2012 Report on the Health of Colorado's Forests

Forest Stewardship through Active Management

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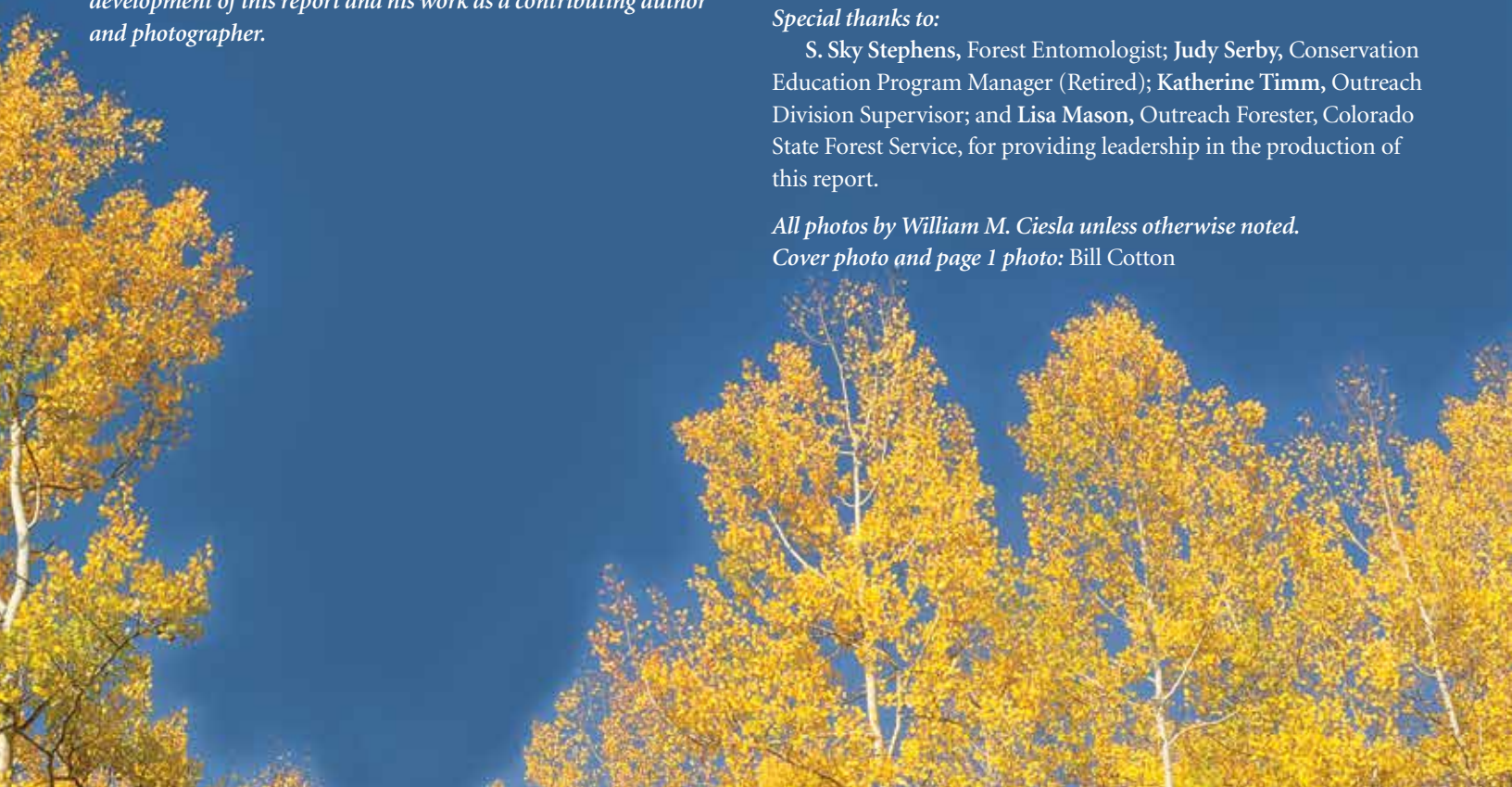


January 2013

On behalf of the Colorado State Forest Service, it is my pleasure to present the annual report on the health of Colorado's forests. The theme of this year's report is "Forest Stewardship through Active Management," with an emphasis on the link between healthy forests and sound forest management efforts. This is the 12th consecutive year we have produced a report on the state of Colorado's forests and actions we are taking to mitigate forest health concerns.

Colorado's forests have experienced significant change over the past two decades. We've seen unprecedented mortality in our conifer forests, driven by poor resiliency to insects and diseases that has been exacerbated by warmer and drier weather conditions. After experiencing many years of a mountain pine beetle epidemic that has exceeded any in Colorado's recorded history, we now face another bark beetle epidemic – the spruce beetle. For the first time in recent years, the acreage impacted by spruce beetle surpassed that of the mountain pine beetle.

We've also seen significant growth in the wildland-urban interface (WUI), the area where structures and other human developments intermingle with forested environments. Management is critical in the WUI to reduce the risk of wildfire to homes, property and infrastructure.

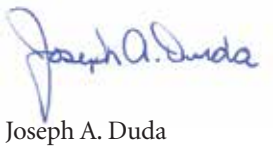
In addition, over the last 15 years, the wood products industry in Colorado has experienced a significant decline. Forest products businesses provide local employment, create economic diversity and support forest management objectives. In turn, forest management can support wood products industries while promoting forest health and reducing wildfire risk.

Last year, we asked two fundamental questions: what do we want our future forests to look like, and what do we want them to provide? The possible answers are as diverse as Colorado's forests, but what is certain is that managing for healthy forests will allow for the production of biomass and traditional wood products; clean air and water; protection of wildlife habitat; enhancement of recreational opportunities; reduced risk from wildfire; and support for local economies.

Now is the time to shape Colorado's future forests. We must seize the opportunity to take action based on the best available information and resources. The Colorado State Forest Service, the lead state agency for forest stewardship, management, applied research, technical assistance, and outreach and education, is prepared to guide landowners and stakeholders throughout Colorado to plan, implement and maintain successful forest management practices. Through sound forest management, we can help ensure that our future forests provide a variety of resources and benefits that will meet the needs and values of current and future generations.

This report provides an overview of the current condition of Colorado's forests and the recent activity of various insects and diseases. It demonstrates how responsible forest management – from wildfire risk mitigation around a single residence to the maintenance of large-scale watersheds – can be achieved. It also provides examples of how active forest management and stewardship will help ensure that Colorado's forests continue to provide all the benefits we enjoy.

I hope you find the information contained in this report to be informative and helpful. Please feel free to contact any CSFS office to learn more about our forests and what you can do to help manage and protect this precious resource.



Joseph A. Duda
Interim State Forester
Colorado State Forest Service

Executive Summary

Each year, the *Report on the Health of Colorado's Forests* provides information to the Colorado General Assembly and citizens of Colorado about the health and condition of forests across the state. In addition to providing a comprehensive overview of the current health of Colorado's forests, this year's report also includes sidebars that highlight the ongoing management and stewardship of our forests. These forest management actions help sustain production of wood and non-timber products, support Colorado communities and economies, and ensure the health and diversity of Colorado's forests for current and future generations.

The principal source of information for this report is the annual aerial forest health survey, a cooperative project between the Colorado State Forest Service and the Rocky Mountain Region of the USDA Forest Service. Other data sources include field inspections and contacts with forest landowners by CSFS personnel; the Colorado Forest Inventory and Analysis (FIA) Program; and special surveys designed to help ensure early detection of potentially invasive insect species, such as gypsy moth, emerald ash borer and exotic bark beetles.

For the first time since the mountain pine beetle epidemic began, the acreage impacted by spruce beetle surpassed that of the mountain pine beetle. A total of 311,000 acres of active spruce beetle infestation were mapped in 2012. Outbreaks of spruce beetle continued in four areas of Colorado: the San Juan and La Garita mountains in southwest Colorado, the Grand Mesa in western Colorado, the Wet Mountains in south-central Colorado and portions of the Arapaho-Roosevelt National Forest and Rocky Mountain National Park in north-central Colorado. Localized infestations also were detected on the eastern slopes of the Sangre de Cristo Range. Infestations in the San Juan and La Garita mountains continued to spread north toward Lake City and northeast into the Cochetopa Hills toward Monarch Pass. Active infestations continued in younger forests and in krummholz at the edge of timberline in these areas. However, many of the mature spruce trees in portions of

◄ The Colorado River is one of the major river systems in Colorado that provides water to 18 states. Photo Credit: CSFS

the San Juan and La Garita mountains, including areas within the Weminuche Wilderness, were killed during previous years of the outbreak.

Although surpassed by spruce beetle in 2012, the mountain pine beetle continued to be one of Colorado's most damaging forest insects. Active infestations occurred on a combined 264,000 acres of limber, lodgepole and ponderosa pine forests. This represents a decline in the overall infested acreage for the fourth consecutive year. The reason for the decline is that most of the trees susceptible to infestation – primarily mature lodgepole pines in Jackson, Grand and Summit counties, and in other lodgepole pine forests west of the Continental Divide – were attacked and killed during previous years of the outbreak. However, in 2012, moderate to severe damage persisted in ponderosa, lodgepole and limber pine forests over much of the northern Front Range. The area of active infestation in ponderosa pine forests dropped for the first time in three years, to 170,000 total acres in 2012. Most of the damage in ponderosa pine occurred in Larimer County (164,000 acres), largely north of the Big Thompson River. Infestations in both lodgepole and ponderosa pine forests also declined in areas along the central Front Range in Boulder, Clear Creek and Gilpin counties, and south of the I-70 corridor, despite the presence of a substantial number of susceptible host trees.

Douglas-fir beetle impacted mature Douglas-fir trees in portions of the Rampart Range, on the slopes of Cheyenne Mountain, in the Sangre de Cristo/Culebra ranges, across portions of the Gunnison Basin and scattered throughout other parts of southwestern Colorado. The western balsam bark beetle/root disease complex also continued to kill subalpine fir trees in many of the state's high-elevation forests. Infestations of the piñon ips bark beetle, detected north of Cañon City and Florence in 2011, increased in size in 2012.

Western spruce budworm continued to defoliate Douglas-fir, white fir and spruce in portions of the Sangre de Cristo/Culebra ranges, the Wet Mountains and the San Juan Range. Approximately 217,000 acres of defoliation were visible during aerial surveying in 2012. Top-kill and tree death continues to occur in forests that have sustained successive years of defoliation.

Several defoliating insects of deciduous trees also were observed in 2012. Defoliation of quaking aspen forests by two insects – western tent caterpillar and large aspen tortrix – increased significantly, with a total of 29,000 acres of aerially visible defoliation detected, predominately in portions of the Sangre de Cristo/Culebra ranges and the San Juan Mountains. For the second consecutive year, fall cankerworm, a defoliator of Gambel oak, also continued to have an impact south of Castle Rock, but is predicted to decline after significant frost damage to the foliage of oak forests. Other relatively minor forest pest damage detected during 2012 includes localized infestations by leaf beetles on narrow-leaf cottonwood trees and damage to piñon pine foliage by piñon needle scale.

Loss of ornamental black walnut trees infested by thousand cankers disease continued in many of Colorado's urban forests in 2012. New centers of infestation were detected in Fort Collins, Loveland, Greeley and Cañon City. Walnut trees are an important part of Colorado's community and urban forests.

Exotic and potentially invasive insects and diseases also continue to threaten Colorado's forests. Surveys were conducted for two potentially invasive exotic insects: gypsy moth and emerald ash borer. Neither species was detected during the 2012 surveys. Pine wilt nematode was identified in exotic pines along the Front Range and in Grand Junction. White pine blister rust, another invasive pest, continued to damage limber and bristlecone pines in several areas of the state, including a new area of infestation detected in the Lefthand Canyon area of Boulder County.

The drought also continued to impact many of Colorado's forests in 2012, and some experienced large wind events in late 2011. Drought conditions caused leaf scorch or severe desiccation of aspen and other broadleaf trees and shrubs in many of the state's forests. Leaf scorch also was present on a variety of broadleaf trees in urban and community forests, especially along the Front Range. In November 2011, hurricane-force winds caused extensive tree windthrow in several areas of the state. Areas of windthrown trees observed during the aerial survey occurred from Monarch Pass south towards Poncha Pass, and on the eastern slopes of the Sangre de Cristo Range south to Medano Pass. Other areas of windthrow occurred in lodgepole pine forests in the Geneva Creek Basin and in spruce forests south of Georgetown near Guanella Pass and the South Chicago Creek Basin. Like drought, windthrow that results from extreme wind events can impact a forest's resiliency to insects and diseases.

The Colorado State Forest Service continues to work with private forest landowners, cooperators and stakeholders to effectively manage Colorado's forested lands. For more information on the data presented within this report, please contact the CSFS or visit www.csfs.colostate.edu.

▲ Greg Zausen, assistant district forester on the CSFS Fort Collins District, uses an increment borer, a tool that measures a tree's age. Photo Credit: Lisa Mason

Update on Forest Insects, Diseases and Environmental Stressors

▼ CSFS Durango District Forester Kent Grant teaches a middle school class at St. Columba School in Durango about spruce beetle and the importance of forest management. Photo Credit: St. Columba School

This section provides a summary of the many insect and disease agents affecting the health and vitality of Colorado's forests. The principal source of information for this section is the annual aerial forest health survey. In Colorado, this survey is a cooperative project of the Colorado State Forest Service and USDA Forest Service, Rocky Mountain Region. High-wing aircraft, such as Cessna models 206 and 210, are used to conduct the surveys. Teams of aerial observers representing the two agencies fly over all of Colorado's forest types, except piñon-juniper woodlands and the dispersed forests of the Great Plains. In 2012, however, a survey also was conducted of piñon-juniper forests in the Purgatoire River Basin south of La Junta.

Aerial observers record the location and extent of forest damage on touch-screen computers using special mapping software. From the air, they can identify impacted tree species and the damage signatures of specific insects, diseases and other threats. The data they collect are then stored using a geographic information system (GIS) and later analyzed to identify trends in forest condition and the activity levels of insects and diseases over time. When additional information is required to confirm or diagnose the agent responsible for tree mortality/decline, aerial observers conduct on-the-ground checks of areas of concern observed during survey flights.

CSFS foresters also regularly observe and report on the occurrence of forest pest activity and provide annual reports for their respective districts around the state. These reports offer information on a smaller, more localized scale, and often include information about insect and disease activity not observable from the air. Results from special surveys conducted by the Colorado Department of Agriculture and USDA Animal and Plant Health Inspection Service (APHIS) to ensure early detection of two potentially invasive exotic forest pests, the gypsy moth and emerald ash borer, also are included in this report.

◄ Diana Selby, assistant district forester for the CSFS Fort Collins District, fells a beetle-kill pine to reduce fuels at the Borden Memorial Forest, a living classroom owned by Colorado State University. Photo Credit: Peggy Ely

Indigenous Pests

Conifer Forests

Spruce Beetle

(Dendroctonus rufipennis)

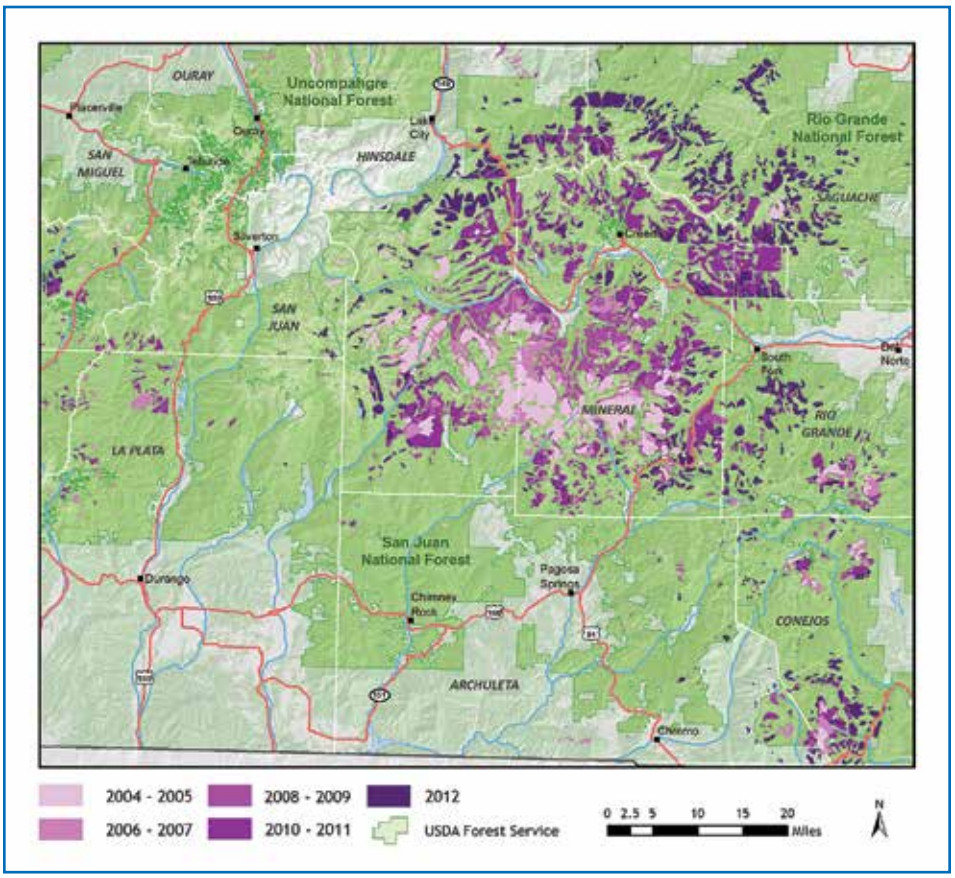
As of 2012, the spruce beetle has become the dominant active insect threat in Colorado's forests. Spruce beetle is the most destructive bark beetle in North America's spruce forests. In Colorado, the spruce beetle can cause significant mortality in mature high-elevation forests, particularly in Engelmann spruce. The spruce beetle typically requires two years to complete a life cycle and, unlike mountain pine beetle, spruce beetle can develop in downed spruce trees. Outbreaks typically occur several years after storms cause windthrow in spruce trees, which are susceptible to blowdown because of their shallow root system. Spruce beetle initially breeds in the freshly windthrown trees and subsequent generations attack and kill live, standing trees. Spruce beetle typically attacks large-diameter spruce trees in decadent stands, but when beetle populations exhaust desirable hosts, they will attack smaller and younger trees.

Unlike the mountain pine beetle epidemic, the scope of active spruce beetle infestation in Colorado has expanded over the past several years – increasing in size for the fourth consecutive year in Colorado's high-elevation spruce forests. This is largely due to an abundance of available host trees for spruce beetles, compared to a decline in susceptible host trees for mountain pine beetles. Surveyors mapped approximately 311,000 acres of tree mortality attributable to spruce beetle, compared to 262,000 acres in 2011; 208,000 acres in 2010; 114,000 acres in 2009; and 64,000 acres in 2008.

In areas where the outbreak has been underway for several years, such as the Weminuche Wilderness in southwest Colorado, most or all of the mature spruce trees already have been killed, and

▲ Pre-emergent spruce beetles overwinter in the inner bark of an Engelmann spruce.

Spruce Beetle Progression in Southwestern Colorado 2004-2012



mortality continues in krummholz – the stunted and deformed trees that live in the harsh conditions on the edge of timberline. Moderate to severe infestations continued in four areas of the state: the San Juan and La Garita mountains in southern Colorado, the Grand Mesa, the Wet Mountains and portions of the Arapaho-Roosevelt National Forest and Rocky Mountain National Park in northern Colorado. Localized infestations also were detected on the eastern slopes of the Sangre de Cristo Range.

A massive spruce beetle outbreak, which began in the Weminuche Wilderness of the Rio Grande and San Juan National Forests around 2002, continued to expand north and east in 2012. 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 Rambouillet Park and Spring Creek Pass. New areas of infestation also were detected south of Lake San Cristobal near Lake City.

Spruce beetle infestations continued in the Wet Mountains near areas affected by a blowdown event that occurred in June 2007. The heaviest damage in 2012 was noted in the Greenhorn Creek Basin and along the National Forest road, from Ophir Pass south to the Greenhorn Peak Mountain Trailhead in the San Isabel National Forest.

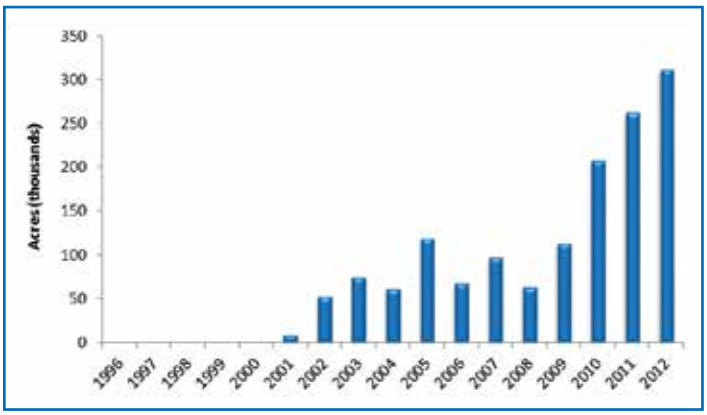
The spruce beetle outbreak in north-central Colorado, which has been underway since 2005, declined in 2012, primarily because most of the susceptible host trees were attacked and killed during previous years. However, small numbers of dying spruce could be seen amid the dead trees from previous years' attacks.

Although the spruce beetle affects high-elevation forests that are much less densely populated with people and homes than lands impacted by mountain pine beetle, it is important that this threat be addressed. The forests attacked and killed by spruce beetles are located at the headwaters of Colorado's rivers, which provide water to 18 states. Water yields may be influenced by the death of so many trees, and the impacts to water quality and quantity would be significant if wildfires occur in these altered forests. Many wildlife species unique to the subalpine communities of the Rocky Mountains also are found in these forests. Recreational opportunities such as downhill and cross-country skiing, camping, hunting and fishing are predominant in areas of the state that could be impacted by the spruce beetle.

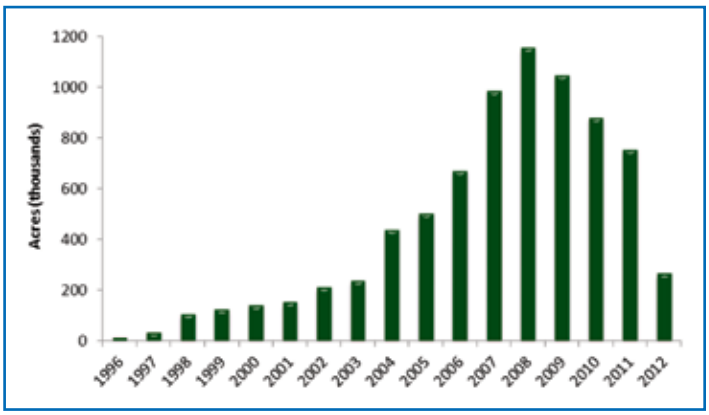
▲ Spring Creek Pass in Hinsdale County has been heavily infested with spruce beetle; infested trees turn a light yellow-green color before turning gray. Visually, spruce beetle mortality is less dramatic than mountain pine beetle-caused mortality in lodgepole pine. Large areas of spruce forests, including areas on the La Garita Range, have a ghostly gray cast.

2012 Statewide Spruce Beetle Activity

Annual Acres Affected by Spruce Beetle in Colorado



Annual Acres Affected by Mountain Pine Beetle in Colorado



Mountain Pine Beetle

(Dendroctonus ponderosae)

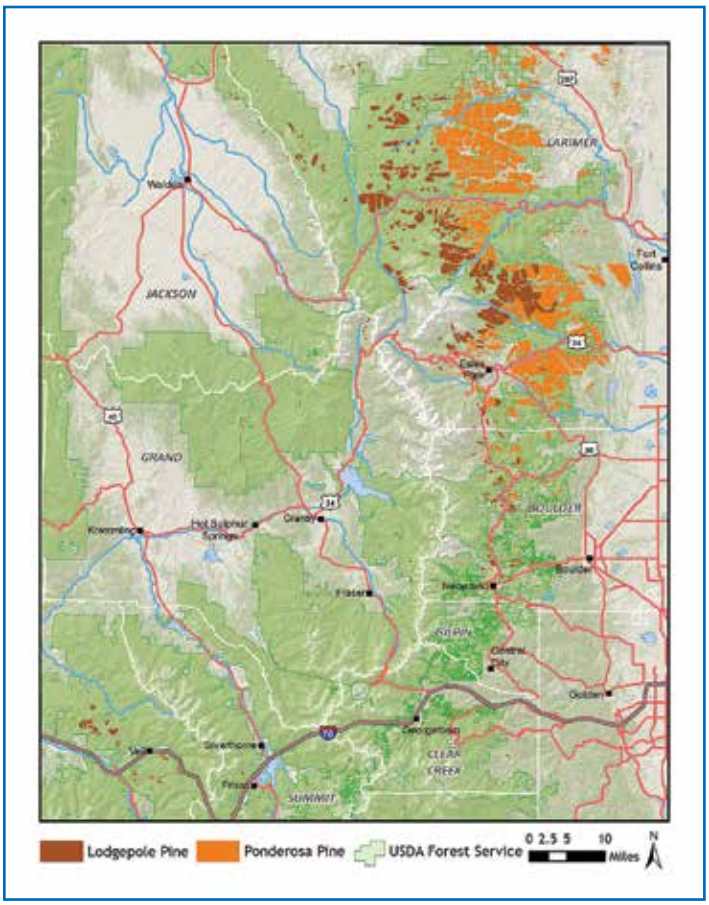
Though smaller in scope than the active spruce beetle infestation in 2012, mountain pine beetle (MPB) infestations continued to cause severe damage to ponderosa, lodgepole and limber pine forests in Colorado, primarily in Larimer County and portions of Boulder County. Aerial surveyors mapped 264,000 acres of active infestation in 2012. This represents a reduction in the area infested for the fourth consecutive year, down from 752,000 acres in 2011; 878,000 acres in 2010; 1,046,000 acres in 2009; and 1,154,000 acres in 2008. This reduction is largely due to the fact that in several areas of the state, including the West Slope and north-central Colorado, many pine forests were previously impacted, leaving fewer acres of susceptible host trees. Approximately 64 percent of the currently infested area (or 170,000 acres) is located in low-elevation ponderosa pine forests along the northern Front Range.

In Larimer County, MPB was most active in low- to mid-elevation forests, including both ponderosa pine and ponderosa pine/lodgepole pine forest types. Moderate to severe damage continued in ponderosa pine forests in the Beaver Creek Basin and on Table Mountain, east of U.S. Highway 287 near the Wyoming border. Damage also continued in ponderosa pine forests east of Red Feather Lakes and in lodgepole pine forests on the slopes of North, Middle and Bald mountains, all west of Red Feather Lakes. Moderate to severe tree mortality also continued in both ponderosa and lodgepole pine forests throughout the South Fork Cache la Poudre Basin, along Buckhorn Creek and in the lower Big Thompson River Basin.

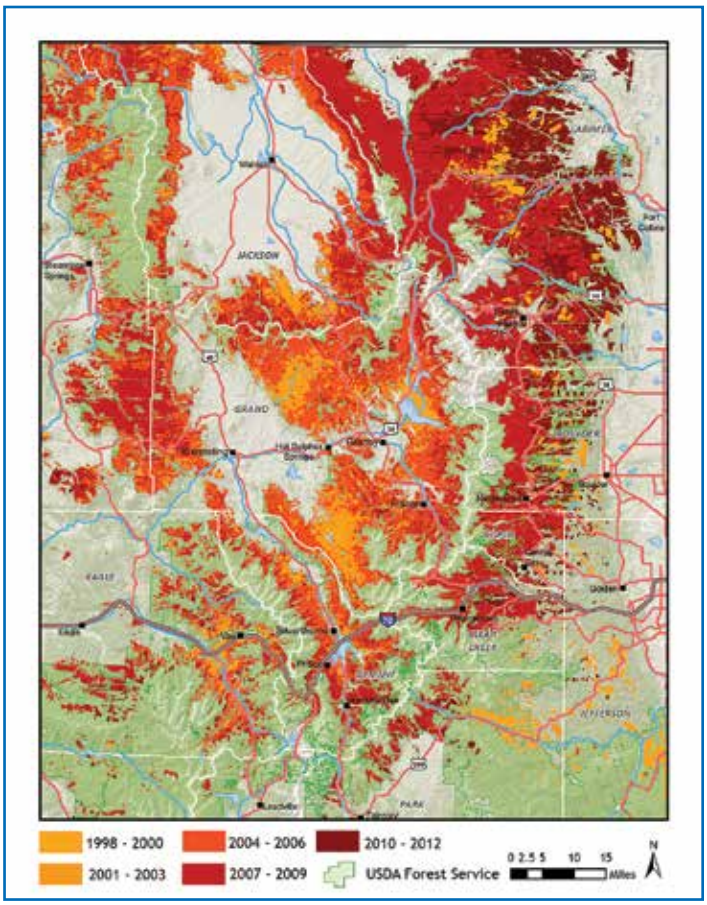
The High Park Fire, which burned approximately 87,284 acres west of Fort Collins in June 2012, occurred in the heart of Colorado's current MPB infestation. Because the fire occurred prior to the 2012 aerial survey flights, it may have reduced the acreage of mapped MPB infestation. Many pines that host soon-to-emerge adult

▲ Mountain pine beetle infestation in the lower Big Thompson River Basin. The yellow trees are ponderosa pines, and the red trees are lodgepole pines impacted by the beetles.

2012 Mountain Pine Beetle Activity by Host Species



Mountain Pine Beetle Progression, 1998-2012



beetles were destroyed in the fire; however, pine forests within the fire perimeter that did not burn still harbor active infestations. Also, some ponderosa pines that survived the fire but suffered bark damage due to scorching were subsequently attacked or may be attacked in 2013.

MPB infestations have declined to nearly imperceptible levels over much of Colorado's lodgepole pine forest type, including in the Middle and North Park areas, where the host tree population has been exhausted. Most mature lodgepole pine forests in these areas now have a gray cast because the red needles have dropped from large numbers of dead trees affected by previous years' attacks. Infestations also have declined in most high-elevation lodgepole pine forests along the Front Range from the Wyoming border south to the I-70 corridor.

▲ A ponderosa pine forest impacted by mountain pine beetle near Mount Margaret in Larimer County.

New attacks on the eastern slope of the Rawah Range and in the upper Cache la Poudre and upper Big Thompson River basins were largely confined to small-diameter lodgepole pine stands. MPB brood production in these trees likely will be insufficient to sustain outbreak populations in these areas in the near future. However, many lodgepole pine forests south of Estes Park, including the Bear Lake area of Rocky Mountain National Park and portions of Boulder, Gilpin, Clear Creek and Park counties, still appear to have a substantial component of lodgepole pine in age classes suitable to sustain an outbreak.

Mountain pine beetle infestations also declined markedly from Guanella Pass and the Geneva Creek Basin south to Fairplay; in 2008-2009, these areas appeared to be on the brink of a major outbreak. Most of the lodgepole pine stands in this area still contain a high proportion of trees suitable for brood development. Infestations in lodgepole pine forests in the Aspen/Snowmass Ski Area and on the slopes of Smuggler Mountain near Aspen have declined to low levels. Aggressive stand management occurred in this area during the outbreak, yielding some success in reducing losses to MPB.

While the impact of MPB on live trees is in decline, concerns remain about how to deal with previously impacted forests. More than 3.3 million forested acres in Colorado have been affected by MPB since the current infestation began more than a decade ago. Standing dead trees continue to dominate these landscapes, posing a hazard to residents, recreationists, infrastructure and watersheds, in the form of falling trees, increased fuel for wildfire and the potential effects on the state's watersheds.

Forest Management to Reduce Tree Mortality from Mountain Pine Beetle

Mountain pine beetle is the most damaging insect pest in Colorado's pine forests. The current outbreak began in 1996 and has killed millions of trees in northern Colorado's ponderosa and lodgepole pine forests. New groups of young trees are now emerging in areas heavily impacted by the outbreak. These emerging forests will need to be managed to ensure that they are healthy, vigorous, diverse and more resilient to forest pests in the future.

"Good forest management, including thinning, timely harvesting and natural fire regimes will help ensure that these future forests meet a diversity of needs, including biomass production and traditional wood products, as well as clean air and water. They also will provide recreational opportunities and support local and state economies," said Scott Woods, acting supervisor of the Forest Management Division, Colorado State Forest Service.

In order to be effective, it is imperative that forest management practices are tailored for specific forest types (i.e., lodgepole pine, ponderosa pine, mixed conifer) and stakeholder objectives for the site (i.e., timber production, fuels mitigation, wildlife habitat). Sound forest management takes into consideration specific tree species and site-condition variables (i.e., slope, aspect, soil type, riparian areas) prior to treating forest stands. Each forest type responds differently to management practices, so there is no one-size-fits-all approach that is best suited for all forest types. For example, reducing the likelihood and severity of mountain pine beetle attack in ponderosa pine forests requires a different forest management strategy than in lodgepole pine forests. These strategies consider silvics – the study of how climate, soil, available moisture, topography and other factors affect tree growth and health – of each forest type.

Ponderosa pine tend to grow in uneven-aged stands in which the age and diameter of individual trees are diverse. Historically, this diversity was maintained by the presence of relatively frequent, low-intensity fires. Ponderosa pines, with their thick bark and deep tap root, are adapted to these low-intensity fires.

In ponderosa pine forests, mountain pine beetle attacks dense stands dominated by smaller-diameter trees, which are under stress, have high competition for resources and display poor annual growth. These dense stands typically occur when fire has been excluded from the landscape. Periodic thinning and harvesting individual trees help maintain healthy ponderosa pine forests by mimicking the characteristics of forests that traditionally were maintained by naturally occurring fire events. Thinned ponderosa pine stands that support vigorous trees of various ages and sizes are less susceptible to mountain pine beetle attack, even when dense neighboring stands are impacted.

Lodgepole pine forests are significantly different from ponderosa pine forests, and require a different approach to stand management. Lodgepole pine forests typically develop as pure, even-aged stands. These stands typically emerge after a disturbance such as wildfire because lodgepole pines, with their thin bark, are less adapted to fire.

In lodgepole pine forests, mountain pine beetle usually attacks trees that are approximately six inches in diameter. As lodgepole pine stands mature, they contain a high proportion of individual trees that are similar in diameter. This uniformity allows mountain pine beetle to be very successful, and a high percentage of the stand can be impacted. Harvesting mature lodgepole pine stands across a landscape in patchcuts reduces the proportion of stands susceptible to mountain pine beetle attack. Unlike ponderosa pine stands, mature lodgepole pine stands, due to their shallow root system, do not respond well to thinning and are prone to windthrow; however, interval thinning of young trees is beneficial because it prevents overstocking. The harvested lodgepole pine stands regenerate naturally and before

long are occupied by a stand of young, vigorous trees. This results in a mosaic of stands consisting of different age classes over the landscape. When mountain pine beetle activity occurs in this more age-diverse landscape of lodgepole pine stands, the areas of mature stands are most susceptible to attack, while surrounding areas of younger lodgepole pines are less susceptible.

Forest management helps maintain healthy stands of lodgepole and ponderosa pine, increasing their resiliency to mountain pine beetle. “While maintaining forest health and promoting ecosystem function, we also can mitigate accumulated fuels, as well as associated fire risks and air quality impacts, preserve the integrity of watersheds and protect property and infrastructure,” said Woods. “We also can support a diverse wood products industry and sustainable forest-based enterprises, which contribute to the health of Colorado’s economy.”

▲ Patchcutting consists of removing sections or patches of lodgepole pine trees. This is an effective management strategy in lodgepole pine forests because the harvested areas regenerate naturally, creating a young stand of trees. Photo Credit: Bill Cotton

▲(Before): Young trees emerge following the mountain pine beetle epidemic. If they are continually and properly managed, forests will be more resilient to forest pests, such as mountain pine beetle. Photo Credit: CSFS

▲ (After): A thinned forest is more resilient over time because there is less competition for water, nutrients and space for individual trees to grow. Photo Credit: CSFS

Douglas-Fir Beetle

(Dendroctonus pseudotsugae)

Douglas-fir beetle continued to impact forests in several areas south of Denver and on Colorado's Western Slope. Approximately 27,000 acres of active infestations occurred in 2012, compared to 25,000 acres in 2011. Many of the identified infestations have been ongoing for several years, and trees with gray crowns from previous years' attacks are adjacent to more recent mortality.

Infestations continued in Douglas-fir forests in the northern Rampart Range and drainages north of Florence and Cañon City. Mortality also continued on steep mountain slopes from Manitou Springs south, along the eastern slopes of Cheyenne Mountain, and south to Turkey Creek. Surveyors commonly observed groups of between one and 20 trees killed by Douglas-fir beetle at the lower-elevation limits of Douglas-fir growth in drainages on the western slopes of the Culebra and Sangre de Cristo ranges. This included several large groups in the lower Medano Creek Basin of the Great Sand Dunes National Park and Preserve.

On the Western Slope, infestations continued in and around Paonia, on the rimrocks of the Black Canyon of the Gunnison, and in low-elevation forests from Gunnison south to Lake City, where mortality was detected in groups of up to 100 trees. Infestations in groups of up to 500 visibly fading Douglas-fir trees were detected in several tributaries of the Crystal River, from Marble north and east to the slopes of Mount Sopris. Infestations also were observed in multiple locations along the base of the San Juan Mountains, in the vicinity of Pagosa Springs.

Subalpine Fir Decline

High-elevation subalpine fir forests are subject to infection by two species of root disease fungi, *Armillaria* spp. and *Heterobasidion parviporum*, which weaken trees and make them susceptible to attack by western balsam bark beetles *(Dryocoetes confusus)*. Chronic levels of tree damage from this complex have been underway in Colorado for several years. In 2012, damage was especially prevalent in portions of the West Elk Mountains between McClure Pass and Independence Pass. Subalpine fir mortality also continued at moderate levels, from Guanella Pass south to Trout Creek Pass in 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.

▲ Piñon pines killed by the piñon ips bark beetle in Phantom Canyon, north of Florence.

Engraver Beetles and Piñon Twig Beetles

(Scolytus ventralis, Ips spp. and Pityophthorus spp.)

Increased mortality levels in white fir occurred in 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 fir engraver beetle is responsible for the damage. This bark beetle attacks and kills several species of true firs, increasing tree damage and mortality during periods of drought or low precipitation.

Localized infestations of the piñon ips bark beetle *(Ips confusus)*, first detected in piñon-juniper forests north of Cañon City in 2011, 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 *Pityophthorus*, 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.

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, a characteristic of damage caused by pine engraver beetle *(Ips pini)*, was seen in ponderosa pines in the vicinity of the Palmer Divide north of Colorado Springs.

Western Spruce Budworm

(Choristoneura occidentalis)

Historically, western spruce budworm is the most damaging defoliating insect of Douglas-fir, white fir and spruce forests in Colorado. Successive years of defoliation causes reduced growth, top kill and sometimes tree mortality. Trees weakened by defoliation also are subject to attack by bark beetles, such as Douglas-fir beetle and fir engraver beetle. Defoliation by western spruce budworm was again present over much of the southern portion of the state in 2012, with a total of 217,000 acres of aerially visible defoliation.

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 and from Medano Pass north to Methodist Mountain.

Western spruce budworm outbreaks in the Wet Mountains also occurred for the third consecutive year. Almost all of the susceptible host trees, from Ophir Pass south to the southern terminus of the mountain range, were defoliated 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. This is the farthest north that defoliation by western spruce budworm has been observed in Colorado in several years.

▲ Defoliation of Douglas-fir and white fir near Lake San Isabel in the Wet Mountains.

▲ Western spruce budworm feeds on new buds and foliage of spruce and fir trees. Photo Credit: Sky Stephens

Piñon Needle Scale

(Matsucoccus acalyptus)

Piñon needle scale is a tiny insect that feeds on the needles of piñon pine. Infestations occur on older needles, which turn brown and drop from the trees. Heavier infestations can give the crowns of affected trees a thin, tufted appearance, because only the needles from the most recent year's growth remain on the trees. Repeated infestations also can weaken and kill trees. In 2012, piñon needle scale infestations appeared in several areas, including the Kerber Creek Basin in the upper San Luis Valley, and in the southern portion of the Sangre de Cristo Range north of Mount Maestas.

▲ Piñon needle scale on piñon pine in the San Luis Valley.

Helicopter Logging, Pheromones Used to Tackle Steamboat Springs Bark Beetle Infestation

In 2012, the Colorado State Forest Service Steamboat Springs District used an integrated management approach to deal with the bark beetle infestation in a very visible and high-use area of Steamboat Springs.

In June 2012, the City of Steamboat Springs requested a complete forest health assessment for the Douglas-fir trees at the Howelsen Hill Ski Jump Complex, located on the southwest edge of town. The assessment, conducted by the Colorado State Forest Service, indicated that many of the Douglas-fir trees in the stand were infested by Douglas-fir beetle, a close relative of the mountain pine beetle that has affected millions of acres of lodgepole pine forest in Colorado. Trees infested by Douglas-fir beetles ultimately fade to yellow and then reddish-brown before dying.

The CSFS determined that removing all infested trees at Howelsen Hill would help prevent further spread of the beetles and made forest management recommendations to be implemented through the summer and fall of 2012. Recommendations included tree harvesting operations, pheromone deployment and further monitoring.

"The removal of all infested trees provided the best opportunity for controlling the infestation," said Carolina Manriquez, forester with the CSFS Steamboat Springs District. She says another significant reason for removing dying trees was that, when dead, they would represent a significant hazard to recreational users and the ski jump infrastructure.

The extreme slope in the project area required a technically complex operation. Local logging company Precision Timber worked with Connors Aviation to remove more than 90 mature Douglas-fir trees from the Howelsen Hill Ski complex. The infested trees were first felled by hand in September and logs were removed by helicopter the next month. This method minimized the impact on healthy vegetation and existing maintenance trails.

To deter new attacks on healthy trees, 150 anti-aggregate pheromone patches were deployed throughout the stand. Patches were nailed on green Douglas-fir trees, about 6 feet off the ground. Although chemical spraying is highly effective, pheromones were used instead because foresters were concerned with the difficulty of spray operations on steep slopes and the use of chemicals close to town and water supplies.

▲ Douglas-fir trees infested by the Douglas-fir beetle at the Howelsen Hill Ski Jump Complex have faded to yellow and reddish-brown. Photo Credit: CSFS

"Douglas-fir beetle is an endemic species in this area, and could still pose a problem in the future," Manriquez said.

To deter future beetle attacks, foresters will continue to deploy anti-aggregate pheromones annually for a minimum of three to five years. Regular monitoring and evaluation of the stand also will be necessary to take timely and appropriate action in the coming years. The next stand assessment is scheduled for early spring 2013.

Deciduous Forests

Thousand Cankers Disease

Thousand cankers disease affects black walnut trees and has caused significant mortality of ornamental black walnuts in many of Colorado's urban forests. The disease is caused by the fungus *Geosmithia morbida*, which is spread from tree to tree by the walnut twig beetle *(Pityophthorus juglandis)*. The fungus produces tiny cankers and causes dieback on branches. Repeated attacks by walnut twig beetles, which lead to multiple infections by thousand cankers disease, eventually cause tree death.

The walnut twig beetle is native to portions of Arizona, New Mexico and Mexico, where it causes little or no damage to its host tree, Arizona walnut. In 2004, large numbers of walnut trees began to die from this disease in several Colorado communities, including the greater Denver and Boulder areas. In 2012, tree mortality from thousand cankers disease intensified in several areas where it has more recently been discovered, including Fort Collins/Laporte, Pueblo and Cañon City. In 2012, the occurrence of thousand cankers disease was confirmed for the first time in Loveland and Greeley.

▲ Adult western tent caterpillar, a common defoliator of aspen in Colorado.

► A dying black walnut in Cañon City displays the symptoms of thousand cankers disease, including foliage decline and discoloration. Loss of ornamental black walnut trees is occurring in many Colorado communities.

Defoliating Insects of Aspen

Approximately 29,000 acres of aspen defoliation were mapped in 2012 aerial surveys, 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 on the west slopes of Mount Sopris and immediately south of the Aspen Highlands Ski Area in Pitkin County, and near the historical mining town of Bonanza in Saguache County.

▲ Aerial view of aspen defoliated by large aspen tortrix near Lake San Isabel.

▲ Fall cankerworm was responsible for defoliation in Gambel oak woodlands in Douglas County.

► Larvae of a cottonwood skeletonizer feeding on the underside of a narrowleaf cottonwood.

Defoliation of aspen stands by western tent caterpillar *(Malacosoma californicum)* and large aspen tortrix *(Choristoneura conflictana)* 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 experienced defoliation for a number of years.

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 in the San Isabel National Forest.

Sudden Aspen Decline

Sudden aspen decline (SAD) is believed to be the result of several interacting factors: drought stress, large areas of aspen stands that are more than 100 years old, and attacks by several species of fungi and insects normally not considered primary tree killers. SAD was first detected 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. Since 2008, the total area of aspen forests affected by SAD has become progressively smaller. This reduction is believed to be due primarily to a return to more normal moisture conditions. Young aspen regeneration now is occurring in many of the aspen stands previously affected by SAD.

In 2012, only 3,100 acres of aspen decline and mortality were mapped. The only location of significance was South Park, where large areas of aspen stands with thin crowns, indicative of stress, were observed. 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.

Fall Cankerworm

(Alsophila pometaria)

Defoliation of Gambel oak woodlands by inchworms occurred for the second consecutive year in Douglas County, south of Castle Rock. Larvae observed during May 2012 were characteristic of fall cankerworm. However, several late-spring frosts occurred in the area infested by the cankerworms, killing the newly formed foliage and destroying a large portion of food available for the young caterpillars. This caused the populations to decline in many of the areas impacted in 2011.

Cottonwood Leaf Skeletonizer

(Altica sp.)

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, commonly known as "flea beetles," feed on cottonwood species, as well as alder and willow.

Exotic Pests

The accidental introduction of exotic and potentially invasive insects, diseases and plants is a continuing threat to the health of Colorado's forests. Two species not yet established in Colorado – gypsy moth and emerald ash borer – are of special concern because of the devastating losses they have caused in other parts of North America, and the significant impact they could have on Colorado's forests. These two insects are the subjects of specialized surveys conducted by the Colorado State Forest Service, Colorado Department of Agriculture, Colorado Parks and Wildlife, and USDA Animal and Plant Health Inspection Service (APHIS).

Emerald ash borer and gypsy moth, like most other exotic insects and diseases, often become established in new areas via the transportation of infested material, including firewood. The movement of infested material has allowed both of these

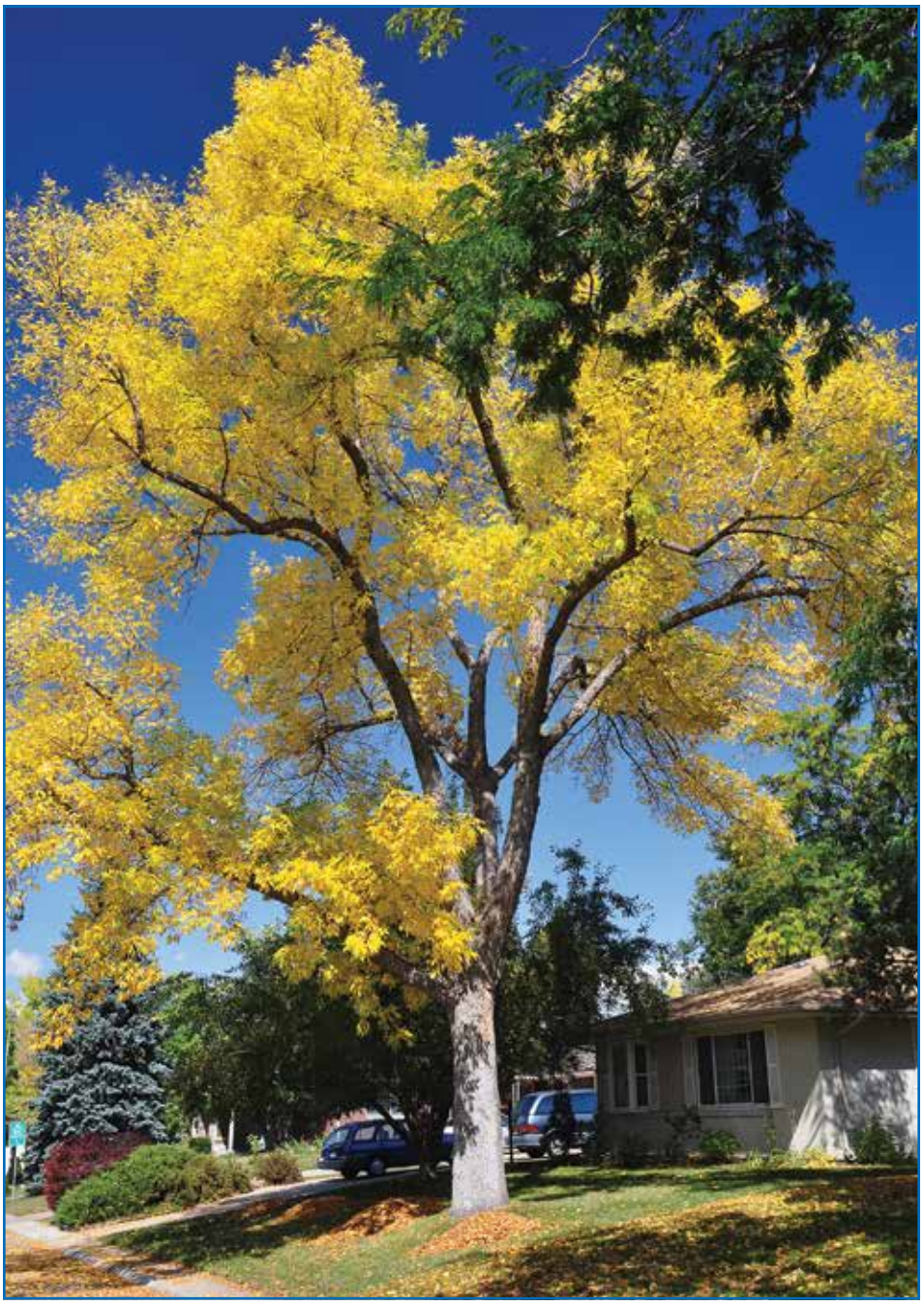
exotic pests to rapidly establish populations in new locations, often hundreds of miles from pre-existing populations.

Gypsy Moth

(Lymantria dispar)

Gypsy moth, an insect native to Eurasia, was introduced into the northeastern United States during the 1800s. The moth's larvae feed on more than 100 species of North American plants, including broadleaf trees and conifers. Since the introduction of this species to the continent, it has defoliated millions of acres of forest in portions of the Northeastern, North-Central and Mid-Atlantic states.

Should the gypsy moth become established in Colorado, it could have devastating effects on the state's native forests, shelterbelts, windbreaks, and urban and community forests. Fortunately, no gypsy moths were detected in the 621 gypsy moth traps that were deployed across the state in 2012, primarily in urban areas.



◄ Ash trees are popular shade trees in urban areas and cities because of their brilliant fall color. All species of ash are susceptible to emerald ash borer.

Emerald Ash Borer

(Agrilus planipennis)

Emerald ash borer is native to Asia, but was first detected in North America in 2002 around Detroit, Mich. It has since caused extensive losses to urban forests, killing millions of ash trees in 17 states. In 2012, emerald ash borer became established in the Kansas City area of Kansas and Missouri, and could easily be introduced in Colorado. In 2012, a total of 200 emerald ash borer traps were deployed in Colorado, and no adults were detected.

Should emerald ash borer become established in Colorado, it would have devastating effects. Ash trees are fast growing and commonly are used as shade trees, ornamental plantings, or in shelterbelts and windbreaks. They have been extensively planted in many Colorado communities, and in some areas represent up to 20 percent of all planted shade trees.

Pine Wilt Nematode

(Bursaphelenchus xylophilus)

Another pest of concern for Colorado's urban and community forests is the pine wilt nematode, which impacts exotic pines and has killed numerous Austrian and Scots pines throughout the eastern United States, as well as Kansas and Nebraska. Pine wilt nematode has been observed in several communities along the Front Range, in Grand Junction and eastern Colorado. Pine wilt nematode could have significant impacts on planted pines, particularly those used in windbreaks and living snow fences.

Cottonwood Leaf Miner

(Zeugophora scutellaris)

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 in 2012. A leaf mining beetle known as poplar black mine beetle, an introduced species native to Europe, has been tentatively identified as the cause of the discoloration. 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.

White Pine Blister Rust

(Cronartium ribicola)

White pine blister rust, a disease of white or five-needle pines, is caused by a fungus. Native to Asia, white pine blister rust was introduced into North America via infected nursery stock during the early part of the 20th century and has caused extensive damage to white pines in many parts of the United States.

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 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. A new area of white pine blister rust infection was detected in May 2012 in the Left Hand Canyon area of Boulder County.

Environmental Influences

Drought

Exceptionally dry weather during the summer of 2012 caused extensive leaf scorch in several forested areas of Colorado. Leaf scorch is characterized by dry, brown leaf margins and is 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 last year, including ash, aspen, boxelder, dogwood, linden, Norway maple, oak and other broadleaf trees in many urban areas along the Front Range.

Leaf scorch was especially prevalent in some aspen forests in 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 South Platte River Basin and at the base of the Arizona and Montana mountains in Gilpin County. Leaf scorch so severe that it could be seen during the aerial forest health survey also was detected on serviceberry shrubs in the Crystal Creek drainage near Gould Reservoir in early July.

Wind Damage

The first winter storm of the 2011-2012 season was accompanied by hurricane-force winds that caused power outages, snarled traffic and blew down thousands of trees in Colorado. Winds 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. Approximately 117 areas with windthrown trees totaling 4,100 acres were mapped in Colorado during the 2012 aerial forest health survey. 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 attack and kill standing trees.

Large patches of windthrown trees were detected in the Sawatch Range, from

▲ Leaf scorch on aspen is characterized by dry, brown leaf margins and discoloration.

Monarch Pass south to Poncha Pass. Patches of windthrow also were detected on the eastern slope of the Sangre de Cristo Range, with 35 areas totaling 1,220 acres and nearly 100-percent blowdown from Methodist Mountain south to Medano Pass. 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.

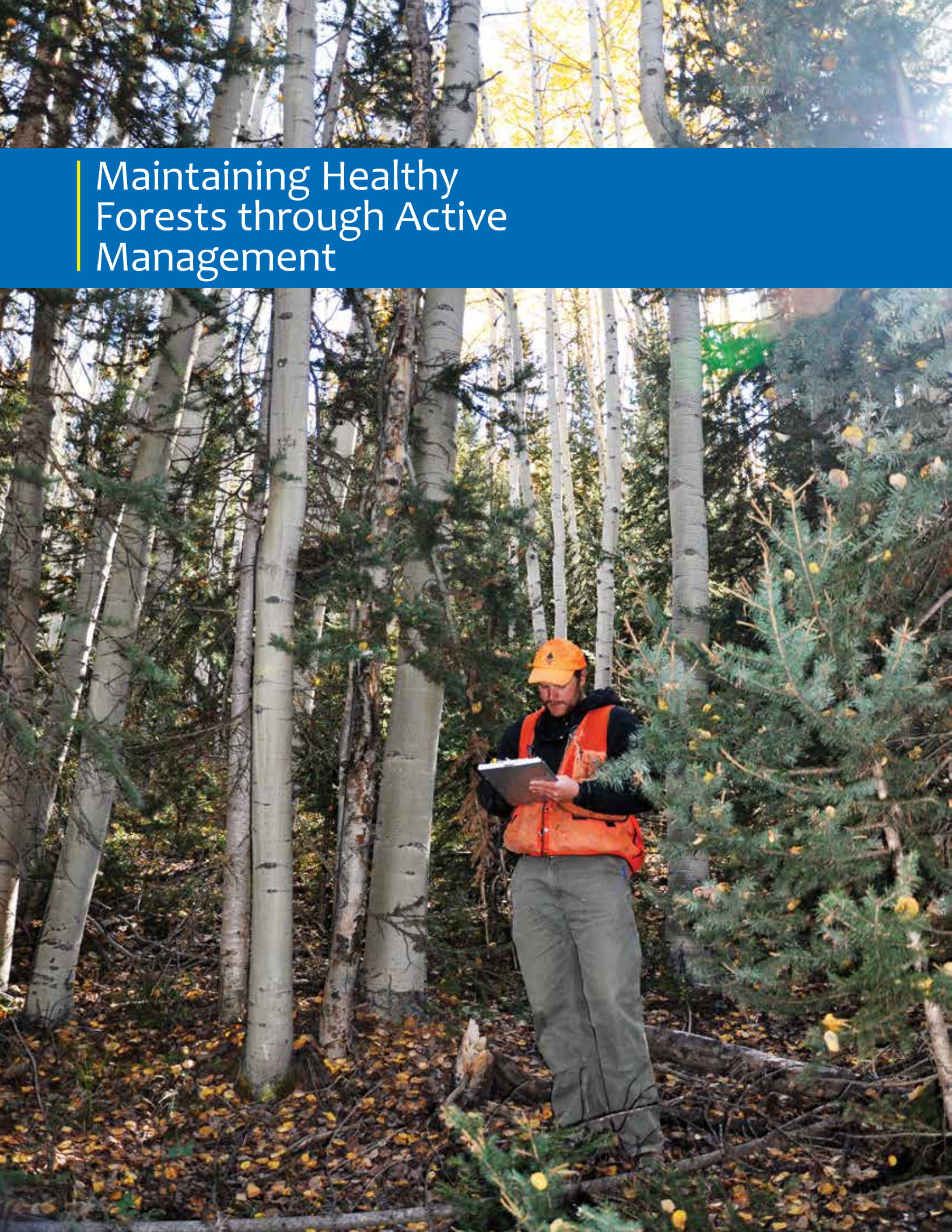
Two small areas of windthrow were detected on the western edge of South Park, one in the Beaver Creek drainage, and the other below Panther Mountain. Both occurred in Engelmann spruce stands and each covered less than two acres. Several small areas of windthrow also were detected in lodgepole pine forests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

Windthrow also was mapped in several areas south of Georgetown, including 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.

▲ High winds in November 2011 caused heavy windthrow in an Engelmann spruce forest on the eastern slope of the Sangre de Cristo Range. This location will become more susceptible to spruce beetle.

▲ Lodgepole pine trees are already susceptible to windthrow because of their shallow root system; after being killed by mountain pine beetle, the risk of windthrow increases. Photo Credit: CSFS

Maintaining Healthy Forests through Active Management



Maintaining healthy forests is essential to Colorado's social, economic and ecological health. Forests require proper management to remain vigorous and productive. Forest management involves the practical application of biological, physical, quantitative, socio-economic and policy principles to the regeneration, management, utilization and conservation of forests. Proper planning and the application of forest management and stewardship practices on all scales, from the single homesite to the regional watershed level, can help promote and sustain healthy forests. When management actions are suitably matched to each forested ecosystem and site objectives, Colorado's forests will be better able to meet our diverse current and future needs, including aesthetics, fish and wildlife habitat, recreation, urban benefits, water yields, wilderness protection and wood products.

▲ This wildland-urban interface community has been heavily impacted by mountain pine beetle. The accumulation of beetle-killed trees has altered aesthetics and property values, and increased wildfire risk. Photo Credit: Sky Stephens

In 2010, the Colorado State Forest Service produced the Statewide Forest Action Plan, which was developed in cooperation with the many stakeholders concerned about Colorado's forests. The Statewide Forest Action Plan was established around three key themes: conserve working forest lands, protect forests from harm and enhance public benefits from trees and forests. The plan identifies threats to Colorado's forests, as well as forest management strategies and tactics for mitigating those threats.

Forest management decisions address many values and concerns, including, but not limited to, the wildland-urban interface, the forest products industry, insect and disease issues, watershed health, invasive species, community forests, wildfire risks, air quality, climate change and forest fragmentation.

▲ Thinning can create more resilient forests, which will reduce the likelihood of landscape-level mortality caused by insect epidemics. Photo Credit: CSFS

◄ Sam Pankratz, forester on the CSFS Gunnison District, records field measurements on private land. Photo Credit: CSFS

The Wildland-Urban Interface

The wildland-urban interface (WUI) is commonly characterized as any area where structures and other human developments meet or intermingle with forested environments. Expansion of low-density residential development in the WUI is expected to increase 300 percent by the year 2030, to almost 2.2 million acres in Colorado. This trend poses many challenges to human and natural communities, including wildfire risks to property and infrastructure, the spread of invasive species, loss and fragmentation of wildlife habitat, and water and air pollution. The CSFS provides education, technical assistance and forest management planning to landowners within the WUI to help mitigate these risks. The CSFS also administers funds to help landowners reduce wildfire-related risks to life and property. Forest management and fuels mitigation within the WUI can protect community values at risk by improving the security of property, infrastructure and watersheds, and the safety of residents and first responders during wildfires.

▲ Most of the forests in the Santa Fe Trail Ranch subdivision were overly dense, increasing wildfire concerns. The community recognized the risks to their lives, homes and forests, and took action to lower those risks. Photo Credit: CSFS

Southern Colorado Community's Efforts Exemplify Effective Fuels Mitigation

After treating 325 acres in 2012 to complement existing fuelbreaks in the community, a mountain subdivision along the New Mexico border has now treated more than 3,000 forested acres. With fuels mitigation work completed on nearly 20 percent of its land area, Santa Fe Trail Ranch provides a model that illustrates how Colorado communities can band together to reduce wildfire risk.

The subdivision covers approximately 17,000 acres in the foothills southwest of Trinidad. Treatments to reduce wildfire risk in the community have been ongoing since 2005, when community leaders first utilized funding and assistance from the Colorado State Forest Service to stimulate widespread landowner involvement. Nearly 15 miles of fuelbreaks along roads, trails, ridgelines and other focal areas within or adjacent to the subdivision will slow the spread and diminish the intensity of an approaching wildfire.

"Now we stand a chance when the big one hits," said Dave Skogberg, a community leader and catalyst to collective efforts.

A Community at Risk

Santa Fe Trail Ranch (SFTR) consists of 454 lots on steep terrain, each approximately 35 acres. Historic fires created a forest mosaic of ponderosa and piñon pine, juniper and Douglas-fir, with a thick shrub understory. Fire history studies show that natural, low-intensity fires once burned in this type of ecosystem every 13 years or less. But the vegetation grows dangerously dense in the absence of regular fires, which creates the potential for more intense wildfire events. And in the long run, wildfire in this area is inevitable.

"Having a fire here is not a matter of if, but a matter of when," said R.C. Ghormley, another resident who has been pivotal to community-wide fire mitigation.

Besides lightning-strike fires that occur almost annually on the ranch, large wildfires are common in the surrounding area. The Morley Fire burned 300 acres within the subdivision in 1978. In 2002, three large fires together burned 40,000 acres near the subdivision. Then, in 2011, the 27,000-acre Track Fire was within 3 miles and headed for the ranch before a wind shift diverted it away and across I-25, which provides primary access to the ranch. Mark Loveall, assistant district forester with the CSFS La Veta District, says these events highlight the need for communities to be prepared before a fire arrives.

"To prevent loss of structures during a wildfire, each landowner needs to take the necessary steps to protect his or her property," said Loveall.

Recent Fuelbreaks Focus on Escape Routes, Fire Spread

Two fuelbreaks, each several miles long and 300 feet or more wide, were completed in the summer of 2012. Many of the 325 treated acres were located along the Gallinas Parkway, which leads to the only major exit route for residents in an emergency. The other major fuelbreak was created along a four-wheel-drive trail inside the community's southern borders to help prevent fire spread within the community. A logging contractor completed the fuelbreaks, and volunteer crews from the subdivision used chainsaws to complete smaller, complementary fuels reduction efforts.

Ghormley took the lead in applying for $240,000 in Emergency Supplemental Funds, administered by the CSFS, to cover the cost of the fuelbreaks and additional mitigation work on private lots. Landowners also personally covered other costs to treat hundreds more acres on their own properties.

The SFTR fuelbreaks are considered shaded fuelbreaks, in which trees and shrubs are selectively thinned to encourage approaching wildfires to transition from catastrophic crown fires to less-intense ground fires. Using five pieces of heavy machinery, loggers reduced tree densities in the fuelbreaks from approximately 300 trees per acre to between 30 and 80 trees per acre – a more natural tree density. Machinery ground most of the woody material into mulch.

CSFS Funding Pivotal to Implementation of Past Work

The 2012 fuelbreaks are only the latest in a series of projects Santa Fe Trail Ranch has implemented to protect the community from wildfires. From 2005-2009, SFTR used CSFS-administered State Fire Assistance grants and Colorado Forest Restoration Pilot Program funds to help create defensible space around homes and implement earlier fuelbreaks. Thousands of hours of landowner labor were used to help match grant funding.

CSFS foresters have made frequent trips to the subdivision to guide property owners through the steps needed to create effective fuelbreaks and obtain grant funding. Loveall says that heavy involvement by residents has been essential to making the subdivision safer.

"I am confident that the work done in this community will aid firefighters in keeping most fire starts from destroying structures and threatening public safety," Loveall said.

▲ Residents of the Santa Fe Trail Ranch subdivision made their community a safer place to live by managing the surrounding forests. Photo Credit: CSFS

Forest Products Industry

Over the last 15 years, Colorado has experienced a significant decline in the number of businesses that harvest and/or manufacture wood products. Facility closures have directly affected the ability to conduct forest management activities and meet land management objectives, and have had negative impacts on many local economies. On an annual basis, more than 90 percent of the forest products Coloradans currently use are imported from other states or countries. Also, less than 10 percent of the net annual growth of Colorado forests is harvested each year. Without harvesting a more substantial percentage of growth, the density of our forests is constantly increasing and natural processes like wildfire and insect and disease outbreaks will continue to have significant impacts on our landscape.

The forestlands available for management in Colorado, which exclude wilderness areas, National Parks and other areas administratively withdrawn for cultural, social and ecological reasons, should be actively managed for a wide array of benefits. Forest products businesses and the markets they create for wood provide local employment, support economic diversity, provide products for local use and help offset forest management costs. Currently, these costs are covered largely through federal and state grants. However, grants can only cover a small fraction of the funding needed to accomplish Colorado's long-term forest management needs, especially within the WUI. Only through active forest management can we achieve healthy forests that can sustain a wood products industry, protect watersheds, reduce wildfire risk and mitigate losses from insects and diseases.

▲ Trees removed during forest management projects can be utilized for a variety of wood products. This supports local economies and the wood products industry. Photo Credit: CSFS

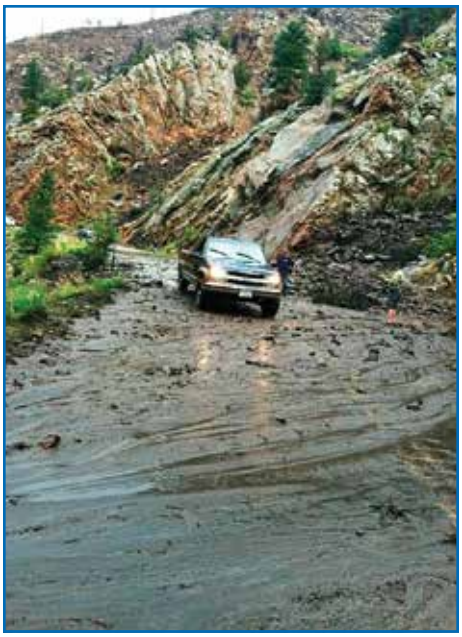
► Beetle-kill trees are often utilized for wood products, including dimensional lumber. Photo Credit: Dan Bihn

Forest Insects and Diseases

Insects and diseases are a natural part of forest ecosystems and play important roles in regulating forest health. However, Colorado has recently seen several of its native forest pests, including mountain pine beetle and spruce beetle, cause widespread tree mortality. These large-scale mortality events typically arise when forests are unhealthy and have experienced high levels of stress. Changing climatic conditions, including more frequent periods of extreme drought and increased temperature, as well as the suppression of natural wildland fire regimes, can exacerbate tree stress and allow insect and disease activity to escalate. Forest management, which decreases competition for water and nutrients and reduces individual tree stress, is the best solution. Active management can maintain healthy forests that are more resilient to insect and disease activity, and reduce the likelihood of forest pest epidemics.

Watershed Health

Colorado's forested watersheds and the water they provide to 18 states often suffer the same fate as the forests themselves; when forest health declines, so does the quality of the water yield flowing through those forests. Soil stability often is compromised in forests that have sustained extensive mortality from wildfires, increasing the likelihood of debris flow that can affect the quality and quantity of drinking water. The timing of snowmelt and runoff from forests can be negatively impacted in forests that have altered canopy conditions caused by insects and diseases. Forest management, particularly in critical, high-priority watersheds, can mitigate these concerns by improving overall forest watershed health, reducing the risk of insect, disease and wildfire-related tree mortality, thus conserving the supply of clean water.



▲ A mudslide in the lower Poudre Canyon after the High Park Fire impacts the highway and increases debris flow in the Cache la Poudre River, an important water resource in northern Colorado. Photo Credit: CSFS

▲ Extensive tree mortality from mountain pine beetle around Dillon Reservoir could impact water quality and quantity. Forest management in watersheds can reduce the risk of large-scale mortality and help protect our water sources. Photo Credit: Sky Stephens (2010)

Invasive Tree Species

Many of Colorado's landscapes, including forests, are threatened by invasive tree species and the displacement of native species. Colorado's riparian ecosystems in particular are declining in many areas, due to invasive species that have out-competed native vegetation. Several invasive species, including tamarisk and Russian-olive, can impact water flow and availability, adversely impact wildlife habitat and reduce recreational opportunities. Forest management can restore native vegetation in riparian and other forested areas and alleviate negative impacts on wildlife and water.

▲ Community forests include parks and open spaces. Photo Credit: CSFS

Community Forests

Urban and community forests provide numerous benefits to populated areas throughout the state, including improved quality of life, clean air and water, windbreaks, shade, energy savings and landscape beautification. These forests are at risk from a number of natural and human-caused factors. Native and exotic insects continue to impact our community forests and have the potential to cause extensive tree mortality. A contributing factor is the lack of diversity in many of our community forests, which can be heavily impacted by the establishment of an insect or disease that targets certain tree species. A good example is the emerald ash borer. Many Front Range communities are dominated by planted ash trees – up to 20 percent of the trees in some communities are ash species. If emerald ash borer, an exotic insect currently established as far west as Kansas City, Kan., becomes established in Colorado, we would expect to lose the majority of these ash trees. Community forests also face a number of challenges unique to the urban environment, including road improvement and maintenance, high traffic and pollution, and resource limitations in hardscapes (i.e., paved areas and sidewalks). Forest management can promote community forest health and diversity, and maintenance of urban forest cover.

▲ Communities benefit from tree cover, which provides shade, energy savings, aesthetics and other values. Photo Credit: CSFS

▲ Creating defensible space by removing or altering fuels around homes can reduce the risk of loss or damage during a wildfire.

Wildfire

Wildfires present risks to many community values, including life, property, water supplies, power lines, communication towers, recreation sites and landscape aesthetics. The record-breaking 2012 fire season was responsible for the loss of six lives and the destruction of more homes than in any other year. The 2012 fires impacted the lives and livelihoods of thousands of Coloradans, including those not directly impacted by wildfire. Hundreds of homes were lost within the WUI, infrastructure was damaged and tens of thousands of acres of forest were impacted. The loss of forest cover may result in slope destabilization, with increased debris flow in waterways, continued risk to infrastructure from mudslides and rock falls, reduction of property values and loss of forest-based economic opportunities. Wildfires and wildfire recovery efforts present a significant financial strain on the state. For example, $26 million have been spent on wildfire recovery activities on Strontia Springs Reservoir following the 1996 Buffalo Creek Fire and the 2002 Hayman Fire. Forest management can reduce the risk of intense wildfires that negatively impact the WUI and the forest landscape, and can help restore forest ecosystem functions.

▲ The 2012 fire season resulted in the loss of six lives and hundreds of homes, and impacted thousands of residents and visitors. The most devastating wildfire season in Colorado's recorded history will have lasting impacts on communities, forests and other natural resources. Photo Credit: National Interagency Fire Center

Air Quality

Our forests, including trees within our communities, constantly interact with the atmosphere to change the composition of the air around us. Trees sequester many pollutants from the atmosphere, including carbon dioxide, nitrogen dioxide, ozone, carbon monoxide and particulate matter. Trees also produce oxygen. Forest management can encourage active new tree growth, which sequesters more carbon dioxide from the atmosphere and improves air quality. As noted earlier, forest management also can reduce the risk of wildfires that release significant amounts of carbon into the atmosphere and negatively impact human health.

Climate Change

Forests are sensitive to climatic variability and change. Climatic factors influencing forest health include temperature, precipitation, atmospheric levels of carbon dioxide and other greenhouse gases, and extreme weather conditions. Forest management can improve the resiliency of forests and make them better able to adapt to climate dynamics. A key approach to climate risk management is diversification of forest management strategies between neighboring forest stands to promote forest structure diversity across landscapes on larger geographic scales.

Fragmentation

Fragmentation of forested landscapes and their conversion to non-forest uses is a growing threat to forests throughout Colorado. Fragmentation is the division of forested landscapes into smaller blocks, often separated from each other by roads, non-forested lands and urban development. Fragmentation can adversely affect wildlife habitat, biodiversity, watershed function and the ability to effectively manage forests. Smaller parcels of forest are more expensive to manage and can limit the ability to achieve forest management objectives on a landscape scale. The Colorado State Forest Service encourages participation in programs that conserve working forests and establish cooperative forest management efforts among multiple landowners.

Fuelbreaks Utilized for Firefighting Efforts during High Park Fire

As the High Park Fire bore down on the northwest corner of Lory State Park west of Fort Collins, foresters who had spent three years thinning a 375-acre fuelbreak in the area held their breath wondering if it would work.

The crown fire roared through the treetops, pushed by high winds and consuming swaths of unbroken canopy comprised of bone-dry, highly flammable pine needles and branches. But when the fire hit the fuelbreak – an area where trees had been thinned out but not completely removed – it no longer could jump from tree to tree, so it dropped to the ground, just as foresters hoped it would.

Later inspection revealed that the flame front became a much more benign ground fire as it burned through the fuelbreak, where it merely torched individual or patches of trees until it hit a control line established by retardant drops from aircraft. And there it stopped, sparing not only the park, but a large section of the watershed for Horsetooth Reservoir.

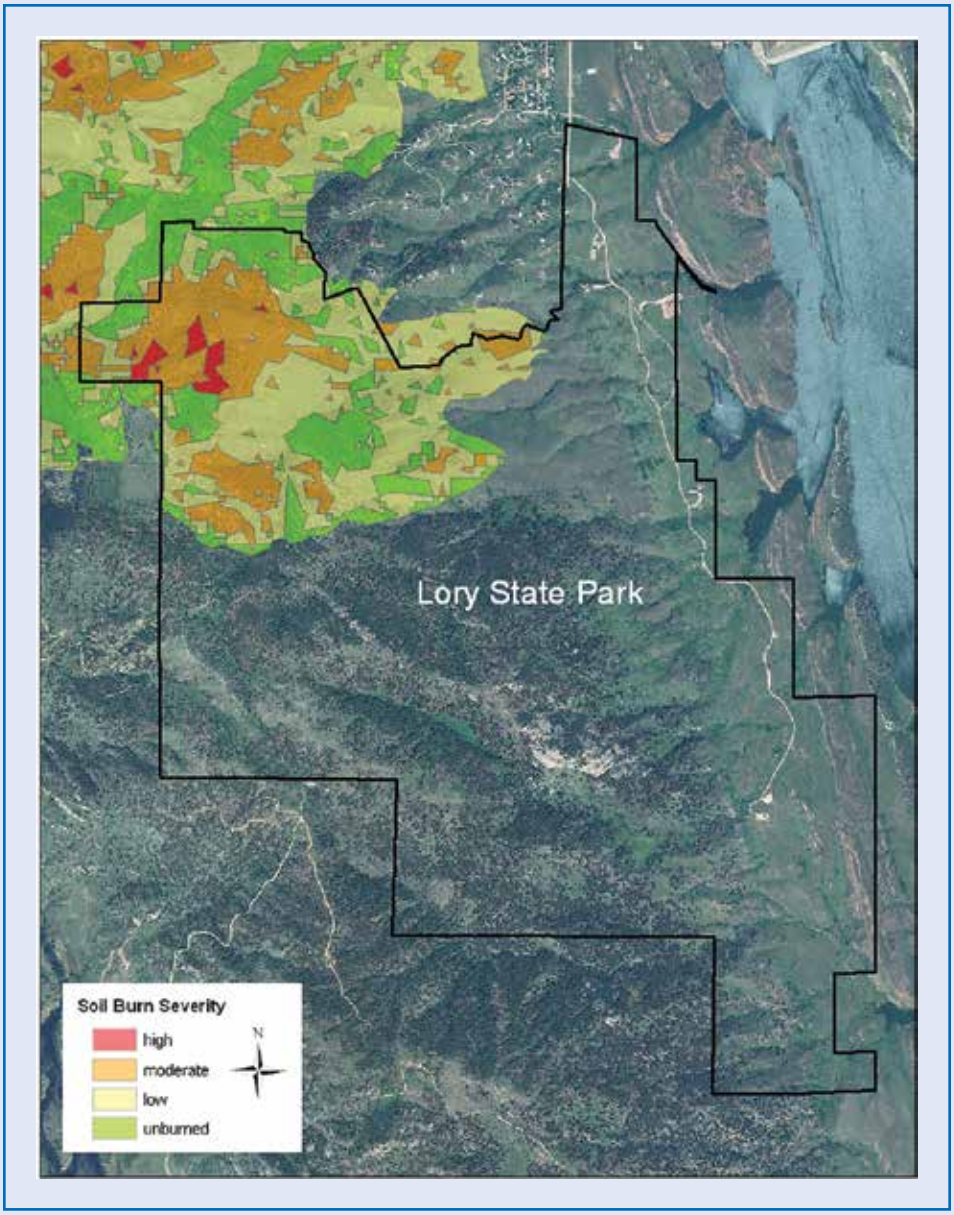
"So many variables affect fire behavior that it's difficult to point to one factor and say that this is what stopped that portion of the fire," said Diana Selby, assistant district forester with the CSFS Fort Collins District. "But we can say that the fire behaved like we wanted it to and that firefighters took the opportunity to stop the fire in the park using retardant drops."

An Ounce of Prevention…

For the past decade, Colorado Parks and Wildlife has been working with the Colorado State Forest Service to actively manage hazardous fuels, including beetle-killed stands, in 20 state parks. The CSFS provides technical forestry assistance and helps plan and implement treatments.

The Lory State Park project was funded by a $250,000 FEMA pre-disaster mitigation grant from the Colorado Division of Emergency Management, matched by $120,000 from Colorado Parks and Wildlife through Great Outdoors Colorado. Treatments included ridge-top shaded

▲ The 87,284-acre High Park Fire burned west of Fort Collins in June 2012. Photo Credit: Mike Hughes



▲ The High Park Fire burned at various intensities, as illustrated on the map. The 375-acre fuelbreak in Lory State Park helped lower the intensity of the fire in the south portion of the burn area.

fuelbreaks – areas where trees and brush are reduced to limit a wildfire's ability to spread rapidly – which firefighters used for retardant drops during the High Park Fire in June 2012. The fuelbreaks also helped prevent erosion in the area from monsoon rains that occurred immediately after the fire.

"The value of fuels mitigation treatments at Lory State Park during the High Park Fire underscores the successful partnership that Colorado Parks and Wildlife and the Colorado State Forest Service have developed over the decade since the Hayman Fire," said Matt Schulz, Colorado Parks and Wildlife forest management coordinator.

Additional Fuels Mitigation in Nearby Communities, on CSU Property

Complementing the fuels treatments implemented in Lory State Park was pre-fire work done by landowners in neighboring Redstone Canyon and by CSFS personnel in the Borden Memorial Forest, a living classroom owned by Colorado State University (CSU).

In Redstone Canyon, community members met every Saturday for four months to thin trees along community roads, creating a shaded fuelbreak and safer conditions for entry and exit during a fire. The group's sweat equity reduced the cash cost of the overall project, resulting in additional acres treated. During the High Park Fire, the established Redstone Canyon fuelbreaks also were used for retardant drops and fire perimeter work.

Further north in Rist Canyon, fuels mitigation work helped keep the fire on the ground in the Borden Memorial Forest, potentially saving homes and minimizing damage to the forest. The 70-acre private forest, a certified Tree Farm that was donated to CSU, provides experiential learning opportunities for CSU students.

Part of a Larger Forest Management Effort

The Lory State Park, Redstone Canyon and Borden Memorial Forest fuels mitigation projects are all part of a larger forest management effort aimed at reducing hazardous fuels, mitigating the impacts of mountain pine beetles and restoring forest health in an area stretching from the lower Poudre Canyon south to Masonville.

Smaller fuelbreaks like the 375-acre fuelbreak at Lory may be dwarfed by massive fires like High Park, but they underscore the benefits of partnerships and well-placed fuels treatments that can keep a large fire from becoming even more damaging and dangerous.

"In addition to protecting Lory State Park, Redstone Canyon and surrounding communities from wildfires, the fuelbreaks established safe zones for firefighters to battle the blaze," said Selby. "The treatments would not have been possible without the partnerships, funding and collective will of everyone involved, and they are a testament to the importance of coordinated efforts to mitigate hazardous fuels."

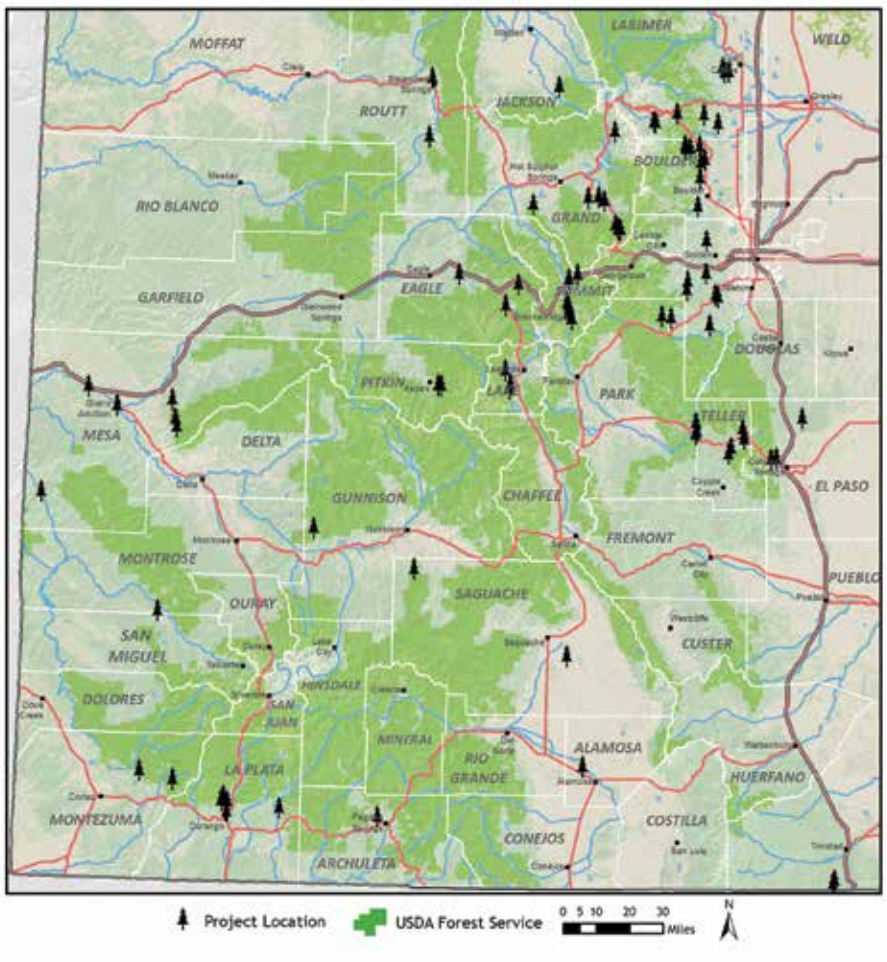
2012 Forestry-Related Legislation in Colorado

Colorado residents and visitors alike value healthy, resilient forest landscapes. Understanding this value, the Colorado General Assembly continues to support forest health efforts, promoting legislation that will help improve the health and vigor of Colorado's forests.

Through the passage of multiple pieces of legislation in recent years, the Colorado General Assembly has supported forest management actions that demonstrate community-based approaches to forest restoration and watershed health. The Colorado Forest Restoration Pilot Grant Program (CFRPGP) is a cost-share program that provides funding for up to 60 percent of total costs for projects. This program was authorized in 2007 through House Bill 1130; that year, projects were implemented with Colorado Water Conservation Board funds. During the 2008 and 2009 legislative sessions, Senate Bill 071 and House Bill 1199, respectively, supported the program and authorized funding from the state's severance tax operation account to implement forest management projects. To date, more than $4.7 million in state funds and another $1 million in leveraged federal funds have been awarded to 86 projects across the state. Those funds additionally leveraged more than $8 million in matching funding to restore more than 12,000 acres of forest, and the 17 CFRPGP projects currently in progress will result in treatments on an additional 1,200 acres.

In 2012, the Colorado General Assembly passed six bills and one resolution addressing forest health, the forest products industry and related public safety. This continued level of legislative interest illustrates the importance and value Coloradans place on our forests. We look forward to continued support as we work together to promote healthier, more diverse forests that are resilient to insect and disease epidemics for the benefit of present and future generations.

Forest Restoration Grant Projects



2012 Forestry Legislation Summary

Bill Number	Bill Name	Bill Summary
HB 1032	Continue Forest Restoration Program	The bill continues the Forest Restoration Program and its associated funding from severance taxes for five years, and specifies that the program is no longer a pilot program. The bill also extends for five years annual transfers of $1.45 million from the operational account of the severance tax trust fund to the healthy forests and vibrant communities fund, and $50,000 to the wildland-urban interface training fund.
HB 1045	Tax Exemption From Beetle-Killed Trees	Wood wholesalers must certify on a Department of Revenue form that a product is lawfully harvested in Colorado from a salvaged tree killed or infested by spruce beetles. The sales tax exemption for these timber products is in effect from July 1, 2012, to July 1, 2020. The bill also extends until July 1, 2020, the sales and use tax exemption for the sale, storage and use of wood from salvaged trees killed or infested in Colorado by mountain pine beetles.
HB 1283	Department of Public Safety, Renaming, Reorganizing Certain Entities	This bill consolidates homeland security functions of Colorado into the Department of Public Safety (DPS). It also transfers wildfire command and control responsibilities from the Colorado State Forest Service (CSFS) to the DPS.
HB 1285	Intergovernmental Cooperative Wildland Fire Mitigation	This bill modifies statutory requirements regarding intergovernmental cooperation for wildland fire mitigation where a municipality owns land inside a county for utility purposes.
HB 1352	State Commission to Address the Lower North Fork Wildfire	This bill creates a commission to study the causes of the Lower North Fork Wildfire and to develop recommendations for preventing similar events from happening again. The commission consisted of five people: two from the House, two from the Senate and the executive director from the Department of Public Safety. Their report was due by the end of 2012.
HB 1361	Concerning Claims Arising under the "Colorado Governmental Immunity Act"	This bill eliminates the state's immunity from damages sustained by citizens due to prescribed fire. It also lifts the $600,000 per event/$150,000 per person cap, and specifies how citizens who sustained damages can receive additional compensation beyond specified limits.
SR 003	Management for Healthy Forest Ecosystems and the Use of Colorado Forest Biomass	This bill requests the Colorado State Forest Service, the Colorado Economic Development Commission, the Colorado Department of Public Health and Environment, and the Governor's Energy Office to work toward promoting and/or developing opportunities for sustainable forest management that can support a forest energy industry.

Forest Stewardship through Active Management: The Key to Healthy Forests

This report highlighted current concerns related to Colorado's forests, and demonstrated how responsible forest stewardship is the most effective way to mitigate these threats. Forest management practices also can help achieve many forest use objectives. Healthy forests are more resilient to insects and disease, and by reducing the likelihood of landscape-level mortality from forest pest epidemics, it is possible to mitigate fuels and associated wildfire risks. Proper forest management also reduces air quality impacts, preserves the integrity of watersheds, and protects property and infrastructure. Additional benefits of forest management include a diverse wood products industry and the economic security of sustainable, forest-based enterprises. These enterprises effectively reduce the cost of forest management, allowing more land to be treated.

Because the benefits of forest management are so readily apparent – from clean drinking water to biomass fuels to the recreation/tourism and timber industries – one must ask: why *wouldn't* we choose to manage our forests? We all have a responsibility to be good stewards of Colorado's forests, and to ensure that they are healthy and will continue to provide the myriad benefits we have come to rely on and enjoy. Through ongoing forest management maintained over the lifetime of Colorado's forests, we can create forest environments that are more resilient to large-scale insect and disease epidemics, while helping to protect human lives, homes and communities from the potentially devastating effects of wildfires. As the impacts of the recent bark beetle epidemics suggest, it is imperative that we act now to achieve our shared vision of healthy future forests.

Colorado is known throughout the world for its unparalleled beauty, recreational opportunities and overall quality of life. Our forests contribute significantly to all of these attributes, and they deserve the benefit of our collective wisdom to make management decisions that will allow present and future generations to continue to enjoy all that Colorado has to offer.

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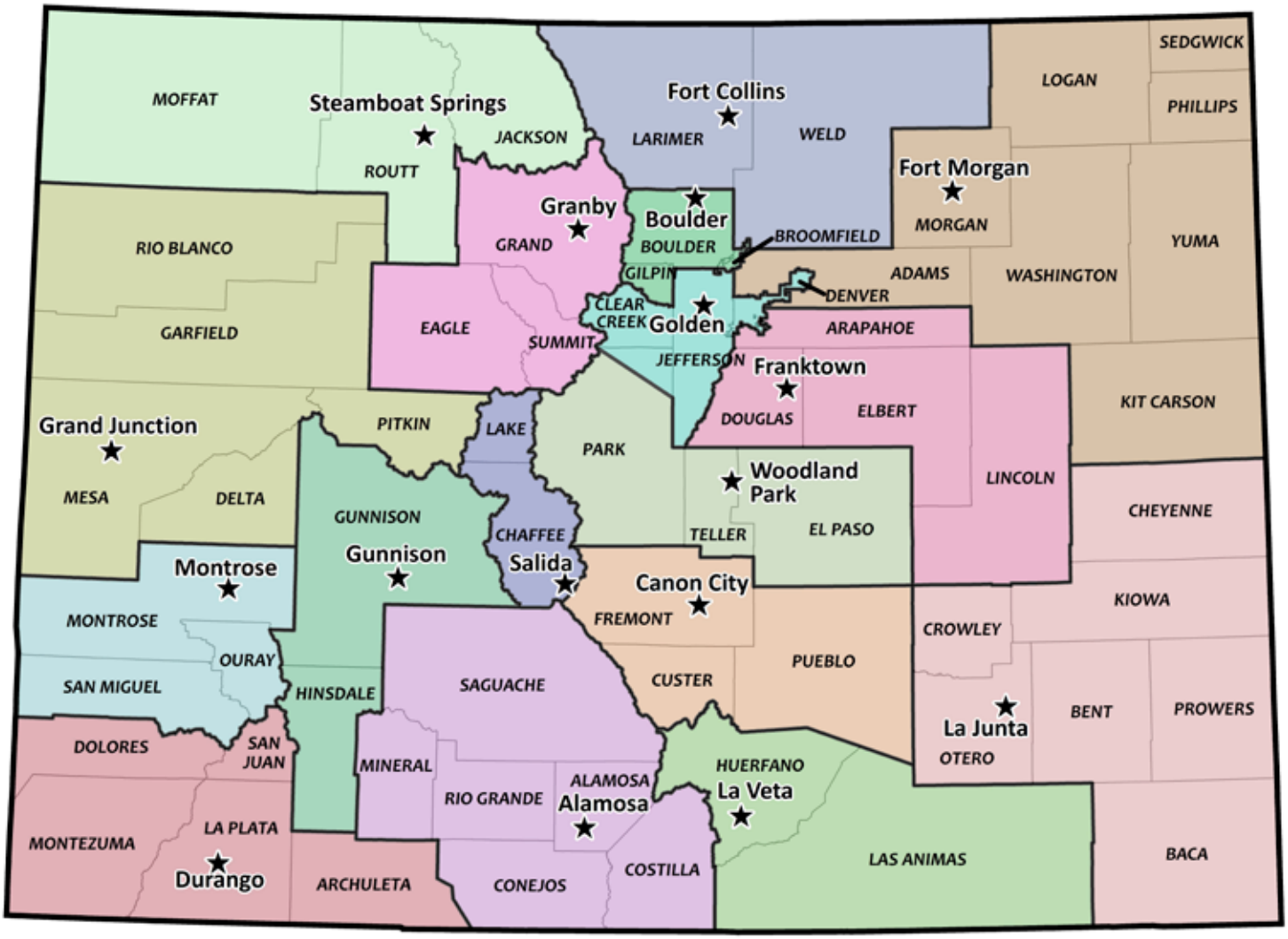

The mission of the Colorado State Forest Service is to achieve stewardship of Colorado's diverse forest environments for the benefit of present and future generations.

For more information, please visit the Colorado State Forest Service website at www.csfs.colostate.edu.

► Forest management practices achieve a variety of objectives, including this fuelbreak which has improved safety along the road and reduced wildfire risk. Photo Credit: Bill Cotton

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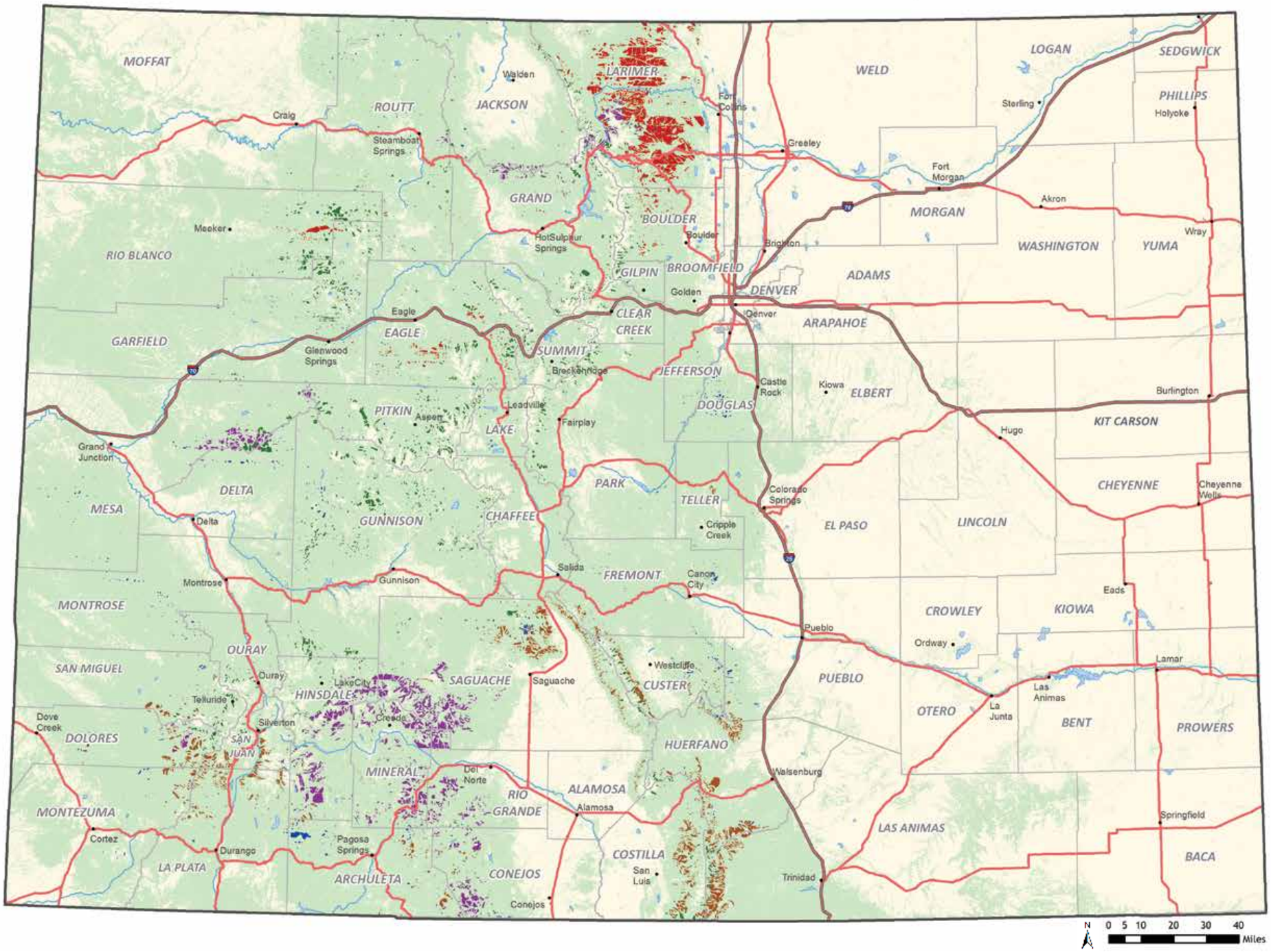
2012 Insect and Disease Activity in Colorado Forests



Spruce Beetle
311,000 acres

Mountain Pine Beetle
264,000 acres

Western Spruce Budworm
217,000 acres

Subalpine Fir Decline
221,000 acres

Other Insects and Diseases
71,000 acres

Aerial Survey Data

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 the 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.

The insect and disease data represented on this map are available digitally from the USDA Forest Service, Region 2 Forest Health Management group. The cooperators reserve the right to correct, update, modify or replace GIS products. Using this map for purposes other than those for which it was intended may yield inaccurate or misleading results.

Map created December 2012
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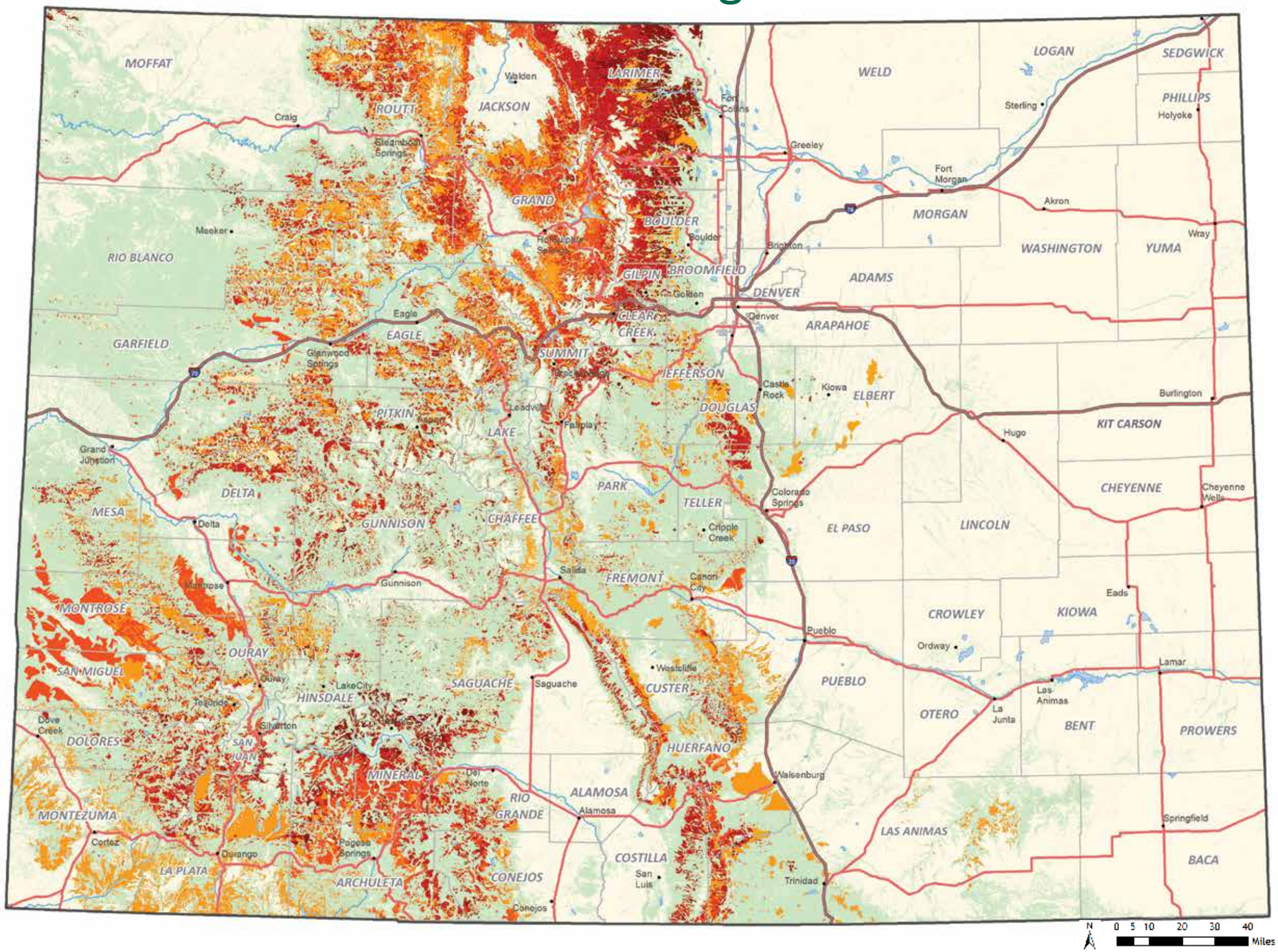
Colorado State Forest Service

Forest Insect and Disease Progression in Colorado from 1996 - 2012



1996 - 1997

1998 - 2000

2001 - 2003

2004 - 2006

2007 - 2009

2010 - 2012

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