R2 Forest Health Protection

Rocky Mountain Region (R2) · State and Private Forestry
Cooperative Forestry & Tribal Relations

Report of the Rocky Mountain Region (R2) 2015 Forest Health Conditions

Section 1 - 2015 Forest Health (FH) conditions of the National Forests (NF) in the Rocky Mountain Region (R2). These 12 reports were produced by the 3 Forest Health Protection (FHP) Service Centers in R2 and assist the national forest managers with their forest health concerns. Section 1 contains the original reports with figures, maps, and photos labeled as in the original reports written by R2 FHP – Gunnison, Lakewood, and Rapid City Service Centers.

Section 2 – Colorado, Kansas, Nebraska, South Dakota, and Wyoming 2015 Forest Health Highlights (FHH) reports internet links to the FH Monitoring website. The FHH reports were produced by state forest health specialists to the latest FHH from all forestlands in each state.

Section 3 - The 2015 Aerial Detection Survey (ADS) summary report for the Rocky Mountain Region (R2) produced by the surveyors and specialists of the ADS program. Here is the original, Nov. 2015, report along with its graphics and tables.

Section 4 - Additional documentation and acknowledgements comprise Section 4. Required documentation for all US Government reports and a listing of all contributors for this report are presented.

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Approved by SPFH Director – July 2016

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2015 Forest Pest Conditions Highlight Arapaho-Roosevelt National Forests and Pawnee National Grassland

USDA Forest Service
Rocky Mountain Region
Forest Health Protection
Lakewood Service Center
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Conditions Highlights

Spruce beetle activity decreased in Colorado and southern Wyoming from 494,000 acres in 2014 to 410,000 acres in 2015. Of this, 18,000 and 1,700 acres were affected on the Arapaho and Roosevelt National Forests (ARNF), respectively. Mortality was concentrated in the Canyon Lakes Sulphur Ranger Districts along the northern and western borders of Rocky Mountain National Park. Numerous windthrow events since 2011 increased the potential for spruce beetle activity through much of the Region and predominately dry conditions continued to stress high-elevation mix-conifer forests. Windthrow events at Guanella Pass and in the northeastern section of Mount Evans Wilderness were assessed for spruce beetle activity and will continue to be monitored for emerging beetle populations.

Tree mortality associated with mountain pine beetle (MPB) continued to decline throughout Colorado and is now considered to be back to endemic levels. MPB activity was mapped on only 1,400 acres on the ARNF; most of the mortality was in limber pine and concentrated west and south of Nederland, CO.

Dwarf mistletoes were common and damage lodgepole, limber, and ponderosa pine to varying degrees throughout the ARNF. A great opportunity exists for managing and reducing the impacts of this disease while the forest conducted vegetation management in campgrounds, administrative areas, and in the forest following the bark beetle epidemic. A dwarf mistletoe management guide is available for the Region (see “Useful Links” section).

White pine blister rust (WPBR) continued to spread and intensify in limber pine in northern Colorado. In a recent study of limber pine stand conditions and interactions with blister rust, mistletoe, and bark beetles in the central and southern Rocky Mountains, only half of all limber pines were classified as healthy (Cleaver et al. 2015). Researchers modeled factors that influence the major damage agents and identified candidate stands for restoration. FHP continues to monitor limber pine health and the distribution, severity, and impacts of the blister rust.

Aerial Detection Survey Highlights

- Spruce beetle activity decreased in Colorado (**Fig.1**) and southern Wyoming from 494,000 acres in 2014 to 410,000 acres in 2015. A large portion of the damage was in southern Colorado, particularly on the Rio Grande (137,000), Gunnison (75,000), San Isabel (46,000), San Juan (46,000), and Uncompahgre (23,000) National Forests. In northern Colorado, spruce beetle-caused mortality was concentrated in and around Rocky Mountain National Park in Grand (18,000), Larimer (14,000), and Jackson (8,300) counties.
- Mountain pine beetle activity in Colorado and southern Wyoming decreased to 7,600 acres in 2015 and the epidemic has ended in most areas.
- Subalpine fir mortality attributed to western balsam bark beetle often in combination with Armillaria root disease affected 126,000 acres in Colorado and southern Wyoming in 2015 and 36,000 acres was mapped on the ARNF. Western balsam bark beetle infestations were widespread and fairly chronic but unlike mountain pine beetle and spruce beetle, resulting tree mortality was not usually uniform across the impacted landscape, although cumulative mortality over years can result in extensive landscape mortality.

FHP Projects

- FHP staff have recommended considering reassessing need for chemical spray for individual tree protection and support moving to an application every other year if MPB activity continues to decline.
- FHP staff continued to assess spruce blowdown on Guanella Pass and Mount Evans for developing spruce beetle populations. No significant activity has been detected to date. Monitoring will continue into 2016.
- FHP staff conducted a survey of pollinators on the Pawnee National Grassland (**Fig. 2**).
- Portions of the ARNF were included in the WO S&PF-TR review conducted in October of 2015 and showcased cooperative forest health partnerships and activities.
- The USFS (Rocky Mountain Research Station, Dorena Genetic Resource Center, and FHP) and the National Park Service are actively collaborating to identify WPBR resistance in limber and bristlecone pine families in the Region. A high level of rust resistance has been confirmed in some limber and bristlecone pine families on the ARNF (Schoettle et al. 2014). We actively protected trees with confirmed resistance to WPBR from MPB on the Boulder, Canyon Lakes, and Clear Creek Ranger Districts by applying verbenone, an anti-aggregation pheromone, annually.
- The Southern Rockies Rust Resistance Trial (SRRRT) was initiated at a revitalized CCC nursery on the MBNF in 2013 to field-verify WPBR resistance. Seed from resistant limber and Rocky Mountain bristlecone pine trees (tested and confirmed in OR) from throughout the southern Rockies, including trees from the ARNF, was sown and seedlings grown at the Colorado State Forest Service Nursery. Over 700 seedlings were outplanted in the fall 2013 and another 700 seedlings in spring 2014. In 2015, seedling

growth and health status were assessed; no evidence of rust infection has been noted yet. The fall planting proved to be more successful for survival.

- Restoration planting options and a conservation strategy have been developed (Casper et al. 2016, Schoettle et al. *In press*) and seed transfer guidelines have been refined (Borgman et al. 2015) for limber pine in the Southern Rocky Mountains.
- The Armillaria root disease pathogen, *Armillaria sinapina*, was reported for the first time in Colorado, including isolates collected from recently killed subalpine firs on the Roosevelt National Forest (Burns et al. 2016). Previous surveys in Colorado only identified *A. solidipes* (as *A*. *ostoyae*) in the state. Although *A*. *sinapina* is frequently considered a weak pathogen, trees that are maladapted due to climate change could become more susceptible to Armillaria root disease caused by *A*. *sinapina*.
- A study of the extent, severity, and causes of aspen mortality in Colorado and southern Wyoming was recently completed (Dudley et al. 2015).

Surrounding Area Conditions of Note

- Rocky Mountain National Park continued to manage high-value, high-risk pines predominately near historic structures and campgrounds with carbaryl or verbenone to prevent mountain pine beetle activity.
- Douglas-fir tussock moth activity continued in an area northwest of Boulder impacting 190 acres and has impacted 17,000 acres on the Pike National Forest.
- Emerald ash borer, a federal regulated pest, has been detected in the city of Boulder. Boulder County is under quarantine for the movement of ash material and all hardwood firewood that does not meet treatment standards outlined in the quarantine rules.
- Aspen discoloration, largely attributed to Marssonina leaf blight, was fairly common and widespread (99,000 acres) in in the Region in 2015, although only 800 acres were mapped on the ARNF. The disease can become more prevalent at any time of the growing season with high precipitation. Mortality is rare unless the outbreak occurs over consecutive years or is combined with other stresses. The damage was not Sudden Aspen Decline (SAD), nor was it believed to be associated with SAD.

Recent Reports and Resource List

Forest Health Protection (FHP), in cooperation with the Colorado State Forest Service, Wyoming State Forestry, and other partners, compiles a Forest Pest Conditions report for the Region each year. FHP also conducted an annual Aerial Detection Surveys, ground surveys, special projects, and site visits to identify, assess, and map insect and disease-caused tree mortality and damage and to provide technical assistance to our cooperators throughout the Region. The following is a list of recent reports, publications, and other resources available.

Service Trip Reports

- Stephens SS, Powell RL. 2015. Pine needle scale assessment of Fraser Valley. Service Trip Report, LSC-15-01.
- Stephens SS, Powell RL. 2015. Evaluation of FY14 Bark Beetle Projects in Rocky Mountain National Park. Service Trip Report, LSC-15-03.
- Powell RL. 2015. Evaluation of stands for presence of mountain pine beetle on the Canyon Lakes District, Arapaho and Roosevelt National Forests. Service Trip Report, LSC-15-09.
- Stephens SS. 2015. Pollinator survey on a restored pipeline on the Pawnee National Grassland. Service Trip Report, LSC-15-10.
- Stephens SS, Powell RL, Burns KS. 2015. Evaluation of FY15 Bark Beetle Projects, the Limber Pine Conservation Program, and other Forest Health Issues in Rocky Mountain National Park and Recommendations for FY16. Service Trip Report, LSC-16-03.
- Kruse JJ, Burns KS. 2015. Assessment of Moffat Stewardship Site, Arapaho National Forest. Service Trip Report, LSC-16-05.

Publications

- Borgman EM, Schoettle AW, Angert AL. 2015. Assessing the potential for maladaptation during active management of limber pine populations: a common garden study detects genetic differentiation in response to soil moisture in the Southern Rocky Mountains. Can. J. For. Res. 45: 496–505.
- Burns KS, Hanna JW, Klopfenstein NB, Kim M-S. 2016. First Report of the Armillaria Root Disease Pathogen, *Armillaria sinapina*, on Subalpine Fir (*Abies lasiocarpa*) and Quaking Aspen (*Populus tremuloides*) in Colorado. Plant Disease 100(1): 17.
- Casper AM, Jacobi WR, Schoettle AW, Burns KS. 2016. Restoration planting options for limber pine (*Pinus flexilis* James) in the Southern Rocky Mountains. The Journal of the Torrey Botanical Society, 143(1):21-37.
- Cleaver CM, Jacobi WR, Burns KS, Means RE. 2015. Limber pine in the central and southern Rocky Mountains: Stand conditions and interactions with blister rust, mistletoe, and bark beetles. Forest Ecology and Management 358: 139-153.
- Dudley MM, Burns KS, Jacobi WR. 2015. Aspen mortality in the Colorado and southern Wyoming Rocky Mountains: extent, severity, and causal factors. Forest Ecology and Management 353 (2015) 240–259.
- Schoettle AW, Cleaver CM, Burns KS, Connor JJ. In press. Limber Pine Conservation Strategy for the Greater Rocky Mountain National Park Area. USDA Forest Service, Rocky Mountain Research Station General Technical Report. RMRS-GTR-xxx.
- Schoettle AW, Sniezko RA, Kegley A, Burns KS. 2014. White pine blister rust resistance in limber pine: evidence for a major gene. Phytopathology 104: 163-173.

Other Useful Links

- R2 Forest Health Protection Website
  - Aerial Survey Data and Maps
  - Dwarf Mistletoes: Ecology and Management in the Rocky Mountain Region
  - Field Guide to Insects and Diseases in the Rocky Mountain Region
  - Hazard Tree Identification and Management
  - Other Reports and Publications
- Forest Health Technology Enterprise Team
  - National Insect and Disease Risk Map
  - National Forest Damage Agent Range Maps
  - Forest Conditions - FHP Mapping and Reporting Tools

We look forward to continued work with the ARNF regarding your forest insect and disease concerns. Please do not hesitate to contact us with your inquiries.

Lakewood Service Center

- Jim Kruse, Service Center Leader, jkruse@fs.fed.us, 303-236-9541
- Sky Stephens, Entomologist, ssstephens@fs.fed.us, 303-236-9552
- Rebecca Powell, Entomologist, rebeccalpowell@fs.fed.us, 303-236-8008
- Kelly Burns, Pathologist, ksburns@fs.fed.us, 303-236-8006

Figures

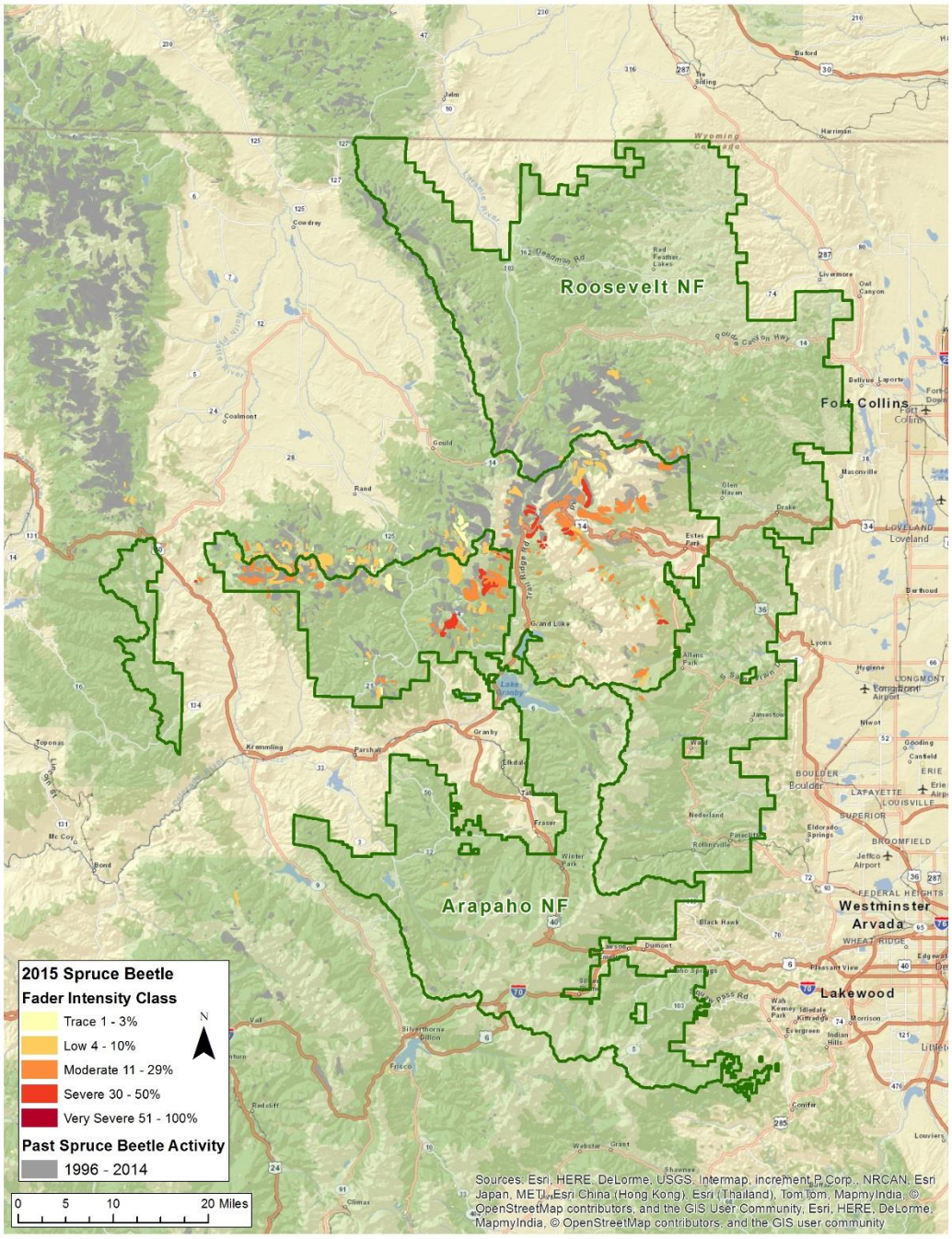

Fig. 1. 2015 Aerial Detection Survey map spruce beetle activity on the ARNF by severity class with past spruce beetle activity shown in gray.

Figures

Figure 2. FHP entomologist conduct a pollinator survey on the Pawnee National Grassland.

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Bighorn National Forest 2015 - Forest Health Highlights

USDA Forest Service, Rocky Mountain Region, Forest Health Protection
Rapid City Service Center, 8221 S Highway 16, Rapid City, SD 57702
Kurt Allen, Entomologist; Jim Blodgett, Plant Pathologist; Al Dymerski, Forestry Technician; Kendra Schotzko, Entomologist. p: 605-343-1567

Conditions

- Western balsam bark beetle activity resulted in increased subalpine fir mortality. An estimated 4,300 acres were affected in 2015, an increase of 1,000 acres from 2014 (**Fig. 1 & 3**). In other forests, Armillaria root disease contributes to subalpine fir mortally, but is uncommon in subalpine fir in the Bighorn National Forest.

Figure 1. 2 pictures from left to right, western balsam bark beetle galleries and western balsam bark beetle stand damage.

- Overall mountain pine beetle caused mortality of pines decreased from 120 acres affected in 2014 to 40 acres affected in 2015 (**Fig. 3**). In 2015 most mortality occurred in lodgepole pine (30 acres), which increased from zero affected acres in 2014. Mortality in ponderosa pine decreased from 90 acres in 2014 to two acres in 2015, and limber pine mortality decreased from 30 acres to four acres.
- Pine engraver beetles (*Ips* sp.) were detected in the southeast in lodgepole and ponderosa pine, affecting 64 and 34 acres, respectively (**Fig. 3**).
- Spruce beetle was detected on the forest in 2015, affecting 70 acres.

- Douglas fir beetle activity increased from one acre affected in 2014 to 10 acres in 2015. There is continued use of MCH to protect high value areas.
- There were some larger areas of lodgepole pine with discolored needles caused by winter desiccation found throughout the forest.
- Within aspen stands, 10 acres were defoliated, which was mostly caused by frost damage, and eight acres were affected by dieback and mortality. Sooty bark canker (**Fig. 2**) followed by Cytospora canker are the most damaging agent in aspen stands. White mottled rot is damaging in select aspen stands (**Fig. 2**).

Figure 2. 2 pictures showing aspen damages. From left to right, sooty bark canker killing an aspen and white mottled rot mortality in an aspen stand on the Bighorn National Forest.

- Dwarf mistletoe continues to be a problem in lodgepole pine stands, but suppression treatments are improving stand conditions.
- Comandra blister rust incidence is slowly decreasing, likely due to low infection rates in the last few years.
- White pine blister rust disease is found in most limber pines stands throughout the forest and is continuing to spread and intensify; with high mortality in Ten Sleep and Shell Canyons.

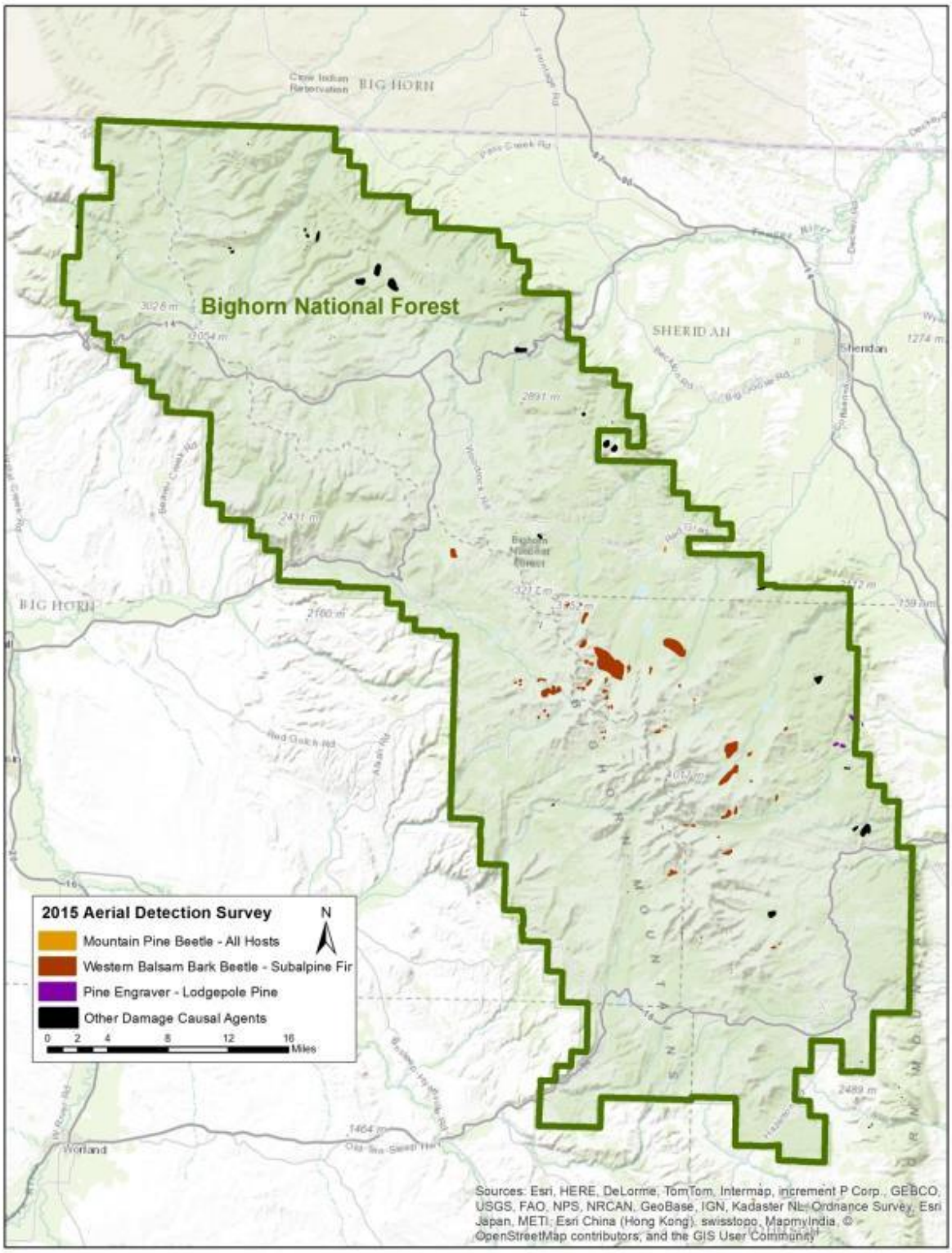

Figure 3. Aerial detection survey map of the Bighorn National Forest: 2015.

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Black Hills National Forest - 2015 Forest Health Highlights

USDA Forest Service, Rocky Mountain Region, Forest Health Protection
Rapid City Service Center, 8221 S Highway 16, Rapid City, SD 57702

Kurt Allen, Entomologist; Jim Blodgett, Plant Pathologist; Al Dymerski, Forestry Technician; Kendra Schotzko, Entomologist. p: 605-343-1567

Conditions

- Mountain pine beetle continues to be the most frequent damage agent found across the forest, with 16,000 acres killed in 2015 compared to 16,500 killed in 2014 (**Fig. 5**). These numbers are taken from remote sensing techniques which are a year behind where the beetles are. Based on 2015 ground surveys done in the fall, there will be a sharp decline in mortality in 2016. It appears the mountain pine beetle epidemic in the Black Hills is finally subsiding. Preventive spraying of high value trees in campgrounds and landscape level thinning of forest stands have provided protection to remaining trees where these have been implemented (**Fig. 1**).

Figure 1. Thinned stands in the left photo and unthinned stands in the right photo. These stands are adjacent to one another.

- Pine engraver beetles (Ips sp.) are frequently found throughout the forest. They often attack trees simultaneously with mountain pine beetle in addition to attacking other stressed or weakened trees. Mortality caused by engravers has been low the past few years as we have seen normal to above normal spring moisture.
- Wood borers' numbers have been high over the past few years, largely due to high levels of dead trees created by recent mountain pine beetle mortality. Borers do not attack live trees and actually compete with mountain pine beetles in infested trees for the same food resource.
- In late summer, Marssonina leaf blight resulted in extensive foliage damage (**Fig. 2**) and premature defoliation in aspen in much of the forest. Sooty bark canker continues to be the most damaging agent in aspen stands, followed by Cytospora

canker and bronze poplar borer. White mottled rot is damaging in select aspen stands.

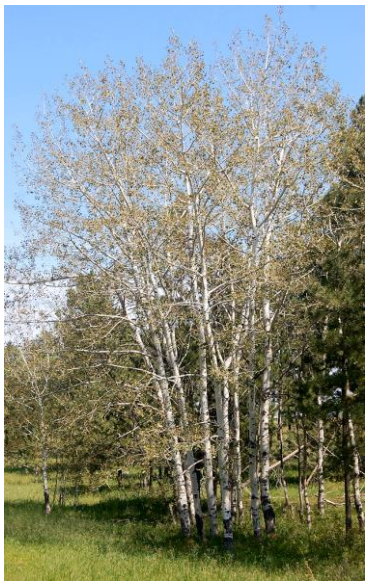

Figure 2. Defoliation caused by Marssonina on aspen

Figure3. Limber pine with white pine blister rust cankers in the stem (this tree will be dead next year).

- Monitoring and pest control efforts continue on the rare limber pine in Black Hills National Forest. The few limber pine are endanger of extinction in the Black Hills due to the exotic white pine blister rust disease.
    - White pine blister rust, and invasive fungal disease, recently killed three of the now 28 known live limber pine (*Pinus flexilis*) on USDA-Forest Service land (on and near Harney Peak).
    - Six of the trees were infected with the rust, but infected branches were removed from four trees. Two trees have stem cankers that cannot be removed (**Fig. 3**).
    - Only two trees are large enough to be infested by mountain pine beetle, so Verbenone pouches were applied to protect the larger trees.

Figure 4. Winter desiccation in spring of 2105.

- Winter desiccation resulted in needle mortality in ponderosa pine trees in scattered areas of the forest. Most of the areas affected were small, though several acres were affected in some areas including the Hazelrodt Recreation Residence Tract (**Fig. 4**). Winter desiccation seldom results in direct tree mortality, but it does stress trees, making them more susceptible to some insects and diseases.
- Diplodia shoot blight and canker disease produced scattered branch mortality in crowns and some tree mortality of ponderosa pine throughout the forest. More extensive branch mortality with some tree mortality was observed in the Northern Hills District. This disease can cause tree mortality, but repeated outbreaks are often required.

- Rodent chewing caused branch mortality in ground juniper throughout the forest resulting in striking orange-brown (dead) juniper needles. In spring, Gymnosporangium rust disease was very common in juniper and the two damages were frequently observed together. The disease was also common in *Amelanchier* spp., the alternate host. The increased rodent chewing might be related to the increased Gymnosporangium rust since rodents often chew rust infected branches.

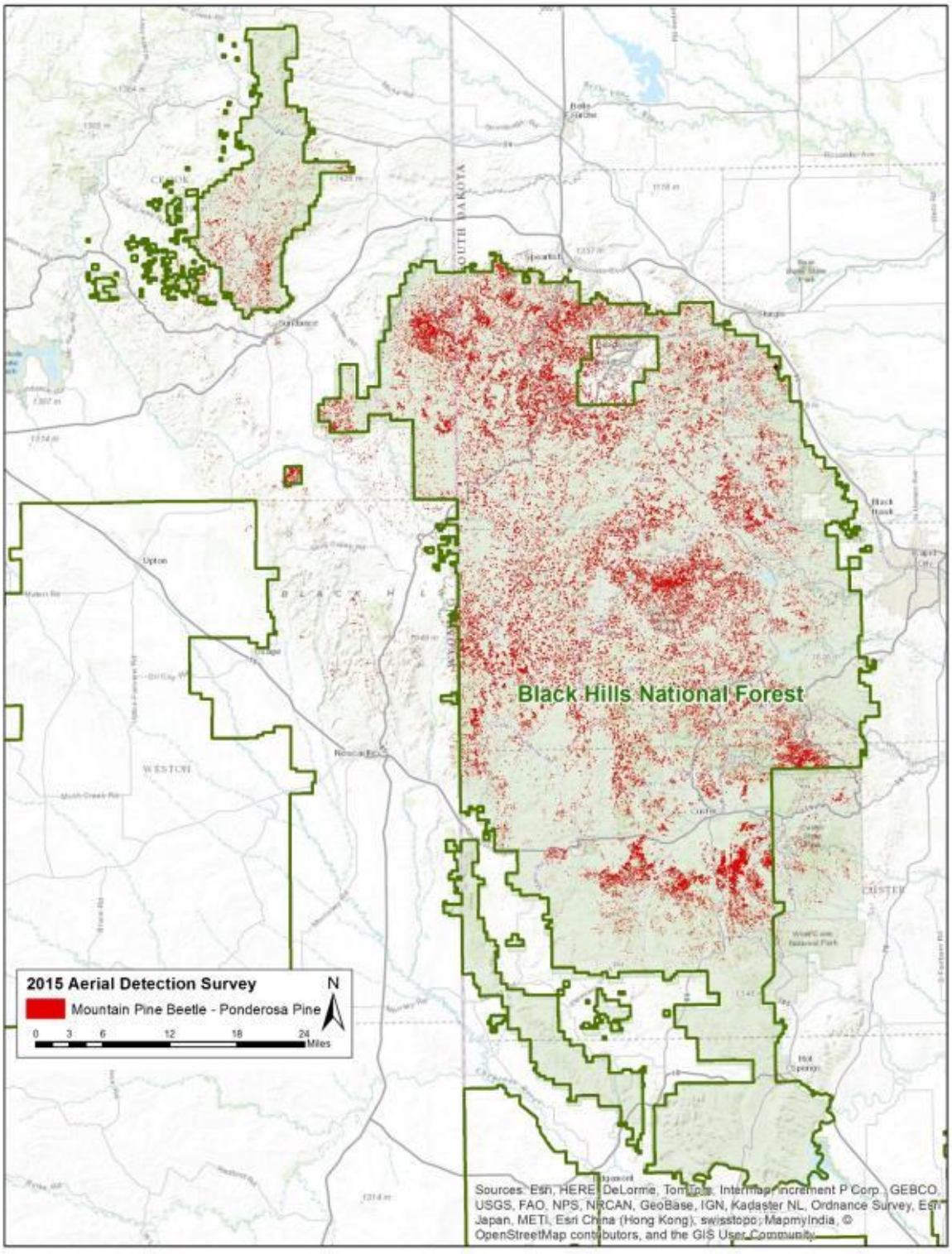

Figure 5. Aerial Photo Interpretation map of mountain pine beetle damages in the Black Hills National Forest: 2015.

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Grand Mesa, Uncompahgre and Gunnison National Forests - Activities of Forest Insects & Diseases on the in 2015

Insects and diseases which affect forest trees are currently active on the Grand Mesa, Uncompahgre and Gunnison (GMUG) National Forest. This activity is present throughout most of the Forest and is due to several different agents in a variety of cover types.

The acreage values presented below were derived from Aerial Detection Survey (ADS), a cooperative program between the USDA Forest Service and Colorado State Forest Service. Each year, trained aerial observers estimate the amount and location of insect and disease caused tree damage or mortality detectable from the air. Aerial survey requires that observers make broad categorizations, and a certain degree of qualitative judgement is inherent in these observations. In addition, there is a time lag between when the damaging agents first affect their hosts and when the damage is visible from the air. Nevertheless, this information is critical in monitoring long-term trends and impacts on the forest. Many of the damaging insects and some disease problems which were observed during the 2015 Aerial Detection Surveys are shown on the ADS map of the GMUG (Fig. 2) and acres affected are shown in Table 1.

Table 1: 2015 Aerial Survey Observations for the GMUG National Forests

Insect	Acres affected in 2014	Acres affected in 2015	Cumulative total of acres affected 1996 > 2015
Spruce beetle	108,000	**100,000**	289,000
Mountain pine beetle	840	**600**	17,000
Douglas-fir beetle	10,000	**2,000**	59,000
Western balsam bark beetle	14,700	**11,700**	N/A means not applicable
Fir engraver	1,600	**11,400**	N/A
Western spruce budworm	0	**1,400**	N/A

Spruce beetles (*Dendroctonus rufipennis*) have been in outbreak status on the GMUG National Forest for the past decade. This activity has been widespread, and in some locales, very intense. The nature of the spruce beetle activity is very much affected by local conditions. While there was a slight decrease in the number of affected acres in 2015, the beetles spread into 65,000 new acres. Recent weather patterns have probably had a dampening effect on spruce beetle populations (there was significant precipitation during the flight period of 2015), but if drought returns, these impacts may only be temporary.

Virtually all portions of the forests with stands of mature spruce have now been impacted. Much of the southern portion of the Forest has been affected by beetles migrating northward from the intense outbreak on the neighboring Rio Grande National Forest. A broad arc of forest, from Monarch Pass in the east, south through the Cochetopa Hills and Los Piños, continuing through the Lake City area, and then westward to the Alpine Plateau and Cimarron Ridge is currently

affected. North of Monarch Pass, the western portion of the Collegiate Range including the upper elevations above the Taylor Park area, as well as Fossil Ridge are more recently affected. The beetles are also widespread in the spruce/fir cover type of the West Elk Wilderness

The situation on the Grand Mesa is somewhat different. Although spruce beetle have been active here for a decade, the patterns of mortality are much more dispersed with an absence of the large polygons of mortality seen elsewhere on the Forest. However, the dispersed nature of the mortality on the Grand Mesa often obscures the fact that individual and small clumps of infested trees can be found everywhere throughout the spruce/fir cover type. One explanation for the different pattern of mortality on the Grand Mesa is that the windswept nature of this area quickly disperses the beetles as well as the pheromones that direct beetle activity.

In the absence of an unusual weather event such as extreme or unseasonable cold or large amounts of precipitation during the beetle's flight period, spruce beetle outbreaks on the GMUG National Forests will most likely continue for several years. Amounts of mortality in affected stands will vary greatly; some stands maintaining varying amounts of residual live trees, while other stands have mortality approaching 100%. Management efforts, primarily salvage and sanitation activities, can affect spruce beetle populations at a local level.

Mountain pine beetles (*Dendroctonus ponderosae*) attack ponderosa, lodgepole, limber, and Rocky Mountain bristlecone pines. These bark beetles are currently at very low levels, having declined from levels of mortality which occurred on the GMUG National Forest about a decade ago. Low numbers of mountain pine beetle allow forest managers to preemptively treat stands to reduce susceptibility to mountain pine beetles.

Douglas-fir mortality from Douglas-fir beetle (*Dendroctonus pseudotsugae*) is currently at a moderate level on the GMUG National Forests; a total of only 2,000 acres were recorded in 2015. Mortality caused by Douglas-fir beetle tends to be of a dispersed nature, although there can be concentrated groups of mortality within a generally affected area. The high level of Douglas-fir mortality previously recorded in the vicinity of the San Miguel River has subsided with time. Current "hot spots" include portions of the Uncompahgre Plateau, and scattered Douglas-fir mortality in the eastern portion of the Gunnison. There are several projects that have utilized the anti-aggregate pheromone MCH to reduce Douglas-fir beetle impacts in high-value stands on the Forest. Funding provided by Forest Health Protection is being used to purchase and apply this material to protect Douglas-fir in recreation and view shed areas in cooperation with District personnel.

Western balsam bark beetle (*Dryocoetes confusus*) attacks subalpine fir and is currently active in high elevation spruce/fir stands throughout the forests. The pattern of tree mortality caused by western balsam bark beetle is of a scattered nature in affected stands. This beetle's activity tends to wax and wane over time, responding to changes in weather patterns from year to year. This bark beetle frequently acts in concert with a fungal root disease, Armillaria root disease (*Armillaria* spp.), with the beetles attacking and killing diseased host trees. The relative contribution of the beetle and the fungus to tree mortality is difficult to determine, and can differ over time and in different localities. The areas with the greatest amount of subalpine fir mortality are found mostly on the northern edges of the Forest, with scattered groups of mortality around Crested Butte.

A Pine Beetle Complex or group of bark beetles often attack ponderosa pine resulting in what are called "mixed broods" of bark beetles. This group has western pine beetle (*Dendroctonus brevicomis)*, round headed pine beetle (*D*. *adjunctus)*, and pine engraver (*Ips pini).* It is not uncommon to find all three of these beetles in one host at the same time; alternatively they can be found attacking host trees as individual species, with other species "filling in" the attacks at a later time.

There is currently a significant outbreak of round headed pine beetle attacking mature ponderosa pine on the San Juan National Forest and a small amount of roundheaded pine beetle activity has been noted on the southern portions of the Norwood Ranger District. Ground based surveys are planned for the summer of 2016 in order to better determine the nature and extent of outbreaks. Forest Health Protection provides funding which supports thinning and sanitation efforts in affected stands. It is hoped that this activity will disperse in response to the sanitation efforts and generally increased precipitation.

There was a dramatic increase in Western Spruce Budworm (*Choristaneura occidentalis (freemani*) activity on the GMUG National Forests in 2015. The defoliation caused by the moth larvae was widespread, with activity evident on the Gunnison, in the West Elk Wilderness and especially on the Ouray and Norwood Districts.

The primary hosts of western spruce budworm are Douglas-fir, white fir, and to a lesser extent, Engelmann spruce. These insects usually do not kill their host outright, but repeated years of defoliation can weaken the host trees and make them more susceptible to other damaging agents such as bark beetles. Stand conditions contribute greatly to the budworm population's ability to increase to outbreak status. Multistory stands of shade-tolerant species are conducive to budworm activity. A combination of suitable habitat and favorable weather patterns have resulted in the current widespread outbreak of western spruce budworm. Management activities such as reducing basal area and thinning from below can render stands less susceptible to western spruce budworm.

Fir Engraver (*Scolytus ventralis*) is a bark beetle that attacks and kills mature white fir; the number of acres affected on the GMUG National Forest was low when compared to other damage agents. However, white fir mortality is concentrated in a highly visible area, namely the vicinity of Ouray and is a cause for concern for local residents. The mortality crosses State, Federal and private property boundaries and affects view sheds and recreational sites within the generally affected areas. The current situation is believed to have originated during the mining era when high-grading of stands for ponderosa pine and Douglas-fir left behind the less valuable white fir. These predominantly white fir stands are now reaching the mature to over-mature stage and the fir engraver population has responded to recent drought conditions and abundant host type by achieving outbreak status. Only a small portion of the GMUG National Forest contains white fir, so the activity of fir engraver will be restricted, but the intense and highly visible nature of this mortality will be a challenge for forest managers. Although some diseases can be observed in ADS, many of the most destructive diseases are not represented in the survey data because these agents are not detectable from aerial surveys.

Aspen Discoloration and Defoliation of aspen were widespread on the GMUG National Forests in 2015 (**Fig 1**). One cause of such damage is Marssonina leaf blight, (*Marssonina* spp.) which discolors foliage, then causes defoliation in midsummer. This disease was

widespread and severe in much of the Colorado aspen stands in 2015 due to frequent rain in much of the summer, particularly on the GMUG. Considering only the discoloration symptom, which is more clearly attributable to this disease, Marssonina was second only to spruce beetle on the GMUG in 2015, at 23,500 acres. The greatest damage was on the Gunnison National Forest, which had 16,000 acres. Likely some of the defoliation observed was due to this disease also. Although Marssonina leaf blight reduces growth, mortality is rare except when severe disease occurs for several consecutive years.

Figure 1. Aspen discoloration on the Grand Mesa National Forest (by Backsen, 2015)

Two other agents, indistinguishable from the air, yet responsible for a great majority of insect-caused aspen defoliation. Most common is the Western Tent Caterpillar (*Malacasoma californicum*). Populations of this insect can increase rapidly and may cause almost total defoliation of affected stands. Typically, populations reach high levels for several years before viral diseases cause the collapse of the insect's populations. In most cases these defoliators do not cause great amounts of tree mortality, but in some cases, repeated intense attack can result in tree death. The other primary defoliator of aspen is the Large Aspen Tortrix (*Choristaneura conflictana*), a bright green caterpillar that can occasionally reach outbreak levels and impact portions of the aspen forest.

For Additional Information and Help

An excellent resource that provides more detailed information on these and other forest insects and forest diseases is the "Field Guide to Diseases & Insects of the Rocky Mountain Region". This publication contains illustrations and descriptions of the damage agents, guidelines for management and a brief introduction to the literature concerning the pertinent topics. This field guide book may be obtained in soft cover format from Gunnison Service Center.

For additional maps and information regarding see Forest health conditions throughout the Rocky Mountain Region, or for more information on R2 Aerial Detection and Survey.

The Gunnison Service Center continues to monitor the status of forest health throughout the GMUG National Forests. For additional information, please contact the Gunnison Service Center: Forest entomology: Tom Eager (teager@fs.fed.us 970-642-4450), Forest pathology: Jim Worrall (jworrall@fs.fed.us 970-642-4453), Biological technician: Suzanne Marchetti (sbmarchetti@fs.fed.us 970-642-4448).

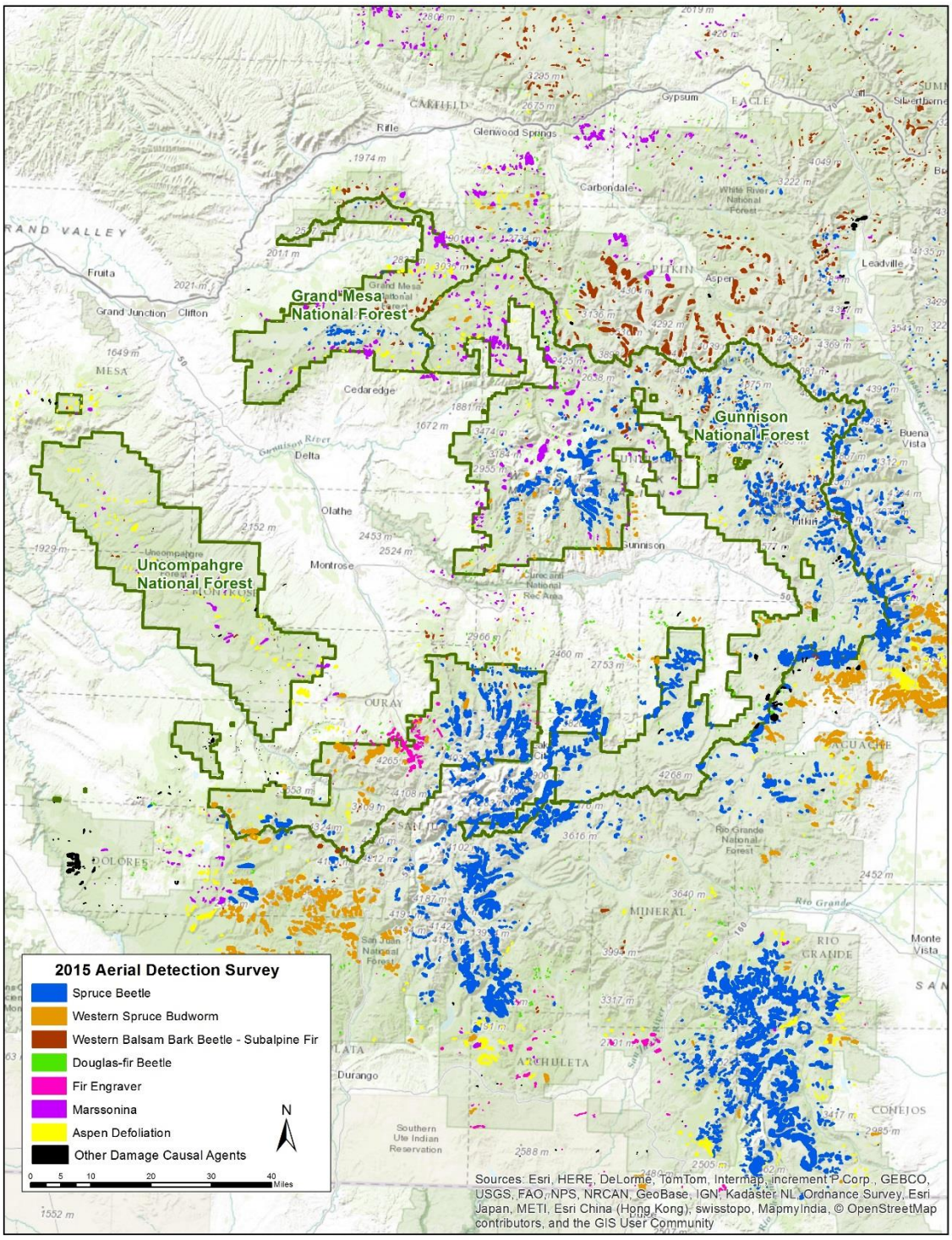

Figure 2. 2015 Aerial Detection Survey map of the Grand Mesa, Uncompahgre and Gunnison National Forests.

Go to the **Table of Contents** for 2015 Rocky Mountain Region Forest Health Conditions report

2015 Forest Pest Conditions Highlight: Medicine Bow-Routt National Forests

USDA Forest Service
Rocky Mountain Region
Forest Health Protection
Lakewood Service Center
740 Simms Street
Golden, CO 80401

Conditions Highlights

In 2015, Colorado and southern Wyoming saw a decrease in spruce beetle. Aerial detection surveys identified 8,750 acres on the Medicine Bow and Routt National Forests (MBRNF). Most of the activity is on the Routt National Forest in Jackson County, CO (8,300 acres). Numerous windthrow events since 2011 have increased the potential for spruce beetle activity through much of the Region and predominately dry conditions continue to stress high-elevation mix-conifer forests.

Tree mortality associated with mountain pine beetle (MPB) continued to decline throughout Colorado and southern Wyoming to levels observed prior to the recent outbreak (7,600 acres). Only 710 acres was observed on the MBRNF in 2015; all of the damage occurred in Natrona County, WY.

Dwarf mistletoe is common and impacts occur to varying degrees in lodgepole pine forest-wide. A great opportunity exists for managing and reducing the impacts of this disease while the forest conducts vegetation management in campgrounds, administrative areas, and in the forest following the bark beetle epidemic.

White pine blister rust (WPBR) is well established and continues to spread and intensify in limber pine in southern Wyoming. However, only one infected tree has been identified in the Sierra Madre Range and the disease has not been detected on the Routt National Forest. In an extensive survey of limber pine health in the central and southern Rocky Mountains, only half of all limber pines were classified as healthy (Cleaver et al. 2015). Researchers modeled factors that influence blister rust, bark beetles, and dwarf mistletoe and identified candidate stands for restoration. FHP continues to monitor the distribution, severity, and impacts of the disease.

Only 8 acres of aspen dieback and mortality, sometimes referred to as Sudden Aspen Decline or “SAD”, was observed on the MBNF in 2015 (none on the RNF). This is consistent with a recent study of aspen health in Colorado and southern Wyoming that reported overstory aspen on the MBRNF was healthy overall, with normal levels of adult aspen mortality and low crown dieback, despite nearly ubiquitous presence of insect and disease damage (Dudley et al. 2015). However, aerial detection surveys found aspen discoloration, largely attributed to Marssonina leaf blight,

to be fairly common in 2015. Of the 99,000 acres mapped in Colorado and southern Wyoming, 12,000 occurred on the Medicine Bow and 5,200 on the Routt. Marsonnina leaf blight is caused by a native pathogen, and exists endemically in many aspen stands. The disease can become more prevalent at any time of the growing season with high precipitation. Mortality is rare unless the outbreak occurs over consecutive years or is combined with other stresses. This damage is not SAD, nor is it believed to be associated with SAD.

Aerial Detection Survey Highlights

- Spruce beetle activity decreased in Colorado and southern Wyoming from 494,000 acres in 2014 to 410,000 acres in 2015. Of this, only 750 and 8,000 acres were affected on the Medicine Bow and Routt National Forests, respectively, in 2015 (**Figs. 1 & 2**).
- Mountain pine beetle activity in Colorado and southern Wyoming decreased to 7,600 acres in 2015. No damage was reported on the Routt and only 1,600 acres was reported on the Medicine Bow.
- Western balsam bark beetle-caused mortality of subalpine fir was reported on 126,000 acres in Colorado and southern Wyoming in 2015. This included 8,900 acres on the Routt and 2,700 acres on the Medicine Bow.
- Aspen discoloration, largely attributed to Marssonina leaf blight, was fairly common and widespread in 2015. Of the 99,000 acres mapped in Colorado and southern Wyoming, 12,000 occurred on the Medicine Bow and 5,200 on the Routt. This damage is not SAD, nor is it believed to be associated with SAD.

FHP Projects

- FHP recommended the Forest consider applying insecticides for MPB prevention every other year rather than annually if bark beetle activity remains at endemic levels (Powell and Stephens 2015).
- FHP and Rocky Mountain Research Station (RMRS), continue to use verbenone (an MPB anti-aggregation pheromone) to protect limber pines with confirmed resistance to WPBR from MPB on the Laramie Ranger District.
- The USFS (RMRS, FHP, and Dorena Genetic Resource Center) and the National Park Service are actively collaborating to identify WPBR resistance in limber and bristlecone pine families in the region. A high level of rust resistance has been confirmed in some limber pine families on the MBNF (Schoettle et al. 2014).
- The Southern Rockies Rust Resistance Trial (SRRRT) was initiated at a revitalized CCC nursery on the MBNF in 2013 to field-verify WPBR resistance (**Fig. 3**). Seed from resistant limber and Rocky Mountain bristlecone pines (tested and confirmed in OR) from throughout the southern Rockies, including trees from the MBNF, was sown and seedlings grown at the Colorado State Forest Service Nursery. Over 700 seedlings were outplanted in the fall 2013 and another 700 seedlings in spring 2014. In 2015, seedling growth and health status were assessed; no evidence of rust infection has been noted

yet. The fall planting proved to be more successful for survival. Crews also installed a snow fence to provide protection over the harsh winter months.

- A study to evaluate the efficacy of pruning to reduce WPBR impacts was initiated in 2005 on two study sites including Vedauwoo Campground on the MBNF and Mosca Pass in the Great Sand Dunes National Park and Preserve. A final assessment was conducted in 2015 and a report is being prepared.
- Restoration planting options have been developed (Casper et al. 2016) and seed transfer guidelines have been refined (Borgman et al. 2015) for limber pine in the southern Rocky Mountains. The limber pine conservation strategy developed for RMNP on 2015 is currently being adapted to a broader region that includes the Arapaho, Roosevelt, and Medicine Bow National Forests (Schoettle et al. *in press*).
- A study of the extent, severity, and causes of aspen mortality in Colorado and southern Wyoming was recently completed (Dudley et al. 2015).

Surrounding Area Conditions of Note

- Rocky Mountain National Park continues to manage high-value, high-risk pines predominately near historic structures and campgrounds with carbaryl or verbenone to prevent mountain pine beetle activity.
- Spruce beetle activity has increased in Rocky Mountain National Park.

Recent Reports and Resource List

Forest Health Protection (FHP), in cooperation with the Colorado State Forest Service, Wyoming State Forestry, and other partners, compiles a Forest Pest Conditions report for the Region each year. FHP also conducts annual Aerial Detection Surveys, ground surveys, special projects, and site visits to identify, assess, and map insect and disease-caused tree mortality and damage and to provide technical assistance to our cooperators throughout the Region. The following is a list of recent reports, publications, and other resources available.

Service Trip Reports

- Burns KS. 2015. Evaluation of Hazard Tree Issues in Tie City Campground and Trailhead. Service Trip Report, LSC-15-5.
- Burns KS. 2015. King's Canyon Thinning Project for Dwarf Mistletoe Control and Wildlife Habitat Improvement. Service Trip Report, LSC-15-8.
- Powell RL, Stephens SS. 2015. Evaluation of Continued Preventative Spraying for MPB on the Laramie Ranger District. Service Trip Report, LSC-15-4.

Publications

- Borgman EM, AW Schoettle, AL Angert. 2015. Assessing the potential for maladaptation during active management of limber pine populations: a common garden study detects

genetic differentiation in response to soil moisture in the Southern Rocky Mountains. Can. J. For. Res. 45: 496–505.

- Casper AM, Jacobi WR, Schoettle AW, Burns KS. 2016. Restoration planting options for limber pine (*Pinus flexilis* James) in the Southern Rocky Mountains. The Journal of the Torrey Botanical Society, 143(1):21-37.
- Cleaver CM, Jacobi WR, Burns KS, Means RE. 2015. Limber pine in the central and southern Rocky Mountains: Stand conditions and interactions with blister rust, mistletoe, and bark beetles. Forest Ecology and Management 358: 139-153.
- Dudley MM, Burns KS, Jacobi WR. 2015. Aspen mortality in the Colorado and southern Wyoming Rocky Mountains: extent, severity, and causal factors. Forest Ecology and Management 353 (2015) 240–259.
- Schoettle AW, Cleaver CM, Burns KS, Connor JJ. *In press*. Limber Pine Conservation Strategy for the Greater Rocky Mountain National Park Area. USDA Forest Service, Rocky Mountain Research Station General Technical Report. RMRS-GTR-xxx.
- Schoettle AW, Sniezko RA, Kegley A, Burns KS. 2013. White pine blister rust resistance in limber pine: evidence for a major gene. Phytopathology 104: 163-173.

Useful Links

- R2 Forest Health Protection Website
  - Aerial Survey Data and Maps (reports and tables are available by request)
  - Dwarf Mistletoes: Ecology and Management in the Rocky Mountain Region
  - Field Guide to Insects and Diseases in the Rocky Mountain Region
  - Hazard Tree Identification and Management
  - Other Reports and Publications
- Forest Health Technology Enterprise Team
  - National Insect and Disease Risk Map
  - National Forest Damage Agent Range Maps
  - Forest Conditions - FHP Mapping and Reporting Tools

We look forward to continued work with the MBRNF regarding your forest insect and disease concerns. Please do not hesitate to contact us with your inquiries.

Lakewood Service Center
- Jim Kruse, Service Center Leader, jkruse@fs.fed.us, 303-236-9541
- Sky Stephens, Entomologist, ssstephens@fs.fed.us, 303-236-9552
- Rebecca Powell, Entomologist, rebeccalpowell@fs.fed.us, 303-236-8008
- Kelly Burns, Pathologist, ksburns@fs.fed.us, 303-236-8006

Figures

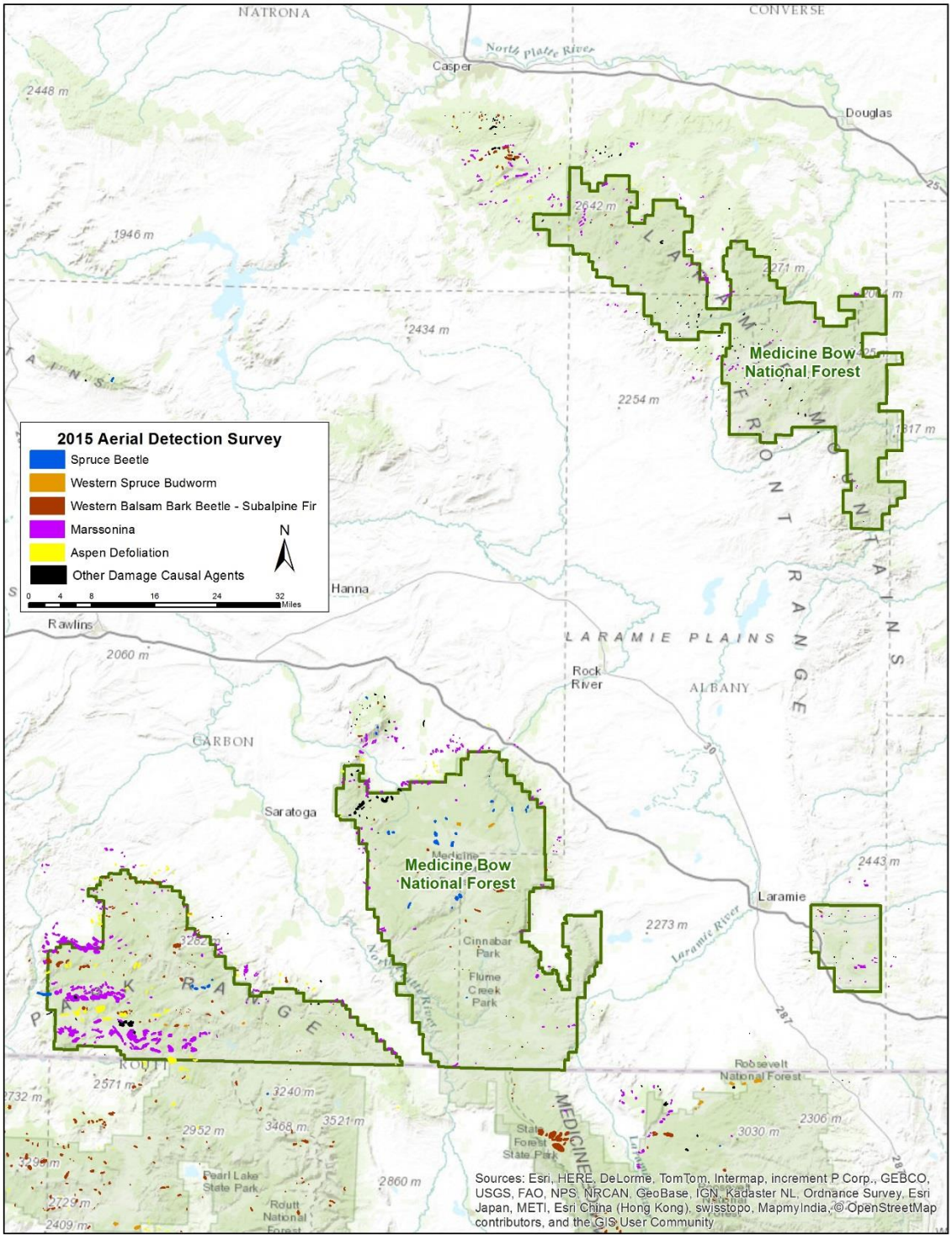

Figure 1 Aerial detection survey map of the Medicine Bow National Forest 2015

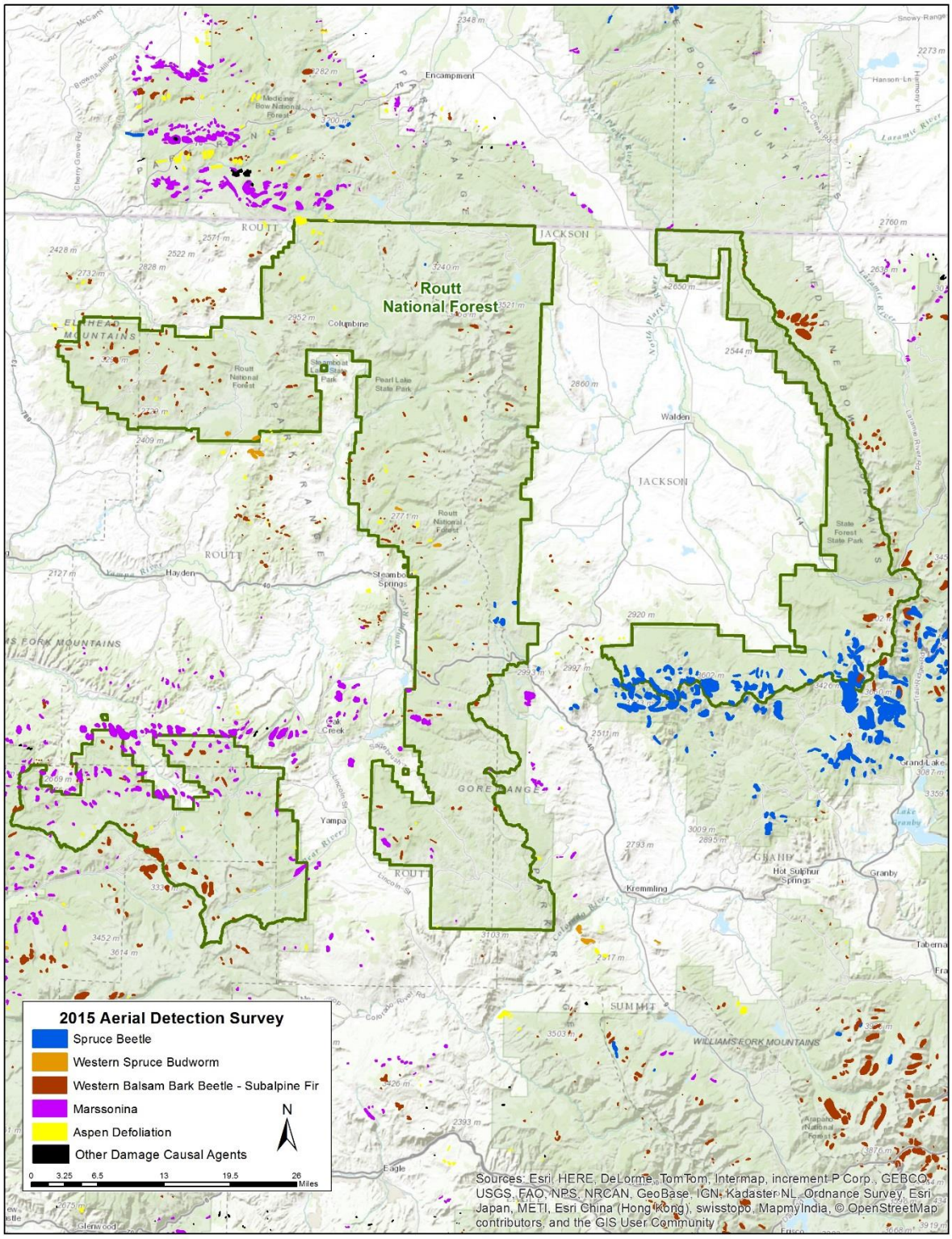

Figure 2. Aerial detection survey map of the Routt National Forest 2015.

Figure 3. In 2015, we assessed over 1400 limber and bristlecone pine seedlings at the Southern Rockies Rust Resistance Trial, Pole Mountain Work Center; no evidence of blister rust infection has been observed. A snow fence was installed to protect seedling over the course of the winter.

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Nebraska National Forest & Bessey Nursery - 2015 Forest Health Highlights

USDA Forest Service, Rocky Mountain Region, Forest Health Protection
Rapid City Service Center, 8221 S Highway 16, Rapid City, SD 57702

Kurt Allen, Entomologist; Jim Blodgett, Plant Pathologist; Al Dymerski, Forestry Technician; Kendra Schotzko, Entomologist. p: 605-343-1567

Conditions

Figure 1. Fire and pine engraver affected areas.

- Pine engraver beetle (*Ips* sp.) combined with fire are the most damaging agents in ponderosa and jack pine (**Fig. 1**).
- Diplodia shoot blight and canker disease, frequently combined with hail and/or pine engraver beetle, are also damaging ponderosa and jack pine (**Fig. 2**).

Figure 2. Widespread Diplodia damage.

- Aerial detection survey identified 930 acres of pine engraver beetle damage in ponderosa pine (**Fig. 4**) in the Pine Ridge Ranger District; other districts were not flown.

- There was widespread light defoliation of oaks and chokecherries by the banded tussock moth in north central Nebraska and south central South Dakota.

Bessey Nursery - Forest Health Conditions:

- Damage agents in conifers at the nursery include *Diplodia pinea*, *Fusarium*, *Phytophthora*, and *Pythium*; and occasionally *Phomopsis*.

- Damage agents in hardwoods at the nursery include black-knot and shot hole in *Prunus*; and occasional foliage diseases including Anthracnose; powdery mildews; Melampsora rust on cottonwood; rusts on *Ribes*; and Gymnosporangium rust ("cedar apple rust") on *Amelanchier*, *Malus*, and *Crataegus*.

- Diseases at the nursery were controlled with proper watering practices, healthy plants, and timely control applications to reduce significant loss (**Fig. 3**).

Figure 3. Fall colors in bur, swamp white, and red oaks at the nursery.

- Animal damage was minimized with deer fence and woven electric fence for small mammals.
- Weeds at the nursery were controlled with mowing, hand-pulling, and herbicide to maintain weed free fields as well as wind-breaks.

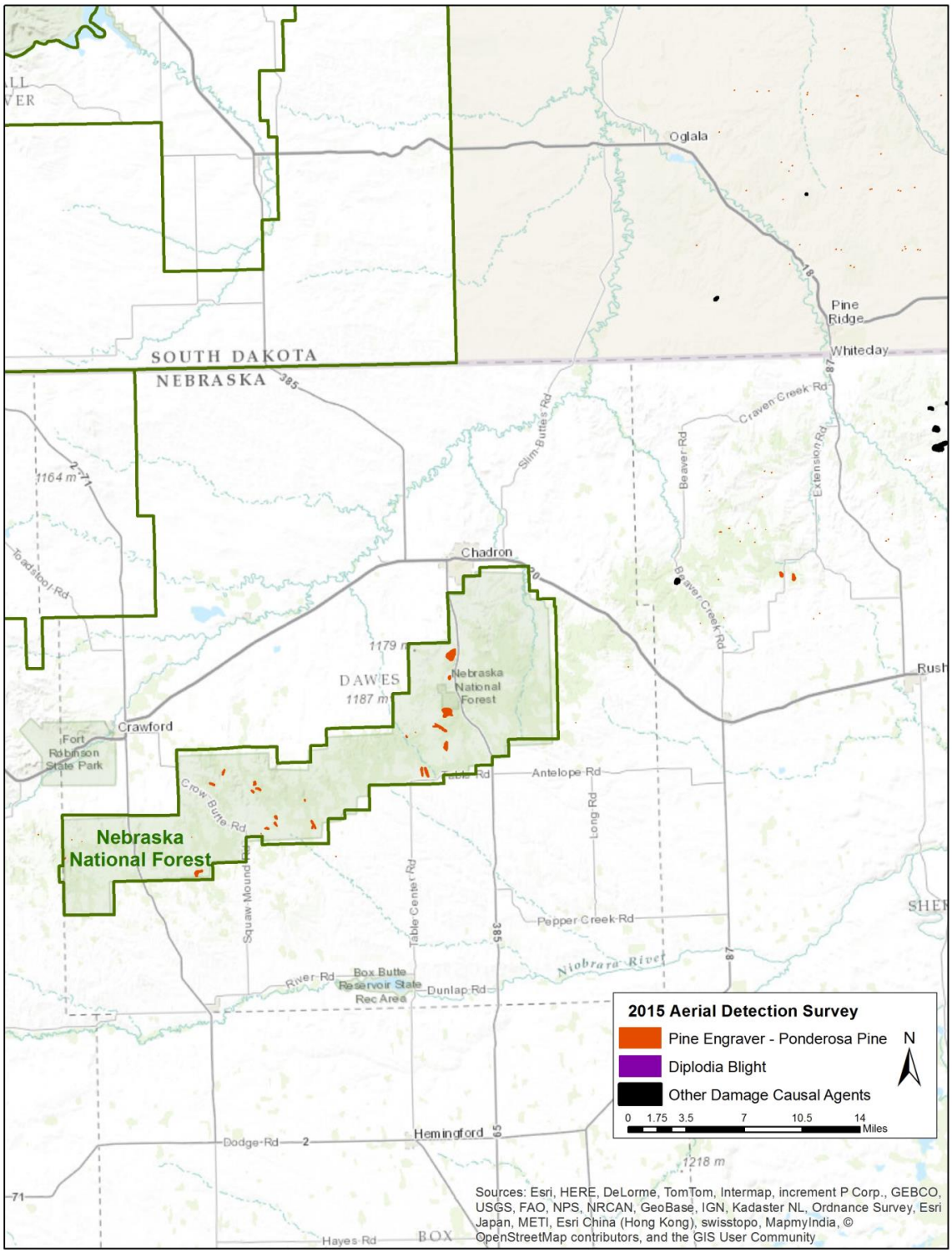

Figure 4. Aerial detection survey map of the Nebraska National Forest: 2015. Only Pine Ridge Ranger District was flown.

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2015 Forest Pest Conditions Highlights: Pike National Forest

USDA Forest Service
Rocky Mountain Region
Forest Health Protection
Lakewood Service Center
740 Simms Street
Golden, CO 80401

Conditions Highlights

In 2015 the Pike National Forest (PNF) saw an increase in Douglas-fir tussock moth (17,000 acres) and western spruce budworm (26,000 acres) activity throughout the Pike's Peak and South Platte Ranger Districts and on adjacent State and private lands (**Fig. 1**). These insects are often observed in the same areas and impacting the same individual trees. Defoliation by Douglas-fir tussock moth garnered considerable attention from the public in 2015 although defoliation by this insect occurred in previous years with less intensity and acreage. Douglas-fir tussock moth damage was most notable in Jefferson (15,000 acres) and Douglas (8,800 acres) counties in 2015.

Bark beetle activity occurs at endemic levels across the Pike National Forests with approximately 470 acres spruce beetle and 290 acres of Douglas-fir beetle detected in aerial detection surveys. Areas have been identified on the ground where spruce beetle activity is of concern in recreation areas including the Crags and its associated diffuse camping area. Douglas-fir beetle is common along the Rampart Range. On July 20th a wind event impacted the Devil's Head area blowing down several acres of trees and causing damage to the trailhead and causing closures (**Figs. 1-3**). This area of blowdown may become impacted by insects such as spruce beetle or Douglas-fir beetle which can reproduce in down woody material. FHP will continue to assist the Forest with monitoring this area.

Dwarf mistletoes are one of the most common and damaging diseases of Douglas-fir, lodgepole pine, and ponderosa pine on the Pike National Forest. A great opportunity exists for managing and reducing the impacts of these diseases while the forest conducts vegetation management in campgrounds, administrative areas, and in the forest following bark beetle outbreaks and other disturbances. A dwarf mistletoe management guide is available for the Region (see "Useful Links" section).

White pine blister rust continues to spread and intensify in limber pine on the forest. The disease is well established in the Sangre de Cristo and Wet Mountains but new infection centers have been identified near Crystal Reservoir in 2009 and in the Rampart Range in 2013, Pikes Peak Ranger District. The only infected bristlecone pines identified to date are located within the Great Sand Dunes National Park and Preserve. Forest Health Protection (FHP) continues to monitor the distribution, severity, and impacts of this disease.

Twenty acres of aspen dieback and mortality, sometimes referred to as Sudden Aspen Decline or "SAD", was observed on the PNF in 2015. This is consistent with a recent study of aspen health in Colorado and southern Wyoming that reported overstory aspen on the PNF was healthy overall, with normal levels of adult aspen mortality and low crown dieback, despite nearly ubiquitous presence of insect and disease damage (Dudley et al. 2015).

Aerial Detection Survey Highlights

- Douglas-fir tussock moth activity was mapped on 26,000 acres in Colorado, most of this damage (17,000 acres) occurred on the PNF (**Figs. 4 and 5**).
- Western spruce budworm activity increased on the PNF from 15,000 acres in 2014 to 26,000 acres in 2015.
- Douglas-fir beetle activity decreased on the PNF from 3,600 acres in 2014 to 290 acres in 2015.
- Western balsam bark beetle activity on the PNF decreased from 13,000 to 3,100 acres in 2015.
- Twenty acres of aspen dieback and/or mortality was detected on the PNF in the 2015.

FHP Projects

- FHP conducted defoliator surveys and trapping across the PNF.
- FHP partnered with the Pacific Northwest Research Station to conduct studies on the Douglas-fir tussock moth population near Cheyenne Mountain.
- Spruce beetle activity was assessed and management recommendations were provided to the PPRD for the Crags Campground area and the diffuse camping area along Fourmile Creek.
- Portions of the PNF were included in the WO S&PF-TR review field trip conducted in October of 2015.
- The USFS (Rocky Mountain Research Station, Dorena Genetic Resource Center, and FHP) and the National Park Service are actively collaborating to identify WPBR resistance in limber and bristlecone pine families in the region. A high level of rust resistance has been confirmed in some families of both species (Schoettle et al. 2014).
- The Southern Rockies Rust Resistance Trial (SRRRT) was initiated at a revitalized CCC nursery on the Medicine Bow National Forest in 2013 to field-verify WPBR resistance. Seed from resistant families (tested and confirmed in OR) from throughout the Southern Rockies, including families from the PSINF, was sown and seedlings grown at the Colorado State Forest Service Nursery. The seedlings are being periodically assessed for signs and symptoms of WPBR.
- A study of the extent, severity, and causes of aspen mortality in Colorado and southern Wyoming was recently completed (Dudley et al. 2015).
- Restoration planting options have been developed (Casper et al. 2016) and seed transfer guidelines have been refined (Borgman et al. 2015) for limber pine in the Southern Rocky Mountains.

- The Armillaria root disease pathogen, *Armillaria sinapina*, was reported for the first time in Colorado, including an isolate collected from a diseased subalpine fir on the SINF (Burns et al. 2016). Previous surveys in Colorado only identified *A. solidipes* (as *A. ostoyae*) in the state. Although *A. sinapina* is frequently considered a weak pathogen, trees that are maladapted due to climate change could become more susceptible to Armillaria root disease caused by *A. sinapina*.
- A Hazard Tree Management training session was conducted June 23-24, 2015 at the Woodland Park Work Center, Pikes Peak Ranger District.

Surrounding Area Conditions of Note

- U.S. Air Force Academy, including the Farish Recreation Area, has experienced light defoliation from western spruce budworm within stands of Engelmann spruce and Douglas-fir.
- Cheyenne Mountain Air Force Station and the adjoining land on Cheyenne Mountain State Park have experienced 1600 acres of partial to complete defoliation by Douglas-fir tussock moth in stands of Douglas-fir (**Figs. 6 and 7**).
- Private property near Perry Park, Foxton, Buffalo Creek and surrounding communities have experienced defoliation by Douglas-fir tussock moth and western spruce budworm. They have treated some areas with an aerial application of Bt.
- FHP will be partnering with the Colorado State Forest Service, the PNWRS and the city of Colorado Springs to assess effectiveness of proposed DFTM treatments.
- A study to evaluate the efficacy of pruning to reduce WPBR impacts was initiated in 2005 on two study sites including Vedauwoo Campground on the MBNF and Mosca Pass in the Great Sand Dunes National Park and Preserve. A final assessment was conducted in 2015 and a report is being prepared.

Recent Reports and Resource List

Forest Health Protection, in cooperation with the Colorado State Forest Service and other partners, compiles a Forest Pest Conditions Report for Colorado each year. FHP also conducts annual Aerial Detection Surveys, ground surveys, special projects, and site visits to identify, assess, and map insect and disease-caused tree mortality and damage and to provide technical assistance to our cooperators throughout the Region. The following is a list of recent reports, publications, and other resources available and relevant to the Pike National Forest. Aerial detection survey tables and reports are available by request.

Service Trip Reports

- Powell RL, Stephens SS. 2015. Evaluation of Douglas-fir Tussock Moth Activity on the Air Force Academy. Service Trip Report, LSC-15-2.
- Powell RL, Stephens SS. 2015. Evaluation of Western Spruce Budworm Defoliation at the Rampart Range Recreation Area on the Pikes Peak Ranger District. Service Trip Report, LSC-15-6.
- Stephens SS, Powell RL. 2015. Evaluation of ponderosa pine and Gambel oak stands at Fort Carson, Service Trip Report, LSC-15-7.
- Stephens SS. 2015. Meadow Ridge Campground Western Spruce Budworm Defoliation Assessment. Service Trip Report, LSC-15-15.
- Stephens SS. 2015. Spruce Beetle Treatment Recommendations for Xcel Powerline Project. Service Trip Report, LSC-15-16.
- Stephens SS, Powell RL. 2015. Spruce Beetle Site Visit to Bear Trap Ranch. Service Trip Report, LSC-16-1.
- Stephens SS, Powell RL. 2016. Assessment of Western Spruce Budworm and Douglas-Fir Tussock Moth and Other Forest Health Issues at the Air Force Academy. Service Trip Report, LSC-16-2.
- Burns KS, Dell I. 2016. Evaluation of Hazard Tree Issues in the Air Force Academy's Farish Recreation Area. Service Trip Report, LSC-16-4.

Publications

- Borgman EM, AW Schoettle, AL Angert. 2015. Assessing the potential for maladaptation during active management of limber pine populations: a common garden study detects genetic differentiation in response to soil moisture in the Southern Rocky Mountains. Can. J. For. Res. 45: 496–505.
- Burns KS, Hanna JW, Klopfenstein NB, Kim M-S. 2016. First Report of the Armillaria Root Disease Pathogen, *Armillaria sinapina*, on Subalpine Fir (*Abies lasiocarpa*) and Quaking Aspen (*Populus tremuloides*) in Colorado. Plant Disease 100(1): 17.
- Casper AM, Jacobi WR, Schoettle AW, and Burns KS. 2016. Restoration Planting Options for Limber Pine (*Pinus flexilis* James) in the Southern Rocky Mountains. Journal of the Torrey Botanical Society 143(1): 21-37.
- Dudley MM, Burns KS, and Jacobi WR. 2015. Aspen mortality in the Colorado and southern Wyoming Rocky Mountains: extent, severity, and causal factors. Forest Ecology and Management 353 (1): 240–259.
- Schoettle AW, Sniezko RA, Kegley A, Burns KS. 2014. White pine blister rust resistance in limber pine: evidence for a major gene. Phytopathology 104: 163-173.

Useful Links

- R2 Forest Health Protection Website
  - Aerial Survey Data and Maps (reports and tables are available by request)
  - Dwarf Mistletoes: Ecology and Management in the Rocky Mountain Region
  - Field Guide to Insects and Diseases in the Rocky Mountain Region
  - Hazard Tree Identification and Management
  - Other Reports and Publications
- Forest Health Technology Enterprise Team
  - National Insect and Disease Risk Map
  - National Forest Damage Agent Range Maps
  - Forest Conditions - FHP Mapping and Reporting Tools

We look forward to continued work with the PNF regarding your forest insect and disease concerns. Please do not hesitate to contact us with your inquiries.

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- Sky Stephens, Entomologist, ssstephens@fs.fed.us, 303-236-9552
- Rebecca Powell, Entomologist, rebeccalpowell@fs.fed.us, 303-236-8008
- Kelly Burns, Pathologist, ksburns@fs.fed.us, 303-236-8006

Figures

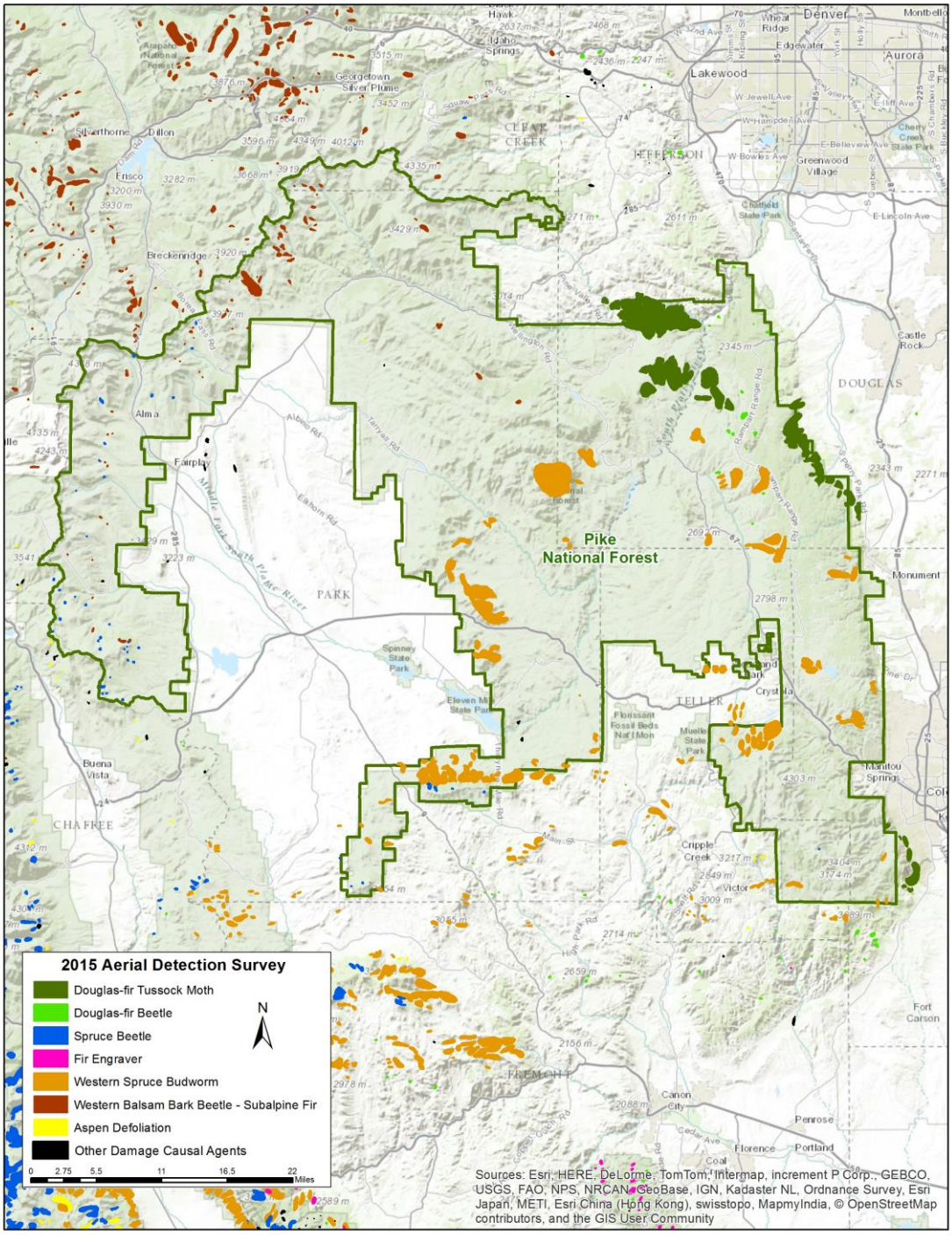

Figure 1. 2015 Aerial detection survey map for Douglas-fir tussock moth and other damaging agents on the Pike National Forest

Figure 2. Blowdown area at Devil's Head trailhead, Pike National Forest. July 2015

Figure 3. Blowdown area at Devil's Head trailhead, Pike National Forest. July 2015

Figure 4. Blowdown area at Devil's Head trailhead, Pike National Forest. July 2015

Figure 5. Douglas-fir tussock moth defoliation (gray patch) on Cheyenne Mountain (2014).

Figure 6. Aerial photo of Douglas-fir tussock moth defoliation (gray patches) on Cheyenne Mountain (2015).

Figure 7. Individual trees defoliated by Douglas-fir tussock moth on Cheyenne Mountain (2014).

Figure 8. Discoloration of host trees by Douglas-fir tussock moth at Buffalo Creek, South Platte Ranger District (2015

Go to the **Table of Contents** for 2015 Rocky Mountain Region Forest Health Conditions report

Rio Grande National Forest – Activities of forest insects and diseases for 2015

In 2015, the activity of spruce beetle continued to have the greatest impact on forested stands on the Rio Grande National Forest (**Fig. 1**). Other insects and diseases which affect forest trees are currently at a moderate level on the Forest, although there was a surprising increase in the amount of aspen defoliation and in acres affected by western spruce budworm.

The acreage values presented in the table (**Table. 1**) are derived from Aerial Detection Survey (ADS), a cooperative program between the USDA Forest Service and state agencies (Colorado State Forest Service). Each year, trained aerial observers estimate the amount and location of insect and disease caused tree damage or mortality detectable from the air (**Fig. 2**). Although some diseases were observed, many of the most destructive diseases are not represented in the data because these agents are not detectable from aerial surveys. Aerial survey requires that observers make broad categorizations, and a certain degree of qualitative judgement is inherent in these observations. In addition, there is a time lag between when the damaging agents first affect their hosts and when the damage is visible from the air. Nevertheless, this information is critical in monitoring long-term trends and impacts on the forest.

Spruce beetle (*Dendroctonus rufipennis*): The Rio Grande National Forest continues to be the epicenter of a spruce beetle outbreak that has affected spruce/fir stands throughout southern Colorado. While the number of acres that are currently being affected by spruce beetle declined in 2015, it is important to note that 34,000 acres of the Rio Grande NF were newly infested. Spruce beetle is now most active in the outer margins of the Forest, particularly within the South San Juan and the Weminuche Wilderness Areas.

The primary reason for the overall decline in acres affected by spruce beetle is the exhaustion of the mature spruce cover type that is the beetle's primary host. The size of the spruce beetle population continues to be very large, and will continue killing mature spruce until the great majority of these trees are dead. The spruce beetle population will collapse on the Rio Grande National Forest, but nearly all mature spruce will be dead by that point. Management efforts, primarily salvage and sanitation activities, can affect spruce beetle populations at a very local level. More importantly, management of affected stands will prepare the sites for future planting and restoration efforts, with funding provided by receipts collected during salvage harvesting.

Western spruce budworm (*Choristaneura occidentalis* (freemani): Defoliation of host conifers by western spruce budworm increased significantly in 2015 on the Rio Grande National Forest and throughout much of southern Colorado. Most of this activity occurred in the northeast portion of the Forest, particularly areas of the Forest due west of Villa Grove.

The primary hosts of western spruce budworm are Douglas-fir, white fir, and to a lesser extent, Engelmann spruce. Stand conditions contribute greatly to the budworm population's ability to increase to outbreak status. Multistory stands of shade-tolerant species are conducive to budworm activity. Although current budworm populations are low, their numbers can be expected to increase over time. Management activities such as reducing basal area and thinning from below can render stands less susceptible to western spruce budworm.

Table 1. Acreage values of damages observed during the 2015 Aerial Detection Survey (ADS)

Damage agent	Acres affected in 2014	Acres affected in 2015	Cumulative total of acres affected 1996 > 2015
Spruce beetle	192,000	**137,000**	588,000
Mountain pine beetle	0	**1,500**	37,000
Douglas-fir beetle	1,300	**1,900**	41,000
Western balsam bark beetle	1,400	**790**	N/A
Fir engraver	0	**40**	N/A
Western spruce budworm	12,000	**46,000**	N/A
Aspen defoliation	0	**14,000**	N/A
Aspen discoloration (Marssonina leaf blight)	N/A	**500**	N/A
Aspen dieback and mortality	N/A	**8**	N/A

Mountain pine beetles (*Dendroctonus ponderosae*): Mountain pine beetles attack ponderosa, lodgepole, limber, and Rocky Mountain bristlecone pines. These bark beetles are currently at low levels, having declined from outbreaks which occurred on the Rio Grande National Forest about a decade ago. Most of this mountain pine beetle activity took place in the vicinity of Bonanza, where large numbers of ponderosa pine were killed. Current low numbers of mountain pine beetle allow forest managers to preemptively treat stands to reduce susceptibility to mountain pine beetles.

Douglas-fir beetle (*Dendroctonus pseudotsugae*): Douglas-fir mortality from Douglas-fir beetle is currently at a moderate level on the Rio Grande National Forest. A total of only 1,900 acres were recorded in 2015. Mortality caused by Douglas-fir beetle tends to be of a dispersed nature, although there can be concentrated groups of mortality within a generally affected area.

Western balsam bark beetle (*Dryocoetes confusus*): This insect attacks subalpine fir in high elevation spruce/fir stands throughout the forest. Western balsam bark beetle numbers are currently at a low level on the Rio Grande National Forest. This beetle's activity tends to wax and wane over time, responding to changes in weather patterns from year to year. The pattern of tree mortality caused by western balsam bark beetle is of a scattered nature. This bark beetle frequently acts in concert with a fungal root disease, Armillaria root disease, with the beetles attacking and killing diseased host trees. The relative contribution of the beetle and the fungus to tree mortality is difficult to determine, and can differ over time and in different localities.

Aspen discoloration and defoliation: Discoloration and defoliation of aspen were widespread on the Rio Grande National Forest in 2015. Two areas that were particularly hard-hit were south of Bonanza and in the country north of La Jara Reservoir. One cause of aspen damage is Marssonina leaf blight, which discolors foliage, then causes defoliation in midsummer. This disease was widespread and severe in much of the Colorado aspen stands in 2015.

Two other agents, indistinguishable from the air, are responsible for the great majority of insect-caused aspen defoliation. Most common is the western tent caterpillar (*Malacasoma californicum*). Populations of this insect can increase rapidly and may cause almost total defoliation of affected stands. Typically, populations reach high levels for several years before viral diseases cause the collapse of the insect's populations. In most cases these defoliators do not cause great amounts of tree mortality, but in some cases, repeated intense attack can result in tree death. The other primary defoliator of aspen is the large aspen tortrix (*Choristaneura conflictana*), a bright green caterpillar that can occasionally reach outbreak levels and impact portions of the aspen forest.

For Additional Information and Help:

An excellent resource that provides more detailed information on these and other forest insects and forest diseases is the "Field Guide to Diseases & Insects of the Rocky Mountain Region". This publication contains illustrations and descriptions of the damage agents, guidelines for management and a brief introduction to the literature concerning the pertinent topics. This document may be obtained in soft cover format from Gunnison Service Center, or may be viewed or downloaded at:

Additional maps and information regarding forest health conditions throughout the Rocky Mountain Region and R2 Aerial Detection and Survey.

The Gunnison Service Center continues to monitor the status of forest health throughout the White River National Forest. For additional information, please do not hesitate to contact the Gunnison Service Center: Forest entomology: Tom Eager (970-642-4450), Forest pathology: Jim Worrall (970-642-4453).

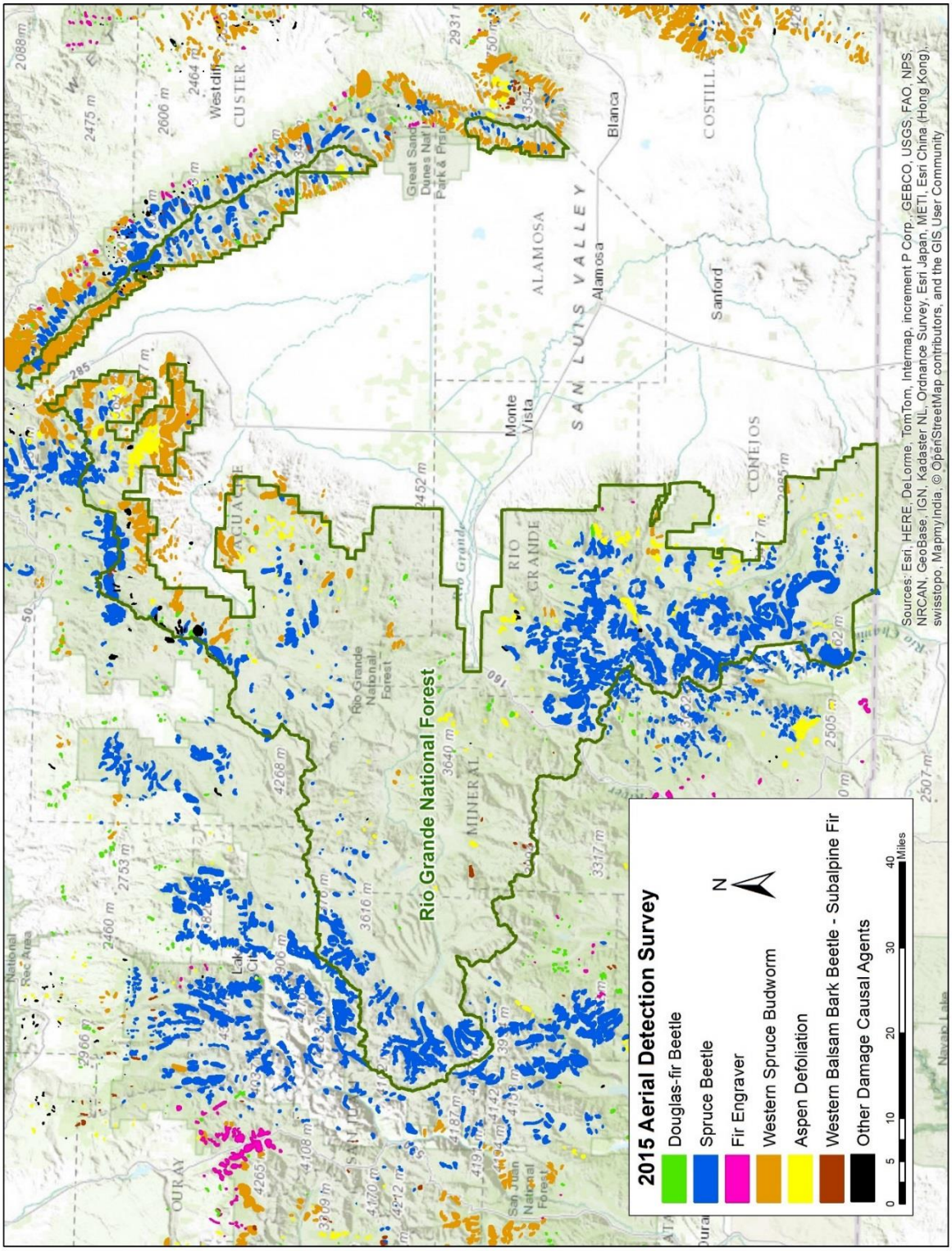

Figure 1. Aerial detection survey map of the Rio Grande National Forest in 2015

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San Isabel National Forest, Comanche & Cimarron National Grasslands - 2015 Activities of forest insects and diseases

Populations of insects that feed on forest trees have been at generally high levels for the past decade on the San Isabel National Forest. Forest diseases have also had significant impacts on forested areas over this same time period.

Forest ecosystems provide habitat for a large number of insect and fungus species, mostly considered benign or beneficial. Only a few of these agents can be considered "pests" which cause large, eruptive outbreaks that drastically change forest conditions over large areas, or chronic damage that limits productivity and affects succession. Currently, two insects, the spruce beetle and western spruce budworm; are in outbreak status and are having large impacts on the San Isabel National Forest.

The acreage values presented (**Table. 1**) were derived from Aerial Detection Survey (ADS), a cooperative program between the USDA Forest Service and Colorado State Forest Service. Each year, trained aerial observers estimate the amount and location of insect and disease caused tree damage or mortality detectable from the air (**Fig. 1**). Although some diseases were observed, many of the most destructive diseases were not represented in the data because these agents are not detectable during aerial surveys. Aerial survey requires that observers make broad categorizations, and a certain degree of qualitative judgment is inherent in these observations. In addition, there is a time lag between when the damaging agents first affect their hosts and when the damage is visible from the air. Nevertheless, this information is critical in monitoring long-term trends and their impacts on the forest.

Spruce beetle (*Dendroctonus rufipennis*): Spruce beetles were killing mature spruce on many portions of the San Isabel National Forest and it will take centuries for impacted stands to recover the older age classes which are the primary host of this insect. Spruce beetle outbreaks on the San Isabel National Forest originated from two sources: 1) localized outbreaks resulting from areas of wind thrown trees, and 2) immigration of beetles from large scale outbreaks on adjacent forests. Much of the activity in the Sangre de Cristo Mountains and in the Collegiate Peaks Range north to Twin Lakes was due to beetle migration northward and eastward from large-scale, ongoing spruce beetle activity to the southwest. In contrast, the spruce beetle outbreak in the Wet Mountains resulted from blowdown of mature spruce that fostered large numbers of beetles which then spread to surrounding spruce stands.

Spruce beetle outbreaks on the San Isabel National Forest will most likely continue for several years. In addition to stands which were attacked in previous years and which still harbor beetles, there were 27,000 new acres of infestation in 2015. Spruce beetle populations will continue to cause mortality in already affected stands and move into new areas with susceptible, large diameter spruce. In the absence of an unusual weather event such as extreme or unseasonable cold, spruce beetles will eventually affect the majority of spruce stands on the San Isabel National Forest. Amounts of mortality in affected stands will vary greatly; some stands maintaining varying amounts of residual live trees, while other stands have mortality approaching 100%. Management efforts, primarily salvage and sanitation activities, can affect spruce beetle populations at a very local level.

Western spruce budworm (*Choristaneura occidentalis* (freemani): These defoliating larvae affected large acreages on the San Isabel National Forest in 2015, but this insect usually does not kill its host outright. The primary hosts of western spruce budworm are Douglas-fir, white fir, and to a lesser extent, Engelmann spruce. Stand conditions contribute greatly to the budworm population's ability to increase to outbreak status. Multistory stands of shade-tolerant species are conducive to budworm activity, and many areas on the San Isabel National Forest have maintained chronic populations of budworm for a long period of time. A combination of suitable habitat and favorable weather patterns have resulted in the current widespread outbreak of western spruce budworm. High levels of budworm defoliation were observed on much of southern portions of the Forest, including the Sangre de Cristo Mountains, the Wet Mountains and south to the La Veta area.

Western spruce budworm populations tend to persist within the most suitable habitat, even when epidemic levels decline across the forest. Management activities such as reducing basal area and thinning from below can render stands less susceptible to western spruce budworm. Projects such as the Scout Ranch Project near Lake Isabel (completed in 2015) were designed to reduce susceptibility to budworm, together with objectives including fuels reduction, in high-value recreational areas

Table 1: Acres of forest damages and damage agents seen on the San Isabel National Forest in 2015 by aerial surveyors.

Damaging Agents on the San Isabel NF	Acres affected in 2014	**Acres affected in 2015**	Cumulative total of acres affected 1996 > 2015
Spruce beetle	31,000	**46,000**	67,000
Mountain pine beetle	1,200	**670**	152,000
Douglas-fir beetle	360	**400**	17,000
Western balsam bark beetle	6,800	**5,700**	N/A = not applicable
Fir engraver	21,000	**2,100**	N/A
Western spruce budworm	56,000	**86,000**	N/A
Aspen defoliation	5,800	**3,000**	N/A
Aspen discoloration (Marssonina leaf blight	N/A	**1,000**	N/A
Lophodermella needle cast	N/A	**1,600**	N/A

Mountain pine beetles (*Dendroctonus ponderosae*): These bark beetles were currently at very low levels, having declined precipitously from outbreaks which occurred on the San Isabel National Forest about a decade ago. Mountain pine beetles attack ponderosa, lodgepole, limber, and Rocky Mountain bristlecone pines. Low numbers of mountain pine beetle allowed forest managers to preemptively treat stands to reduce susceptibility to mountain pine beetles. The Tennessee Pass Project was an example of managing forests to increase tree age and species diversity and to lower stand densities that reduce overall susceptibility to mountain pine beetle.

Douglas-fir beetle (*Dendroctonus pseudotsugae*): Douglas-fir mortality from Douglas-fir beetle was currently low, compared to the recent past. A total of only 400 acres were affected in 2015. Douglas-fir beetle activity may increase in the future as stress from repeated defoliation by western spruce budworm makes Douglas-fir hosts less resistant to bark beetle attack.

Western balsam bark beetle (*Dryocoetes confusus*): There was a modest decline in acres impacted by western balsam bark beetle. This insect attacks subalpine fir and was currently active only in high elevation stands in the northern portions of the forest. The pattern of tree mortality caused by western balsam bark beetle was of a scattered nature in affected stands. This beetle's activity tends to be more constant over time, responding to changes in weather patterns from year to year. This beetle frequently acts in concert with a fungal root disease, Armillaria root disease (*Armillaria* spp.), with the beetles attacking and killing diseased host trees.

Aspen discoloration and defoliation: Defoliation of aspen declined on the San Isabel National Forest in 2015; this was in contrast to increased aspen defoliation on adjacent forests. The defoliation that occurred was observed throughout the Forest, but was somewhat concentrated in aspen stands on the southern portions of the Forest. One cause of aspen damage was Marssonina leaf blight, which discolors foliage (1,000 acres of aspen discoloration was reported in the northern San Isabel), then causes defoliation in midsummer. This disease was widespread and severe in much of the Colorado aspen stands in 2015.

Two other agents, indistinguishable from the air, are responsible for the great majority of insect-caused aspen defoliation. Most common is the western tent caterpillar (*Malacasoma californicum*). Populations of this insect can increase rapidly and may cause almost total defoliation of affected stands. Typically, populations reach high levels for several years before viral diseases cause the collapse of the insect's populations. In most cases these defoliators do not cause great amounts of tree mortality, but in some cases, repeated intense attack can result in tree death. The other primary defoliator of aspen is the large aspen tortrix (*Choristaneura conflictana*), a bright green caterpillar that can occasionally reach outbreak levels and impact portions of the aspen forest.

Fir engraver (*Scolytus ventralis*): For the past several years, fir engraver activity has been high on the San Isabel National Forest. Stands of white fir on the eastern edge of the Wet Mountains and in eastern portions of the Sangre de Cristo Mountains have been particularly hard hit. White fir in these areas were also repeatedly defoliated by western spruce budworm, feeding that resulted in high levels of stress in the affected white fir and subject to subsequent attack by fir engraver. The level of mortality caused by the fir engraver declined dramatically in

2015, to approximately one-tenth of that of the previous year. It was likely that fir engraver beetles exhausted the supply of stressed white fir in the eastern Wet Mountains, and populations are not expected to rebound in the near future.

Piñon ips (*Ips confusus*): Populations of the piñon killing bark beetle, piñon ips, were rare on the San Isabel in 2015. Numbers of this insect declined from outbreak levels in just a few years. Pockets of piñon mortality that were common recently in the vicinity of Cañon City and in the Arkansas River corridor, have all but disappeared. Much of this decrease was attributed to higher levels of precipitation over the past several years.

Unknown piñon defoliator: Defoliation of piñon pine was noticed in piñon pine stands in the vicinity of Buena Vista in 2015. This insect activity was not evident until after the insect had completed its life cycle as the affected foliage dried out in late summer. The pattern of feeding in tree tops and on branch tips, as well as the timing of the defoliation indicates that tiger moth caterpillars (*Lophocampa ingens*) may be responsible, but no specimens were collected during the feeding period. Monitoring of these piñon pine stands is planned for the field season in 2016 which should result in a definitive identification of the causal agent.

Lophodermella needle cast of lodgepole pine: Two *Lophodermella* species commonly cause needle cast in our lodgepole pine: *L. concolor* and *L. montivaga*. These diseases were widespread and can usually be found killing foliage in many stands. In some areas they were chronically severe, limiting growth, thinning crowns, and killing trees in the understory. Usually they were not detected in aerial survey, but in 2015 about 1,600 acres were recorded. Most of it was in Lake County, with several areas of damage in Chaffee County (see map, “Other Damage” in the northern San Isabel National Forest).

Aspen dieback and mortality: Approximately 2000 acres of this aspen damage were detected on the southern tip of the San Isabel National Forest in Las Animas County and along the western edge of the Wet Mountains, mostly in Custer County (black areas on the map). Currently the cause is unknown. We will coordinate a site visit in 2016 to investigate the nature and cause of this damage.

Flooding caused by beavers: On the extreme northern edge of the Forest, in northern Lake County, about 14 acres of spruce were damaged by a combination of flooding and beaver activity.

For Additional Information and Help

An excellent resource that provides more detailed information on these and other forest insects and forest diseases is the “Field Guide to Diseases & Insects of the Rocky Mountain Region”. This publication contains illustrations and descriptions of the damage agents, guidelines for management and a brief introduction to the literature concerning the pertinent topics. This field guide book may be obtained in soft cover format from Gunnison Service Center.

For additional maps and information regarding see Forest health conditions throughout the Rocky Mountain Region, or for more information on R2 Aerial Detection and Survey.

The Gunnison Service Center continues to monitor the status of forest health throughout the GMUG National Forests. For additional information, please contact the Gunnison Service Center: Forest entomology: Tom Eager (teager@fs.fed.us 970-642-4450), Forest pathology: Jim

Worrall (jworrall@fs.fed.us 970-642-4453), Biological technician: Suzanne Marchetti (sbmarchetti@fs.fed.us 970-642-4448).

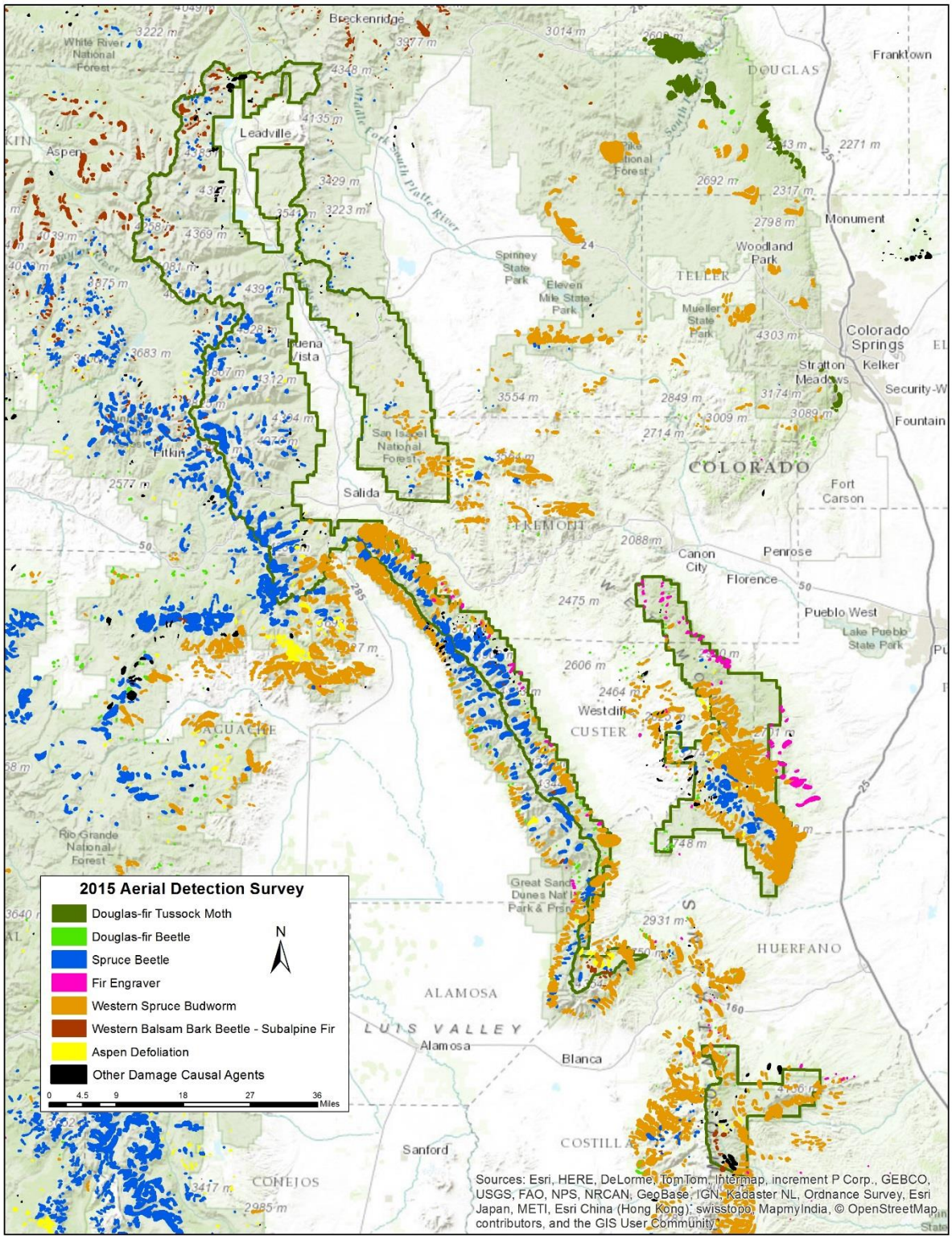

Figure 1. 2015 Aerial Detection Survey map of the San Isabel National Forest showing estimated locations and amounts of forest damaging agents.

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San Juan National Forest – 2015 Activities of forest insects and diseases

Several insects and diseases which affect forest trees are currently influencing stands throughout the San Juan National Forest. The greatest long-term impacts are being caused by the spruce beetle which is killing mature spruce in several locations on the Forest. Western spruce budworm, a defoliating caterpillar of conifers, was also very active in 2015. The other major impact was the defoliation of aspens which caused by several different agents and has been active for several years.

The acreage values presented (**Table. 1**) below are derived from Aerial Detection Survey (ADS), a cooperative program between the USDA Forest Service and state agencies (Colorado State Forest Service). Each year, trained aerial observers estimate the amount and location of insect and disease caused tree damage or mortality detectable from the air (**Fig. 1**). Although some diseases were observed, many of the most destructive diseases are not represented in the data because these agents are not detectable from aerial surveys. Aerial survey requires that observers make broad categorizations, and a certain degree of qualitative judgement is inherent in these observations. In addition, there is a time lag between when the damaging agents first affect their hosts and when the damage is visible from the air. Nevertheless, this information is critical in monitoring long-term trends and impacts on the forest.

Table 1. Acres of forest damages and the damaging agents

Insect	Acres affected in 2014	Acres affected in 2015	Cumulative total of acres affected 1996 > 2015
Spruce beetle	53,000	**46,000**	225,000
Mountain pine beetle	200	**0**	28,000
Douglas-fir beetle	4,000	**1,100**	80,000
Western balsam bark beetle	2,600	**1,300**	N/A
Fir engraver	2,000	**4,600**	N/A
Western spruce budworm	14,000	**31,000**	N/A
Aspen defoliation	N/A	**14,000**	N/A
Aspen discoloration (Marssonina leaf blight)	N/A	**2,600**	N/A

Spruce beetle (*Dendroctonus rufipennis*): Spruce beetles have been in outbreak status on the San Juan National Forest for the past decade. Nearly a quarter of a million acres have now been affected, with 27,000 acres being newly affected in 2015

Spruce beetle outbreaks on the San Juan National Forest will most likely continue for several years. Spruce beetle populations will continue to cause mortality in already affected stands and move into new areas with susceptible, large diameter spruce. There are three areas on the Forest that are undergoing the major impacts from spruce beetle. On the eastern portion of the Forest, scattered activity is present around the border with the Rio Grande National Forest. These areas have been affected by spruce beetle for some time, and much of the most susceptible host is already gone. In stands north of the Piedra Area (especially around Tuckerville), spruce beetle activity has also been evident for the past decade or so, and mortality of spruce is starting to taper off. The most active area of spruce beetle mortality is north of Stoner Mesa where the spruce beetle activity is relatively recent. However, stand data and field surveys indicate that the stands on the western part of the Forest are more variable in terms of age class distribution, and appear to have a higher proportion of fir, attributes which should decrease overall susceptibility to spruce beetle. In addition, the summers of 2014 and 2015 had substantial precipitation, another factor which should slow down the progression of the beetle.

In the absence of an unusual weather event such as extreme or unseasonable cold or large amounts of precipitation during the beetle's flight period, spruce beetles will eventually impact the majority of spruce stands on the San Juan National Forest. Amounts of mortality in affected stands will vary greatly; some stands maintaining varying amounts of residual live trees, while other stands have mortality approaching 100%. Management efforts, primarily salvage and sanitation activities, can affect spruce beetle populations at a local level.

Western spruce budworm (*Choristaneura occidentalis* (freemani): The area affected by this defoliating caterpillar increased significantly compared to the levels of 2014. Mixed conifer stands in the west-central portion of the Forest, especially stands around Taylor Mesa, were particularly hard hit.

The primary hosts of western spruce budworm are Douglas-fir, white fir, and to a lesser extent, Engelmann spruce. These insects usually do not kill their host outright, but repeated years of defoliation can weaken the host trees and make them more susceptible to other damaging agents such as bark beetles. Stand conditions contribute greatly to the budworm population's ability to increase to outbreak status. Multistory stands of shade-tolerant species are conducive to budworm activity. A combination of suitable habitat and favorable weather patterns have resulted in the current widespread outbreak of western spruce budworm. Management activities such as reducing basal area and thinning from below can render stands less susceptible to western spruce budworm.

Mountain pine beetles (*Dendroctonus ponderosae*): Mountain pine beetles attack ponderosa, lodgepole, limber, and Rocky Mountain bristlecone pines. These bark beetles are currently at very low levels, having declined precipitously from significant impacts which occurred about a decade ago. Low numbers of mountain pine beetle allow forest managers to preemptively treat stands to reduce susceptibility to mountain pine beetles.

Pine beetle complex (western pine beetle, *Dendroctonus brevicomis*, round headed pine beetle, *D*. *adjunctus*, pine engraver, *Ips pini*): This group of bark beetles often attack ponderosa pine on the San Juan National Forest resulting in what are called “mixed broods” of bark beetles. It is not uncommon to find all three of these beetles in one host at the same time; alternatively they can be found attacking host trees as individual species, with other species “filling in” the attacks at a later time. There is currently a significant outbreak of round headed pine beetle attacking mature ponderosa pine on the western edge of the Forest. The affected area, found in the vicinity of Lake Canyon on the Dolores District, has had substantial impacts from this insect for three years running. It is hoped that this outbreak will taper off because of the substantial precipitation that has occurred over the past two years during their flight period (late August to September). Forest Health Protection has provided funding which supports thinning and sanitation efforts in the affected stands. Ground based surveys are planned for the summer of 2016 in order to better determine the nature and extent of this outbreak.

Douglas-fir beetle (*Dendroctonus pseudotsugae*): Douglas-fir mortality from Douglas-fir beetle is currently at a moderate level on the San Juan National Forest. A total of only 1,100 acres were recorded in 2015. Mortality caused by Douglas-fir beetle tends to be of a dispersed nature, although there can be concentrated groups of mortality within a generally affected area.

Western balsam bark beetle (*Dryocoetes confusus*): This insect attacks subalpine fir and is active in high elevation spruce/fir stands throughout the forest. Current activity is low, but this beetle’s activity tends to wax and wane over time, responding to changes in weather patterns from year to year. The pattern of tree mortality caused by western balsam bark beetle is of a scattered nature in affected stands. This bark beetle frequently acts in concert with a fungal root disease, Armillaria root disease, with the beetles attacking and killing diseased host trees. The relative contribution of the beetle and the fungus to tree mortality is difficult to determine, and can differ over time and in different localities.

Aspen discoloration and defoliation: Discoloration and defoliation of aspen were widespread on the San Juan National Forest in 2015. One cause of such damage is Marssonina leaf blight, which discolors foliage, then causes defoliation in midsummer. Marssonina discoloration was recorded on 2,600 acres of the San Juan, mostly in the Dunton area. This disease was widespread and severe in much of the Colorado aspen stands in 2015.

Two other agents, indistinguishable from the air, are responsible for the great majority of insect-caused aspen defoliation. Most common is the western tent caterpillar (*Malacasoma californicum*). Populations of this insect can increase rapidly and may cause almost total defoliation of affected stands. Typically, populations reach high levels for several years before viral diseases cause the collapse of the insect's populations. In most cases these defoliators do not cause great amounts of tree mortality, but in some cases, repeated intense attack can result in tree death. The other primary defoliator of aspen is the large aspen tortrix (*Choristaneura conflictana*), a bright green caterpillar that can occasionally reach outbreak levels and impact portions of the aspen forest.

Aspen stands to the south of Rico showed significant impacts from aspen defoliation in 2015. An outbreak of western tent caterpillar has been active in the "Beaver Meadows outbreak", activity which has been monitored for the past four years. The level of activity south of the Piedra Area has appeared to decline over time, but significant defoliation is still evident.

Fir engraver (*Scolytus ventralis*): Fir engraver activity increased during 2015, but this insect is usually active whenever mature white fir is present. Stands of white fir north of Pagosa Springs have been particularly hard hit. The activity of western spruce budworm stresses host trees and makes defoliated white fir susceptible to fir engraver, so an increase in the activity of this insect may be expected in the future.

For Additional Information and Help:

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The Gunnison Service Center continues to monitor the status of forest health throughout the White River National Forest. For additional information, please do not hesitate to contact the Gunnison Service Center: Forest entomology: Tom Eager (970-642-4450), Forest pathology: Jim Worrall (970-642-4453).

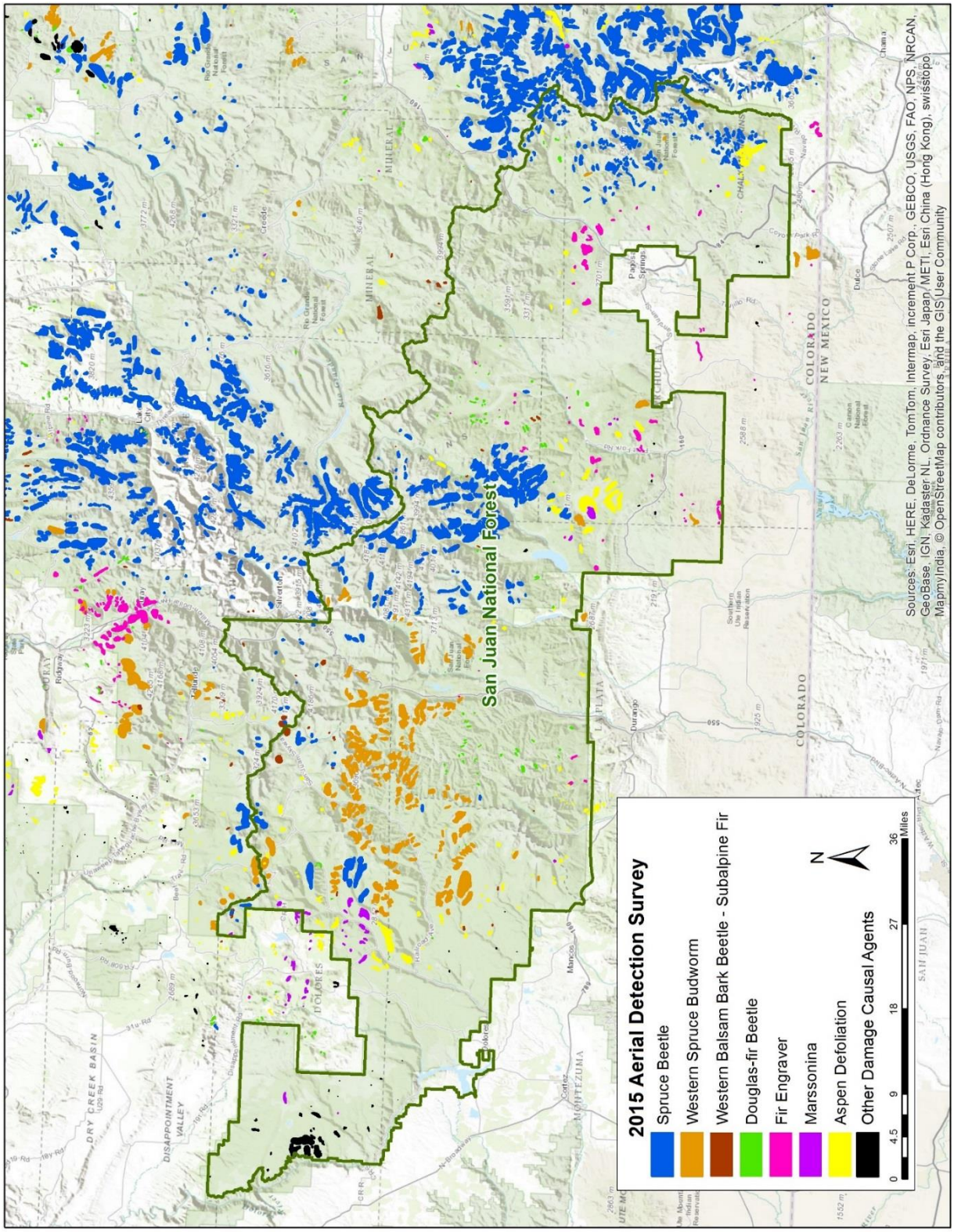

Figure 1. Aerial detection survey map of the San Juan National Forest – 2015.

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Shoshone National Forest - 2015 Forest Health Highlights

USDA Forest Service, Rocky Mountain Region, Forest Health Protection
Rapid City Service Center, 8221 S Highway 16, Rapid City, SD 57702

Kurt Allen, Entomologist; Jim Blodgett, Plant Pathologist; Al Dymerski, Forestry Technician; Kendra Schotzko, Entomologist. p: 605-343-1567

Conditions

- There is an ongoing, intense spruce beetle epidemic occurring on the forest. Acreage affected remained relatively constant from 2014 to 2015, with 41,000 acres reported in 2014 and 35,000 acres detected in 2015. The epicenter of the epidemic is on the Wind River Ranger District. The epidemic has appeared to be moving south over the past few years (**Fig. 1** & **5**). Preventive spraying is used to protect trees in campgrounds.

Figure 1. Spruce beetle caused spruce tree mortality

- Mountain pine beetle mortality of five-needle and lodgepole pine decreased to 14,000 acres in 2015 down from 58,000 acres in 2014. Eleven thousand acres of the mortality was in 5-needle pines, the other 3,000 acres were in lodgepole pine (**Fig. 2** & **5**). At this point the epidemic is mostly in the south, west of Lander. There are scattered remnant pockets of mortality throughout the rest of the forest. Verbenone is being used to protect 5-needle pines and preventive spraying is used to protect trees in campgrounds.

- Western spruce budworm affected 11,000 acres, down from 26,000 acres in 2014 (**Fig. 3** & **5**); in the Clarks Fork drainage. The heaviest defoliation is occurring on Douglas-fir, with lesser amounts on spruce and true fir. The defoliation has been heavy in affected Douglas-fir stands, with 50-90% defoliation on mature trees. Seedlings and saplings are also being heavily defoliated in these areas.

Figure 2. Mountain pine beetle caused mortality in 5 needle pines

Figure 3. Western spruce budworm defoliation

- A decrease in subalpine fir mortality was detected with 3,500 acres affected (**Fig. 5**). Subalpine fir decline is attributed to damage from western balsam bark beetle, Armillaria root disease, and potentially other damage agents.

- In general, aspen is in good shape. As older trees are dying off, the stands are often regenerating back from root suckers. Sooty bark canker continues to be the most damaging agent in aspen stands (**Fig. 4**), followed by Cytospora canker and bronze poplar borer. White mottled rot (Ganoderma) is causing mortality in select aspen stands.

- Persistent diseases problems often not detected during aerial detection survey include:
  - White pine blister rust, which continues to intensify and cause limber and whitebark pine mortality. White pine blister rust can be particularly damaging on seedlings and small trees, which is exacerbating the widespread mortality that has been caused by mountain pine beetle to the overstory over the past 10 years.
  - Dwarf mistletoe continues to affect lodgepole, limber, and whitebark pines.
  - Comandra blister rust disease is found at high levels in lodgepole pines, particularly on the Wind River Ranger District.
  - Various root diseases including Armillaria root disease, white mottled rot, schweinitzii root and butt rot, and tomentosus root rot.

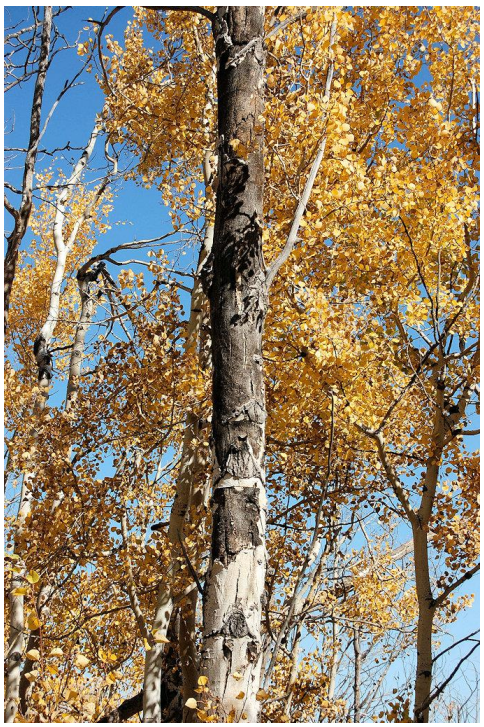

Figure 4. Sooty bark canker killing an aspen

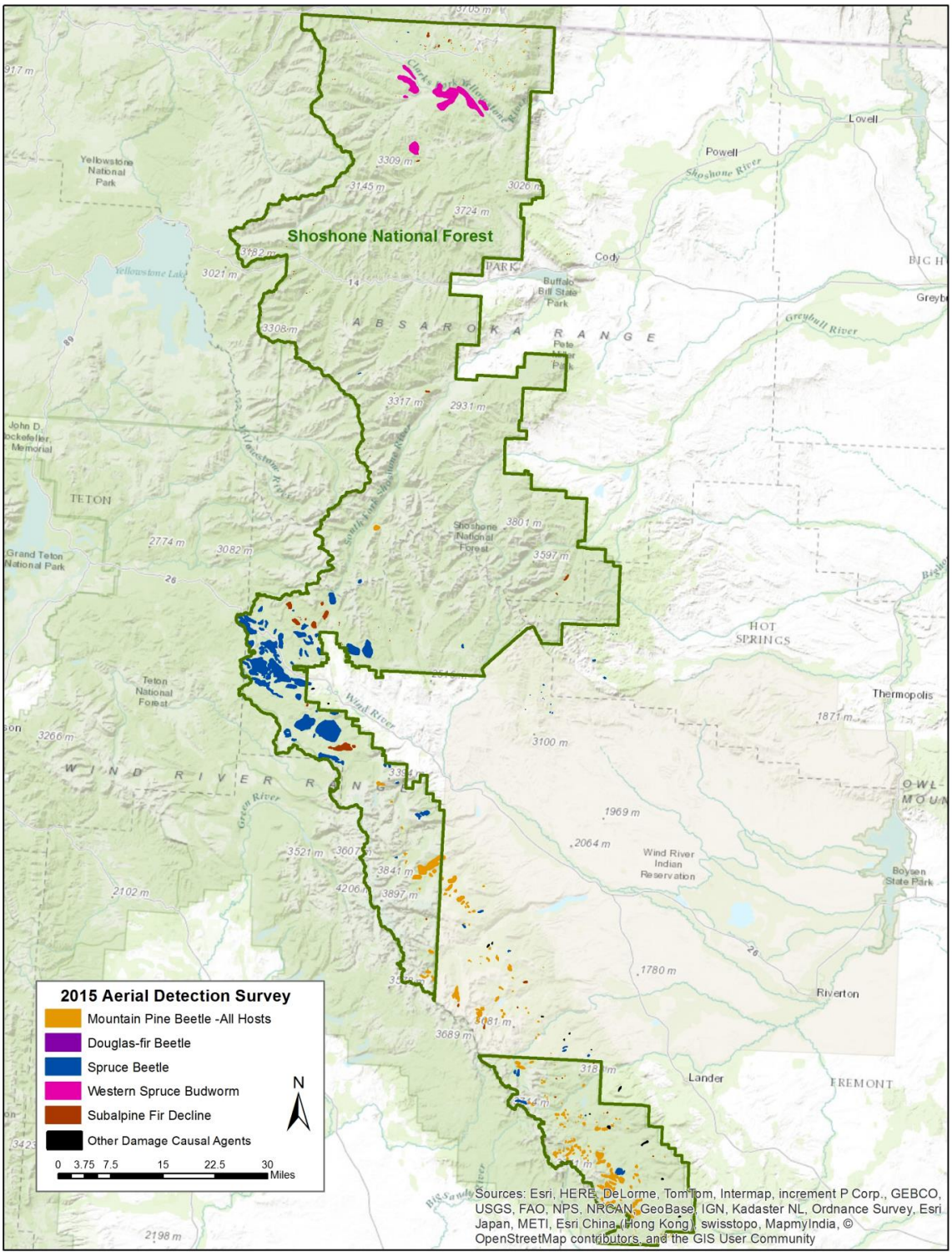

Figure 5. Aerial detection survey map of the Shoshone National Forest: 2015.

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White River National Forest – 2015 Activities of forest insects and diseases

Insects and diseases which affect forest trees are currently at a moderate level on the White River National Forest. The most active agent is western balsam bark beetle which is killing large numbers of subalpine fir. The other major agent in 2015 was Marssonina leaf blight, causing damage to aspen. Marssonina is a fungal disease which rarely kills its host, and varies widely from year to year, depending on weather patterns.

The acreage values presented (**Table.1**) are derived from Aerial Detection Survey (ADS), a cooperative program between the USDA Forest Service and state agencies (Colorado State Forest Service). Each year, trained aerial observers estimate the amount and location of insect and disease caused tree damage or mortality detectable from the air (**Fig. 1**). Although some diseases were observed, many of the most destructive diseases are not represented in the data because these agents are not detectable from aerial surveys. Aerial survey requires that observers make broad categorizations, and a certain degree of qualitative judgement is inherent in these observations. In addition, there is a time lag between when the damaging agents first affect their hosts and when the damage is visible from the air. Nevertheless, this information is critical in monitoring long-term trends and impacts on the forest.

Table 1. Damaged forest acres and the damaging agents observed during the aerial detection survey of 2015.

Insect	Acres affected in 2014	Acres affected in 2015	Cumulative total of acres affected 1996 > 2015
Western balsam bark beetle	62,000	**51,000**	N/A
Spruce beetle	9,400	**1,400**	31,000
Mountain pine beetle	10	**110**	386,000
Douglas-fir beetle	4,000	**1,100**	27,000
Western spruce budworm	0	**1,400**	N/A
Aspen defoliation	N/A	**2,900**	N/A
Aspen discoloration (Marssonina leaf blight)	N/A	**21,000**	N/A
Aspen dieback and mortality	N/A	**70**	N/A

Western balsam bark beetle (*Dryocoetes confusus*): This insect attacks subalpine fir and is currently active in high elevation spruce/fir stands throughout the forest. The pattern of tree mortality caused by western balsam bark beetle is of a scattered nature in affected stands. This beetle's activity tends to wax and wane over time, responding to changes in weather patterns from year to year. This bark beetle frequently acts in concert with a fungal root disease, Armillaria root disease, with the beetles attacking and killing diseased host trees. The relative contribution of the beetle and the fungus to tree mortality is difficult to determine, and can differ over time and in different localities.

Some areas that had a significant amount of subalpine fir mortality included the White River Plateau northwest to Papoose Lake, the headwaters of the Roaring Fork River, and spruce/fir stands in the Maroon Bells, the Hunter Fryingpan, and the Eagles Nest Wilderness Areas.

Spruce beetle (*Dendroctonus rufipennis*): Spruce beetle activity on the White River National Forest was recorded at a lower number than previous years. Much of the affected area was in the vicinity of Baylor Park and Middle Thompson Park where spruce beetle have been active for more than a decade. This resident population of beetles kills new hosts every year. Management efforts, primarily salvage and sanitation activities, can affect spruce beetle populations at a local level. These management strategies are underway at Yeoman Campground where forest health issues (bark beetles and root disease) are being addressed in a cooperative effort between Forest Health Protection and the Recreation and Timber staff of the White River National Forest.

Mountain pine beetles (*Dendroctonus ponderosae*): Mountain pine beetles attack ponderosa, lodgepole, limber, and Rocky Mountain bristlecone pines. These bark beetles are currently at very low levels, having declined precipitously from outbreaks which occurred on the White River National Forest about a decade ago. Low numbers of mountain pine beetle allow forest managers to preemptively treat stands to reduce susceptibility to mountain pine beetles. Many stands that had been treated prior to this recent something outbreak have retained advanced tree age classes and demonstrated the value of diversifying stand conditions across the landscape. Treatments conducted in response to mountain pine beetle at Dillon Reservoir are good examples of the benefits of large-scale forest management.

Douglas-fir beetle (*Dendroctonus pseudotsugae*): Douglas-fir mortality from Douglas-fir beetle is currently at a moderate level on the White River National Forest. A total of only 1,100 acres were recorded in 2015. Mortality caused by Douglas-fir beetle tends to be of a dispersed nature, although there can be concentrated groups of mortality within a generally affected area. One area that has a large pocket of mortality (290 acres) is west of Marion Springs on the Sopris Ranger District.

Western spruce budworm (*Choristaneura occidentalis* (freemani)): The area affected by this defoliating caterpillar increased slightly compared to the low levels of 2014. One area of notable budworm activity was south of Glenwood Springs, where an outbreak of 840 acres was observed in the mixed conifer stands between East Park Creek and East Divide Creek.

The primary hosts of western spruce budworm are Douglas-fir, white fir, and to a lesser extent, Engelmann spruce. Stand conditions contribute greatly to the budworm population's ability to increase to outbreak status. Multistory stands of shade-tolerant species are conducive to budworm activity. Although current budworm populations are low, their numbers can be

expected to increase over time. Management activities such as reducing basal area and thinning from below can render stands less susceptible to western spruce budworm.

Aspen discoloration and defoliation: Discoloration and defoliation of aspen were widespread on the White River National Forest in 2015. One cause of such damage is Marssonina leaf blight, which discolors foliage, then causes defoliation in midsummer. This disease was widespread and severe in much of the Colorado aspen stands in 2015. On the White River National Forest, 21,000 acres of discoloration was recorded, and some portion of the defoliation is attributable to this disease as well. Additional damage was recorded outside the Forest boundaries. The disease was most severe and widespread in the western portions of the Forest, especially Rio Blanco, Garfield, and Mesa Counties, but it was also prevalent in portions of Eagle County.

Two other agents, indistinguishable from the air, are responsible for the great majority of insect-caused aspen defoliation. Most common is the western tent caterpillar (*Malacasoma californicum*). Populations of this insect can increase rapidly and may cause almost total defoliation of affected stands. Typically, populations reach high levels for several years before viral diseases cause the collapse of the insect's populations. In most cases these defoliators do not cause great amounts of tree mortality, but in some cases, repeated intense attack can result in tree death. The other primary defoliator of aspen is the large aspen tortrix (*Choristaneura conflictana*), a bright green caterpillar that can occasionally reach outbreak levels and impact portions of the aspen forest.

Lophodermella needle cast of lodgepole pine: Two *Lophodermella* species commonly cause needle cast in our lodgepole pine: *L. concolor* and *L. montivaga*. These diseases are widespread and can usually be found killing foliage in many stands. In some areas they are chronically severe, limiting growth, thinning crowns, and killing trees in the understory. Usually they are not detected in aerial survey, but in 2015 over 100 acres were recorded just south of Aspen.

For Additional Information and Help:
An excellent resource that provides more detailed information on these and other forest insects and forest diseases is the "Field Guide to Diseases & Insects of the Rocky Mountain Region". This publication contains illustrations and descriptions of the damage agents, guidelines for management and a brief introduction to the literature concerning the pertinent topics. This document may be obtained in soft cover format from Gunnison Service Center, or may be viewed or downloaded at:

Additional maps and information regarding forest health conditions throughout the Rocky Mountain Region and R2 Aerial Detection and Survey.

The Gunnison Service Center continues to monitor the status of forest health throughout the White River National Forest. For additional information, please do not hesitate to contact the Gunnison Service Center: Forest entomology: Tom Eager (970-642-4450), Forest pathology: Jim Worrall (970-642-4453).

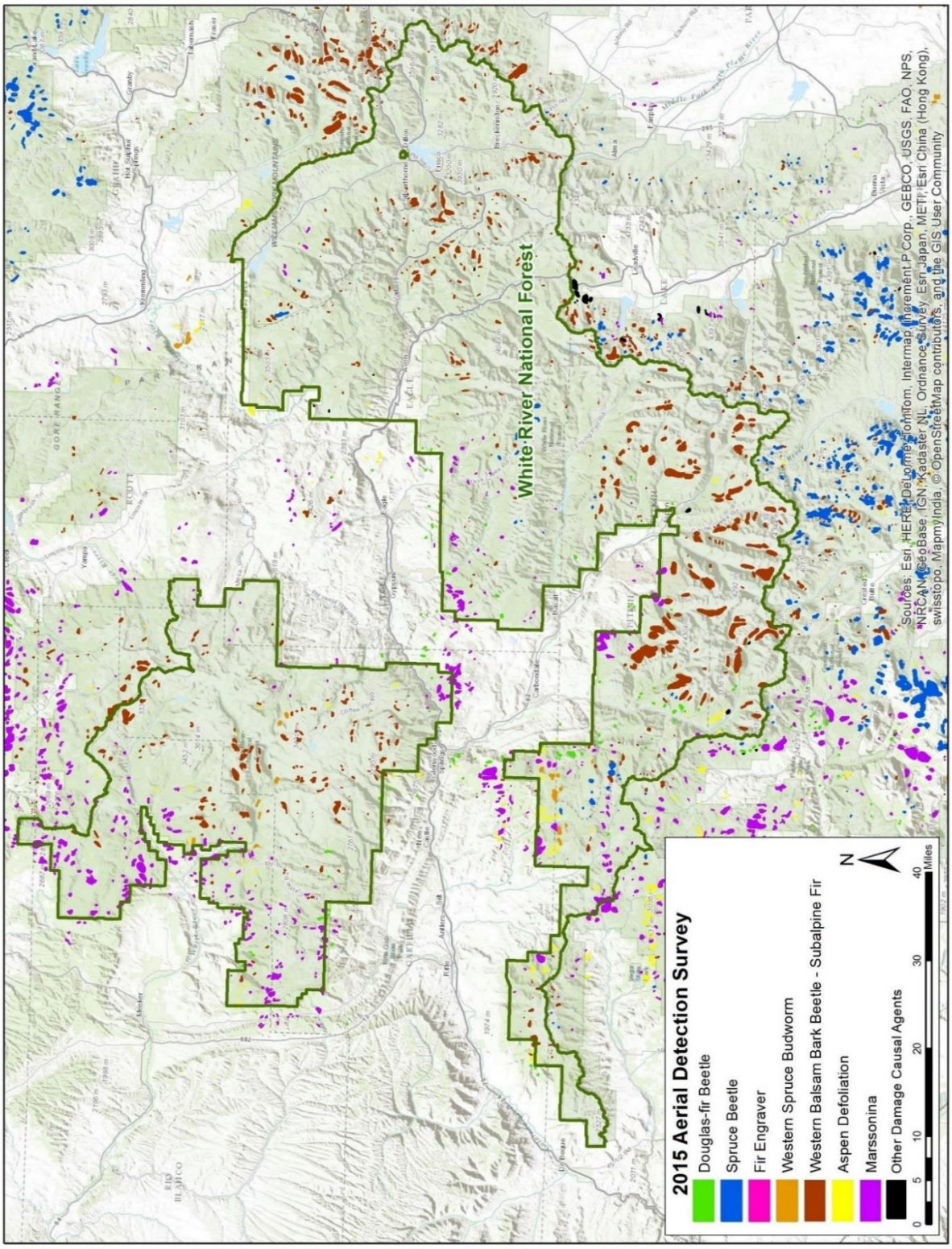

Figure 1. Aerial Detection Survey Map of the White River National Forest - 2015

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Section 2 States' FHH reports

Internet links to the 2015 Forest Heath Highlights' reports from each state in the Rocky Mountain Region
Colorado
Kansas
Nebraska
South Dakota
Wyoming

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Section 3 - 2015 ADS Summary

See the Aerial Detection Survey: Highlights for 2015:

2015 Aerial
Detection Survey Su

~~Please, double click on this PDF report icon to open the ADS summary report in a PDF~~.

PDF report icon not functional when the completed report is made into a PDF.

Please contact R2 Rocky Mountain Region to obtain this ADS summary report.

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Section 4 Documentation & Acknowledgements

Reference for Citation and Public Notices:

Harris J.L. (comp.); R2 FHP staff, and States' Forest Health specialists 2016. **2015 Forest Health Conditions of the Rocky Mountain Region (R2)**. USDA Forest Service. State & Private Forestry & Tribal Relations, Forest Health Protection, R2-SPF-TR_15-RO-31. 69 pp.

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Information shown is based upon data compiled as of March 2016. References and GPS data provided upon request. For more information, contact R2 FHP. www.fs.usda.gov/goto/r2/fh

Acknowledgements:
State Foresters and state forest health specialists in the Rocky Mountain Region are excellent cooperators in the work of monitoring forest health in Colorado, Kansas, Nebraska, South Dakota, and Wyoming. Also major contributions to forest health efforts in the Rocky Mountain Region are done by R2 Forest Health Protection group.

- **Colorado State Forest Service**: Mike Lester and Dan West
- **Kansas Forest Service**: Larry Biles and Aaron Armbrust
- **Nebraska Forest Service**: Scott Josiah, and Mark Harrell, Laurie Stepanek, Rachel Allison
- **South Dakota Conservation & Forestry**: Greg Josten and Brian Garbisch, Marcus Warnke, John Ball
- **Wyoming State Forestry Department**: Bill Crapser and Les Koch (resigned in 2016)

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Justin Backsen - R2 aerial surveyor
Jim Blodgett - RCSC plant pathologist
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Rick Cooksey - Director of Cooperative Forestry & Tribal Relations, also FHP oversight
Alan Dymerski - RCSC forestry technician & ADS surveyor
Tom Eager – Gunnison Service Center leader
Jeri Lyn Harris – Forest Health Monitoring coordinator
Justin Hof (moved to R6) - LSC biological technician
Brian Howell – Aerial Detection Survey program manager
Jim Kruse – Lakewood Service Center leader
Suzanne Marchetti - GSC biological technician
Roy Mask – Assistant Director & R2 FHP group leader
Rebecca Powell - LSC entomologist
Jennifer Ross - GIS specialist
Kendra Schotzko - RCSC entomologist
Sky Stephens - LSC entomologist
Jim Worrall - GSC plant pathologist

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