed. Limber pine mortality was evident near Horse Creek. There were infestations of mountain pine beetle in limber pine in the Shirley Mountains in northern Carbon County: Bald Mountain and south of Grinnell Lake.

On the Shoshone National Forest, there was a big, rolling outbreak of mountain pine beetles in both whitebark/limber and lodgepole on the Wind River District.

In southern Wyoming, mountain pine beetle populations continued at epidemic levels in the Medicine Bow Mountains and the Sierra Madre Range in Albany and Carbon Counties. Severely affected stands in these areas were particularly evident along the lower and middle slopes of these mountain ranges.

Lodgepole pine beetles (*Dendroctonus murrayanae*), which resembles the spruce beetle (*Dendroctonus rufipennis*) in appearance and gallery construction, was found infesting the base of lodgepole pine trees in the Medicine Bow Mountains in Albany County, WY. In an unusual situation, spruce beetles were infesting Engelmann spruce trees and intermingled lodgepole pine trees and the lodgepole pine beetle was found infesting the lower several feet of the stem of the lodgepole pine trees that had been attacked by the spruce beetle (see spruce beetle discussion, below).

Spruce Beetle
Dendroctonus rufipennis

Spruce beetle activity intensified on the Grand Mesa-Uncompahgre-Gunnison, Rio Grande, San Juan and White River National Forests. Of particular management concern were three expanding outbreaks; one on the White River National Forest in proximity to Baylor Park; one near the Colorado-New Mexico State line on the Rio Grande National Forest, and a third massive outbreak throughout high elevation spruce trees from Wolf Creek Pass to west of Telluride (Rio Grande, San Juan, and Uncompahgre National Forests). Recreational values are currently in grave risk as spruce beetles are impacting stands near the Wolf Creek and Telluride ski areas as well as within the Wiminuche and South San Juan Wilderness areas. Over 1,000,000 trees across 90,000 acres were killed within the San Juan Mountains in 2005.

Spruce beetle activity was noted in several Colorado Wilderness Areas, including Eagle's Nest, La Garita, San Juan, South San Juan, Uncompahgre and Weminuche. A spruce beetle outbreak expanded along the Middle and East Forks of the Cimarron River, within the Uncompahgre Wilderness, for at least the past four years. In southern Colorado, several small-scale salvage and sanitation efforts were successful in removing wind-thrown spruce that would contribute to additional beetle-caused tree mortality.

Spruce beetle populations in northern Colorado remained at epidemic levels in Jackson and Routt counties in the general vicinity of Steamboat Springs on the Routt National Forest. Spruce beetle populations were reaching epidemic levels adjacent to Rocky Mountain National Park and north to the Wyoming state line, in Grand, Jackson and Larimer Counties, Colorado. These epidemics occurred on Colorado State Forest lands, and on the Roosevelt and Routt National Forests.

In southern Wyoming on the Medicine Bow National Forest, spruce beetle populations were at epidemic levels in the Medicine Bow Mountains and Sierra Madre Range in Albany and Carbon counties. Populations increased rapidly in the Foxpark area of the Medicine Bow Mountains, which is southwest of Laramie, Wyoming.

In the Foxpark area, spruce beetles were observed attacking Engelmann spruce and intermingled lodgepole pine trees in stands containing mixes of these two species. This is an unusual occurrence, but has been observed repeatedly during the current spruce beetle epidemic in northern Colorado and southern Wyoming. Very high numbers of spruce beetles appear to "spill-over" and infest adjacent lodgepole pine trees during the mass attack of spruce trees. Galleries are constructed and eggs are deposited. It is not clear yet whether brood beetles will survive and emerge from these trees. Large aggregations of spruce beetles were occasionally found under the bark of green lodgepole pine trees, another unusual observation.

Finally, close examination of the litter at the base of the trees reveals an abundance of dead spruce beetles, suggesting significant losses of beetles during the mass attack on lodgepole pine trees. In a few instances, the lower portion of these lodgepole pine trees were attacked and infested by the lodgepole pine beetle, which successfully produced brood. Because spruce beetle adults resemble lodgepole pine beetle adults and because the egg galleries of these two species are rather similar, it was difficult to characterize these particular infestations.

Spruce beetle were in epidemic status along the North Fork Corridor and Sunlight drainage on the Shoshone National Forest. Small outbreaks occurred in the Burgess Junction area and Powder River Pass area of the Bighorn Mountains.

Douglas-fir Beetle
Dendroctonus pseudotsugae

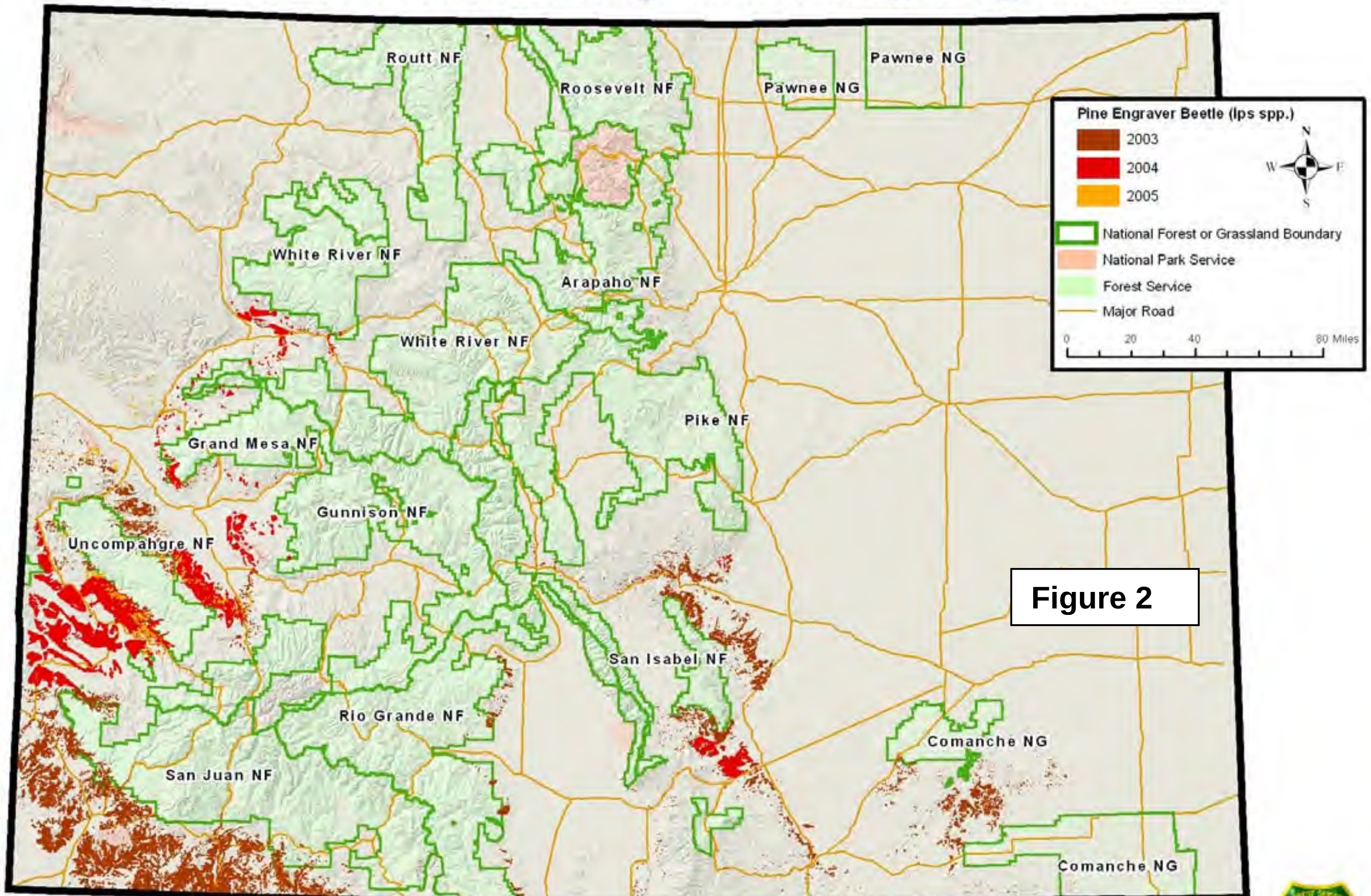
Douglas-fir beetle activity continued or increased at various locations in southern Colorado, impacting both public and private lands. Some beetle activity was in direct association with prior prescribed burns and wildfires, while some had no association with fire/tree scorch. Douglas-fir beetle activity was observed on the Gunnison, Rio Grande, San Isabel, San Juan, and White River National Forests and surrounding lands of mixed ownership. Chronic Douglas fir beetle activity continues in stands previously defoliated by western spruce budworm within the Saguache Ranger District of the Rio Grande National Forest. . Douglas-fir beetle activity increased adjacent to the 2002 Million Fire perimeter on the Rio Grande National Forest and to a lesser extent near the 2002 Missionary Ridge Fire on the San Juan National Forest. For the third consecutive year, beetle activity continued to intensify in old, dense Douglas-fir stands along Hwy. 145, above the Dolores River on the San Juan National Forest.

Large Douglas-fir beetle outbreaks continue along the western slopes of the Bighorn Mountains within Shell Canyon, Tensleep Canyon, Battle Park as well as throughout the North and South Forks of the Shoshone River in the Absaroka Mountains. Populations also increased within the Clark’s Fork of the Yellowstone River and were conspicuously evident within the upper Sunlight Creek basin. Approximately 700,000 Douglas-fir trees throughout 170,000 acres were killed in 2005 within these areas.

Pine Engraver Beetle
***Ips* spp.**

Ips activity in piñon pine has subsided along with the drought in southern Colorado. The final tally from a 2003-2005 comprehensive piñon *Ips* aerial survey (Figure 2) resulted in over 5.5 million piñon trees being killed across 1.5 million acres throughout the state.

Pinyon Pine Mortality Caused by Pine Engraver Beetles (Ips spp.) from Aerial Detection Surveys done in 2003, 2004, and 2005



Due to the nature of aerial surveys, the data on this map will only provide rough estimates of location, intensity and the resulting trend information for agents detectable from the air. Many of the most destructive diseases are not represented on this map because these agents are not detectable from aerial surveys. The data presented on this map should only be used as a partial indicator of insect and disease activity, and should be validated on the ground for actual location and casual agent.
Shaded areas show locations where tree mortality or defoliation were apparent from the air. Intensity of damage is variable and not all trees in shaded areas are dead or defoliated.

While piñon *Ips* and piñon twig beetle activity were much reduced from the large mortality event which occurred in 2003 and 2004, there were still some areas of notable mortality; specifically throughout the southern portion of the Uncompahgre Plateau.

In virtually all affected piñon *Ips* areas from prior years, remnant populations of the causal bark beetles have survived; this coupled with low moisture levels recorded during the winter of 2006 may cause these populations to rebound, which may result in increased mortality. The close correlation between beetle activity and moisture availability make additional large mortality events possible. While many stands of piñon were virtually wiped out during the last mortality event, there are still many areas containing mature, susceptible piñon.

Ips activity in ponderosa pine continued to be problematic in South Dakota and Nebraska as well as in jack pine at Bessey Nursery in central Nebraska. *Ips* was still very active on the Bessey Ranger District of the Nebraska National Forest and in some isolated parts of the around Chadron, Nebraska.

Ips declined in the Black Hills, although there were still some areas, especially wildland-urban interface, that were getting hit hard. One significant source of tree mortality was *Ips* attacks on pines weakened by *Sphaeropsis* blight and hail damage.

Ips spp. beetles were causing significant mortality to limber pine in the Shoshone National Forest. The six-spined engraver beetle (*Ips calligraphus*) and other *Ips* spp. were causing considerable mortality to the lodgepole pine.

Subalpine Fir Mortality, Western Balsam Bark Beetle, and Root Diseases

Subalpine fir mortality, caused by western balsam bark beetle and root diseases, were again the most damaging combination of agents in the Rocky Mountain Region affecting over 1.5 million trees across 500,000 acres. Subalpine fir mortality was present everywhere throughout the region. In Southern Colorado, mortality levels are lower than those seen during recent years. This mortality may be closely associated with drought and low moisture availability. The high elevations of the northern Bighorn Mountains of Wyoming had extensive areas of dying subalpine fir.

Armillaria root disease is the most common root disease in the Region. *Armillaria* root rot was seen in oaks along floodplains and in grazed areas around Wyoming. The combination of stresses between flooding in the 1990's and drought (1999-2004) promoted its growth in these areas.

Armillaria spp. were found on various tree species throughout Wyoming and were quite common in the Black Hills National Forest. This disease contributed to beetle-caused pine mortality.

Heterobasidion annosum root disease was was most prominent in white fir in the southern part of Colorado. This root disease was also recently discovered on ponderosa pine and eastern redcedar in the Bessey Ranger District of the Nebraska National Forest. The root disease had previously been identified there on jack pine. The incidence levels were low.

Dwarf Mistletoe
***Arceuthobium* spp.**

Although there's little change from year to year in area and severity of dwarf mistletoe infestations, there was some evidence that these parasitic plants have been slowly increasing. This increase was probably due to fire exclusion without compensatory management.

Dwarf mistletoes remained among the most important of forest health issues, substantially impacting timber productivity, fire behavior, and other forest values over more than a million acres in the Region. At least 638,000 acres of National Forest System lands were infested in Colorado (6% of all National Forest System lands) and 560,100 acres in Wyoming (10%).

Dwarf mistletoe species were slowly, but continually building up on limber, lodgepole, and ponderosa pines in Wyoming. Nearby, epidemic mountain pine beetle populations provide additional pressure on this isolated pine population. Green Mountain in southeastern Fremont County had noticeable levels of dwarf mistletoe in lodgepole pine.

In the increasing number of fuels reduction projects undertaken recently, both on Bureau of Land Management and National Forest System lands, treatments sometimes included mistletoe-infested stands. In some projects, treatments were designed after careful evaluation of the disease and its impact on future forest development, while others were planned without adequate consideration of such impacts. Failure to address these impacts could contribute to greater future severity of the disease and the fuel problems that accompany it.

White pine blister rust
Cronartium ribicola

White pine blister rust continued to spread and intensify in the Rocky Mountain Region (Figure 3) and often promoted mountain pine beetle attack of the five-needle, white pines.

In Colorado, the disease front is now approximately 12 miles north of the northern boundary of Rocky Mountain National Park raising concerns about sustaining white pines in one of our national treasures. In 2003, the disease was also discovered in isolated locations of the Sangre de Cristo and Wet Mountain Ranges of southern Colorado more than 200 miles from any other known infection zone. The Sangre de Cristo outbreak was observed on the San Carlos Ranger District and the Conejos Peak District of the San Isabel and Rio Grand National Forests respectively. The rust disease occurs in the Great Sand Dunes National Park, and on other state and federal lands nearby. In the Wet Mountains, the disease was distributed throughout the eastern side of the range, just west of Rye and Beulah, Colorado. Infections in southern Colorado were found primarily on limber pine. Of additional significance was the first ever recorded infection of Rocky Mountain bristlecone pines in their native habitat found in 2004.

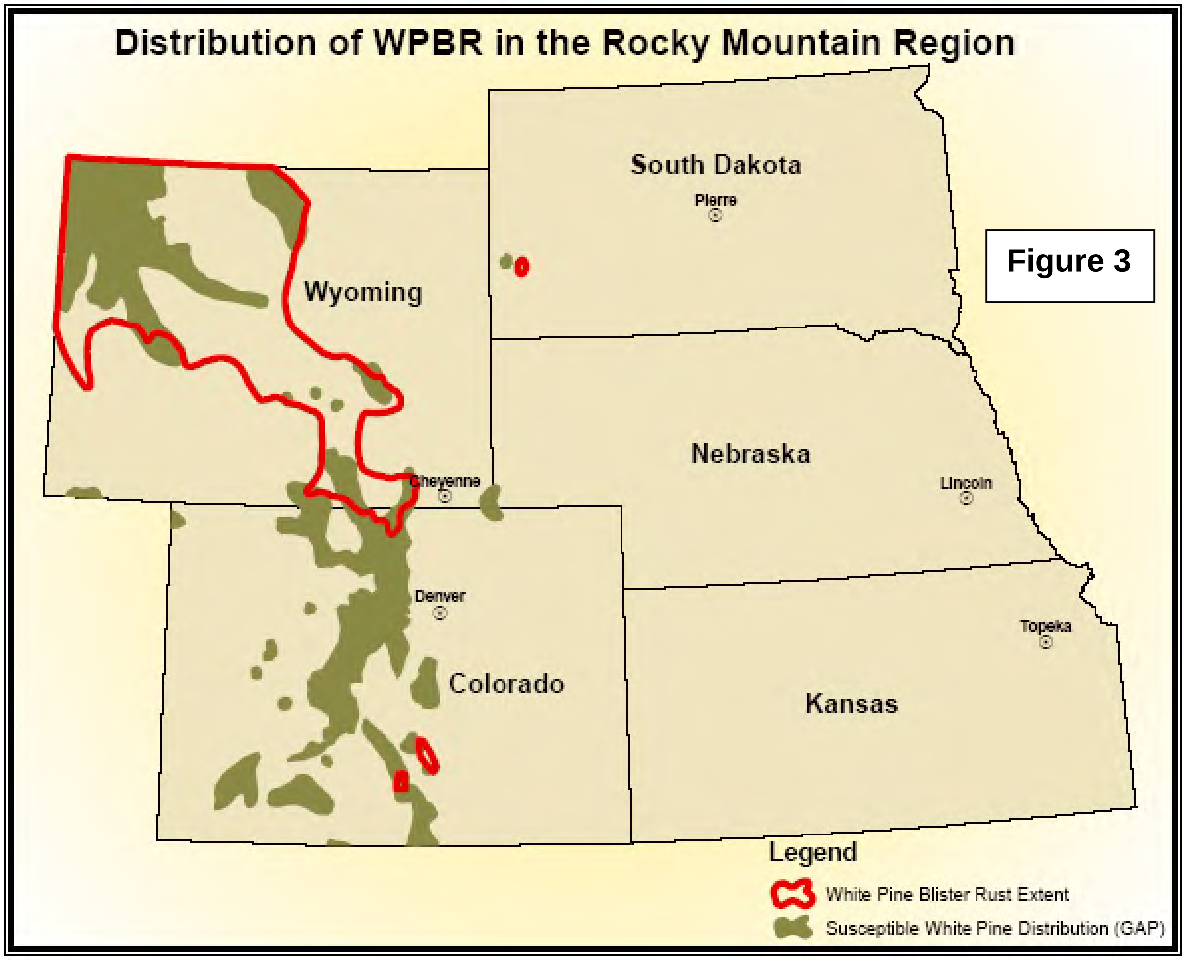
In the Black Hills of South Dakota, the only existing small area of limber pine were found to be infected with this disease.

White pine blister rust was found on whitebark and limber pines throughout Wyoming. This disease was spreading and intensifying throughout the state. The disease was already causing considerable ecological impacts in some areas of Wyoming.

White pine blister rust was discovered in several new locations in south-central Wyoming including the Snowy Mountains and the Sierra Madre Mountains where the incidence was previously low. In the Sierra Madre Mountains, the disease was only observed on several trees on private land along Highway 80 just east of the Medicine Bow National Forest boundary.

Limber pine mortality was widespread throughout the Bighorn Mountains and Crooks, Green, Ferris, and Shirley Mountain Ranges. Virtually all of the northern Shirley Mountains had declining limber pine due to infection by white pine blister rust. Intensities range from four to fifteen infected trees per acre.

According to results from a 2004-2005 limber pine aerial survey done throughout Wyoming (Figure 4), white pine blister rust and mountain pine beetle affected over 1,000,000 trees across 200,000 acres. Most of the mortality was attributed to mountain pine beetle; but a recent forest health survey of limber pine in the Bighorn National Forest showed that mountain pine beetle incidence positively correlates with white pine blister rust branch canker severity and stem canker incidence. Mountain pine beetle infested trees had higher incidences of branch cankers and stem cankers compared with non-infested trees.


Distribution of WPBR in the Rocky Mountain Region
South Dakota
Pierre
Figure 3
Wyoming
Nebraska
Cheyenne
Lincoln
Denver
Topeka
Colorado
Kansas
Legend
White Pine Blister Rust Extent
Susceptible White Pine Distribution (GAP)

Damage Recorded in 5-Needle Pines
From 2004 & 2005 Aerial Surveys

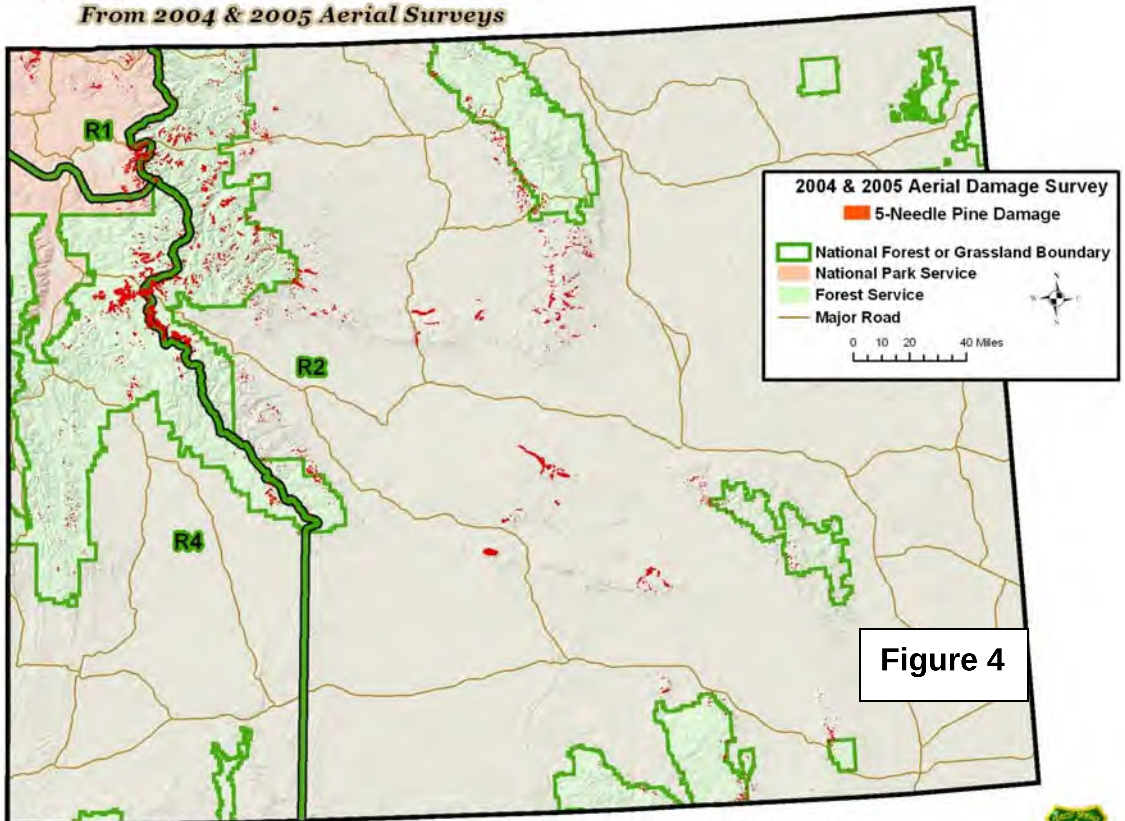


Figure 4

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Insects, Diseases, and Other Damaging Agents of Concern in Colorado (CO), Kansas (KS), Nebraska (NE), South Dakota (SD), and Wyoming (WY)

Insects, Host Trees, and States	Remarks
Banded Elm Bark Beetle *Scolytus schevyrewi* **(Non-native)** American, English, Rock, and Siberian Elms **CO, KS, NE, SD, WY**	Banded elm bark beetle continued to be abundant in the Front Range communities of Colorado. Losses of Siberian elms to this beetle lessened due to improved rainfall and soil moisture conditions in these areas. This beetle was also associated with Dutch elm diseased American elm. Bolts of American elm infected with Dutch elm disease fungus were readily attacked and infested by the banded elm bark beetle and brood beetles emerging from these bolts were found to carry spores of this pathogen. The beetle was present in Nebraska, but the amount of damage it caused was not determined. Banded elm bark beetle was found infesting declining Siberian elms in communities across the state of South Dakota, however, the infestations appeared to be concentrated in many of the western communities where Siberian elm was a dominant tree species and a long-term drought has been occurring. This beetle remains active in Wyoming but tree damages have lessened due to improved soil moisture.
Douglas-fir Pole Beetle *Pseudohylesinus nebulosus* Douglas-fir **CO**	Douglas-fir pole beetle was commonly observed in stands also being impacted by Douglas-fir beetle.
Douglas-fir tussock moth *Orgyia pseudotsugata* Douglas-fir **CO**	Defoliation in Douglas-fir due to Douglas-fir tussock moth continued to increase in Jefferson County on private forested lands, west of Denver, Colorado. The Douglas-fir tussock moth early-warning traps located on the Rampart Range, west of Colorado Springs in Douglas and El Paso Counties, caught a total of 29 moths. This was the first time since the outbreak of 1993 – 1995 that more than just a few moths were caught in this area, indicating Douglas-fir tussock moth populations may be on the increase again. Douglas-fir tussock moth infestations on spruce in urban landscapes were reported in Cheyenne, Wyoming.

Fir Engraver Beetle *Scolytus ventralis* and *Scolytus* spp*.* Corkbark, Subalpine, and White Firs **CO**	*Scolytus ventralis* populations expanded for the third consecutive year in dense white fir stands on the Pagosa Ranger District, San Juan National Forest and on the San Carlos Ranger District, Pike-San Isabel National Forest. On the southern portions of the San Juan National Forest, corkbark fir (*Abies lasiocarpa arizonica*) was also a preferred host of the fir engraver. Fir engraver beetle caused tree mortality diminished from 2004 in the Wet Mountains of southern Colorado. Fir engraver outbreaks, however, persist to the southwest in the Rio Grande and San Juan National Forests.
Flatheaded Wood Borer *Agrilus* spp*., Chrysobothris texanus* Gambel oak, English oak, Eastern redcedar **KS, SD**	Many species of flatheaded borer were trapped this year in Kansas and were under identification study by a specialist. Two-lined chestnut borer was associated with dying bur oaks located in native stands in south central South Dakota. These infestations appeared to be concentrated along the White and Little White River and were a concern to ranchers as these stands provide winter shelter for cattle.
Gypsy Moth *Lymantria dispar* **(Non-native)** Several hardwood and conifer tree species **CO, KS, NE, SD, WY**	Annual detection trapping for gypsy moth was again conducted in 2005. Traps were placed among potential hosts stands, at popular developed recreation sites throughout the Region. No gypsy moths were found among trap collections.
Pine Needle Scales *Chionaspis pinifoliae* *Matsucoccus acalyptus* Scots pine, piñon pine **CO**	Some increased scattered activity was found in the vicinity of the Colorado National Monument.
Pine Sawflies *Neodiprion fulviceps* Ponderosa pine **CO**	There were several small pockets of sawfly defoliation in ponderosa pine stands across the northern Black Hills after years of almost no activity. It has been approximately eight years since the last major outbreak of these defoliators occurred.
Pine Tip Moth *Rhyacionia* spp., *Dioryctria* spp. Austrian, Scotch, and Ponderosa pines, Colorado blue spruce **KS, NE, SD**	Young pines in windbreaks and plantations are often damaged by pine tip moth. This insect appeared in several pine plantations in the southeastern part of South Dakota though injury was light.
Pine Tussock Moth *Dasychira grisefacta* Ponderosa pine **NE**	An area of a few hundred acres of ponderosa pine on private land near Kimball, Nebraska had an outbreak in 2003 and 2004. Heavy defoliation of old needles occurred locally and control actions were contemplated by some landowners. This outbreak ended in 2005.

Twig Beetles *Pityophthorus* spp. *Pityogenes* spp. Lodgepole pine, ponderosa pine, piñon pine **CO**	Twig beetle activity continued to cause notable damage in piñon pine stands in southern Colorado, but at lower levels than the previous two years. These beetles were also found in the Sangre de Cristo Mountains attacking limber pine.
Western Spruce Budworm - *Choristoneura occidentalis* Douglas-fir, sugalpine fir, Englemann Spruce **CO**	In 2005, defoliated Douglas-fir due to western spruce budworm activity was apparent in small patches in areas of Boulder County, west of Boulder, Colorado, and in Jefferson County, west of Denver. This suggested that budworm populations are on the increase along the northern portion of the Front Range. Populations of budworm declined to inconspicuous levels along the Rampart Range, west of Colorado Springs. Western spruce budworm damage was seen in spruce-fir stands of the southern Uncompahgre Plateau and within an area around the Cimarron Ridge. Several consecutive years of defoliation had decimated understory spruce and firs and top-kill was readily evident in overstory and mid-story trees. Budworm activity continued in another high elevation spruce-fir forest on the Rio Grande National Forest, below Wolf Creek Pass. Significant impact was evident in understory spruce and fir. Both sites were noteworthy because the insects were attacking both spruce and subalpine fir in the affected stands. The Mosca Pass trail head area in the Sangre de Cristo Range had defoliation from this insect. Both Douglas-fir and white fir were affected.
Western Tent Caterpillar *Malacosoma californicum* Aspen **CO**	Western tent caterpillar damaged aspens on 265 acres during 2005 along the northwestern rim above Colorado’s San Luis Valley. A low intensity outbreak of western tent caterpillar was observed in the vicinity of Cuchara in southern Colorado. However, no tree mortality was observed.
Zimmerman pine moths *Dioryctria* spp. Austrian pine, Ponderosa pine, Blue spruce **NE, SD**	Zimmerman pine moth continued to be a problem in windbreaks and ornamental plantings of Nebraska and South Dakota. Austrian pine is the primary species affected, though ponderosa pine windbreaks in drought-stricken areas were also experiencing significant branch injury. These borers continued to kill branches and entire trees in windbreaks and plantations in much of central and western Nebraska.

Diseases, Host Trees, and States	Remarks
Cankers *Cytospora* spp., *Ceratocystis fimbriata, Hypoxylon mammatum, Cryptosphaeria populina* Alder, Aspen **CO, SD, WY**	A survey in 2004 showed that about one third of the standing alder (*Alnus incana* ssp. *tenuifolia*) in Region 2 was dead and another third has at least minor dieback, both associated with cankers caused by *Valsa melanodiscus* (*Cytospora umbrina*). Photographs and reports recently came to light suggested that unusual levels of mortality may have already begun before 1995. The cankers expanded very rapidly during the growing season. Aspen Bark Beetle, (*Procryphalus mucronatus*), generally attacked aspen also affected by *Cytospora* canker, and the combination of the two agents often resulted in the death of the host tree. Areas of the southern Uncompahgre and northern San Juan National Forests had been particularly hard hit, and some stands experienced as much as 30% mortality over a two year period. *Hypoxylon* and *Botryosphaeria* cankers were observed on oaks under stress (grazed, flooded woodlands) in eastern Kansas.
Dutch Elm Disease *Ophiostoma ulmi* **(Non-native)** American elm **CO, KS, NE, SD, WY**	The incidence of Dutch elm disease in the Region had not increased beyond the 2004 report, though the mortality was higher than what was experienced during the 1990s. Dutch elm disease annual mortality was currently about 2 to 5 percent of communities' elm populations in our states. This disease is still a concern, especially in trees that escaped the first wave of the disease and are about 5-6" diameter and about 20 years of age. Some larger trees were succumbing as well. The disease continues to be a problem in riparian areas and cities in the Region.

Pine Wilt and Pinewood Nematode *Bursaphelenchus xylophilus* Scotch, Austrian, and white pines **NE, SD**	Pine wilt caused by pinewood nematode was an increasing problem in Great Plains windbreaks. Pine wilt nematode continued to spread westward in Kansas and occupied the eastern half of the state. We do not consider a couple of reports from the western part of Kansas as indicative of pest establishment at this time but rather as single introductions. The highest level of disease activity currently in Kansas was in south central and northeast Kansas. The spread of the disease may be slowing in the western half of the state. This primarily was due to fewer pine populations. Also, the pine species used in west Kansas plantings, their isolation from other nematode population centers and being located in grassland ecosystems hampers natural spread of the nematode. Introduction by diseased nursery stock or some other man facilitated pathway could change this and vector the disease into some scattered urban settings in western Kansas. Hundreds of trees, mostly Scotch pine, were killed by pine wilt in Nebraska. It was present mostly in southeastern Nebraska, but the area heavily affected by the disease continued to expand north and west. Pine wilt continued to cause significant Scotch pine mortality in the southwestern South Dakota. Windbreak and ornamental trees were being killed at an alarming rate. Austrian pines, though few in number within this region, were also being affected. The nematode associated with pine wilt has not been found north of I-90 in the state.
Sphaeropsis Shoot Blight and Canker *Sphaeropsis sapinea (*syn. *Diplodia sapinea)* Ponderosa and Jack pines **NE, SD**	*Sphaeropsis* blight seemed to increase in importance in the Great Plains and was one of the most important diseases affecting pines in this area. There were few reports of this disease in the 1900's. This shoot blight pathogen is considered a non-native, invasive, forest pathogen in Kansas, Nebraska, and South Dakota. Hail impact and the associated shoot blight disease were observed on many pines in localized areas at the Bessey and Pine Ridge Ranger Districts of the Nebraska National Forest from 2004 storms. By 2005, considerable tree mortality had occurred in these areas as a result of the disease and attack by opportunistic insects such as *Ips*. *Sphaeropsis* caused higher than normal amounts of damage in 2005 because of added stress on the trees from the drought. On August 12, 2005, a storm that spawned a tornado in Wright, Wyoming, passed across the southern Black Hills and continued over the Pine Ridge of Nebraska and South Dakota. Severe hail and *Sphaeropsis* impacts were detected on 1,700 acres, and far more acres were likely affected.

Western Gall Rust *Endocronartium harknessii* Lodgepole pine, Ponderosa pine **CO, NE, SD, WY**	This pathogen was widespread throughout the Rocky Mountain Region and usually occurs at low to moderate intensities. Occasionally, the disease severely infects trees planted “off-site” or during years with climatic conditions favorable for infection. In the Black Hills of South Dakota, the Pine Ridge Ranger District of the Nebraska National Forest, and areas in Wyoming, this disease contributed to the death of small ponderosa pines. The disease infrequently occurred on limbs of large trees or causes an occasional stem canker, but normally was not a severe problem.
Other Damaging Agents, Host Trees, and States	**Remarks**
Drought All Tree Species **CO, KS, NE, SD, WY**	Moisture conditions improved somewhat in 2005, but the drought was still stressing trees in each state and causing many conifers and broadleaf trees to die from secondary and stress-related insect pests and diseases, such as bark beetles, *Sphaeropsis* blight, and root diseases. Reduced growth and poor color were seen in many tree species, especially conifers. Windbreak trees were particularly stressed with drought conditions in Kansas, Nebraska, and South Dakota.
Ice and Snow Damages All Tree Species **CO, SD**	Heavy snowstorms caused extensive damage in Colorado. Three-hundred acres of Englemann spruce and subalpine fir were destroyed by avalanches in the San Juan Mountains of southwestern Colorado during heavy snows the winter of ‘04/’05. A heavy May snowstorm in western South Dakota resulted in death or decline of thousands of trees within South Dakota. Many deciduous trees already had produced their first flush of leaves and the cold temperature killed the tender foliage. In addition, the heavy snow and ice resulted in branch breakage.

Oak Decline Oaks **KS**	Oak health faces many challenges in Kansas. It is a complex issue dealing with many biological, environmental, and agricultural factors that combine into situations unfavorable to oaks. *Hypoxylon* and *Botryosphaeria* canker were noted in decline situations. Incidence of both canker diseases have been recorded in moderate to high levels in select sites. Weather extremes of flooding and drought were important as were animal husbandry practices such as cattle lots in oak stands and related soil compaction and erosion issues. Oak decline was long term and appeared to be brought on by a combination of weather and man-made stresses which gradually wear down the trees allowing opportunistic diseases to establish themselves in a stand. Each decline site situation was different but the combination of these factors was common to all situations and absent when undisturbed native stands were observed. In 2005, a detections survey for sudden oak death was performed in forest stands near nurseries receiving planting stock from California. No infected samples were found.
Wind Englemann spruce, Subalpine fir **CO**	A strong wind event in September and another in October, toppled and snapped approximately 100 acres of spruce and fir on Colorado's Grand Mesa. The downed trees were significant because of impacts to at least four different developed recreation sites and because of spruce beetle populations that will respond to the downed spruce, their ideal habitat. Efforts were initiated to clean up the recreation sites and to address the downed spruce in the forest at large.

2005 Rocky Mountain Region Aerial Survey

Aerial sketchmapping is a remote sensing technique for observing forest damage caused by insects, disease or other damaging agents. Aerial surveys are conducted from fixed-wing aircraft and include documentation of observations onto maps. Forested areas exhibiting damaged or dying foliage are delineated by points or polygons onto a paper map or computer touch screen. When feasible, the numbers of affected trees per point or polygon are estimated.

Aerial overview detection survey goals are to detect and describe, not to quantify or exactly locate, forest insect and tree disease impacts. Sketchmappers "capture the essence" of what they are seeing onto maps, while traveling at about 100 miles per hour approximately 1,500 feet above the terrain, looking out across about 1.5 miles per swath. By timing the survey to occur during the appropriate "biological window", the observers record recent activity and minimize remapping past impacts. Aerial surveys are timed to see current "faders", which are discolored tree crowns resulting from damaging agents occurring during the current and previous year. Aerial overview detection surveys provide reconnaissance, a first step, in what can become a multi-stage survey that requires additional activities to improve accuracy. Consecutive annual aerial surveys over the same area may provide rough trend information.

Approximately 40 million acres of land within the USDA Forest Service's Rocky Mountain Region were aerially surveyed in cooperation with the Colorado State Forest Service and the Wyoming State Forestry Division in 2005. Ground verification of aerial survey polygons were carried out on 114 of the 26,735 aerial survey polygons delineated during the aerial survey.

Additionally in 2005, a pilot study was initiated by the Rocky Mountain Region to assess the accuracy of aerial survey data using the "*error or contingency matrix"* approach The goal of this project was to determine the spatial and classification accuracies of select categories of aerial survey observations. No attempt was made to assess the accuracies of the mortality level estimates commonly attributed during aerial surveys. Aerial survey accuracy results ranged from an estimated 61.1% accurate based on site-specific comparisons to an estimated 78.6% accurate when a 500 meter spatial tolerance was allowed. Results of the accuracy assessment were incorporated into the aerial survey's metadata in order to give users a better understanding of its limitations and value.

Data, aerial survey maps, and related documentation (including the accuracy assessment report) can be viewed and downloaded from our aerial survey website at the following URL: http://www.fs.fed.us/r2/resources/fhm/aerialsurvey/

Results from the 2005 aerial surveys are depicted in the following maps: Colorado - Figure 5, Nebraska - Figure 6, South Dakota - Figure 7, and Wyoming – Figure8.

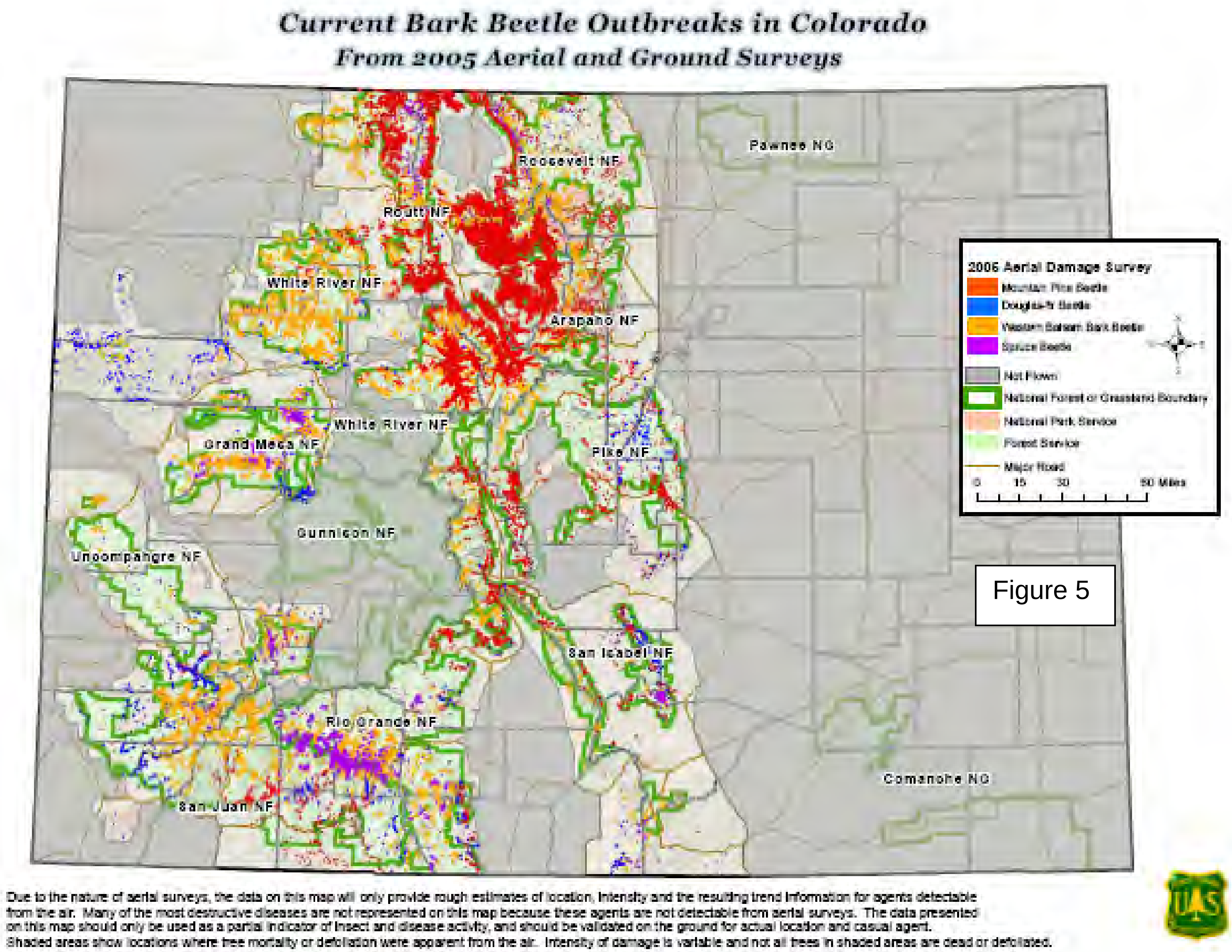
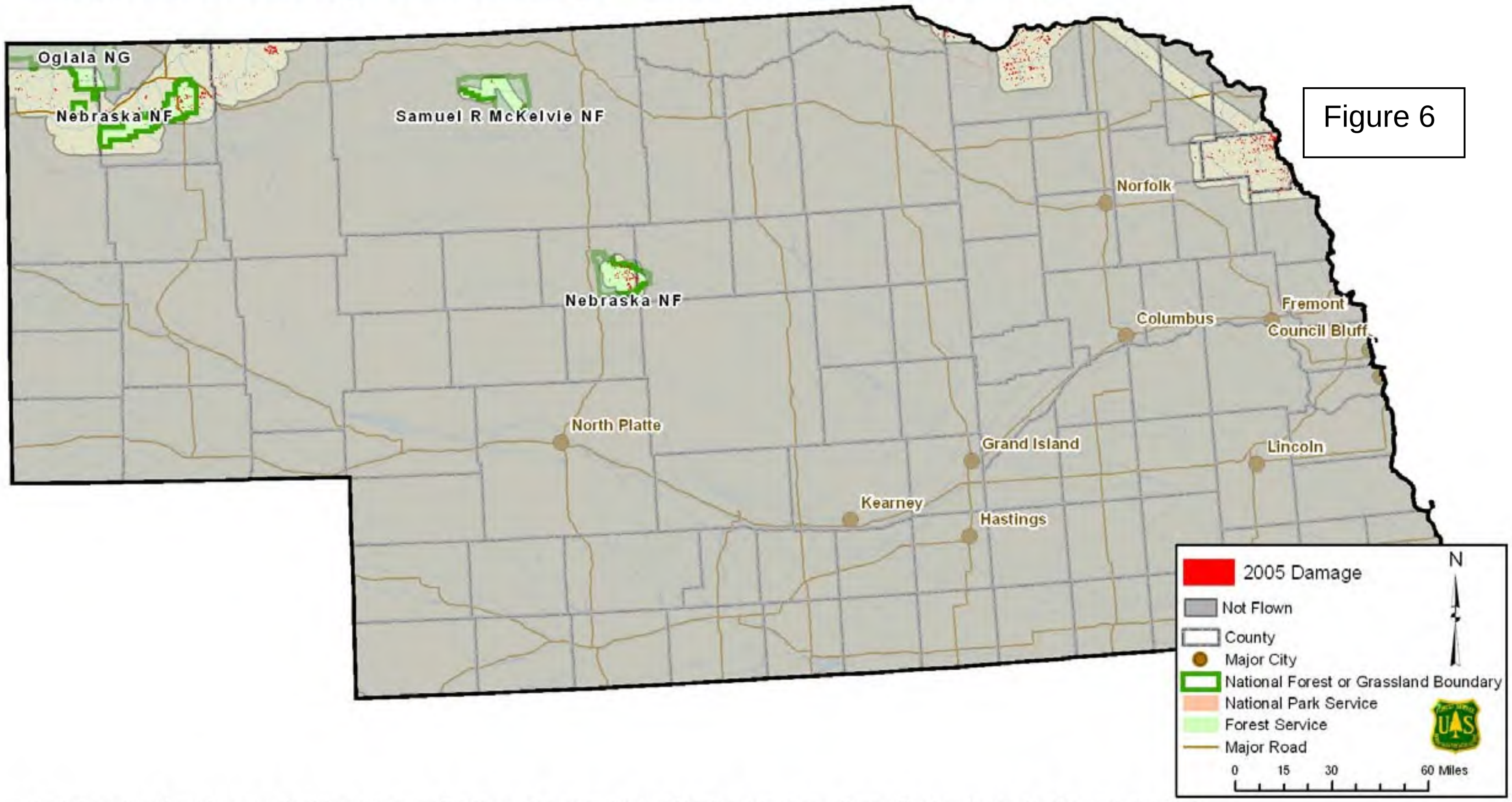

Current Bark Beetle Outbreaks in Colorado
From 2005 Aerial and Ground Surveys
Pawnee NG
Roosevelt NF
Routt NF
White River NF
Arapaho NF
White River NF
Grand Mesa NF
Pike NF
Gunnison NF
Uncompahgre NF
San Isabel NF
Rio Grande NF
Comanche NG
San Juan NF
2006 Aerial Damage Survey
Mountain Pine Beetle
Douglas-fir Beetle
Western Balsam Bark Beetle
Spruce Beetle
Not Flown
National Forest or Grassland Boundary
National Park Service
Forest Service
Major Road
0 15 30 60 Miles
Due to the nature of aerial surveys, the data on this map will only provide rough estimates of location, intensity and the resulting trend information for agents detectable from the air. Many of the most destructive diseases are not represented on this map because these agents are not detectable from aerial surveys. The data presented on this map should only be used as a partial indicator of insect and disease activity, and should be validated on the ground for actual location and casual agent.
Shaded areas show locations where tree mortality or defoliation were apparent from the air. Intensity of damage is variable and not all trees in shaded areas are dead or defoliated.

Figure 5

2005 Forest Damage Detected by Aerial Survey in Nebraska

Figure 6



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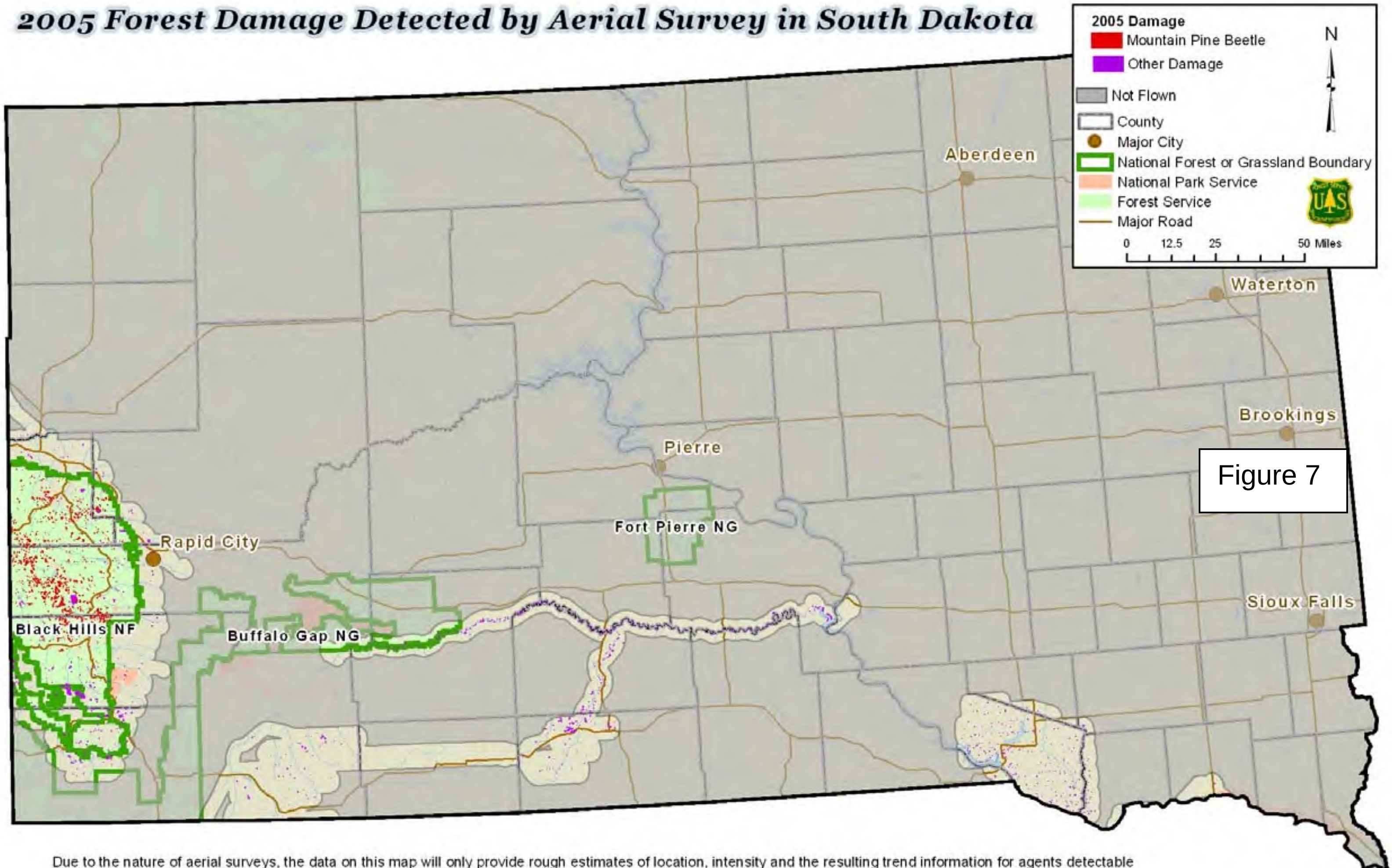
Shaded areas show locations where tree mortality or defoliation were apparent from the air. Intensity of damage is variable and not all trees in shaded areas are dead or defoliated.

2005 Forest Damage Detected by Aerial Survey in South Dakota



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Shaded areas show locations where tree mortality or defoliation were apparent from the air. Intensity of damage is variable and not all trees in shaded areas are dead or defoliated.

Current Bark Beetle Outbreaks in Wyoming From 2005 Aerial and Ground Surveys

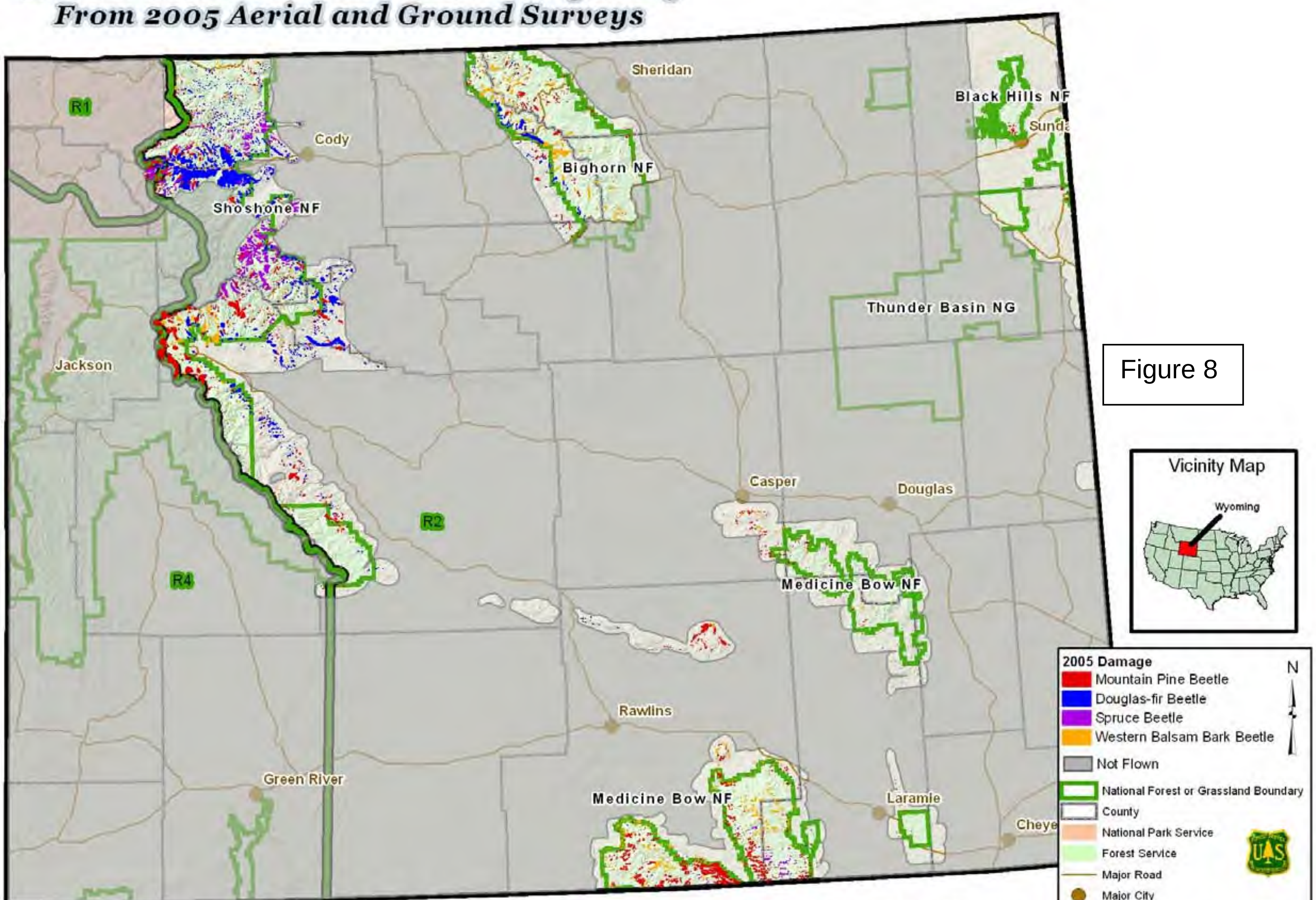

Figure 8

Due to the nature of aerial surveys, the data on this map will only provide rough estimates of location, intensity and the resulting trend information for agents detectable from the air. Many of the most destructive diseases are not represented on this map because these agents are not detectable from aerial surveys. The data presented on this map should only be used as a partial indicator of insect and disease activity, and should be validated on the ground for actual location and casual agent. Shaded areas show locations where tree mortality or defoliation were apparent from the air. Intensity of damage is variable and not all trees in shaded areas are dead or defoliated.

Forest Health Management Special Projects

Project Title: Alder Dieback and Mortality in the Central Rocky Mountains

Investigators and Cooperators: Jim Worrall, Barry Johnston (GMUG), Gerald Adams (Michigan State Univ.), Tom Eager, Roy Mask. **Years:** 2004 – 2007

Project Description: Poor condition of thinleaf alder (Alnus incana ssp. tenuifolia) has been noted in the Central Rocky Mountains in recent years. To quantify the extent and severity, and gather data that may suggest a cause, we surveyed watersheds that had alder and were at least partly in Colorado.

In 2005 we began work on the cause of alder dieback and mortality. One of the aspects that must be considered is the dynamics of alder populations. We measured and aged 129 stems, both with and without dieback, including recently killed stems. The maximum age was 69 years. We detected no effect of dieback on growth (as measured by 5-year ring-width increments), nor does it appear that stems decreased growth over a number of years before death. Other evidence also indicates that canker growth, dieback and death progress very rapidly. We marked edges of 10 cankers on live trees in late 2004. In July 2005, 4 trees were completely dead, 3 were girdled but still had green foliage (essentially dead), 1 was a branch infection and the infected branch had died, and 2 infected trees were still alive but the cankers had grown. In ungirdled trees, canker growth was several feet up and somewhat less down. Reexamination this fall of cankers marked this summer will indicate if canker growth occurs during the growing season, but that appears to be the case. Attempts to detect change in alder over time, by finding and remeasuring old riparian transects, were largely unsuccessful. However, we established 32 new, permanent transects this year that will permit detection of changes in alder in the future. Confirming the results of the broader, previous survey, severity was similar and there was no correlation with elevation. Our cooperator from Michigan State University, Dr. Gerry Adams, conclusively identified the canker pathogen in Colorado as *Valsa melanodiscus* (anamorph *Cytospora umbrina*), and preliminary indications are that the pathogen causing the similar disease in Alaska is the same. We closely examined roots on 5 sites and found no significant root disease, fine root mortality or N_2-fixing nodule mortality preceding or even accompanying early stages of dieback. We placed net traps on 39 stems in 6 sites to trap any boring insects exiting diseased trees.

Project Title: Distribution, Species, and Ecology of *Armillaria* Fungi in Wyoming

Investigators: Jim Blodgett and John Lundquist **Years:** 2003 - 2006

Project Description: A statewide investigation of Armillaria root disease is being conducted on federal, state, and tribal lands throughout Wyoming. This field survey is designed to examine the distribution of Armillaria species causing root disease in various forest types throughout Wyoming, and to explore relationships among hosts, site conditions, and Armillaria species. Along with providing new information about the distribution and species of Armillaria in Wyoming, this study will also examine relationships among the different species of Armillaria detected in this state and their associated soil and stand ecology. In doing this we will develop coarse-scale distribution and hazard maps for this pathogen. The spatial distribution of Armillaria will be compared with Forest Health Detection Monitoring data, and with annual precipitation data throughout the state. This study will provide scientific information regarding an important forest health issue, result in the diagnosis of pathogenic Armillaria species in Wyoming, and provide the base information for future monitoring/surveys of this important disease.

We completed 220 plots in 12 different forest cover types in 2004 and 2005 and expect to have 300 total plots by the end of 2006. To date, Armillaria has been found at 49 locations. Sixty-nine isolates were collected, and these are being identified to species. Three Armillaria species have been identified so far, with *A. sinapina* being the most common, followed by *A. gallica* and *A. ostoyae*.

Project Title: Landscape scale hazard-rating system for white pine blister rust in the central Rocky Mountains

Investigators and Cooperators: William Jacobi, Holly Kearns, Kelly Sullivan-Burns, Jeri Lyn Harris, Jim Hoffman, Eric Smith, Brian Geils, Anna Schoettle, Diana Tomback, Jim Blodgett.

Years: 2001-2005 (completed)

Project Description: Development for a hazard rating system to identify areas where limber pines and bristlecone pines are threatened by white pine blister rust in Colorado continues. Using the current outbreak of this disease in southern Wyoming and northern Colorado, a model system is being developed using epidemiological factors and site features.

Accomplishments

- A tested hazard rating system applicable to central Rockies relating rust severity to epidemiological factors and site and stand features.
- Maps for various forests with white pines delimiting areas of rust hazard.
- Microclimatological factors for southern Wyoming and northern Colorado (interpolated site conditions as corrected for topography, elevation, and other factors).
- Disease control recommendations and vegetation management strategies linked to hazard zones. These include a determination where practices such as Ribes control, pruning, and growing white pines would be feasible.

Project Title: *Scolytus schevyrewi*, a newly detected bark beetle attacking elm

Investigators and Cooperators: José Negrón, Steve Seybold, Jeff Witcosky, Bob Cain, Bernard Benton, Bill Jacobi, Ronda Koski, and Tom Harrington. Years: 2003 - 2006

Project Description: We conducted two large-scale laboratory experiments collecting pheromones produced by *Scolytus shevyrewi*, completed a field attraction study to varying release rates of 2-methyl-3-buten-2-ol, and initiated a field study on attraction to host compounds. We initiated DNA analyses for the identification of microsatellite DNA sequences, and collected populations of *Scolytus schevyrewi* in Wyoming, Colorado and South Dakota. We conducted a host range study on various fruit, elm and ornamental trees, degree-day development study, diurnal flight monitoring, and height of flight studies.

Project Title: Monitoring of wood deterioration after wildfire

Investigators: Jim Worrall, Tom Eager, Roy Mask, Don Martinez, Jerry Ryszka

Cooperators: Staff from Black Hills, Shoshone, Medicine-Bow, White River, Pike, Uncompahgre, and Rio Grande National Forests **Years:** 2002 - 2007

Project Description: We have been assessing defect, decay and insect attack in trees killed in the 2002 fire season. Five tree species are included in nine fires on seven forests
Decay as measured by decrease in block density from 2002-2004 was greatest in Douglas-fir and ponderosa pine. Area covered by visually detected saprot was near 0 in 2002 and 2003, but increased sharply in 2004 in Engelmann spruce, ponderosa pine and Douglas-fir. Wood borers were already found in some fires in 2002, but were still increasing in many cases in 2004. Data from 2005 have not yet been assessed, but observations indicate a much greater increase in saprot than in 2004 in most species.

Project Title: Forest Health Survey of Limber and Whitebark Pines in the Shoshone National Forest –

Investigators: Jim Blodgett **Years:** 2004 - 2005
Project Description: To determine disease, physical damage, and insect conditions of limber and whitebark pines in the Shoshone National Forest, 200 plots were established to survey 40 stands during the summers of 2004 and 2005. White pine blister rust disease, *Ips* spp., and mountain pine beetle were the main disturbance agents observed.

Recent Publications

Blodgett, J. T., Herms, D. A., and Bonello, P. 2005. Effects of fertilization on red pine defense chemistry and resistance to *Sphaeropsis sapinea*. For. Ecol. Manage. 208:373-382.

Blodgett, J. T., W. C. Schaupp, Jr., and D. F. Long. 2005. Evaluation of white pine blister rust and mountain pine beetle on limber pine in the Bighorn National Forest. USDA For. Serv., Rocky Mountain Region, For. Health Mgt., Bio. Evaluation R2-05-08.

Blodgett, J. T., and Lundquist, J. E. 2005. *Armillaria* in Wyoming. Phytopathology 95:S10.

Blodgett, J. T., and Lundquist, J. E. 2004. Forest fires influence the abundance of Armillaria root disease in ponderosa pine. Phytopathology 94:S8.

Cain, R. J., and Howell, B. E. 2005. Biological Evaluation of mountain pine beetle activity on the Rock Creek Analysis Area of Yampa Ranger District, Medicine Bow-Routt National Forests and Thunder Basin National Grassland, 2005. USDA For. Serv., Rocky Mountain Region, For. Health Mgt., Bio. Evaluation R2-05-02. 27p.

Cain, R. J., and Howell, B. E. 2005. Biological Evaluation of mountain pine beetle activity on the Upper Fraser Analysis Area of Sulphur Ranger District, Arapaho-Roosevelt National Forest and Pawnee National Grassland, 2005. USDA For. Serv., Rocky Mountain Region, For. Health Mgt., Bio. Evaluation R2-05-03. 36p.

Cain, R. J., and Howell, B. E. 2005. Biological Evaluation of mountain pine beetle activity on the Black Trout Analysis Area of South Park Ranger District, Pike-San Isabel National Forests and Comanche and Cimarron National Grasslands, 2005. USDA For. Serv., Rocky Mountain Region, For. Health Mgt., Bio. Evaluation R2-05-04. 36p.

Cain, R. J., and Howell, B. E. 2005. Biological Evaluation Spruce Beetle and Mountain Pine Beetle Activity on the French Creek Analysis Area of Brush Creek/Hayden Ranger District, Medicine Bow-Routt National Forests and Thunder Basin National Grassland. 2005. USDA For. Serv., Rocky Mountain Region, For. Health Mgt., Bio. Evaluation R2-05-05. 52p.

Cain, R. J., Howell, B. E., and Burns, K. S. 2005. Addendum to R2-05-05, Biological Evaluation Spruce Beetle and Mountain Pine Beetle Activity on the French Creek Analysis Area of Brush Creek/Hayden Ranger District, Medicine Bow-Routt National Forests and Thunder Basin National Grassland. 2005. USDA For. Serv., Rocky Mountain Region, For. Health Mgt., Bio. Evaluation R2-05-05a. 18p.

Harris, J. L., comp. 2005. Forest Insect and Disease Conditions in the Rocky Mountain Region, 2004. USDA For. Serv., Rocky Mountain Region, Renewable Resources. R2-05-09. 39p.

Negrón, J.F., J.J. Witcosky, R.J. Cain, J.R. LaBonte, D.A. Duerr, S.J. McElwey, J.C. Lee and S.J. Seybold. 2005. The banded elm bark beetle: a new threat to elms in North America. American Entomologist 51: 84-94.