

2012 Forest Insect & Disease Conditions

Rocky Mountain Region (R2)

Cover Photo – Figure1. Spruce Regeneration at Squaw Creek on the Rio Grande National Forest. The "New Forest" when trees are "released" after a spruce beetle epidemic infested and killed the mature trees. Photo by Mike Blakeman

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Information shown is based upon data compiled as of March 2013. References and GPS data provided upon request. For more information, contact R2 FHP.

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Major Damage Agents

Douglas-fir Beetle (*Dendroctonus pseudotsugae*) occurs on Douglas-fir trees in **Colorado and Wyoming**.

Numerous infestations of the Douglas-fir beetle were identified in stands of Douglas-fir along the Front Range of **Colorado**, especially in Douglas, El Paso, and Park Counties. Smaller infestations were noted in Grand, Jackson, Jefferson, and Routt Counties in northern Colorado.

Throughout Colorado's south-central Rocky Mountains, Douglas-fir beetle activity continued at elevated levels (Fig.2). Levels of host mortality vary widely with some areas experiencing only scattered mortality, while other stands are greatly affected resulting in almost the total loss of mature Douglas-fir. Specific locations of high beetle activity include the San Miguel River headwaters near Telluride, areas surrounding Glenwood Springs, and stands to the east of Paonia, CO. In some areas Douglas-fir beetle activity started after forest fires; scorched host trees are particularly attractive to the beetle.

Ground observations in northwestern **Wyoming** show Douglas-fir beetle activity increasing in some areas of the northern zone of the Shoshone National Forest and western side of the Bighorn National Forest and adjacent lands. Managers of the Shoshone National Forest removed infested Douglas-fir in a small sanitation sale and continued to successfully use MCH to protect high value trees on developed sites in this area. Aerial detection surveys in the Bighorn Mountains, the Absaroka Mountains, and Wind River Ranges show relatively low levels of new Douglas-fir beetle causing tree mortality. In south-eastern Wyoming, small infestations were noted in Albany and Carbon County.

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Drought – Drought has been occurring throughout **Colorado, Kansas, Nebraska, South Dakota, and Wyoming** for several years. There were some severe floods along the Missouri River Basin in South Dakota, Nebraska, and Kansas during 2011. The Riparian and Urban forests of the Great Plains states were already stressed from the flooding, and now suffered even more environmental stresses with extreme drought conditions in 2012. Tree insect and disease populations were also affected by these stressors often promoting increased population sizes. Brief Forest Health reports from each state in the Rocky Mountain Region describing the drought effects on the trees are described below.



Figure 2. Douglas-fir beetle damage on the Gunnison National Forest

Drought (continued):

Colorado: Exceptionally dry weather during the summer of 2012 caused extensive leaf scorch in several forested areas of Colorado. Leaf scorch was characterized by dry, brown leaf margins and caused by a plant's inability to take up sufficient moisture to meet its needs. Leaf scorch was present in both shade and ornamental trees in 2012; especially on ash, aspen, boxelder, dogwood, linden, Norway maple, oak and other broadleaf trees in many urban areas along the Front Range were scorched.

Leaf scorch was especially prevalent in some aspen forests of Boulder and Gilpin counties, including the South Boulder Creek Basin. Aspen stands with a gray cast to the foliage, suggestive of leaf scorch, were seen during aerial surveys in the South Fork of the South Platte River Basin and at the base of Arizona and Montana mountains in Gilpin County. Leaf scorch was so severe that it could be seen during the aerial forest health survey and detected even on serviceberry shrubs in the Crystal Creek drainage near Gould Reservoir in early July.

Kansas: Trees in general had an extremely challenging year in 2012 when historic drought conditions continued from the previous year and persisted into the end of 2012. For much of the growing season, Kansas was at the center of the drought in the nation. Significant drought effects were seen around the state as trees suffered from the unrelenting dryness of 2011 and the extreme heat that persisted throughout the summer. Much into the autumn months, there was very little moisture. It became increasingly common to see wind-breaks, riparian systems, and woodlots with trees succumb to the lack of water and heat stress. September brought cooler temperatures and periodic rain events that mitigated drought conditions in some localized areas, but by no means eliminated the damage.

The National Drought Mitigation Center - U. S. Drought Monitor continued to indicate that most Kansas counties remained in the levels of "Exceptional Drought" (63% of the state), "Extreme Drought" (90% of the state), or "Severe Drought" categories. The latest Drought Monitor indicates that conditions were expected to continue through the winter into 2013. Lack of precipitation and hot temperatures caused many trees to show their fall color as early as August and drop their leaves. Trees on higher, rocky sites, and along dry stream beds turned yellow and then brown in late summer. The continuation of dry weather has taken the toll on our planted pine species, eastern red cedar, native oak species, silver maple, cottonwood, ash, and black walnut.

Nebraska: The past year was one of extreme to exceptional drought over most of Nebraska, with 95% of the state affected by extremely dry conditions. Drought caused significant tree losses in communities and rural areas as it killed trees outright when soil became too dry; drought made trees more susceptible to serious disease and insect pests because of the additional stress that the drought causes.

In 2012, probably 100 to 200 pines and spruce were killed in Nebraska by the extremely dry conditions. The drought had the potential to directly kill an estimated 48,000 white pine, Colorado blue spruce, and Norway spruce across the state in the more susceptible younger age classes when drought conditions did not improve.

South Dakota: Blue spruce, cottonwood, green ash, and a number of other tree species were affected by drought during 2012. Much of South Dakota experienced drought starting late summer 2011 and the dry conditions persisted during the winter and throughout 2012. In spring 2012 some planting in southeastern South Dakota of young seedlings in wind- break plantings were particularly impacted with losses more than 80%. The increased environmental stress resulted in tree mortality of urban trees attributed in part by colonization of insects such as ash bark beetles (*Hylesinus*), cottonwood borer (*Plectrodera scator*), and Zimmerman pine moth (*Dioryctria*). [Table of Contents](#)

Mountain Pine Beetle (*Dendroctonus ponderosae*) occurs on Limber Pine, Lodgepole Pine, Ponderosa Pine, Rocky Mountain Bristlecone Pine, Southwestern White Pine, and Whitebark Pine in **Colorado, Nebraska, South Dakota, and Wyoming.**

In northern **Colorado**, the mountain pine beetle epidemic continued but was declining in many of the affected counties. The epidemic had nearly ended west of the Continental Divide (Grand, Jackson, Routt, and Summit Counties). East of the Continental Divide, mountain pine beetle populations in Clear Creek, Gilpin, and Park Counties also had declined abruptly. The southern portion of Boulder County declined while the northern portion of the county was approximately static. In Larimer County, mountain pine beetle remained very active, although populations were beginning to decline as well. Along the southern edge of the epidemic in Pitkin, Lake and Park counties there were a few new areas of infestation but the activity generally decreased or stopped. Several of the areas not affected by the recent massive outbreak were under consideration for vegetation treatments. The aim of the treatments was to increase diversity of stand size and density in order to reduce beetle susceptibility in the future.

In northwestern **Nebraska**, mountain pine beetle mortality in ponderosa and Scotch pine in the Wildcat Hills and Pine Ridge was much reduced in 2012 compared to the previous several years. In a continued effort to slow the spread of the beetle and limit its impact, a cost-share funding program was used to help public and private landowners manage the insect. Monitoring continued in 2012 by scouting for dead and dying trees.

In **South Dakota**, on the Black Hills National Forest and adjacent lands, mountain pine beetle continued to kill ponderosa pines throughout the area in 2012. All land ownerships were affected. The Black Elk Wilderness Area bordering Custer State Park has experienced near 100 percent mortality of large ponderosa pine due to mountain pine beetle attacks.

The adjacent land in Custer State Park had much lower pine mortality due to a combination of tactics; thinning stands to reduce susceptibility, sanitation measures of removing infested trees and cutting infested trees into short bolts, then leaving the bolts in place to dry as larvae develop. New infestations occurred in the western portion of Custer State Park.

Landowners adjacent to Rapid City were also seeing mortality of their pines due to the beetle. The state forestry employees, in cooperation with the local conservation districts, were marking infested trees on private property at the request of landowners. There was also cost-share funding available to assist landowners in removal and treating the infested trees.

Relic stands of limber pine in the Cathedral Spires of Custer State Park are highly valued. There was concern that the expanding beetle population from the adjacent Wilderness Area might spread into these stands and eliminate the limber pine species

from the area. The trees were already stressed by white pine blister rust and encroachment by white spruce and the additional stress of beetle attacks; even unsuccessful beetle attacks could result in significant limber pine mortality. The anti-aggregation pheromone, verbenone, was used as part of the management of these relic stands of pines. The efforts were very successful with the loss of less than 1% of the trees to mountain pine beetle, despite a high infestation of the beetles in the area.

In south-central **Wyoming** (Medicine Bow National Forest and adjacent lands in Carbon, Albany, Converse, Natrona, Laramie and Platte counties) mountain pine beetle populations remained active but declined. Beetle populations in all identified counties, except Natrona, impacted fewer acres in 2012 than in 2011. Notable areas with new mountain pine beetle activity were seen on Casper Mountain, portions of the Laramie Range, and the Shirley and Ferris Mountains.

In northwest Wyoming (Shoshone NF and adjacent lands) mountain pine beetle continued to kill lodgepole and 5-needle pines but activity declined in many areas largely due to susceptible pine depletion. North-central Wyoming (Bighorn National Forest and adjacent lands in Bighorn, Johnson, Sheridan and Washakie counties) had relatively little mountain pine beetle activity. Large forest stands remain unaffected by mountain pine beetle in this area. Eastern Wyoming (Weston and Crook Counties, along the Wyoming & South Dakota state line primarily in the Black Hills National Forest) continued to see elevated levels of mountain pine beetle activity.

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Root Rot Diseases (updates)

Black stain root disease (*Leptographium wagnererii*) in R2 usually occurs on piñon pines in the southwest forests of **Colorado**. However, another related species of *Leptographium* (*L. terrebrantis*) was causing a dark stain and necrotic tissue in the roots on ponderosa and jack pine in Central **Nebraska**. This same pathogen was also found on ponderosa pine in the northern Black Hills National Forest in **South Dakota**

Leptographium terrebrantis was associated with sapwood stain and mortality of ponderosa pine in the northern Black Hills of South Dakota. This fungal pathogen was found on dead and dying ponderosa pine in the Black Hills National Forest in Lawrence County, South Dakota. The overstory was composed of widely spaced mature ponderosa pine, likely resulting from a seed tree cut at least a decade earlier. Symptoms included chlorotic and wilted crowns and mortality, with occasional thin crowns. A blue-gray to black staining in the outer sapwood of roots, root crowns, and lower stems were consistently associated with the foliar symptoms; mortality occurred in all large and small trees with symptoms.

Leptographium terrebrantis, fungal pathogen, was confirmed and associated with symptomatic trees. No other pathogen, insect, or animal damage was consistently associated with the mortality. The red turpentine beetle (*Dendroctonus valens*) was

found in the area, but there was no association with symptoms on these dead trees with the fungal pathogen. Based on symptoms and landscape patterns, abiotic effects were not known to occur in the absence of insect vectors. Red turpentine beetle and root bark beetles (*Hylastes* spp. and *Hylergops* spp.) were often vectors of this fungus, but these beetles do not typically kill trees.

L. terebrantis might be a vascular wilt disease that is spreading from tree-to-tree across root contacts or root grafts, or there might be insects feeding deep in the roots that transmitted the fungus. Black-stain-root disease was reportedly the only disease in which a species in the genus *Leptographium* (*L. wageneri*) causes disease independent of an insect vector. It has been demonstrated that *L. terebrantis* killed ponderosa pine seedlings independent of an insect vector with artificial inoculations.

Armillaria Root Disease, *Armillaria ostoyae*, was the most common species of *Armillaria* found on Austrian pine, Douglas-fir, Engelmann spruce, limber pine, lodgepole pine, ponderosa pine, subalpine fir, and whitebark pine in Nebraska, South Dakota, and Wyoming. A recent study in Wyoming identified four species of *Armillaria* in the state and *Armillaria ostoyae* was the most common species found, however all four species caused root disease.

Root disease distribution the Region is based upon root disease surveys and permanent plot studies by the Region's plant pathologists. *Armillaria* spp. accounts for the majority of root disease findings in the Region. Occasionally black stain root disease and *Heterobasidion annosum* root disease also occurred. GPS coordinates and exact locations of all of these root disease pathogens will be supplied upon request to the R2 Forest Health Protection group. Regional Root Disease distribution map (Fig.3) was a beginning at mapping root disease locations and problems in the Region. Further study is necessary to show the root diseases occurring in the Great Plains states of Kansas, Nebraska, and South Dakota.

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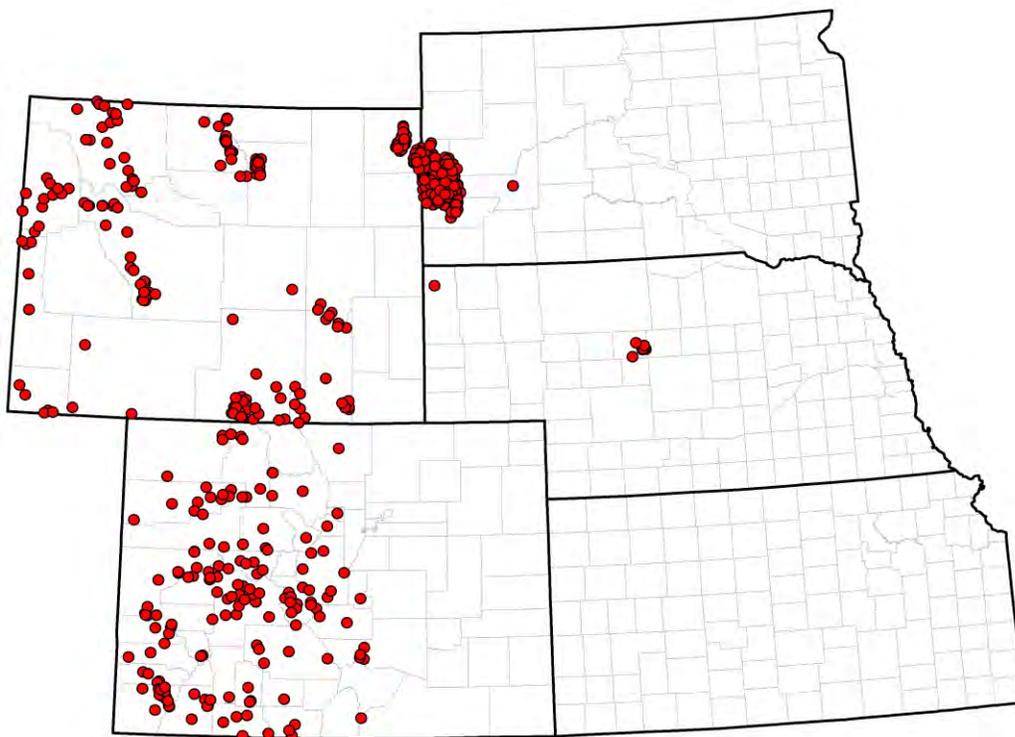


Figure 3. Regional root disease distribution map; 95% of survey observations were *Armillaria* spp.

Spruce Beetle (*Dendroctonus rufipennis*) occurs on Englemann spruce and Blue spruce in **Colorado and Wyoming**

Spruce beetle epidemics continue in Colorado and Wyoming within the Rocky Mountain Region leaving many areas of large dead standing trees.

Colorado had large increases in spruce beetle activity in 2012 (Fig.4a). Due to several forested areas with wind damages in 2012 (Fig. 4b), there will probably be another large increase in spruce beetle in 2013 that will become visually evident in 2014. Moderate to severe epidemics were ongoing in southern Colorado (Fig. 4a, 4c), including areas of the San Juan/La Garita Mountains, Grand Mesa and the Wet Mountains. Localized infestations were detected on the eastern slopes of the Sangre de Cristo Range. Also portions of the Arapaho-Roosevelt National Forest, Routt National Forest and Rocky Mountain National Park in northern Colorado had severe epidemics of spruce beetle.

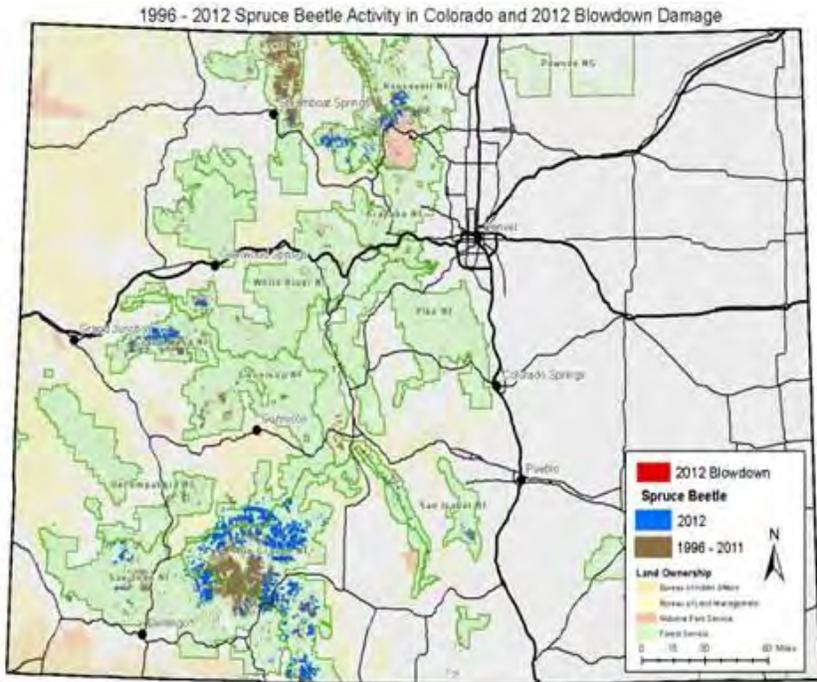


Figure 4a. Aerial Detection Survey map of past spruce beetle outbreaks. Current spruce beetle activity, and recent blowdowns where future outbreaks are likely to occur.

Due to the nature of aerial surveys, the data on this map will only provide rough estimates of location, intensity and the resulting forest 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 general indicator of insect and disease activity and should be validated on the ground for actual location and causal agent. Checkered areas show locations where tree mortality or defoliation were apparent from the air. Intensity of damage is variable and not all trees in checkered areas are dead or defoliated.

Figure 4b. Wind damaged (blow down) sites near Monarch and Poncha Passes.



Figure 4c. Spruce tree mortality caused by a spruce beetle epidemic on the San Juan National Forest, North of Pagosa Springs

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Other Spruce beetle increases were especially noticed in southwest **Colorado** (Fig.4a). A massive spruce beetle outbreak began in the Weminuche Wilderness of the Rio Grande and San Juan National Forests in the early 2000's. This outbreak continued to expand north and east in 2012. In a number of cases increases in tree mortality were due to immigration of beetles rather than expansion of local populations. Large numbers of beetles were transported with prevailing winds, infesting new areas, and quickly expanding the scope of the outbreak. Outbreak intensity was so great that in some locations non-host lodgepole pine and immature spruce down to 1 inch DBH were attacked (Fig. 5 a & b). Small groups of dead and dying spruce were detected along the Continental Divide as far north as Monarch Pass. Heavy infestations occurred in the Cochetopa Hills from Cochetopa Pass south to the La Garita Range, and in Ramboulliet Park, and Spring Creek Pass. New spruce beetle areas of infestation were also detected south of Lake San Cristobal near Lake City.

In northwestern **Wyoming**, on the Shoshone National Forest, spruce has been killing spruce at epidemic levels in the Absaroka Mountains; the epidemic activity continued north to the Montana border and south into the Wind River Range. Yet also in this area, we saw some decreases in spruce beetle numbers; this may be due in part to not being able to survey the area in 2012 (roughly Togwotee pass to the Washakie needles).

Other areas of **Wyoming** in the Rocky Mountain Region showed recent damages from spruce beetle. Spruce beetle activity was increasing in the northern Big Horn Mountains in north-central Wyoming where much suitable green spruce remains. In southeastern Wyoming, spruce beetle continued at epidemic levels on the Sierra Madre, Snowy Range and Medicine Bow Mountains and many areas have been depleted of suitable hosts.

Figure 5 a & b. Small spruce seedling attacked and infested with spruce beetle.



Wind Damage (Blowdown and Windthrow) - Colorado

The first winter storm season of the 2011-2012 was accompanied by hurricane-force winds that caused power outages, snarled traffic and blew down many trees in Colorado. Winds of up to 125 miles per hour were recorded in the Wet Mountain valley community of Westcliffe on Nov. 11, 2011. Extremely high winds also were recorded in portions of Summit County.

The heavy winds associated with this winter storm caused moderate to severe windthrow in conifer forests around the state. Some 117 areas with windthrown trees, for a total of 4,100 acres, were mapped in Colorado during the 2012 aerial forest health survey (Fig. 4a). Counties impacted include Chaffee, Clear Creek, Custer, Fremont, Gunnison, Larimer, Park and Saguache. Many of the downed and injured trees are susceptible to attack by several bark beetle species, including spruce beetle, Douglas-fir beetle and engraver beetles. These bark beetles attack and reproduce in the damaged and windthrown trees, eventually building large populations. The subsequent generations may then successfully attack and kill standing trees.

Large patches of windthrown trees were detected in the Sawatch Range, from Monarch Pass south to Poncha Pass (Fig.4b). Patches of windthrow also were detected on the eastern slope of the Sangre de Cristo Range, with 35 areas, totaling 1,220 acres and having nearly 100% blowdown. Most of the affected areas occurred in high-elevation Engelmann spruce forests near the edge of timberline. However, several areas of windthrow also were detected in mid-elevation mixed conifer forests.

Two small areas of windthrow were detected on the western edge of South Park – one in the Beaver Creek drainage, and the other below Panther Mountain. Both occurred in Engelmann spruce stands and each covered less than two acres. Several small areas of windthrow also were detected in lodgepole pine forests on the north-facing slopes of the lower Geneva Creek Basin, north of Kenosha Pass.

Windthrow was also mapped in several areas south of Georgetown, including in the South Chicago Creek Basin, several areas in upper Cabin Creek near Guanella Pass and in the lower Leavenworth Creek Basin. Eleven locations totaling 300 acres of windthrow were mapped in these areas. Another small area of windthrow was detected in the upper Willow Creek Basin, a tributary of the upper Cache La Poudre River. Additional areas of scattered windthrown trees, not visible from the air, were reported in many areas affected by the November 2011 storm.

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Sudden Aspen Decline - Colorado

Sudden aspen decline (SAD) was theorized to be the result of several interacting factors: drought stress, large areas with aspen stands more than 100 years old, and attacks by several species of fungi and insects normally considered incapable of damaging healthy trees. SAD was first noted in **Colorado's** aspen forests in 2004,

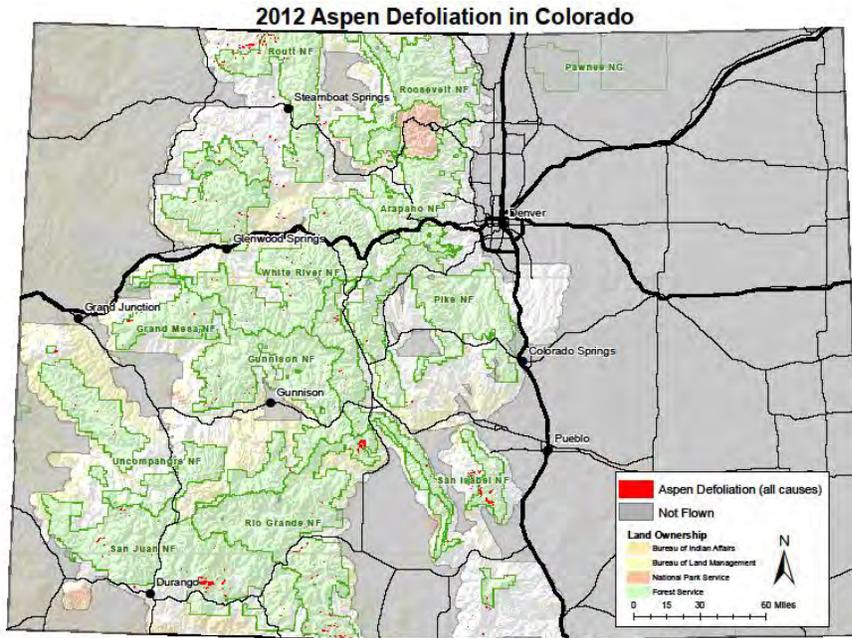
when aspen stands at the lower elevation limits of tree growth abruptly began to die off. By 2008, the decline had become so prominent that 541,600 acres, or 11 percent of Colorado's aspen forests, were affected that year. Since 2008, the total area of aspen forests affected by SAD had become progressively smaller. This reduction was believed due primarily to a return to normal moisture conditions. Many of the aspen stands previously affected by SAD now have young aspen regeneration replacing the dead trees (Fig. 6).

In 2012, the area near South Park, where large areas of aspen stands with thin crowns, indicative of stress, were observed and mapped as SAD. However, Colorado has now endured two successive years of below-normal moisture, which may lead to an increase of SAD in the next few years. Concentrated areas of aspen dieback and mortality have declined dramatically in the Rocky Mountain Region in 2011 and 2012 based on Aerial Detection Surveys (ADS). Damage peaked in 2008 when over half-a-million acres were impacted acres and mapped. However, fewer acres were mapped in 2012 in both CO and WY. Aerial observers report that the aerial signature of SAD was undetectable in many previously impacted stands, likely due to increased moisture in 2009 and 2010 which stabilized mortality levels and enabled the release of regeneration. Region-wide, only 116 polygons were mapped as SAD by aerial surveyors in 2012 and these were variable in size, ranging from less than an acre to several hundred acres. The highest concentration of damage occurred on the western slope of Colorado in and around the Grand Mesa, Gunnison, and Uncompahgre National Forests and in southwestern Wyoming on BLM, private, and FWS lands near Little Mountain and Pine Mountain in Sweetwater County.

Although damage declined on a regional scale based on aerial detection and also ground surveys in southwestern Colorado (Grand Mesa, Gunnison, and Uncompahgre NFs), surveyors found that substantial mortality continued on half of surveyed sites. Similarly, ground surveys in the Bighorn, Black Hills, and Shoshone NFs found increased levels of mortality in some stands which were likely associated with the 2012 drought.

The majority of surveyed aspen stands in these Forests were still healthy, but a few scattered stands had increased aspen mortality. Over forty different damage agents were noted on mature aspens and/or aspen regeneration. Most of the tree mortality was associated with *Cytospora* canker (*C. chrysosperma*), sooty-bark canker (*Encoelia pruinosa*), white mottled rot (*Ganoderma applanatum*), Armillaria root disease (*Armillaria* spp.), and/or bronze poplar borer (*Agrilus liragus*). Mortality of aspen regeneration was mostly associated with animal browsing and canker diseases.

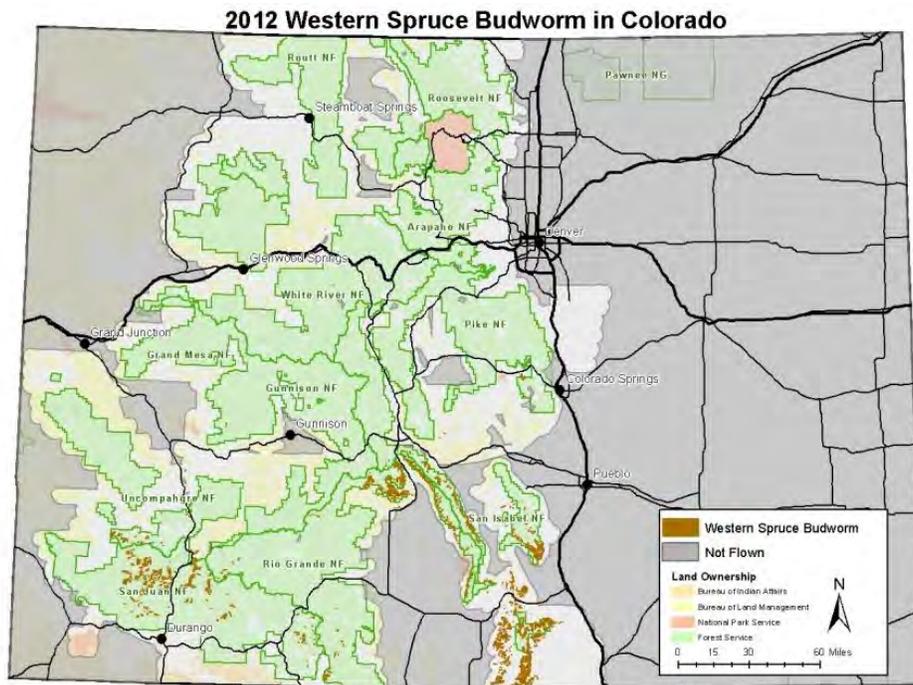
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Figure 6. Fewer areas with damaged aspen were observed in the 2012 aerial detection surveys.

Figure 7. WSBW areas observed in ADS in 2012.



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(NOTE - enlarging these 2 maps shows reduced areas of damages mapped.)

Western Spruce Budworm (*Choristoneura occidentalis*) - Host trees: Douglas-fir, white fir, & spruce in **Colorado and Wyoming**

Defoliation by western spruce budworm was again present over much of the southern portion of **Colorado** in 2012, with a total of 217,000 acres of aerially visible defoliation mapped during the annual aerial forest health survey (Fig.7).

Localized areas of defoliation occurred in mixed white fir/Douglas-fir forests on both sides of the Culebra Range, from La Veta Pass south to Cucharas Pass and the Trincheras Creek Basin. Defoliation was more extensive from Cucharas Pass and Ojitos south to the New Mexico border, and on the south-facing slopes of the Spanish Peaks. Heavy defoliation also was noted in North La Veta Pass and on the north slopes of Mount Maestas, and in all of the susceptible host tree types on the eastern slopes of Iron Mountain and on Sheep and Little Sheep mountains.

Conspicuous defoliation of white fir and Douglas-fir again occurred on the eastern slopes of the Sangre de Cristo Range, from Methodist Mountain south to Medano Pass. From Medano Pass south to Blanca Peak, defoliation tended to be more localized. Defoliation also occurred in most forests along the western slopes of the Sangre de Cristo Range, from Blanca Peak to Mosca Pass.

Western spruce budworm outbreaks also continued for the third successive year in the Wet Mountains. Almost all of the susceptible host trees from Ophir Pass south to the southern terminus of the mountain range exhibited defoliation on both the eastern and western slopes. Damage also was prevalent in Douglas-fir forests on the western side of the San Luis Valley, from Poncha Pass south to Bonanza and Saguache, and along the southern slopes of the San Juan Mountains, especially in the Animas and Dolores river basins.

Farther north, localized defoliation was detected in two locations north of U.S. Highway 50: in Teller County on the east-facing slopes of Raspberry Mountain, and in several drainages immediately north and northwest of Raspberry Mountain, to the southeast of the community of Divide. Two small areas of suspected western spruce budworm defoliation also were mapped in Fremont County near Mullock Gulch. These areas are the farthest north that defoliation by western spruce budworm has been observed in Colorado for several years.

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White Pine Blister Rust (WPBR) (*Cronartium ribicola*) - Host trees: 5-needle pines - Limber, Rocky Mountain Bristlecone, Southwestern White, & Whitebark occurring in Colorado, South Dakota, and Wyoming

In **Colorado**, white pine blister rust was first detected in Colorado in 1998 on limber pines in Larimer County. In 2004, the disease was detected in the Wet Mountains and the Sangre de Cristo Range, where both limber and Colorado bristlecone pines were infected. More recently, localized infections have been found in Rocky Mountain National Park, near the community of Ward, and on the north slope of Pikes Peak. In 2012, a new area of white pine blister rust disease was detected in the Left-Hand-Canyon area of Boulder County.

Decline and mortality were occurring in limber pine populations on the Arapaho-Roosevelt, Pike-San Isabel, and Rio Grande National Forests. Bristlecone pines in the Great Sand Dunes National Park and Preserve (GSRA) were also infected and dying.

The combined impacts of WPBR and mountain pine beetle (MPB) remain a Forest Health concern about the health of limber and whitebark pine populations in northern Colorado and throughout Wyoming. Forest Health Protection (FHP) installed long term monitoring plots to evaluate pest trends and impacts of WPBR and other damaging agents in these five needle pine stands. The incidence of WPBR was less than 5% in the Northern Front Range based on a 2011 survey.

All infected branches identified within Rocky Mountain National Park and on the north slopes of Pikes Peak were pruned out and subsequent surveys in 2010 and 2011 identified no new infections within the Park. Little was known about the incidence of the disease on Pikes Peak since that area was not surveyed extensively. WPBR has never been reported in southwestern Colorado but extensive surveys were lacking and populations of white pines are scattered.

WPBR was discovered in **South Dakota** in the relic stands of limber pine in the Cathedral Spires area of Custer State Park in the 1990s and on limber pine near Harney Peak in the Black Hills National Forest in October 2011. WPBR cankers were present on branches and some stems of trees in these areas and some mortality occurred. Only a few of the approximately 200 trees had the disease girdle the trunk but there has been perhaps a dozen or more trees that had branches killed by the disease. The disease was pruned out of the trees. Verbenone pouches were used on the Harney Peak limber pine populations for MPB protection. (Fig. 8)

White pine blister rust continues to slowly spread and intensify in **Wyoming**. Decline and mortality were also occurring in the limber and whitebark pine populations on the Bighorn, Medicine Bow, and Shoshone National Forests and on BLM lands in central Wyoming (Ferris, Shirley, and Green Mountains, and the Rattlesnake Hills).

WPBR caused mortality on limber and whitebark pine trees and regeneration statewide and the disease continues to intensify and spread into previously uninfected stands.

The incidence of WPBR is lowest (<5%) in the Medicine Bow and Sierra Madres Ranges based on a 2011 survey. However, MPB impacts were significant throughout the state wherever white pines grow and the resource has not been depleted. MPB recently replaced WPBR as the leading cause of large-tree mortality.

There was no observed interaction between mountain pine beetle infestation and white pine blister rust in a recent study in the Bighorn National Forest. “White pine blister rust infections occurred in all areas sampled and levels were similar in all stands. White pine blister rust killed a small number of trees in uninfested stands, but tree mortality in the infested stands was dominated by mountain pine beetle. In a similar study that compared mountain pine beetle infested and uninfested whitebark pine, it was suggested that beetles prefer trees with more white pine blister rust infections when beetle populations are low, however, beetles prefer trees with little or no white pine blister rust when their populations are high (Schwandt and Kegley 2004). Earlier observations in some of these same limber pine stands indicated that beetle caused mortality may be related to white pine blister rust branch and stem canker severity and incidence. These results suggest the beetles have no such preference in limber pine, and will attack and kill limber with no white pine blister rust or with severe white pine blister rust infections (Blodgett et al. 2005). [Table of Contents](#)



Figure 8a & b. Verbenone pouches were placed on plot trees of Bristlecone and Limber pines to protect the trees from mountain pine beetle attack.

Other Damage Agents of Concern

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| A Ash/Lilac Borer (<i>Podosesia syringae</i>) | Green Ash South Dakota |
| <p>This phloem/wood-boring insect caused loss of green ash in windbreak and urban plantings, particularly among young trees. Tree mortality increased in 2012 probably due to an increase in host susceptibility because of the drought.</p> | |
| Asian Bush Honeysuckle (non-native) (<i>Lonicera maackii</i> , & <i>L. tarica</i>) | Invading many woodlands, forests, and nature preserves in Kansas |
| <p>These non-native honeysuckles cause decline in species diversity and richness of native ground cover and mid-story vegetation (Miller 2004; Batcher and Stiles 2005). The loss of the fine-rooted forbs in the ground cover often has prompted an increase in erosion in these wooded areas, which has negative impacts on downstream aquatic systems. Honeysuckle infestation can be ascribed, in part, to their adaptability to a wide variety of habitats and spread as a result of being a prolific producer of seeds (bush honeysuckles primarily) that are easily dispersed by birds. Japanese honeysuckle possesses rapid aboveground and belowground growth, is adapted to low-light environments, begins growth earlier and can continue growing later in the growing season than most other woodland species (Nuzzo 2005). Our urban woodlands around Wichita, Topeka, and the Kansas City metro area are now getting some much needed additional management to combat these invasive shrubs and vine. This project will need several seasons of control efforts in the prescribed high priority target areas controlled by county parks & recreation, Kansas Dept. of Wildlife, Parks & Tourism, and private stakeholders.</p> | |
| Aspen Defoliators | Aspen Colorado |
| <p>Approximately 29,000 acres of aspen defoliation were mapped in aerial surveys, as compared to 22,000 acres in 2011. Recent aspen defoliation occurred in the Sangre de Cristo and Culebra ranges; the San Juan and Wet mountains; and the West Elk Mountains. Localized areas of aspen defoliation occurred in Pitkin County on the west slopes of Mount Sopris and immediately south of the Aspen Highlands Ski Area, and in Saguache County near the historical mining town of Bonanza.</p> <p>Defoliation of aspen stands by western tent caterpillar (<i>Malacosoma californicum</i>) and large aspen tortrix (<i>Choristoneura conflictana</i>) increased significantly in southern Colorado in 2012. Western tent caterpillar is the more commonly occurring defoliating insect of Colorado's aspen forests. This insect also feeds on a wide range of low-growing woody plants, including mountain mahogany, wild currant, chokecherry and bitterbrush. Larvae emerge in spring and feed in colonies that construct tents of silken webbing. Defoliation from this insect continued in the North Fork Purgatory River Basin on the eastern slopes of the Culebra Range, and on the slopes of Cattle Mountain in the Park Creek drainage, south of the community of South Fork in the Rio Grande National Forest. Both of these areas have been defoliated for consecutive years.</p> <p>Large aspen tortrix is closely related to the western spruce budworm and has a similar life cycle. Mature larvae feed inside aspen leaves that have been rolled and tied with webbing. Aspen defoliation from this insect, first detected in 2011 above Lake San Isabel, expanded in 2012 to encompass aspen stands growing along the Saint Charles Mountain and Cisneros hiking trails on the San Isabel National Forest.</p> | |

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| Banded Elm Bark Beetle (<i>Scolytus schevyrewi</i>) | American and Siberian elms South Dakota |
| This bark beetle has been found in declining Siberian elms throughout the state. The infestations are particularly heavy in western South Dakota, beginning in Pierre and extending north in to Harding County and south to Fall River County. The beetle can also be found in declining Siberian elms in the eastern portion of the state but the populations do not appear as high. The insect has also been found in some declining American elms along streams and rivers in south-central South Dakota. | |
| C Cedar Bark Beetles (<i>Phloeosinus</i>) | Eastern redcedar, Rocky Mountain juniper South Dakota |
| These bark beetles were found in the branches and trunks of declining junipers in the central part of the state, most likely because the trees were stressed by the drought. | |
| Cottonwood Leaf Miner (<i>Zeugophora scutellaris</i>) | Narrowleaf cottonwood Colorado |
| Moderate to heavy discoloration of the foliage of narrowleaf cottonwood occurred in the lower portions of both the Big Thompson and Cache La Poudre canyons during 2012. The damage has been tentatively identified as being caused by a leaf mining beetle known as poplar black mine beetle (<i>Zeugophora scutellaris</i>), an introduced species native to Europe. Poplar black mine beetle is now known to occur over most of the eastern United States and as far west as Montana, Colorado and New Mexico. | |
| Cottonwood Leaf Skeletonizer (<i>Altica</i> sp.) | Narrowleaf cottonwood, alder, willow Colorado |
| Localized infestations of a leaf skeletonizer of narrowleaf cottonwood were observed in riparian areas in the Wet Mountains and upper San Luis Valley. Affected areas ranged in size from approximately one to five acres. Adults of this group of insects feed on species of not only cottonwood, but also alder and willow, and are commonly known as “flea beetles.” | |
| Cytospora Canker (<i>Cytospora</i> sp.) | Blue spruce, other spruces Nebraska |
| Cytospora canker of spruce has become more common in landscape plantings and windbreaks, probably because of the additional stress in the trees caused by this year’s drought and the multi-year drought that ended only a few years ago. Colorado blue spruce is the species most commonly affected. Branches and sometimes the tops of trees are killed by the disease. | |
| Diplodia Blight (<i>Diplodia</i> sp.) | Austrian & Ponderosa pines Nebraska |
| Diplodia blight continued to increase in Nebraska in both urban and rural landscapes. Damage was often seen in both Austrian and ponderosa pines. Stressed trees were more susceptible, such as those affected by drought or overcrowded stands. Some of the symptoms of Diplodia blight were similar to those of pine wilt, so care must be taken when identifying the disease. | |

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| Dutch Elm Disease (<i>Ophistoma ulmi</i>) | American elm South Dakota & Nebraska |
| <p>SD - The incidence of Dutch elm disease has dramatically increased in communities that still have American elms as a dominant street tree. The losses in 2012 were approximately three times the losses many communities experienced the previous year. Small communities had increased difficulties removing these infected trees in a timely manner; this probably was responsible for the continuing increase in tree losses to the disease.</p> | |
| <p>NE- Dutch elm disease continued to cause mortality in American elm throughout the state, particularly in riparian areas and communities. Vectors include the European elm bark beetle (<i>Scolytus multistriatus</i>), the native elm bark beetle (<i>Hylurgopinus rufipes</i>) and potentially a new exotic species, the banded elm bark beetle (<i>S. schevyrewi</i>).</p> | |
| E Emerald Ash Borer (<i>Agrilus planipennis</i>) | White, Green, & Blue ash trees Kansas & Nebraska |
| <p>Kansas Forest Service was involved in projects to survey and prepare Kansas's urban and rural forestland owners for the arrival of EAB. In 2012, Kansas enacted its EAB Quarantine for Wyandotte County. Information sessions with community leaders in Leavenworth, Wyandotte, and Johnson counties were held to guarantee our cities had the necessary information needed for their EAB Strategic Plans. State survey efforts were made during the late summer and early fall months to detect any new isolated populations. No new detections were found in non-quarantined counties. Visual surveys will continue in 2013 along with an increased deployment traps. Traps were placed at a greater frequency near the initial find, and at areas of high-risk like our heavily visited state campgrounds in the east, major travel corridors, and sawmills.</p> <p>Additional Pest Detector Trainings were offered around the state to increase our detection efforts and keep our citizens informed. Training sessions to municipality leaders were conducted in the tri-county region of Leavenworth, Wyandotte, and Johnson.</p> | |
| <p>Emerald ash borer remained at the top of the list for potential economic impact to Nebraska's forest resources. Recent inventory estimates placed the number of ash trees in the state at 44 million. Detection trapping and park/campground surveys were ongoing efforts. Citizen "Tree Pest Detectors" were trained in emerald ash borer identification and survey methods and assisted with survey efforts across the state. The insect has not been detected in the state.</p> | |
| Fall Cankerworm (<i>Alsophila pomataria</i>) | Gambel oak Colorado |
| <p>Defoliation of Gambel oak woodlands by inchworms occurred for the second successive year in Douglas County, south of Castle Rock. Larvae observed during May 2012 were characteristic of fall cankerworm (<i>Alsophila pomataria</i>). Several late-spring frosts occurred in the area infested by the cankerworms, however, which killed the newly formed foliage and destroyed a large portion of food available for the young caterpillars. This caused the populations to collapse in the area.</p> | |

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| Engraver Beetles - (<i>Scolytus ventrali</i> & <i>Ips</i> spp.) | White fir, Piñon, & Ponderosa pines Colorado & South Dakota |
| <p>Increased mortality levels in white fir occurred in Colorado forests in the Culebra Range, from La Veta Pass south to Cucharas; on the north facing slopes of the Spanish Peaks; and along the entire eastern slope of the Wet Mountains. The bark beetle responsible for the damage is the fir engraver beetle – a bark beetle that attacks and kills several species of true firs, increasing tree damage and mortality during periods of drought or low precipitation.</p> <p>Localized infestations of the piñon ips bark beetle (<i>Ips confusus</i>), first detected in piñon-juniper forests north of Cañon City in 2011, and erupted into an outbreak in 2012. Damage occurred from Colorado Springs south and west into the Arkansas River Basin. The heaviest damage occurred in the lower elevations of Phantom Canyon, north of Florence, and in the lower Four Mile Canyon north of Cañon City. Damage to piñon pine shoots, caused by twig beetles of the genus <i>Pityophthorus</i>, also was noted in several locations along the Arkansas River Valley west of Cañon City and in Phantom Canyon. A few small areas of piñon engraver beetle activity also occurred in piñon-juniper forests south of La Junta and in the southern portions of the Flat Tops Range on the Western Slope.</p> <p>Scattered tree mortality suggestive of ips engraver beetle attacks was detected in ponderosa pine stands in the Culebra Range near the New Mexico border, and east of the South Platte River between the Eleven Mile Reservoir Dam and Lake George. Top kill, characteristic of damage caused by pine engraver beetle (<i>Ips pini</i>) was seen in ponderosa pine in the vicinity of the Palmer Divide north of Colorado Springs.</p> <p>An outbreak of pine engraver was also occurring on the western side of Fort Carson adjacent to Colorado Route 115. The pine engraver outbreak developed during the summer of 2011 in stands of ponderosa pine that were injured by the TA25 wildfire in 2008. Control actions were initiated and pine engraver-infested trees were cut, piled, and burned during the winter of 2012 – 2013.</p> <p>Pine engraver beetle populations were very low during the past several years in South Dakota. However, they were beginning to increase dramatically and causing some ponderosa pine mortality in the southern and central Black Hills. Pine engraver beetles were typically found in dead and dying trees, as well as slash piles, but the populations were expanding and becoming a major cause of tree mortality. The population was increasing again perhaps due to the number of trees killed by the mountain pine beetle. The increase in chipping, as a means of treating pines infested with mountain pine beetle, attracted engraver beetles to these treated stands.</p> | |
| G Gypsy Moth (<i>Lymantria dispar</i>) | Colorado, Nebraska, & Wyoming |
| <p>Colorado - Fortunately, in 2012, 621 gypsy moth traps were deployed across the state, primarily in urban areas, but no gypsy moth adults were detected.</p> <p>Nebraska - Annual detection trapping for gypsy moth is conducted each year in the state. Traps were placed among potential hosts at state parks, rest areas and nurseries. No gypsy moths were found in traps in 2012.</p> <p>Wyoming - No invasive insects or diseases of national interest including European gypsy moth or Emerald ash borer were detected during 2012.</p> | |
| Juniper Blight <i>Cercospora sequoia</i> var. <i>juniperi</i> , <i>Kabatina juniper</i> , and <i>Phomopsis juniperovora</i> | Eastern redcedar & Rocky Mountain Juniper South Dakota |
| <p>These 3 diseases can be found on both the eastern redcedar and Rocky Mountain juniper. <i>Cercospora</i> was found in several eastern redcedar windbreaks in eastern South Dakota. <i>Kabatina</i> and <i>phomopsis</i> were detected in scattered windbreaks throughout the state. <i>Phomopsis</i> was also associated with tip dieback in a number of ornamental plantings of Chinese junipers in Sioux Falls, S.D. Table of Contents</p> | |

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| Oak Decline and Oak Wilt | Oak tree species Nebraska |
| <p>Several biological and environmental factors appear to be involved in a general decline of bur oak in northern and eastern areas of the state. Environmental factors include root disturbance and soil compaction from livestock or human activities, herbicide exposure, and long term effects of drought. These factors have stressed trees and made them more susceptible to pests such as cankers, borers and root decays (including <i>Armillaria</i>). Oak wilt and bur oak blight (<i>Tubakia</i> sp.) were also contributing to the decline in many cases.</p> | |
| P Pine Sawflies (<i>Neodiprion</i> sp.) | Ponderosa pine South Dakota |
| <p>There were several small pockets of sawfly defoliation in ponderosa pine stands across the southern Black Hills, though less than had been experienced during the past few years.</p> | |
| Pinewood Nematode (<i>Bursaphelenchus xylophilus</i> & Pine Sawyer Beetles (<i>Monochamus</i> spp.) | Austrian, Mugo, Scots (Scotch), & white pines Kansas, Nebraska, South Dakota |
| <p>In 2011, eleven counties in western Kansas had detections of pine wilt. In 2012, we have not seen this disease move to any other counties. Pine wilt, caused by a plant parasitic nematode called the pine wood nematode, is vectored by a long-horned borer, called a pine sawyer beetle. These beetles and the nematodes <i>Monochamus</i>, kill pine trees by feeding and reproducing in the resin canals of the branch and trunk. This disease may continue to spread westward. Since most pines were planted in the state, the windbreaks and conservation plantings were often damaged.</p> | |
| <p>Pine wilt, caused by the pinewood nematode, a pathogen that is native to most of North America. Recent research suggests that a bacterium carried by the nematode may also play a significant role in the disease. Pine wilt killed thousands of Scotch pines in Nebraska annually since the late 1990s. The disease occurred in scattered locations throughout much of the state, but was prevalent in the east and south-central areas. The Nebraska Forest Service no longer recommends using Scotch pine in long-term plantings in the southeast portion of the state.</p> | |
| <p>Scotch and Austrian pines in the southern part of South Dakota, south of I-90, from Lake Andes to Hot Springs were dying from pine wilt. Sampling of pines that expressed symptoms associated with the disease have also contained populations of the pinewood nematode. The number of trees found infected with this disease increased dramatically during the past year, perhaps related to the continued drought and a mild winter.</p> | |
| Poplar Cankers (<i>Dothichiza populea</i> , <i>Cytospora chrysosperma</i> , & <i>Phomopsis macrospora</i>) | Cottonwoods & Lombardy poplars South Dakota |
| <p>These pathogens were common in declining cottonwoods, hybrid poplars, and Lombardy poplars throughout the state. The incidence of these diseases appeared to be increasing and was most likely due to the weakened condition of the host trees from the drought.</p> | |
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| Piñon Needle Scale (<i>Matsucoccus acalyptus</i>) | Piñon pine Colorado |
| Piñon needle scale is a tiny parasitic insect that feeds on the needles of piñon pine. Infestations occurred on older needles, which turn brown and drop from the trees. Heavier infestations gave the crowns of affected trees a thin, tufted appearance, because only the needles from the most recent year's growth remained on the trees. Repeated infestations weakened and even killed trees. In 2012, piñon needle scale infestations appeared in several areas in Colorado, including the Keiber Creek Basin in the upper San Luis Valley, and in the southern portion of the Sangre de Cristo Range north of Mount Maestas. | |
| Red Turpentine Beetle (<i>Dendroctonus valens</i>) | Ponderosa pine South Dakota |
| Populations of red turpentine beetle appeared to increase recently. Infested trees were identified most often by doing intensive inspections for mountain pine beetle. Increased treatments of chipping trees killed by mountain pine beetle, also attracted turpentine beetles. | |
| S Sawyer Beetles (<i>Monochamus spp.</i>) | Ponderosa pine South Dakota |
| Sawyer beetle populations increased in recently in mountain pine beetle infested trees. Previously, the sawyer beetles were not typically found in mountain pine beetle attacked trees until the following spring. Now it was common to find sawyer beetle larvae in "green" infested trees, soon after the pines were colonized by mountain pine beetle. | |
| Siberian Elm Canker (<i>Botryodiplodia hypodermia</i>) | Siberian elm South Dakota |
| This disease was a common secondary stressor of Siberian elms throughout the state. The additional stresses of drought and the banded elm bark beetle resulted in widespread mortality of this species throughout the state | |
| Subalpine Fir Decline (<i>Dryocoetes confuses</i>) occasionally <i>Armillaria spp.</i> or <i>Heterobasidium spp.</i> root disease | Subalpine fir Colorado |
| High-elevation subalpine fir forests were subject to infection by two species of root disease fungi, <i>Armillaria spp.</i> and <i>Heterobasidium parviporum</i> , which weaken trees and make them susceptible to attack by western balsam bark beetles (<i>Dryocoetes confusus</i>). Chronic levels of tree damage from this complex have been underway in Colorado for a number of years. In 2012, damage was especially prevalent in portions of the West Elk Mountains between McClure Pass and Independence Pass. | |
| Mortality of subalpine fir also continued at moderate levels from Guanella Pass south to Trout Creek Pass (Park County). A total area of 221,000 acres of dead and dying subalpine fir were mapped in 2012 – a slight increase from the 180,000 acres mapped in 2011. | |
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| I Thousand Cankers Disease (<i>Geosmithia morbida</i> & <i>Pityophthorous juglandis</i>) | Black walnut Colorado, Kansas, and Nebraska |
| <p>Thousand cankers disease, a disease of black walnut trees, caused significant mortality of ornamental black walnuts in many of Colorado's urban forests. In 2012, tree mortality from thousand cankers disease intensified in several areas where it was recently discovered, including Fort Collins/Laporte and Pueblo. The occurrence of thousand cankers disease was also confirmed for the first time in Loveland and Greeley.</p> | |
| <p>This newly discovered disease of black walnut has not been detected in Kansas. However Colorado has infestations of this disease. Street-side and ground surveys of black walnut were conducted across the state. Lindgren traps with lures were set up and monitored by Kansas Dept. of Agriculture at key locations statewide. TCD trainings occurred quarterly during the year to arborists, municipalities, and citizens. This should greatly increase the detection network and provide further outreach efforts.</p> | |
| <p>In 2012, street-side surveys of black walnut disease symptoms and trapping surveys for walnut twig beetle were conducted across the state. No evidence of the disease or twig beetle was found. In addition, 120 citizen volunteers were trained in the past three years to survey for thousand cankers disease. These "Tree Pest Detectors" have greatly increased detection efforts across the state. A quarantine of walnut wood from infested states was in effect to prevent the movement of this disease and its vector into Nebraska.</p> | |
| Winter Desiccation/Drying | Birches & Maples South Dakota |
| <p>The drought conditions last autumn and the warm, dry winter resulted in desiccation injury to birches and maples throughout the eastern half of the state. It is a common sight to see young (5 to 20 year old) birches and maples that had dieback to the upper half of the canopies. Some of these trees only experienced bud injury and recovered during the summer but the majority did not recover and most tree owners have removed the trees.</p> | |
| Zimmerman Pine Moth - (<i>Dioryctria</i>) | Austrian, Scotch, & Ponderosa pine Nebraska & South Dakota |
| <p>Three species of <i>Dioryctria</i> (Zimmerman) pine moth continued to cause branch and tree mortality in Nebraska. Symptoms included masses of pitch (resin) that form on the bark where the insects were inside tunneling. The insects were present in western and central Nebraska, as well as in the Lincoln and Omaha areas. Ponderosa, Austrian and Scotch pines were commonly attacked, and young trees generally sustained more damage than mature trees.</p> | |
| <p>Zimmerman pine moth continued to be a problem in windbreaks and ornamental plantings across South Dakota. Austrian pine was the primary species affected, though ponderosa pine windbreaks were also experiencing significant branch injury. The injury was also being confused with mountain pine beetle attacks on some of the infested trees in the Rapid City area.</p> <p>Table of Contents</p> | |

The 2012 Aerial Detection Survey Summary for the Rocky Mountain Region (R2) of the US Forest Service



Mountain pine beetle in Larimer county, CO. 2012. Photo credit: Justin Backsen

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Introduction

Acreage figures are rounded as follows:

X < 10 acres- to the nearest acre
10 < X < 1,000 acres- to the nearest 10 acres
1,000 < X < 10,000 acres- to the nearest 100 acres
X > 10,000 acres- to the nearest 1,000 acres

These tables provide summaries for the major damage agents detected in the 2012 aerial detection survey for the Rocky Mountain Region (R2) of the Forest Service.

Counties or National Forests that have zero mapped acres for all categories in the tables are omitted.

Wyoming acres include only acres within the R2 portion of Wyoming. The acres for Fremont, Park, Sublette, Teton counties include only the portion of the county which falls in R2.

CO plus S.WY numbers include all of Colorado and the six Wyoming counties that encompass the Medicine Bow NF: Albany, Carbon, Converse, Laramie, Natrona, and Platte.

Certain calculations using these data should be avoided. Adding numbers from different categories in an attempt to produce a total of acres impacted by multiple agents, for example will produce inaccurate, inflated results because acres experiencing multiple damages are double-counted. Producing totals for multiple agents is a separate GIS exercise.

Caution should be exercised when making year to year comparisons using these data, the survey area is not identical from year to year and extent flown each year may not equal 100 % of the forested acres in a given area. A GIS dataset of area flown is available and provides information on the spatial extent of the aerial survey for a particular year.

The county summaries include all ownerships within the county boundary. National Forest summaries are based on the Forest's proclamation boundary and include inholdings of all ownership types.

Interpreting the 2012 Aerial Detection Survey Summary Tables

The 2012 aerial detection survey summary tables for the Rocky Mountain Region of the USDA Forest Service have been prepared to answer the majority of questions concerning the aerial survey data and to provide consistent answers to questions from our clients. Raw GIS files are available for analysis; however minor differences in query structure can result in multiple “correct” answers to the same question. Therefore the numbers provided in these tables are to be considered final. The numbers reported here are the results of GIS queries that remain consistent from year to year. In these tables, the major forest pests that were detected in the region’s forests are summarized by state, county, and national forest. County totals include all ownerships within a counties’ boundary. Forest totals include all acres within the forest’s proclamation boundary.

For bark beetles including mountain pine beetle, spruce beetle and Douglas-fir beetle the aerial survey tables provide the number of acres where some level of trees were detected that were currently dying (fading) from bark beetle attack. Fading occurs one year after initial attack so trees mapped in a given year were killed by bark beetles the previous year. Information from the prior year (2011 Acres Affected) is also provided to assess the trend of the epidemic over the last year in a given area. Because bark beetles may be active in an area for multiple years there is considerable overlap of acres from year to year. Cumulative acres affected since 1996 through the current and through the prior year are provided to determine the area affected by the ongoing epidemic. By subtracting the current cumulative acres (1996-2012 Cumulative Acres Affected) for a given area from the prior year’s cumulative acres (1996-2011 Cumulative Acres Affected) for that area, the expansion of the beetle epidemic onto new (not previously mapped) acres can be determined. .

For western balsam bark beetle and associated subalpine fir disease problems, western spruce budworm, aspen defoliation, and aspen dieback and mortality caused by a combination of insects and diseases only the current and prior years acres detected are provided. For these pests, general trend information about the population of the insect or disease affects can be determined by comparing acres affected with the prior year.

There are several small updates to the prior year’s numbers (2011) in the table due to the results of ground checking conducted after the release of the 2012 tables.

2012 Mountain Pine Beetle Activity

| State | 2011 Acres Affected | 2012 Acres Affected | 1996-2011 Cumulative Acres Affected | 1996-2012 Cumulative Acres Affected |
|----------------------|---------------------|---------------------|-------------------------------------|-------------------------------------|
| Colorado | | | | |
| Lodgepole Pine | 523,000 | 118,000 | 2,594,000 | 2,605,000 |
| Ponderosa Pine | 275,000 | 170,000 | 898,000 | 950,000 |
| 5-Needle Pines | 7,100 | 2,300 | 121,000 | 122,000 |
| All Hosts | 752,000 | 264,000 | 3,328,000 | 3,359,000 |
| Wyoming – R2 | | | | |
| Lodgepole Pine | 446,000 | 66,000 | 1,086,000 | 1,113,000 |
| Ponderosa Pine | 55,000 | 13,000 | 181,000 | 186,000 |
| 5-Needle Pines | 141,000 | 79,000 | 928,000 | 964,000 |
| All Hosts | 582,000 | 129,000 | 1,923,000 | 1,976,000 |
| CO plus S. WY | | | | |
| Lodgepole Pine | 844,000 | 134,000 | 3,306,000 | 3,324,000 |
| Ponderosa Pine | 329,000 | 182,000 | 1,004,000 | 1,061,000 |
| 5-Needle Pines | 19,000 | 27,000 | 246,000 | 267,000 |
| All Hosts | 1,130,000 | 314,000 | 4,207,000 | 4,265,000 |
| South Dakota | | | | |
| Lodgepole Pine | 0 | 0 | 0 | 0 |
| Ponderosa Pine | 66,000 | 30,000 | 389,000 | 400,000 |
| 5-Needle Pines | 0 | 0 | 0 | 0 |
| All Hosts | 66,000 | 30,000 | 389,000 | 400,000 |
| Nebraska | | | | |
| Ponderosa Pine | 300 | 9 | 310 | 310 |
| 5-Needle Pines | 0 | 0 | 1 | 1 |
| All Hosts | 300 | 9 | 310 | 320 |

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| Colorado County | Host Tree | 2011 Acres Affected | 2012 Acres Affected | 1996-2011 Cumulative Acres Affected | 1996-2012 Cumulative Acres Affected |
|-----------------|----------------|---------------------|---------------------|-------------------------------------|-------------------------------------|
| Adams | Lodgepole Pine | 0 | 0 | 0 | 0 |
| | Ponderosa Pine | 0 | 0 | 1 | 1 |
| | 5-Needle Pines | 0 | 0 | 0 | 0 |
| | All Hosts | 0 | 0 | 1 | 1 |
| Alamosa | Lodgepole Pine | 0 | 0 | 0 | 0 |
| | Ponderosa Pine | 0 | 0 | 430 | 430 |
| | 5-Needle Pines | 0 | 0 | 10 | 10 |
| | All Hosts | 0 | 0 | 430 | 430 |
| Archuleta | Lodgepole Pine | 2 | 0 | 3 | 3 |
| | Ponderosa Pine | 0 | 0 | 16,000 | 16,000 |
| | 5-Needle Pines | 0 | 0 | 0 | 0 |
| | All Hosts | 2 | 0 | 16,000 | 16,000 |
| Boulder | Lodgepole Pine | 44,000 | 5,700 | 110,000 | 110,000 |
| | Ponderosa Pine | 18,000 | 5,100 | 67,000 | 69,000 |
| | 5-Needle Pines | 1,200 | 160 | 16,000 | 16,000 |
| | All Hosts | 56,000 | 9,500 | 139,000 | 140,000 |
| Chaffee | Lodgepole Pine | 300 | 2 | 5,600 | 5,600 |
| | Ponderosa Pine | 90 | 20 | 77,000 | 77,000 |
| | 5-Needle Pines | 0 | 0 | 1,700 | 1,700 |
| | All Hosts | 390 | 20 | 83,000 | 83,000 |
| Clear Creek | Lodgepole Pine | 15,000 | 440 | 76,000 | 76,000 |
| | Ponderosa Pine | 400 | 8 | 8,900 | 8,900 |
| | 5-Needle Pines | 430 | 30 | 9,400 | 9,400 |
| | All Hosts | 15,000 | 480 | 82,000 | 82,000 |
| Conejos | Lodgepole Pine | 0 | 0 | 0 | 0 |
| | Ponderosa Pine | 0 | 0 | 4,800 | 4,800 |
| | 5-Needle Pines | 0 | 0 | 0 | 0 |
| | All Hosts | 0 | 0 | 4,800 | 4,800 |

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| Colorado County | Host Tree | 2011 Acres Affected | 2012 Acres Affected | 1996-2011 Cumulative Acres Affected | 1996-2012 Cumulative Acres Affected |
|-----------------|----------------|---------------------|---------------------|-------------------------------------|-------------------------------------|
| Costilla | Lodgepole Pine | 0 | 0 | 0 | 0 |
| | Ponderosa Pine | 6 | 0 | 4,600 | 4,600 |
| | 5-Needle Pines | 0 | 0 | 7 | 7 |
| | All Hosts | 6 | 0 | 4,600 | 4,600 |
| Custer | Lodgepole Pine | 0 | 0 | 160 | 160 |
| | Ponderosa Pine | 20 | 0 | 35,000 | 35,000 |
| | 5-Needle Pines | 0 | 5 | 850 | 860 |
| | All Hosts | 20 | 5 | 35,000 | 35,000 |
| Delta | Lodgepole Pine | 0 | 0 | 2 | 2 |
| | Ponderosa Pine | 0 | 0 | 6 | 6 |
| | 5-Needle Pines | 0 | 0 | 0 | 0 |
| | All Hosts | 0 | 0 | 8 | 8 |
| Dolores | Lodgepole Pine | 0 | 330 | 0 | 330 |
| | Ponderosa Pine | 1 | 120 | 550 | 680 |
| | 5-Needle Pines | 0 | 0 | 0 | 0 |
| | All Hosts | 1 | 450 | 550 | 1,000 |
| Douglas | Lodgepole Pine | 0 | 0 | 270 | 270 |
| | Ponderosa Pine | 410 | 100 | 34,000 | 34,000 |
| | 5-Needle Pines | 0 | 0 | 0 | 0 |
| | All Hosts | 410 | 100 | 34,000 | 34,000 |
| Eagle | Lodgepole Pine | 27,000 | 11,000 | 187,000 | 189,000 |
| | Ponderosa Pine | 0 | 10 | 4,600 | 4,600 |
| | 5-Needle Pines | 0 | 0 | 190 | 190 |
| | All Hosts | 27,000 | 11,000 | 191,000 | 193,000 |
| El Paso | Lodgepole Pine | 0 | 0 | 2 | 2 |
| | Ponderosa Pine | 3 | 10 | 13,000 | 13,000 |
| | 5-Needle Pines | 0 | 0 | 0 | 0 |
| | All Hosts | 3 | 10 | 13,000 | 13,000 |

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| Colorado County | Host Tree | 2011 Acres Affected | 2012 Acres Affected | 1996-2011 Cumulative Acres Affected | 1996-2012 Cumulative Acres Affected |
|-----------------|----------------|---------------------|---------------------|-------------------------------------|-------------------------------------|
| Elbert | Lodgepole Pine | 0 | 0 | 0 | 0 |
| | Ponderosa Pine | 40 | 1 | 430 | 430 |
| | 5-Needle Pines | 0 | 0 | 0 | 0 |
| | All Hosts | 40 | 1 | 430 | 430 |
| Fremont | Lodgepole Pine | 0 | 0 | 170 | 170 |
| | Ponderosa Pine | 40 | 5 | 32,000 | 32,000 |
| | 5-Needle Pines | 20 | 70 | 1,900 | 2,000 |
| | All Hosts | 60 | 70 | 34,000 | 34,000 |
| Garfield | Lodgepole Pine | 1,800 | 1,100 | 10,000 | 11,000 |
| | Ponderosa Pine | 1 | 0 | 60 | 60 |
| | 5-Needle Pines | 0 | 30 | 480 | 510 |
| | All Hosts | 1,800 | 1,100 | 11,000 | 11,000 |
| Gilpin | Lodgepole Pine | 13,000 | 210 | 52,000 | 52,000 |
| | Ponderosa Pine | 50 | 7 | 10,000 | 10,000 |
| | 5-Needle Pines | 1,000 | 30 | 16,000 | 16,000 |
| | All Hosts | 13,000 | 250 | 56,000 | 56,000 |
| Grand | Lodgepole Pine | 1,300 | 490 | 579,000 | 579,000 |
| | Ponderosa Pine | 0 | 0 | 500 | 500 |
| | 5-Needle Pines | 0 | 0 | 3,700 | 3,700 |
| | All Hosts | 1,300 | 490 | 581,000 | 581,000 |
| Gunnison | Lodgepole Pine | 0 | 0 | 2,800 | 2,800 |
| | Ponderosa Pine | 30 | 0 | 1,400 | 1,400 |
| | 5-Needle Pines | 1 | 1 | 1 | 2 |
| | All Hosts | 30 | 1 | 4,200 | 4,200 |
| Hinsdale | Lodgepole Pine | 0 | 0 | 3 | 3 |
| | Ponderosa Pine | 0 | 0 | 3,200 | 3,200 |
| | 5-Needle Pines | 0 | 0 | 0 | 0 |
| | All Hosts | 0 | 0 | 3,200 | 3,200 |

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| Colorado County | Host Tree | 2011 Acres Affected | 2012 Acres Affected | 1996-2011 Cumulative Acres Affected | 1996-2012 Cumulative Acres Affected |
|-----------------|----------------|---------------------|---------------------|-------------------------------------|-------------------------------------|
| Huerfano | Lodgepole Pine | 0 | 0 | 50 | 50 |
| | Ponderosa Pine | 0 | 0 | 26,000 | 26,000 |
| | 5-Needle Pines | 0 | 0 | 220 | 220 |
| | All Hosts | 0 | 0 | 26,000 | 26,000 |
| Jackson | Lodgepole Pine | 11,000 | 540 | 362,000 | 362,000 |
| | Ponderosa Pine | 20 | 0 | 1,200 | 1,200 |
| | 5-Needle Pines | 9 | 0 | 13,000 | 13,000 |
| | All Hosts | 11,000 | 540 | 364,000 | 364,000 |
| Jefferson | Lodgepole Pine | 2,900 | 30 | 7,700 | 7,800 |
| | Ponderosa Pine | 830 | 30 | 29,000 | 29,000 |
| | 5-Needle Pines | 0 | 0 | 300 | 300 |
| | All Hosts | 3,700 | 50 | 35,000 | 35,000 |
| La Plata | Lodgepole Pine | 0 | 0 | 0 | 0 |
| | Ponderosa Pine | 0 | 0 | 12,000 | 12,000 |
| | 5-Needle Pines | 0 | 0 | 0 | 0 |
| | All Hosts | 0 | 0 | 12,000 | 12,000 |
| Lake | Lodgepole Pine | 170 | 3 | 11,000 | 11,000 |
| | Ponderosa Pine | 0 | 0 | 320 | 320 |
| | 5-Needle Pines | 0 | 5 | 560 | 570 |
| | All Hosts | 170 | 8 | 11,000 | 11,000 |
| Larimer | Lodgepole Pine | 373,000 | 90,000 | 576,000 | 580,000 |
| | Ponderosa Pine | 254,000 | 164,000 | 327,000 | 377,000 |
| | 5-Needle Pines | 4,400 | 2,000 | 54,000 | 56,000 |
| | All Hosts | 587,000 | 232,000 | 783,000 | 807,000 |
| Las Animas | Lodgepole Pine | 0 | 0 | 10 | 10 |
| | Ponderosa Pine | 0 | 0 | 12,000 | 12,000 |
| | 5-Needle Pines | 0 | 0 | 6 | 6 |
| | All Hosts | 0 | 0 | 12,000 | 12,000 |

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|-----------------|----------------|---------------------|---------------------|-------------------------------------|-------------------------------------|
| Mesa | Lodgepole Pine | 0 | 0 | 0 | 0 |
| | Ponderosa Pine | 90 | 50 | 5,600 | 5,700 |
| | 5-Needle Pines | 0 | 0 | 0 | 0 |
| | All Hosts | 90 | 50 | 5,600 | 5,700 |
| Mineral | Lodgepole Pine | 0 | 0 | 0 | 0 |
| | Ponderosa Pine | 0 | 0 | 840 | 840 |
| | 5-Needle Pines | 0 | 0 | 3 | 3 |
| | All Hosts | 0 | 0 | 840 | 840 |
| Moffat | Lodgepole Pine | 0 | 4 | 16,000 | 16,000 |
| | Ponderosa Pine | 0 | 0 | 440 | 440 |
| | 5-Needle Pines | 0 | 0 | 100 | 100 |
| | All Hosts | 0 | 4 | 16,000 | 16,000 |
| Montezuma | Lodgepole Pine | 0 | 0 | 0 | 0 |
| | Ponderosa Pine | 0 | 0 | 690 | 690 |
| | 5-Needle Pines | 0 | 0 | 0 | 0 |
| | All Hosts | 0 | 0 | 690 | 690 |
| Montrose | Lodgepole Pine | 0 | 0 | 0 | 0 |
| | Ponderosa Pine | 170 | 130 | 2,500 | 2,600 |
| | 5-Needle Pines | 0 | 0 | 0 | 0 |
| | All Hosts | 170 | 130 | 2,500 | 2,600 |
| Ouray | Lodgepole Pine | 0 | 0 | 5 | 5 |
| | Ponderosa Pine | 6 | 50 | 260 | 290 |
| | 5-Needle Pines | 0 | 0 | 0 | 0 |
| | All Hosts | 6 | 50 | 260 | 300 |
| Park | Lodgepole Pine | 2,100 | 220 | 47,000 | 47,000 |
| | Ponderosa Pine | 160 | 40 | 90,000 | 90,000 |
| | 5-Needle Pines | 20 | 5 | 410 | 410 |
| | All Hosts | 2,200 | 260 | 137,000 | 137,000 |

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| Colorado County | Host Tree | 2011 Acres Affected | 2012 Acres Affected | 1996-2011 Cumulative Acres Affected | 1996-2012 Cumulative Acres Affected |
|-----------------|----------------|---------------------|---------------------|-------------------------------------|-------------------------------------|
| Pitkin | Lodgepole Pine | 3,100 | 200 | 22,000 | 22,000 |
| | Ponderosa Pine | 0 | 0 | 90 | 90 |
| | 5-Needle Pines | 0 | 0 | 4 | 4 |
| | All Hosts | 3,100 | 200 | 22,000 | 22,000 |
| Pueblo | Lodgepole Pine | 0 | 0 | 0 | 0 |
| | Ponderosa Pine | 0 | 0 | 21,000 | 21,000 |
| | 5-Needle Pines | 0 | 0 | 0 | 0 |
| | All Hosts | 0 | 0 | 21,000 | 21,000 |
| Rio Blanco | Lodgepole Pine | 12,000 | 7,200 | 42,000 | 44,000 |
| | Ponderosa Pine | 0 | 0 | 40 | 40 |
| | 5-Needle Pines | 0 | 0 | 100 | 100 |
| | All Hosts | 12,000 | 7,200 | 42,000 | 44,000 |
| Rio Grande | Lodgepole Pine | 0 | 0 | 0 | 0 |
| | Ponderosa Pine | 0 | 0 | 3,400 | 3,400 |
| | 5-Needle Pines | 0 | 0 | 0 | 0 |
| | All Hosts | 0 | 0 | 3,400 | 3,400 |
| Routt | Lodgepole Pine | 13,000 | 430 | 345,000 | 345,000 |
| | Ponderosa Pine | 30 | 0 | 390 | 390 |
| | 5-Needle Pines | 0 | 0 | 540 | 540 |
| | All Hosts | 13,000 | 430 | 345,000 | 345,000 |
| Saguache | Lodgepole Pine | 0 | 0 | 790 | 790 |
| | Ponderosa Pine | 0 | 0 | 39,000 | 39,000 |
| | 5-Needle Pines | 7 | 10 | 340 | 350 |
| | All Hosts | 7 | 10 | 40,000 | 40,000 |
| San Miguel | Lodgepole Pine | 0 | 0 | 10 | 10 |
| | Ponderosa Pine | 10 | 120 | 2,900 | 3,000 |
| | 5-Needle Pines | 0 | 0 | 10 | 10 |
| | All Hosts | 10 | 120 | 3,000 | 3,100 |

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|-----------------|----------------|---------------------|---------------------|-------------------------------------|-------------------------------------|
| Summit | Lodgepole Pine | 4,000 | 370 | 142,000 | 142,000 |
| | Ponderosa Pine | 0 | 0 | 40 | 40 |
| | 5-Needle Pines | 40 | 2 | 630 | 630 |
| | All Hosts | 4,000 | 370 | 143,000 | 143,000 |
| Teller | Lodgepole Pine | 0 | 0 | 10 | 10 |
| | Ponderosa Pine | 60 | 40 | 9,700 | 9,800 |
| | 5-Needle Pines | 0 | 0 | 20 | 20 |
| | All Hosts | 60 | 40 | 9,800 | 9,800 |

| Nebraska County | Host Tree | 2011 Acres Affected | 2012 Acres Affected | 1996-2011 Cumulative Acres Affected | 1996-2012 Cumulative Acres Affected |
|-----------------|----------------|---------------------|---------------------|-------------------------------------|-------------------------------------|
| Banner | Ponderosa Pine | 150 | 3 | 150 | 150 |
| Dawes | Ponderosa Pine | 20 | 0 | 20 | 20 |
| Morrill | Ponderosa Pine | 4 | 0 | 4 | 4 |
| Scotts Bluff | Ponderosa Pine | 110 | 5 | 110 | 110 |
| Sheridan | Ponderosa Pine | 20 | 0 | 20 | 20 |
| | 5-Needle | 0 | 0 | 1 | 1 |
| | All Hosts | 20 | 0 | 20 | 20 |

| South Dakota County | Host Tree | 2011 Acres Affected | 2012 Acres Affected | 1996-2011 Cumulative Acres Affected | 1996-2012 Cumulative Acres Affected |
|---------------------|----------------|---------------------|---------------------|-------------------------------------|-------------------------------------|
| Butte | Ponderosa Pine | 0 | 0 | 120 | 120 |
| Custer | Ponderosa Pine | 4,300 | 3,400 | 44,000 | 46,000 |
| Fall River | Ponderosa Pine | 0 | 0 | 1,400 | 1,400 |
| Lawrence | Ponderosa Pine | 20,000 | 11,000 | 141,000 | 145,000 |
| Meade | Ponderosa Pine | 70 | 140 | 26,000 | 26,000 |
| Pennington | Ponderosa Pine | 42,000 | 16,000 | 176,000 | 181,000 |

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|----------------|----------------|---------------------|---------------------|-------------------------------------|-------------------------------------|
| Albany | Lodgepole Pine | 161,000 | 5,600 | 211,000 | 212,000 |
| | Ponderosa Pine | 37,000 | 6,900 | 67,000 | 69,000 |
| | 5-Needle Pines | 9,600 | 830 | 56,000 | 57,000 |
| | All Hosts | 201,000 | 12,000 | 292,000 | 295,000 |
| Big Horn | Lodgepole Pine | 20 | 4 | 1,500 | 1,500 |
| | Ponderosa Pine | 0 | 0 | 1,200 | 1,200 |
| | 5-Needle Pines | 10 | 0 | 21,000 | 21,000 |
| | All Hosts | 30 | 4 | 24,000 | 24,000 |
| Campbell | Lodgepole Pine | 0 | 0 | 0 | 0 |
| | Ponderosa Pine | 0 | 8 | 180 | 180 |
| | 5-Needle Pines | 0 | 0 | 0 | 0 |
| | All Hosts | 0 | 8 | 180 | 180 |
| Carbon | Lodgepole Pine | 157,000 | 8,700 | 490,000 | 495,000 |
| | Ponderosa Pine | 3,900 | 650 | 13,000 | 14,000 |
| | 5-Needle Pines | 1,300 | 12,000 | 29,000 | 39,000 |
| | All Hosts | 160,000 | 21,000 | 514,000 | 527,000 |
| Converse | Lodgepole Pine | 2,800 | 1,100 | 7,600 | 8,200 |
| | Ponderosa Pine | 900 | 400 | 5,100 | 5,400 |
| | 5-Needle Pines | 40 | 80 | 4,700 | 4,800 |
| | All Hosts | 3,800 | 1,400 | 16,000 | 17,000 |
| Crook | Lodgepole Pine | 0 | 0 | 0 | 0 |
| | Ponderosa Pine | 1,300 | 610 | 32,000 | 32,000 |
| | 5-Needle Pines | 0 | 0 | 0 | 0 |
| | All Hosts | 1,300 | 610 | 32,000 | 32,000 |
| Fremont | Lodgepole Pine | 110,000 | 37,000 | 257,000 | 268,000 |
| | Ponderosa Pine | 2 | 10 | 1,400 | 1,400 |
| | 5-Needle Pines | 112,000 | 46,000 | 356,000 | 368,000 |
| | All Hosts | 173,000 | 58,000 | 461,000 | 475,000 |
| Goshen | Lodgepole Pine | 0 | 0 | 10 | 10 |
| | Ponderosa Pine | 20 | 4 | 70 | 80 |
| | 5-Needle Pines | 0 | 0 | 0 | 0 |
| | All Hosts | 20 | 4 | 80 | 90 |

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|----------------|----------------|---------------------|---------------------|-------------------------------------|-------------------------------------|
| Hot Springs | Lodgepole Pine | 2,300 | 3,600 | 6,800 | 9,600 |
| | Ponderosa Pine | 0 | 0 | 860 | 860 |
| | 5-Needle Pines | 2,000 | 1,300 | 42,000 | 43,000 |
| | All Hosts | 4,300 | 4,700 | 46,000 | 49,000 |
| Johnson | Lodgepole Pine | 20 | 0 | 3,600 | 3,600 |
| | Ponderosa Pine | 60 | 50 | 22,000 | 22,000 |
| | 5-Needle Pines | 30 | 7 | 35,000 | 35,000 |
| | All Hosts | 110 | 60 | 59,000 | 59,000 |
| Laramie | Lodgepole Pine | 0 | 0 | 20 | 20 |
| | Ponderosa Pine | 10,000 | 3,200 | 14,000 | 14,000 |
| | 5-Needle Pines | 550 | 40 | 1,000 | 1,100 |
| | All Hosts | 11,000 | 3,200 | 14,000 | 14,000 |
| Natrona | Lodgepole Pine | 290 | 70 | 3,600 | 3,600 |
| | Ponderosa Pine | 110 | 150 | 5,000 | 5,100 |
| | 5-Needle Pines | 200 | 11,000 | 34,000 | 43,000 |
| | All Hosts | 600 | 11,000 | 40,000 | 49,000 |
| Niobrara | Lodgepole Pine | 0 | 0 | 0 | 0 |
| | Ponderosa Pine | 10 | 50 | 110 | 160 |
| | 5-Needle Pines | 0 | 0 | 0 | 0 |
| | All Hosts | 10 | 50 | 110 | 160 |
| Park | Lodgepole Pine | 13,000 | 7,600 | 99,000 | 103,000 |
| | Ponderosa Pine | 0 | 0 | 40 | 40 |
| | 5-Needle Pines | 14,000 | 5,700 | 310,000 | 313,000 |
| | All Hosts | 24,000 | 12,000 | 364,000 | 369,000 |
| Platte | Lodgepole Pine | 30 | 30 | 30 | 70 |
| | Ponderosa Pine | 1,700 | 570 | 2,400 | 2,900 |
| | 5-Needle Pines | 3 | 340 | 130 | 460 |
| | All Hosts | 1,700 | 600 | 2,500 | 3,000 |

Due to the nature of aerial surveys, this data 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 in the data because these agents are not detectable from aerial surveys. The data presented should only be used as a partial indicator of insect and disease activity, and should be validated on the ground for actual location and causal agent. The insect and disease data is available digitally from the USDA Forest Service, Region Two Forest Health Management group. The cooperators reserve the right to correct, update, modify or replace GIS products. Using this data for purposes other than those for which it was intended may yield inaccurate or misleading results.

| Wyoming County | Host Tree | 2011 Acres Affected | 2012 Acres Affected | 1996-2011 Cumulative Acres Affected | 1996-2012 Cumulative Acres Affected |
|----------------|----------------|---------------------|---------------------|-------------------------------------|-------------------------------------|
| Sheridan | Lodgepole Pine | 0 | 0 | 2,100 | 2,100 |
| | Ponderosa Pine | 260 | 370 | 6,700 | 6,800 |
| | 5-Needle Pines | 10 | 9 | 2,600 | 2,600 |
| | All Hosts | 270 | 380 | 11,000 | 11,000 |
| Sublette | Lodgepole Pine | 140 | 130 | 140 | 270 |
| | Ponderosa Pine | 0 | 0 | 0 | 0 |
| | 5-Needle Pines | 700 | 650 | 1,900 | 2,100 |
| | All Hosts | 700 | 650 | 1,900 | 2,100 |
| Sweetwater | Lodgepole Pine | 0 | 2,400 | 0 | 2,400 |
| | Ponderosa Pine | 0 | 0 | 0 | 0 |
| | 5-Needle Pines | 0 | 690 | 0 | 690 |
| | All Hosts | 0 | 3,000 | 0 | 3,000 |
| Teton | Lodgepole Pine | 0 | 0 | 390 | 390 |
| | Ponderosa Pine | 0 | 0 | 0 | 0 |
| | 5-Needle Pines | 60 | 0 | 2,400 | 2,400 |
| | All Hosts | 60 | 0 | 2,400 | 2,400 |
| Washakie | Lodgepole Pine | 20 | 0 | 2,200 | 2,200 |
| | Ponderosa Pine | 5 | 2 | 1,800 | 1,800 |
| | 5-Needle Pines | 30 | 7 | 32,000 | 32,000 |
| | All Hosts | 50 | 9 | 35,000 | 35,000 |
| Weston | Lodgepole Pine | 0 | 0 | 0 | 0 |
| | Ponderosa Pine | 80 | 120 | 8,100 | 8,100 |
| | 5-Needle Pines | 0 | 0 | 0 | 0 |
| | All Hosts | 80 | 120 | 8,100 | 8,100 |

Due to the nature of aerial surveys, this data 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 in the data because these agents are not detectable from aerial surveys. The data presented should only be used as a partial indicator of insect and disease activity, and should be validated on the ground for actual location and causal agent. The insect and disease data is available digitally from the USDA Forest Service, Region Two Forest Health Management group. The cooperators reserve the right to correct, update, modify or replace GIS products. Using this data for purposes other than those for which it was intended may yield inaccurate or misleading results.

| National Forest | Host Tree | 2011 Acres Affected | 2012 Acres Affected | 1996-2011 Cumulative Acres Affected | 1996-2012 Cumulative Acres Affected |
|-----------------------------|----------------|---------------------|---------------------|-------------------------------------|-------------------------------------|
| Arapaho National Forest | Lodgepole Pine | 12,000 | 400 | 452,000 | 453,000 |
| | Ponderosa Pine | 0 | 3 | 3,500 | 3,500 |
| | 5-Needle Pines | 700 | 30 | 12,000 | 12,000 |
| | All Hosts | 13,000 | 430 | 456,000 | 456,000 |
| Bighorn National Forest | Lodgepole Pine | 20 | 4 | 5,400 | 5,400 |
| | Ponderosa Pine | 170 | 160 | 6,200 | 6,200 |
| | 5-Needle Pines | 20 | 10 | 15,000 | 15,000 |
| | All Hosts | 210 | 170 | 26,000 | 26,000 |
| Black Hills National Forest | Lodgepole Pine | 0 | 0 | 0 | 0 |
| | Ponderosa Pine | 67,000 | 31,000 | 405,000 | 416,000 |
| | 5-Needle Pines | 0 | 0 | 0 | 0 |
| | All Hosts | 67,000 | 31,000 | 405,000 | 416,000 |
| Grand Mesa National Forest | Lodgepole Pine | 0 | 0 | 2 | 2 |
| | Ponderosa Pine | 0 | 0 | 10 | 10 |
| | 5-Needle Pines | 0 | 0 | 0 | 0 |
| | All Hosts | 0 | 0 | 20 | 20 |
| Gunnison National Forest | Lodgepole Pine | 0 | 0 | 3,400 | 3,400 |
| | Ponderosa Pine | 30 | 0 | 2,100 | 2,100 |
| | 5-Needle Pines | 0 | 4 | 0 | 4 |
| | All Hosts | 30 | 4 | 5,500 | 5,500 |

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| National Forest | Host Tree | 2011 Acres Affected | 2012 Acres Affected | 1996-2011 Cumulative Acres Affected | 1996-2012 Cumulative Acres Affected |
|------------------------------|----------------|---------------------|---------------------|-------------------------------------|-------------------------------------|
| Medicine Bow National Forest | Lodgepole Pine | 296,000 | 7,500 | 637,000 | 638,000 |
| | Ponderosa Pine | 18,000 | 5,500 | 38,000 | 40,000 |
| | 5-Needle Pines | 2,200 | 1,100 | 35,000 | 35,000 |
| | All Hosts | 313,000 | 13,000 | 676,000 | 680,000 |
| Nebraska National Forest | Lodgepole Pine | 0 | 0 | 0 | 0 |
| | Ponderosa Pine | 20 | 0 | 20 | 20 |
| | 5-Needle Pines | 0 | 0 | 0 | 0 |
| | All Hosts | 20 | 0 | 20 | 20 |
| Pike National Forest | Lodgepole Pine | 2,200 | 230 | 47,000 | 47,000 |
| | Ponderosa Pine | 330 | 150 | 101,000 | 101,000 |
| | 5-Needle Pines | 20 | 4 | 300 | 300 |
| | All Hosts | 2,500 | 380 | 148,000 | 148,000 |
| Rio Grande National Forest | Lodgepole Pine | 0 | 0 | 90 | 90 |
| | Ponderosa Pine | 0 | 0 | 35,000 | 35,000 |
| | 5-Needle Pines | 5 | 7 | 300 | 310 |
| | All Hosts | 5 | 7 | 36,000 | 36,000 |
| Roosevelt National Forest | Lodgepole Pine | 371,000 | 85,000 | 606,000 | 610,000 |
| | Ponderosa Pine | 223,000 | 150,000 | 328,000 | 371,000 |
| | 5-Needle Pines | 4,300 | 1,800 | 63,000 | 64,000 |
| | All Hosts | 554,000 | 213,000 | 790,000 | 808,000 |
| Routt National Forest | Lodgepole Pine | 14,000 | 860 | 611,000 | 611,000 |
| | Ponderosa Pine | 0 | 0 | 350 | 350 |
| | 5-Needle Pines | 6 | 0 | 10,000 | 10,000 |
| | All Hosts | 14,000 | 860 | 613,000 | 613,000 |
| San Isabel National Forest | Lodgepole Pine | 320 | 6 | 13,000 | 13,000 |
| | Ponderosa Pine | 140 | 20 | 134,000 | 134,000 |
| | 5-Needle Pines | 20 | 80 | 5,100 | 5,200 |
| | All Hosts | 480 | 100 | 151,000 | 151,000 |

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| National Forest | Host Tree | 2011 Acres Affected | 2012 Acres Affected | 1996-2011 Cumulative Acres Affected | 1996-2012 Cumulative Acres Affected |
|----------------------------------|------------------|----------------------------|----------------------------|--|--|
| San Juan National Forest | Lodgepole Pine | 2 | 330 | 3 | 330 |
| | Ponderosa Pine | 0 | 120 | 27,000 | 28,000 |
| | 5-Needle Pines | 0 | 0 | 3 | 3 |
| | All Hosts | 2 | 450 | 27,000 | 28,000 |
| Shoshone National Forest | Lodgepole Pine | 81,000 | 36,000 | 263,000 | 276,000 |
| | Ponderosa Pine | 0 | 0 | 40 | 40 |
| | 5-Needle Pines | 92,000 | 33,000 | 524,000 | 533,000 |
| | All Hosts | 139,000 | 50,000 | 649,000 | 663,000 |
| Thunder Basin National Grassland | Lodgepole Pine | 0 | 0 | 0 | 0 |
| | Ponderosa Pine | 0 | 80 | 220 | 300 |
| | 5-Needle Pines | 0 | 0 | 0 | 0 |
| | All Hosts | 0 | 80 | 220 | 300 |
| Uncompahgre National Forest | Lodgepole Pine | 0 | 0 | 20 | 20 |
| | Ponderosa Pine | 240 | 330 | 8,200 | 8,500 |
| | 5-Needle Pines | 0 | 0 | 0 | 0 |
| | All Hosts | 240 | 330 | 8,200 | 8,500 |
| White River National Forest | Lodgepole Pine | 46,000 | 19,000 | 376,000 | 381,000 |
| | Ponderosa Pine | 2 | 3 | 3,600 | 3,600 |
| | 5-Needle Pines | 40 | 30 | 1,400 | 1,400 |
| | All Hosts | 46,000 | 19,000 | 380,000 | 385,000 |

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2012 Spruce Beetle Activity

| | 2011 Acres Affected | 2012 Acres Affected | 1996-2011 Cumulative Acres Affected | 1996-2012 Cumulative Acres Affected |
|---------------------|---------------------|---------------------|-------------------------------------|-------------------------------------|
| Colorado | 262,000 | 311,000 | 741,000 | 924,000 |
| Wyoming – R2 | 75,000 | 29,000 | 476,000 | 490,000 |
| CO plus S.WY | 303,000 | 320,000 | 853,000 | 1,041,000 |
| South Dakota | 0 | 0 | 100 | 100 |

| Colorado County | 2011 Acres Affected | 2012 Acres Affected | 1996-2011 Cumulative Acres Affected | 1996-2012 Cumulative Acres Affected |
|-----------------|---------------------|---------------------|-------------------------------------|-------------------------------------|
| Archuleta | 1,200 | 5,100 | 8,100 | 12,000 |
| Boulder | 0 | 0 | 50 | 50 |
| Chaffee | 40 | 0 | 60 | 60 |
| Clear Creek | 5 | 0 | 40 | 40 |
| Conejos | 10,000 | 23,000 | 20,000 | 33,000 |
| Costilla | 10 | 0 | 1,500 | 1,500 |
| Custer | 210 | 1,100 | 1,100 | 2,100 |
| Delta | 14,000 | 7,000 | 21,000 | 24,000 |
| Dolores | 3,200 | 6,500 | 5,000 | 10,000 |
| Douglas | 0 | 0 | 20 | 20 |
| Eagle | 110 | 50 | 5,800 | 5,900 |
| El Paso | 0 | 0 | 10 | 10 |
| Fremont | 5 | 80 | 90 | 170 |
| Garfield | 20 | 50 | 4,100 | 4,200 |
| Gilpin | 0 | 0 | 20 | 20 |
| Grand | 9,600 | 12,000 | 18,000 | 24,000 |
| Gunnison | 5,100 | 300 | 21,000 | 21,000 |
| Hinsdale | 42,000 | 60,000 | 110,000 | 144,000 |
| Huerfano | 300 | 330 | 1,800 | 1,900 |
| Jackson | 9,500 | 3,700 | 74,000 | 76,000 |

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| Colorado County | 2011 Acres Affected | 2012 Acres Affected | 1996-2011 Cumulative Acres Affected | 1996-2012 Cumulative Acres Affected |
|------------------------|----------------------------|----------------------------|--|--|
| Jefferson | 60 | 0 | 80 | 80 |
| La Plata | 6,400 | 280 | 11,000 | 11,000 |
| Lake | 10 | 0 | 50 | 50 |
| Larimer | 24,000 | 16,000 | 48,000 | 56,000 |
| Las Animas | 0 | 0 | 650 | 650 |
| Mesa | 24,000 | 22,000 | 36,000 | 42,000 |
| Mineral | 73,000 | 54,000 | 198,000 | 221,000 |
| Moffat | 0 | 0 | 750 | 750 |
| Montezuma | 2,300 | 970 | 2,600 | 3,100 |
| Montrose | 60 | 2 | 550 | 560 |
| Ouray | 0 | 0 | 1,400 | 1,400 |
| Park | 0 | 1 | 40 | 40 |
| Pitkin | 450 | 2,000 | 7,600 | 8,000 |
| Pueblo | 60 | 120 | 2,300 | 2,300 |
| Rio Blanco | 30 | 0 | 3,800 | 3,800 |
| Rio Grande | 18,000 | 29,000 | 29,000 | 48,000 |
| Routt | 500 | 1,200 | 85,000 | 85,000 |
| Saguache | 15,000 | 64,000 | 17,000 | 72,000 |
| San Juan | 2,200 | 1,100 | 4,000 | 4,900 |
| San Miguel | 0 | 1 | 950 | 950 |
| Summit | 550 | 20 | 1,300 | 1,300 |

| Wyoming County | 2011 Acres Affected | 2012 Acres Affected | 1996-2011 Cumulative Acres Affected | 1996-2012 Cumulative Acres Affected |
|-----------------------|----------------------------|----------------------------|--|--|
| Albany | 8,900 | 4,200 | 27,000 | 29,000 |
| Big Horn | 310 | 450 | 11,000 | 12,000 |
| Carbon | 32,000 | 4,900 | 85,000 | 88,000 |
| Converse | 0 | 0 | 80 | 80 |
| Fremont | 8,300 | 6,400 | 59,000 | 62,000 |

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| Wyoming County | 2011 Acres Affected | 2012 Acres Affected | 1996-2011 Cumulative Acres Affected | 1996-2012 Cumulative Acres Affected |
|----------------|---------------------|---------------------|-------------------------------------|-------------------------------------|
| Hot Springs | 11,000 | 9,100 | 14,000 | 19,000 |
| Johnson | 510 | 0 | 4,400 | 4,400 |
| Natrona | 0 | 0 | 40 | 40 |
| Park | 12,000 | 2,800 | 268,000 | 269,000 |
| Sheridan | 400 | 770 | 5,600 | 6,300 |
| Sublette | 200 | 0 | 200 | 200 |
| Sweetwater | 0 | 3 | 0 | 3 |
| Teton | 0 | 60 | 1,100 | 1,100 |
| Washakie | 0 | 0 | 670 | 670 |

| National Forest | 2011 Acres Affected | 2012 Acres Affected | 1996-2011 Cumulative Acres Affected | 1996-2012 Cumulative Acres Affected |
|------------------------------|---------------------|---------------------|-------------------------------------|-------------------------------------|
| Arapaho National Forest | 8,200 | 8,300 | 15,000 | 19,000 |
| Bighorn National Forest | 1,200 | 1,200 | 21,000 | 22,000 |
| Black Hills National Forest | 0 | | 100 | 100 |
| Grand Mesa National Forest | 29,000 | 24,000 | 40,000 | 48,000 |
| Gunnison National Forest | 25,000 | 44,000 | 41,000 | 75,000 |
| Medicine Bow National Forest | 41,000 | 8,700 | 110,000 | 114,000 |
| Pike National Forest | 0 | 1 | 60 | 60 |
| Rio Grande National Forest | 120,000 | 165,000 | 276,000 | 378,000 |
| Roosevelt National Forest | 16,000 | 10,000 | 38,000 | 43,000 |
| Routt National Forest | 9,800 | 4,900 | 159,000 | 161,000 |
| San Isabel National Forest | 630 | 1,700 | 5,600 | 6,800 |
| San Juan National Forest | 43,000 | 39,000 | 111,000 | 130,000 |
| Shoshone National Forest | 26,000 | 13,000 | 299,000 | 305,000 |
| Uncompahgre National Forest | 60 | 30 | 7,700 | 7,700 |
| White River National Forest | 1,700 | 3,000 | 24,000 | 24,000 |

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2012 Douglas-fir Beetle Activity

| State | 2011 Acres Affected | 2012 Acres Affected | 1996-2011 Cumulative Acres Affected | 1996-2012 Cumulative Acres Affected |
|---------------|---------------------|---------------------|-------------------------------------|-------------------------------------|
| Colorado | 25,000 | 27,000 | 321,000 | 341,000 |
| Wyoming – R2 | 1,300 | 800 | 327,000 | 327,000 |
| CO plus S. WY | 25,000 | 28,000 | 335,000 | 356,000 |

| Colorado County | 2011 Acres Affected | 2012 Acres Affected | 1996-2011 Cumulative Acres Affected | 1996-2012 Cumulative Acres Affected |
|-----------------|---------------------|---------------------|-------------------------------------|-------------------------------------|
| Alamosa | 2 | 0 | 20 | 20 |
| Archuleta | 2,600 | 2,100 | 34,000 | 36,000 |
| Boulder | 0 | 0 | 280 | 280 |
| Chaffee | 60 | 80 | 2,900 | 3,000 |
| Clear Creek | 0 | 0 | 1,100 | 1,100 |
| Conejos | 8 | 120 | 5,800 | 5,900 |
| Costilla | 9 | 240 | 1,600 | 1,900 |
| Custer | 10 | 30 | 6,200 | 6,300 |
| Delta | 250 | 110 | 3,100 | 3,200 |
| Dolores | 350 | 320 | 3,700 | 4,000 |
| Douglas | 6,800 | 5,000 | 36,000 | 39,000 |
| Eagle | 480 | 990 | 7,000 | 7,800 |
| El Paso | 240 | 110 | 4,700 | 4,700 |
| Elbert | 0 | 1 | 0 | 1 |
| Fremont | 190 | 380 | 14,000 | 15,000 |
| Garfield | 940 | 1,700 | 27,000 | 28,000 |
| Gilpin | 0 | 0 | 60 | 60 |
| Grand | 20 | 100 | 920 | 1,000 |
| Gunnison | 2,800 | 3,700 | 20,000 | 23,000 |
| Hinsdale | 1,400 | 1,300 | 9,100 | 10,000 |

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| Colorado County | 2011 Acres Affected | 2012 Acres Affected | 1996-2011 Cumulative Acres Affected | 1996-2012 Cumulative Acres Affected |
|------------------------|----------------------------|----------------------------|--|--|
| Huerfano | 4 | 0 | 2,100 | 2,100 |
| Jackson | 200 | 110 | 440 | 530 |
| Jefferson | 1,400 | 700 | 9,200 | 9,700 |
| La Plata | 880 | 710 | 12,000 | 13,000 |
| Lake | 0 | 0 | 80 | 80 |
| Larimer | 0 | 0 | 2,500 | 2,500 |
| Las Animas | 0 | 10 | 5,900 | 5,900 |
| Mesa | 990 | 460 | 6,500 | 6,900 |
| Mineral | 1,300 | 1,700 | 8,300 | 9,600 |
| Moffat | 0 | 0 | 970 | 970 |
| Montezuma | 160 | 60 | 7,800 | 7,800 |
| Montrose | 1,700 | 1,900 | 6,300 | 7,600 |
| Ouray | 980 | 1,400 | 3,200 | 4,200 |
| Park | 7 | 20 | 1,600 | 1,600 |
| Pitkin | 230 | 610 | 5,500 | 5,900 |
| Pueblo | 0 | 0 | 3,700 | 3,700 |
| Rio Blanco | 100 | 370 | 7,700 | 8,000 |
| Rio Grande | 110 | 300 | 7,900 | 8,100 |
| Routt | 120 | 240 | 4,200 | 4,400 |
| Saguache | 260 | 760 | 30,000 | 31,000 |
| San Juan | 7 | 210 | 190 | 410 |
| San Miguel | 180 | 1,100 | 15,000 | 15,000 |
| Summit | 80 | 100 | 380 | 480 |
| Teller | 1 | 70 | 1,600 | 1,700 |

| Wyoming County | 2011 Acres Affected | 2012 Acres Affected | 1996-2011 Cumulative Acres Affected | 1996-2012 Cumulative Acres Affected |
|-----------------------|----------------------------|----------------------------|--|--|
| Albany | 0 | 60 | 5,300 | 5,400 |
| Big Horn | 100 | 110 | 33,000 | 33,000 |
| Carbon | 10 | 280 | 8,900 | 9,200 |

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| Wyoming County | 2011 Acres Affected | 2012 Acres Affected | 1996-2011 Cumulative Acres Affected | 1996-2012 Cumulative Acres Affected |
|----------------|---------------------|---------------------|-------------------------------------|-------------------------------------|
| Converse | 0 | 0 | 10 | 10 |
| Crook | 1 | 0 | 1 | 1 |
| Fremont | 190 | 90 | 49,000 | 49,000 |
| Hot Springs | 40 | 0 | 26,000 | 26,000 |
| Johnson | 30 | 2 | 1,500 | 1,500 |
| Natrona | 0 | 0 | 150 | 150 |
| Park | 830 | 70 | 196,000 | 196,000 |
| Sheridan | 40 | 2 | 980 | 980 |
| Sweetwater | 0 | 160 | 0 | 160 |
| Washakie | 50 | 20 | 6,200 | 6,200 |

| National Forest | 2011 Acres Affected | 2012 Acres Affected | 1996-2011 Cumulative Acres Affected | 1996-2012 Cumulative Acres Affected |
|------------------------------|---------------------|---------------------|-------------------------------------|-------------------------------------|
| Arapaho National Forest | 0 | 3 | 490 | 500 |
| Bighorn National Forest | 140 | 90 | 26,000 | 27,000 |
| Grand Mesa National Forest | 230 | 40 | 1,700 | 1,800 |
| Gunnison National Forest | 2,700 | 3,400 | 18,000 | 21,000 |
| Medicine Bow National Forest | 0 | 80 | 11,000 | 12,000 |
| Pike National Forest | 6,700 | 5,200 | 42,000 | 45,000 |
| Rio Grande National Forest | 190 | 640 | 37,000 | 37,000 |
| Roosevelt National Forest | 0 | 0 | 1,800 | 1,800 |
| Routt National Forest | 20 | 10 | 2,100 | 2,100 |
| San Isabel National Forest | 80 | 150 | 16,000 | 16,000 |
| San Juan National Forest | 6,700 | 6,200 | 65,000 | 70,000 |
| Shoshone National Forest | 810 | 70 | 204,000 | 204,000 |
| Uncompahgre National Forest | 3,200 | 3,100 | 15,000 | 17,000 |
| White River National Forest | 1,000 | 2,300 | 17,000 | 19,000 |

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2012 Western Balsam Bark Beetle Activity

| State | 2011 Acres Affected | 2012 Acres Affected |
|--------------|------------------------|------------------------|
| Colorado | 180,000 | 221,000 |
| Wyoming – R2 | 35,000 | 14,000 |
| CO plus S.WY | 184,000 | 224,000 |

| Colorado County | 2011 Acres Affected | 2012 Acres Affected |
|--------------------|------------------------|------------------------|
| Alamosa | 20 | 30 |
| Archuleta | 20 | 160 |
| Boulder | 3,500 | 3,200 |
| Chaffee | 2,900 | 1,600 |
| Clear Creek | 11,000 | 2,700 |
| Conejos | 1,300 | 1,600 |
| Costilla | 1,900 | 4,600 |
| Custer | 1,300 | 3,500 |
| Delta | 2,700 | 5,200 |
| Dolores | 3,300 | 3,400 |
| Eagle | 10,000 | 14,000 |
| Fremont | 140 | 100 |
| Garfield | 10,000 | 17,000 |
| Gilpin | 2,700 | 2,300 |
| Grand | 9,100 | 14,000 |
| Gunnison | 33,000 | 35,000 |
| Hinsdale | 1,900 | 4,100 |
| Huerfano | 1,400 | 2,900 |
| Jackson | 1,600 | 2,500 |
| Jefferson | 110 | 5 |
| La Plata | 230 | 280 |
| Lake | 1,100 | 1,400 |
| Larimer | 13,000 | 12,000 |
| Las Animas | 1,100 | 3,200 |

Due to the nature of aerial surveys, this data 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 in the data because these agents are not detectable from aerial surveys. The data presented should only be used as a partial indicator of insect and disease activity, and should be validated on the ground for actual location and causal agent. The insect and disease data is available digitally from the USDA Forest Service, Region Two Forest Health Management group. The cooperators reserve the right to correct, update, modify or replace GIS products. Using this data for purposes other than those for which it was intended may yield inaccurate or misleading results.

| Colorado County | 2011 Acres Affected | 2012 Acres Affected |
|------------------------|----------------------------|----------------------------|
| Mesa | 3,000 | 6,400 |
| Mineral | 1,800 | 1,200 |
| Moffat | 420 | 360 |
| Montezuma | 470 | 50 |
| Montrose | 970 | 270 |
| Ouray | 700 | 1,500 |
| Park | 6,300 | 9,600 |
| Pitkin | 25,000 | 25,000 |
| Pueblo | 2 | 0 |
| Rio Blanco | 8,100 | 18,000 |
| Rio Grande | 890 | 830 |
| Routt | 2,000 | 4,500 |
| Saguache | 4,000 | 6,500 |
| San Juan | 2,400 | 1,400 |
| San Miguel | 7,100 | 4,600 |
| Summit | 4,200 | 6,000 |

| Wyoming County | 2011 Acres Affected | 2012 Acres Affected |
|-----------------------|----------------------------|----------------------------|
| Albany | 4 | 660 |
| Big Horn | 4,200 | 950 |
| Carbon | 3,300 | 2,000 |
| Converse | 40 | 50 |
| Fremont | 12,000 | 1,500 |
| Hot Springs | 0 | 3 |
| Johnson | 5,200 | 2,300 |
| Natrona | 140 | 210 |
| Park | 7,500 | 3,700 |
| Sheridan | 2,800 | 740 |
| Sweetwater | 0 | 1,800 |
| Washakie | 10 | 9 |

Due to the nature of aerial surveys, this data 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 in the data because these agents are not detectable from aerial surveys. The data presented should only be used as a partial indicator of insect and disease activity, and should be validated on the ground for actual location and causal agent. The insect and disease data is available digitally from the USDA Forest Service, Region Two Forest Health Management group. The cooperators reserve the right to correct, update, modify or replace GIS products. Using this data for purposes other than those for which it was intended may yield inaccurate or misleading results.

| National Forest | 2011 Acres Affected | 2012 Acres Affected |
|------------------------------|--------------------------------|--------------------------------|
| Arapaho National Forest | 18,000 | 14,000 |
| Bighorn National Forest | 12,000 | 4,000 |
| Grand Mesa National Forest | 3,300 | 6,300 |
| Gunnison National Forest | 28,000 | 32,000 |
| Medicine Bow National Forest | 3,300 | 2,100 |
| Pike National Forest | 6,800 | 10,000 |
| Rio Grande National Forest | 5,200 | 5,500 |
| Roosevelt National Forest | 12,000 | 12,000 |
| Routt National Forest | 7,700 | 14,000 |
| San Isabel National Forest | 8,500 | 11,000 |
| San Juan National Forest | 5,000 | 5,000 |
| Shoshone National Forest | 17,000 | 5,100 |
| Uncompahgre National Forest | 14,000 | 11,000 |
| White River National Forest | 55,000 | 75,000 |

Due to the nature of aerial surveys, this data 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 in the data because these agents are not detectable from aerial surveys. The data presented should only be used as a partial indicator of insect and disease activity, and should be validated on the ground for actual location and causal agent. The insect and disease data is available digitally from the USDA Forest Service, Region Two Forest Health Management group. The cooperators reserve the right to correct, update, modify or replace GIS products. Using this data for purposes other than those for which it was intended may yield inaccurate or misleading results.

2012 Western Spruce Budworm Activity

| State | 2011 Acres Affected | 2012 Acres Affected |
|--------------|---------------------|---------------------|
| Colorado | 90,000 | 217,000 |
| Wyoming- R2 | 15,000 | 16,000 |
| CO plus S.WY | 91,000 | 217,000 |

| Colorado County | 2011 Acres Affected | 2012 Acres Affected |
|-----------------|---------------------|---------------------|
| Alamosa | 0 | 1,600 |
| Archuleta | 1,900 | 7,100 |
| Chaffee | 0 | 2 |
| Conejos | 1,200 | 890 |
| Costilla | 9,800 | 27,000 |
| Custer | 9,900 | 12,000 |
| Dolores | 4,400 | 15,000 |
| Douglas | 770 | 0 |
| El Paso | 1,100 | 40 |
| Fremont | 40 | 3,300 |
| Grand | 60 | 20 |
| Gunnison | 500 | 170 |
| Hinsdale | 1,400 | 3,100 |
| Huerfano | 14,000 | 37,000 |
| Jackson | 0 | 80 |
| La Plata | 9,700 | 14,000 |
| Las Animas | 12,000 | 31,000 |
| Mineral | 200 | 540 |
| Montezuma | 3,300 | 6,300 |
| Ouray | 740 | 490 |
| Pueblo | 4,400 | 2,300 |

Due to the nature of aerial surveys, this data 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 in the data because these agents are not detectable from aerial surveys. The data presented should only be used as a partial indicator of insect and disease activity, and should be validated on the ground for actual location and causal agent. The insect and disease data is available digitally from the USDA Forest Service, Region Two Forest Health Management group. The cooperators reserve the right to correct, update, modify or replace GIS products. Using this data for purposes other than those for which it was intended may yield inaccurate or misleading results.

| Colorado County | 2011 Acres Affected | 2012 Acres Affected |
|------------------------|----------------------------|----------------------------|
| Rio Blanco | 40 | 0 |
| Rio Grande | 30 | 60 |
| Routt | 10 | 380 |
| Saguache | 2,000 | 35,000 |
| San Juan | 12,000 | 15,000 |
| San Miguel | 1,300 | 5,600 |
| Teller | 0 | 950 |

| Wyoming County | 2011 Acres Affected | 2012 Acres Affected |
|-----------------------|----------------------------|----------------------------|
| Albany | 450 | 40 |
| Carbon | 0 | 30 |
| Fremont | 6,000 | 3,900 |
| Johnson | 320 | 0 |
| Park | 7,900 | 12,000 |
| Washakie | 550 | 110 |

| National Forest | 2011 Acres Affected | 2012 Acres Affected |
|------------------------------|----------------------------|----------------------------|
| Bighorn National Forest | 320 | 0 |
| Gunnison National Forest | 440 | 170 |
| Medicine Bow National Forest | 430 | 6 |
| Pike National Forest | 1,400 | 390 |
| Rio Grande National Forest | 4,300 | 35,000 |
| Routt National Forest | 50 | 380 |
| San Isabel National Forest | 27,000 | 44,000 |
| San Juan National Forest | 28,000 | 54,000 |
| Shoshone National Forest | 12,000 | 15,000 |
| Uncompahgre National Forest | 2,300 | 5,800 |

Due to the nature of aerial surveys, this data 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 in the data because these agents are not detectable from aerial surveys. The data presented should only be used as a partial indicator of insect and disease activity, and should be validated on the ground for actual location and causal agent. The insect and disease data is available digitally from the USDA Forest Service, Region Two Forest Health Management group. The cooperators reserve the right to correct, update, modify or replace GIS products. Using this data for purposes other than those for which it was intended may yield inaccurate or misleading results.

2012 Aspen Dieback and Mortality

| | Acres Affected |
|----------------|----------------|
| Colorado | 3,100 |
| Wyoming – R2 | 1,700 |
| CO. plus S. WY | 3,300 |
| South Dakota | |

| Colorado County | 2012 Acres Affected |
|-----------------|---------------------|
| Custer | 40 |
| Delta | 1,100 |
| Eagle | 50 |
| Fremont | 50 |
| Grand | 40 |
| Gunnison | 460 |
| Huerfano | 10 |
| Jackson | 7 |
| La Plata | 6 |
| Mesa | 970 |
| Moffat | 6 |
| Montrose | 160 |
| Park | 10 |
| Pitkin | 10 |
| Rio Blanco | 50 |
| Routt | 4 |
| Saguache | 1 |
| San Miguel | 150 |

| Wyoming County | 2012 Acres Affected |
|----------------|---------------------|
| Carbon | 140 |
| Fremont | 10 |
| Johnson | 10 |
| Sweetwater | 1,600 |

| South Dakota County | 2012 Acres Affected |
|---------------------|---------------------|
| Pennington | |

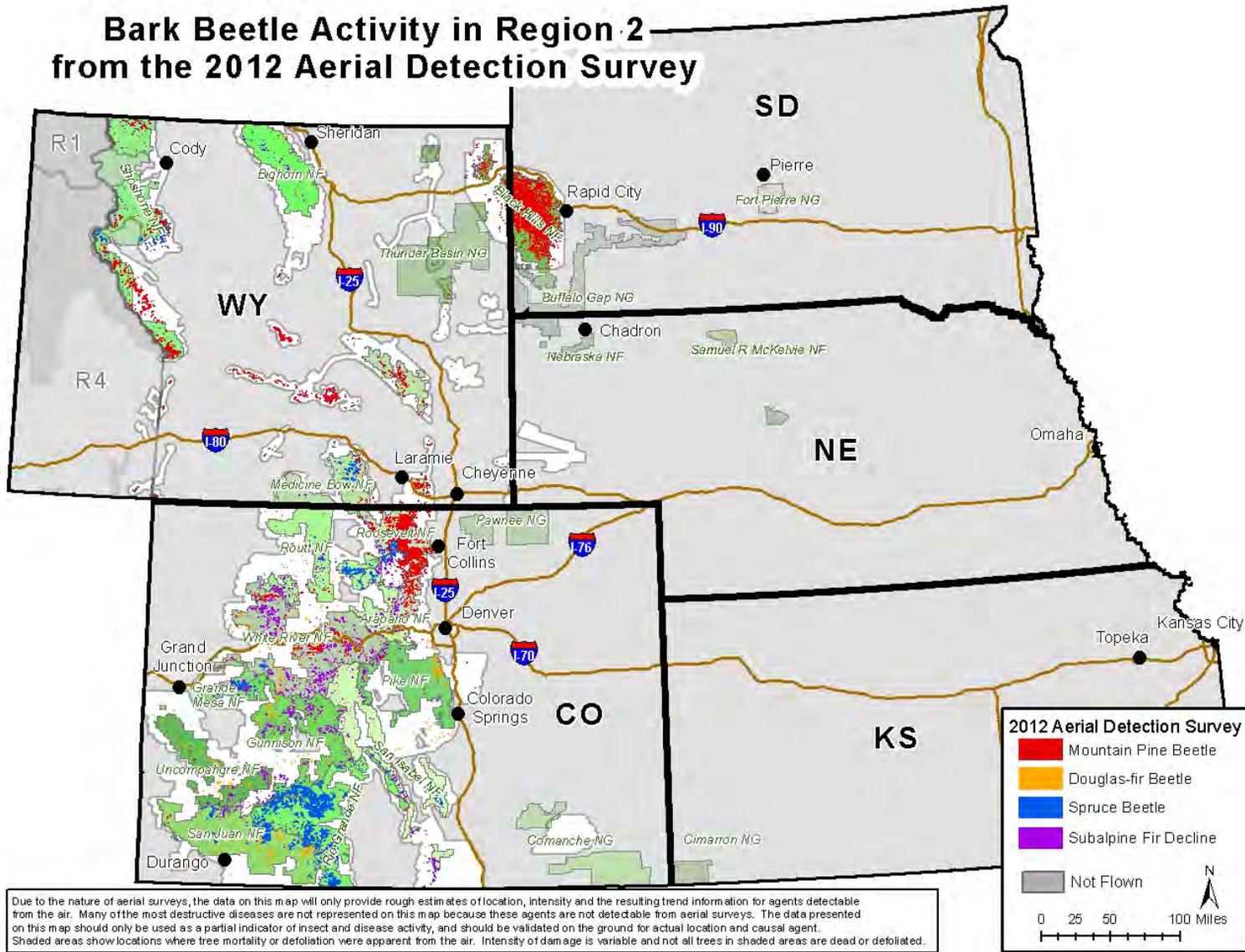
| National Forest | 2012 Acres Affected |
|-----------------------------|---------------------|
| Arapaho National Forest | 8 |
| Grand Mesa National Forest | 1,100 |
| Gunnison National Forest | 740 |
| Pike National Forest | 10 |
| Routt National Forest | 20 |
| San Isabel National Forest | 20 |
| Uncompahgre National Forest | 200 |
| White River National Forest | 110 |

Due to the nature of aerial surveys, this data 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 in the data because these agents are not detectable from aerial surveys. The data presented should only be used as a partial indicator of insect and disease activity, and should be validated on the ground for actual location and causal agent. The insect and disease data is available digitally from the USDA Forest Service, Region Two Forest Health Management group. The cooperators reserve the right to correct, update, modify or replace GIS products. Using this data for purposes other than those for which it was intended may yield inaccurate or misleading results.

2012 Aerial Survey and Detection Monitoring Maps

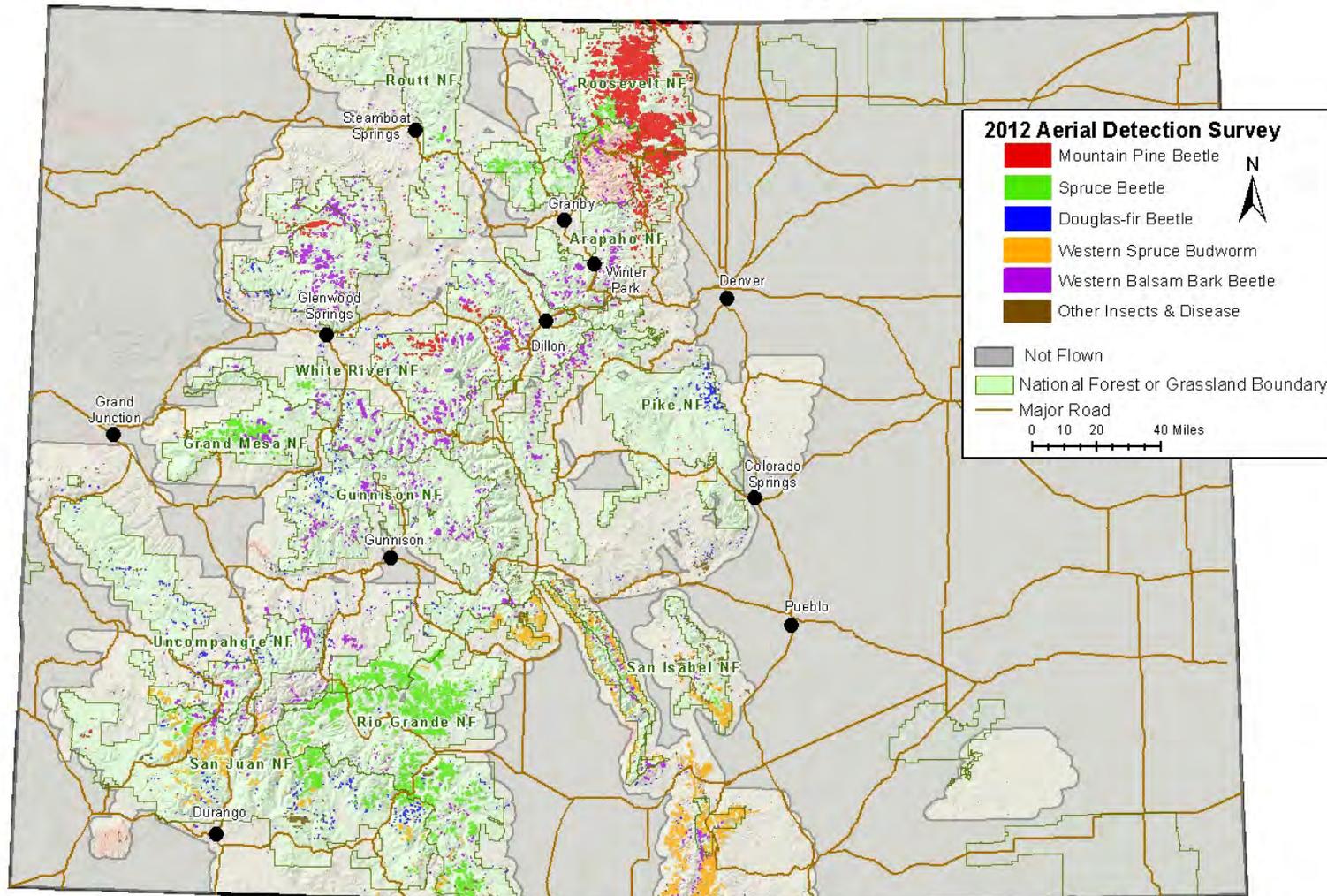
Entire Rocky Mountain Region (R2)

Bark Beetle Activity in Region 2 from the 2012 Aerial Detection Survey



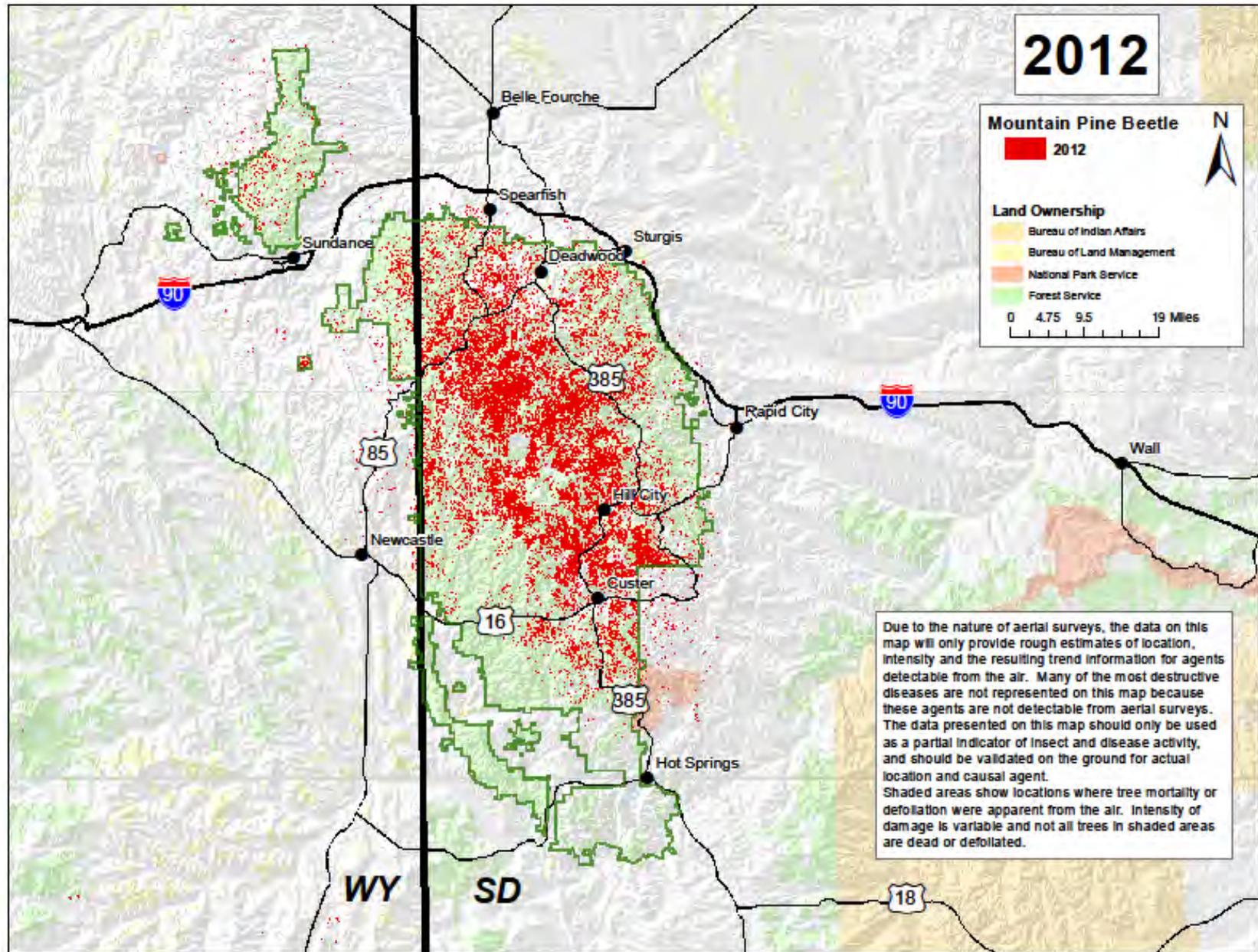
Colorado

2012 Aerial Detection Survey



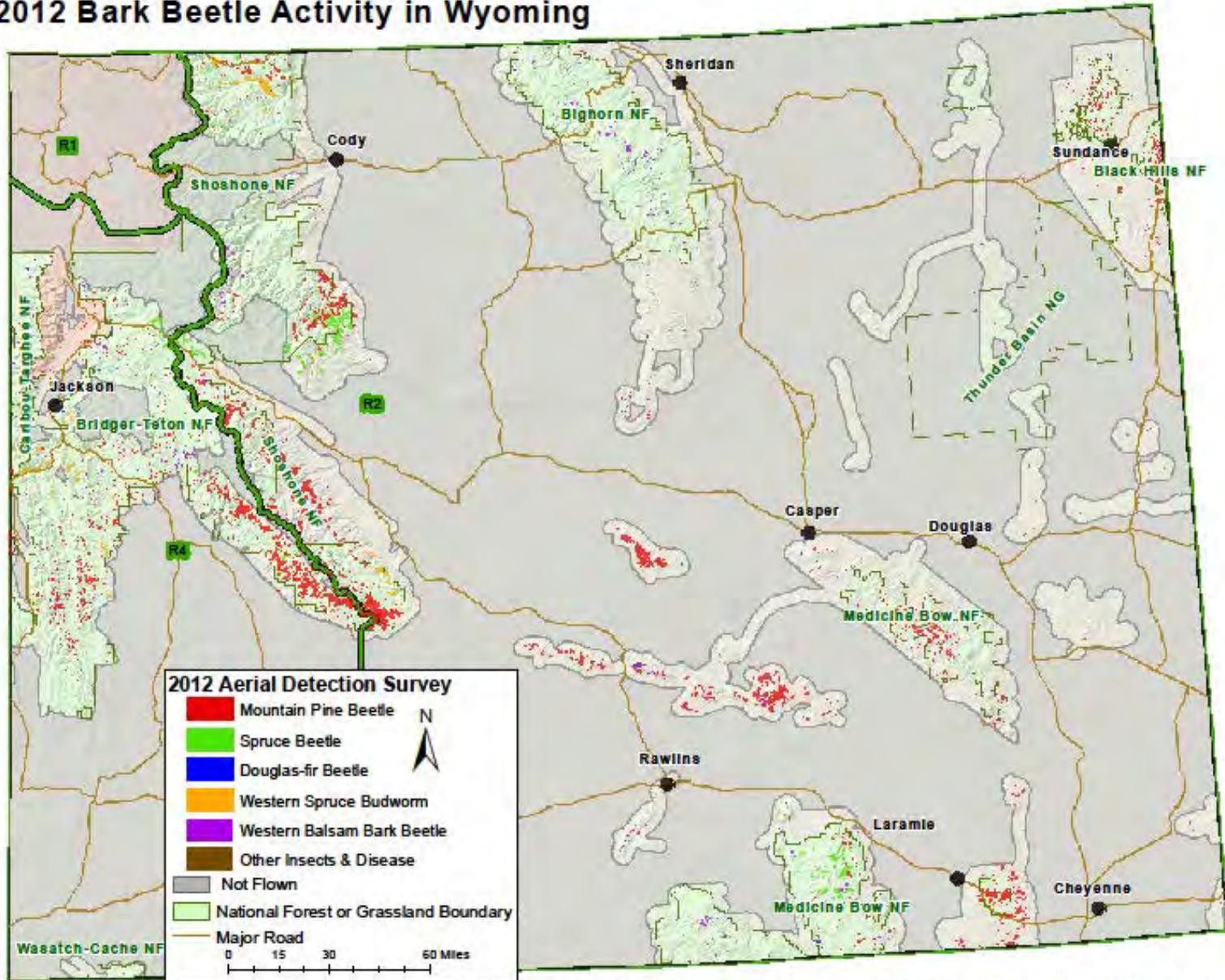
Due to the nature of aerial surveys, the data on this map will only provide rough estimates of location, intensity and the resulting trend information for agents detectable from the air. Many of the most destructive diseases are not represented on this map because these agents are not detectable from 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 causal 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.

South Dakota from special Remote Sensing Project (see Appendix C)



Wyoming: Region 2 (central and eastern Wyoming), Regions 1 & 4 (western Wyoming)

2012 Bark Beetle Activity in Wyoming



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

Mountain Pine Beetle Digitization Protocol and 2012 Survey Results

Authored by:

Josh Van Vlack,
Neiman Timber Company

Abstract:

This paper describes the protocols used to inventory mountain pine beetle infestations in the Black Hills of South Dakota and Wyoming. High resolution aerial photography taken in 2010, 2011 and 2012 was used to delineate infested groups of red-top trees. Infested acres from 2009-2011 are reported.

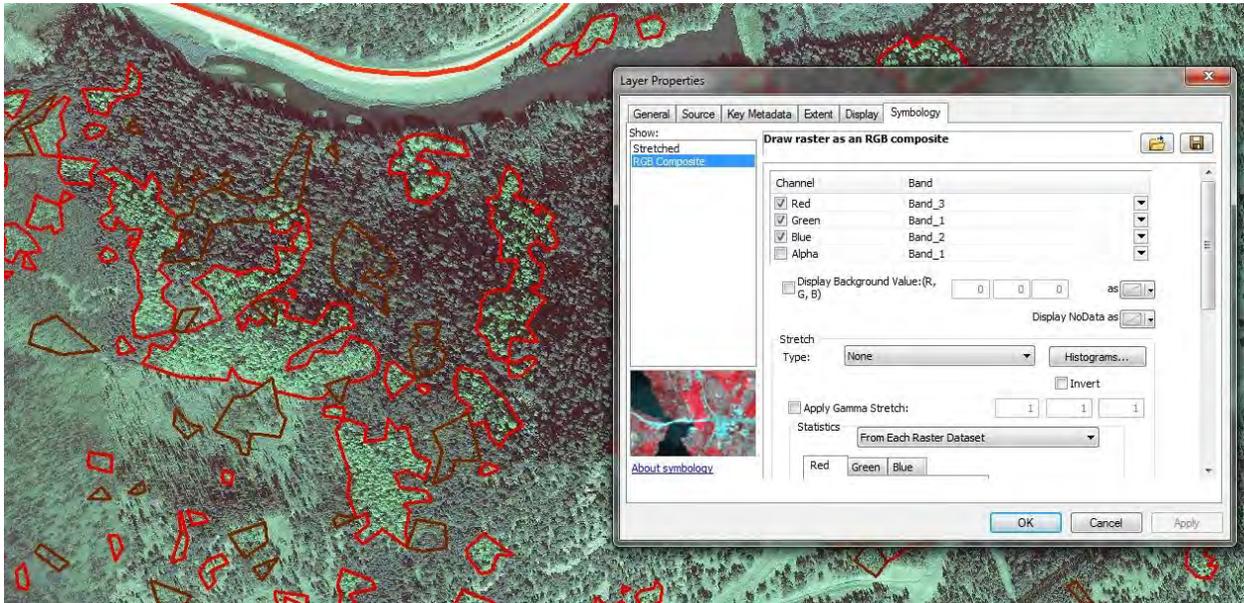
Introduction and History:

In the winter of 2011/2012 Neiman Timber Company (NTC) began the process of identifying and digitally mapping the extent of the mountain pine beetle (MPB) epidemic. The project was based on high-resolution USFS aerial photography taken in late summer/early fall of 2010/2011. All current year red-top trees were manually delineated in each of the annual aerial photo series, utilizing the techniques outlined in this document and Arcmap10.0. The photography taken in 2010 represents **infestation year 2009**, the year the trees were actually attacked by the MPB, likewise the 2011 photography represents **infestation year 2010**.

2011 Photo Interpretation:

NTC staff determined that priority should be given to analyzing the 2011 photo coverage because the resulting data would have immediate management implications. The following techniques were used while identifying the MPB patches.

- Photo preparation:
 - The 2011 photography was provided in Quarter-Quarter-Quarter Quads (QQQQ). Our first step in the digitization process was to combine each of the QQQQ tiles into full-quad layer groups.
 - Adjustments were then made to sharpen the photos and enhance the clarity. Layer properties were set to the following values:
 - Display tab: **Resample during display using:** set to "**Nearest Neighbor**".
 - Symbology tab: **Stretch** set to **None**.
 - Additionally, under the Symbology tab the **Channel/Band** combination could be altered to force the red-topped trees stand out bright green against dark green healthy trees. The settings as well as the resulting photo are shown below:



- After some experimentation, it was determined that setting the view scale at 1:2,500 best balanced drawing accuracy, small patch identification, and drawing speed. This scale level also aided in discerning the 2011 red-topped trees from previous years' mortality.
- A symbol style with no fill and a bright, bold outline was selected for drawing beetle polygons in an effort to ensure accurate polygon boundaries.
- In an effort to maximize computer drawing speed and minimize drawing hiccups, only the photography layer and current drawing layer were enabled.
- One photo quad was enabled at a time. A methodical back and forth, top to bottom system was utilized to ensure complete coverage of each quad. The adjoining quad was then enabled and the process repeated.
- All beetle patches were identified regardless of ownership, location, and jurisdiction.
- Every effort was made to only identify red-topped trees within patches and exclude pockets of green timber from the polygons. The polygons were drawn as close as possible to the patch boundaries in an effort to obtain accurate data. All red-topped patches were identified, down to 2 tree groups.
- Areas of discernible mortality other than MPB were excluded, i.e. fire mortality.

2010 Photo Interpretation:

Following the completion of the 2011 MPB digitization, the same methodology was applied to the 2010 photography; thereby beginning to build a record of the epidemic's progression. Only slight variations were made in the process.

- A new shapefile was created for the 2010 photo flight.
- The layer created for the 2011 photography was intentionally left off while digitizing the 2010 photos. Doing so helped ensure that red-top trees were

categorized in the proper layer. Overlapping and duplicated polygons were later removed via geoprocessing.

- All other techniques remained the same.

Geoprocessing:

Upon completion of the 2010 and 2011 MPB digitizing the following steps were taken to combine the data.

- Because some patches identified in the 2011 layer were also identified in 2010, the **Clip** tool was used to remove any MPB pockets from the 2011 data that overlapped the 2010 data.
- The 2010 and clipped 2011 MPB shapefiles were combined using the **Merge** tool, creating one shapefile containing all the features from each original file. The infestation year is identified in the attribute table.
- The acres were then calculated using the **Calculate Geometry** tool.

Recommendations for Future Digitization:

- Having the two prior years' infestation mapped, going forward the digitization can be sped up by utilizing the **trace feature** tool when drawing new MPB impact adjoining to existing patches.
- The greatest consistency and accuracy was achieved when one technician completed all the digitizing, but hopefully through the use of this document the labor can be divided while maintaining a high level of accuracy.
- One of the greatest improvements to the speed and accuracy of the process would be the addition of a WACOM interactive display. Utilizing an interactive display has the potential to reduce digitizing time by nearly 50%. The initial cost of the hardware would be quickly offset by the reduced man-hours required to complete the digitization. Information on the WACOM displays can be found at www.wacomGIS.com

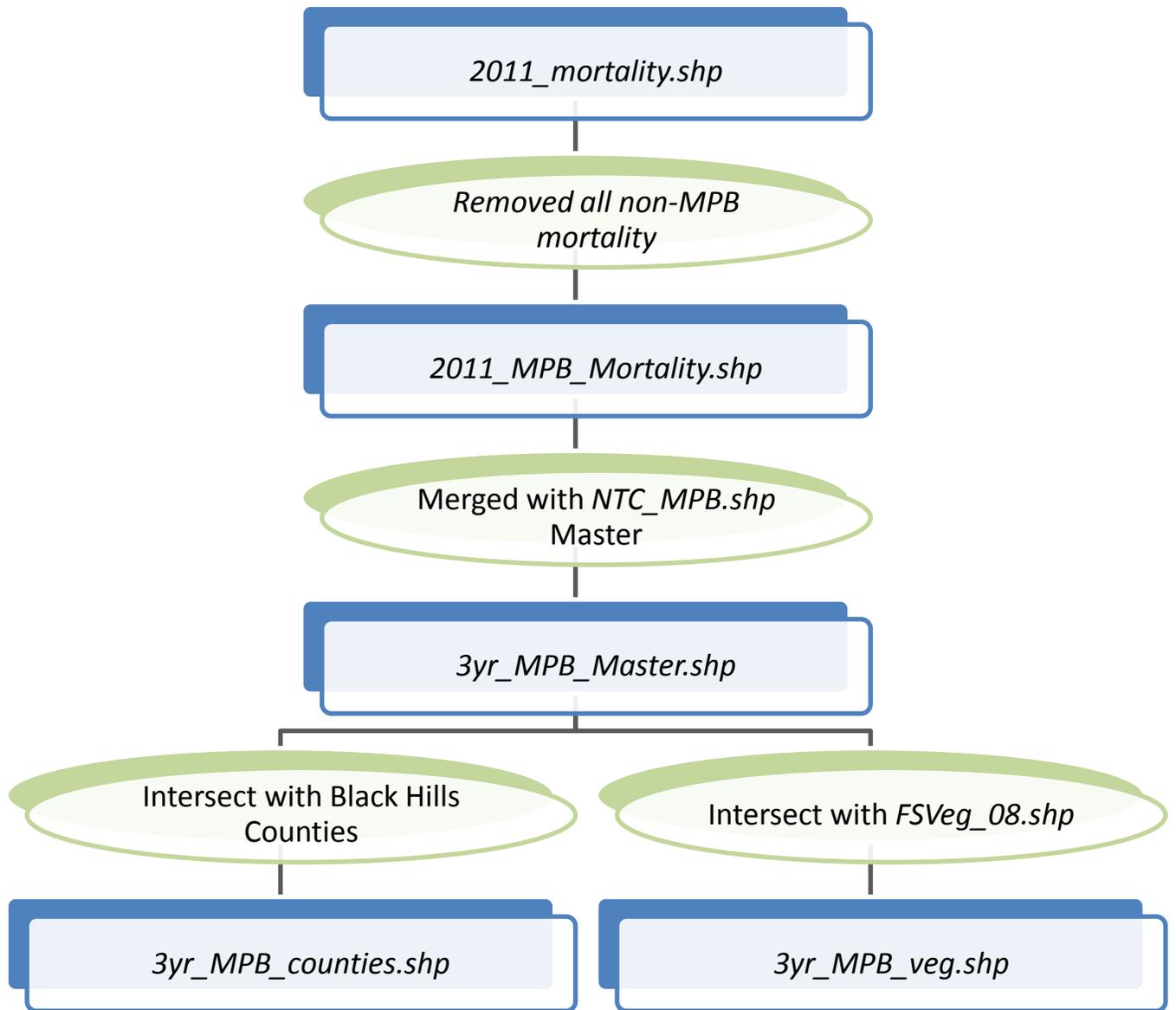
Fall 2012 Update:

Upon receiving the individual components digitized by NTC, South Dakota Division of Resource Conservation and Forestry, WY State Forestry Division, and the USFS-Black Hills National Forest¹, the following steps were taken to combine the data into the final working document.

1. Manually removed overlapping polygons and duplicates along the overlapping seams utilizing the polygons that best fit the beetle patches on the photography.
2. Merged all components into *2011_mortality.shp*
3. Ran "Repair Geometry" tool to solve any polygon geometry errors
4. Using the "Dissolve" tool to combine overlapping polygons and polygons with common boundaries, thus reducing the total polygon count
5. Populated attribute table with infest year and code
6. Reviewed the code classification against the wildfire and prescribed fire layers and the photography to ensure proper coding.
7. Clipped *2011_mortality.shp* by our *NTC_MPB.shp* master to remove dead patches identified in previous years, creating *clip_erase.shp* that will be discarded.
 - a. Added a field to the *clip_erase.shp* file called "erase", and populated it with a "yes" value.
 - b. Ran the "Union" tool to join *2011_mortality.shp* and *clip_erase.shp*
 - c. Erased all features identified as repeats from previous years by selecting and deleting all "yes" features in the "erase" field.
 - d. The resultant shapefile represents only the 2011 tree mortality.
8. Ran "Repair Geometry" on *2011_mortality.shp* once again
9. Ran "Calculate Geometry" on *2011_mortality.shp* to calculate acres.
10. Double checked all attribute table fields.

¹ The author would like to acknowledge the support of Ken Marchand, USFS-BHNF; Doug Haugan, SD-DRCF; Emma Rowbotham, Neiman Timber Company; and Tiffany Allen, WSFD/Weston County Weed and Pest who completed the digitization.

The following additional shapefiles were created off the *2011_mortality.shp*



2012 Results:

| MPB Acres by County & Year | | | | | | | | | | | |
|----------------------------|------------------|--------------------|--------------------|------------------|--------------------|--------------------|-------------|-------------------|--------------------|--------------------|-------------|
| | 2009 | | | 2010 | | | GROWTH (%) | 2011 | | | GROWTH (%) |
| | Patch Count | Average Patch Size | New Infested Acres | Patch Count | Average Patch Size | New Infested Acres | | Patch Count | Average Patch Size | New Infested Acres | |
| Crook | 1,578.00 | 0.06 | 89.38 | 6,284.00 | 0.06 | 352.26 | 394% | 9,349.00 | 0.07 | 656.15 | 186% |
| Custer | 4,855.00 | 0.24 | 1,167.69 | 14,955.00 | 0.17 | 2,552.11 | 219% | 27,609.00 | 0.13 | 3,498.77 | 137% |
| Lawrence | 12,323.00 | 0.15 | 1,890.49 | 14,189.00 | 0.20 | 2,837.51 | 150% | 41,267.00 | 0.25 | 10,175.58 | 359% |
| Meade | 489.00 | 0.03 | 16.55 | 1,225.00 | 0.06 | 69.78 | 422% | 2,434.00 | 0.05 | 130.49 | 187% |
| Pennington | 20,866.00 | 0.30 | 6,337.22 | 31,105.00 | 0.46 | 14,166.07 | 224% | 41,645.00 | 0.41 | 17,267.75 | 122% |
| Weston | 425.00 | 0.07 | 28.58 | 747.00 | 0.09 | 66.54 | 233% | 1,351.00 | 0.06 | 87.33 | 131% |
| SUM | 40,536.00 | | 9,529.91 | 68,505.00 | | 20,044.27 | 210% | 123,655.00 | | 31,816.07 | 159% |

| MPB Acres By Ownership & Year | | | | | | | |
|-------------------------------|-----------------|--------------|------------------|--------------|------------------|--------------|--|
| | 2009 | | 2010 | | 2011 | | |
| | Acres | % of Total | Acres | % of Total | Acres | % of Total | |
| USFS | 9,120.72 | 96.69% | 18,793.34 | 95.96% | 29,354.36 | 96.27% | |
| Private | 301.79 | 3.20% | 779.88 | 3.98% | 1,126.14 | 3.69% | |
| State | 10.39 | 0.11% | 11.71 | 0.06% | 12.66 | 0.04% | |
| SUM | 9,432.90 | acres | 19,584.93 | acres | 30,493.16 | acres | |

*** Total Acres differ from above Acres by County table due to the coverage area of our ownership data.
USFS acres are accurate, but State and Private acres are underestimated, particularly in Wyoming

| 2009 | County | Polygon Count | Minimum Acres | Maximum Acres | Average Acres | Total Acres | Standard Deviation Acres | Variance Acres |
|------|-----------------|------------------|--------------------|--------------------|--------------------|-----------------|--------------------------|-------------------|
| | Crook | 1,562.00 | 0.0010688 | 1.054239988 | 0.057219303 | 89.38 | 0.066408972 | 0.004410152 |
| | Custer | 4,834.00 | 0.00119889 | 235.0950012 | 0.241555818 | 1,167.68 | 3.481122972 | 12.11821715 |
| | Lawrence | 12,292.00 | 0.00108116 | 40.3382988 | 0.153798215 | 1,890.49 | 0.646116115 | 0.417466034 |
| | Meade | 480.00 | 0.00108116 | 2.303509951 | 0.034474848 | 16.55 | 0.11104285 | 0.012330515 |
| | Pennington | 20,805.00 | 0.00106853 | 195.8139954 | 0.304600007 | 6,337.20 | 2.311980224 | 5.345252555 |
| | Weston | 421.00 | 0.00182015 | 2.170480013 | 0.067900516 | 28.59 | 0.124849105 | 0.015587299 |
| | TOTALS | 40,394.00 | | | | 9,529.88 | | |
| | AVERAGES | | 0.001219782 | 79.46258756 | 0.143258118 | | 1.123586706 | 2.98554395 |

| 2010 | County | Polygon Count | Minimum Acres | Maximum Acres | Average Acres | Total Acres | Standard Deviation Acres | Variance Acres |
|------|-----------------|------------------|--------------------|--------------------|--------------------|------------------|--------------------------|--------------------|
| | Crook | 6,087.00 | 0.00100179 | 4.143539906 | 0.057858597 | 352.19 | 0.124303759 | 0.015451424 |
| | Custer | 14,887.00 | 0.00108116 | 349.8320007 | 0.171431151 | 2,552.10 | 2.971317004 | 8.828724738 |
| | Lawrence | 14,117.00 | 0.00107239 | 22.99220085 | 0.200997408 | 2,837.48 | 0.65541548 | 0.429569451 |
| | Meade | 1,209.00 | 0.00112766 | 0.909198999 | 0.057712057 | 69.77 | 0.072337358 | 0.005232693 |
| | Pennington | 30,969.00 | 0.00100392 | 222.5780029 | 0.457426274 | 14,166.03 | 2.238489411 | 5.010834844 |
| | Weston | 741.00 | 0.00127061 | 1.456140041 | 0.089806109 | 66.55 | 0.142701301 | 0.020363661 |
| | TOTALS | 68,010.00 | | | | 20,044.12 | | |
| | AVERAGES | | 0.001092922 | 100.3185139 | 0.172538599 | | 1.034094052 | 2.385029469 |

| 2011 | County | Polygon Count | Minimum Acres | Maximum Acres | Average Acres | Total Acres | Standard Deviation Acres | Variance Acres |
|------|-----------------|-------------------|--------------------|--------------------|--------------------|------------------|--------------------------|--------------------|
| | Crook | 9,403.00 | 0.00100032 | 4.841919899 | 0.064743718 | 608.79 | 0.145151801 | 0.021069045 |
| | Custer | 27,608.00 | 0.00100109 | 26.38669968 | 0.126145717 | 3,482.63 | 0.535622724 | 0.286891703 |
| | Lawrence | 41,264.00 | 0.00100385 | 313.8919983 | 0.244107898 | 10,072.87 | 2.110692267 | 4.455021844 |
| | Meade | 2,539.00 | 0.00102712 | 0.983892977 | 0.049556415 | 125.82 | 0.07625415 | 0.005814695 |
| | Pennington | 41,640.00 | 0.00100332 | 73.91120148 | 0.403908371 | 16,818.74 | 1.395758805 | 1.948142641 |
| | Weston | 1,345.00 | 0.00102473 | 1.037289977 | 0.060084473 | 80.81 | 0.098686193 | 0.009738965 |
| | TOTALS | 123,799.00 | | | | 31,189.67 | | |
| | AVERAGES | | 0.001010072 | 70.17550038 | 0.158091099 | | 0.727027657 | 1.121113149 |

| | | | | | | | | |
|-------------------------|-------------------|--------------------|--------------------|--------------------|--|--------------------|--------------------|--|
| Grand Total | 232,203.00 | | | | | 60,763.66 | | |
| Overall Averages | | 0.001107592 | 83.31886728 | 0.157962605 | | 0.961569472 | 2.163895523 | |

Soon after releasing the 2011 MPB Mortality data, it became apparent that the digitization was not as accurate as anticipated in portions of the Wyoming coverage area. The entirety of Wyoming was then re-sampled by two technicians to pick up missed areas; an additional 400 acres were identified.

2012 Summary:

In all, I believe that the 2012 MPB digitization effort was a successful venture, and will provide useful data going forward. The following are some observations of this year's process as well as recommendations going forward.

- **WACOM Tablets:** The investment made by the State of South Dakota in the WACOM tablets undoubtedly increased the accuracy and expediency of the process. Our technician reported that she felt digitizing on the drawing tablet increased her productivity approximately 40% and her drawing accuracy 80% or more. One downside of the tablet digitizing was substantially increased file size due to the quantity of vector points in the data. In the future, post processing to simplify polygons may reduce file size.
- **Digitization Method:** There was observable difference in accuracy between mouse-digitized and tablet-digitized polygons, with the tablet-digitized polygons clinging closer to the actual MPB patches in the photography. Going forward, if the final users are concerned about this variance we may consider having all technicians digitize on tablets, rather than a mix of both.
- **Revisions:** The Wyoming revision resulted in an additional 16 hours of processing time, beyond the actual digitizing. The majority of this processing time was attributable to the file structure of the revisions. In the future, any revisions should be made as an entirely new file, as opposed to a continuation of the previous file. When multiples of the original are modified, it becomes very labor intensive to merge the branches without duplicating data within the file.
- **Timeline:** The digitizing was completed in approximately three weeks, despite an additional one week delay in beginning the digitizing. The original goal of having the digitizing completed by November 16th was met, as was the goal of having the first draft analysis completed by December 1. Hopefully next year we will further refine the process and reduce turnaround time.

2013 Program

We are currently going through the process of digitizing all mortality that occurred prior to 2009 with the goal of calculating an estimated total mortality of the recent infestation. The same techniques are being utilized on this process, as well as multiple years of aerial photography. Estimated completion date is February, 2013.