

Forest Health Conditions of the Rocky Mountain Region (R2) in 2017



R2 Forest Health Protection

USDA – Forest Service - Rocky Mountain Region (R2)
State and Private Forestry & Tribal Relations



Picture above is of conifer tree mortality on the San Juan National Forest. Mortality of faded Douglas-firs caused by Douglas-fir beetle. These are surrounded by gray, dead spruce killed by spruce beetle. Picture by Dan West. Picture to the left is a symbol of the Rocky Mountain Region with mountains and prairies. Symbols of USDA and the Forest Service visible in the lower right corner.



Overview of this Rocky Mountain Region (R2) Report 2017 Forest Health Conditions R2-2018-RO-31

Section 1 – 2017 Forest Health (FH) Conditions of the National Forests (NF) in the Rocky Mountain Region (R2). These 11 reports to the National Forests were produced by the Gunnison, Lakewood, and Rapid City Service Centers of R2 Forest Health Protection (FHP) group. These were compiled alphabetically.

Section 2 – Internet links to the Colorado, Kansas, Nebraska, South Dakota, and Wyoming 2017 Forest Health Highlights (FHH) reports. These FHH reports were produced by state forest health specialists and discuss the latest FHH from all forest lands in each state.

Section 3 – The 2017 Aerial Detection Survey (ADS) Highlights and Maps for Colorado, Wyoming, and South Dakota. These were produced by GIS specialists and surveyors of the respective R2 ADS program.

Section 4 – Reference citation, additional required documentation, and acknowledgements of all contributors.

***Report Approved by State and Private Forestry, and Tribal Relations (acting) Director
Roy Mask – June 2018.***

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Section 1: Conditions of National Forests

2017 Forest Insect and Disease Conditions Report: Arapaho-Roosevelt National Forest

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Conditions Highlights

This report provides a summary of forest health conditions based on surveys, monitoring, and other activities conducted by Forest Health Protection (FHP) on the Arapaho and Roosevelt National Forests (ANF, RNF) in 2017.

Spruce beetle (*Dendroctonus rufipennis*) activity decreased in Colorado and southern Wyoming from 350,000 acres in 2016 to 208,000 in 2017 based on Aerial Detection Survey (ADS) results. Even with this current decline in aerially detectable spruce beetle activity, considerable amounts of susceptible host type remain on the landscape (Fig. 1). Several areas of active spruce beetle infestation are present on the ANF and RNF including the Guanella Pass area. Of this, 4,500 and 3,400 acres were mapped on the ANF and RNF, respectively. Mortality was concentrated in and increased in the Canyon Lakes and Sulphur Ranger Districts along the northern and western borders of Rocky Mountain National Park (RMNP). We continued to assess spruce beetle activity around Guanella Pass through ground observations, surveys, and trapping. Spruce beetle has moved outside of the windthrow areas and is attacking standing live trees. Over 13,000 spruce beetles were trapped in a semio-chemical trial at Guanella Pass.

Mountain pine beetle (*D. ponderosae*, MPB) activity continued to decline throughout Colorado and is now considered to be at endemic levels. MPB activity was mapped by ADS on only 54 acres on the ARNF; most of this was in isolated pockets of lodgepole and ponderosa pine. No MPB mortality was observed in five-needle pines on the ARNF in 2017. FHP staff supports the application of chemical sprays only where MPB activity continues to threaten resources of significant value. Spraying is no longer warranted in most sites on the ARNF.

Dwarf mistletoes are common and damaging to varying degrees forest-wide. The most common species are *Arceuthobium americanum* on lodgepole pine, *A. cyanocarpum* on limber pine, and *A. vaginatum* ssp. *cryptopodum* on ponderosa pine. A great opportunity exists for managing and reducing disease impacts while the forest conducts vegetation management and/or timber stand improvements 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 (*Cronartium ribicola*, WPBR) continues to spread and intensify in limber pine in northern Colorado. Infections were recently confirmed in RMNP but the disease has not been detected on the ANF to date (LSC-18-04). A 10-year re-measurement was recently completed on FHP's network of long-term, limber pine health monitoring plots, including 9 on RNF (Fig. 2). Incidence of WPBR in live limber pine has decreased within most RNF plots but disease severity has increased substantially. Many limber pines (~28%) have died since plots were established; WPBR (8%) and MPB (8%) were the most common causes. New trees continue becoming infected so incidence is expected to rise. Regeneration is common but density is variable and seedling mortality due to WPBR is occurring. Proactive intervention will be needed on sites with low regeneration density or high WPBR infection levels to sustain the species on the landscape. We are working with Rocky Mountain Research Station (RMRS) to develop a conservation strategy for limber pine (Schoettle et al. *in press*) and we continue to explore and exploit resistance in pine populations through breeding and natural selection. Restoration planting options and pruning guidelines for limber pine are available (Casper et al. 2016, Jacobi et al. 2017).

Aerial Detection Survey Highlights

- Spruce beetle activity decreased in Colorado and southern Wyoming from 350,000 acres in 2016 to 208,000 in 2017. A large portion of the damage was in southern Colorado.
- MPB activity decreased to 1,300 acres in 2016 in Colorado and southern Wyoming and is considered to be at endemic levels in most areas.
- Subalpine fir mortality attributed to western balsam bark beetle often in combination with Armillaria root disease affected 56,000 acres in Colorado and southern Wyoming in 2017, including 10,800 acres on the ARNF. Subalpine fir mortality is widespread and fairly chronic but unlike MPB and spruce beetle, resulting tree mortality is not usually uniform across the landscape, although cumulative mortality over years can result in landscape-level impacts.

FHP Projects

- FHP staff participated in a semio-chemical trial in cooperation with RMRS funded by Forest Service Pesticide Impact Assessment Program funds. This project assessed various semio-chemicals for area and individual tree protection from spruce beetle. A full report is forthcoming. Additional study is anticipated in 2018.
- A Hazard Tree Management Guide for the Rocky Mountain Region and an App (Survey123 for ArcGIS Online) for collecting hazard tree assessment data on smart phones and tablets are now available (Blodgett et al. 2017). A User's Guide for the App can be found in the [Hazard Tree Management Training Supplement](#).
- The USFS (RMRS, 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 resistance has been confirmed in some families on the ARNF (Schoettle et al. 2014). We continue to actively protect trees with

confirmed resistance from MPB on the Clear Creek and Canyon Lakes Ranger Districts by applying the anti-aggregation pheromone verbenone.

- The Southern Rockies Rust Resistance Trial (SRRRT) was initiated at a revitalized CCC nursery on the Medicine Bow NF 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 (CSFS) Nursery. Over 700 seedlings were outplanted in fall 2013 and another 700 in spring 2014. In 2017, we completed our annual seedling growth and health assessment. Seedlings have grown well on the site and natural WPBR infections are occurring. Disease severity and mortality are more advanced on bristlecone than limber pine seedlings. A report is available (R2-18-01).
- FHP and Colorado State University remeasured 110 long-term monitoring plots, including 9 in the RNF, to assess limber pine health following the MPB epidemic in the Rocky Mountains (Fig. 2). A 10-year report will be available in the future.
- USDA Forest Service (RMRS, FHP, WWETAC), NPS, and Alberta Government are collaborating on a range-wide limber pine common garden study to quantify variation in WPBR resistance, growth traits, and their relationships to climate. Many ARNF seed sources are included in this study.

Surrounding Area Conditions of Note

- RMNP continued to manage high-value, high-risk pines predominately near historic structures and campgrounds with carbaryl or verbenone to prevent MPB activity.
- Spruce beetle activity has been increasing on the east side of RMNP and impact has increased in recreation areas including Endovalley and Hidden Valley. FHP is advising RMNP on management of spruce beetle.
- Emerald ash borer, a federally regulated pest, has been detected in the city of Boulder, CO and other communities within Boulder County. 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.

Recent Reports and Resource List

FHP, in cooperation with CSFS, 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.

Forest Health Protection Reports

- LSC-17-03. Burns KS. Update on the Status of the Limber Pine Conservation Strategy for Rocky Mountain National Park
- LSC-18-04. Burns KS. White Pine Blister Rust Infections Confirmed on Limber Pine in Rocky Mountain National Park in 2017.
- LSC-17-05. Stephens SS. Establishment of Woodborer and Biological Survey Traps.
- LSC-17-06. Stephens SS. Cooperative Spruce Beetle Project with Rocky Mountain Research Station.
- R2-18-01. Schoettle AW, Burns KS, Douville T, Holtz C. Update on the Southern Rockies Rust Resistance Trial (SRRRT). Biological Evaluation.

Publications

- Blodgett JT, Burns KS, Worrall JW. 2017. Guide to Hazard Tree Management. USDA Forest Service, Rocky Mountain Region, SPFTR, FHP. Tech. Rep. R2-69. 30 pp.
- Casper AM, Jacobi WR, Schoettle AW, Burns KS. 2016. Restoration planting options for limber pine in the Southern Rocky Mountains. J. Torrey Bot. Soc. 143(1): 21-37.
- Jacobi WR, Bovin PP, Burns KS, Crump A, Goodrich BA. 2017. Pruning limber pine to reduce impacts from wpbr in the Southern Rocky Mountains. For. Sci. 63(2): 218-224.
- Schoettle AW, Burns KS, Cleaver CM, Connor J. In press. Limber pine conservation strategy for the greater RMNP area. USDA Forest Service, RMRS-GTR-xxx.
- Schoettle AW, Snieszko 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](#)
 - [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](#)
 - [Diseases of Trees in the Great Plains](#)
 - [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 health concerns. Please do not hesitate to contact us with your inquiries.

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Appendix

2017 Spruce Beetle in Colorado

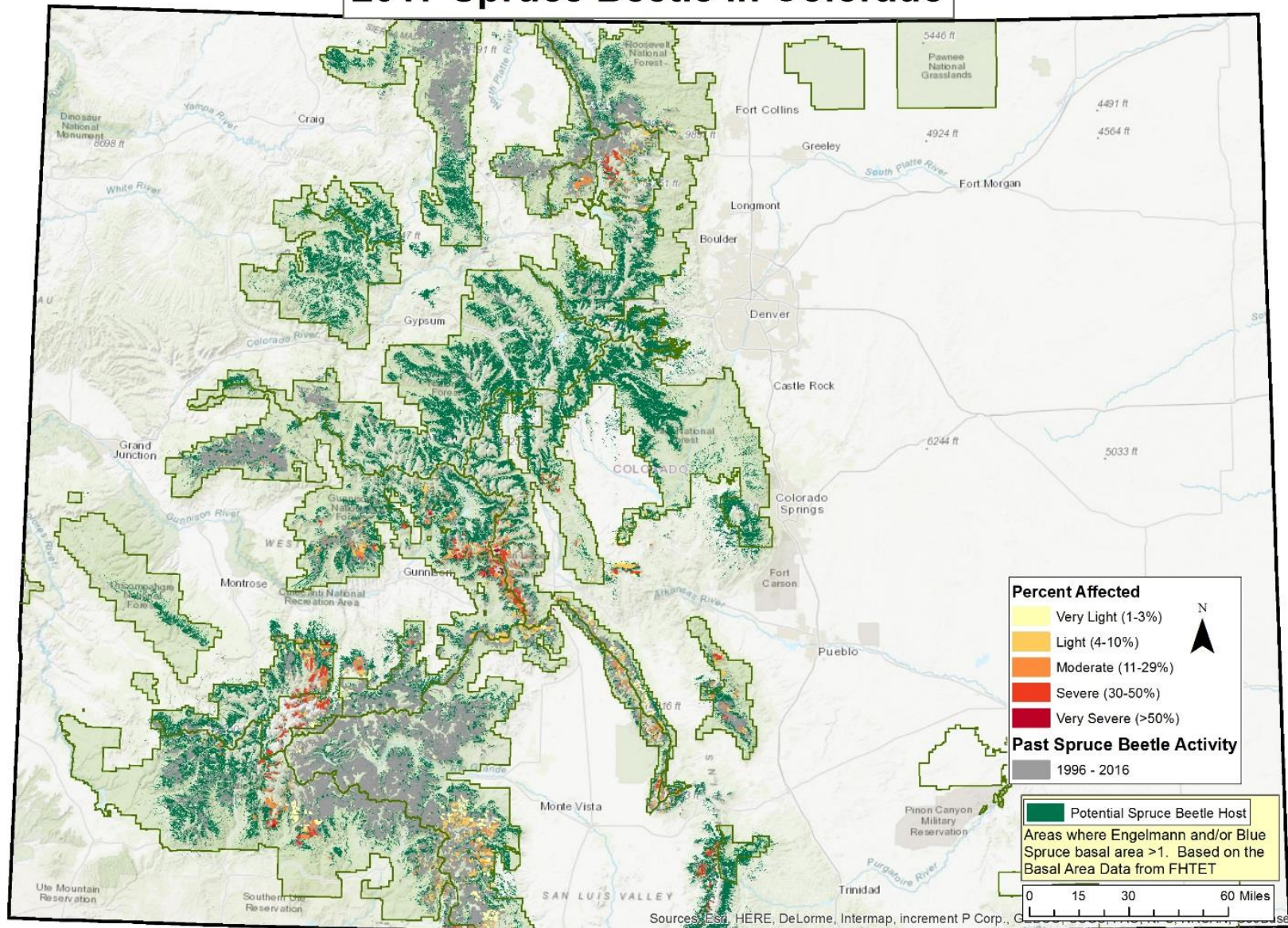


Figure 1. Potential spruce beetle host (green) with past spruce beetle activity (grey) and 2017 severity categories (yellow to red) in Colorado.

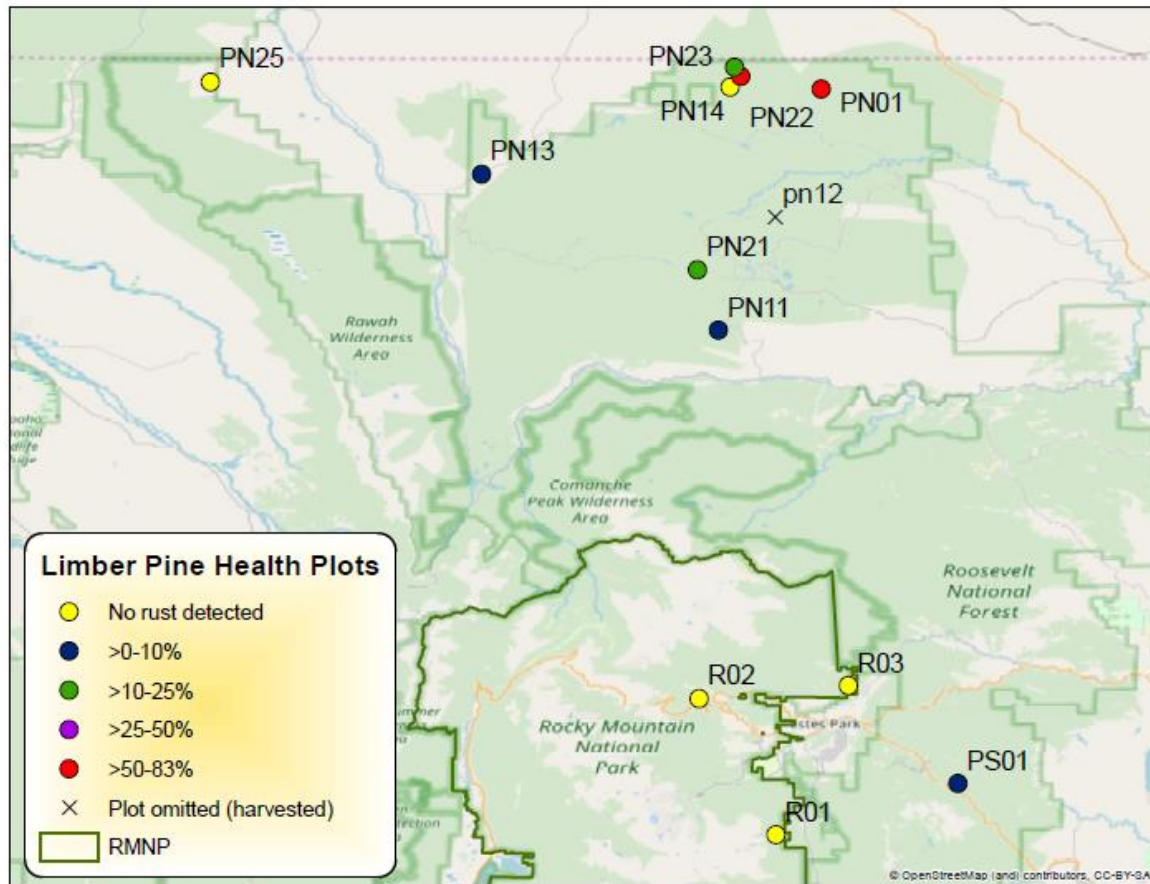


Figure 2. Map showing WPBR incidence as of 2016 in limber pine health plots in and around RNF. WPBR infections have been confirmed (and removed via pruning) on several trees near plot R02 in RMNP, these are the only infections identified within the Park to date.

2017 Forest Insect and Disease Conditions: Bighorn National Forest

Overview

Figure 1 shows areas of mapped damage on the Bighorn NF in 2017. Most tree mortality is light and scattered.

An estimated 810 acres of subalpine fir mortality was recorded this year, indicating a sustained decrease since 2012. In other forests, *Armillaria* root disease contributes to subalpine fir mortality, but has not been detected in subalpine fir in the Bighorn National Forest.

Overall mountain pine beetle caused mortality of pines has decreased in the past year. In 2017 a total of roughly 20 acres were affected by mountain pine beetle, all of which occurred in limber pine. This represents a 560 acre decrease from 2016 when mountain pine beetle activity was documented in both lodgepole and limber pines. Spruce beetle activity has also decreased since 2016, from 160 acres to zero acres affected in 2017. Acres of Douglas-fir beetle caused mortality increased this year, from six acres in 2016 to 120 acres currently affected.

While not on the forest specifically, increasing defoliation from western spruce has been found just off the southern end of the forest near Dull Knife reservoir.

Within aspen stands, 70 acres were affected by defoliation, and 20 additional acres were discolored. Diseases affecting aspen are difficult to identify from the air, but sooty bark canker, followed by Cytospora canker, are typically the most damaging agents in aspen stands. White mottled rot is damaging in select aspen stands.

Though not recorded during aerial survey, dwarf mistletoe is a persistent problem in lodgepole pine stands, but suppression treatments can be used to improve stand conditions. White pine blister rust disease also difficult to detect from the air, but is found in most limber pines stands throughout the forest and is continuing to spread and intensify.

Recent Reports and Projects

Mortality in Subalpine fir stands. Subalpine fir stands on the Bighorn NF have suffered extensive mortality over the past 20 years. Surveys were done to determine the extent and major causal agents for this mortality. The western balsam bark beetle was the major cause of mortality and it appears that stand conditions may be a player in how much mortality was caused by the beetle (Figure 2). Report RCSC-17-03.

Dwarf mistletoe. Dwarf mistletoe is causing widespread impact to lodgepole pine stands throughout the forest. Over the past 5 years we have provided assistance in reducing mistletoe infested stands through silvicultural means. These treatments are highly effective at reducing the amount of mistletoe in lodgepole pine stands (Figure 3). Report RCSC-15-01.





Figure 2. Adult western balsam bark beetle.
(Photo Kendra Schotzko)

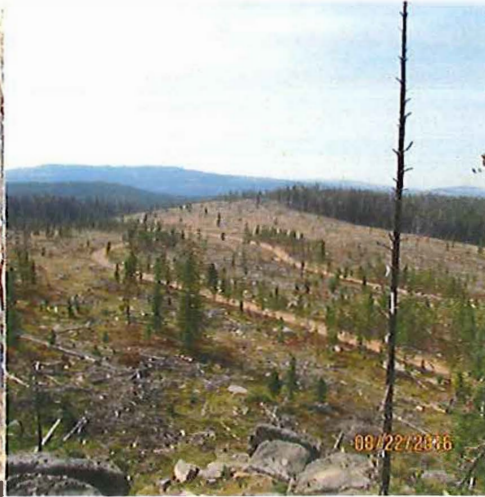


Figure 3. Dwarf mistletoe treatment area.
(Photo Bob Cain)

If you have any questions or concerns about forest health on the forest, our contact information is listed below.

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Black Hills-2017 Forest Insect and Disease Conditions: Black Hills National Forest

Overview

This year was the first since 2011 that tree condition and mortality in the Black Hills National Forest was assessed by aerial detection survey (Figure 1). Between 2010 and 2016 aerial photos were taken and interpreted post-flight to estimate tree mortality on the forest.

Mountain pine beetle populations within the Black Hills National Forest remain at endemic levels. The increase in the estimated acres of beetle caused mortality between 2016 and 2017 is due to the different methods used to collect the data during these years (Air photo interpretation versus aerial detection survey). Ground surveys of the Black Hills National Forest indicate that despite year to year fluctuations, mountain pine beetle populations and associated tree mortality have continued to decrease dramatically since 2013.

Wood borer numbers remain relatively high, largely due to the abundance of dead trees created by past mountain pine beetle activity. Wood borers do not attack live trees, and compete with mountain pine beetles when they do co-occur in the same tree. Pine engraver beetles (*Ips* sp.) also compete with mountain pine beetle when they co-occur, but more often are found in stressed or weakened trees. There was an increase in pockets of mortality caused by engraver beetles in parts of the forest this year.

Low levels of aspen defoliation (110 acres) and spruce mortality (30 acres) were observed, though neither damages have been attributed to single agents. In both cases it is likely that a combination of factors and/or agents are impacting these trees. Damage was also noted on small spruce, likely caused by environmental factors in areas where stand conditions have changed significantly. Deformities in new growth was seen in multiple locations on small ponderosa pine, which was caused by herbicides.

Recent Reports and Projects

Mountain pine beetle activity on the Black Hills. After a 20 year mountain pine beetle epidemic, beetle levels have returned to endemic status at this time (Figure 2). Tree mortality and beetle brood production are at very low levels. Monitoring of beetle levels will continue into the future by a variety of large scale aerial detection and ground surveys as warranted. Report RCSC-17-01.

Condition of aspen on the Black Hills. Overall, the condition of aspen stands is good. Mortality is relatively low and regeneration is occurring to replace older trees. There are canker diseases which are the largest mortality factors in older trees that are being killed (Figure 3). Report RCSC-17-6.

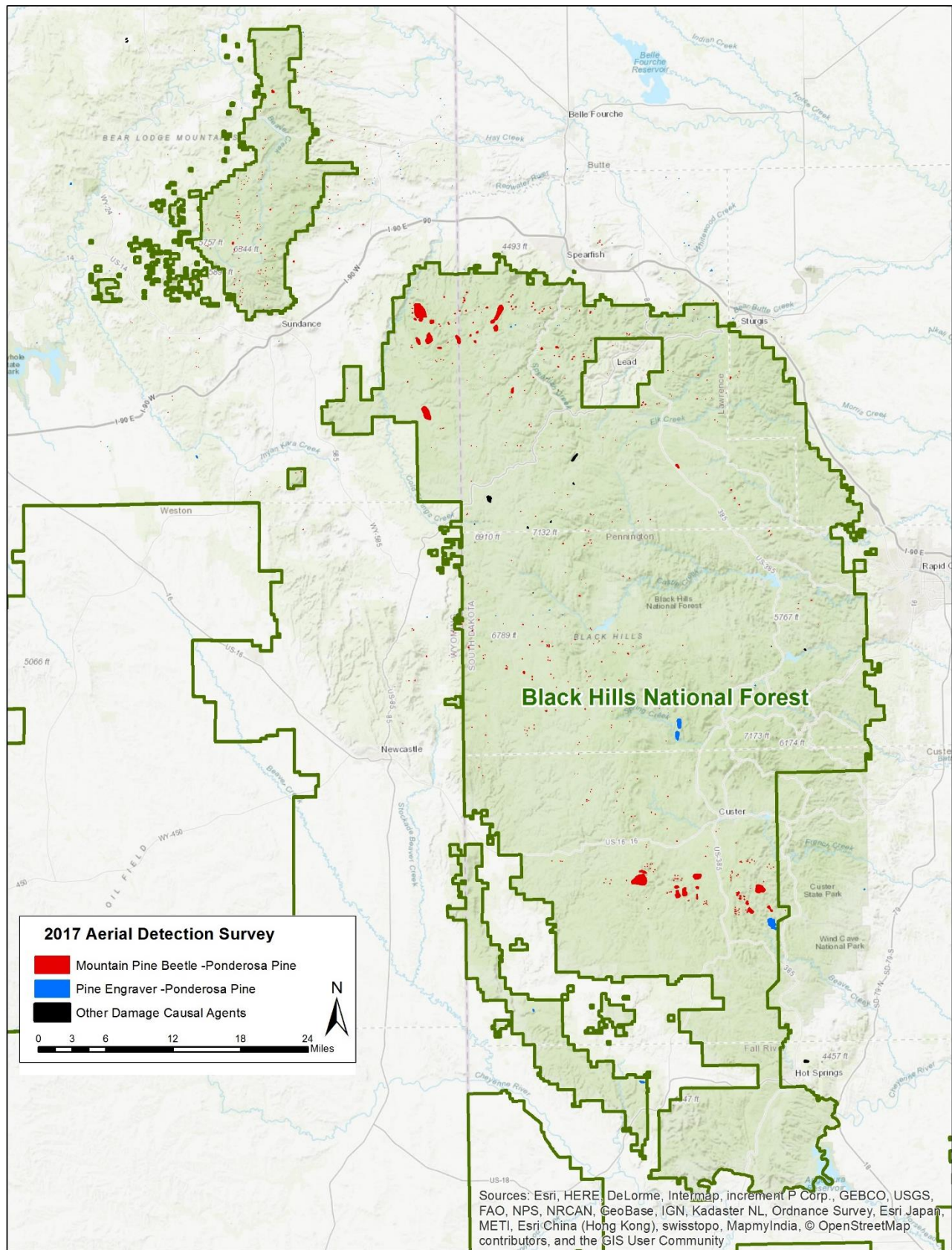


Figure 1. Aerial detection survey map of the Black Hills National Forest: 2017.



Figure 2. Mountain pine beetle pitch out. (Photo Kendra Schotzko)



Figure 3. Canker on aspen. (Photo Jim Blodgett)

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2017 Forest Insect and Disease Conditions: Grand Mesa, Uncompahgre, and Gunnison National Forests

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Overview

The Grand Mesa, Uncompahgre, and Gunnison National Forests (GMUG) currently face several serious forest health issues. Among those that go through dramatic cycles, causing conspicuous damage in ‘boom’ phases followed by quiescent ‘bust’ phases, are spruce beetle and western spruce budworm. Several diseases cause more persistent, widespread damage, including root diseases and dwarf mistletoes.

Spruce beetle (*Dendroctonus rufipennis*) activity was detected by aerial survey on over 51,000 acres in 2017 on the GMUG (Tables 1 – 3). Of those 51,000 acres, the spruce beetle epidemic spread into 14,000 new acres not previously mapped. The Grand Mesa NF had nearly 500 acres of spruce beetle activity detected. The Uncompahgre NF had 12,000 active acres, 4,000 of which were mapped as newly infested. The Gunnison NF had more new acres overall, with 10,000 newly mapped acres of 39,000 active acres. Total area impacted on the GMUG over the course of the current epidemic since the late 1990’s is about 342,000 acres according to aerial surveys. The epidemic has been most severe on the Gunnison NF with about 236,000 acres affected, much with extensive tree mortality.

Activity on the GMUG in recent years has been widespread, and in some areas, very intense. Virtually all major portions of the Gunnison NF with mature spruce have now been impacted to some degree (Figure 1). Areas currently affected are Monarch Pass, south through the Cochetopa Hills and Los Piños areas, continuing through the Lake City area, and then westward to the Alpine Plateau and Cimarron Ridge on the Uncompahgre NF. North of Monarch Pass, the western portion of the Collegiate Range, and the Maroon Bells-Snowmass and Raggeds Wilderness areas are more recently affected. The beetles are also widespread on the east side of the West Elk Wilderness.

The Mountain Division of the Uncompahgre NF has seen increased spruce beetle activity in 2016 and 2017, to the east and west of the Silver Jack Reservoir area. The Ouray RD has begun setting up timber sales to reduce stand density by sanitation and group selection, and salvage where necessary. No spruce beetle activity was observed by aerial surveyors on the Plateau Division in 2017.

The situation differs on the Grand Mesa NF. Although spruce beetle has been active here for a decade, mortality is much more dispersed. This area experienced a large outbreak in the 1950's which might account for pockets of mortality instead of widespread mass mortality, like the Rio Grande and parts of the Gunnison have experienced.

Management efforts, primarily sanitation, can affect spruce beetle populations at a local level, but tend to be ineffective with an outbreak of this magnitude. Sanitation is recommended when possible; otherwise salvage offers the opportunity to capture value and reduce hazards from dead standing trees on the GMUG NF. In high value areas like campgrounds, insecticide application (carbaryl) has proven very effective in protecting trees from future spruce beetle attack. Several campgrounds on the GMUG have used funding from Forest Health Protection to facilitate these projects.

Douglas-fir beetle (*Dendroctonus pseudotsugae*) is currently at a moderate level on the GMUG. Approximately 3,000 acres of mortality were mapped in 2017. Most acres mapped were new, and primarily on the Gunnison NF (Tables 1-3). In recent years, Douglas-fir tree mortality has varied widely from scattered mortality in some stands to almost total loss of mature Douglas-fir in others. Current activity includes portions of the Uncompahgre NF mountain division and the West Elks and Sawatch Range of the Gunnison NF (Figures 3 and 5). Several projects have utilized the anti-aggregation 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 MCH to protect Douglas-fir in recreation and viewshed areas in cooperation with District personnel. Douglas-fir beetle may increase in areas where stress from repeated defoliation by western spruce budworm makes Douglas-fir more vulnerable to bark beetle attack.

Western spruce budworm (*Choristoneura freemani*) activity was severe across the GMUG, particularly on the Gunnison NF. Aerial surveyors observed an increase in activity and recorded nearly 52,000 active acres on the GMUG in 2017. Area of defoliation on the Gunnison NF increased to 42,000 acres, the Uncompahgre NF increased to 9,200 acres observed, and the Grand Mesa NF increased slightly to 480 acres. Severe defoliation was noted in ground observations east along Highway 50 near Sargents and Marshall Pass, south on Highway 114 around the Cochetopa Hills area, and north up Taylor Park Canyon. Drying needles webbed to twigs impart a brown cast to infested trees (Figure 6). Significant impacts are occurring in both mixed conifer and spruce-fir forest types across Colorado. Feeding from this insect can cause growth loss, top-killing, and tree mortality, especially on suppressed trees. A combination of suitable habitat and favorable weather patterns have resulted in the current widespread outbreak in Colorado. Stand conditions contribute greatly to the budworm population's ability to increase to outbreak levels. Reduced fire frequency allows shade-tolerant white fir (around Ouray) and Douglas-fir to increase in mixed conifer stands, improving habitat for western spruce budworm. Multistory stands of shade-tolerant species favor western spruce budworm survival as larvae disperse from overstory trees. Management activities such as reducing basal area, favoring ponderosa pine where possible, and thinning from below can render stands less susceptible to damage from western spruce budworm.

Western tent caterpillar (*Malacosoma californicum*) and **large aspen tortrix** (*Choristoneura conflictana*) are two aspen defoliators likely responsible for the 8,200 acres affected on the GMUG. Field observations on the Gunnison NF revealed heavy early-season impact around Gothic and Kebler Pass. Defoliation can lead to tree mortality if it occurs repeatedly over several years, especially during droughts. Defoliated aspen typically grow new leaves in mid-late summer. 2017 defoliation observed by aerial surveyors was higher than reported in 2016 (3,600 acres).

Root diseases are important in the ecology and productivity of mixed conifer and spruce-fir stands on the GMUG. In spruce-fir, **Armillaria root disease** (caused by *Armillaria solidipes*) is usually most important, infecting both Engelmann spruce and subalpine fir. Subalpine fir often also becomes infested by **western balsam bark beetle** (*Dryocoetes confusus*), and is usually killed while standing. Engelmann spruce more often falls due to decayed roots while still green. Infected spruce may serve as hosts for spruce beetle during non-epidemic conditions, and strip attacks can be found above infected roots. When infected spruce fall, they provide resources for build-up of spruce beetle populations. The root disease generally intensifies as stands mature.

Around Ouray, white fir is increasingly impacted by insects and disease. Throughout the West, true firs have become more prevalent due to past selective harvesting of pines and Douglas-fir as well as fire exclusion. White fir is regulated by fire because seedlings are killed and mature trees frequently receive fire scars. Fire scars are readily infected by decay fungi and trees soon die. Because white fir is shade tolerant, in the absence of fire pine is replaced by white-fir, creating ideal conditions for its insects and diseases.

White fir is the primary host of **annosus root disease** (caused by *Heterobasidion occidentale*) and **fir engraver** (*Scolytus ventralis*), and is particularly susceptible to western spruce budworm (described above). Annosus root disease increases as white fir increases. Dense white fir stands are often severely affected. In campgrounds, the disease is of particular concern because it causes mechanical failure of green, often healthy-looking trees. Fir engraver attacks white fir boles and branches larger than 4 inches in diameter. Trees infected with root disease or defoliated by western spruce budworm are especially subject to attack. The beetles may also attack the tops of trees, causing top-kill. Fir engraver activity decreased from 2,800 acres in 2016 to 1,500 acres in 2017. In the long term, where possible, the best management treatment for all these agents is to favor non- or less susceptible species like pines, junipers, and Douglas-fir, and discriminate against white fir.

Dwarf mistletoes cause significant growth loss, and over time can substantially impact forest productivity and increase fire severity. Mortality can result when infestations are severe. The most important and damaging dwarf mistletoe on the GMUG is *Arceuthobium americanum*, lodgepole pine dwarf mistletoe, on the Gunnison Ranger District. On the District, 52% of the lodgepole pine type is infested. Art Haines has long led the charge against this disease, and we are pleased to see the Forest supporting that effort with the Taylor Park Environmental Assessment. We look forward to assisting with this effort.

Aerial Survey Highlights

- Spruce beetle activity was detected on 206,000 acres in Colorado in 2017. Of these, 67,000 acres are in areas not previously mapped as having spruce beetle activity. Aerial observers mapped 51,000 acres of active spruce beetle activity in the GMUG in 2017, of which 14,000 acres were newly reported.
- Defoliation by western spruce budworm was detected in Colorado on 252,000 acres in 2017, compared to 226,000 acres in 2016. Activity was most notable on the White River, Pike-San Isabel, Gunnison, San Juan, and Rio Grande National Forests and adjoining lands.
- Aspen defoliation was observed by aerial surveyors on 38,000 acres in Colorado. Defoliation on the GMUG increased from 3,600 affected acres in 2016 to 8,200 acres in 2017. Field observations suggest that most of the damage mapped is due to western tent caterpillar and large aspen tortrix.
- Fir engraver (*Scoytus ventralis*) activity decreased from 2,800 acres in 2016 to 1,500 acres in 2017. Activity is centered around Ouray, where its host, white fir, occurs. Extensive sanitation efforts have been made.

Table 1. **Grand Mesa National Forest:** acres of major damage agents detected in aerial survey. ^a

Agent	2016 Acres Affected	2017 Acres Affected	1996-2017 Cumulative Acres Affected	2017 New Acres Affected ^b
Spruce beetle	3,000	460	62,000	0
Subalpine fir mortality	1,000	570		
Aspen discoloration	380	40		
Western spruce budworm	310	480		
Douglas-fir beetle	40	10	2,400	0
Aspen defoliation	20	1,500		
Mountain pine beetle	0	0	20	0

^a Due to the nature of aerial surveys, these data will only provide rough estimates of location, intensity and the resulting trend information for agents detectable from the air. Many of the most destructive diseases are not represented in the data because these agents are not detectable from aerial surveys. The data presented should only be used as a partial indicator of insect and disease activity, and should be validated on the ground for actual location and causal agent. Using these data for purposes other than those for which it was intended may yield inaccurate or misleading results.

^b since 1996

Table 2. **Uncompahgre National Forest:** acres of major damage agents detected in aerial survey.

Agent	2016 Acres Affected	2017 Acres Affected	1996-2017 Cumulative Acres Affected	2017 New Acres Affected
Spruce beetle	16,000	12,000	44,000	4,000
Western spruce budworm	6,000	9,200		
Fir engraver	2,800	1,500		
Subalpine fir mortality	1,800	470		
Aspen defoliation	1,800	2,300		
Douglas-fir beetle	880	600	32,000	500
Aspen discoloration	30	130		
Mountain pine beetle	0	0	11,000	0

Table 3. **Gunnison National Forest:** acres of major damage agents detected in aerial survey.

Agent	2016 Acres Affected	2017 Acres Affected	1996-2017 Cumulative Acres Affected	2017 New Acres Affected
Spruce beetle	72,000	39,000	236,000	10,000
Western spruce budworm	9,700	42,000		
Fir engraver	3	0		
Subalpine fir mortality	3,900	4,700		
Aspen defoliation	1,800	4,400		
Douglas-fir beetle	2,600	2,400	30,000	2,000
Aspen Dieback & Mortality	40	270		
Aspen discoloration	30	20		
Mountain pine beetle	0	0	11,000	0

FHP Projects

- Gunnison Service Center and the Gunnison and Ouray Ranger Districts continue to deploy MCH at several high value campgrounds and heavily-trafficked trails to protect against future Douglas-fir beetle attacks and further loss of mature Douglas-fir.

- Gunnison Service Center worked with Gunnison Ranger District to spray and protect high value spruce trees with insecticide carbaryl at Alpine Guard Station and Big Blue Campground.
- The Ouray Ranger District continues to work with Telski at Telluride Ski Area to mitigate any spruce blowdown using partial funding from Forest Health Protection.
- Gunnison Service Center worked with the Ouray Ranger District to assess and manage annosus root disease in Amphitheater Campground. After two early-season tree failures, we surveyed the south side of the Campground together with District staff. The District then arranged for removal of host trees within 30-50 feet of occurrences of the pathogen in stumps and failed trees. We ordered Cellu-Treat that was applied to fresh stumps to prevent new infections. The project is featured on the RO website: <https://www.fs.usda.gov/detail/r2/home/?cid=fseprd495228>
We plan to do a similar project in Angel Creek Campground in early summer 2018.
- The Southwestern Colorado Bioclimate Project projects climate change impacts on tree species to aid forest adaptation efforts on the SJNF, RGNF, GMUG, Southern Ute Indian Tribe, Tres Rios BLM, and Mesa Verde National Park. Rocky Mountain Research Station is developing adaptation management recommendations based on the projections. We held a workshop for participants in Durango, Nov. 2, 2017, hosted by Mountain Studies Institute. Presentations are available at <http://www.mountainstudies.org/bioclimate>. Maps and rasters of bioclimate projections for 14 species will soon be available on their website.
- SBEADMR: Jim Worrall and Amy Lockner contributed presentations at the annual public meeting, January 2017.
- GMUG Forest Plan revision: At various times on request we contributed files, reviews, and information regarding insects, diseases, and climate change projections to planners.
- Gunnison Service Center held the annual regional Insect, Disease and Hazard Tree Training in Ouray, June 6-8, 2017.

Recent Reports and Resources

Forest Health Protection (FHP), in cooperation with the Colorado State Forest Service, Wyoming State Forestry, and other partners, compiles a Forest Conditions report for the Region each year. They also conduct an annual aerial forest health survey, ground surveys and site visits to identify and map insect and disease-caused tree mortality and damage throughout the Region. The following is a list of recent reports and resources available.

- Lockner, Amy. January 2017. Spruce beetle trap trees, Hay Park Salvage Sale, Grand Mesa. Service Trip Report GSC-17-02.
- [Dwarf Mistletoes: Ecology and Management in the Rocky Mountain Region](#)
- [Forest Health Protection](#)
 - Other Forest Condition Reports

- Other Regional Reports
- [Aerial Detection Survey](#)
 - Shapefiles
 - Data tables by state, county, and forest available by request
- [Mapping and Reporting](#)
- [Forest Health Technology Enterprise Team](#)
 - Risk Map
 - National Forest damage Agent Range Maps
 - Forest Pest Conditions

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

Gunnison Service Center

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- Amy Lockner, Entomologist, alockner@fs.fed.us, 970-642-4448
- Suzanne Marchetti, Biological Science Technician, sbmarchetti@fs.fed.us, 970-642-4446

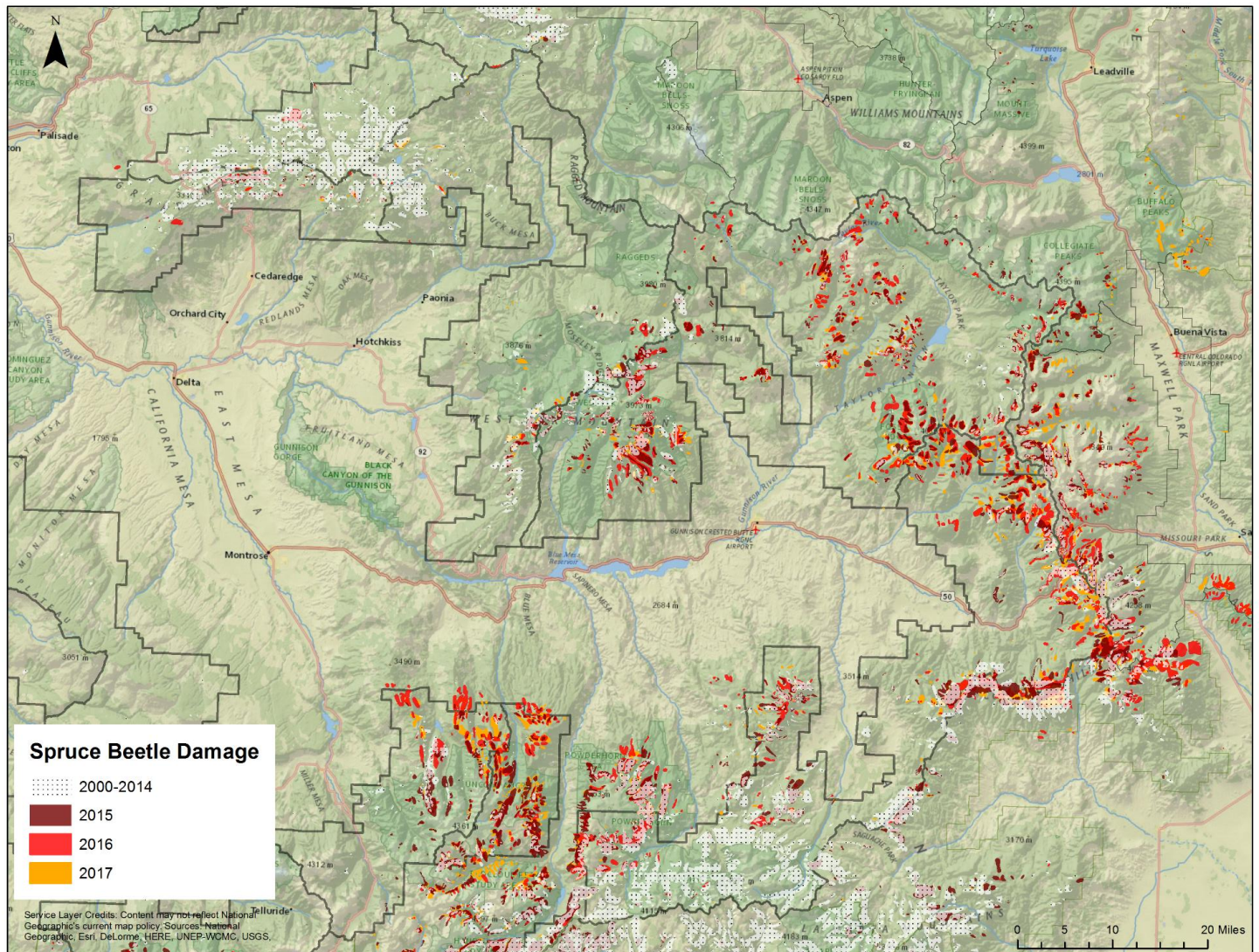


Figure 1. Active and historical spruce beetle activity across the GMUG. There are approximately 51,000 affected acres in 2017 and 14,000 newly affected.

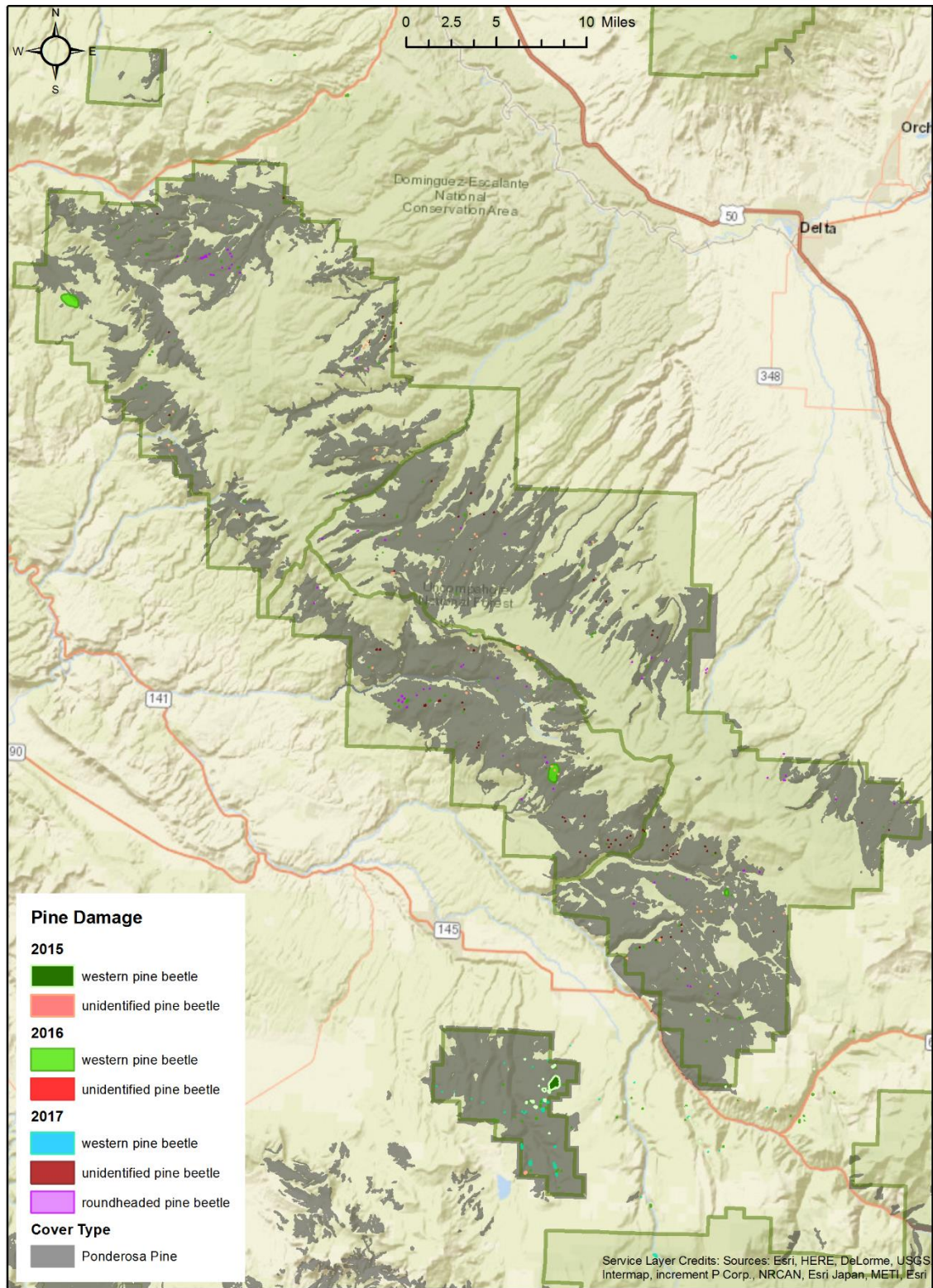


Figure 2. Scattered areas of ponderosa pine mortality caused by more than one species of bark beetles are developing across the Uncompahgre Plateau. Aerial surveyors are not able to identify specific bark beetle species, but ground checking indicates western, roundheaded and pine engraver beetles are all killing trees. Just south of the Uncompahgre on the San Juan National Forest, there has been a large mortality center associated with mostly roundheaded pine beetle.

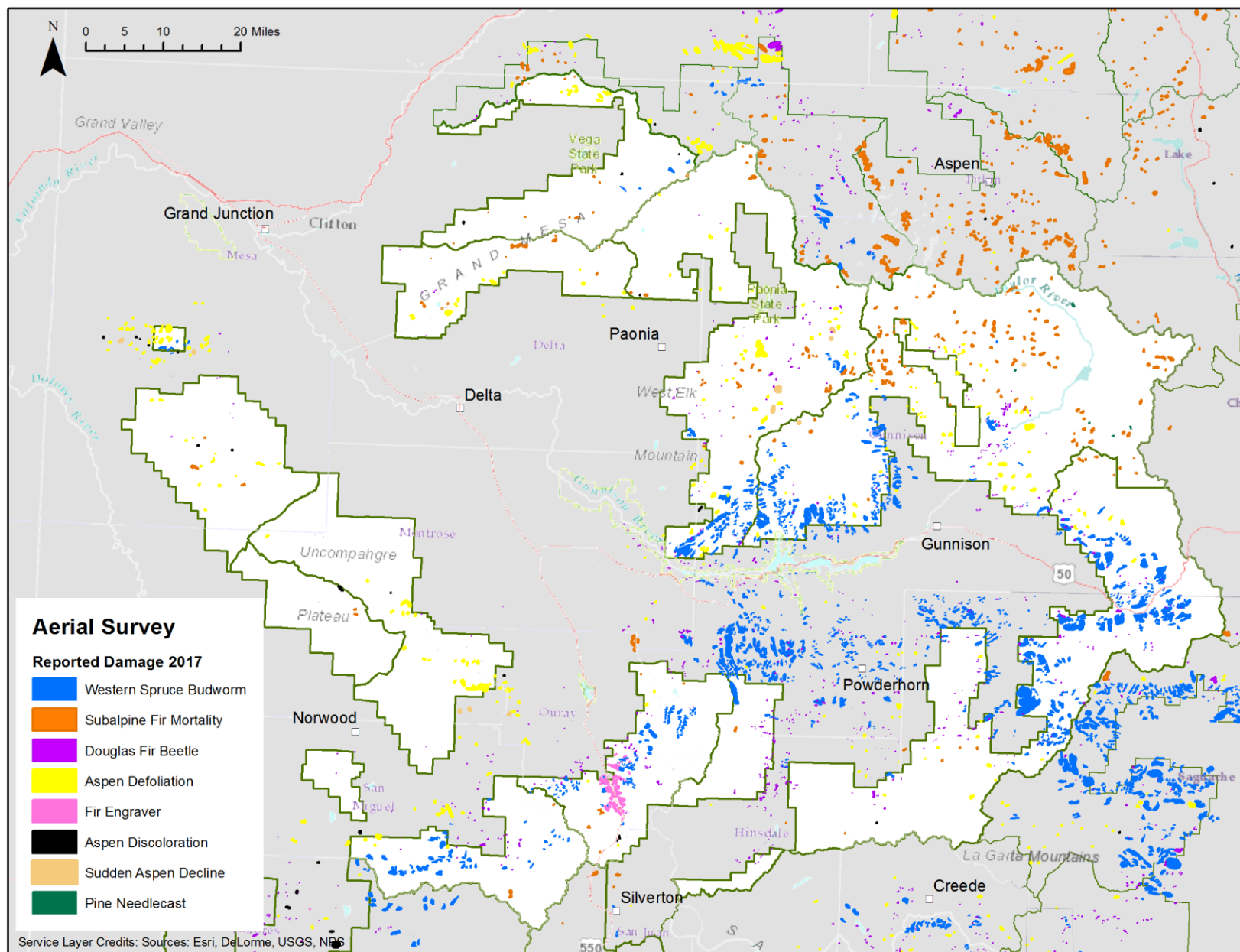


Figure 3. Reported insect and disease damage from aerial survey (see Figs. 1 and 2 for major bark beetles).



Figure 4. Treating for annosus root disease in Amphitheater Campground. a) Removing trees with likelihood of infection. b) Decay typical of annosus root disease in fresh stump. c) Treating stumps with Cellu-Treat. Photos courtesy of Todd Gardiner.

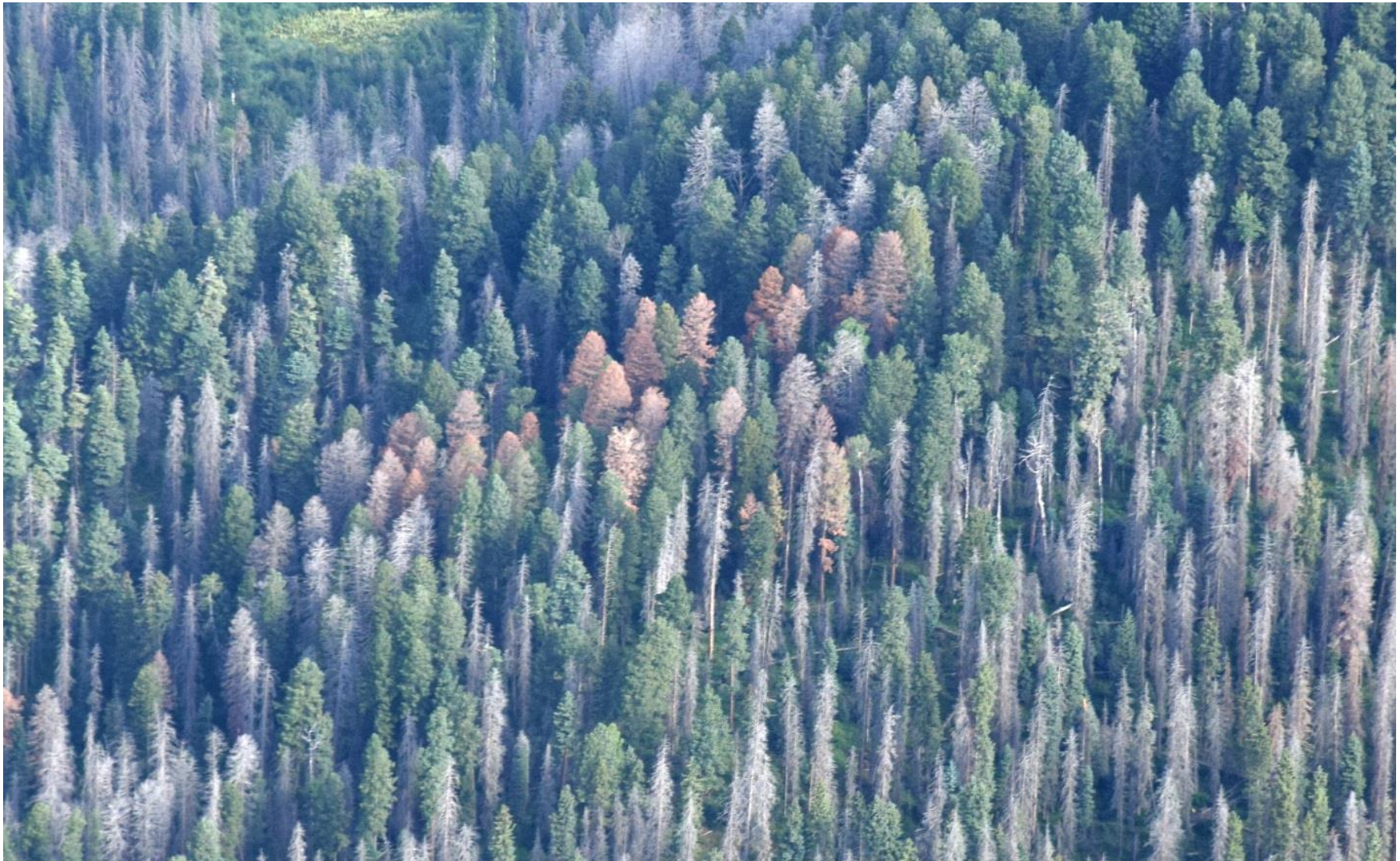


Figure 5. Mortality due to Douglas-fir beetle in an area surrounded by older mortality due to spruce beetle.



Figure 6. Western spruce budworm defoliated trees near Marshall Pass on the San Isabel National Forest. Photo: Dan West.

2017 Forest Insect and Disease Conditions Report: Medicine Bow-Routt National Forests

USDA Forest Service
Rocky Mountain Region
Forest Health Protection
Lakewood Service Center
1617 Cole Blvd Bldg 17
Lakewood, CO 80401

Conditions Highlights

This report provides a summary of forest health conditions based on surveys, monitoring, and other activities conducted by Forest Health Protection (FHP) on the Medicine Bow and Routt National Forests (MBNF, RNF) in 2017.

Spruce beetle (*Dendroctonus rufipennis*) activity detectable from Aerial Detection Surveys (ADS) continued to decrease in Colorado and southern Wyoming in 2017. Aerial surveyors identified 4,600 acres of recent mortality on the MBNF and RNF in 2017. The activity previously observed on the RNF in Jackson County, CO (7,000 acres in 2016) declined to 230 acres in 2017. Meanwhile, activity mapped on the MBNF, particularly in Carbon County, rose from 200 acres in 2016 to 1,200 acres in 2017. Suitable stand conditions exist to support spruce beetle populations in Colorado (Fig. 1) and impacted acres mapped during ADS may under-represent ground conditions. Considerable cumulative mortality in spruce stands exists on the RNF (Fig. 2). Numerous windthrow events since 2011 have increased the potential for spruce beetle activity through much of the Region. Predominately dry conditions continue to stress high-elevation mixed-conifer forests.

Mountain pine beetle (*D. ponderosae*) continued to decline throughout Colorado and southern Wyoming and populations are considered to be at endemic levels. Fewer than 100 acres of MPB mortality were observed in 2017 on the MBNF and RNF. All recorded tree mortality occurred on the MBNF. Preventive insecticide spraying is no longer warranted or needed in most situations.

Subalpine fir mortality was reported on 56,000 acres in Colorado and southern Wyoming in 2017. This is down 56% since 2016 (128,000 acres) and includes 4,200 acres on the RNF and 4,200 acres on the MBNF. Subalpine fir mortality is widespread and chronic in the western USA. In Colorado, mortality has been attributed to western balsam bark beetle (*Dryocoetes confusus*) either alone or in combination with root disease fungi (primarily *Armillaria* spp.) which likely predisposes trees to beetle attack. However, a recent study on the Bighorn National Forest found that mortality was solely attributed to *D. confusus* (RCSC-17-03). A study of the Medicine Bow National Forest is planned for 2018.



Dwarf mistletoes are common and damaging forest-wide, primarily on lodgepole pine. The most important dwarf mistletoes are *Arceuthobium americanum* on lodgepole pine and *A. cyanocarpum* on limber pine. A great opportunity exists for managing and reducing impacts of these diseases in conjunction with vegetation management and timber stand improvement projects 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) is well established in limber pine on the MBNF but has not been detected on the RNF to date. A long-term study of limber pine health, including 21 permanent plots located on the MBNF, was completed in 2017 (Fig. 3). Disease incidence (percent of live limber pines infected with WPBR) has decreased but disease severity has increased substantially since plots were established in 2006. Incidence declined because many trees (~25%) were killed since the plots were established. WPBR and MPB were the most common causes of mortality (Table 1). New trees are becoming infected so incidence is expected to rise and impacts will continue. Regeneration is common but density is variable and seedling mortality due to WPBR is occurring. A report will be available soon. Proactive intervention will be needed on sites with low regeneration density or high WPBR infection levels to sustain the species on the landscape. A conservation strategy for limber pine will be available soon (Schoettle et al. *in press*) and we continue to explore and exploit resistance in pine populations through breeding and natural selection.

Aerial Detection Survey Highlights

- Spruce beetle activity decreased in Colorado and southern Wyoming from 350,000 acres in 2016 to 208,000 acres in 2017.
- MPB activity in Colorado and southern Wyoming decreased to 1,500 acres in 2016. ADS found no MPB mortality on the RNF and only 80 acres on the MBNF in 2017.
- Western spruce budworm was detected on approximately 6,200 acres, predominately (5,900 acres) on the RNF.
- Subalpine fir mortality was mapped on 56,000 acres in Colorado and southern Wyoming in 2017, including 4,200 acres on the RNF and 4,200 acres on the MBNF. Mortality is generally attributed to western balsam bark beetle and Armillaria root disease.
- Aspen defoliation was detected on 1700 acres forest-wide (1,100 on the MBNF and 600 acres on the RNF). Most of the damage was observed in Routt County, Colorado and Carbon County, Wyoming.
- Aspen discoloration was mapped on 41,000 acres in Colorado and southern Wyoming in 2017. Most of the damage was located in northwestern Colorado in Moffat (3,600 acres, Rio Blanco (11,000) acres, and Routt (19,000) counties, including 12,000 acres on the RNF. The damage is likely attributed to Marssonina leaf blight (*Marssonina* spp.), a disease that is typically associated with warm, wet conditions like those that occurred during the spring and early summer. Marssonina rarely causes mortality unless the outbreak occurs over consecutive years or is combined with other stresses.



FHP Projects

- 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). Trees with confirmed resistance are treated annually with verbenone (an MPB anti-aggregation pheromone) to prevent bark beetle attacks.
- The Southern Rockies Rust Resistance Trial (SRRRT) was initiated on the MBNF in 2013 to field-verify WPBR resistance. 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 CO State Forest Service Nursery. Over 700 seedlings were outplanted in fall 2013 and another 700 in spring 2014. In 2017, we completed our annual seedling growth and health assessment. Seedlings have grown well on the site and natural WPBR infections are occurring. Disease severity and mortality are more advanced on bristlecone than limber pine seedlings. A report is available (R2-18-01).
- The USFS (RMRS, FHP, and Western Wildland Environmental Threat Assessment Center), NPS, and Alberta Government are collaborating on a range-wide limber pine common garden study that will quantify variation in WPBR resistance, growth traits, and their relationships to climate. Many MBNF seed sources are included in this study.
- A Hazard Tree Management Guide for the Rocky Mountain Region and an App (Survey123 for ArcGIS Online) for collecting hazard tree assessment data on smart phones and tablets are now available (Blodgett et al. 2017). A User's Guide for the App can be found in the [Hazard Tree Management Training Supplement](#).
- FHP assisted the Hahns Peak/Bears Ears Ranger District with a hazard tree survey of Meadows Campground (Fig. 4) (LSC-18-01).

Surrounding Area Conditions of Note

- Spruce beetle activity has increased throughout Rocky Mountain National Park and many areas are known to be infested from ground survey that were not captured in ADS efforts.
- Emerald ash borer has not yet been confirmed outside of Boulder County, CO. A quarantine is in place for regulated articles, which includes all hardwood firewood, for Boulder County.



Recent Reports and Resource List

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 ADS, ground surveys, special projects, and site visits to identify, assess, and map forest health-related issues and to provide technical assistance to our cooperators throughout the Region. The following is a list of recent reports, publications, and other resources.

Forest Health Protection Reports

- LSC-17-05. Stephens, SS. Establishment of Woodborer and Biological Survey Traps.
- LSC-17-08. Stephens, SS. Forest Health Assessment of North Fork Campground, Laramie Ranger District, Medicine Bow National Forest.
- RCSC-17-03. Allen K, Blodgett J, Dymerski A, Schotzko K. Effects of Western Balsam Bark Beetle Outbreaks in the Bighorn National Forest.
- LSC-18-01. Burns K, Chambers A. Hazard Tree Survey of the Left Side Loop of Meadows Campground, Hahns Peak/Bears Ears Ranger District, Medicine Bow-Routt National Forests.
- LSC-18-02. Burns, KS. Blacktail Timber Sale Dwarf Mistletoe Treatments, Yampa Ranger District, Medicine Bow and Routt National Forests.
- R2-18-01. Schoettle AW, Burns KS, Douville T, Holtz C. Update on the Southern Rockies Rust Resistance Trial (SRRRT). Biological Evaluation.

Publications

- Blodgett JT, Burns KS, Worrall JW. 2017. Guide to Hazard Tree Management. USDA Forest Service, Rocky Mountain Region, SPFTR, FHP. Tech. Rep. R2-69. 30 pp.
- Casper AM, Jacobi WR, Schoettle AW, Burns KS. 2016. Restoration planting options for limber pine in the Southern Rockies. J. Torrey Bot. Soc. 143(1): 21-37.
- Jacobi WR, Bovin PP, Burns KS, Crump A, Goodrich BA. 2017. Pruning limber pine to reduce impacts from WPBR in the southern Rocky Mountains. For. Sci. 63(2):218-224.
- Schoettle AW, Burns KS, Cleaver CM, Connor J. In press. Limber pine conservation strategy for the greater RMNP area. USDA Forest Service, RMRS-GTR-xxx.



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](#)
 - [Diseases of Trees in the Great Plains](#)
 - [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 health concerns. Please do not hesitate to contact us with your inquiries.

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Appendix

2017 Spruce Beetle in Colorado

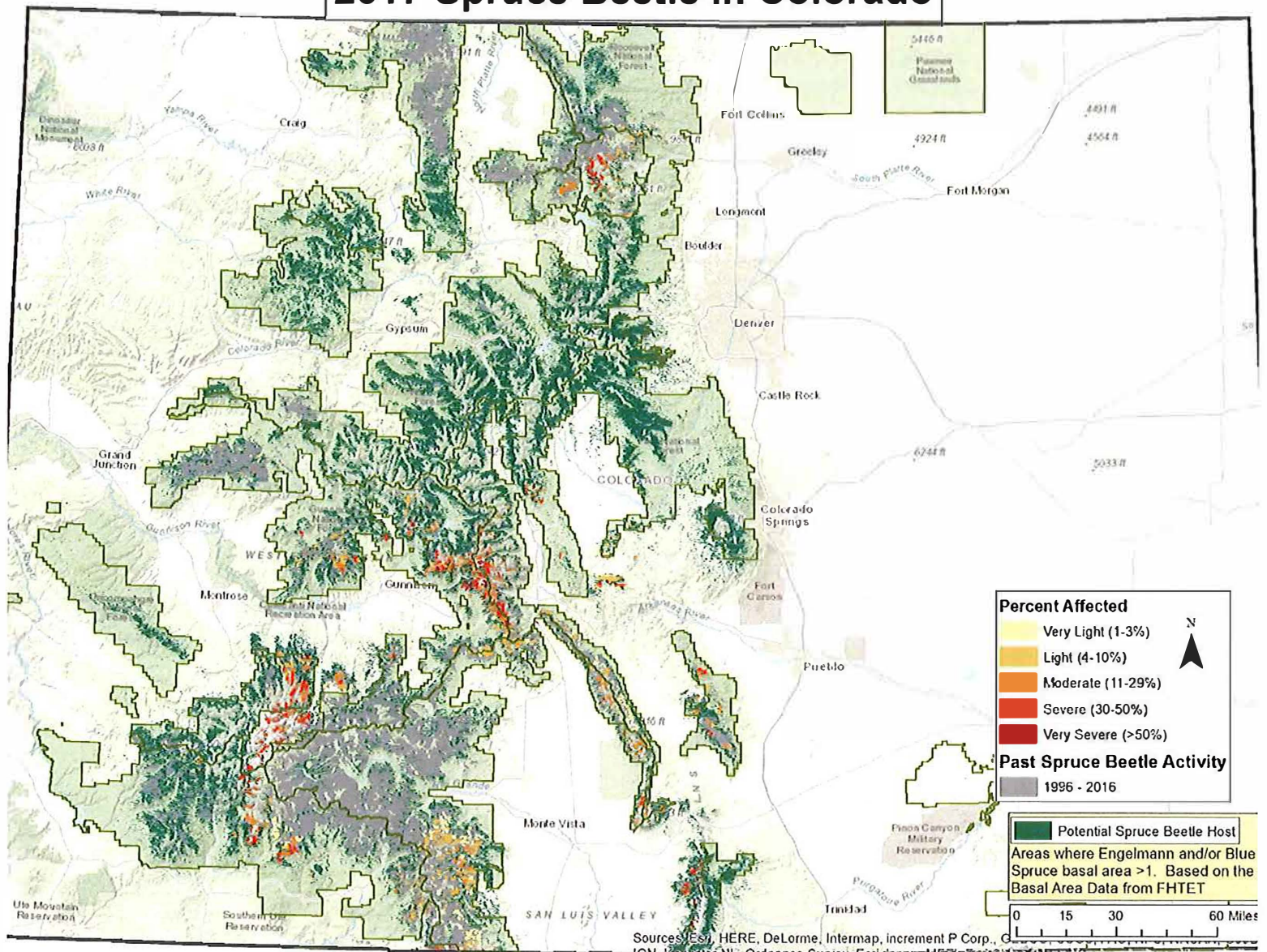


Figure 1. Potential spruce beetle host (green) with past spruce beetle activity (grey) and 2017 severity categories (yellow to red) in Colorado.



Caring for the Land and Serving People

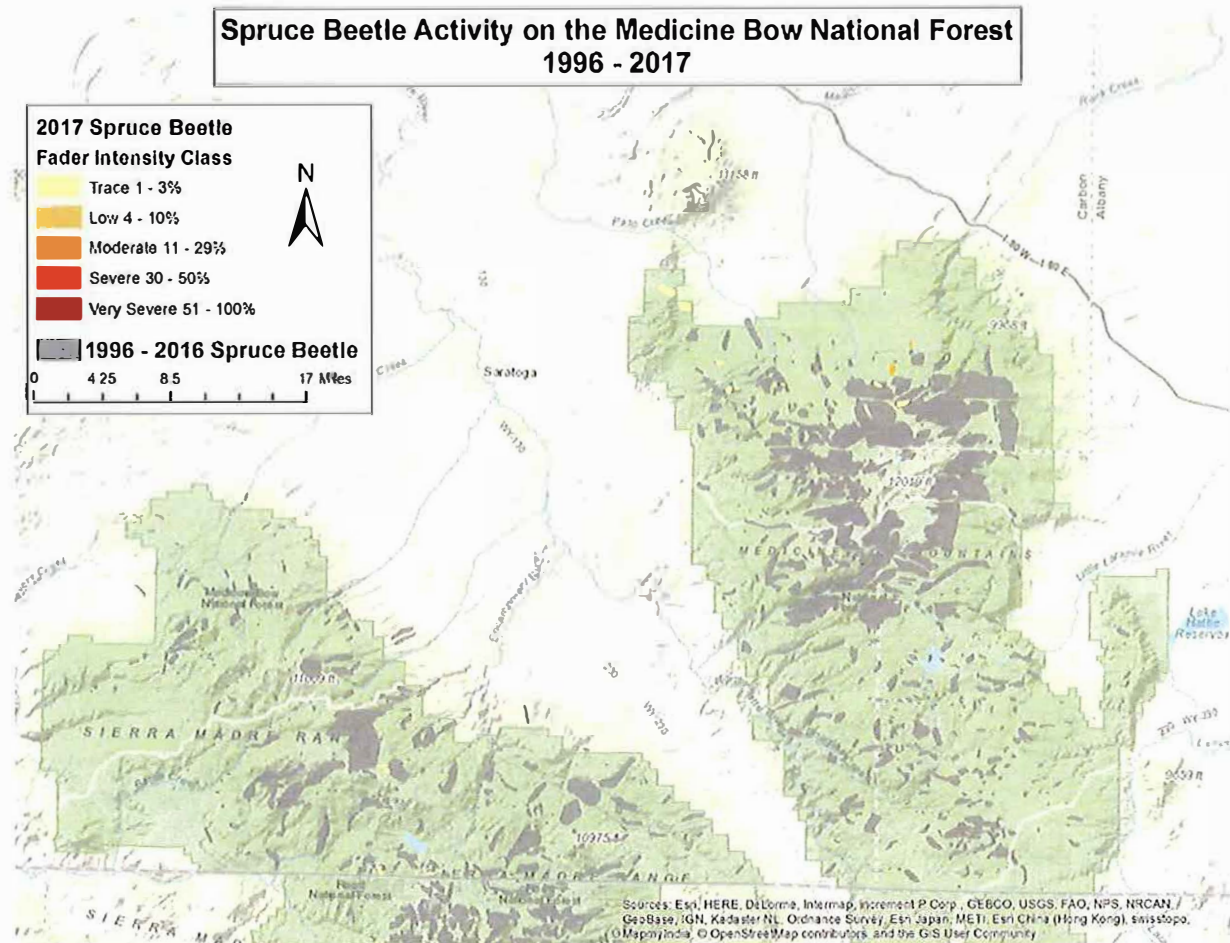


Figure 2. Potential spruce beetle host (green) with past spruce beetle activity (grey) and 2017 severity categories (yellow to red) in Colorado.



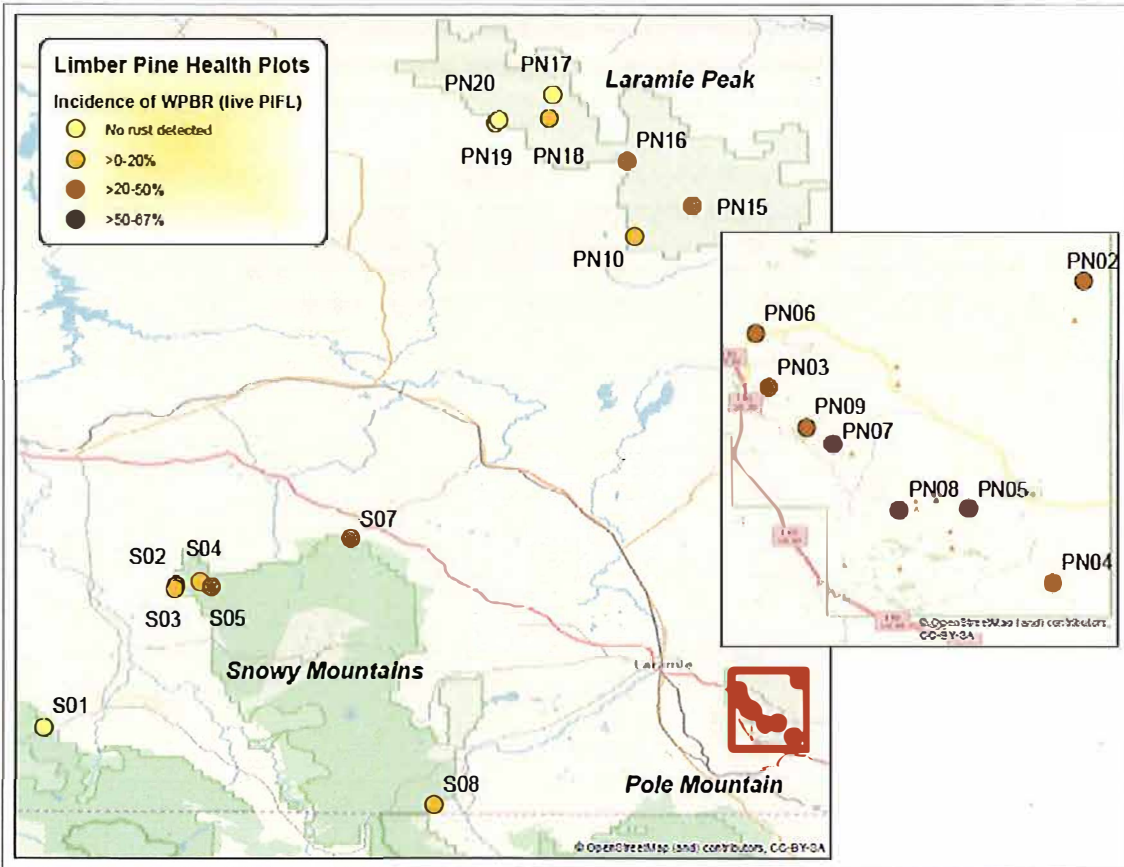


Figure 3. Location of 21 permanent limber pine health plots with WPBR incidence on the MBNF.



Figure 4. FHP assisted with a hazard tree survey of Meadows Campground on the Hahns Peak/Bears Ears Ranger District. Stem decays were common in the campground (left). Crews removed highly hazardous trees identified by the survey (right). Photos: Betsy Frick, MBRNF.

Caring for the Land and Serving People



Table 1. Incidence of WPBR and causes of limber pine mortality identified in 21 permanent limber pine health plots established in 2006 and re-measured in 2016 on the MBNF.

<i>Study Location</i>	<i>N</i> ¹	<i>WPBR in Live Trees</i>		<i>Limber Pine Mortality Since 2006</i>		
		<i>Incidence (%)</i> ²	<i>Change (%)</i> ³	<i>WPBR (%)</i> ⁴	<i>MPB (%)</i> ⁵	<i>Other (%)</i> ⁶
<i>Laramie Peak</i>	7	15.9	-5.3	5.0	3.5	14.9
<i>Snowy Mountains</i>	6	18.9	2.5	0.0	11.1	3.8
<i>Pole Mountain</i>	8	50.0	-15.0	19.0	8.0	9.2
<i>Overall</i>	21	28.3	-5.9	8.0	7.5	9.3

¹ Number of plots.

² Mean number of live infected limber pines/number of live limber pines per plot in 2016.

³ Mean change in incidence since plots were established in 2006 to when they were re-measured in 2016.

⁴ Mean percent of trees per plot killed by WPBR from 2006-2016.

⁵ Mean percent of trees per plot killed by MPB from 2006-2016.

⁶ Mean percent of trees per plot killed by other causes from 2006-2016.



2017 Forest Insect and Disease Conditions: Nebraska National Forest

Report RCSC-18-2.

Overview

While mountain pine beetle may be one of the most well-known bark beetles, pine engraver beetles (*Ips* sp.) can also be damaging agents in ponderosa and jack pine, particularly when combined with fire. Aerial detection survey identified 5 acres of pine engraver beetle caused mortality in ponderosa pine in the Pine Ridge Ranger District (Figure 1); other districts were not flown. Low levels of engraver beetle activity were detected by ground surveys on the Bessey and McKelvie Districts.

Severe weather events can also cause damage to forests and initiate a cascade of secondary insects and disease. Trees can be stripped of their foliage by the hail, or the branches may be so damaged by the impact of hail that the foliage dies. Wounds caused by hail can also serve as infection pathways for *Diplodia* shoot blight and canker disease. Additionally, trees under stress from the hail impacts or secondarily from disease may be attractive and susceptible to pine engraver beetles

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 are controlled with proper watering practices, healthy plants, and timely control applications to reduce significant loss. Animal damage is minimized with deer fence and woven electric fence for small mammals. Weeds at the nursery are being controlled with mowing, hand-pulling, and herbicide to maintain weed free fields as well as wind-breaks.

Recent Reports and Projects

Pine engraver beetle activity. Pine engraver beetles are the most important tree killing bark beetle on the Nebraska NF. Their populations can fluctuate depending on weather and availability of stressed trees (Figure 2). Fire damaged trees can be a potential source to increase beetle populations. Presently, engraver beetles are at relatively low levels across the Nebraska NF.

Large scale hail damage. Depending on intensity, hail can cause tree mortality by itself (figure 3). Additionally, weather events such as hail storms can create swaths of highly stressed trees making them more susceptible to other agents that may kill trees that otherwise would have survived. Treatment of areas affected by weather events can reduce the possibility of increasing damage from other agents.

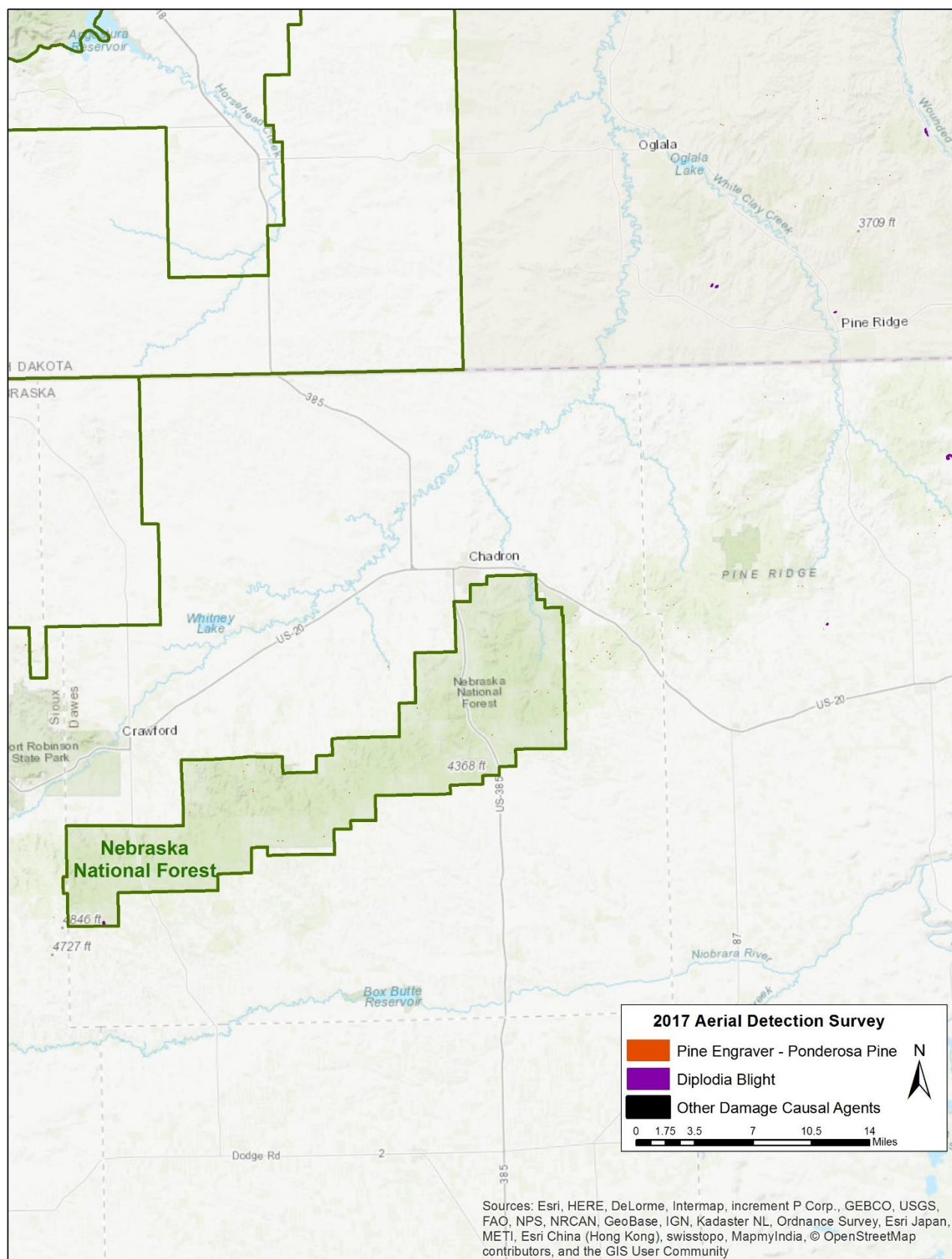


Figure 1. Aerial detection survey map of the Nebraska National Forest: 2017.



Figure 2. Engraver beetle frass on downed log. (Photo Kurt Allen)



Figure 3. Hail damaged trees. (Photo John Lee)

If you have any questions or concerns about forest health on the forest, our contact information is listed below.

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[Al Dymerski](#), Forestry Technician, 308-432-0334

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USDA Forest Service, State and Private Forestry and Tribal Relations
Rocky Mountain Region, Forest Health Protection
Rapid City Service Center
8221 Mt. Rushmore Rd.
Rapid City, SD 57702

2017 Forest Insect and Disease Conditions: Pike-San Isabel National Forest

USDA Forest Service
Rocky Mountain Region
Forest Health Protection

Gunnison Service Center
216 N. Colorado St.
Gunnison, CO 81230

Lakewood Service Center
1617 Cole Blvd, Bldg 17
Lakewood, CO 80401

Overview

The Pike (PNF) and San Isabel (SINF) National Forests currently face several serious forest health issues. Among those that go through “boom-and-bust” cycles, some are still causing conspicuous damage, including spruce beetle and western spruce budworm. Several diseases cause more persistent, widespread damage, including root diseases and dwarf mistletoes.

Spruce beetle (*Dendroctonus rufipennis*) activity was detected by aerial survey on 4,400 acres on the PNF (Table 1) and 29,000 acres on the SINF (Table 2) in 2017. Increased activity has been confirmed during field assessments in and around Craggs Campground on PNF where spruce beetle management activities are ongoing. Activity on the SINF in recent years has been widespread, and in some areas, very intense (Fig. 4). Spruce beetle is now most active in the Saguache Mountains, Sangre de Cristo Mountains, Buffalo Peaks Wilderness, and the Wet Mountains (Fig. 1). Acres affected by spruce beetle are declining overall in Colorado due to exhaustion of the mature spruce that is the beetle’s primary host. However, spruce beetle activity will likely continue for several more years on both forests since significant suitable host type is still intact. Furthermore, a windthrow event impacted 660 scattered acres of Engelmann spruce in the Wet Mountains in 2016. This likely provided ideal habitat for expanding spruce beetle populations, which may infest green trees in the coming years.

Management efforts, primarily sanitation, can affect spruce beetle populations at a local level, but tend to be ineffective during large outbreaks. Sanitation is recommended when possible; otherwise salvage offers the opportunity to capture value and reduce hazards from dead standing trees. In high-value areas like campgrounds, insecticide application (carbaryl) has proven very effective in protecting trees from future spruce beetle attack. Several campgrounds on the Forest have used funding from Forest Health Protection (FHP) to facilitate these projects, and will continue to do so in 2018.

Western spruce budworm (*Choristoneura freemani*) defoliation was mapped by aerial surveyors on 7,900 acres on the PNF and 35,000 acres on the SINF in 2017, compared to 28,000 and 40,000, respectively, in 2016. This insect feeds on the new needles of white fir, Douglas-fir and less notably on spruce and subalpine fir. Drying needles webbed to twigs impart a brown cast to infested trees (Fig. 5). Significant impacts are occurring in both mixed conifer and

spruce-fir forest types. Feeding from this insect can cause growth loss, top-killing, and tree mortality, especially on suppressed trees. A combination of suitable habitat and favorable weather patterns have resulted in the current widespread outbreak in Colorado. Stand conditions contribute greatly to the budworm population's ability to increase to outbreak levels. Reduced fire frequency allows shade-tolerant white fir and Douglas-fir to increase in mixed conifer stands, improving habitat for western spruce budworm. Multistoried stands of shade-tolerant species favor western spruce budworm survival as larvae disperse from overstory trees. Management activities such as reducing basal area, favoring ponderosa pine where possible, and thinning from below can render stands less susceptible to damage from western spruce budworm.

Subalpine fir mortality continued to decline on both the PNF and the SINP in 2017, but is still important in some high-elevation stands (Fig. 2). It has occurred fairly consistently in large areas across the Region for over a decade. It is generally caused by **western balsam bark beetle** (*Dryocoetes confusus*) and **Armillaria root disease** (caused by *Armillaria* spp.). Typically, the beetles attack and kill subalpine fir with root disease. The resulting brood may attack neighboring, uninfected trees. It is also not unusual to find trees killed by root disease that are not attacked by the beetle. The relative contribution of the beetle and the fungus to tree mortality is difficult to determine, and can differ over time and among localities.

White pine blister rust (WPBR) continues to spread and intensify in limber pine on both forests. The exotic, invasive disease, caused by the fungus *Cronartium ribicola*, was brought to North America over a century ago, and is still making its way to the last remaining uninfested regions of North America. All North American five needle pines are susceptible and host populations have been decimated where conditions are favorable. The disease is well established in the Sangre de Cristo and Wet Mountains and more recently infection centers have been confirmed near Crystal Reservoir and in the Rampart Range on the Pikes Peak Ranger District. The only infected Rocky Mountain bristlecone pines identified to date are located within the Great Sand Dunes National Park and Preserve. FHP re-measured 26 long-term monitoring plots, initially established in 2004, in the Sangre de Cristo Mountains in 2017 (Fig. 3). The infestation is concentrated in the Mosca and Medano Pass areas. Disease incidence increased substantially since the study was initiated, rising from 9% to 21% of live limber pines infected. FHP is working with Rocky Mountain Research Station to explore and exploit resistance in limber pine populations through breeding and natural selection (Schoettle et al. in press). Restoration planting options and pruning guidelines to reduce WPBR impacts are available (Casper et al. 2016, Jacobi et al. 2017).

Dwarf mistletoes (*Arceuthobium* spp.) are common and damaging diseases of Douglas-fir (*A. douglasii*), lodgepole pine (*A. americanum*), limber pine (*A. cyanocarpum*), and ponderosa pine (*A. vaginatum* ssp. *cryptopodum*) on the PSINPs. 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).

Other Bark Beetles

Douglas-fir beetle (*Dendroctonus pseudotsugae*) activity is currently low on both forests. Only 220 and 140 new acres were recorded by aerial surveyors on the PNF and SINF, respectively, in 2017. Douglas-fir beetle outbreaks are often triggered by an event such as windthrow or injury by fire. Beetle populations may also increase in areas where stress from repeated defoliation by western spruce budworm leaves Douglas-fir more vulnerable to bark beetle attack. A blowdown event occurred in July 2015 in the Devil's Head area of the South Platte Ranger District. FHP deployed MCH, an anti-aggregation pheromone, at Topaz Point and Devil's Head in 2017 to prevent new beetle attacks. We will continue to assist the Forest with monitoring these areas.

Fir engraver (*Scolytus ventralis*) activity recorded by aerial surveyors decreased from 2,500 acres in 2016 to only 10 acres in 2017 on the SINF. Fir engraver beetles attack white fir boles and branches larger than 4 inches in diameter. Trees infected with root disease or defoliated by western spruce budworm are especially subject to attack (Fig. 6). The beetles may also attack the tops of trees, causing top-kill.

Mountain pine beetle (*Dendroctonus ponderosae*) activity is currently very low, having declined quickly from outbreaks in ponderosa and lodgepole pine which occurred on the PSINFs more than a decade ago. However, some new, concentrated areas of mortality were mapped in high elevation limber pine east of Saguache, in the Sangre de Cristo Mountains in 2017 (Fig. 1). Some of this mortality may also be due to **limber pine engraver beetles** (*Ips woodi*) or a combination of the two bark beetles.

Aerial Survey Highlights

- Spruce beetle activity was detected on 206,000 acres in Colorado in 2017. Of these, 67,000 acres are in areas not previously mapped as having spruce beetle activity. Aerial observers mapped 29,000 acres of active spruce beetle activity on the SINF and 4,400 acres on the PNF in 2017, of which 9,000 and 3,000 acres, respectively, were newly reported.
- Defoliation by western spruce budworm was detected in Colorado on 252,000 acres in 2017, compared to 226,000 acres in 2016. Activity was most notable on the White River, Pike-San Isabel, Gunnison, San Juan, and Rio Grande National Forests and adjoining lands.
- Aspen defoliation was observed by aerial surveyors on 38,000 acres in Colorado. Defoliation on the SINF decreased from 420 affected acres in 2016 to 290 acres in 2017. Field observations suggest that most of the damage mapped is due to western tent caterpillar and large aspen tortrix.

Table 1. **Pike National Forest:** acres of major damage agents detected in aerial survey. ^a

Agent	2016 Acres Affected	2017 Acres Affected	1996-2017 Cumulative Acres Affected	2017 New Acres Affected ^b
Spruce beetle	2,800	4,400	6,400	3,000
Western spruce budworm	28,000	7,900		
Fir engraver	0	0		
Subalpine fir mortality	5,500	2,100		
Aspen defoliation	50	240		
Douglas-fir beetle	70	220	52,000	0
Aspen discoloration	2,300	30		
Mountain pine beetle	70	160	149,000	0

^a Due to the nature of aerial surveys, these data will only provide rough estimates of location, intensity and the resulting trend information for agents detectable from the air. Many of the most destructive diseases are not represented in the data because these agents are not detectable from aerial surveys. The data presented should only be used as a partial indicator of insect and disease activity, and should be validated on the ground for actual location and causal agent. Using these data for purposes other than those for which it was intended may yield inaccurate or misleading results.

^b since 1996

Table 2. **San Isabel National Forest:** acres of major damage agents detected in aerial survey.

Agent	2016 Acres Affected	2017 Acres Affected	1996-2017 Cumulative Acres Affected	2017 New Acres Affected
Spruce beetle	46,000	29,000	100,000	9,000
Subalpine fir mortality	4,300	1,900		
Aspen discoloration	80	660		
Western spruce budworm	40,000	35,000		
Douglas-fir beetle	910	140	18,000	0
Aspen defoliation	420	290		
Fir Engraver	250	10		
Mountain pine beetle	390	50	152,000	0

Surrounding Area Conditions of Note

- Emerald ash borer, a federally regulated pest, has been detected in the city of Boulder, CO and other communities within Boulder County. 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.

FHP Projects

- FHP conducted defoliator surveys and trapping across the PNF for WSBW, Pandora moth, and DFTM.
- Spruce beetle activity was assessed and management recommendations were provided to the Pikes Peak Ranger District for the Craggs Campground area and the dispersed camping area along Fourmile Creek.
- FHP staff participated in a semio-chemical trial in cooperation with RMRS funded by Forest Service Pesticide Impact Assessment Program funds. This project assessed various semio-chemicals for area and individual tree protection from spruce beetle. A full report is forthcoming. This study will likely continue in 2018.
- The Southern Rockies Rust Resistance Trial (SRRRT) was initiated on the MBNF in 2013 to field-verify WPBR resistance. Seed from resistant limber and Rocky Mountain bristlecone pines (tested and confirmed in OR) from throughout the southern Rockies, including trees from the PSINF, was sown and seedlings grown at the CO State Forest Service Nursery. Over 700 seedlings were outplanted in fall 2013 and another 700 in spring 2014. In 2017, we completed our annual seedling growth and health assessment. Seedlings have grown well on the site and natural WPBR infections are occurring. Disease severity and mortality are more advanced on bristlecone than limber pine seedlings. A report is available (Schoettle et al. 2018, R2-18-01).
- A Hazard Tree Management Guide for the Rocky Mountain Region and an App (Survey123 for ArcGIS Online) for collecting hazard tree assessment data on smart phones and tablets are now available (Blodgett et al. 2017). A User's Guide for the App can be found in the [Hazard Tree Management Training Supplement](#).

Recent Reports and Resources

Forest Health Protection, 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. They also conduct an annual aerial forest health survey, ground surveys and site visits to identify and map insect and disease-caused tree mortality and damage throughout the Region. The following is a list of recent reports and resources available.

FHP Reports

- Burns K. 2017. Tree Health Assessments at the Carlton House on the Air Force Academy. Service Trip Report. LSC- 17-01.

- Lockner A, Worrall J. 2018. Forest Health Projects and Issues on the San Isabel National Forest. Service Trip Report. GSC-18-03.
- Powell R. 2017. Assessment of Forest Health Issues at the Air Force Academy and Farish Recreation Area. Service Trip Report. LSC-17-02.
- Schoettle AW, Burns KS, Douville T, Holtz C. 2018. Update on the Southern Rockies Rust Resistance Trial (SRRRT). Biological Evaluation. R2-18-01.
https://www.fs.usda.gov/Internet/FSE_DOCUMENTS/fseprd574292.pdf
- Stephens SS, Burns KS. 2017. Assessment of Tree Decline and Mortality at Carlton House, Air Force Academy. Service Trip Report. LSC-17-04.
- Stephens SS. 2017. Cooperative Spruce Beetle Project with Rocky Mountain Research Station (FS PIAP Funding). Service Trip Report. LSC-17-06.
- Stephens SS. 2017. Forest Health Assessment of Silvicultural Certification Stand on Pikes Peak Ranger District for Cory Ashby. Service trip Report. LSC-17-09.

Publications

- Blodgett JT, Burns KS, Worrall JW. 2017. Guide to Hazard Tree Management. USDA Forest Service, Rocky Mountain Region, SPFTR, FHP. Tech. Rep. R2-69. 30 pp.
- Casper AM, Jacobi WR, Schoettle AW, Burns KS. 2016. Restoration planting options for limber pine in the Southern Rockies. J. Torrey Bot. Soc. 143(1): 21-37.
- Jacobi WR, Bovin PP, Burns KS, Crump A, Goodrich BA. 2017. Pruning limber pine to reduce impacts from WPBR in the southern Rocky Mountains. For. Sci. 63(2):218-224.
- Schoettle AW, Burns KS, Cleaver CM, Connor J. In press. Limber pine conservation strategy for the greater RMNP area. USDA Forest Service, RMRS-GTR-xxx.

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](#)
 - [Diseases of Trees in the Great Plains](#)
 - [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 Pike and San Isabel National Forests regarding your forest disease and insect concerns. Please do not hesitate to contact us with your questions.

Gunnison Service Center

- Jim Worrall, Group Leader and Pathologist, jworrall@fs.fed.us, 970-642-4453
- Amy Lockner, Entomologist, alockner@fs.fed.us, 970-642-4448
- Suzanne Marchetti, Biological Science Technician, sbmarchetti@fs.fed.us, 970-642-4446

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- 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, rebeccapowell@fs.fed.us, 303-236-8008
- Kelly Burns, Pathologist, ksburns@fs.fed.us, 303-236-8006
- Amy Chambers, Biological Technician, amychambers@fs.fed.us, 303-236-8002

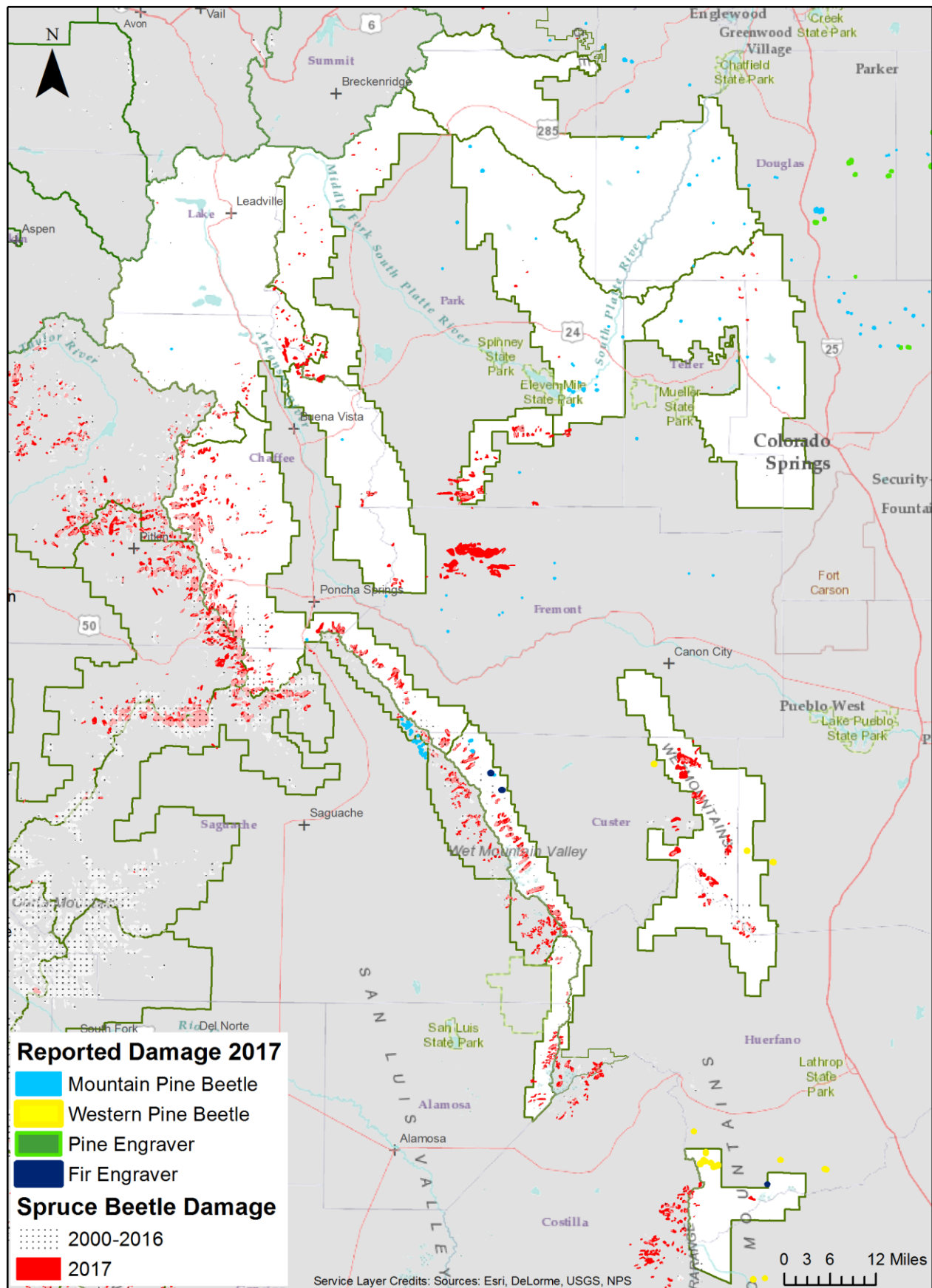


Figure 1. Bark beetle activity in the Pike-San Isabel area in 2017.

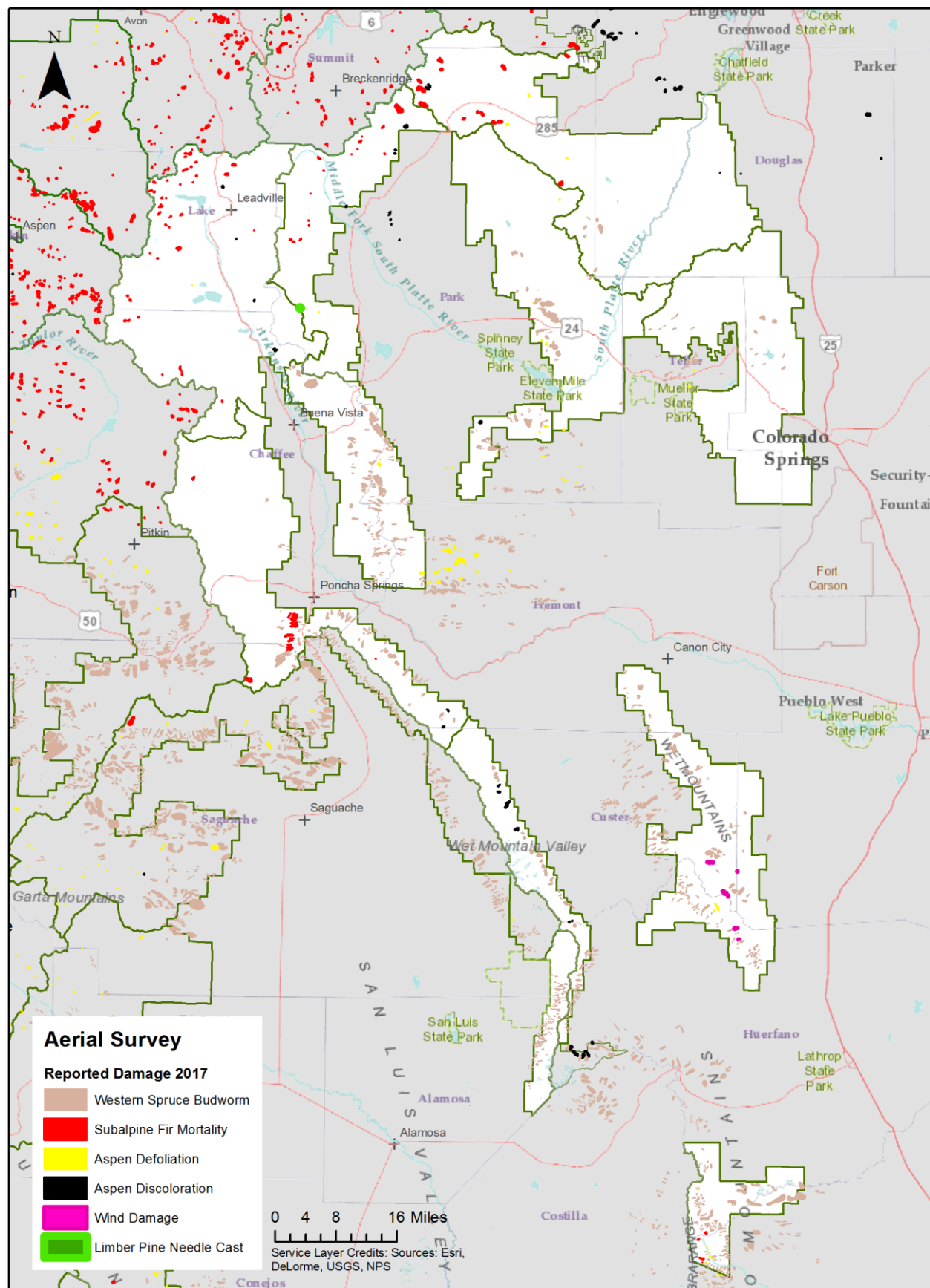


Figure 2. Other damages recorded by aerial survey in the Pike-San Isabel area in 2017.

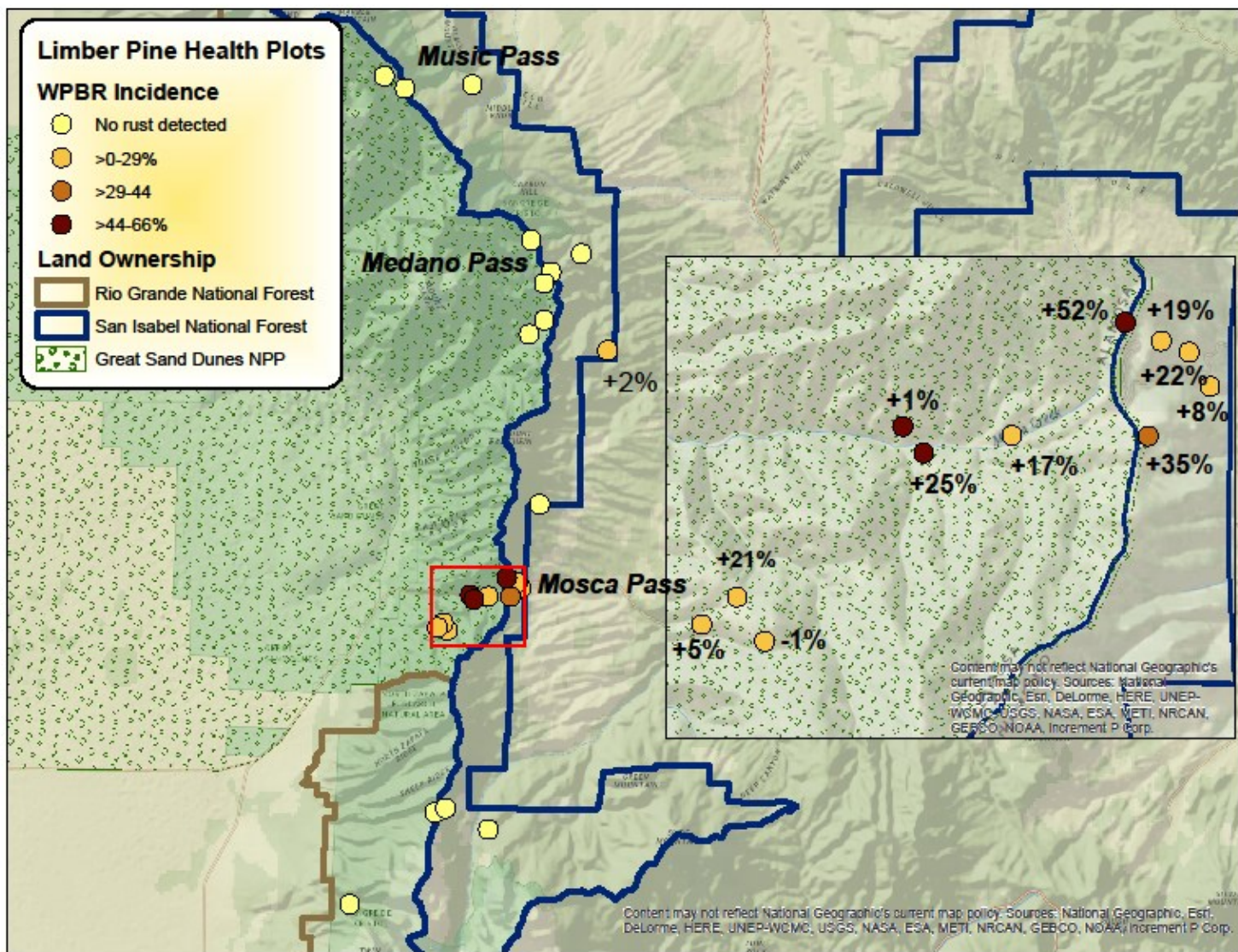


Figure 3. Incidence of white pine blister rust in limber pine plots in the Sangre de Cristo Mountains. The color of plot markers indicates the incidence class in 2017 (percentage of living trees infected). The number beside each plot with rust shows the change in percentage points between 2004 and 2017.



Figure 4. Engelmann spruce trees killed by spruce beetle on the Rio Grande National Forest. Photo: Justin Backsen.



Figure 5. Trees defoliated by western spruce budworm near Marshall Pass on the San Isabel National Forest. Photo: Dan West.



Figure 6. White fir trees killed by annosus and fir engraver beetles near Ouray on the Uncompahgre National Forest. Photo: Justin Backsen.

2017 Forest Insect and Disease Conditions: Rio Grande National Forest

USDA Forest Service
Rocky Mountain Region
Forest Health Protection
Gunnison Service Center
216 N. Colorado St.
Gunnison, CO 81230

Overview

The Rio Grande National Forest currently faces a number of serious forest health issues. Among those that go through “boom-and-bust” cycles, some are still causing conspicuous damage, including spruce beetle and western spruce budworm. Several diseases cause more persistent, widespread damage, including root diseases and dwarf mistletoes, which are not mapped by aerial surveyors.

Spruce beetle (*Dendroctonus rufipennis*): While the number of currently affected acres detected by aerial survey continued to decline from 2016 to 2017 (from 93,000 to 47,000), it is important to note that 7,000 acres of the Rio Grande NF were newly infested (Table 1). Spruce beetle is now most active in the outer portions of the forest, particularly on the Sangre de Cristo Range in the Saguache Ranger District and adjacent lands in the San Isabel NF and south through the Conejos Peak Ranger District into New Mexico (Figure 1). The Rio Grande NF is the epicenter of a spruce beetle outbreak that has affected spruce-fir stands throughout southern Colorado. Acres affected by spruce beetle are declining due to exhaustion of the mature spruce cover type that is the beetle’s primary host (Figure 4). Management efforts, such as sanitation, can affect spruce beetle populations at a local level, but tend to be ineffective with an outbreak of this magnitude. Now with most of the mature spruce being dead, salvage is the primary management option.

Douglas-fir beetle (*Dendroctonus pseudotsugae*): Douglas-fir mortality from Douglas-fir beetle is currently at a moderate level on the Rio Grande NF. A total of 2,000 new acres were recorded in 2017, an increase from 1,000 new acres in 2016. In recent years, Douglas-fir tree mortality has varied widely from scattered mortality in some stands to almost total loss of mature Douglas-fir in others (Figure 5). Often Douglas-fir beetle outbreaks are triggered by an event such as windthrow or injury by fire. Douglas-fir beetles may also increase in areas where stress from repeated defoliation by western spruce budworm makes Douglas-fir more vulnerable to bark beetle attack. In high value areas such as campgrounds, District personnel could utilize the anti-aggregation pheromone MCH to protect against new attacks.

Western spruce budworm (*Choristoneura freemani*): The Rio Grande NF had 50,000 defoliated acres observed by aerial surveyors in 2017, an increase from 2016. This insect feeds on the new needles of white fir, Douglas-fir and less notably on spruce and subalpine fir. Drying needles webbed to twigs impart a brown cast to infested trees (Figure 6). Significant impacts are

occurring in both mixed conifer and spruce-fir forest types. Feeding from this insect can cause growth loss, top-killing, and tree mortality, especially on suppressed trees. A combination of suitable habitat and favorable weather patterns have resulted in the current widespread outbreak in Colorado. Stand conditions contribute greatly to the budworm population's ability to increase to outbreak levels. Reduced fire frequency allows shade-tolerant white fir and Douglas-fir to increase in mixed conifer stands, improving habitat for western spruce budworm. Multistoried stands of shade-tolerant species favor western spruce budworm survival as larvae disperse from overstory trees. Management activities such as reducing basal area, favoring ponderosa pine where possible, and thinning from below can render stands less susceptible to damage from western spruce budworm.

Western tent caterpillar (*Malacosoma californicum*) and **large aspen tortrix** (*Choristoneura conflictana*) are two defoliators likely responsible for the 5,700 acres of defoliated aspen detected on the Rio Grande NF. Field observations on the Divide Ranger District revealed heavy early-season impact near South Fork from the tortrix. Defoliation can lead to tree mortality if it occurs repeatedly over several years, especially during droughts. Defoliated aspen typically grow new leaves in mid-late summer although canopies may appear thin. Defoliation observed by aerial surveyors in 2017 was higher than reported in 2016 (3,500 acres).

Dwarf mistletoes cause significant growth loss, and over time can substantially impact forest productivity. Mortality can result when infestations are severe. The most important dwarf mistletoe on the Rio Grande NF is Douglas-fir dwarf mistletoe (*Arceuthobium douglasii*), primarily infecting Douglas-fir. Forest management activities that do not address dwarf mistletoe usually increase abundance and severity, so it is important to carefully consider dwarf mistletoe in management plans.

Aerial Survey Highlights

- Spruce beetle activity was detected on 206,000 acres in Colorado in 2017. Of these, 67,000 acres are in areas not previously mapped as having spruce beetle activity. Aerial observers mapped 47,000 acres of active spruce beetle activity on the Rio Grande NF in 2017, of which 7,000 acres were newly reported.
- Defoliation by western spruce budworm was detected in Colorado on 252,000 acres in 2017, compared to 226,000 acres in 2016. Activity was most notable on the White River, Pike-San Isabel, Gunnison, San Juan, and Rio Grande National Forests and adjoining lands. Western spruce budworm damage on the Rio Grande NF is often more chronic and less cyclic than areas further north due to the abundance of Douglas-fir and white fir in dry mixed conifer forests.
- Aspen defoliation was observed by aerial surveyors on 38,000 acres in Colorado. Defoliation on the Rio Grande NF increased from 3,500 affected acres in 2016 to 5,700 acres in 2017. Field observations suggest that most of the damage mapped is due to western tent caterpillar and large aspen tortrix.

Table 1. Acres of major damage agents detected in aerial survey. ^a

Agent	2016 Acres Affected	2017 Acres Affected	1996-2017 Cumulative Acres Affected	2017 New Acres Affected ^b
Spruce beetle	93,000	47,000	617,000	7,000
Western spruce budworm	25,000	50,000		
Aspen defoliation	3,500	5,700		
Douglas-fir beetle	1,600	2,200	44,000	2,000
Mountain pine beetle	210	80	37,000	0
Fir engraver	130	60		
Subalpine fir mortality	110	380		

^a Due to the nature of aerial surveys, these data will only provide rough estimates of location, intensity and the resulting trend information for agents detectable from the air. Many of the most destructive diseases are not represented in the data because these agents are not detectable from aerial surveys. The data presented should only be used as a partial indicator of insect and disease activity, and should be validated on the ground for actual location and causal agent. Using these data for purposes other than those for which it was intended may yield inaccurate or misleading results.

^b since 1996

FHP Projects

- Entomologist Amy Lockner participated in an upcoming short documentary about the West Fork Complex fire and how trees killed by spruce beetle played a role.

Surrounding Area Conditions of Note

Forest Health Protection conducted monitoring of an infestation of **white pine blister rust** in the Sangre de Cristo Mountains in 2004 and 2017. The disease has not been detected on the Rio Grande NF, but is present on the Great Sand Dunes National Park and Preserve as well as the east side of the range on the San Isabel NF (Figure 3). Incidence of the disease on limber pine has generally increased between the two measurements.

The disease is caused by the non-native fungus *Cronartium ribicola*. It was brought to North America over a century ago, and is still making its way to the last remaining uninfested regions in the United States. It infects virtually all 5-needle pines and has decimated populations where conditions are favorable. The Great Sand Dunes was the site of the first infection of *Pinus aristata*, Rocky Mountain bristlecone pine, ever found. The disease causes branch and stem cankers that kill seedlings and saplings. Mature trees are disfigured and produce abundant inoculum. Spores from pines infect the alternate hosts, generally *Ribes* spp., on which other spores are produced to reinfect pine.

Recent Reports and Resources

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. They also conduct an annual aerial forest health survey, ground surveys and site visits to identify and map insect and disease-caused tree mortality and damage throughout the Region. The following is a list of recent reports and resources available.

- Lockner, Amy and Worrall, Jim. September 2017. Forest Health Projects and Issues on the Divide Ranger District of the Rio Grande National Forest. Service Trip Report. GSC-17-03
- Lockner, Amy. January 2018. Forest Health Projects and Issues on the Rio Grande National Forest, Conejos Peak Ranger District. Service Trip Report. GSC-18-03.
- [Dwarf Mistletoes: Ecology and Management in the Rocky Mountain Region](#)
- [Forest Health Protection](#)
 - Other Forest Condition Reports
 - Other Regional Reports
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We look forward to continued work with the Rio Grande NF regarding forest disease and insect concerns. Please do not hesitate to contact us with questions.

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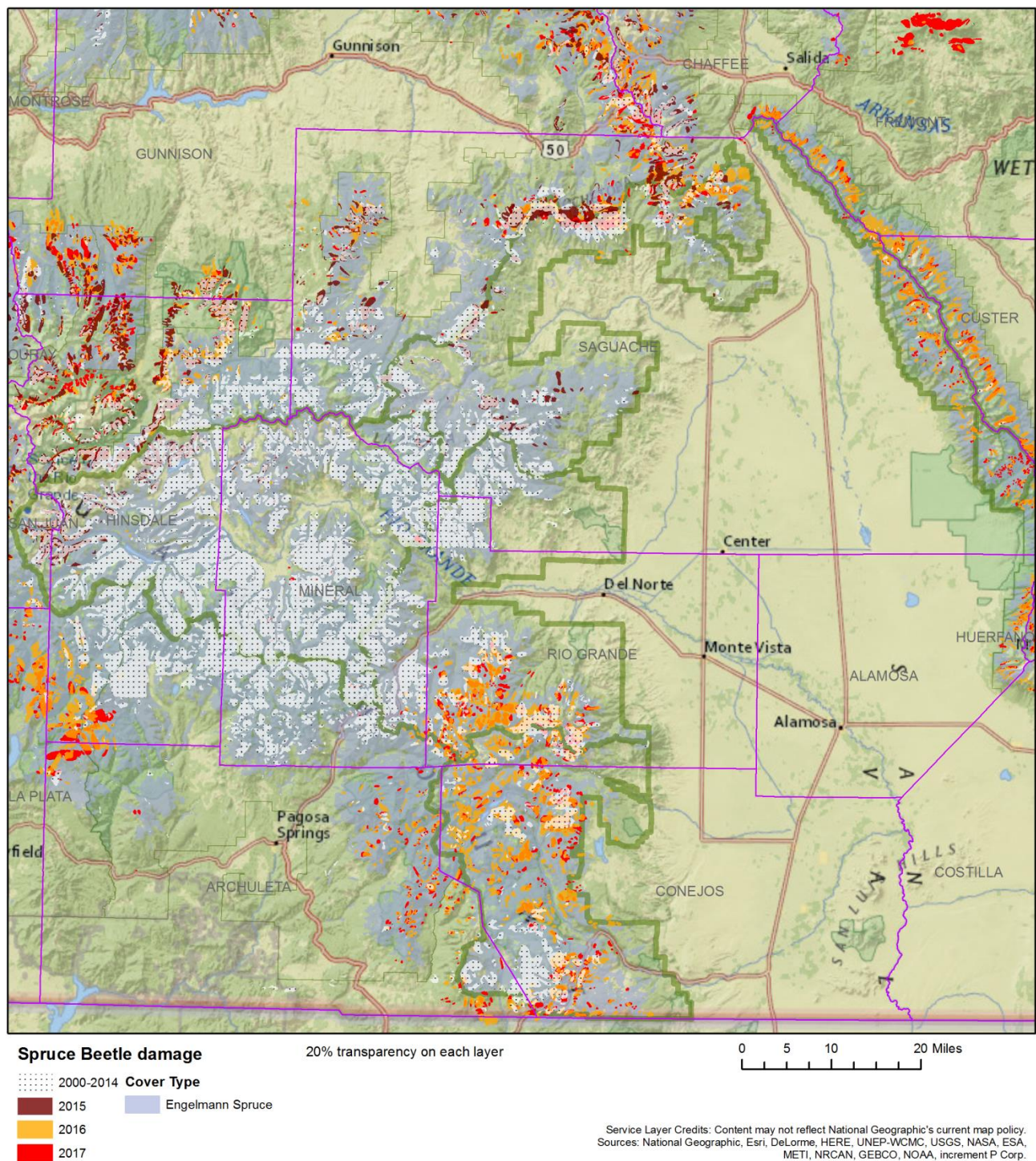


Figure 1. Spruce beetle damage detected by aerial survey, 2000-2017, with Engelmann spruce host cover type.

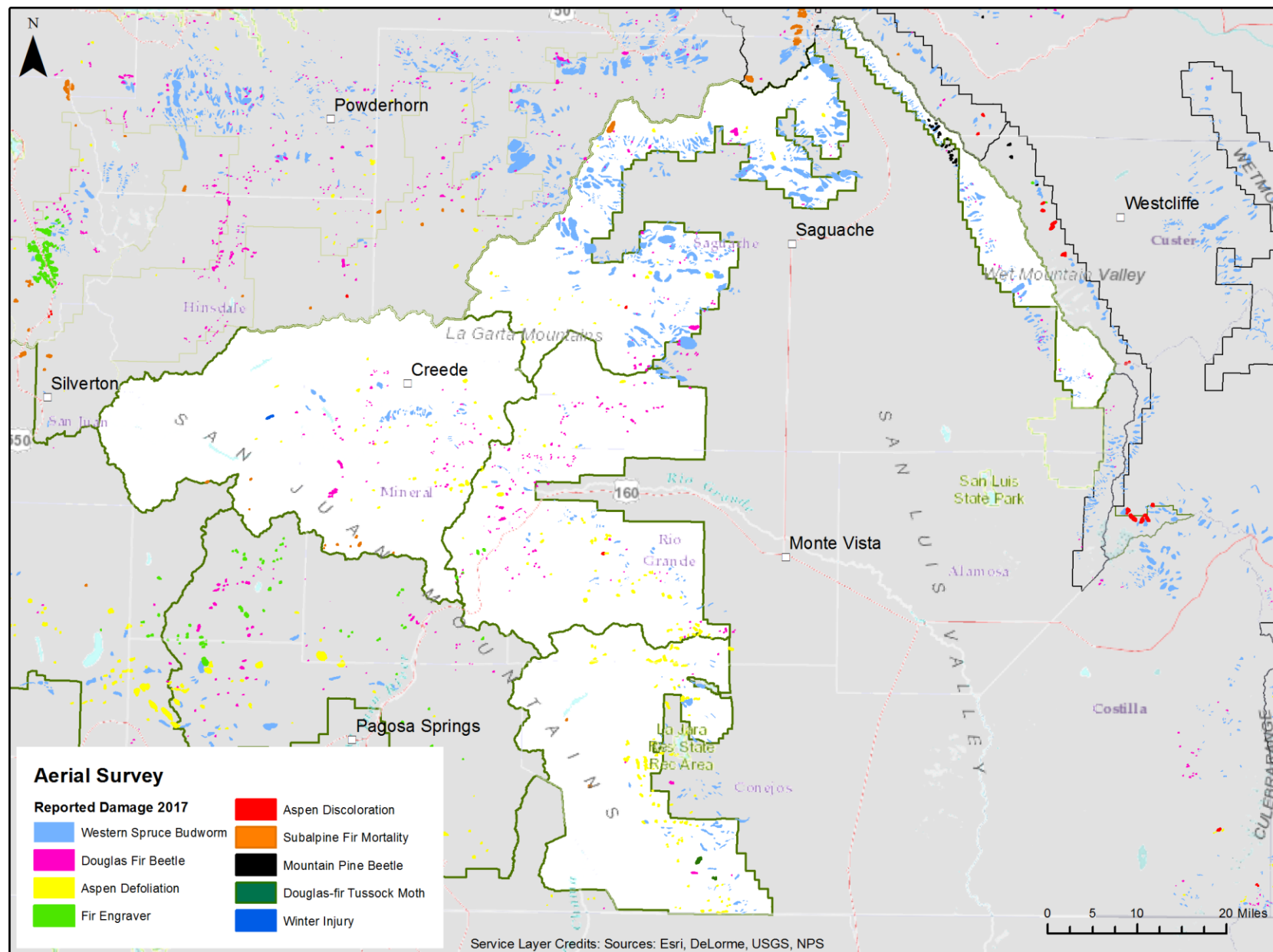


Figure 2. Insects and diseases detected by aerial survey on the Rio Grande National Forest (see Figure 1 for spruce beetle).

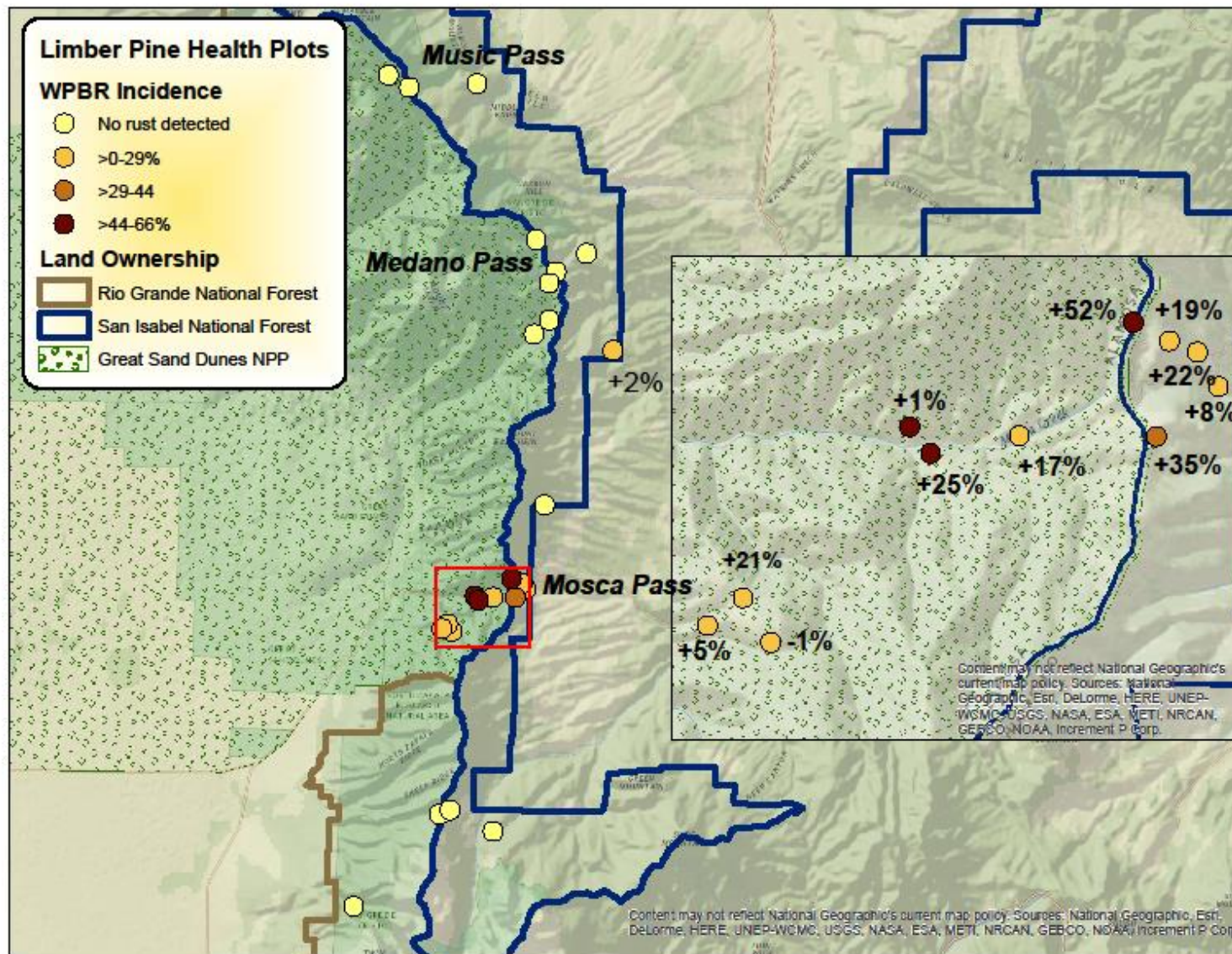


Figure 3. Incidence of white pine blister rust in limber pine plots. The color of plot markers indicates the incidence class in 2017 (percentage of living trees infected). The number beside each plot with rust shows the change in percentage points between 2004 and 2017.



Figure 4. Engelmann spruce trees killed by spruce beetle on the Rio Grande National Forest. Photo: Justin Backsen.



Figure 5. Pockets of mortality due to Douglas-fir beetle on the Gunnison National Forest. Photo: Amy Lockner.



Figure 6. Trees heavily defoliated by western spruce budworm (left) and top-killed by repeated defoliation (right). Photos: Amy Lockner.

2017 Forest Insect and Disease Conditions: San Juan National Forest

USDA Forest Service
Rocky Mountain Region
Forest Health Protection
Gunnison Service Center
216 N. Colorado St.
Gunnison, CO 81230

Overview

The San Juan National Forest currently faces a number of serious forest health issues. Among those that go through dramatic cycles, causing conspicuous damage in 'boom' phases followed by quiescent 'bust' phases, are spruce beetle, roundheaded pine beetle, and western spruce budworm. Several diseases cause more persistent, widespread damage, including root diseases and dwarf mistletoes.

Roundheaded pine beetle (*Dendroctonus adjunctus*) and associated bark beetles have killed ponderosa pines in Dolores County on the San Juan NF for several years and affected nearly 10,000 acres in 2017 (Table 1, Figures 1 and 5). The outbreak expanded substantially. This insect has been active primarily in southwest Colorado, especially in the Lake Canyon area. Generally, epidemics of roundheaded pine beetle tend to grow more slowly and are more localized than spruce beetle or mountain pine beetle. This insect may be part of a bark beetle complex that includes western pine beetles, pine engraver beetles, and/or mountain pine beetles also attacking the same trees. The Dolores RD is currently working with the Gunnison Service Center and Colorado State Forest Service to monitor the spread of the outbreak by conducting annual transects, installing 1/10th acre fixed-radius plots, and deploying beetle traps baited with lures. This coming field season, emergence cages will be placed on numerous trees and monitored throughout the summer to determine which bark beetles are present in the attacked trees. The persistence and expansion of this particular outbreak is notable.

Spruce beetle (*Dendroctonus rufipennis*) was active on 25,000 acres in 2017 on the San Juan National Forest (Table 1). Active acres indicate all areas of insect activity, including areas that may have been impacted in previous years. Of these active acres, 9,000 new acres were recorded (new acres are those of insect activity not previously mapped since 1996). Spruce beetle has affected 246,000 acres on the Forest since 1996. The spruce beetle outbreak on the San Juan is likely to continue for several more years, as plenty of Engelmann spruce host trees are available (Figures 2 and 3). 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 likely impact the majority of spruce stands on the San Juan NF. 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,

such as sanitation, can affect spruce beetle populations at a local level, but tend to be ineffective with an outbreak of this magnitude.

Western spruce budworm (*Choristoneura freemani*) activity decreased on the San Juan NF from 18,000 acres of defoliation to 16,000 acres in 2017. This insect feeds on the new needles of white fir, Douglas-fir and less notably on spruce and subalpine fir. Drying needles webbed to twigs impart a brown cast to infested trees (Figure 6). Significant impacts are occurring in both mixed conifer and spruce-fir forest types. Feeding from this insect can cause growth loss, top-killing, and tree mortality, especially on suppressed trees. A combination of suitable habitat and favorable weather patterns have resulted in the current widespread outbreak in Colorado. Stand conditions contribute greatly to the budworm population's ability to increase to outbreak levels. Reduced fire frequency allows shade-tolerant white fir and Douglas-fir to increase in mixed conifer stands, improving habitat for western spruce budworm. Multistory stands of shade-tolerant species favor western spruce budworm survival as larvae disperse from overstory trees. Management activities such as reducing basal area, favoring ponderosa pine where possible, and thinning from below can render stands less susceptible to damage from western spruce budworm.

Douglas-fir beetle (*Dendroctonus pseudotsugae*) affected 1,700 acres in 2017, most of which were new acres not previously mapped. Mortality from Douglas-fir beetle is currently at a moderate level on the San Juan NF, and mostly occurs on the eastern side of the Columbine and Pagosa Ranger Districts (Figure 4). In recent years, Douglas-fir tree mortality has varied widely from scattered mortality in some stands to almost total loss of mature Douglas-fir in others. Often Douglas-fir beetle outbreaks are triggered by an event such as windthrow or injury by fire. Douglas-fir beetle may also increase in areas where stress from repeated defoliation by western spruce budworm makes Douglas-fir more vulnerable to bark beetle attack. In high value areas such as campgrounds, District personnel could utilize the anti-aggregation pheromone MCH to protect against new attacks. Forest Health Protection funding will provide MCH in 2018 for the Treasure Falls Trailhead and West and East Fork Campground areas on the Pagosa Ranger District.

Western tent caterpillar (*Malacosoma californicum*) and **large aspen tortrix** (*Choristoneura conflictana*) are two aspen defoliators likely responsible for the 9,200 acres affected on the San Juan. Defoliation can lead to tree mortality if it occurs repeatedly over several years, especially during droughts. Defoliated aspen typically grow new leaves in mid-late summer. 2017 defoliation observed by aerial surveyors was higher than reported in 2016 (3,700 acres).

Root diseases are important in the ecology and productivity of mixed conifer and spruce-fir stands on the San Juan National Forest. In spruce-fir, **Armillaria root disease** (caused by *Armillaria solidipes*) is usually most important, infecting both Engelmann spruce and subalpine fir. Subalpine fir often also becomes infested by **western balsam bark beetle** (*Dryocoetes confusus*), and is usually killed while standing. Engelmann spruce more often falls due to decayed roots while still green. Infected spruce may serve as hosts for spruce beetle during non-epidemic conditions, and strip attacks can be found above infected roots. When infected

spruce fall, they provide resources for build-up of spruce beetle populations. The disease generally intensifies as stands mature.

In mixed conifer stands, **annosus root disease** (caused by *Heterobasidion occidentale*) is also important. White fir is the primary host of this disease. White fir has become more prevalent due to past selective harvesting of ponderosa pine and Douglas-fir as well as fire exclusion. As white fir has increased, so has the disease. Dense white fir stands are often severely affected. Because white fir is shade-tolerant, they are replaced by more white fir, and the disease intensifies. The severity of this disease on the San Juan NF is likely outside the natural range of variability due to both fire exclusion and past harvesting practices.

Dwarf mistletoes cause significant growth loss, and over time can substantially impact forest productivity. Mortality can result when infestations are severe. The most important dwarf mistletoes on the San Juan National Forest are southwestern dwarf mistletoe (*Arceuthobium vaginatum* ssp. *cryptopodum*) infecting ponderosa pine and Douglas-fir dwarf mistletoe (*A. douglasii*), primarily infecting Douglas-fir. Forest management activities that do not address dwarf mistletoe usually increase abundance and severity, so it is important to carefully consider dwarf mistletoe in management plans.

Aerial Survey Highlights

- Since 1996, spruce beetle has affected 1,782,000 acres in Colorado, of which 67,000 acres are new and were not previously mapped. Aerial observers mapped 25,000 acres of active spruce beetle activity in the San Juan in 2017, of which 9,000 acres were newly reported.
- Defoliation by western spruce budworm was detected in Colorado on 252,000 acres in 2017, compared to 226,000 acres in 2016. Activity was most notable on the White River, Pike-San Isabel, Gunnison, San Juan, and Rio Grande National Forests and adjoining lands.
- Roundheaded pine beetle infested 47% more acres in 2017 than in 2016 on the Mancos-Dolores Ranger District.
- Aspen defoliation increased from 3,700 affected acres in 2016 to 9,200 acres in 2017. Field observations suggest that most of the damage mapped is due to western tent caterpillar and large aspen tortrix.

Table 1. Acres of major damage agents detected in aerial survey.^a

Agent	2016 Acres Affected	2017 Acres Affected
Spruce beetle	36,000	25,000
Western spruce budworm	18,000	16,000
Roundheaded pine beetle ^b	6,600	9,700
Aspen defoliation	3,700	9,200
Douglas-fir beetle	1,900	1,700
Fir engraver	1,900	820
Subalpine fir mortality	1,400	140
Aspen discoloration	?	110
Mountain pine beetle	0	0
Western pine beetle ^b	100	1,000

^a Due to the nature of aerial surveys, these data will only provide rough estimates of location, intensity and the resulting trend information for agents detectable from the air. Many of the most destructive diseases are not represented in the data because these agents are not detectable from aerial surveys. The data presented should only be used as a partial indicator of insect and disease activity, and should be validated on the ground for actual location and causal agent. Using these data for purposes other than those for which it was intended may yield inaccurate or misleading results.

^b The western and roundheaded pine beetles noted by surveyors across the San Juan National Forest were not always thoroughly ground checked and are interpreted as a complex of one or more bark beetle types in ponderosa pine.

FHP Projects

- The Southwestern Colorado Bioclimate Project projects climate change impacts on tree species to aid forest adaptation efforts on the SJNF, RGNF, GMUG, Southern Ute Indian Tribe, Tres Rios BLM, and Mesa Verde National Park. Rocky Mountain Research Station is developing adaptation management recommendations based on the projections. We held a workshop for participants in Durango, Nov. 2, 2017, hosted by Mountain Studies Institute. Presentations are available at <http://www.mountainstudies.org/bioclimate>. Maps and rasters of bioclimate projections for 14 species will soon be available on their website.
- Gunnison Service Center held the annual regional Insect, Disease and Hazard Tree Training in Ouray, June 6-8, 2017. We were happy to have participants from the San Juan National Forest.
- Entomologist Amy Lockner assisted Dave Casey, Mancos Dolores Ranger District, in establishing surveys to better monitor the roundheaded pine beetle epidemic.

Recent Reports and Resources

Forest Health Protection (FHP), in cooperation with the Colorado State Forest Service, conducts an annual aerial forest health survey, ground surveys, and site visits to identify, assess, and map

forest damage due to diseases and insects throughout the Region. The following is a list of recent reports and resources available.

- [Dwarf Mistletoes: Ecology and Management in the Rocky Mountain Region](#)
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We look forward to continued work with the San Juan regarding your forest disease and insect concerns. Please do not hesitate to contact us with your questions.

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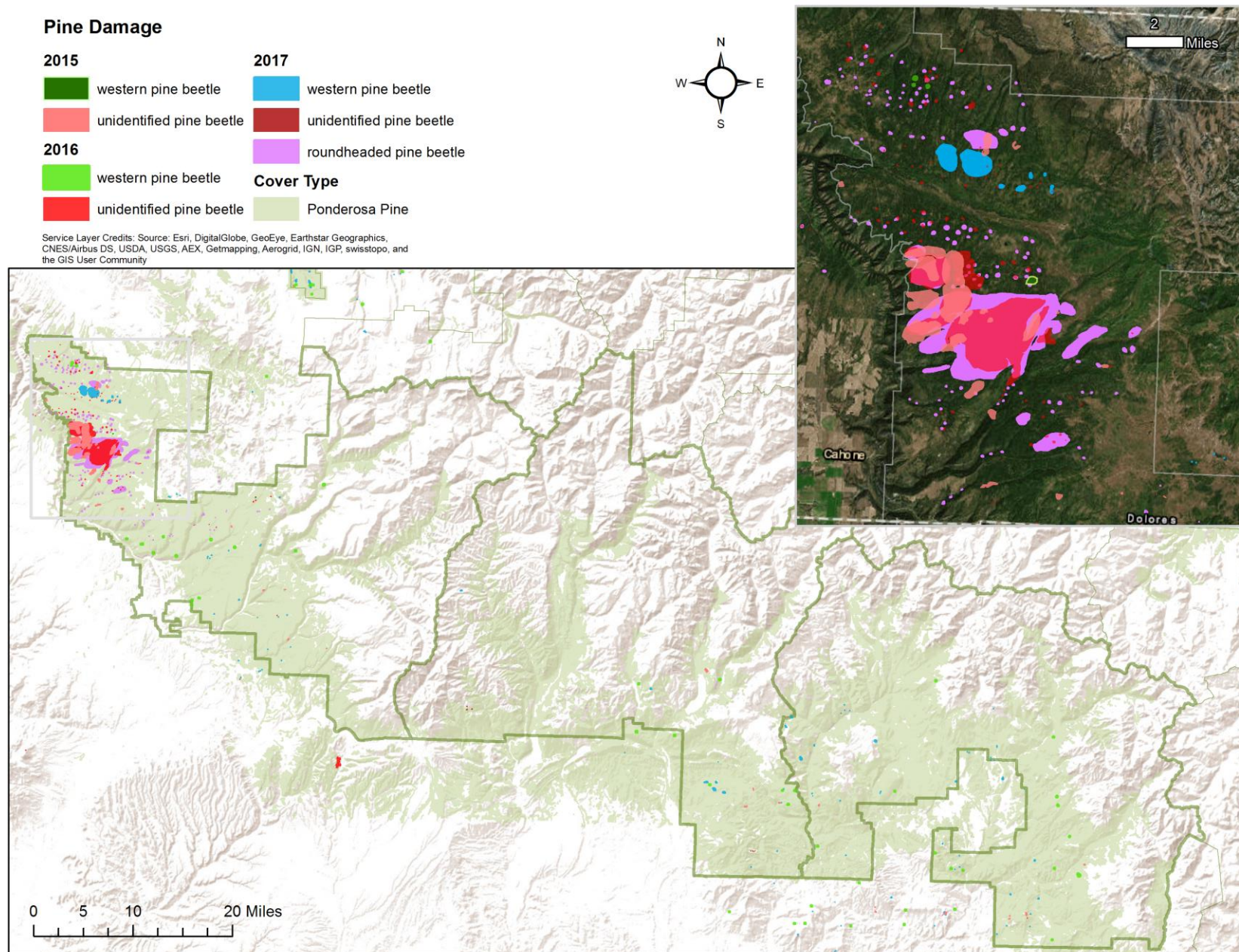


Figure 1. 2017 Pine beetle activity and ponderosa pine presence on the SJNF. Unidentified pine beetles are commonly a mix.

2017 Spruce Beetle in Colorado

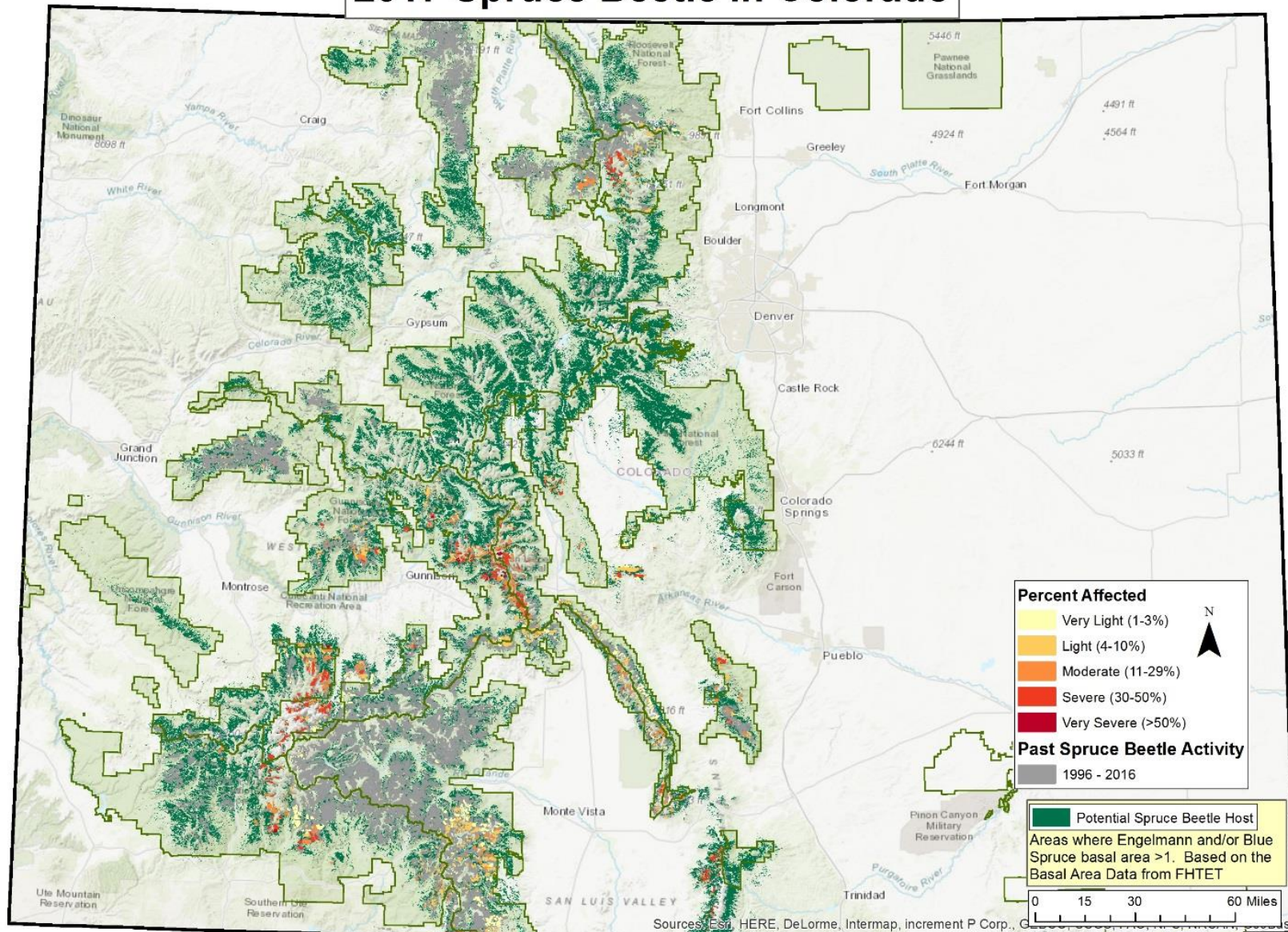


Figure 2. Spruce beetle severity in Colorado 1996 – 2017, with potential spruce beetle host.

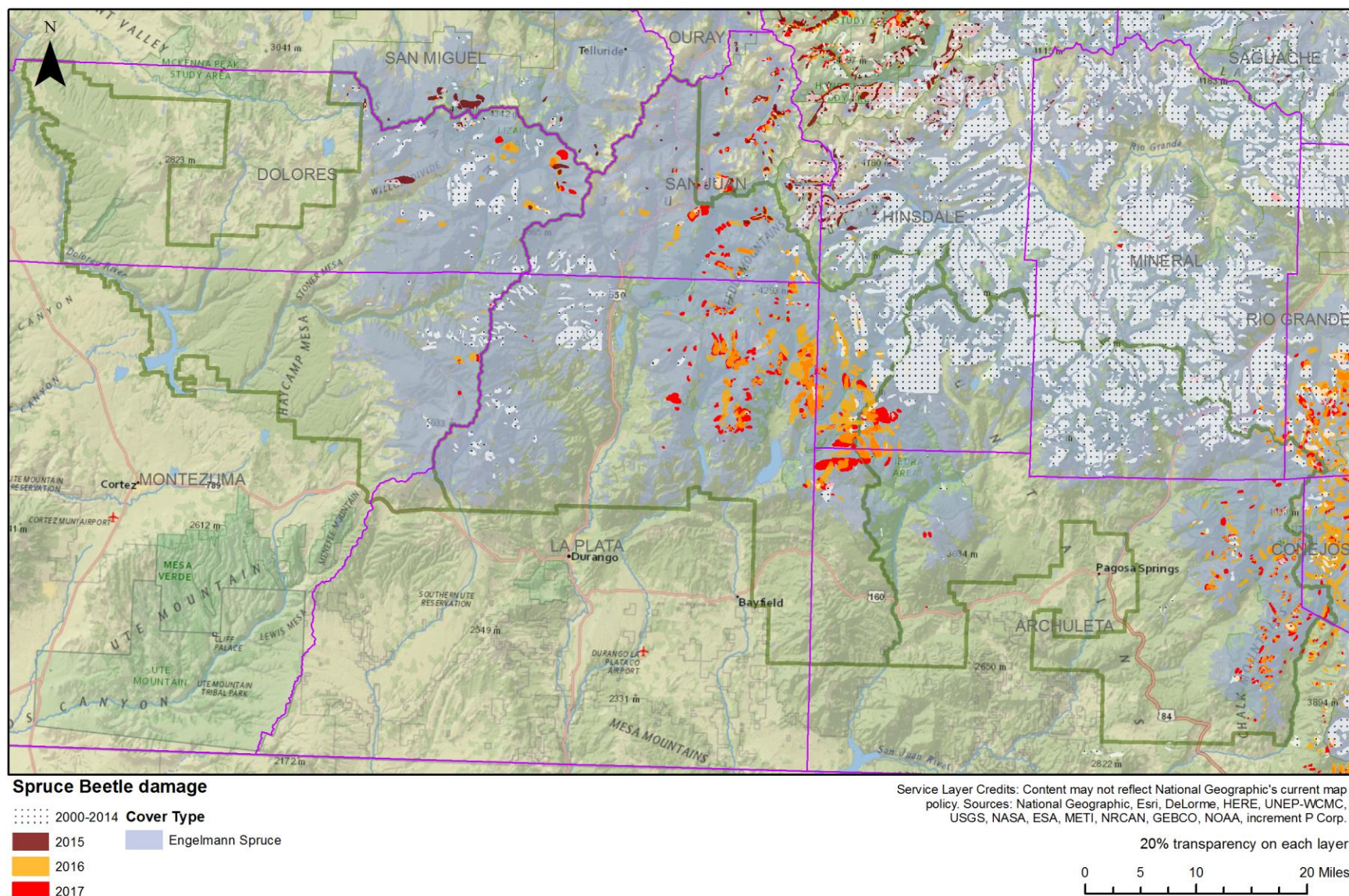


Figure 3. Spruce beetle activity in the San Juan NF 1996 – 2017, with Engelmann spruce distribution.

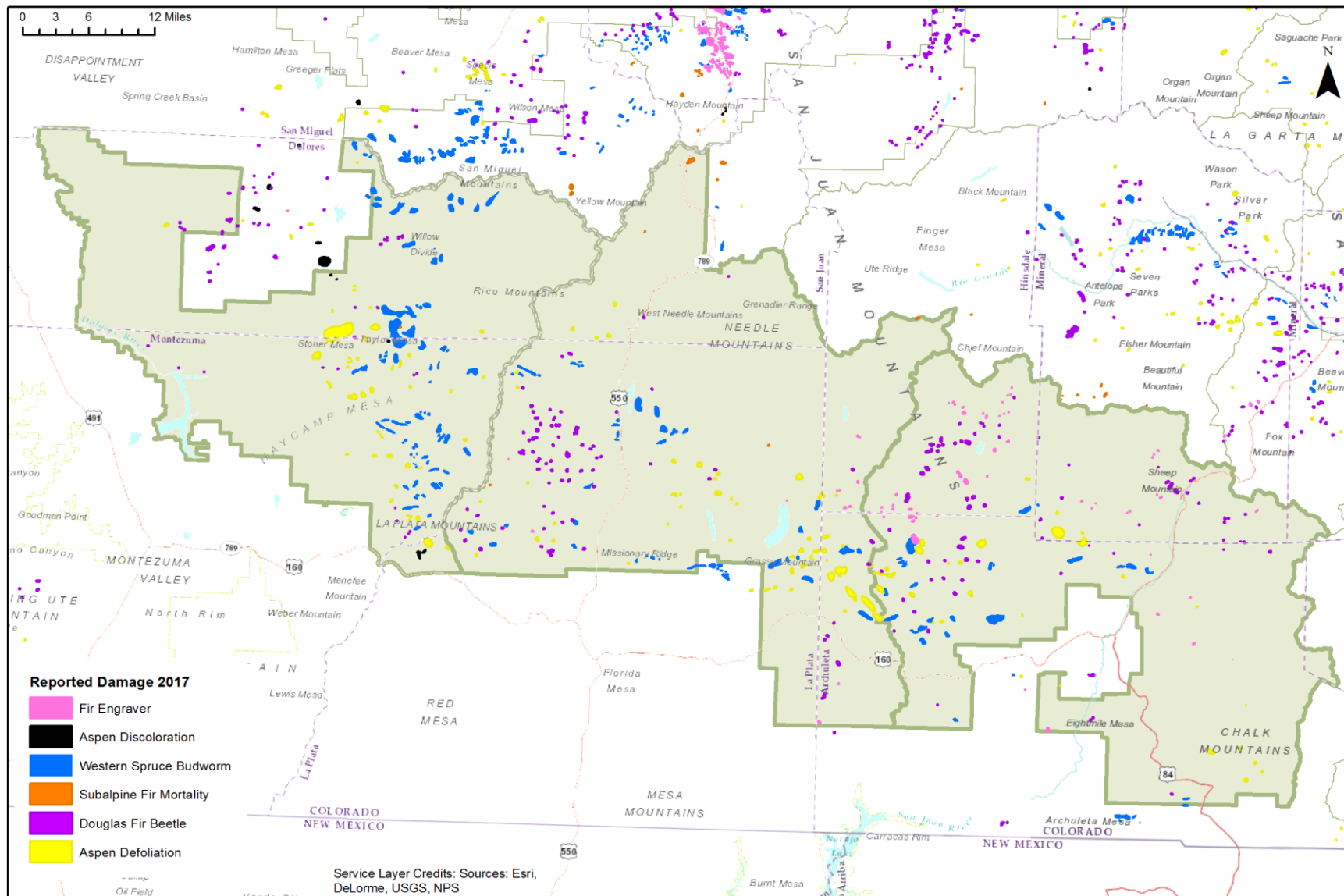


Figure 4. Other damage reported from aerial survey on the SJNF. See Figs. 1-3 for spruce beetle and pine beetles.



Figure 5. Ponderosa pines killed by roundheaded pine beetle in Dolores County. Photo: Dan West



Figure 6. Trees defoliated by western spruce budworm near Marshall Pass on the San Isabel National Forest. Photo: Dan West.

2017 Forest Insect and Disease Conditions: Shoshone National Forest

Overview

Tree mortality (Figure 1) caused by bark beetles continues throughout the Shoshone National Forest. In the Wind River Ranger District spruce beetle activity has resulted in 9,300 acres of spruce mortality, an increase of 1,800 acres relative to 2016 levels (Figure 4). This year's mortality estimate, however, still encompasses far fewer acres than were reported in 2015 (35,000).

Mountain pine beetle caused mortality of five-needle pines increased from 200 acres in 2016 to 570 acres in 2017 (Figure 5). No mountain pine beetle caused mortality was observed in lodgepole pine. Western balsam bark beetle caused mortality of subalpine fir was also detected, with 1,600 acres affected.

Douglas-fir defoliation by western spruce budworm has continued within the Clarks Fork Ranger District (Figures 1 and 2). The acres detected have decreased from 14,000 acres in 2016 to 9,000 acres in 2017. The heaviest defoliation is occurring on Douglas-fir, often with defoliation of 50-100% of mature tree crowns. Seedlings and saplings are also being heavily defoliated in these areas, but are difficult to observe from the air. Additionally, budworm defoliation was detected on the southern end of the forest in the Sinks Canyon area. This is the first year of defoliation noted in this part of the forest.

Persistent diseases problems often not detected during aerial detection survey include: White pine blister rust (particularly damaging to seedlings and small trees), dwarf mistletoe (affecting lodgepole, limber, and whitebark pines), commandra blister rust disease (impacting lodgepole pines), and various root diseases including *Armillaria* root disease, white mottled rot, *schweinitzii* root and butt rot, and *tomentosus* root rot. Seventy acres of aspen were as either defoliated or discolored. Sooty bark canker and *Cytospora* canker often impact aspen in the Shoshone National Forest.

Recent Reports and Projects

Western spruce budworm activity. The western spruce budworm has been heavily impacting a large area on the north end of the forest over the past 5 years. Trees are suffering complete defoliation and there is a high likelihood for heavy mortality. Budworm caused defoliation is going to remain high in the near future and treatments are being considered. Report RCSC-17-5.

Mountain pine beetle in whitebark pine. The forest has had a widespread mountain pine beetle epidemic over the 15 years. There is interest in how much impact it is having in whitebark pine. Also, using different methods to prevent attacks in whitebark pine have been employed. Report RCSC-17-4.





Figure 2. Adult western spruce budworm.
(Photo Kendra Schotzko)



Figure 3. Mortality in whitebark pine.
(Photo Kendra Schotzko)

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WR-2017 Forest Insect and Disease Conditions: White River National Forest

USDA Forest Service
Rocky Mountain Region
Forest Health Protection
Gunnison Service Center
216 N. Colorado St.
Gunnison, CO 81230

Overview

The spruce beetle epidemic to the south of the White River National Forest has slowed but still threatens to expand into the Forest. Mountain pine beetle activity was undetected on the Forest in 2016 and was negligible in 2017. Aspen discoloration caused by leaf blight and defoliation caused by spruce budworm and large aspen tortrix are unlikely to inflict much mortality on dominant trees. A number of other significant forest health issues persist or bear watching. The widespread mortality of Douglas-fir from Douglas-fir beetle is continuing regionally, as is loss of subalpine fir in the spruce-fir forest through root disease and western balsam bark beetle. Root diseases, though undetected by aerial survey, are widespread and create gaps in forest structure and hazard tree risks for forest users. In the aftermath of the mountain pine beetle epidemic, management of lodgepole pine dwarf mistletoe is at a critical point that will determine the future of stands for a century or more.

Subalpine fir mortality occurs in subalpine forests across the White River NF. It decreased in 2016 and again in 2017, but is still the most important form of damage on the Forest (Table 1, Figure 1). It has occurred fairly consistently in large areas across the Region for over a decade. Subalpine fir mortality is generally caused by **western balsam bark beetle** (*Dryocoetes confusus*) and **Armillaria root disease** (caused by *Armillaria* spp.). Typically, the root disease infects several trees in a group, then the beetle attacks and kills the weakened trees. The resulting brood may attack neighboring, uninfected trees. It is also not unusual to find trees killed by root disease that are not attacked by the beetle. The relative contribution of the beetle and the fungus to tree mortality is difficult to determine, and can differ over time and among localities.

Western spruce budworm (*Choristoneura freemani*) activity decreased on the White River NF from 22,000 acres mapped by aerial surveyors in 2016 to 13,000 in 2017. Notable activity is scattered through the Flat Tops Wilderness and two separate active areas, east of Carbondale and east of Aspen (Figure 1). This insect feeds on the new needles of Douglas-fir and less notably on spruce and subalpine fir. Drying needles webbed to twigs impart a brown cast to infested trees (Figure 3). Significant impacts are occurring in both mixed conifer and spruce-fir forest types. Feeding from this insect can cause growth loss, top-killing, and tree mortality, especially on suppressed trees. A combination of suitable habitat and favorable weather patterns have resulted in the current widespread outbreak in Colorado. Stand conditions

contribute greatly to the budworm population's ability to increase to outbreak levels. Reduced fire frequency allows shade-tolerant white fir and Douglas-fir to increase in mixed conifer stands, improving habitat for western spruce budworm. Multistoried stands of shade-tolerant species favor western spruce budworm survival as larvae disperse from overstory trees. Management activities such as reducing basal area, favoring ponderosa pine where possible, and thinning from below can render stands less susceptible to damage from western spruce budworm.

Western tent caterpillar (*Malacosoma californicum*) and **large aspen tortrix** (*Choristoneura conflictana*) are two defoliators likely responsible for the 3,000 acres of defoliated aspen detected on the White River NF (mostly near Sunlight Mountain Resort on the Aspen-Sopris RD). Defoliation can lead to tree mortality if it occurs repeatedly over several years, especially during droughts. Defoliated aspen typically grow new leaves in mid-late summer although canopies may appear thin.

As in 2015, discoloration and defoliation of aspen were very abundant on the White River National Forest. **Marssonina leaf blight** (caused by *Drepanopeziza* spp.) discolors foliage, then causes defoliation in midsummer. It caused much less damage in 2016, but discoloration doubled in 2017 to 7200 acres. Damage was most severe in the Blanco Ranger District, especially in the western Flat Tops Wilderness. This disease tends to vary with spring and summer moisture. Mortality can occur if trees are heavily infected in several consecutive years.

Douglas-fir beetle (*Dendroctonus pseudotsugae*) affected 2,300 acres in 2017, a decrease from 2016; 1,000 acres are new activity mapped from aerial survey. Mortality is scattered throughout Hardscrabble and Red Table Mountains, in the Maroon Bells Wilderness, on the eastern side of the Flat Tops Wilderness, and north of Sunlight Mountain Resort east of Carbondale (Figure 1). In recent years, Douglas-fir tree mortality has varied widely from scattered mortality in some stands to almost total loss of mature Douglas-fir in others (Figures 4 and 5). Often Douglas-fir beetle outbreaks are triggered by an event such as windthrow or injury by fire. Douglas-fir beetles may also increase in areas where stress from repeated defoliation by western spruce budworm or severe infection by **Douglas-fir dwarf mistletoe** (*Arceuthobium douglasii*) makes Douglas-fir more vulnerable to bark beetle attack. In high value areas such as campgrounds and ski areas, District personnel could utilize the anti-aggregation pheromone MCH to protect against new attacks. The Aspen-Sopris RD has requested and been granted forest health funding for MCH deployment on the Buttermilk Ski area in 2018.

Spruce beetle (*Dendroctonus rufipennis*) was mapped by aerial surveyors on only 160 acres in 2017 on the White River NF, and only 31,000 acres have been mapped since 1996 (Table 1). The spruce beetle outbreak in the 1940's and early 1950's killed most of the mature spruce in the Flat Tops Wilderness. It is likely the current outbreak that the GMUG, Rio Grande, San Juan, and San Isabel NFs are experiencing will not affect the Flat Tops Wilderness portion of the White River NF. However, the Elk Mountain Range including the Maroon Bells and Raggeds Wilderness areas, south of Aspen, is at high risk if spruce beetle populations on the northern Gunnison NF continue to move north. The Sawatch Range, east of Aspen, is also at potential high risk for

mortality. Statewide, acres affected by spruce beetle are declining due to exhaustion of the mature spruce cover type that is the beetle's primary host.

Armillaria root disease is important in spruce-fir stands. It infects both Engelmann spruce and subalpine fir. Infected subalpine fir is often attacked by western balsam bark beetle, and is usually killed while standing. Engelmann spruce more often falls due to decayed roots while still green. Infected spruce may serve as hosts for spruce beetle during non-epidemic conditions. When infected spruce fall, they can lead to increases in spruce beetle populations. The disease generally intensifies as stands mature.

Dwarf mistletoes cause significant growth loss and can substantially impact forest productivity. Mortality can result when infestations are severe. The most important dwarf mistletoe on the White River NF is **lodgepole pine dwarf mistletoe** (*Arceuthobium americanum*; Figs. 2 and 3). Stand-replacing fire is a natural regulator of the disease. Fire exclusion and uneven-aged management have led to increased spread and intensification of dwarf mistletoe on the Forest. In the absence of stand-replacing fire, silviculture can be used to regulate the disease. Forest management activities that do not address dwarf mistletoe usually increase disease abundance and severity.

A significant portion of mature lodgepole pines that were not killed during the mountain pine beetle epidemic is heavily infected with dwarf mistletoe. Infection is severe in the residual overstory, in part because mountain pine beetle avoids heavily infected lodgepole pine (McGregor 1978, Roe & Amman 1970, Ziegler 1978). Advanced regeneration is also largely infested. This disease poses a serious and immediate threat to regenerating lodgepole pine in campgrounds and stands previously affected by mountain pine beetle. If the infected overstory trees are not removed promptly and the understory sanitized as needed, the disease will spread through the understory, leading to chronic infection through the life of the new stand. The results are stunting, development of witches' brooms, top kill, and early mortality.

McGregor MD. 1978. Management of mountain pine beetle in lodgepole pine stands in the Rocky Mountain area. In: Kibbee DL, Berryman AA, Amman GD, Stark RW, editors. Theory and Practice of Mountain Pine Beetle Management in Lodgepole Pine Forests. Symposium Proceedings. Washington State University, Pullman, WA: Forest, Wildlife and Range Experiment Station, University of Idaho, Moscow, ID. p 129-139.

Roe AL, Amman GD. 1970. The mountain pine beetle in lodgepole pine forests. Research Paper INT-71. Missoula, MT: USDA Forest Service, Intermountain Forest and Range Experiment Station. 23 p.

Ziegler RS. 1978. The vegetation dynamics of *Pinus contorta* forest, Crater Lake National Park, Oregon [Master's thesis]. Corvallis, OR: Oregon State University. 182 p.

Aerial Survey Highlights

- Spruce beetle activity was detected on 206,000 acres in Colorado in 2017. Of these, 67,000 acres are in areas not previously mapped as having spruce beetle activity. Aerial

observers only mapped 160 acres of active spruce beetle activity on the White River NF in 2017.

- Defoliation by western spruce budworm was detected in Colorado on 252,000 acres in 2017, compared to 226,000 acres in 2016. Activity was most notable on the White River, Pike-San Isabel, Gunnison, San Juan, and Rio Grande National Forests and adjoining lands.
- Aspen defoliation was observed by aerial surveyors on 38,000 acres in Colorado. Defoliation on the White River NF decreased from 3,800 affected acres in 2016 to 3,000 acres in 2017. Field observations suggest that most of the damage mapped is due to western tent caterpillar and large aspen tortrix.

Table 1. Acres of major damage agents detected in aerial survey on the White River NF. ^a

Agent	2016 Acres Affected	2017 Acres Affected	1996-2017 Cumulative Acres Affected	2017 New Acres Affected ^b
Subalpine fir mortality	37,000	20,000		
Western spruce budworm	22,000	13,000		
Aspen discoloration	3,600	7,200		
Aspen defoliation	3,800	3,000		
Douglas-fir beetle	3,800	2,300	31,000	1,000
Spruce beetle	230	160	31,000	0
Mountain pine beetle	0	10	386,000	0
Western Pine Beetle	100	0		

^a Due to the nature of aerial surveys, these data will only provide rough estimates of location, intensity and the resulting trend information for agents detectable from the air. Many of the most destructive diseases are not represented in the data because these agents are not detectable from aerial surveys. The data presented should only be used as a partial indicator of insect and disease activity, and should be validated on the ground for actual location and causal agent. Using these data for purposes other than those for which it was intended may yield inaccurate or misleading results.

^b since 1996

FHP Projects

- The Blanco RD in Meeker has been participating in biocontrol with yellow toadflax for several years. Amy Lockner, entomologist, has taken some of the duties that Hal Pierce (retired) held to continue these projects and hopefully expand into more National Forests.

Recent Reports and Resources

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. They also conduct an annual aerial forest health survey, ground surveys and site visits to

identify and map insect and disease-caused tree mortality and damage throughout the Region. The following is a list of recent reports and resources available.

- Burns, Kelly S and Stephens, S. Sky. December 2017. Proposed Dwarf Mistletoe Treatments in the Tenderfoot Mountain Units of the Lower Snake Wildland Urban Interface Project, Dillon Ranger District, White River National Forest. Service Trip Report LSC-18-03. USFS Rocky Mountain Region, Forest Health Protection, Gunnison Service Center.
- Lockner, Amy. January 2018. Forest Health Issues on the White River National Forest. Service Trip Report GSC-18-01. USFS Rocky Mountain Region, Forest Health Protection, Gunnison Service Center. 6 pp.
- [Dwarf Mistletoes: Ecology and Management in the Rocky Mountain Region](#)
- [Forest Health Protection](#)
 - Other Forest Condition Reports
 - Other Regional Reports
 - [Aerial Detection Survey](#)
 - Shapefiles
 - Data tables by state, county, and forest available by request
 - [Mapping and Reporting](#)
- [Forest Health Technology Enterprise Team](#)
 - Risk Map
 - National Forest damage Agent Range Maps
 - Forest Pest Conditions

We look forward to continued work with the White River NF regarding forest disease and insect concerns. Please do not hesitate to contact us with questions.

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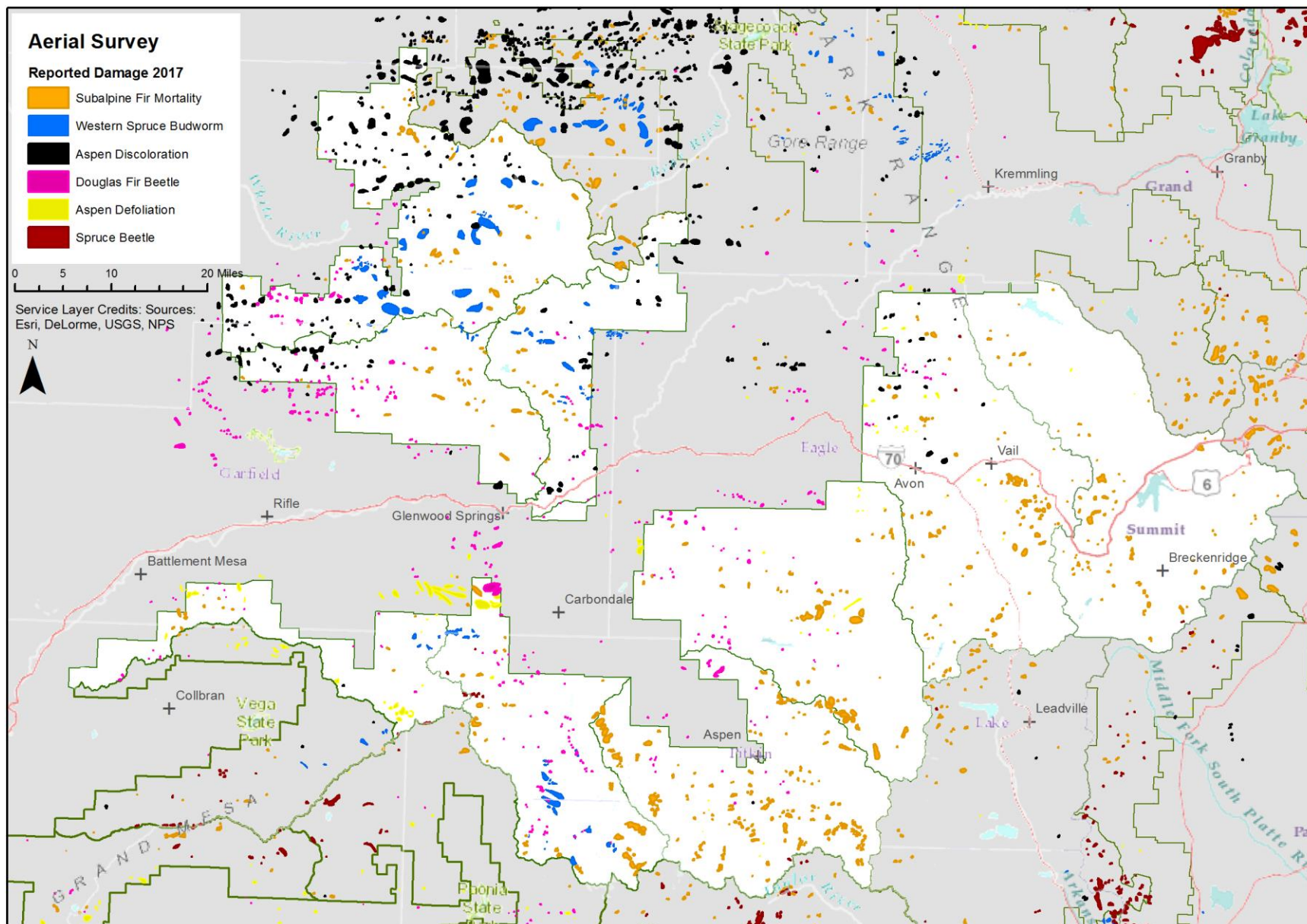


Figure 1. Insect and disease activity mapped by aerial survey on the White River NF in 2017.



Figure 3. Trees heavily defoliated by western spruce budworm (left) and top-killed by repeated defoliation (right) on the White River NF. Photos: Amy Lockner.



Figure 4. Pockets of mortality due to Douglas-fir beetle on the Gunnison National Forest. Photo: Amy Lockner.



Figure 5. Douglas-fir trees killed by Douglas-fir beetle in 2016/2017 on the Buttermilk Ski Area on the Aspen-Sopris RD. Photos: Monte Lutterman.

Section 2 – Internet Links to State FHH reports from their state websites:

[COLORADO](#)

[KANSAS](#)

[NEBRASKA](#)

[SOUTH DAKOTA](#)

[WYOMING](#)

Hopefully, these FHH reports from the state forestry agencies in the USDA Forest Service - Rocky Mountain Region (R2) will be available during 2018 on the [USDA Forest Service, Forest Health Monitoring website](#).

Section 3 – [Internet Links to R2 FHP Aerial Survey Detection Highlights and Maps](#):

[Colorado](#)

[South Dakota](#)

[Wyoming](#)

Section 4 Documentation & Acknowledgements

Reference for Citation and Public Notices:

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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](#).

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