

Rocky Mountain Region (R2) - 2018 Forest Health Conditions



An EF-3 tornado occurred in South Dakota on June 29, 2018 near the northwest corner of the Black Hills National Forest. Foresters started tree removal and salvage logging shortly after the tornado. (Links in [Table of Contents](#))

Rocky Mountain Region (R2) Report 2018

Forest Health Conditions

Table of Contents

Section 1 - A collection of reports about the Forest Health of **R2 National Forests** written by the Forest Health Protection staff from Gunnison, Lakewood, and Rapid City Service Centers.

Section 1 - National Forest Reports	Pages
Arapaho - Roosevelt	3
Bighorn	10
Black Hills	14
Grand Mesa - Uncompahgre - Gunnison	19
Medicine Bow - Routt	26
Nebraska	32
Pike	36
Rio Grande	41
San Isabel	48
San Juan	53
Shoshone	60
White River	64
2018 Beetle Activity in R2 national forests	69

Section 2 – Forest Health Highlights' (FHH) reports from Colorado, Kansas, Nebraska, South Dakota, and Wyoming. These FHH reports were produced by state forest health specialists and discuss the 2018 FHH from all forest lands in each state.

Section 2 - States' reports of 2018 Forest Health Highlights	Pages
Colorado	71
Kansas	83
Nebraska	95
South Dakota	98
Wyoming	110

Section 3 – Acknowledgements of all contributors, required documentation, and reference citation for this report.

Section 3 - Acknowledgements and More p. 116

Report approved by State and Private Forestry, and Tribal Relations
Director Jason Lawhon – May 2019.

2018 Forest Insect and Disease Conditions Report: Arapaho-Roosevelt National Forest

USDA Forest Service
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Forest Health Protection
Lakewood Service Center
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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 2018.

Spruce beetle (*Dendroctonus rufipennis*) activity continued to decrease in all of Colorado and southern Wyoming from 208,000 in 2017 to 178,000 in 2018 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. In 2018, 7,400 and 6,300 acres were mapped on the ANF and RNF, respectively. This was a significant increase from 2017 mapped acreage in the ARNF area. 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 and surveys. Spruce beetle has moved outside of the windthrow areas at Guanella Pass and is attacking standing live trees.

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 20 acres on the ARNF; most of this was in isolated pockets of lodgepole and ponderosa pine. 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. Lakewood Service Center personnel are available to conduct a site visit and assist in the management decision process. A dwarf mistletoe management guide is also available for the Region (see “Useful Links” section).

Caring for the Land and Serving People



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 208,000 in 2017 to 178,000. A large portion of the damage was in southern Colorado.
- MPB activity decreased to 490 acres in 2018 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 decreased almost by half to 27,000 acres in Colorado and southern Wyoming in 2018. 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.
- 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.

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

- R2-18-01. Schoettle AW, Burns KS, Douville T, Holtz C. Update on the Southern Rockies Rust Resistance Trial (SRRRT). Biological Evaluation.
- LSC-19-02. Powell, R, Stephens, SS. Forest Health Review at Rocky Mountain National Park.

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. 30pp.
- 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](#)

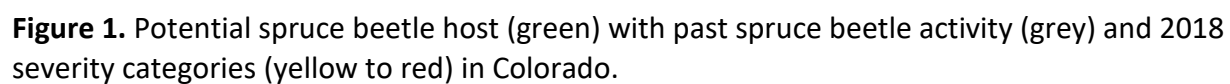
We look forward to continued work with the ARNF regarding your forest health concerns. Please do not hesitate to contact us with your inquiries.



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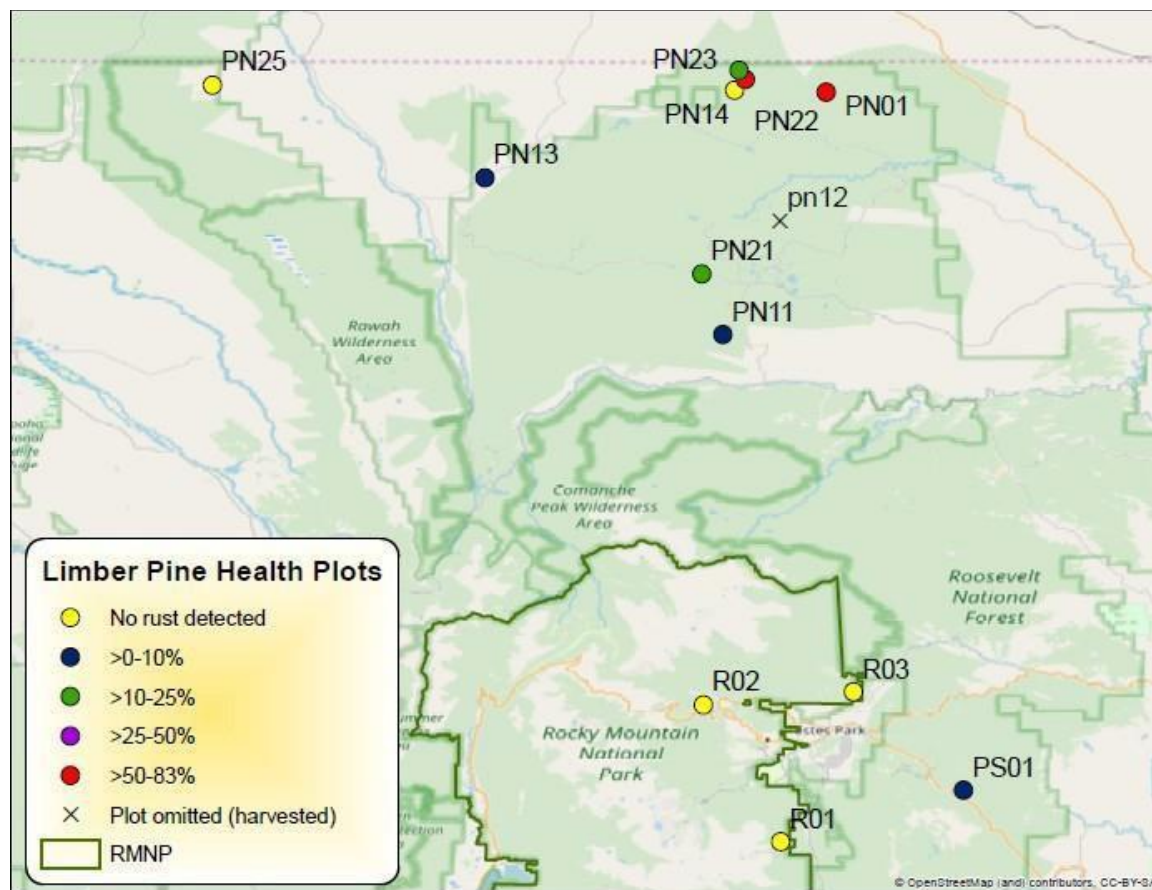


Figure 2. Map showing WPBR incidence as of 2016 in limber pine health plots in and around RNF. WPBR infections have been confirmed (and removed via pruning) on several trees near plot R02 in RMNP, the only infections identified within the Park to date. [Table of Contents](#)



2018 Forest Insect and Disease Conditions: Bighorn National Forest

Overview

Figure 1 of this report shows areas of mapped damage on the Bighorn NF in 2018. Most bark beetle caused tree mortality is light and scattered. There are larger areas of defoliation/foliage damage.

An estimated 890 acres of subalpine fir mortality was recorded this year, a slight increase from last year. In other forests, *Armillaria* root disease contributes to subalpine fir mortality, but has not been detected in subalpine fir in the Bighorn National Forest.

Mountain pine beetle and spruce beetle continue to occur at very low levels as single trees or small groups. In 2018 there 50 acres recorded of mountain pine beetle and 90 acres of spruce beetle. Douglas-fir beetle also continues to occur at low levels and most of the activity occurring now is just off the forest on the southern end of the Bighorn Mountains.

There was a large area of fading trees totaling about 300 acres that had pine engraver activity in it (Figure 2, a&b). Much of this area had standing live trees girdled and then subsequently attacked by pine engravers. Beetle activity in surrounding non-girdled trees is minimal at this time.

There was a total of 5,700 acres listed as either western spruce budworm or winter damage (also referred to as red belt). The exact amount of each is unknown, but there are known large areas that did incur winter desiccation with most of the foliage being killed and turned orange. Multiple tree species were affected by the winter damage (Figure 3, a&b). There were about 2,500 acres of confirmed heavy spruce budworm activity just outside the forest in Johnson County.

Though not recorded during aerial survey, dwarf mistletoe is a persistent problem in lodgepole pine stands, but silvicultural treatments can be used to reduce mistletoe and improve stand conditions (Figure 4, a&b). Other diseases such as white pine blister rust and commandra blister rust are difficult to detect from the air, but is found causing damage throughout the forest.

Recent Reports and Projects

Mortality in Subalpine fir stands. Numerous stands of Subalpine fir on the Bighorn NF have been surveyed recently. While there is extensive mortality in some of them, there was no evidence of the exotic balsam woolly adelgid. Report RCSC-18-03.

Aspen Conditions. The condition of aspen stands on the forest was recently re-assessed. Overall, mortality is low. There are canker diseases that are one of the biggest factors in causing tree death. Report RCSC-17-06.



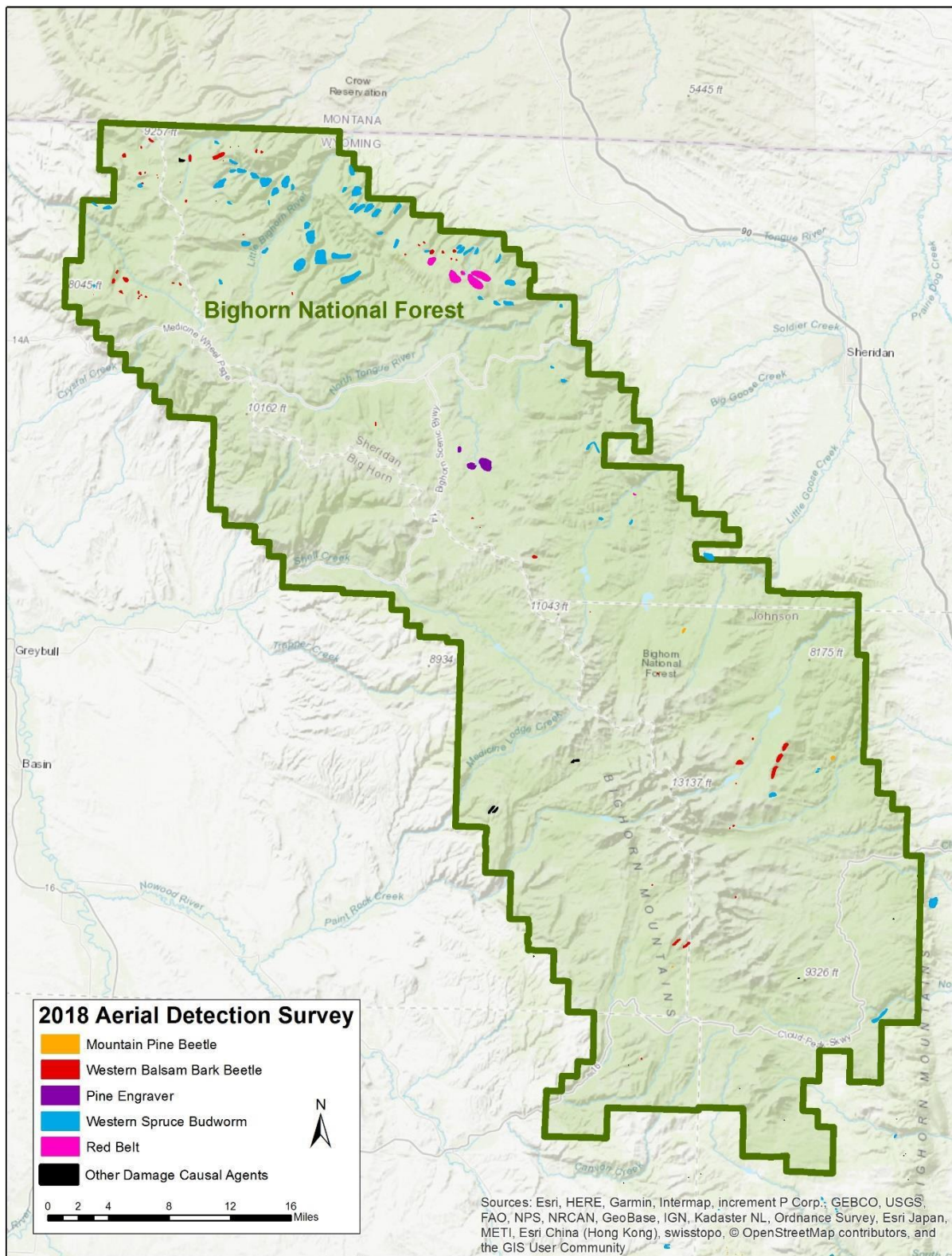


Figure 1. Map of aerial detection survey for the Bighorn National Forest: 2018.





Figure 2, a&b. Fading trees and maturing engraver beetles in an infested tree.



Figure 3, a&b. Winter damage causing heavy defoliation.



Figure 4, a&b. Dwarf mistletoe plants and affected trees.



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

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[Table of Contents](#)



Black Hills National Forest – 2018 Insect and Disease Conditions

Overview

Monitoring of tree mortality in the Black Hills National Forest was assessed by aerial detection survey (Figure 1). In 2018 there were 230 acres of ponderosa pine mortality associated with bark beetle in the Black Hills. This includes both mountain pine beetle and *fps* engraver beetles (Figures 2 and 3).

Mountain pine beetle populations within the Black Hills National Forest remain at endemic levels. 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.

Low levels of aspen defoliation (50 acres) and 10 acres of spruce mortality (Figure 4) 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.

There was a large amount of Diplodia shoot blight noted, covering 1,100 acres on the National Forest and another 8,400 acres on surrounding state and private lands. Additionally, there was activity of pine engravers noted in areas heavily impacted by Diplodia. Much of the Diplodia increase was in areas affected by early summer hail storms (Figure 5).

Also of note was around 16,000 acres that were damaged by tornado or windstorm with trees blown down and broken off (Figure 5).

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-19-03).

Condition of birch on the Black Hills. Overall, the condition of birch stands is good. Mortality had declined compared to previous measures. Regeneration is scarce in many areas due to dense overstory. (Report RCSC-18-5).



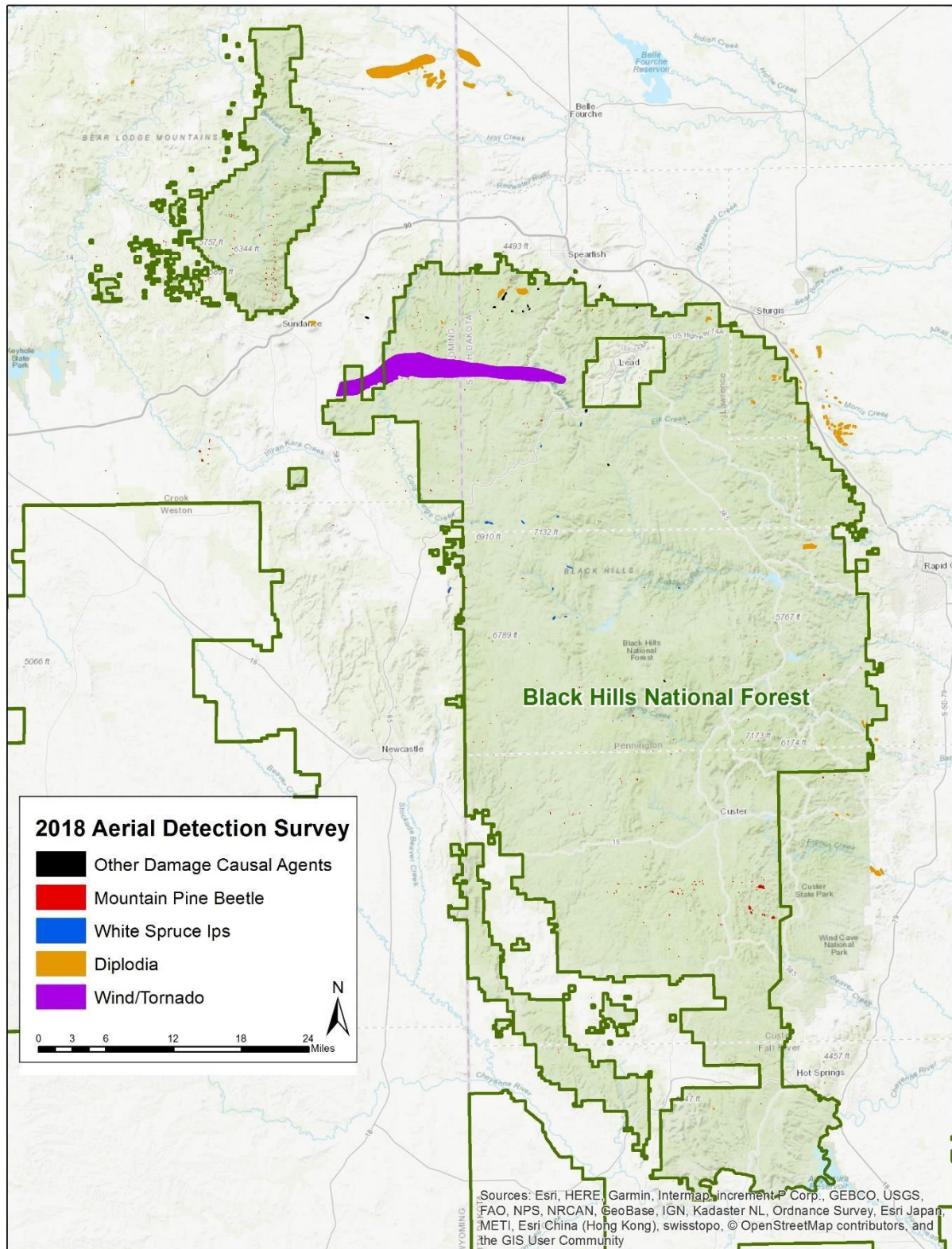


Figure 1. Aerial Detection Survey Map of the Black Hills in 2018.





Figure 2, a & b. a). *Ips* beetles killed these ponderosa pines. b). *Ips* beetle galleries on this dead ponderosa pine tree.



Figure 3. Mountain pine beetle in a "pitch tube."





Figure 4. Top photo is a declining white spruce stand. Lower left photo shows spruce beetle galleries and lower right indicates Armillaria root disease on spruce.



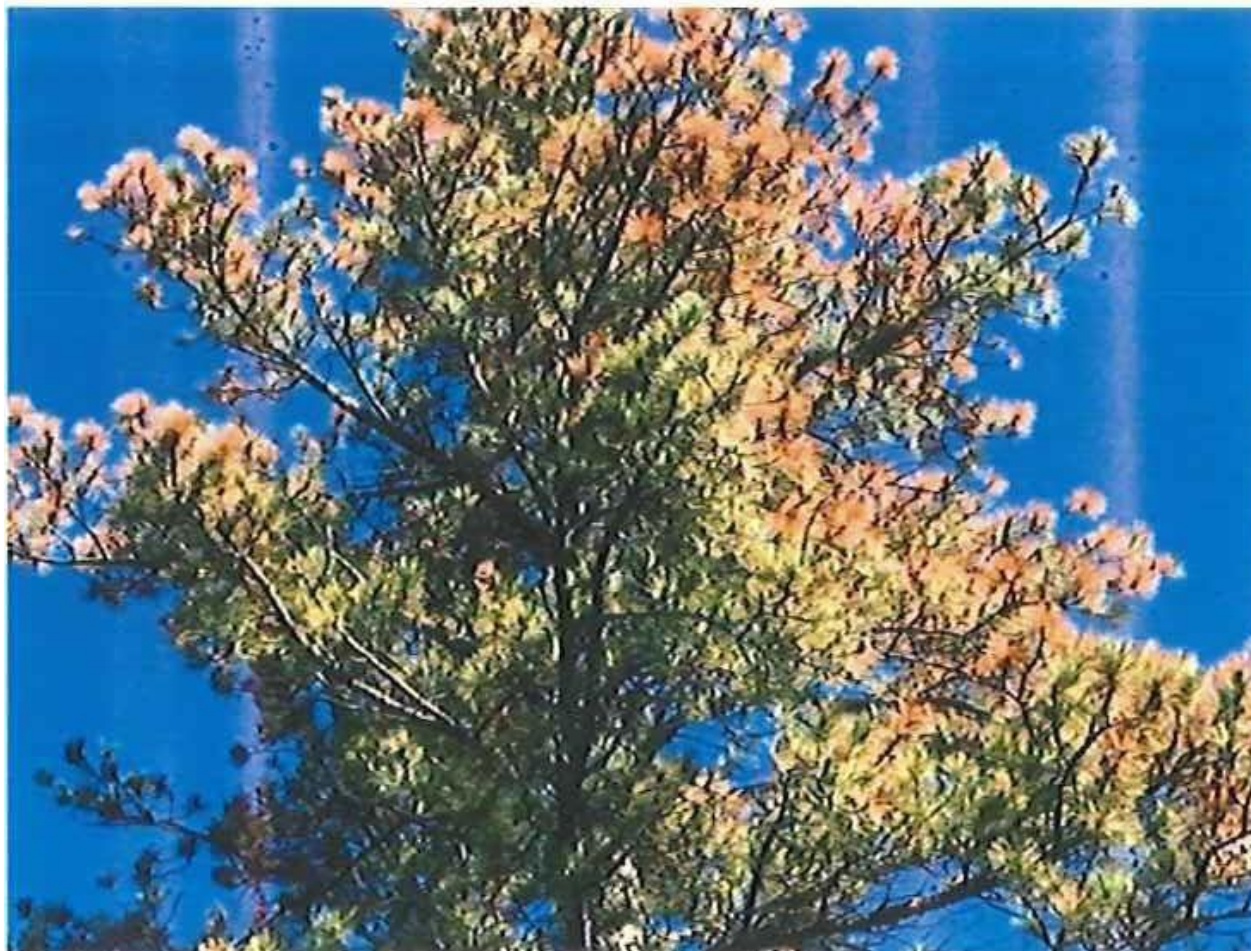


Figure 5. Diplodia blight damage on ponderosa pine and tornado damage.

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[Table of Contents](#)



2018 Forest Insect and Disease Conditions: Grand Mesa, Uncompahgre, and Gunnison National Forests

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The 2018 **water year** brought one of the hottest, driest years on record for the GMUG National Forests (Fig 1, a&b) creating favorable conditions for many forest insect and disease pests.

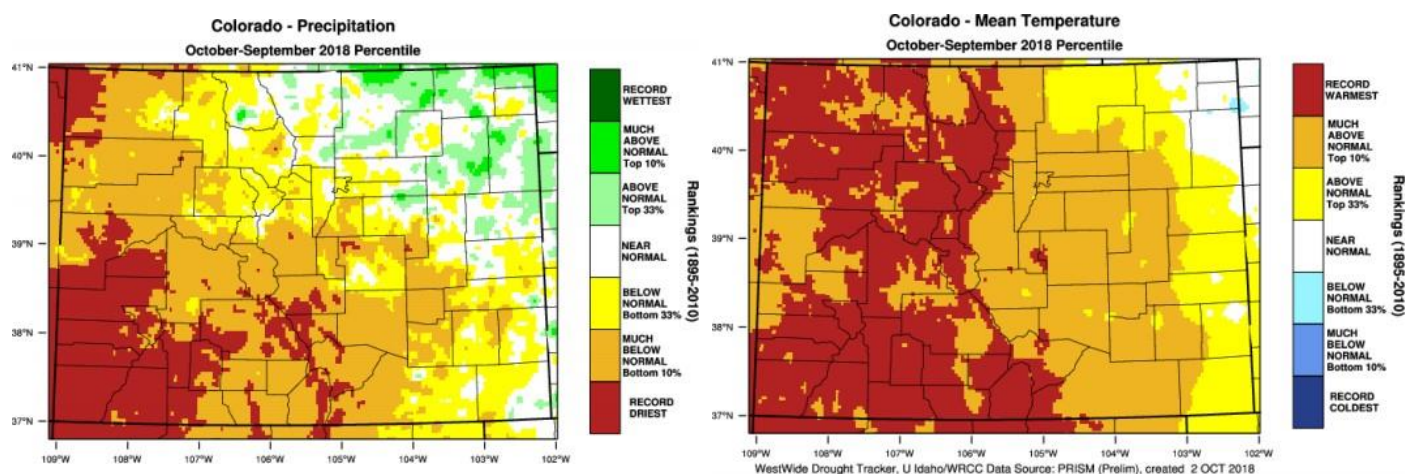


Figure 1, a&b. SW Colorado 2018 water year rankings for precipitation (above, left) and record drought (right), especially in the four corners areas. [More on Colorado's water Year 2018.](#)

Spruce beetle (*Dendroctonus rufipennis*) activity expanded onto 7,000 new acres on the GMUG. Aerial survey showed 27,000 total active acres in 2018, with 7,000 acres not previously mapped (Table 1, fig. 3 a,b,&c). Total area impacted on the GMUG over the course of the current epidemic was about 349,000 acres. The epidemic has been most severe on the Gunnison NF with about 239,000 acres affected, much with extensive tree mortality. There is still a significant amount of large dense spruce stands that can provide habitat for expanding spruce beetle populations. With last year's drought, spruce beetle activity may increase. The Uncompahgre NF had 13,000 active acres, 4,000 of which were mapped as newly infested. The Gunnison NF had only 3,000 newly mapped acres out of 14,000



Figure 2. Four-eyed spruce bark beetle found at a Grand Mesa timber sale.

active acres, which is down from 2017. The Uncompahgre Plateau and Grand Mesa NF had very little spruce beetle activity detected either by aerial or ground surveys. Gunnison Service Center staff visited a timber sale on the Grand Mesa and found little spruce beetle activity. Rather, most down spruce were heavily infested with spruce engraver (*Ips* spp.) and a member of the four-eyed bark beetles (*Polygraphus convexifrons*; Fig 2). Both species are common in down spruce and are not a major concern for forest health.

Douglas-fir beetle (*Dendroctonus pseudotsugae*) is currently at a moderate level on the GMUG. Approximately 3,000 acres of mortality were mapped in 2018. Most acres mapped were new, and primarily on the Gunnison NF (table 1c, fig. 3 and 6). 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 distribute MCH to protect Douglas-fir in recreation and viewshed areas in cooperation with District personnel. Douglas-fir beetle may increase in areas where the stress from repeated defoliation by western spruce budworm makes Douglas-fir more vulnerable to attack.

Western spruce budworm (*Choristoneura freemani*) activity was moderate across the GMUG, particularly on the Gunnison and Uncompahgre NFs (table 1, b&c). Aerial surveyors observed a decrease in activity since last year. Drying needles webbed to twigs impart a brown cast to infested trees (fig. 3). Detection of WSBW during aerial survey varies year to year due to sunlight, weather, and smoke from nearby fires.

Fir engraver (*Scolytus ventralis*) has decimated mature white fir trees in and around Ouray on the Uncompahgre NF. Trees infected with root disease or defoliated by western spruce budworm are especially vulnerable. The beetles may also attack the tops of trees, causing top-kill. Fir engraver activity detected by aerial survey decreased from 1,500 acres in 2017 to 1,000 acres in 2018. In the long term, where possible, the best management treatment for all these agents is to favor less susceptible species such as pines, junipers, and Douglas-fir.



Figure 3. Douglas-fir on Hwy 114. Trees defoliated by western spruce budworm in the foreground and Douglas-fir beetle mortality in the background (photo by Amy Lockner).



Table 1, a, b, & c. Acres of major damage agents detected in aerial survey for each forest.

Grand Mesa National Forest		1996-2018		
Agent	2018 Acres Affected	2017 Acres Affected	Cumulative Acres Affected	2018 New Acres Affected
Spruce beetle	70	460	62,000	0
Subalpine fir mortality	20	570		
Western spruce budworm	170	480		
Douglas-fir beetle	3	10	2,400	0
Aspen defoliation	2	1,500		
Mountain pine beetle	0	0	20	0

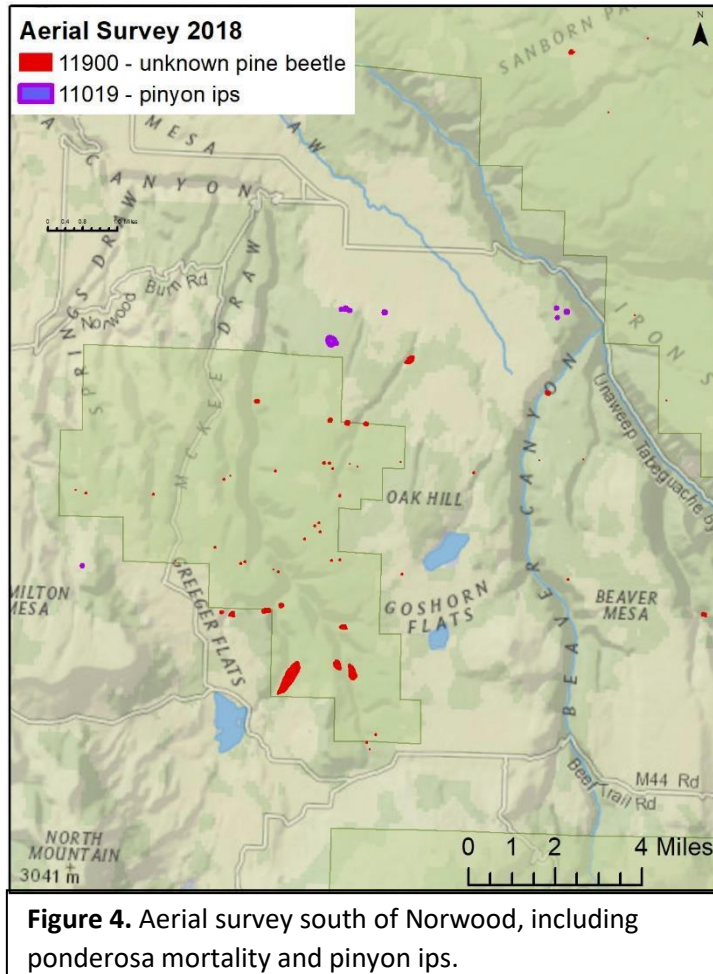
Uncompahgre National Forest		1996-2018		
Agent	2018 Acres Affected	2017 Acres Affected	Cumulative Acres Affected	2018 New Acres Affected
Spruce beetle	13,000	12,000	48,000	4,000
Western spruce budworm	14,000	9,200		
Fir engraver	1,000	1,500		
Subalpine fir mortality	20	470		
Aspen defoliation	590	2,300		
Douglas-fir beetle	950	600	33,000	500
Unknown Pine Beetle	260	140		
Mountain pine beetle	0	0	11,000	0

Gunnison National Forest		1996-2018		
Agent	2018 Acres Affected	2017 Acres Affected	Cumulative Acres Affected	2018 New Acres Affected
Spruce beetle	14,000	39,000	239,000	3,000
Western spruce budworm	8,200	42,000		
Fir engraver	0	0		
Subalpine fir mortality	3,300	4,700		
Aspen defoliation	1,200	4,400		
Douglas-fir beetle	2,000	2,400	32,000	2,000
Mountain pine beetle	50	0	6,100	50

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.



Roundheaded pine beetle (*Dendroctonus adjunctus*) has been most active on the Dolores Ranger District of the San Juan NF and aerial survey noted increasing spots of ponderosa mortality south of Norwood on the Uncompahgre NF (fig. 4). This may indicate a regional spread of a bark beetle complex that includes roundheaded pine beetle, western pine beetle and engraver beetles.



Pinyon ips (*Ips confusus*) activity has been noted in patches in SW Colorado. Areas in particular include north to south on the Uncompahgre Plateau, the Four Corners area including Canyons of the Ancients National Monument, Colorado National Monument, and the Black Canyon National Park. Where possible, thinning and sanitation of infested trees will reduce the chance of pinyon ips from building up and attacking additional trees. For very high value pinyon, such as popular trails or in developed sites watering can help alleviate tree stress during drought.

Utah juniper discoloration was especially noticeable in 2018. Fall and winter of 2017/2018 was warm and dry across the GMUG and in all the four corner states, which likely caused a reddish-brown hue observed on

juniper scales. Discoloration was often in elevational bands on south facing slopes. We used the term "**juniper bronzing syndrome**" to describe it. A close look at the scales showed it to be a breakdown of chloroplasts. The juniper we monitored greened up in the spring. Utah juniper along the Utah/Colorado border are experiencing some drought induced mortality.

Hazard Trees are a concern for any space where people congregate. With high levels of pine, fir, and spruce mortality, it is essential that the GMUG staff is knowledgeable and ready to manage hazard trees. Region 2 holds hazard tree as well as an insect and disease trainings annually to assist in training seasonal and permanent employees.



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 continues to work with the Ouray Ranger District to assess and manage annosus root disease in Amphitheater Campground. A similar project was completed in Angel Creek Campground summer 2018.
- SBEADMR: Amy Lockner attended public field trips on the Alpine Plateau in August 2018.
- GMUG Forest Plan revision: At various times on request we contributed files, reviews, and information regarding insects, diseases, and climate change projections to planners.

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- Suzanne Marchetti, Biological Science Technician, sbmarchetti@fs.fed.us, 970-642-4446
- Jim Worrall, Pathologist, retired fall 2018. Until we can fill that position, if you have any plant pathology questions, please direct them towards Suzanne Marchetti.



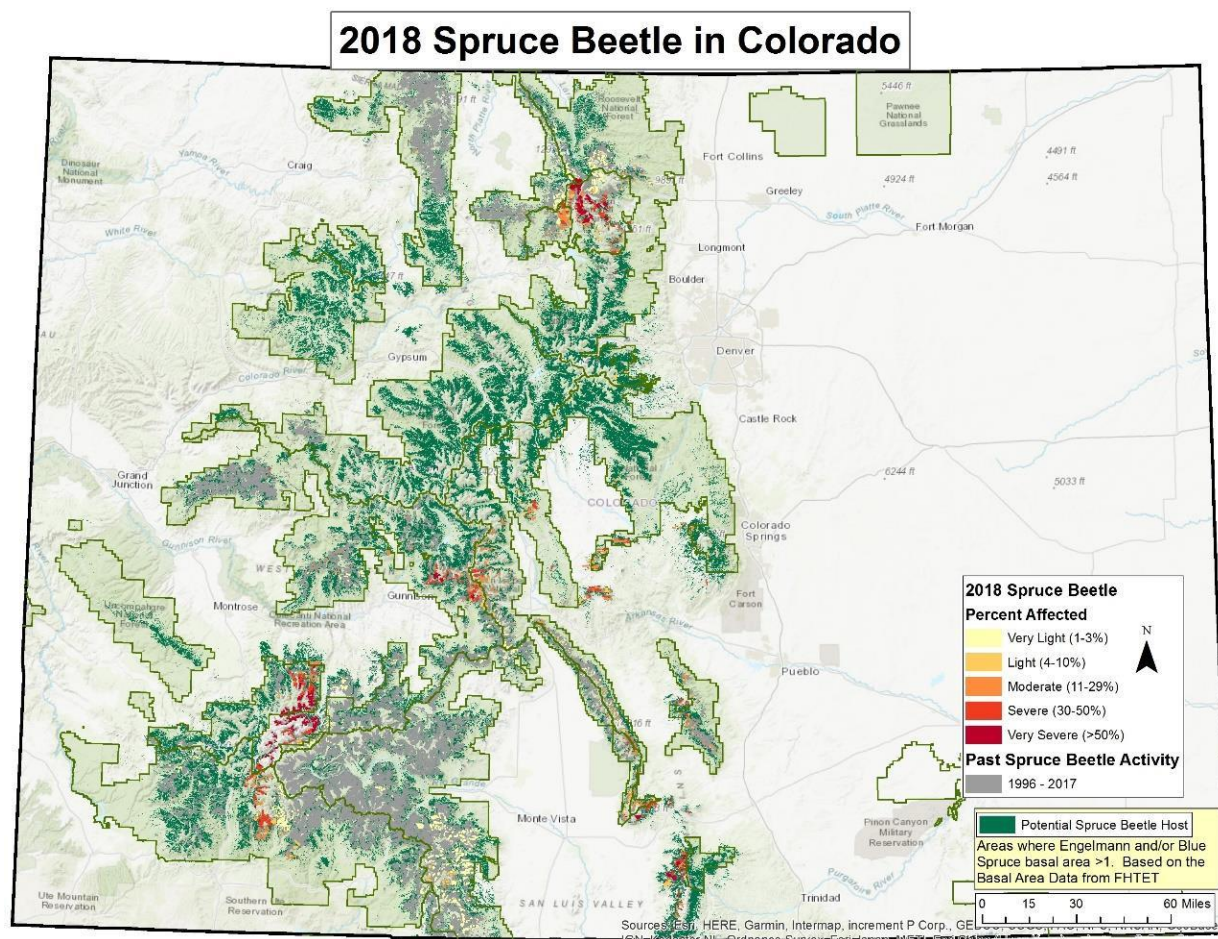


Figure 5. Spruce beetle activity throughout Colorado, 1996 - 2018.



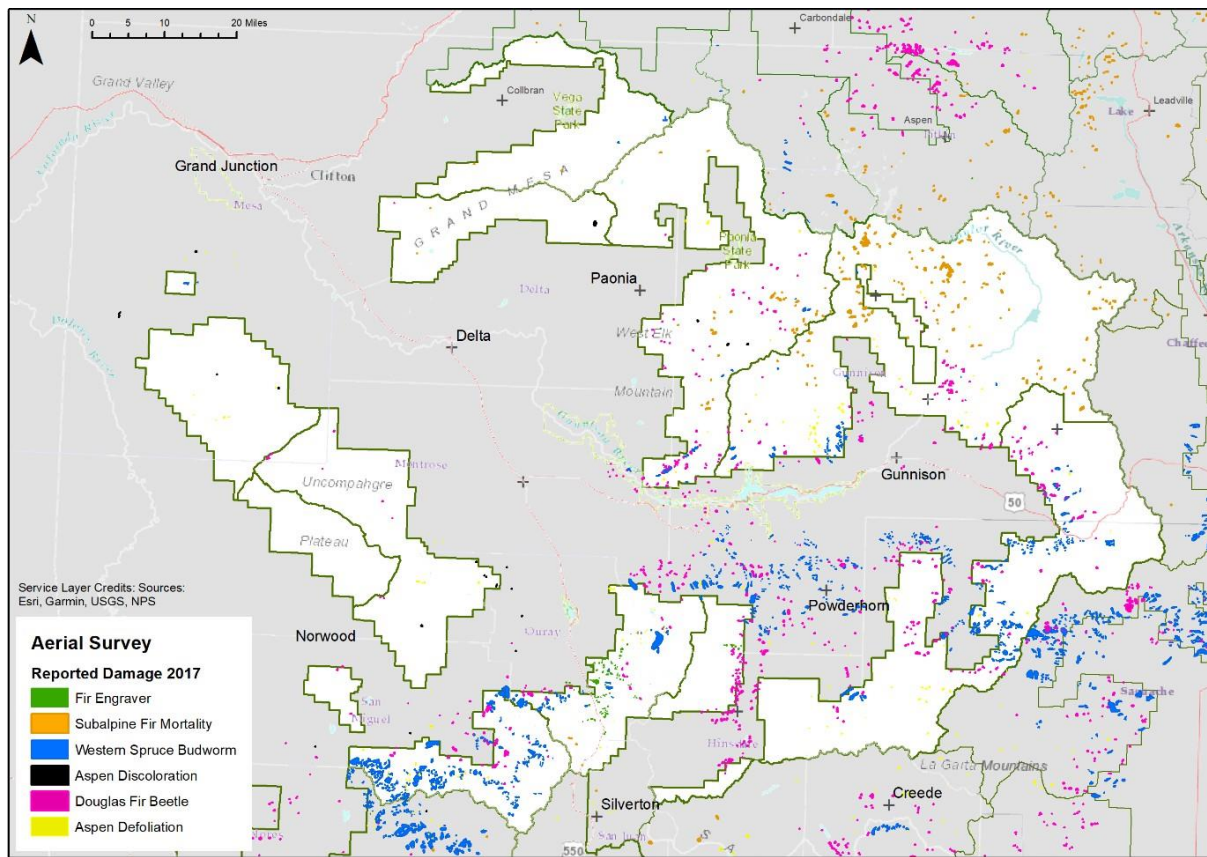


Figure 6. Aerial detection survey for several damage agents recorded in 2017.

[Table of Contents](#)



2018 Forest Insect and Disease Conditions Report: Medicine Bow-Routt National Forests

USDA Forest Service
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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 Medicine Bow and Routt National Forests (MBNF, RNF) in 2018.

Spruce beetle (*Dendroctonus rufipennis*) activity detectable from Aerial Detection Surveys (ADS) continued to decrease in Colorado and southern Wyoming in 2018. Aerial surveyors identified 3,020 acres of recent mortality on the MBNF and RNF in 2018.

Activity mapped on the MBNF, particularly in Carbon County, declined from 1200 acres in 2017 to 20 acres in 2018. The RNF saw an increase from 240 acres in 2017 to 3,000 acres in 2018. The majority of impacted acreage was located in Jackson County with 2,800 acres. Suitable stand conditions exist to support spruce beetle populations in Colorado (Fig. 1) and impacted acres mapped during ADS may under-represent ground conditions. 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. A total of 12 acres of MPB mortality were observed in 2018 on the MBNF and RNF. Preventive insecticide spraying is no longer warranted or needed in most situations.

Subalpine fir mortality continues to decline from 56,000 acres reported in 2017 to 27,000 acres in Colorado and southern Wyoming in 2018. This downward trend is echoed for MBNF and RNF with 8,400 acres in 2017 to 5,700 acres in 2018. 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).

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.*

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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. Lakewood Service Center can assist with site assessments and advice. A dwarf mistletoe management guide is also 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. 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. 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 208,000 acres in 2017 to 178,000 acres in 2018.
- MPB activity in Colorado and southern Wyoming decreased to 490 acres in 2018. ADS found 8 acres of MPB mortality on the RNF and only 4 acres on the MBNF in 2018.
- Western spruce budworm declined dramatically from 6,200 acres in 2017 to 1,460 acres in 2018 among the MBNF and RNF.
- Subalpine fir mortality declined from 56,000 acres in 2017 to 27,000 acres in 2018. Mortality is generally attributed to western balsam bark beetle and Armillaria root disease.
- Aspen defoliation was detected on 150 acres forest-wide (120 on the MBNF and 30 acres on the RNF). Most of the damage was observed in Routt County, Colorado and Carbon County, Wyoming in 2018.

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).

- 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

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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 (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-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.

Lakewood Service Center

- Jim Kruse, Service Center Leader, james.kruse@usda.gov , 303-236-9541
- Sky Stephens, Entomologist, stephanie.s.stephens@usda.gov, 303-236-9552
- Rebecca Powell, Entomologist, rebeccapowell@usda.gov , 303-236-8008
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[Table of Contents](#)



2018 Forest Insect and Disease Conditions: Nebraska National Forest

Overview

The most damaging tree killing bark beetle on the Nebraska National Forest is a complex of pine engraver beetles (*Ips* sp.). These beetles attack all species of pine that are found on the forest. Typically, these beetles increase or decrease rapidly depending on suitable host and weather conditions. Trees stressed by other agents provide suitable hosts. Aerial detection survey identified 10 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 (Figure 4, a&b). Aerial survey detected about 2,600 acres of *Diplodia* in Sheridan County, mostly on surrounding private lands, with about 5 acres on the National Forest. 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 and 3). Fire damaged trees can be a potential source to increase beetle populations. Presently, engraver beetles are at relatively low levels across the Nebraska NF. Report RCSC-19-4.



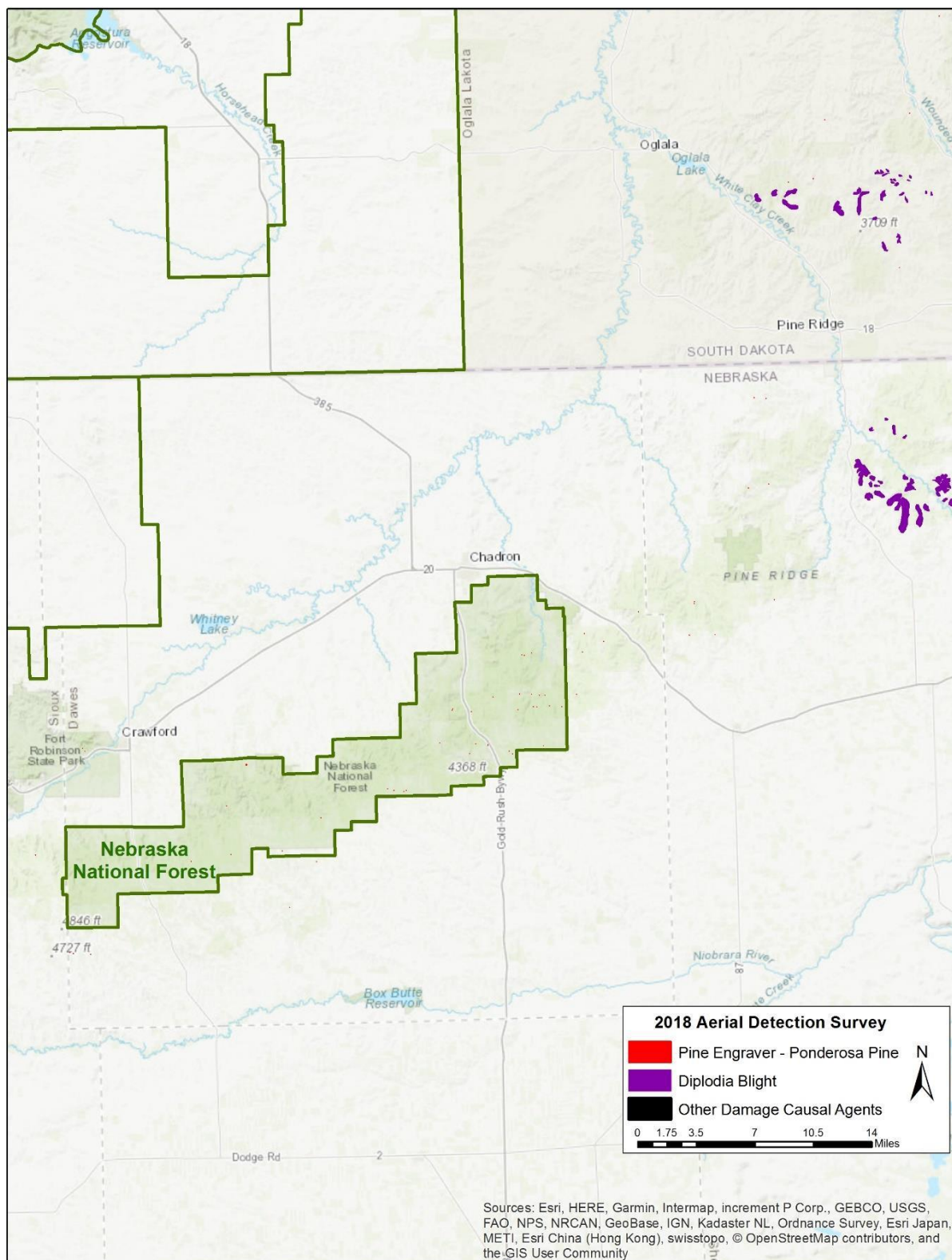


Figure 1. Aerial detection survey map of the Nebraska National Forest: 2018.





Figure 2. Engraver beetle caused mortality.



Figure 3. Engraver beetle galleries in a dead pine tree.





Figure 4, a&b. (a.) Diplodia shoot blight on ponderosa pine and (b.) Elytroderma broom in jack pine.

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

Kurt Allen, Forest Entomologist & Group Leader, kallen@fs.fed.us, 605-716-2781

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Al Dymerski, Forestry Technician, adymerski@fs.fed.us, 308-432-0334

Kendra Schotzko, Forest Entomologist, kschotzko@fs.fed.us, 605-716-2183

USDA Forest Service, State and Private Forestry and Tribal Relations

Rocky Mountain Region, Forest Health Protection

Rapid City Service Center

8221 South Mt. Rushmore Rd.

Rapid City, SD 57702 [Table of Contents](#)



2018 Forest Insect and Disease Conditions Report: Pike National Forest

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 Pike National Forests (PNF) in 2018. Bark beetle activity occurred at largely endemic levels across the PNF. Several diseases are important on the forest but are not reliably detected by Aerial Detection Surveys (ADS).

Douglas-fir beetle (*Dendroctonus pseudotsugae*) decreased to 110 acres in 2018 from 220 acres in 2017. Impacts by this beetle are common along the Rampart Range. On July 20th, 2015 a significant wind event caused several acres of blowdown in the Devil's Head area which lead to closure of the trailhead. This area of blowdown may become impacted by insects such as spruce beetle or Douglas-fir beetle which can reproduce in down woody material. FHP deployed MCH, an anti-aggregation pheromone, at Topaz Point and Devil's Head in 2018 and will continue to assist the Forest with monitoring these areas.

Spruce beetle (*Dendroctonus rufipennis*) activity has continued to increase on the PNF with 9,200 areas mapped in 2018; an increase of almost 50% from 2017 mapped acres. Increased activity has been confirmed during field assessments in and around Craggs Campground. Several spruce beetle management activities have occurred on the PNF in 2018 and additional individual tree and area protection efforts are planned for 2019.

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 PNF. A great opportunity exists for managing and reducing the impacts of these diseases while the forest conducts vegetation management in campgrounds, administrative areas, and in the forest following bark beetle outbreaks and other disturbances. A dwarf mistletoe management guide is available for the Region (see "Useful Links" section).

White pine blister rust (*Cronartium ribicola*, WPBR) continues to spread and intensify in limber pine on the forest. The disease is well established in the Sangre de Cristo and Wet Mountains and isolated infection centers have been confirmed near Crystal Reservoir and in the Rampart Range on the Pikes Peak Ranger District (2009) and more recently on private land in Costilla

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County just west of the Spanish Peak unit of the San Carlos Ranger District (2018). Infections were discovered on both limber and Rocky Mountain bristlecone pines in this new infestation area; before 2018 the only infected Rocky Mountain bristlecone pines identified are located about 25 miles northwest along Mosca Creek in Great Sand Dunes National Park and Preserve. FHP is currently monitoring the distribution and impacts of of this disease in southwest Colorado and northern New Mexico. Restoration planting options, pruning guidelines to reduce WPBR impacts, and a conservation strategy are available for limber pine (Casper et al. 2016, Jacobi et al. 2017, Schoettle et al. 2019).

Aerial Detection Survey Highlights

- Western spruce budworm activity increased slightly on the PNF from 7,900 acres in 2017 to 8,100 acres in 2018.
- Western balsam bark beetle activity on the PNF decreased from 2,100 acres in 2017 to 440 acres in 2018.
- Aspen defoliation was mapped at 410 acres for the PNF in 2018.

FHP Projects

- FHP conducted defoliator surveys and trapping across the PNF for WSBW 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 was completed 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), 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 2018, 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, in collaboration with Adam's State University, initiated a study of the health & abundance of southwestern white pine & limberpine in southern Colorado & northern New Mexico. In 2018, crews evaluated 29 plots, primarily on the Rio Grande National Forest. The study will continue in 2019 and a report will be available soon.
- A Hazard Tree Management Guide for the Rocky Mountain Region was recently published (Blodgett et al. 2017). We have also developed an App (Survey123 for ArcGIS Online) for collecting hazard tree assessment data on smart phones and tablets A User's Guide for the App can be found in the [Hazard Tree Management Training Supplement](#).



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.

Recent Reports and Resource List

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

Forest Health Protection Reports

- R2-18-01. Schoettle AW, Burns KS, Douville T, Holtz C. Update on the Southern Rockies Rust Resistance Trial (SRRRT). Biological Evaluation.
- LSC-18-05. Stephens, SS and Burns, KS. Forest Health Review at the Air Force Academy.
- LSC-18-08. Burns, KS. Evaluation of a Tree Failure in Devils Head Campground, South Platte Ranger District, Pike-San Isabel National Forest.
- LSC-18-09. Stephens, SS, Powell, R, Burns, KS. Identification of Decay Fungus at Topaz Point.
- LSC-18-13. Stephens, SS, Powell, R. Forest Health Review at Fort Carson.

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. 2019. Limber pine conservation strategy for the greater RMNP area. USDA Forest Service, RMRS-GTR-379. 81 pp.

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 Management](#)
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We look forward to continued work with the PNF regarding your forest health concerns. Please do not hesitate to contact us with your inquiries.

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Appendix

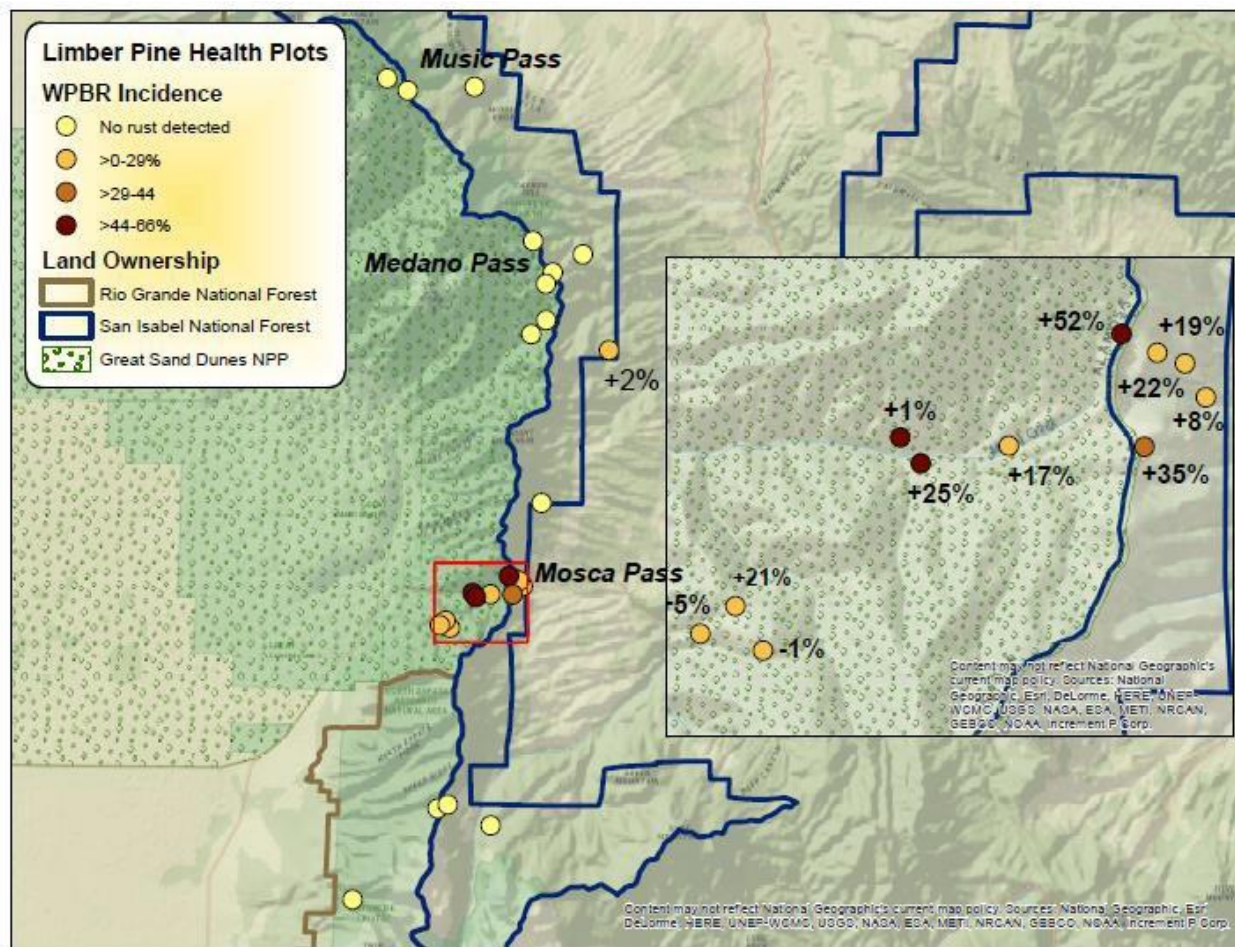


Fig. 1. WPBR incidence (# infected live limber pines/# live limber pines) in 26 long-term limber pine health monitoring plots in the Sangre de Cristo Mountains. Numbers next to symbols indicate difference in percent rust incidence from 2004 to 2017.

Table of Contents



Caring for the Land and Serving People

2018 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

The Rio Grande National Forest currently faces a number of serious forest health issues. This report provides a summary of forest health conditions based on ground observations, monitoring, and aerial detection surveys (ADS) conducted by Forest Health Protection (FHP) on the Rio Grande National Forest (RGNF) in 2018.

2018 was one of the hottest, driest years on record for the state of Colorado and the Rio Grande National Forest (Figure 1). Such conditions stress forests and lay the foundation for future mortality.

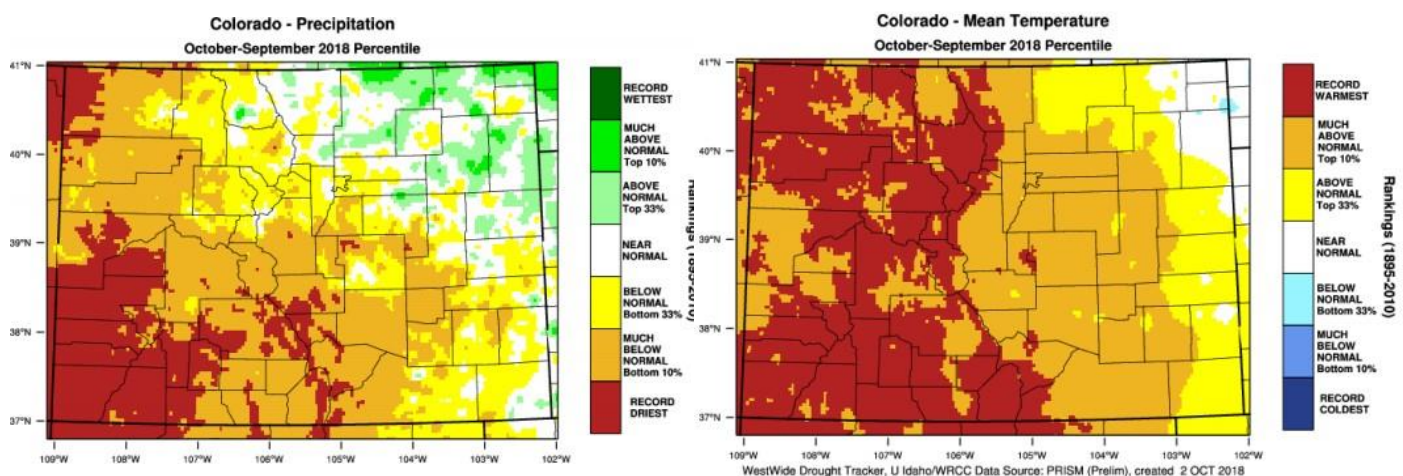


Figure 1, a&b. SW Colorado 2018 water year rankings for precipitation (above, left) and record drought (right), especially in the four corners areas. [More on Colorado's Water Year, 2018.](#)

Spruce beetle (*Dendroctonus rufipennis*) activity continues to decline on the RGNF as fewer green mature spruce are available for the epidemic to expand. The number of currently affected acres detected by aerial survey declined from 47,000 acres in 2017 to 34,000 acres in 2018. Of those active 34,000 acres, only 5,000 acres were recorded as newly infested. 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 (Figures 5 and 7).



Douglas-fir beetle (*Dendroctonus pseudotsugae*) activity remains about the same as last year. A total of 2,000 new acres were recorded in 2018, with 2,800 total affected acres (compared to 2,200 in 2017). Douglas-fir beetle mortality is scattered throughout the RGNF, with heaviest mortality north of Saguache through Cochetopa Pass and surrounding areas (Figures 2 and 6). In high value spaces such as campgrounds, District personnel could utilize the anti-aggregation pheromone MCH to protect against new attacks.



Figure 2. Douglas-fir mortality caused by Douglas-fir beetle (photo by Amy Lockner).

Pinyon ips (*Ips confusus*) activity has been noted in patches in southwest Colorado (Figure 3). Areas in particular include the Uncompahgre Plateau, the Four Corners area including Canyons of the Ancients National Monument, Colorado National Monument, and the Black Canyon National Park. Adult beetles attack mature pinyon pines from March until the end of October. A significant outbreak occurred from 2002 to 2004, killing millions of pinyon pines over portions of six southwestern states. Where possible, thinning and sanitation of infested trees will reduce the chance of pinyon ips from building up and attacking additional trees.



Figure 3. Pinyon pine mortality caused by pinyon ips (left), with the classic tuning fork gallery caused by the adult ips (right)(Photos by Amy Lockner).



Western spruce budworm (*Choristoneura freemani*) activity decreased from 50,000 acres in 2017 to 20,000 defoliated acres observed by aerial surveyors in 2018. Budworm feeding can cause growth loss, top-kill, and tree mortality, especially in understory trees. A combination of abundant shade tolerant firs, Douglas-fir and spruce and persistent dry, warm weather creates favorable conditions for western spruce budworm outbreaks. 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 3,100 acres of defoliated aspen detected on the Rio Grande NF. Field observations on the Divide Ranger District revealed heavy season-long defoliation south of Antonito on La Manga Pass (Hwy 17) (Figure 4) from the tortrix. Defoliated aspen typically grow new leaves in mid-late summer although canopies may appear thin. Defoliation can lead to tree mortality if it occurs repeatedly over several years, especially during droughts.



Figure 4. An aspen stand defoliated by early July on La Manga Pass (left) and the same stand in mid-September (photos by Amy Lockner).

Dwarf mistletoes cause significant growth loss, and over time can substantially impact forest productivity. Mortality can result when infestations are severe. Douglas-fir dwarf mistletoe (*Arceuthobium douglasii*), is especially damaging on the RGNF. 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.

Hazard Trees are a concern for any space where people congregate. With high levels of pine, fir, and spruce mortality, it is essential that the Rio Grande staff is knowledgeable and ready to manage hazard trees. Root rots and stem rots can render even green trees hazardous. Region 2 holds annual training that offers assistance in identifying and mitigating hazard trees.



FHP Projects:

- Entomologist Amy Lockner participated in a short documentary about the West Fork Complex fire and how trees killed by spruce beetle played a role, titled “Five Years After”. There was a viewing in Creede and Lake City in summer 2018. You can view the documentary by clicking on this link: <https://vimeo.com/275306160>

Gunnison Service Center Forest Health Protection Staff look forward to continued work with the RGNF. Please contact us with your questions and assistance needs with regard to forest disease and insect concerns.

Contacts:

- Amy Lockner, Entomologist, alockner@fs.fed.us, 970-642-4448
- Suzanne Marchetti, Biological Science Technician, sbmarchetti@fs.fed.us, 970-642-4446
- Jim Worrall, Pathologist, retired fall 2018. Until we can fill that position, if you have any plant pathology questions, you can direct them towards Suzanne Marchetti.



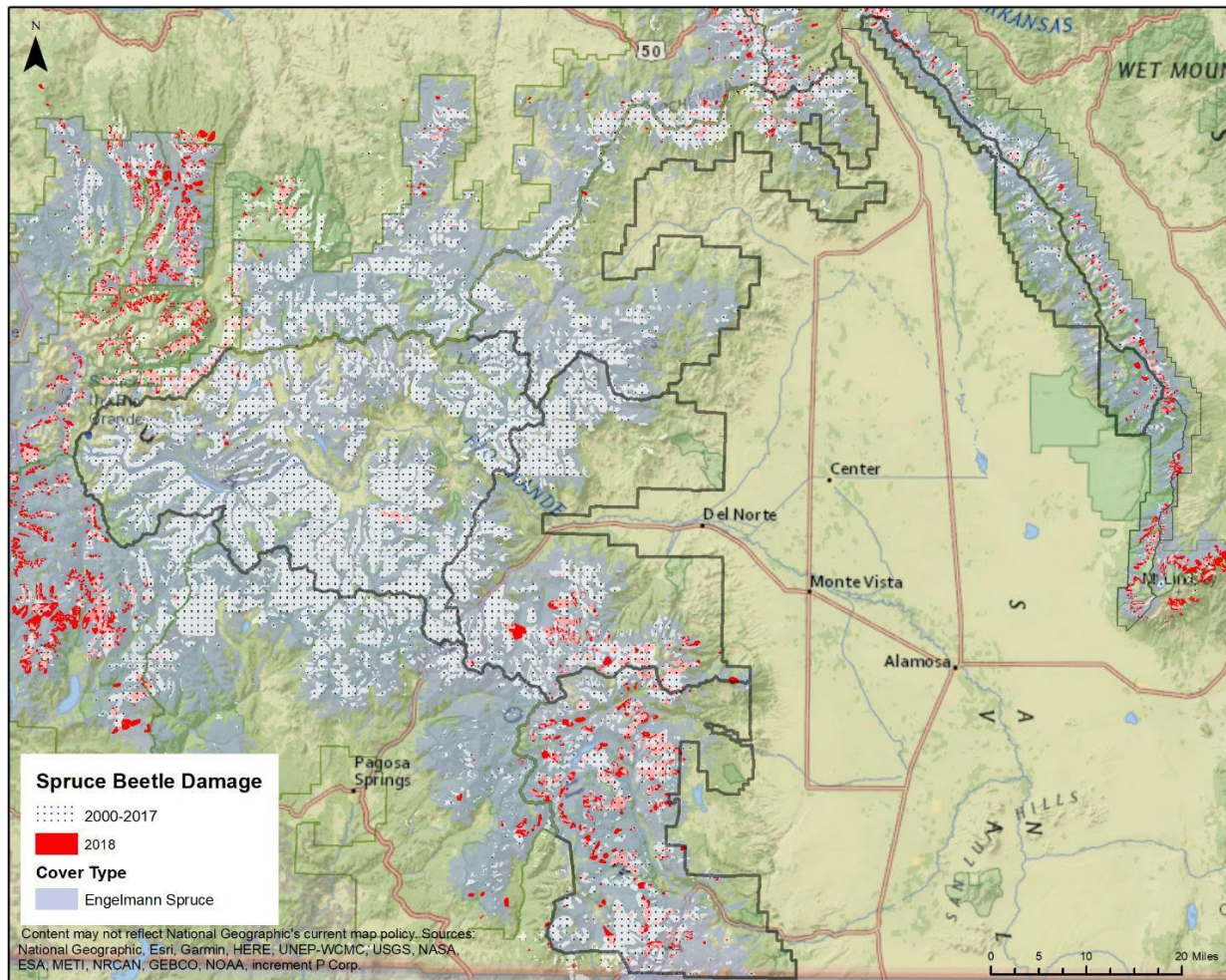


Figure 5. Spruce beetle damage detected by aerial survey, 2000-2018, with Engelmann spruce host cover type.



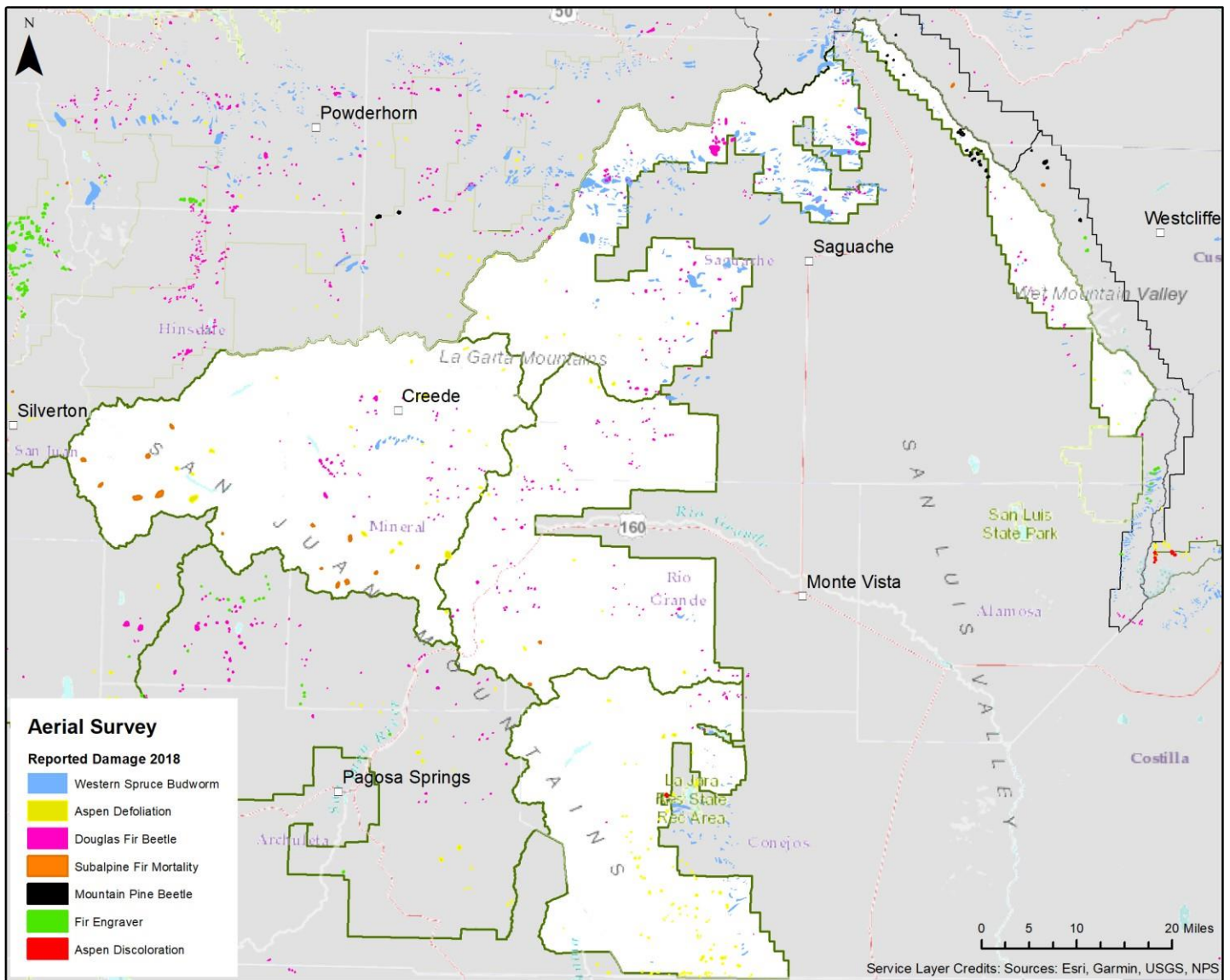
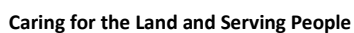


Figure 6. Insects and diseases detected by aerial survey on the Rio Grande National Forest (see Figure 1 for spruce beetle).





2018 Forest Insect and Disease Conditions: San Isabel National Forest

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

Overview

This report provides a summary of forest health conditions based on ground observations, monitoring, and aerial detection surveys (ADS) conducted by Forest Health Protection (FHP) on the San Isabel National Forest (SINF) in 2018.

Spruce beetle (*Dendroctonus rufipennis*) activity was detected by aerial survey on 16,000 acres in 2018 on the San Isabel NF. Of those 16,000 acres, the spruce beetle spread into 5,000 new acres not previously mapped. Expansion onto new acres decreased from 9,000 acres last year. Spruce beetle continues to be most active in the Saguache Mountains, Sangre de Cristo Mountains, Buffalo Peaks Wilderness, and the Wet Mountains (Table 1, Fig. 5). Acres affected by spruce beetle are declining overall in Colorado due to depletion of mature spruce that is the beetle's primary host. However, spruce beetle outbreaks are expected to continue on the SINF where large areas of mature spruce still exist near spruce beetle activity. 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 SINF have used funding from Forest Health Protection to facilitate these projects, and will continue to do so in 2019.

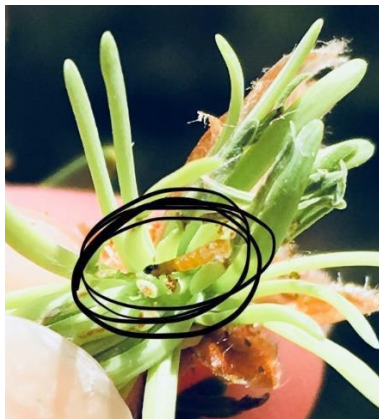


Figure 1. Early instar western spruce budworm larvae feeding on fresh Douglas-fir needles (photo by Amy Lockner).

Western spruce budworm (*Choristoneura freemani*) activity decreased considerably in 2018 with 18,000 acres recorded, compared to 35,000 acres in 2017. Budworm feeding can cause growth loss, top-kill, and tree mortality, especially in understory trees. A combination of abundant shade tolerant firs, Douglas-fir, and spruce and persistent dry, warm weather creates favorable conditions for western spruce budworm outbreaks. 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*) activity continues to stay at a low level on the San Isabel NF. A total of only 110 active acres were recorded by aerial surveyors in 2018; active acres in 2017 was at 140 acres. If Douglas-fir beetle caused tree mortality is noted in or near high value areas such as

campgrounds, District personnel could utilize the anti-aggregation pheromone MCH to protect against new attacks.

Fir engraver (*Scolytus ventralis*) activity recorded by aerial surveyors remained low in 2018 increasing slightly, from only 9 acres in 2017 to 80 acres in 2018. Fir engraver beetles attack white fir boles and branches larger than 4 inches in diameter. Fir engraver beetle populations often increase when trees are drought stressed. 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.

Mountain pine beetle (*Dendroctonus ponderosae*) is currently at very low levels (70 acres mapped this year), having declined quickly from outbreaks in ponderosa and lodgepole pine which occurred on the San Isabel NF more than a decade ago. Mortality observed by aerial survey of high elevation limber pine may be due to mountain pine beetle or to **limber pine engraver beetles** (*Ips woodi*) or a combination of the two bark beetles. Currently, new limber pine mortality occurs east of Saguache, in the Sangre de Cristo mountain range (Figure 6). Several small polygons mapped in 2017 were ground checked in 2018 north of the Culebra Range, and MPB was determined to be the primary tree killer (Figure 2).

Subalpine fir mortality continues on the San Isabel NF, and is still most active in high-elevation stands in the north near Leadville, and a small area in the southern San Carlos District (Figure 6). 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.). The beetle preferentially attacks and kills subalpine fir with root disease (Figure 3) but may attack uninfected trees as well. 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.



Figure 2. A ponderosa pine killed by mountain pine beetle west of La Veta (photo by Amy Lockner).



Figure 3. Western balsam bark beetle on a subalpine fir (photo by Kurt Allen).



White pine blister rust is present on the east side of the range on the San Isabel NF, the west side in the Great Sand Dunes National Park and Preserve, and in the Wet Mountains. 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 uninfested regions in the United States. It infects both limber and bristlecone pines on the SINF and has decimated populations where conditions are favorable. The Great Sand Dunes National Park 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. Infected mature trees become disfigured and can greatly increase spore production. Spores from pines infect the alternate hosts, generally *Ribes* spp., on which other spores are produced to reinfect pine.



Figure 4. Tiger moth creates tents and feeds on the tops of pine species (pinyon pictured here) near Salida (photo by Amy Lockner).

Contacts:

Please contact us for assistance with forest insect and disease concerns or questions.

- Amy Lockner, Entomologist, alockner@fs.fed.us, 970-642-4448
- Suzanne Marchetti, Biological Science Technician, sbmarchetti@fs.fed.us, 970-642-4446
- Jim Worrall, Pathologist, retired fall 2018. Until we can fill that position, direct plant pathology questions to Suzanne Marchetti.



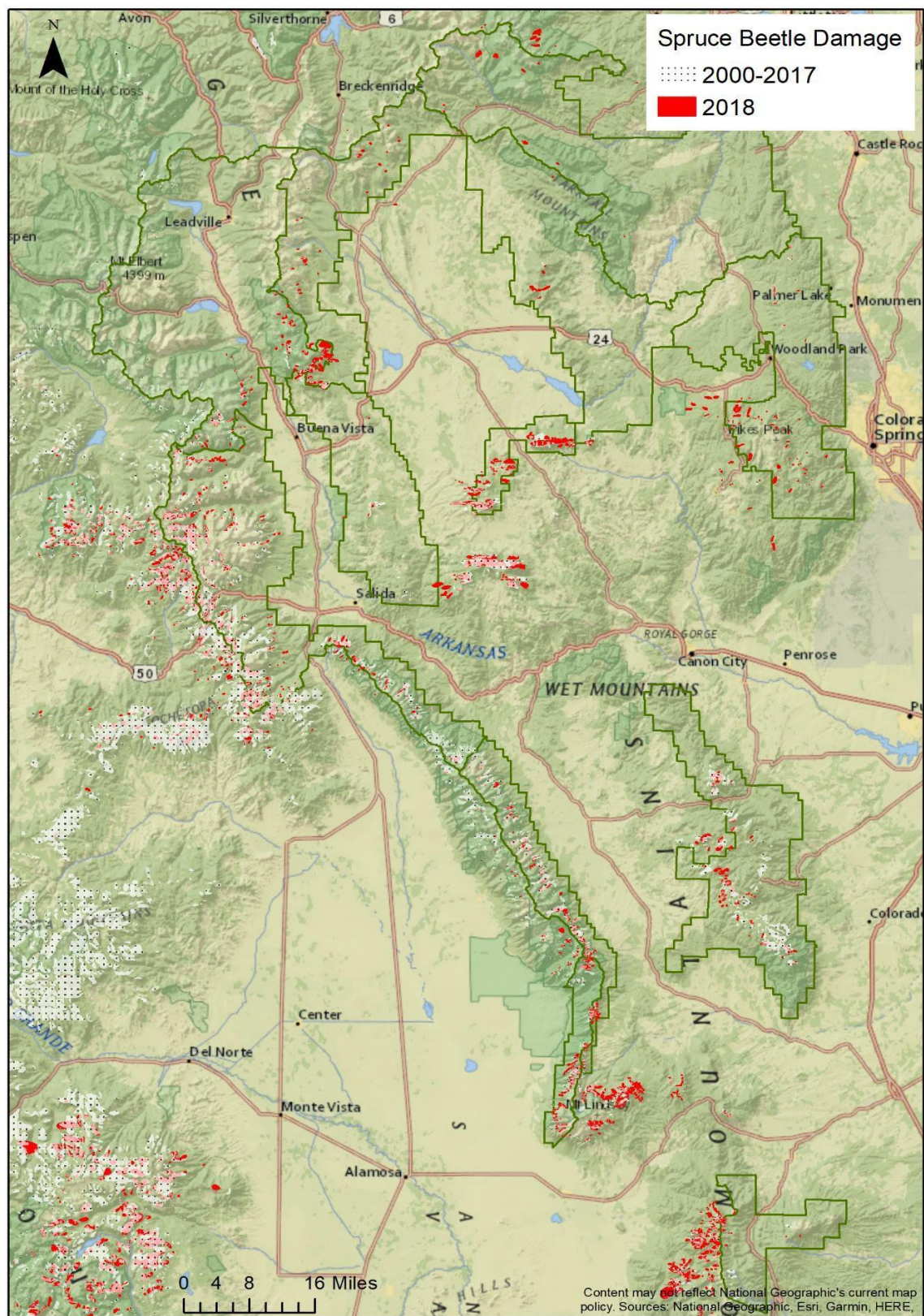


Figure 5. Spruce beetle activity on the San Isabel National Forest.



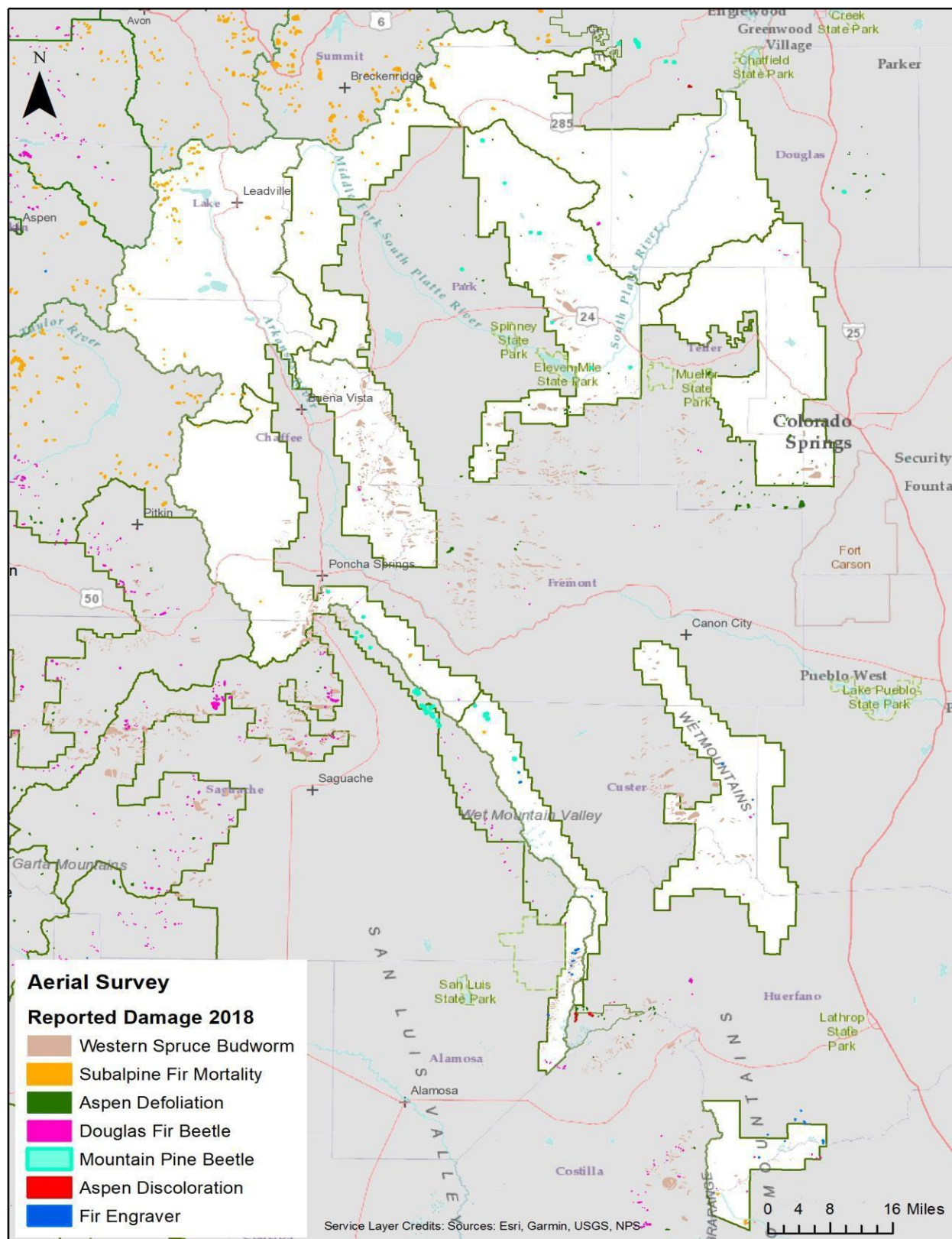


Figure 6. 2018 Aerial survey damage in the Pike-San Isabel National Forest

[Table of Contents](#)



2018 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

The 2018 **water year** brought one of the hottest, driest years on record for the San Juan National Forest (Fig 1, a&b). Not only did that cause broad forest closures and catastrophic fires, but also created stressed forests that lay the foundation for future mortality.

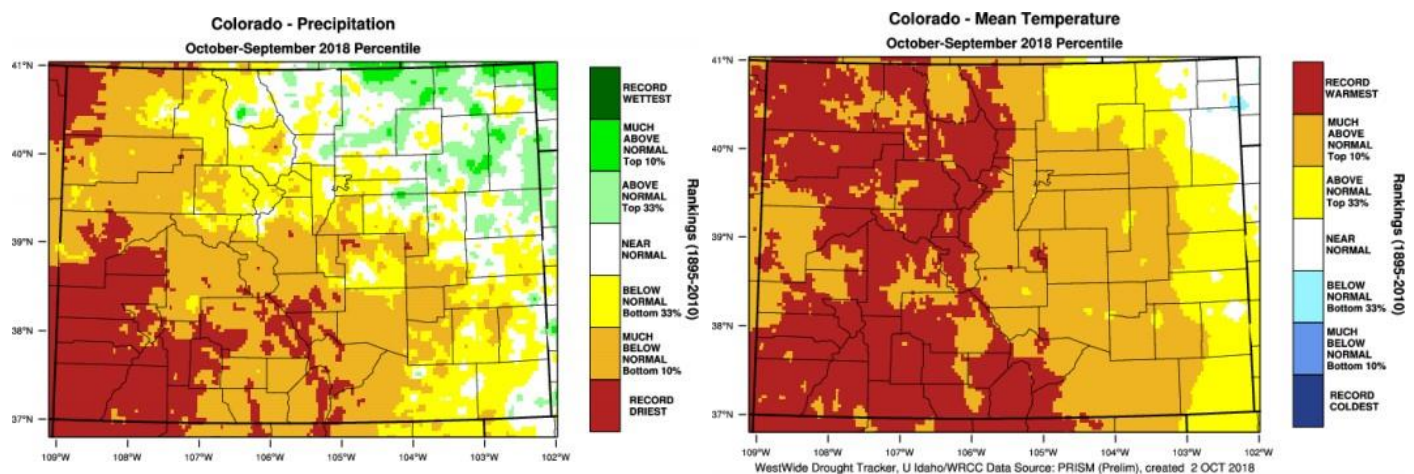


Figure 1, a&b. SW Colorado 2018 water year rankings for precipitation (above, left) and record drought (right), especially in the four corners areas. [More on Colorado's Water Year 2018.](#)

Spruce beetle (*Dendroctonus rufipennis*) was active on 23,000 acres in 2018. Out of the total 23,000 acres, 11,000 new acres were recorded where the agent had not been previously mapped since 1996. Spruce beetle has affected 257,000 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 5 & 6). Management efforts, such as sanitation of infested trees or concentrating beetles in trap trees, can affect spruce beetle populations at a local level, but tend to be ineffective with an outbreak of this magnitude.

Roundheaded pine beetle (*Dendroctonus adjunctus*) is currently the primary mortality agent in ponderosa pine on the San Juan NF. This insect is often part of a bark beetle complex that includes western pine beetles, pine engraver beetles, and/or mountain pine beetles all attacking the same trees. It and associated bark beetles have killed ponderosa pines in Dolores County on the San Juan NF for several years and affected nearly 27,000 acres in 2018 (Figures 2 & 4). The leap from 11,000 to 27,000 is partially an artifact of the aerial survey. Some areas



Figure 2. Ponderosa pine mortality caused by roundheaded pine beetle complex (photo by Dan West, CSFS).

that were previously drawn as small points with high severity mortality were circled as large areas with light mortality because the spots were getting so numerous that the digital sketchmapper was not capturing the data. The persistence and expansion of this outbreak is fueled by favorable weather conditions and abundant hosts. Generally, epidemics of roundheaded pine beetle grow more slowly and are more localized than spruce beetle or mountain pine beetle.

Western spruce budworm (*Choristoneura freemani*) activity increased from 16,000 acres of defoliation to 18,000 acres in 2018. Budworm feeding can cause growth loss, top-kill, and tree mortality, especially in understory trees. A combination of abundant shade tolerant firs, Douglas-fir and spruce and persistent dry, warm weather creates favorable conditions for western spruce budworm outbreaks. 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*) feed on aspen leaves and were the primary cause of visible defoliation of aspen on 4,400 acres on the San Juan NF. The 2018 defoliation delineated by aerial survey was less than half what was reported 2017 (9,200 acres). Defoliation can lead to tree mortality if it occurs repeatedly over several years, especially during droughts. Defoliated aspen typically recover and grow new leaves in summer.

Douglas-fir beetle (*Dendroctonus pseudotsugae*) affected 1,900 acres in 2018, 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 5). In high value areas such as campgrounds, District personnel



could utilize the anti-aggregation pheromone MCH to protect against new attacks. Gunnison Service Center will provide MCH in 2019 for the Treasure Falls Trailhead and West and East Fork Campground areas on the Pagosa Ranger District.

Pinyon ips (*Ips confusus*) activity has been noted in patches in southwest Colorado. Noteworthy areas include the Uncompahgre Plateau, Colorado National Monument, the Black Canyon National Park, and the Four Corners area including Canyons of the Ancients National Monument. Adult beetles attack mature pinyon pines from April until the end of October. A significant outbreak occurred from 2002 to 2004, killing millions of pinyon pines over portions of six southwestern states. Where possible, thinning and sanitation of infested trees will reduce the chance of pinyon ips from building up and attacking additional trees.



Figure 3. Pinyon pine mortality caused by pinyon ips (left), with the classic tuning fork gallery caused by the adult ips (right), on the Uncompahgre Plateau (Photos by Amy Lockner).

Hazard Trees are a concern for any space where people congregate. With high levels of pine, fir, and spruce mortality, it is essential that the San Juan staff is knowledgeable and ready to manage hazard trees. Root rots and stem rots can render even green trees hazardous. At a campground on the Uncompahgre NF, they were managing white fir mortality from both fir engraver and **annosus root disease** (caused by *Heterobasidion occidentale*). Cutting in an annosus prone area can transmit the pathogen, which aggressively colonizes stumps and spreads disease through root contacts. Using Cellu-Treat on the stumps prevents the spread of the disease. Region 2 holds annual training that offers assistance in identifying and mitigating hazard trees.



FHP Projects:

- Entomologist Amy Lockner with Colorado State entomologist Dan West assisted Dave Casey, Mancos Dolores Ranger District, in establishing surveys to better monitor the roundheaded pine beetle epidemic.
- Forest Health Protection will assist in the use of MCH for Douglas-fir beetle in 2019 for the Treasure Falls Trailhead and West and East Fork Campground areas on the Pagosa Ranger District and monitor its effectiveness.

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.

Contacts:

- Amy Lockner, Entomologist, alockner@fs.fed.us, 970-642-4448
- Suzanne Marchetti, Biological Science Technician, sbmarchetti@fs.fed.us, 970-642-4446
- Jim Worrall, Pathologist, retired fall 2018. Until we can fill that position, please direct plant pathology questions to Suzanne Marchetti.



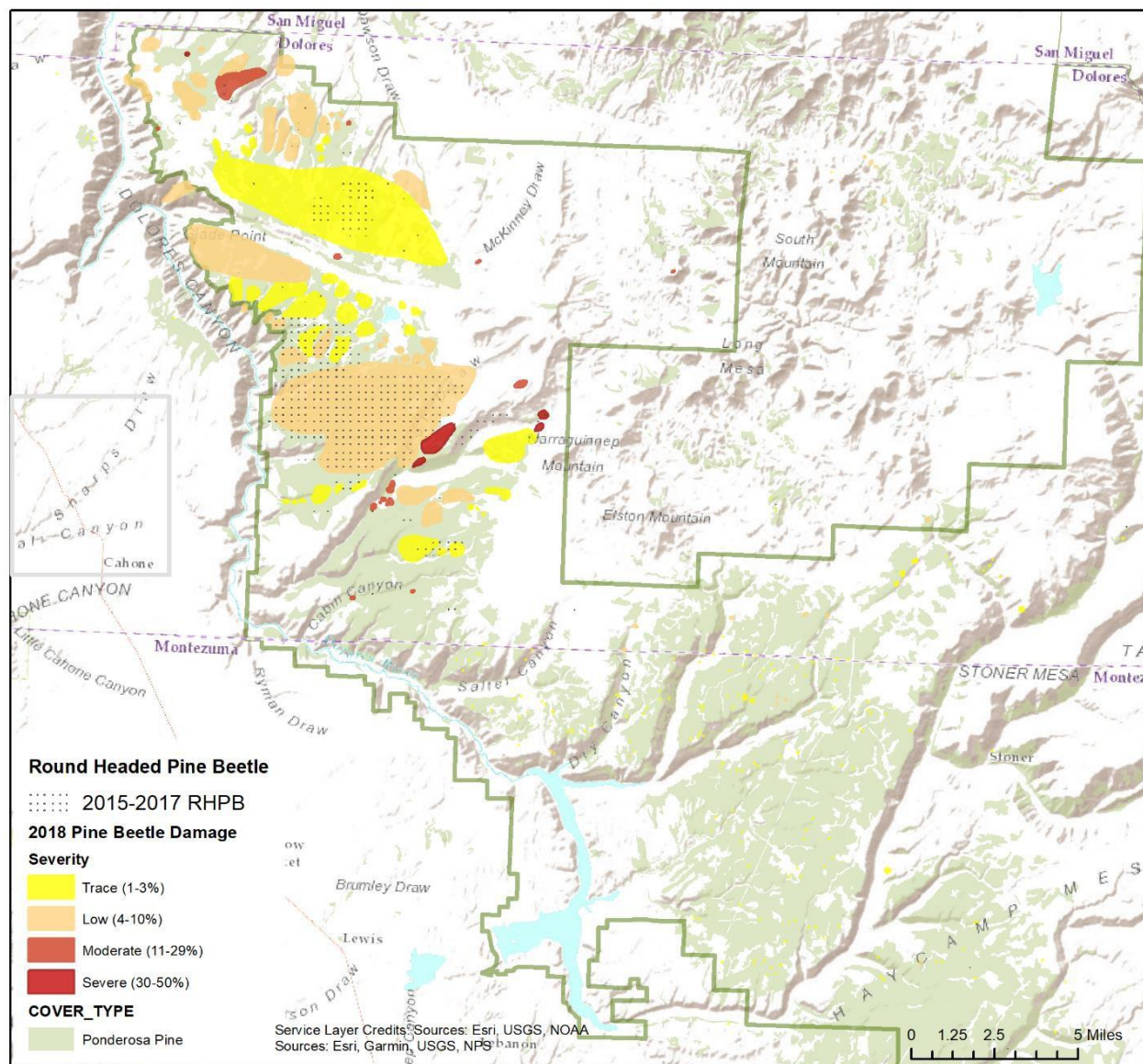


Figure 4. 2018 Ponderosa pine damage. The majority of damage in this area is by roundheaded pine beetle, but there can be a complex of western, pine engraver, and mountain pine beetles.



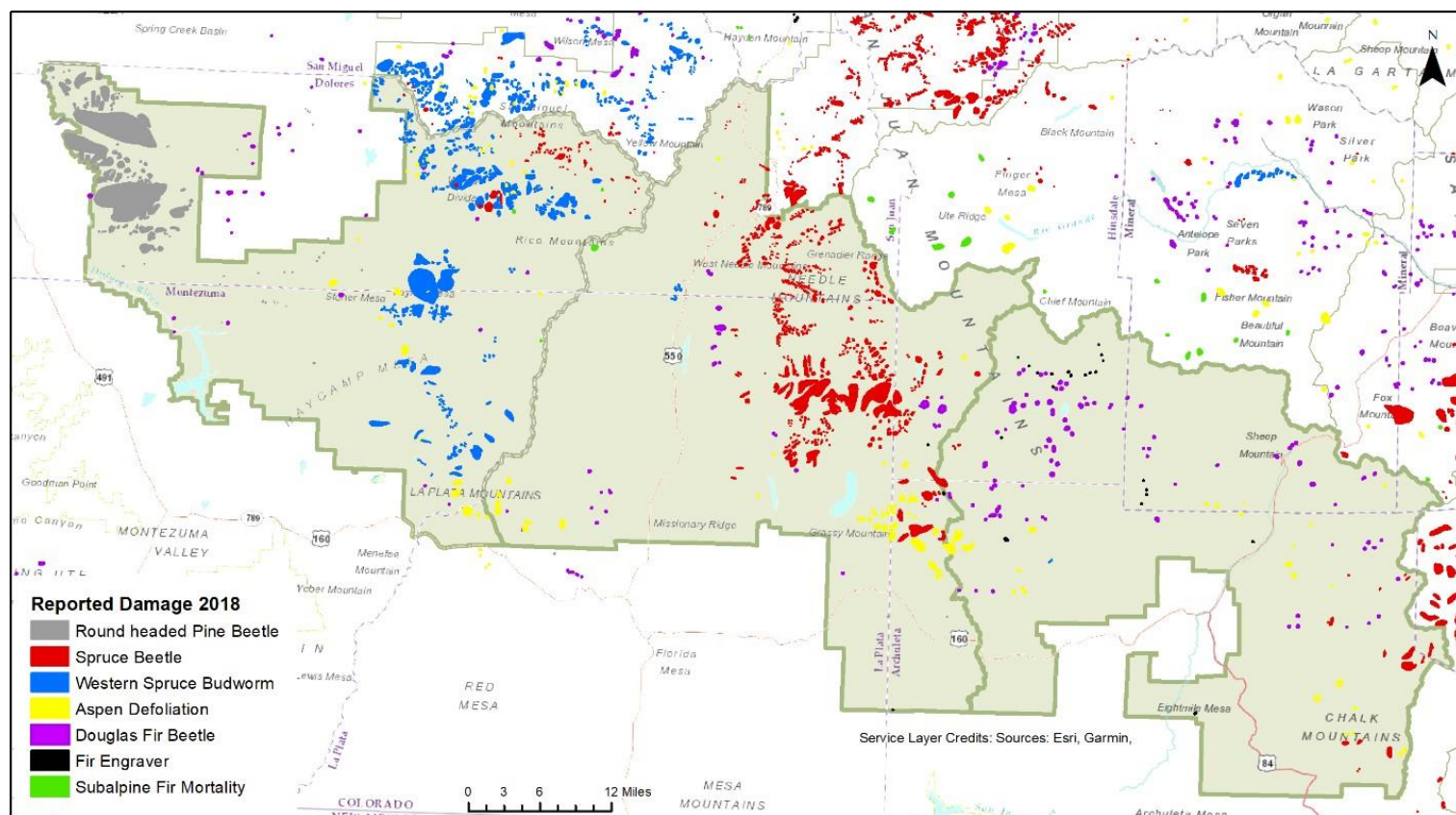


Figure 5. Damage agents mapped and noted by aerial surveyors on the San Juan National forest and surrounding areas.



2018 Forest Insect and Disease Conditions: Shoshone National Forest

Overview

Tree mortality (Figure 1) caused by bark beetles is declining throughout the Shoshone National Forest. In the Wind River Ranger District spruce beetle activity has resulted in 8,800 acres of spruce mortality, a decrease of 500 acres from 2017 levels.

Mountain pine beetle caused mortality was only detected on 30 acres. The epidemic that had affected the forest is now over. Western balsam bark beetle caused mortality of subalpine fir was down to only 50 acres detected.

Douglas-fir defoliation by western spruce budworm has continued within the Clarks Fork District and has increased on the Washakie District. The acres detected have increased from 9,000 acres in 2017 to 21,000 acres in 2018. The heaviest defoliation is occurring on Douglas-fir, often with defoliation of 50-100% of mature tree crowns being stripped of foliage. Seedlings and saplings are also being heavily defoliated in these areas, but are difficult to observe from the air. Mortality of both mature trees and seedlings is occurring due to the multiple years of heavy defoliation (Figure 2).

There were 350 acres of aspen defoliation detected, mostly caused by Marssonina leaf spot. It appears that a favorable weather pattern led to this high level of this disease.

Other persistent disease problems are often not detected during aerial detection survey, but are widespread and causing damage across the forest. These include: dwarf mistletoe (affecting lodgepole, limber, and whitebark pines), white pine blister rust, and commandra blister rust disease (impacting lodgepole pines) (Figures 3 and 4).

Additionally, there was some significant winter desiccation damage to trees on the forest and just outside the forest in 2018. This was found mostly on the north end of the forest (Figure 4).

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-18- 6.

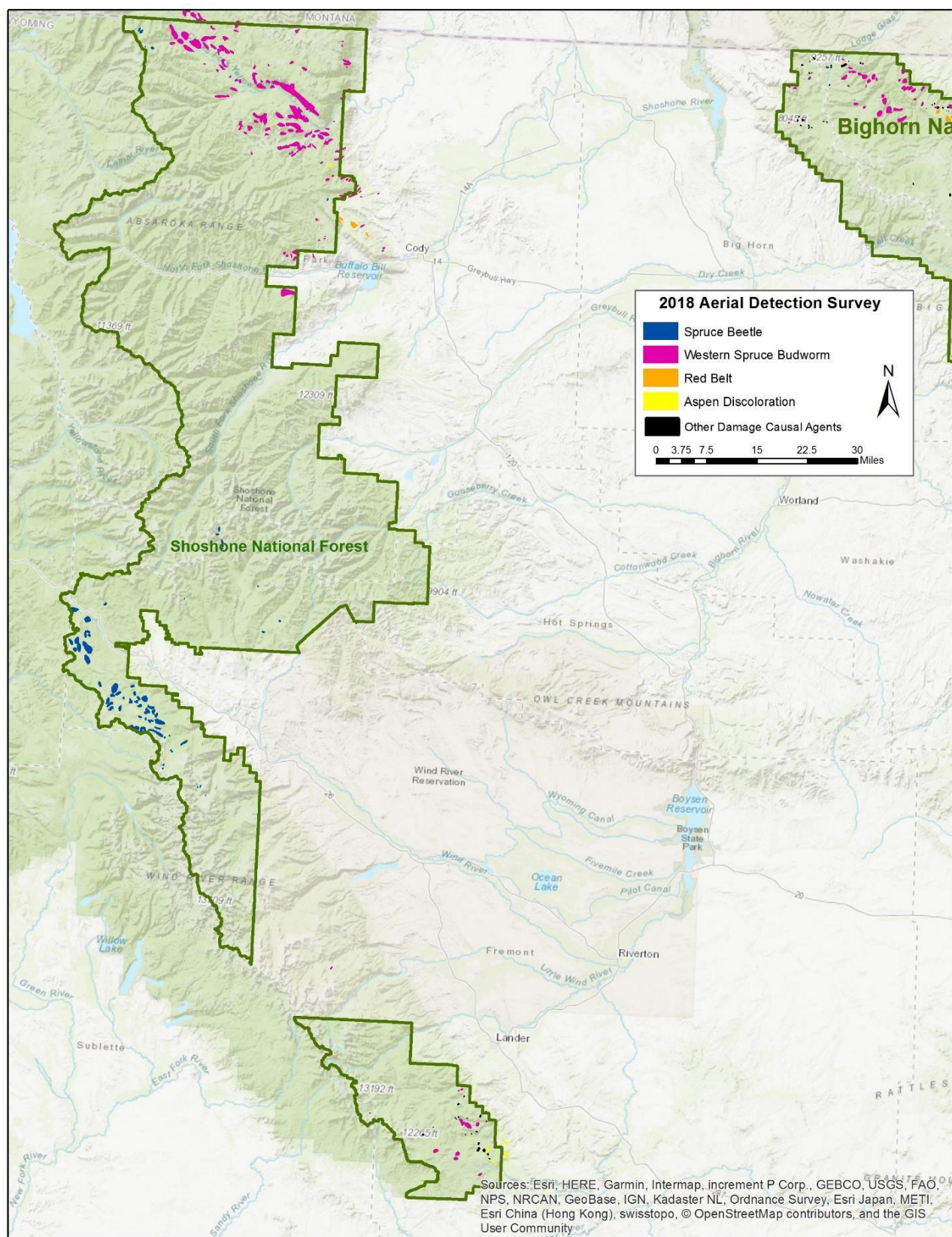


Figure 1. Aerial detection range survey map of the Shoshone National Forest, 2018.



Figure 2. Tree defoliation and mortality from spruce budworm and budworm egg mass on needle.



Figure 3. White pine blister rust on whitebark pine and dwarf mistletoe on lodgepole pine.

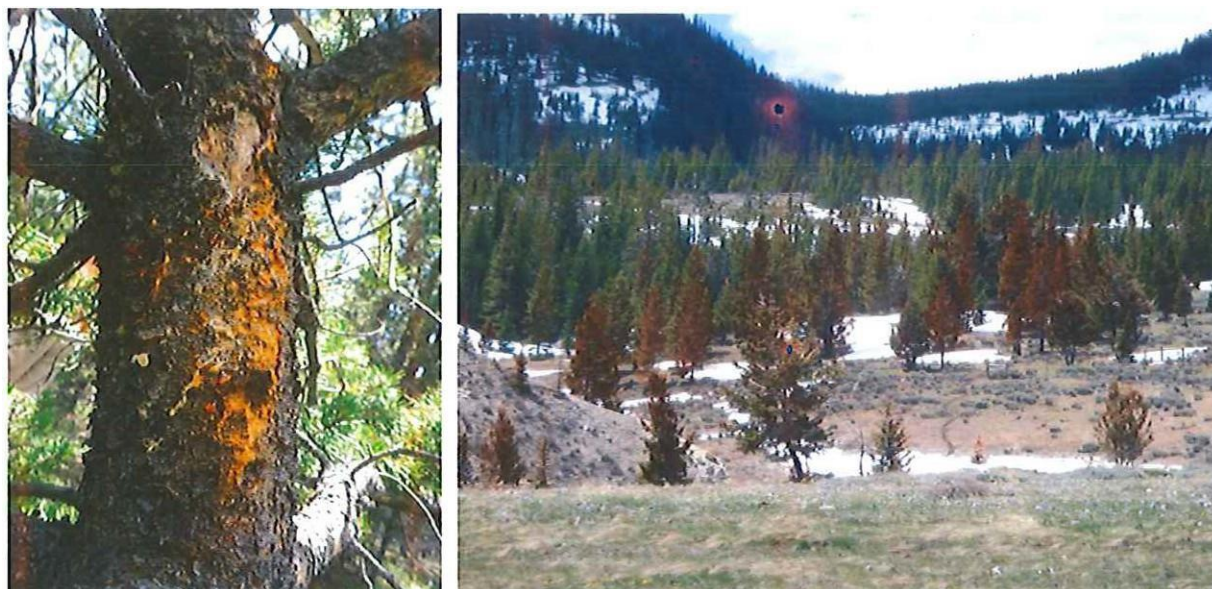


Figure 4. Commandra blister rust on lodgepole pine and winter damage on multiple tree species.

Mortality in subalpine fir stands. Low levels of subalpine fir mortality occur across the forest.

A look at how much mortality is occurring and what agents are most responsible, such as the western balsam bark beetle were documented. Report RCSC-18- 9.

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

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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 South Mt. Rushmore Rd.

Rapid City, SD 57702

[Table of Contents](#)

2018 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

This report provides a summary of forest health conditions based on ground observations, monitoring, and aerial detection surveys (ADS) conducted by Forest Health Protection (FHP) on the White River National Forest (WRNF) in 2018.

Subalpine fir mortality occurs in subalpine forests across the White River NF. It decreased considerably from 2017 to 2018 (20,000 acres to 5,200 mapped by aerial surveyors), but is still the most common damage on the Forest (Table 1, Figure 4). It occurs consistently in mature spruce-fir forests across the Region. Subalpine fir mortality is most often caused by **western balsam bark beetle** (*Dryocoetes confusus*) and **Armillaria root disease** (caused by *Armillaria* spp.) (Figure 1). 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.

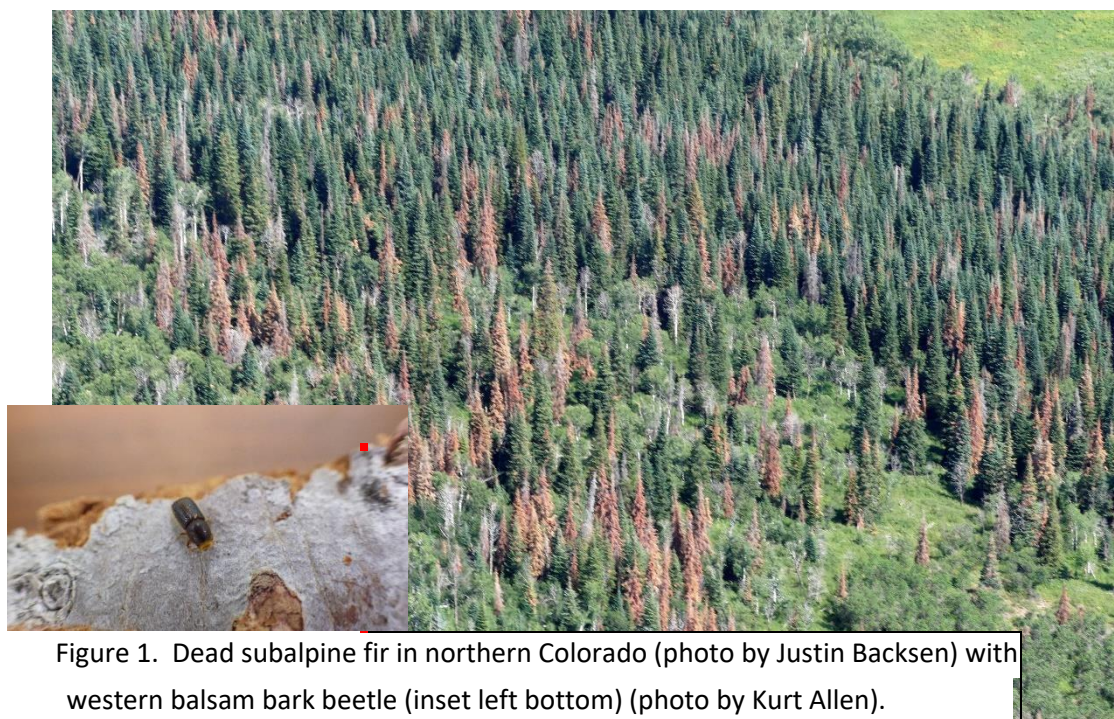


Figure 1. Dead subalpine fir in northern Colorado (photo by Justin Backsen) with western balsam bark beetle (inset left bottom) (photo by Kurt Allen).

Western spruce budworm (*Choristoneura freemani*) activity decreased on the White River NF from 13,000 acres mapped by aerial surveyors in 2017 to only 780 in 2018. Aerial surveyors may have difficulty seeing budworm activity if the weather is poor (cloudy, smoke from fires, low light, etc). 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. Multistoried stands of shade tolerant true firs and Douglas-fir are especially favorable budworm habitat. 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.



Figure 2. Early instar western spruce budworm larvae feeding on fresh Douglas-fir needles (photo by Amy Lockner).

Douglas-fir beetle (*Dendroctonus pseudotsugae*) affected 2,300 acres in 2018; 2,000 acres are new areas not previously mapped by aerial survey. Mortality is most concentrated north of Aspen and east of Carbondale (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. 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 have utilized the anti-aggregation pheromone MCH to protect against new attacks. The Aspen-Sopris RD deployed MCH on Buttermilk Ski area in 2018; additional applications should be made and Gunnison Service Center will supply the MCH in 2019.

Spruce beetle (*Dendroctonus rufipennis*) was mapped by aerial surveyors on only 7 acres in 2018 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*). 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 consider dwarf mistletoe may increase disease abundance and severity.



Figure 3. Lodgepole pine dwarf mistletoe on lodgepole pine at Prospector campground, Dillion RD.

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 infected in these stands. This disease poses a threat to regenerating lodgepole pine in campgrounds and stands previously affected by mountain pine beetle. If infected trees are not removed, the disease will spread through the regeneration, 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.



Table 1. 2018 Acres of major damage agents detected in aerial survey on the White River NF.

Agent	2018 Acres Affected	2017 Acres Affected	1996-2018 Cumulative Acres Affected	2018 New Acres Affected ^b
Subalpine fir mortality	5,200	20,000		
Douglas-fir beetle	2,300	2,300	33,000	2,000
Western spruce budworm	780	13,000		
Aspen defoliation	70	3,000		
Fir Engraver	7	0		
Spruce beetle	7	160	31,000	0
Mountain pine beetle	0	10	386,000	0

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.

Contacts:

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.

Gunnison Service Center (All but Dillon Ranger District)

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- Jim Worrall, Pathologist, retired last fall. Until we can fill that position, please direct plant pathology questions to Suzanne Marchetti.

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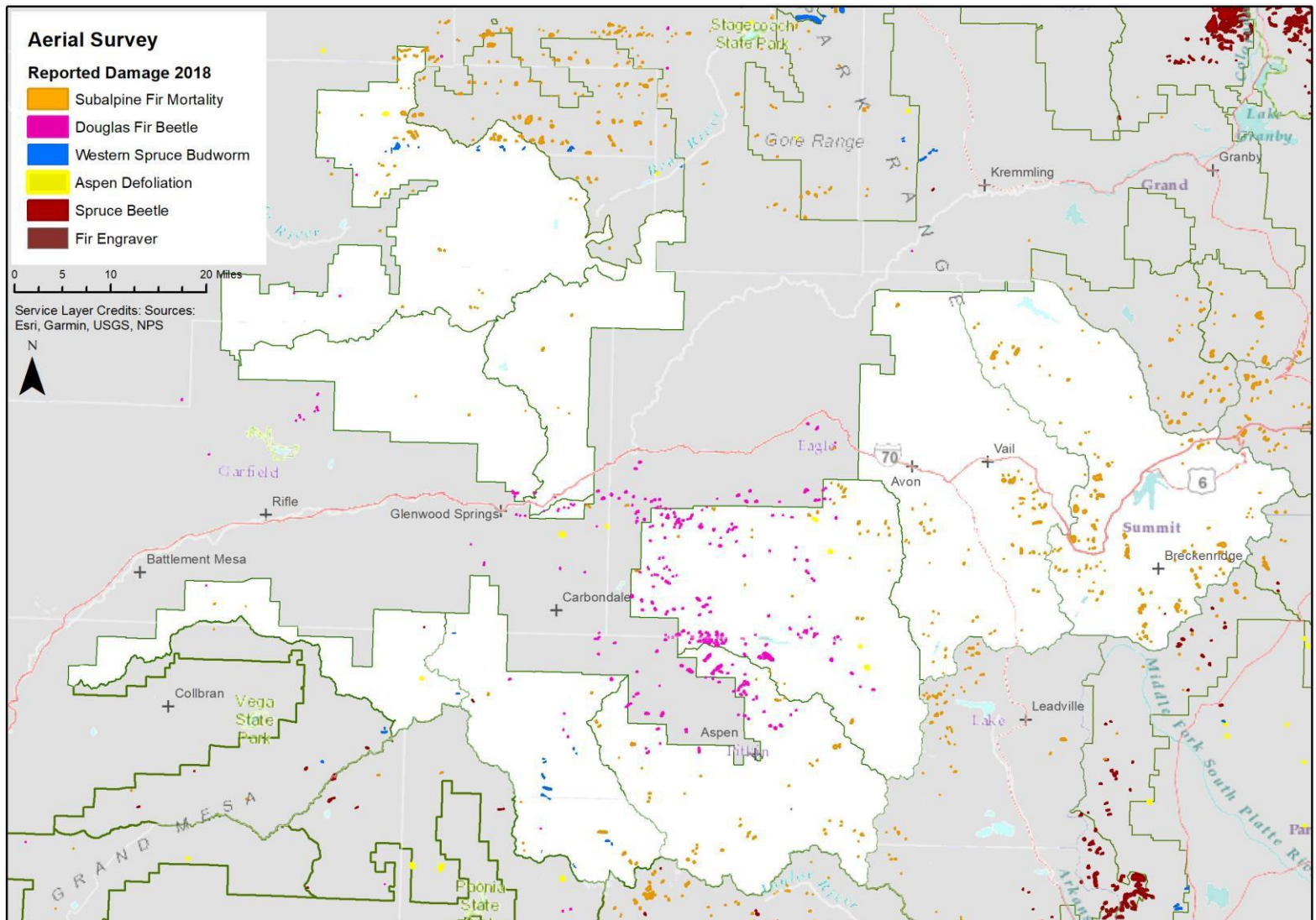


Figure 4. Insect and disease activity mapped by aerial survey on the White River NF in 2018.

[Table of Contents](#)



2018 Mountain Pine Beetle Activity

Includes All Hosts

States	2017 Acres Affected	2018 Acres Affected	1996-2017 Cumulative Acres Affected	1996-2018 Cumulative Acres Affected
Colorado	880	470	3,375,000	3,375,000
Wyoming – R2	3,000	210	2,043,000	2,043,000
CO plus S.WY	1,300	490	4,284,000	4,284,000
South Dakota	2,900	210	433,000	433,000
Nebraska	8	0	470	470

2018 Spruce Beetle Activity

States	2017 Acres Affected	2018 Acres Affected	1996-2017 Cumulative Acres Affected	1996-2018 Cumulative Acres Affected
Colorado	206,000	178,000	1,782,000	1,841,000
Wyoming – R2	11,000	9,000	568,000	570,000
CO plus S.WY	208,000	178,000	1,903,000	1,962,000
South Dakota	30	0	130	130

2018 Douglas-fir Beetle Activity

State	2017 Acres Affected	2018 Acres Affected	1996-2017 Cumulative Acres Affected	1996-2018 Cumulative Acres Affected
Colorado	14,000	14,000	433,000	444,000
Wyoming – R2	210	20	330,000	330,000
CO plus S. WY	14,000	14,000	448,000	459,000

2018 Western Balsam Bark Beetle Activity

States	2017 Acres Affected	2018 Acres Affected
Colorado	50,000	24,000
Wyoming – R2	8,500	3,900
CO plus S.WY	56,000	27,000

2018 Fir Engraver

State	2017 Acres Affected	2018 Acres Affected
Colorado	2,500	1,400

[Table of Contents](#)

Colorado 2018 Forest Health Highlights

Forest insects and diseases are primary natural drivers in the dynamics of forest ecology. A primary example in Colorado is tree-killing bark beetles. During outbreaks, these beetles attack trees in mature, often overly dense forests, setting the stage for the replacement of older, less healthy trees with younger, more vigorous ones. These outbreaks, on the other hand, also can affect many of the values that humans place on forests, including timber production, wildlife habitat, recreation and watershed protection.

A key part of forest management is the regular monitoring for damage caused by forest pests. In Colorado, the primary source of information on forest pest conditions is an annual aerial forest health survey. This is a cooperative program that involves specialists from the U.S. Forest Service (USFS), Rocky Mountain Region and the Colorado State Forest Service (CSFS).

Trained aerial observers from both agencies fly over the majority of the state's 24.4 million acres of native forests in small aircrafts, to map and classify the intensity of the current year's damage. When necessary, some areas flown also are ground-checked to verify the agent (i.e. insect) responsible for the damage and/or the severity of damage.

Another important source of information for this report is field visits made by CSFS foresters. These experts identify and assess forest pest activity, while advising private landowners – who together own 30 percent of the state's forests – on how to best manage their forests. CSFS foresters also are directly responsible for management of state - owned forestlands, including State Trust Lands, and for conducting state wide forest inventories. Additionally, in cooperation with other agencies such as the Colorado Department of Agriculture, USDA Animal and Plant Health Inspection Service (APHIS) and USFS, the CSFS is involved in the design and implementation of special surveys

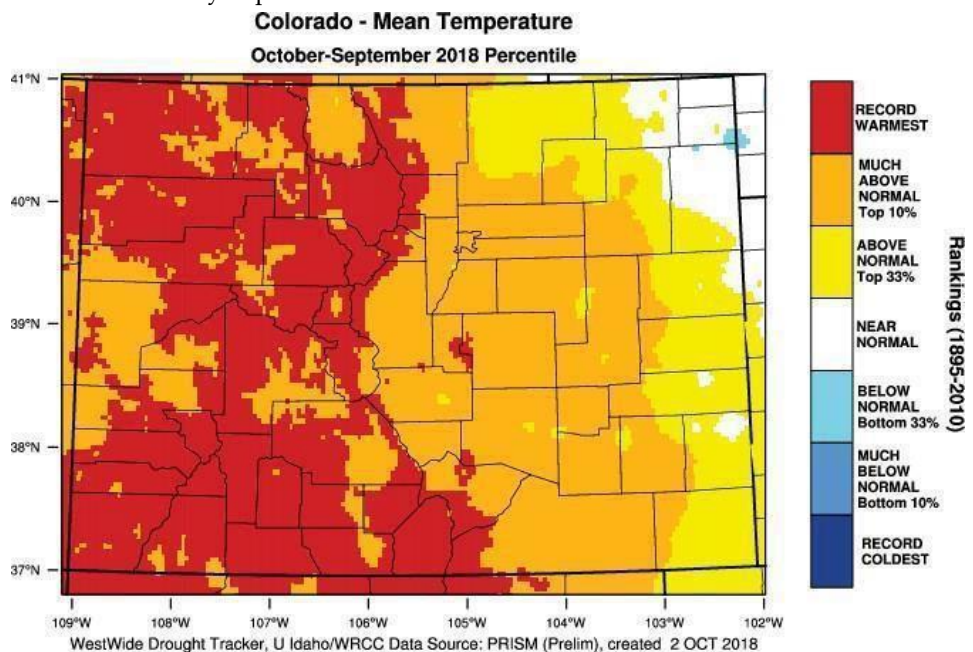
Highlights for 2018

According to the National Oceanic and Atmospheric Administration, Colorado experienced the warmest annual temperatures on record (spanning the last 124 years) during the water year of October 2017 through September 2018. During that same period, precipitation levels state wide plummeted to the second driest on record, dating back to 1895. The southwest quadrant of the state was the warmest and driest region, while precipitation in the northeast quadrant of the state was near average. The Western Slope saw a record number of days with highs exceeding 90 degrees F, and record-low precipitation values.

These dramatic shifts in annual temperature and precipitation levels have real implications for forest insect and disease activity. Forest disturbance from epidemic bark beetle populations tracks closely with long-term precipitation levels and temperature patterns. Warmer temperatures during the winter months also reduce over-winter beetle and larvae mortality, while lower than average precipitation may reduce one important line of tree defense: the ability to produce

enough sap to resist insects attempting to enter through the bark. The warmer temperatures and drought conditions in 2018 thus played a powerful role in shaping forest insect and disease activity in the state, which included the following impacts:

- For the seventh consecutive year, Colorado's most widespread and destructive forest insect pest was the spruce beetle. This insect has now affected more than 1.8 million cumulative acres since 2000, or approximately 40 percent of the state's spruce-fir forests. A total of 178,000 acres of active infestations occurred in high-elevation Engelmann spruce forests throughout the state in 2018. Of those, a total of 59,000 new, or previously uninfested, acres were affected. An ongoing four-year trend of a high number of newly infested acres indicates a continuing spread of spruce beetle into previously uninfested forests. Susceptible Engelmann spruce forests exist in the northern and central portions of the state, indicating that this insect has the potential to affect more new areas in the upcoming year.



Colorado experienced the warmest annual temperatures on record during the water year from October 2017 through September 2018. Image: Western Regional Climate Center

- Roundheaded pine beetle and associated native bark beetles continue to affect more acres of ponderosa pine in Dolores County, with 27,000 acres impacted in 2018. Although not all acres are intensely infested, impacts in affected acres have significantly increased since 2012. Record - low precipitation values in the county have weakened tree defenses, providing an environmental window favoring increased beetle populations in the coming year.
- For the past several years, Douglas-fir beetle has continued to attack and kill mature Douglas-fir trees in the central and southern portions of the state. In 2018, Gunnison, Hinsdale and Saguache counties were heavily affected in the south-central portion of the state, while Eagle, Mineral, and Pitkin counties also were heavily affected. Approximately 14,000 total acres were impacted statewide, with 11,000 acres being new.
- Western spruce budworm defoliated 131,000 acres of Douglas-fir, whitefir and spruce in central and southern Colorado.
- White fir mortality declined across all affected areas, and for the fourth consecutive year, mortality from the fir engraver beetle declined in and around Ouray. Localized activity occurred in Archuleta County and continues to be at only background levels elsewhere. Tree mortality occurred on 1,400 acres statewide.
- Western balsam bark beetle and associated root disease fungi persisted throughout Colorado's spruce-fir forests, causing tree mortality over 24,000 acres of high- elevation subalpine fir.
- Emerald ash borer, an exotic pest, still has not been detected outside of Boulder County, where it was first confirmed in 2013. Early detection of this invasive remains challenging, but new detections in 2018 occurred in the communities of Lyons and Superior.



Spruce beetle-caused mortality of high-elevation Engelmann spruce in the San Juan National Forest. Photo: Dan West, CSFS

- Japanese beetle infestations in Boulder, Denver and Pueblo were at the highest levels ever reported in Colorado. Most communities from Fort Collins and Greeley south to Pueblo, along the Front Range, are now affected.

Indigenous Pests Conifer Forests

Spruce Beetle

(Dendroctonus rufipennis)

Spruce beetle is the most damaging pest of mature spruce forests in North America, and was the most damaging forest pest in Colorado for the seventh consecutive year. These small, native bark beetles infest the state's high-elevation Engelmann spruce, usually above 9,000 feet in elevation, and occasionally Colorado blue spruce. They live and develop in a thin layer of inner bark, between the thicker sapwood and outer bark. Feeding by developing larvae girdles the tree, causing spruce needles to fade in color from green to light yellow, and eventually to a reddish-brown color.

Spruce beetles typically produce another generation within two years. Adults emerge and fly to seek new host trees

from late May through July, preferring large-diameter trees until these have been depleted from the forest. As the spruce beetle moves through contiguous stands of Engelmann spruce, its host type is depleted, which has resulted in less actively affected acreage since 2014.

In 2018, severe outbreaks continued in portions of the San Juan Mountains, West Elk Mountains and Sawatch Range; the southern reaches of the Sangre de Cristo Mountains through the Culebra Range; and portions of north-central Colorado west of the Continental Divide, in and around Rocky Mountain National Park, in Grand and Larimer counties. Susceptible contiguous Engelmann spruce forests exist between expanding outbreaks in the northern and central portions of the state, indicating that the spruce beetle has the potential to affect new areas in the upcoming year.

- Spruce beetle has affected 1.84 million cumulative acres in Colorado from 2000 to 2018.
- Although some acres are more intensely affected than others.



Boring dust on a downed Engelmann spruce tree on the Alpine Plateau, Gunnison County. The dust results from spruce beetles entering the tree. Photo: Kelsey Lesniak, CSFS

- 178,000 actively affected acres of Engelmann spruce forest were observed in 2018, compared with 206,000 acres in 2017.
- 59,000 “new,” or previously uninfested, acres were detected statewide in 2018, compared to 67,000 new acres in 2017.
- Infestations intensified in 2018 in Rocky Mountain National Park and in the Sawatch Range, Culebra Mountains and San Juan Mountains.
- Notable counties affected by new acres in 2018:

Colorado County	2017 Acres Affected	2018 Acres Affected	1996-2018 Cumulative Acres Affected	Previously Uninfested Acres
Costilla	4,800	8,900	16,000	6,300
Park	5,300	8,700	13,000	6,100
Gunnison	40,000	20,000	140,000	6,000
LaPlata	9,200	13,000	41,000	6,000
Larimer	9,500	18,000	92,000	5,000
Grand	5,800	17,000	70,000	5,000
Hinsdale	22,000	19,000	275,000	3,000

- Counties affected by the most cumulative acres through 2018:

Colorado County	2017 Acres Affected	2018 Acres Affected	1996-2018 Cumulative Acres Affected
Hinsdale	22,000	19,000	275,000
Mineral	590	1,400	236,000
Saguache	18,000	4,400	217,000
Gunnison	40,000	20,000	140,000
Conejos	18,000	19,000	104,000
Rio Grande	18,000	9,900	95,000

[Data on all counties](#)

Mountain Pine Beetle

(Dendroctonus ponderosae) Another native bark beetle, mountain pine beetle, infests all pine species naturally found in Colorado. Populations reproduce once every year, requiring new, live trees to complete development. Adults fly to green trees typically from late June into early August in Colorado.

Aside from localized spot activity, populations remain at endemic – or background – levels statewide. Infestations in ponderosa, limber and bristlecone pines continued at low levels in the northern and central Sangre de Cristo Mountains. Localized spot activity occurred throughout the Front Range, impacting ponderosa and lodgepole pines, although other native bark beetles in the *Ips* genus may also have contributed to some localized impacts.

- 2018 saw the lowest acreage impacted by mountain pine beetle statewide in two decades.
- Notable counties with mountain pine beetle-caused mortality in 2018:

Colorado County	2017 Acres Affected	2018 Acres Affected	1996-2018 Cumulative Acres Affected
Saguache	100	180	43,000
Jefferson	90	140	36,000
Custer	50	70	36,000

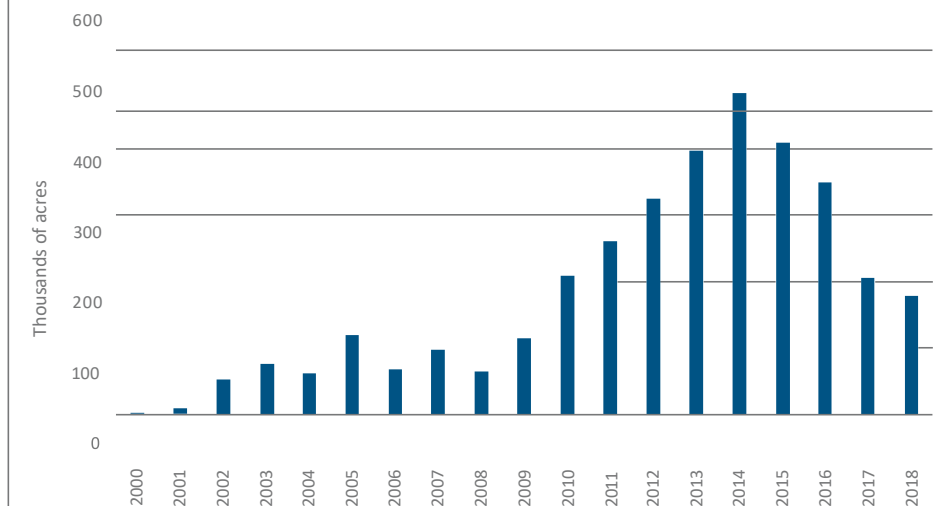
Roundheaded Pine Beetle

(Dendroctonus adjunctus)

The roundheaded pine beetle is also native to Colorado, being a bark beetle closely related to mountain pine beetle, spruce beetle and Douglas-fir beetle. The range of this bark beetle extends north into Colorado from as far south as Guatemala; southern Colorado is the northern most extent of its range. Ponderosa pine is the only primary host tree species in the United States, though other pine species are attacked throughout Mexico and into Central America.

In Colorado, trees are attacked later in the year than with other Colorado bark beetles, from late August through November. With only one generation flying per year, these beetles attack a wide range of tree sizes and ages, typically after a prolonged drought period. Outbreaks south of Colorado's border are typically short in duration, though contiguous ponderosa pine forests in Dolores County have

Forested Acreage Affected by Spruce Beetle in Colorado, 2000-2018



sustained increased mortality for the seventh consecutive year.

Roundheaded pine bark beetles are often associated with several other species of bark beetles, typically western pine beetle (*D. brevicornis*), pine engraver beetles (*Ips* spp.) and mountain pine beetle (*D. ponderosae*). These associated bark beetles, working in conjunction with one another, produce a “bark beetle complex” that results in tree injury and death.

Approximately 27,000 acres were affected in 2018, compared to 11,000 acres in 2017, as the infestation intensified in Dolores County. However, many of those acres were of low intensity, where the complex affected only small groups of trees.

Douglas-fir Beetle

(*Dendroctonus pseudotsugae*)

Douglas-fir beetle, another close relative of spruce beetle and mountain pine beetle, is an important native bark beetle

of mature Douglas-fir forests across most of the West. Outbreaks tend to be associated with overly dense forests containing mature Douglas-fir, during extended periods of below-normal precipitation. Adults typically seek new trees to attack from May through September.

Widespread groupings of tree mortality occurred in 2018, in portions of the northern Sawatch Range near the community of Carbondale; northern areas of the La Garita Mountains, south of the community of Gunnison; the Needle Mountains near Lake City; and the San Miguel River drainage around the community of Telluride in the San Juan Mountains.

- 14,000 acres of forests comprising Douglas-fir were impacted in 2018.
- 11,000 new, previously uninfested acres of Douglas-fir were impacted statewide.
- Notable counties with the most newly infested acres in 2018:

Colorado County	2017 Acres Affected	2018 Acres Affected	1996-2018 Cumulative Acres Affected	Previously Uninfested Acres
Saguache	2,500	2,700	42,000	2,700
Gunnison	1,900	2,600	37,000	2,600
Hinsdale	1,100	1,800	16,000	1,000
Eagle	500	1,500	12,000	1,000
Pitkin	590	1,400	13,000	1,000

Western Balsam Bark Beetle/ Root Disease Complex

Disturbance caused by western balsam bark beetle (*Dryocoetes confusus*) and several species of fungi that cause root decay has remained persistent for many years now, in Colorado’s high-elevation subalpine fir.

Actively affected acres from western balsam bark beetle decreased by approximately 50 percent in 2018. This is not highly significant, however, as the area affected may vary from year to year, though is typically relatively low in intensity in the absence of localized drought conditions.



A grouping of ponderosa pines killed by roundheaded pine beetle/associated native bark beetles in San Juan National Forest, Dolores County. Photo: Dan West, CSFS

Several areas of significant damage occurred in the Flat Tops Wilderness and Mount Zirkel Wilderness near Steamboat Springs; the Sawatch Range near the town of Aspen; and along the northern portion of the Front Range in 2018.

- 24,000 acres of high-elevation, mixed-conifer forests comprising subalpine fir were affected in 2018, compared to 50,000 acres in 2017.
- Notable counties affected in 2018:

Colorado County	2017 Acres Affected	2018 Acres Affected
Gunnison	6,400	3,600
Grand	4,400	2,800
Summit	1,900	2,700
Larimer	4,400	2,600
Routt	2,400	2,500
Rio Blanco	2,500	1,900

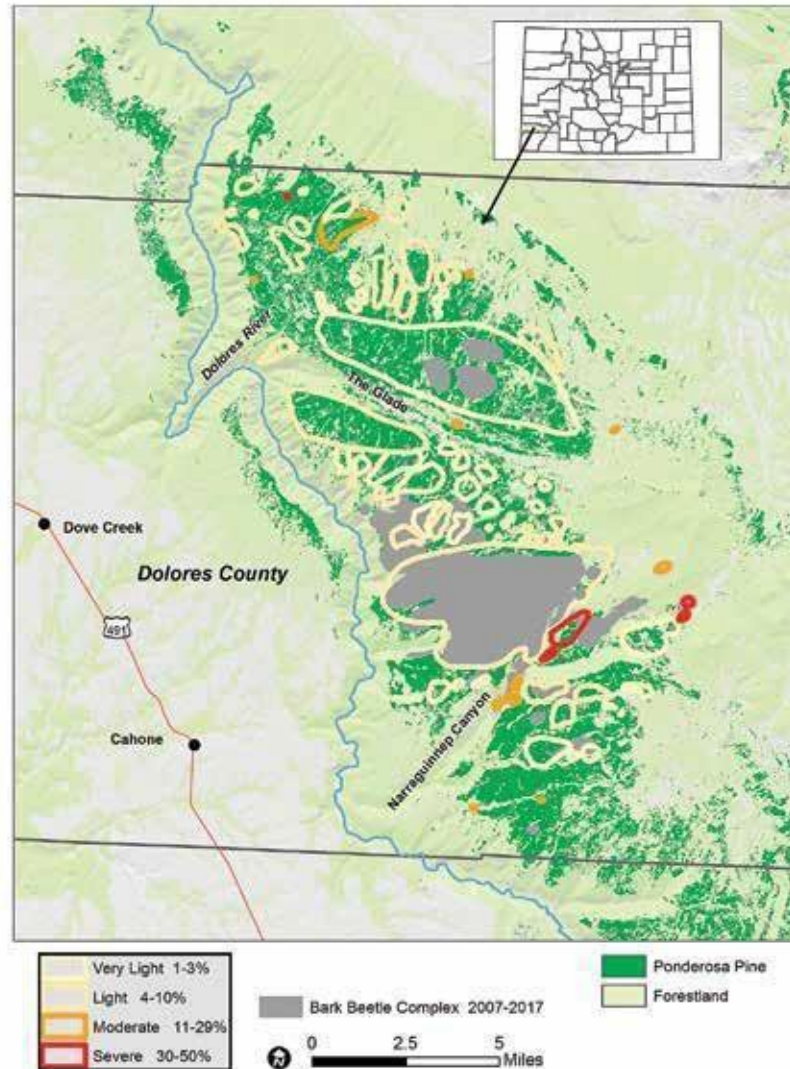
Fir Engraver Beetle

(*Scolytus ventralis*)

Fir engraver beetle is a native bark beetle that primarily impacts white fir, and occasionally subalpine fir, Douglas-fir and Engelmann spruce. Outbreaks often are associated with below-normal precipitation or defoliation. Adults typically disperse to seek new trees in which to lay eggs under the bark during a peak time of July and August. In 2018, tree mortality continued to decrease statewide, and occurred in southern and central Colorado where white fir grows in mixed - species forests, often alongside Douglas-fir.

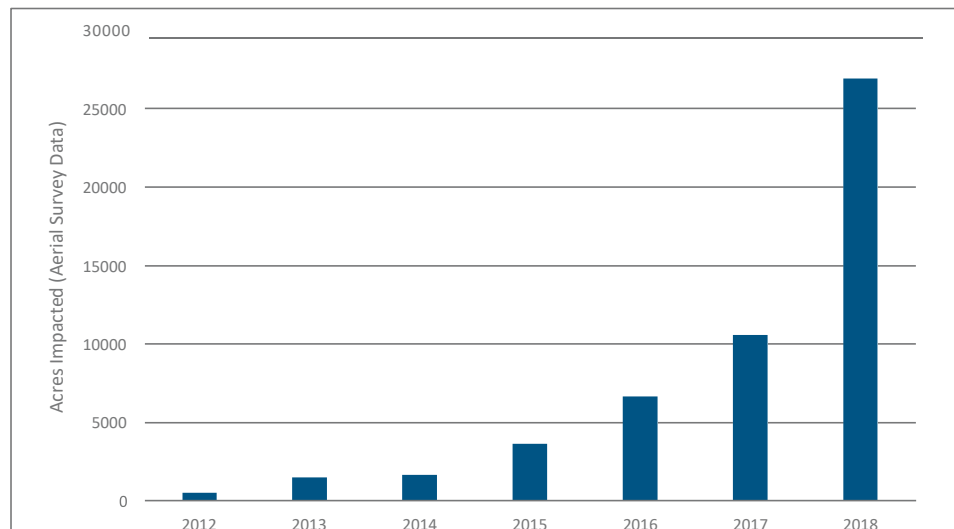
- 1,400 acres of white fir in southern Colorado were affected in 2018, where as 2,500 acres were impacted in 2017 and 6,300 acres in 2016.
- Portions of the Sangre de Cristo Mountains were impacted in localized areas in 2018.
- Archuleta County, within the San Juan National Forest, continues to see low-level, localized fir mortality.
- Infestations near the mountain town of Ouray declined, but continue to affect the few remaining white firs in the area, in an infestation that is ongoing for the sixth straight year.
- Notable counties affected in 2018:

Colorado County	2017 Acres Affected	2018 Acres Affected
Ouray	1,600	950
Gunnison	-	150
Archuleta	400	70
Hinsdale	380	60



Roundheaded pine beetle and associated native bark beetle-caused mortality has increased exponentially in total area in Dolores County over the past six years.

Roundheaded Pine Beetle and Associated Bark Beetle-Caused Mortality in Colorado, 2012-2018



Western Spruce Budworm

(*Choristoneura freemani*)

Larvae of the western spruce budworm feed in the buds and on new shoots of Douglas-fir, true firs (*Abies* spp.) and spruce. Feeding on the needles causes a reddish-brown color in the branch tips and terminal ends of affected trees.

Larval damage occurs from early in the spring through mid-summer, at which time the insects pupate and emerge as adult moths. Adults are typically active in July and August.

This moth has been Colorado's most damaging and wide spread forest defoliator for a number of consecutive years. Heavy damage occurred in 2018 in most of the Douglas-fir forests in the southern portion of the state.

- 131,000 acres of Douglas-fir, true firs and spruce were impacted statewide in 2018.
- Significant areas affected included the southern Front Range; the Sawatch Range and West Elk Wilderness; the Culebra Range in the southern Sangre de Cristo Mountains; the Mosquito Range and all mountains surrounding South Park; along the southern portions of the Rampart Range; and the western edge of the San Juan Mountains.

- Notable counties affected in 2018:

Colorado County	2017 Acres Affected	2018 Acres Affected
Saguache	75,000	30,000
Park	12,000	14,000
Dolores	5,000	13,000
Freemont	11,000	12,000
Gunnison	42,000	11,000
San Miguel	3,900	11,000
Chafee	7,700	7,000
Custer	11,000	5,900

Piñon Engraver Beetle

(*Ips confusus*)

Piñon pines typically grow in harsh, low-elevation sites below the mixed-conifer/ponderosa pine forests of Colorado. Piñons often grow in proximity to juniper trees and shrubs, where conditions are dry and precipitation fluctuations are the norm. During prolonged periods of below-average precipitation, populations of the piñon engraver beetle can build in already-stressed piñon trees.

Isolated or localized tree mortality was observed in 2018 near the Colorado National Monument around Glade Park; and along the I-70 corridor near Rife, Carbondale and Grand Junction. Record-warm temperatures and record-low precipitation along the Western Slope and in the southwest corner



A late-stage caterpillar of the large aspen tortrix, which is responsible for defoliating aspens in Colorado. Photo: Dan West, CSFS

of Colorado are likely to produce continued dieback/die-off of piñon pines in these areas in the coming year.



A piñon pine expressing symptoms of attack from piñon engraver beetle, Chafee County. Photo: Dan West, CSFS

Deciduous Forests

Defoliating Insects/Leaf Diseases of Aspen

Two insect species, western tent caterpillar

(*Malacosoma californicum*) and large aspen tortrix (*Choristoneura confictana*), can defoliate Colorado's aspen forests when at higher population levels.

Western tent caterpillars produce and live within silken tents, typically in the crowns of affected aspen and cottonwood trees, although mountain mahogany, chokecherry and plums also are occasionally affected. The caterpillars are typically present in spring, though can be seen as late as September. Large aspen tortrix also feed upon the leaves of aspen, and roll the leaves into shelters in which they pupate. Adult tortrix are typically present in July and August.

- 12,000 acres of aspen forests were defoliated statewide in 2018, compared to 38,000 acres the prior year.



At a workshop in Montezuma County, Dr. Dan West, CSFS forest entomologist, describes to stakeholders and private landowners how bark beetles attack and kill ponderosa pines. Photo: Amy Lockner, U.S. Forest Service

- Notable counties affected by aspen-defoliating insects in 2018:

Colorado County	2017 Acres Affected	2018 Acres Affected
Archuleta	3,400	2,300
Conejos	2,300	1,400
La Plata	1,600	1,200
Gunnison	4,400	1,000
Mineral	1,600	1,000

Several species of leaf fungi are responsible in some years for the thinning or discoloration of aspens, poplars and cottonwoods in Colorado; in severe cases this damage forces affected trees to drop their leaves early. However, record-dry conditions in 2018 were not conducive to these fungal pathogens in the summer months, and no significant damage was observed in the aerial survey.

Other Broadleaf Disturbance

Thousand Cankers Disease/ Walnut Twig Beetle

(*Pityophthorus juglandis*)

Thousand cankers disease is native to the Western United States and is the result of small twig beetles (*Pityophthorus juglandis*) feeding on primarily black walnut trees, and in the process spreading a canker-causing

fungi (*Geosmithia morbida*). Black walnut trees continue to die off along the Front Range and Eastern Plains of Colorado. The most recent new detection occurred in 2017 in the community of Brush, in Morgan County. No additional detections occurred across the state in 2018.

Exotic Pests

The introduction and establishment of exotic—and potentially invasive—insects, fungi, plants and other organisms threatens forests worldwide. Invasive species can cause severe damage in their new habitats, as unfamiliar host trees may have little or no resistance to the introduced pest, and natural enemies may not be present to help keep invasive populations in

check. Once established, invasive pests can be inadvertently spread by humans over long distances, via the transport of firewood, nursery stock and other plant material. Several exotic, invasive insects and diseases pose a threat to both native and urban forests in Colorado; two of primary significance are described below.

Japanese Beetle

(*Popillia japonica*)

Japanese beetle is an invasive pest that affects hundreds of species of trees, grasses and plants in North America. The adult beetles damage for a by feeding on leaves, flowers and fruit, with larvae feeding on roots. This beetle was first detected in the U.S. more than a century ago. Although first detected in Colorado in the mid-1990s, populations had not established until 2003, initially in the Palisade, Colorado area. Eradication attempts there were successful after a seven-year effort. Meanwhile, discoveries of the beetle occurred in Denver in 2005 and subsequently in Pueblo in 2009. Japanese beetles are a metallic-green color with copper-colored wing covers.

Most insects have a primary feeding stage, being either larvae or adults. However, the challenge with Japanese beetles is that both larvae and adults cause significant damage to affected trees or plants. The larvae are white, C-shaped grubs that feed under ground on the roots of grasses. Upon completing their development, adult beetles feed on the foliage and flowers of a wide range of plants. Foliage damage appears “skeletonized” as the adults typically feed between, but not on, the structural leaf veins.

In Colorado, linden, apple, crabapple, cherry, plum and peach trees are most affected. Grape, Virginia creeper, rose, raspberry, hollyhock and Rose of Sharon are plants that are also heavily affected. In 2018, Boulder, Denver and Pueblo had high Japanese beetle populations, while the remainder of Front Range communities experienced varying degrees of infestation, ranging from moderate to low. No new detections in 2018 occurred north of Fort Collins and Greeley, nor south of Pueblo.

Emerald Ash Borer

(*Agrilus planipennis*)

Emerald ash borer (EAB) is an insect native to Asia, introduced into North America some time during the 1990s. Since its initial discovery in Michigan in 2002, this insect has killed millions of true ash trees (*Fraxinus* spp.) throughout the central and northeastern U.S. and eastern Canada. EAB is now considered the most destructive tree insect ever to be introduced into North America.

Infestations were first detected in Colorado in the City of Boulder, in 2013. Approximately 15 percent of all trees in Colorado’s urban and community forests are ash, making EAB a major threat to these forests statewide. New detections in 2018 occurred in the towns of Lyons and Superior, still within an established quarantine that primarily encompasses the generally infested County of Boulder. No additional detections in Colorado were reported outside of the county, though early detection of this pest remains difficult.

A collaborative Colorado EAB Response Team has been working together to coordinate surveys and pest management activities designed to limit



The invasive Japanese beetle infests a wide variety of flora in Colorado. The highest populations of this pest are in Boulder, Denver and Pueblo. Photo: David Cappaert, Bugwood.org

the spread and reduce the impact of this extremely destructive insect. Agencies and organizations represented on this team include the CSFS, Boulder County, City of Boulder, Colorado Department of Agriculture, Colorado State University Extension, Colorado Tree Coalition, Green Industries of Colorado, USFS, University of Colorado, USDA Animal and Plant Health Inspection Service (APHIS) and various municipalities. Representatives of this team have been instrumental in: evaluating traps designed to attract flying adult beetles for early detection of infestations; the release of four species of parasitic wasps that prey on EAB; maintenance of the quarantine for Boulder County and adjoining areas, intended to help restrict movement of infested plant materials; and providing up-to-date information on the insect's status and the most effective ways to protect trees.

Other Damaging Agents

Juniper Die-Back/Die-Off

The piñon pine-juniper forest cover type occupies more area than any other forest type in Colorado, at approximately 5.1 million acres of the state's 24.4 million forested acres. Below-average precipitation for numerous years in southern Colorado has predisposed Rocky Mountain juniper, one-seed juniper and Utah juniper to branch die-off and dieback. Cedar bark beetles (*Phloeosinus*

spp.), the black-horned juniper borer (*Callidium texanum*) and the juniper twig pruner (*Styloxus bicolor*) are typically associated with dead and declining juniper trees.

Extreme springtime temperature fluctuations, coupled with numerous years of below-average precipitation, have resulted in some juniper dieback and die-off in the Four Corners region. No other causal agent has been associated with observed damage.

Pine Needle Scale (*Chionaspis pinifoliae*)

Pine needle scale feeds on the needles of most pine species,

Douglas-fir, Engelmann spruce and Colorado blue spruce. During outbreaks, insects can settle on every surface of the needles, robbing the affected tree of nutrients. Heavy infestations can cause premature needle drop, branch dieback, increased susceptibility to other insects or disease, or even tree death. Lodgepole pines of every

every size, from small saplings to mature trees, can be heavily infested during outbreaks.

Pine needle scale has been active in many areas of the Fraser Valley and Vail Valley for the past several years. Activity declined in 2018 throughout Grand County, where the scale had caused significant tree damage from 2015 through 2017, though remained persistent in the communities of Grand Lake, Grandby, Fraser, Winter Park and portions of Summit County. Communities along the I-70 corridor (including Empire, Vail, Breckenridge and Frisco) also had noticeable insect populations in both native and transplanted spruce, likely a result of prior heavy and sustained chemical preventive spraying for bark beetles. While chemical use to protect trees from bark beetles is effective, prolonged spraying also diminishes populations of beneficial insects that naturally keep scale infestations in check.

Dwarf and Leafy Mistletoes

Five species of dwarf mistletoe (*Arceuthobium* spp.) and one leafy mistletoe occur in Colorado. Dwarf mistletoes are leafless "holoparasites," deriving



An adult emerald ash borer on an ash leaf, Boulder County. Photo: Dan West, CSFS

both necessary carbohydrates and water exclusively from their host trees by sinking roots down into tree branches and stems. Shoots develop and produce flowers and seeds within five to six years. Seeds are dispersed locally from shoots, while long-range dispersal occurs via animals and birds. All native pines and Douglas-fir trees in the state are susceptible to dwarf mistletoe.

Dwarf mistletoes cause branches to swell at the infection site, subsequently forming large “witches brooms” that appear as densely clumped twigs, and eventually cause trees to become stunted and deformed. Infections can result in loss of tree growth and vigor, and susceptibility to other insects and diseases. Infested trees often are targeted for removal to improve over all stand health.

A range of infection severity regularly occurs across the state, from localized pockets and stand-level occurrence to severe infections that impact entire drainages and forests. Dwarf mistletoes continue to be a persistent problem for communities and forests statewide.

The only leafy mistletoe in Colorado, commonly known as the juniper mistletoe (*Phoradendron juniperinum*), occurs in the southwest corner of the state on several juniper varieties. This mistletoe is considered less aggressive than dwarf mistletoes, though is still impactful in harsh conditions where many junipers occur. Leafy mistletoes are “hemiparasites,” deriving water and only partial carbohydrate needs from their tree hosts. Infection rates for this mistletoe are low in southwest Colorado; however, affects are noticeable in areas throughout Dolores, Montezuma and La Plata counties.

Lodgepole Pine Needle Cast

Lodgepole pine forests along I-70 over Vail Pass, and over Monarch Pass in Saguache County, were discolored by a needle cast disease in 2017. Premature needle drop of older needles and discoloration of older and new needles was caused by two species of fungi of the genus *Lophodermella* due to above-average precipitation in the spring of that year. Environmental conditions were unfavorable to these and other fungi throughout Colorado in 2018, and no new reports of incidence were recorded.

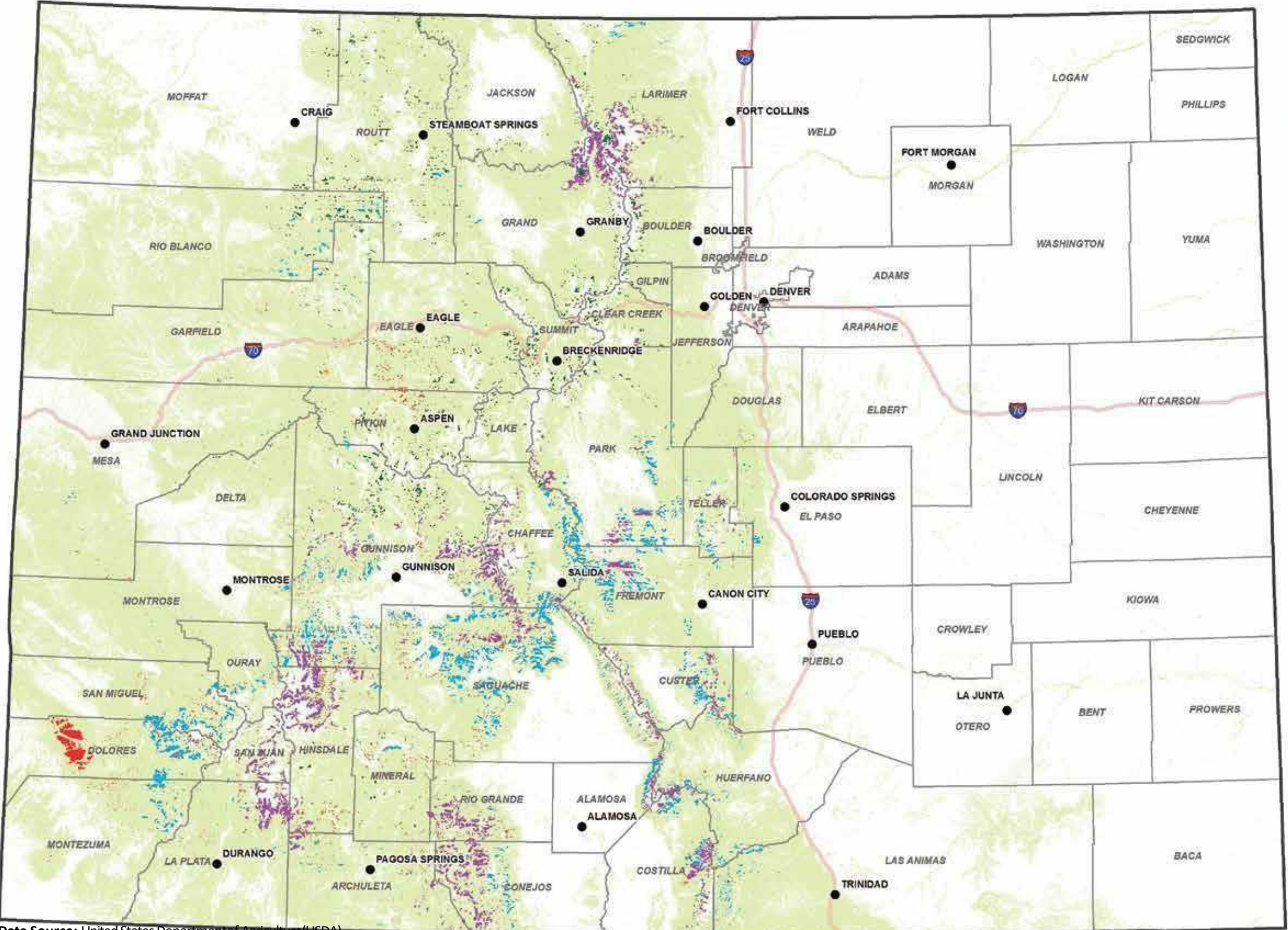


Juniper die-off and die-back in the Four Corners region, Montezuma County. Photo: Dan West, CSFS



A juniper tree infected with juniper mistletoe, Dolores County. Photo: Dan West, CSFS

2018 Insect and Disease Activity in Colorado Forests



Forestland	Spruce Beetle
24.4 million acres	178,000 acres
Western Spruce Budworm	Western Balsam Bark Beetle
131,000 acres	24,000 acres
Douglas-fir Beetle	Bark Beetle Complex
14,000 acres	27,000 acres

Aerial Survey Data

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

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

Caution should be used when comparing this year's data to prior years, due to slightly differing sampling tools and variability between observers.

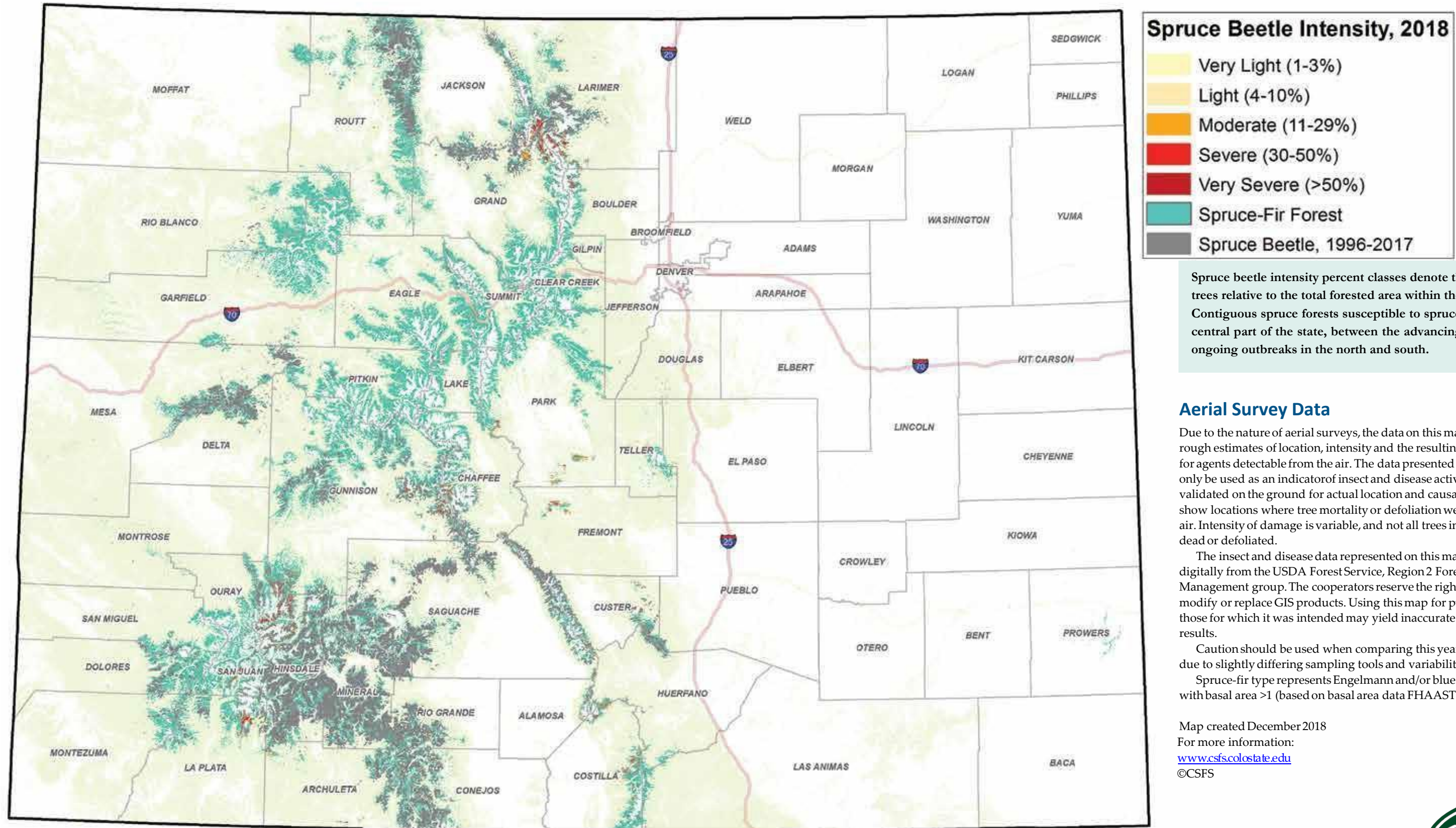
Map created December 2018 For more information: <https://csfs.colostate.edu>



Data Source: United States Department of Agriculture (USDA) Forest Health Assessment & Applied Sciences Team (FHA/AST)



Spruce Beetle Activity in Colorado Forests, 2000-2018



Spruce beetle intensity percent classes denote the number of dead trees relative to the total forested area within the polygon. Contiguous spruce forests susceptible to spruce beetle exist in the central part of the state, between the advancing fronts of separate ongoing outbreaks in the north and south.

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Spruce-fir type represents Engelmann and/or blue spruce occurrence with basal area >1 (based on basal area data FHAAS*).).

Map created December 2018

For more information:

www.csfs.colostate.edu

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*Data Source: United States Department of Agriculture (USDA) Forest Health Assessment & Applied Sciences Team (FHAAS)

0 25 50 100 Miles





**THE MISSION OF THE COLORADO STATE FOREST
SERVICE IS TO ACHIEVE STEWARDSHIP OF COLORADO'S
DIVERSE FOREST ENVIRONMENTS FOR THE BENEFIT
OF PRESENT AND FUTURE GENERATIONS.**

[Table of Contents](#)

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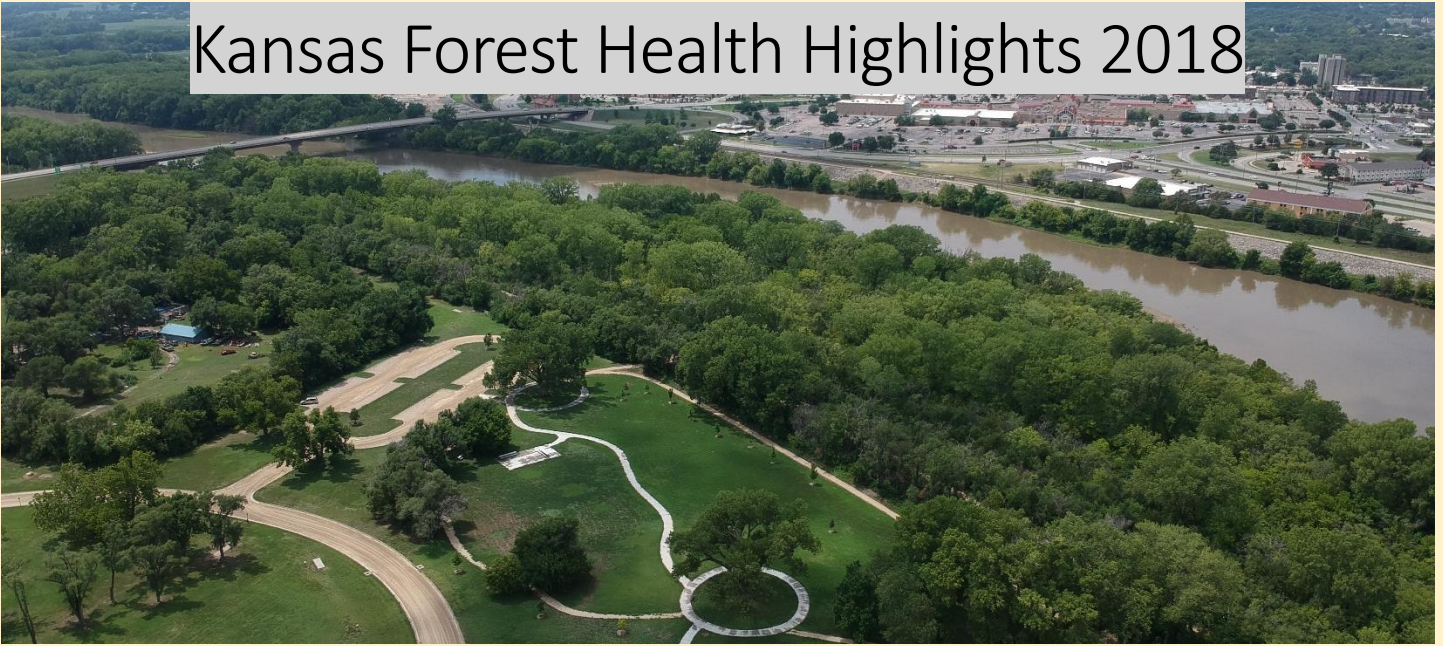
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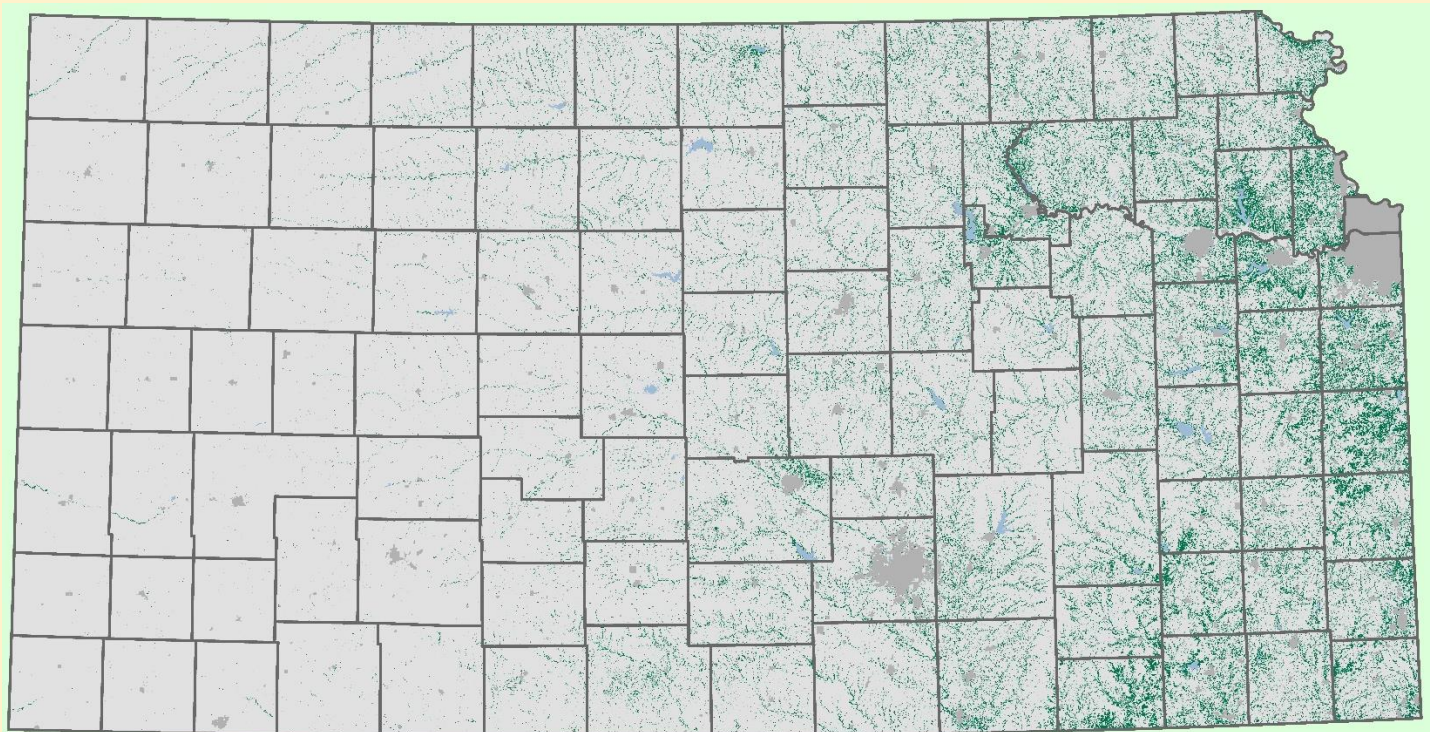
Kansas Forest Health Highlights 2018



Forestland along the Kansas River at Fairmont Park, Manhattan, Kansas.

Forest Resources of Kansas

In Kansas, the central hardwood forests transition into the Great Plains, with more than **4.6 million acres of trees**; 2.5 million acres of forest land and an additional 2.1 million acres of trees outside forest land. These forests, which are 93% privately owned, are productive; local forest products contribute approximately **\$2.1 billion annually** to the Kansas economy. Much of the landscape is devoted to agriculture, but forests and trees are prominent components. The majority of these woodlands are linear in nature and follow water features along the terrain, although contiguous forestland can be found in far eastern Kansas.



-  Tree Canopy
-  Bodies of Water
-  Incorporated Areas
-  County

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Miles

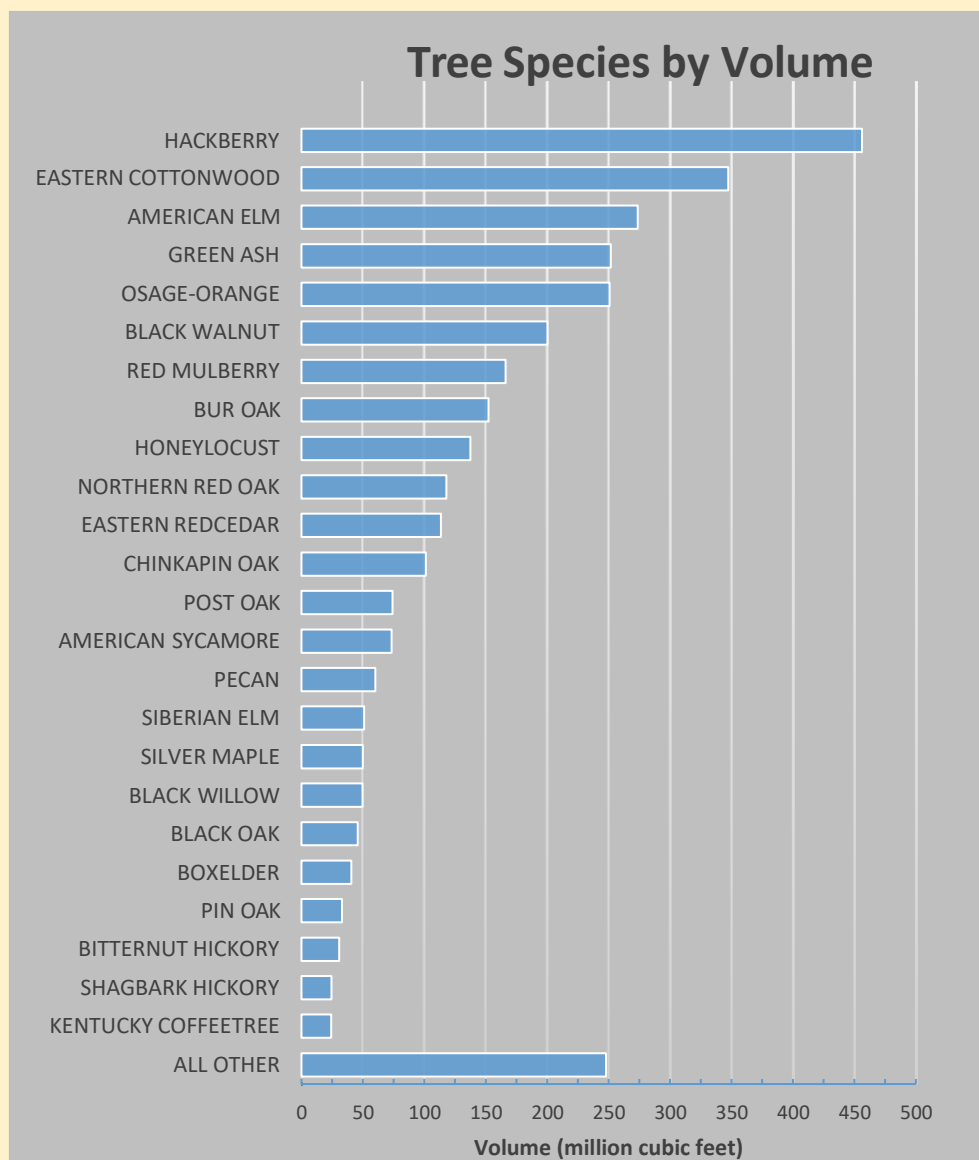


The top tree species, by statewide volume, are hackberry, eastern cottonwood, American elm, green ash, osage-orange, black walnut, red mulberry, bur oak, honeylocust, and northern red oak.

The two dominant forest types in Kansas are Elm/ash/cottonwood and Oak/Hickory.

Over the past 60 years or so, cottonwood regeneration levels have been low. Re-engineering of riparian environments due to the expansion of agriculture, construction of dams, and stream channelization have altered the landscape where cottonwood previously flourished. Unlike cottonwoods, eastern red-cedar trees have been very successful as early invaders on grasslands and abandoned range and farmlands.

Even though Kansas's forests are increasing in acreage, the oak component is decreasing in some areas as forest succession favors shade-tolerant species, such as hackberry and American elm.



According to Forest Inventory and Analysis (FIA) data, forest land in Kansas has increased since the earliest inventory and currently is showing signs of plateauing. In terms of stand-size class, sawtimber stands comprise half of all timberland area while poletimber and sapling/seedling stands occupy 29 and 19 percent of timberland area, respectively.

The forests of Kansas contain approximately **833 million live trees** (≥ 1 -inch diameter) and nearly **3.3 billion cubic feet of net volume** (live trees ≥ 5 -inches diameter). The five most numerous species are hackberry, American elm, eastern redcedar, Osage-orange, and green ash; together, they make up 52 percent of all trees. The five most voluminous species contain nearly half (48%) of total net volume, and of the five species previously listed, four are in the top five for volume as well: hackberry, green ash, American elm, and Osage-orange. Eastern cottonwood is the second-most voluminous species in the state but ranks 25th in terms of number of trees, and while eastern redcedar is 3rd in terms of number of trees, it ranks 11th in volume.

There are more than **89 million oven-dry tons of biomass** in Kansas forests; most of which is contained in non-growing stock trees (59%), followed by growing-stock trees (35%) and live trees 1- to 5-inches diameter (6%). Nearly one-third of all biomass is found in three species: hackberry, Osage-orange, and American elm. Osage-orange now ranks second in biomass, surpassing eastern cottonwood and American elm.

Overall, hackberry, eastern cottonwood, and American elm have the highest growth rates, followed closely by black walnut and Osage-orange. However, mortality has increased while the area of forest land, number of live trees, and net growth of live trees has decreased since 2012. This could be a concern if this trend continues.

Emerald Ash Borer

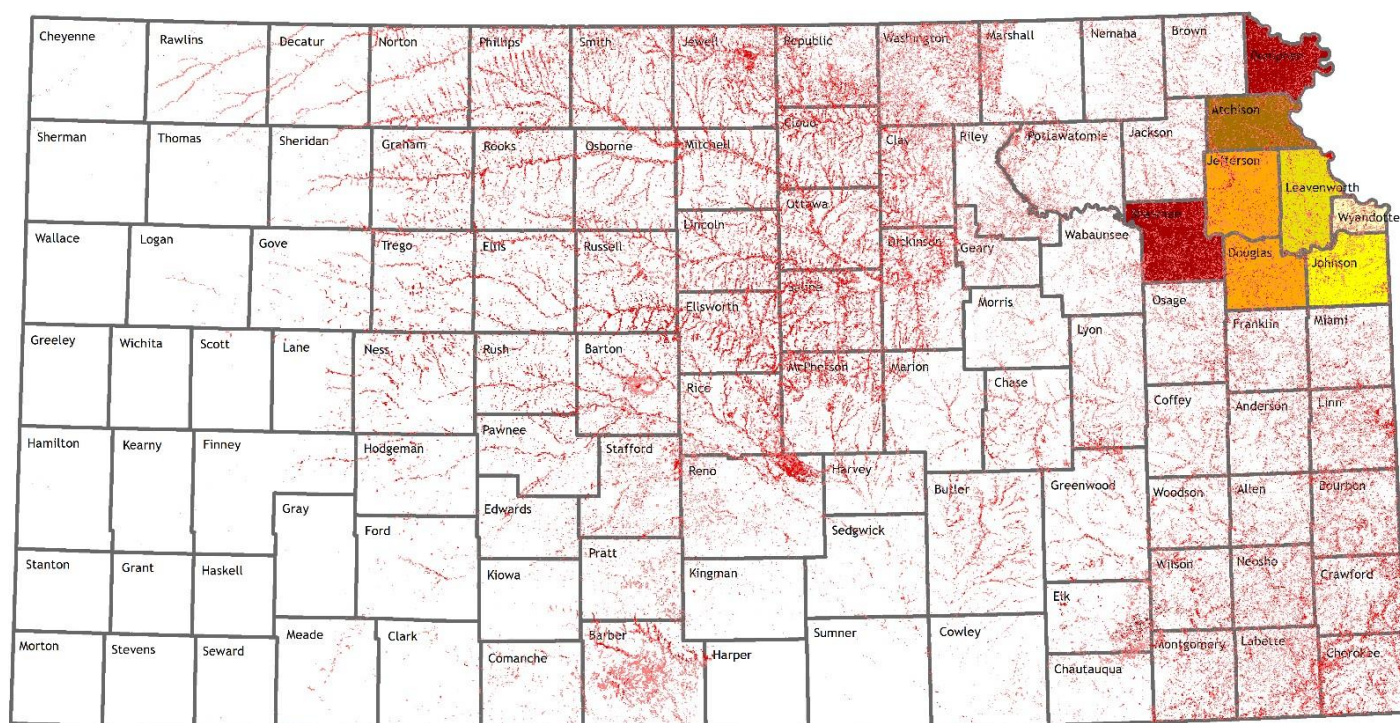
Emerald ash borer (EAB), an exotic wood-boring beetle, was first detected in 2012 in Wyandotte County, Kansas. Since that time, EAB has also been found in Johnson, Leavenworth, Douglas, Jefferson, Atchison, Doniphan, and Shawnee counties.

EAB is a pest of all North American ash (*Fraxinus* spp.). Kansas' forest land contains **51.1 million ash trees**, or an average of about 20 trees per acre of forest land. Ash trees account for nearly **275 million ft³** of volume, or **8 percent** of total net volume of live trees on forest land. Most of the ash resource (93%) is located on privately owned forest lands and is distributed primarily in the central and eastern parts of the state; the heaviest concentrations of ash are in the northeastern corner and along the eastern boundary.



Green and white ash in a parking lot in Manhattan, Kansas.

In 2018, **no new counties** were added to the existing Emerald Ash Borer Quarantine in Kansas, leaving the total number of counties with confirmed EAB presence to eight; all contiguous in the Kansas City area. In previously quarantined counties, ash tree mortality was observed to increase over previous years.



**EAB Detection
Year**

2012 2013 2014 2015 2016 2017

**Density of Live Ash
Trees per Acre**

Less than 5
5 - 25
More than 25



As of: 3/6/2018

All trap trees placed in non-quarantined northeast Kansas counties (Brown, Riley, Osage, Miami) and southeast Kansas counties (Labette, Crawford, Cherokee) were negative for EAB presence. Emphasis on trapping in southeast Kansas was justified by the detection of EAB in northeast Oklahoma (Delaware County) in late 2016, less than 25 miles from the Kansas-Oklahoma border.



KFS and KDA staff peel EAB trap trees in Osage (left) and Miami (right) counties in October 2018. No EAB larvae were found at either site.

Releases of three biocontrol species (*Tetrastichus*, *Spathius*, *Oobius*) were done by the Kansas Department of Agriculture throughout the season at sites around Wyandotte County Lake. This is the third year for biocontrol releases in Kansas. Additional releases of biocontrol agents are planned for 2019, along with follow-up survey to assess if the biocontrol species are established.

In response to EAB, a message of forest health resilience through diversity has been promoted statewide, in addition to the presentation of EAB and invasive pest information at forestry field days and workshops.



Outreach materials and "bug box" samples of EAB and other invasive pests were displayed on site at forestry field days and workshops.

Pine Wilt

Pine wilt is caused by a plant parasitic nematode called the pine wood nematode, *Bursaphelenchus xylophilus*. The nematode is vectored by the pine-sawyer beetle, a long-horned borer in the genus *Monochamus*. They kill pine trees by feeding and reproducing in the resin canals of the branch and trunk.

This disease is continuing to spread westward, frequently damaging and causing high mortality in windbreaks and conservation plantings containing Austrian pine (*Pinus nigra*) and Scotch pine (*P. sylvestris*).

In 2015, several pine wilt positive trees were found in a Scotch pine windbreak, several miles north of Goodland (**Sherman County**). These trees were removed and destroyed. In October 2016, four pine wilt positive Scotch pine trees were found in Goodland. In March 2018, eight Scotch pine trees were removed after two positives. This site will continue to be monitored for additional dead trees.

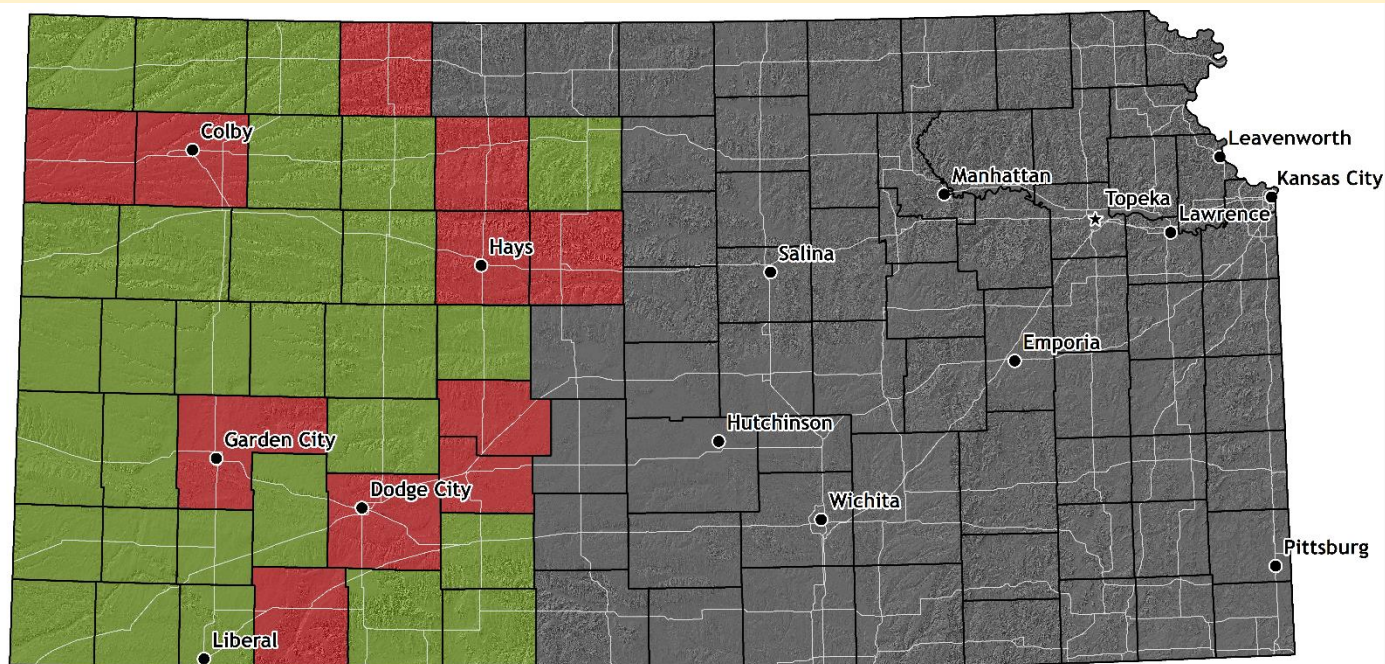
Five pine wilt positive Scotch pine trees were found and destroyed in the town of Alma (**Norton County**) in March and April 2017. A delimiting survey was performed and no additional suspicious trees were found.

A Kansas Department of Agriculture (KDA) survey of the previously non-infested Finney, Greeley, Hamilton, Wichita, Rush, Scott, and Lane counties was negative for pine wilt.

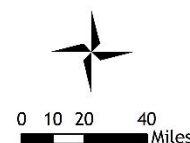
The city of Hays (**Ellis County**) has thousands of susceptible pines, and is surveyed annually as part of the pine wilt initiative project by KDA, Kansas Forest Service, and Ellis county extension. The disease has been eliminated at several sites throughout the community and outlying developments. Trees found positive for pine wilt disease have been removed and destroyed, and the site continues to be monitored and controlled with City of Hays and county extension help. The City of Hays offers rebates for removal of infested pines, incentivizing removal for private landowners.



An Austrian pine showing signs of decline due to pine wilt in late summer, in Manhattan, KS. Healthy ponderosa pine is nearby.



- Pine Wilt established in both communities and rural settings.
- Pine Wilt not yet discovered.
- Pine Wilt present, but limited to one or a few locations. Eradication ongoing.

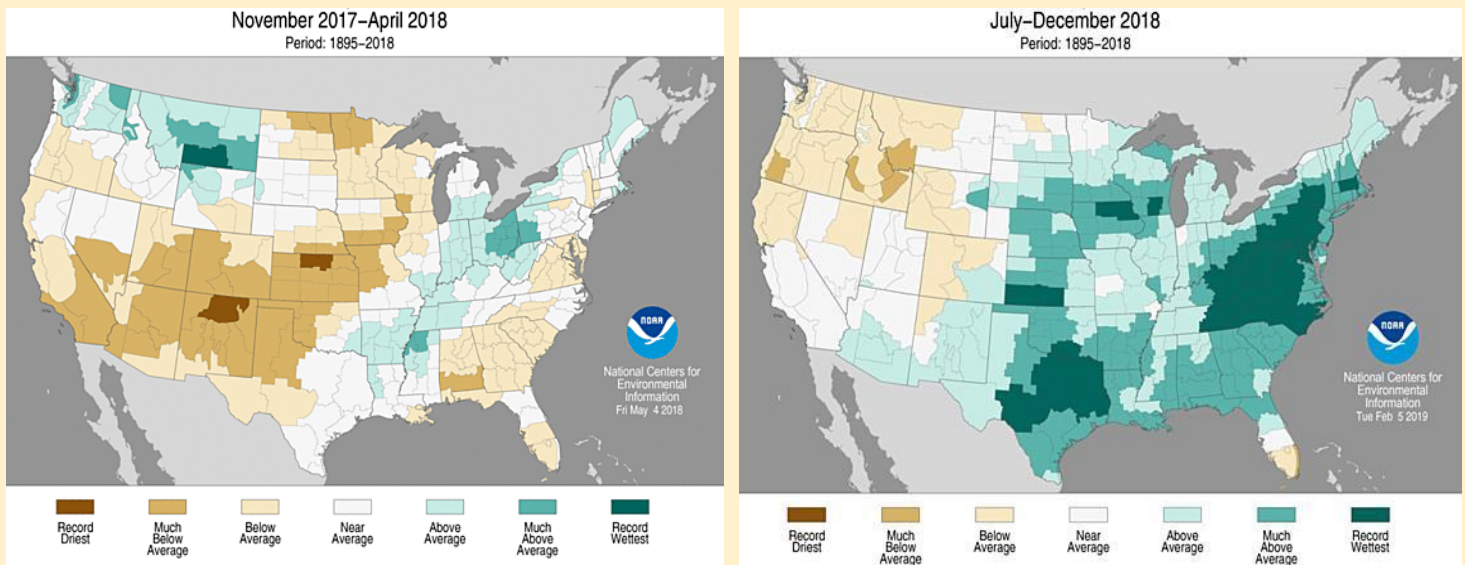


Abiotic Stress

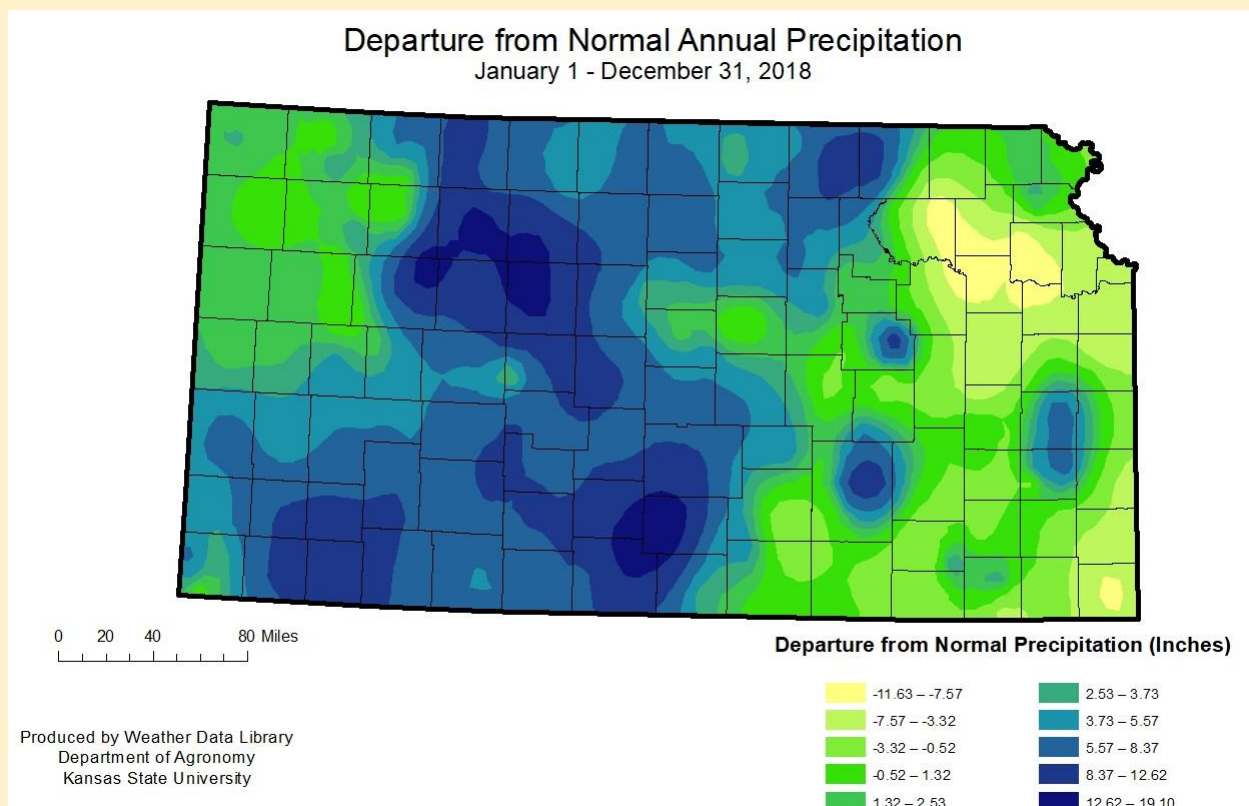
After one of the wettest springs on record in 2017, the winter of 2017-2018 was one of the driest on record for Kansas, leaving little soil moisture for trees to draw on as the growing season approached. Statewide, it was the second-driest November-to-April period since records began in 1895, and the driest on record for the north-central region of the state.

Especially in April, May and June, northwest Kansas continued to receive heavy rains while northeast Kansas was significantly below average for rainfall well into the growing season and heat of summer.

This trend reversed for the second half of the year, as July-to-December was the second-wettest on record statewide, including the wettest second half recorded for south-central and southwest Kansas.



While the acute stress from the short-term drought in eastern Kansas will certainly be reflected in the loss of vigor for those forest lands, the significant rainfall in the fall and winter of 2018 meant that Kansas ended 2018 with no level of drought anywhere in the state, according to the United States Drought Monitor.



Invasive Bush Honeysuckle



Bush honeysuckle creating a dense monoculture in the understory of native forestland along a walking trail at Anneberg Park in Manhattan.

The non-native bush honeysuckles (*Lonicera maackii*, *L. tatarica*, and *L. x bella*) and their vine counterpart, Japanese honeysuckle (*L. japonica*) have invaded many woodlands, forests, and nature preserves causing declines in species diversity and richness of native ground cover and mid-story vegetation.

Honeysuckle infestation can be ascribed, in part, to their adaptability to a wide variety of habitats and spread as a result of being a prolific producer of seeds (bush honeysuckles primarily) that are easily dispersed by birds.

Asian bush honeysuckle possesses rapid aboveground and belowground growth, is adapted to low-light environments, begins growth earlier and can continue growing later in the growing season than most other woodland species.

Urban woodlands around **Wichita, Topeka**, and the **Kansas City** metro area continue to implement management efforts to combat these invasive shrubs and vine. Some land managers have been utilizing backpack mistblowers for control, which show promise in economical, effective control of this forestland invader.

The Kansas Forest Service provides backpack mistblowers on loan to landowners for no charge, in order to facilitate treatment of infestations in late fall, when off-target impact is minimized and control of bush honeysuckle has been shown to be highly effective.



Leaves and fruit of bush honeysuckle in late fall, still green well after leaf drop of native woodland trees and shrubs.

Herbicide Injury

While woody plants in Kansas have experienced varying levels of impact from herbicides for decades, a noticeable increase has taken place in recent years.

The application of herbicides that readily volatilize, such as ester formulation of 2,4-D, has long been known to cause leaf deformation in sensitive species such as oak, redbud, sycamore, and others.

Symptoms consistent with 2,4-D exposure have been documented on woody species across the state. While a one-time exposure to low levels of herbicide may cause deformation of new growth without having a significant impact on long-term tree health and vigor, repeated exposure and injury will contribute to decline, especially when complexed with the existing abiotic and biotic stressors that already impact trees in Kansas.

In 2017, the controversial topic of dicamba injury came to a national forefront, focusing mainly on injury to non-tolerant crops adjacent to dicamba-tolerant fields.

However, Kansas (like many other states in the region) also witnessed injury to many trees within forested land both adjacent to, and some distance from, agricultural land where dicamba may have been applied.

These symptoms manifested especially strongly on black walnut adjacent to agricultural fields where dicamba was applied as an early spring “burn down” herbicide to control glyphosate-resistant weeds before planting soybeans or corn. Even if the applicator has taken steps to limit risk for wind-aided drift, dicamba could move off-target due to volatilization or movement through the soil water.

A clear causal relationship between herbicide application and tree injury has not yet been established, but based on the widespread symptoms observed in 2017 and 2018, further study will be undertaken in 2019 to document and investigate the source of these symptoms. A focus will be on testing of symptomatic trees to determine herbicide residues, if any.



Deformation and cupping of new growth and chlorosis, symptoms consistent with herbicide injury on redbud (top photo), sycamore (middle photo), and northern red oak

Invasive Callery Pear



Invasive callery pear seedlings proliferate in grasslands in rural Geary County. Untreated seedlings on the left, treated seedlings on the right.



A seedling of callery pear in forestland in rural Labette County.



A large callery pear exhibits strong pyramidal form, in a waste area in rural Cherokee County.

Callery pear (*Pyrus calleryana*) was introduced to the United States from China in 1917 as an ornamental tree. Starting in the 1950s with the introduction of the popular cultivar 'Bradford', these small trees have been widely planted in landscapes across the country. Efforts to address poor branching structure and subsequent storm damage led to the introduction of improved cultivars, but these new trees with better branch angles were also genetically distinct from the clonally propagated and identical 'Bradford' that existed in the landscape. With these new cultivars came cross-pollination of previously sterile 'Bradford' flowers, and birds widely distributed the now-viable seeds where they became established in undermanaged margins and interfaces between forestland, urban areas, grasslands and "waste" areas.

Callery pear's prolific ability to resprout, tolerance of a wide range of environmental conditions, and dense shade cast by its canopy, has led to a rapid infestation and conversion of previously diverse ecosystems into a virtually impenetrable monoculture of callery pear seedlings and trees in a short time. In many cases, this invasion and conversion happens without land managers being aware of the process, and it is only noticed when it's too late and management has become a challenge.

Evidence shows that callery pear seedlings are becoming established in important ecosystems such as the tallgrass prairies and gallery forests of the Flint Hills and the remnant post oak savannah forestland of the Cross Timbers. Unlike states to the east of Kansas, from Missouri to Indiana, where infestations are widespread and well-established, Kansas is early in the callery pear infestation stage. There are a few well-established populations of callery pear near urban areas of Wichita and Kansas City, but many smaller infestations are still becoming established in other areas such as Hutchinson, Manhattan, Topeka, and towns in southeast Kansas.



A callery pear seedling produces a proliferation of fruit, with seeds that are likely viable, at an infestation in Riley County.

Forest Health Threats

Thousand Cankers Disease



A 20-year-old black walnut plantation in northeast Kansas, which is threatened by the potential for TCD to enter Kansas.

This disease complex has **not yet been detected** in Kansas. However, Kansas shares a 200-mile border with Colorado, an infested state, increasing the risk of TCD introduction. With TCD existing as close as Colorado, Kansas is a potential “doorway” to the entry of thousand cankers disease into the native range of black walnut, which would have disastrous consequences both economically and environmentally.

Doniphan, Bourbon, Franklin, Osage, Linn, Leavenworth and Pottawatomie counties contain the largest number of black walnut trees in Kansas.

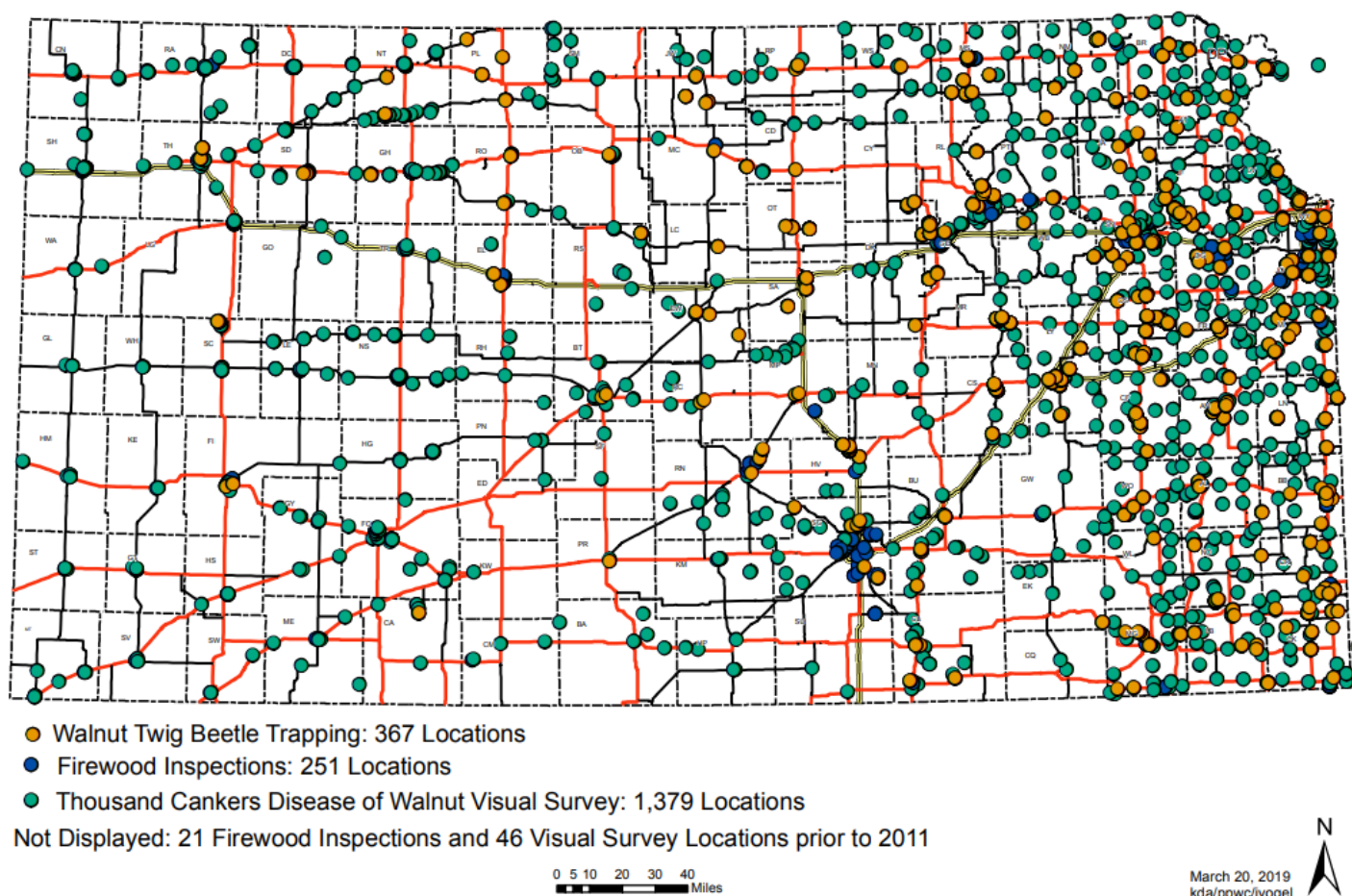
A recent estimate of economic loss associated with the introduction of thousand cankers disease to Kansas suggests at least **\$160 million** over the next 20 years.

TCD trainings occurred throughout the year to arborists, municipalities, and landowners, greatly increasing the detection network and providing further outreach efforts. Walnut Twig Beetle pocket ID cards were distributed to interested parties, including arborists and extension agents.



Small exit holes and galleries from the walnut twig beetle are visible on this TCD-infested tree in Colorado. Pocket knife is for scale.

Thousand Cankers Disease of Walnut Survey, 2009 - 2018



Street-side and on-the-ground visual surveys of black walnut have been conducted across the state. High risk areas of central and eastern Kansas were visually surveyed, where walnut is common and pathways are of concern. Lindgren traps, with lure, were set and monitored by Kansas Department of Agriculture (KDA) personnel at key locations statewide. **No walnut twig beetle (WTB) specimens have been found to date.**

The 2018 WTB survey began on May 30 and concluded on August 3. Forty-four Lindgren funnel traps were deployed in 14 southeast Kansas counties, in Franklin, Miami, Coffey, Anderson, Linn, Woodson, Allan, Bourbon, Wilson, Neosho, Crawford, Cherokee, Labette, and Montgomery counties. This was the first year of dry cup trapping, providing easier collection and sorting, but some predation was observed.

A dedicated sentinel site trap program was maintained in western Kansas of known walnut locations. This was prompted by the discovery of walnut twig beetle in Eads, Colorado, about 40 miles directly west of the Colorado-Kansas border. The Eads infestation remains the nearest known TCD positive, although a new infestation in along Interstate 76 in Brush, Colorado was found in 2017, 85 miles from northwestern Kansas.

The Interstate 70 corridor from Denver to Kansas City remains the most likely pathway for TCD, linking the TCD-positive Denver metro area with the major black walnut production area of eastern Kansas and Missouri.



A Lindgren funnel trap, used to monitor for walnut twig beetles..



The onset of autumn on native forestland at Pomona Lake in Osage County, Kansas.

For Forest Health assistance and further information on Forest Health in Kansas, please refer to the following.



[Kansas Forest Service](#)

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[USDA Forest Service – Rocky Mountain Region](#)

Forest Health Protection (FHP) – Forest Health Monitoring (FHM)

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<https://www.fs.usda.gov/main/r2/home>

[Table of Contents](#)

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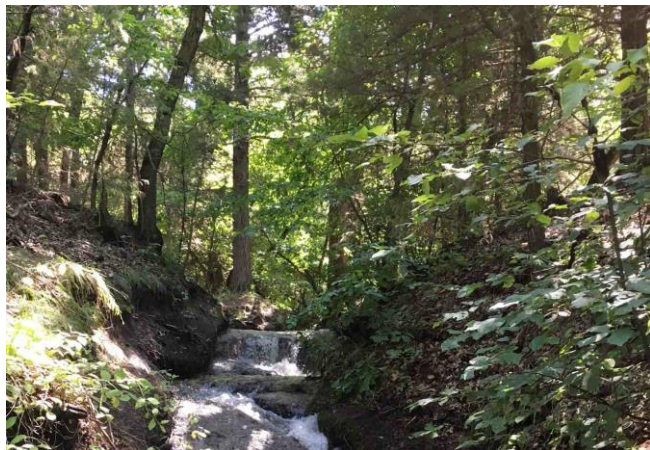
K-STATE
Research and Extension

Forest Health Highlights 2018

Nebraska



Nebraska Forest Service



The Forest Resource

Nebraska boasts a diverse array of forest resources. From the ponderosa pine forests of the Panhandle's Pine Ridge to the hardwood forests of the Missouri River bluffs, trees and forests play an important role in the lives of all Nebraskans and in the stability of ecological systems across the state and region.

Nebraska's 1.24 million acres of forestland represents many unique mixes of vegetation types. The hardwood forests of eastern Nebraska are representative of the central hardwoods of the eastern United States. Ponderosa pine forests in the west are representative of the Rocky Mountains, and the birch/aspen forests in northern Nebraska are representative of northern boreal forests. These forest types, combined with elm-ash-cottonwood riparian forests, mixed conifer forests, conservation tree plantings and urban forests, create a highly diverse and unique array of tree and forest resources growing within an agricultural and range landscape. With the addition of non-forestland with trees, conservation plantings and community forests, the total number of acres of treed or forested areas is approximately 3.3 million acres.

The dominant species of Nebraska's non-forestland with trees (defined as less than one acre, less than 120 feet wide and less than 10% stocked) are eastern redcedar, Siberian elm, hackberry, red mulberry and ash. These trees provide unique benefits such as rural home wind protection, snow drift management, energy savings, livestock protection, crop protection and yield increases, water quality and soil protection, wildlife habitat and other ecosystem services. Although not large units individually, combined these areas are important components that provide key and essential ecosystem services in Nebraska's rural agriculture-dominated landscape.



*Ponderosa pine in the Pine Ridge
Top photo: Stream in the Niobrara River Valley*

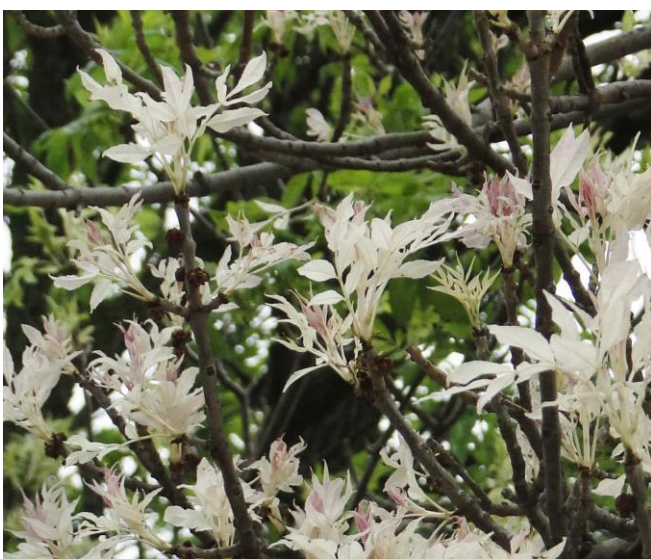
Pests and Problems of Note in 2018

Herbicide Damage

Herbicide damage to trees was common in 2018, especially symptoms such as leaf curling, cupping, and distortion typical of the damage caused by growth regulator herbicides. These herbicides are commonly used in agricultural fields and urban landscapes. Many are volatile and can move off-site long distances.



Curled, cupped leaves of ash, possibly caused by growth regulator type herbicides



Pink to white new growth on ash in a landscape treated with mesotrione

Spring Heat Stress

Record-breaking high temperatures occurred in late May across Nebraska, with temperatures topping 100 degrees F in some areas. Leaf yellowing and defoliation was evident on trees, especially hackberry.



Early hot spring temperatures induced yellowing and defoliation of hackberry.

Diplodia Blight

Diplodia blight (*Diplodia sapinea*) continued to damage and kill many pines in Nebraska in 2018 in both urban and rural areas. According to a USFS aerial survey, large areas in the Pine Ridge north of Rushville were damaged by Diplodia. Such large areas typically result when latent infections are triggered by hail storms.

Velvet Longhorned Beetle

In 2018, walnut wood originating from South Dakota and brought to Wynot in the northeastern part of Nebraska was determined to be infested with velvet longhorned beetle (*Trichoferus campestris*). A table made from the wood and sold to a resident of Yankton, South Dakota, had adult beetles emerge. Nebraska Department of Agriculture placed traps at 15 sites in 10 counties, mainly in locations at high risk for introduction and establishment (primarily state parks and nurseries). Most were in the northern and eastern parts of the state. No suspect specimens were collected. Trapping will continue in 2019.

Emerald Ash Borer

Emerald ash borer (*Agrilus planipennis*) was detected in two new counties in 2018: Lancaster (city of Lincoln; adult in trap) and Dodge (city of Fremont; infested trees). This brings the number of known infested counties to four (including Douglas and Cass). Adult beetles were also trapped at Mahoney State Park in 2018, which is located in Cass County. Eight counties (Cass, Dodge, Douglas, Lancaster, Otoe, Sarpy, Saunders, and Washington) are included in a state quarantine to restrict the movement of ash and other hardwood materials.

[More information on eab in Nebraska.](#)



Emerald ash borer larva in ash wood from Fremont showing the typical "J" shape of the overwintering larvae

Japanese Beetle

Japanese beetle (*Popillia japonica*) continues to spread to new areas of the state. The Nebraska Department of Agriculture added three more counties to the list of infested counties: Nance, Polk, and Pierce. A total of 41 of 93 counties are considered infested. Linden, cherry, peach, birch, and hazelnut are among the common trees and shrubs heavily defoliated by this pest.

[Visit the Nebraska Department of Agriculture for more information.](#)

Pine Wilt

Pine wilt (*Bursaphelenchus xylophilus*) continued to kill Scotch and Austrian pines in 2018. The disease occurs throughout the state, and the Nebraska Forest Service no longer recommends using Scotch pine in long-term plantings.

Oak Decline

Over the last several years, an increasing number of bur oaks in the eastern counties of the state have had browning leaves in late summer, early leaf drop, or leaves that stay on the tree through the winter months. Other symptoms include severe twig and branch dieback. These are all common symptoms of bur oak blight (*Tubakia iowensis*). This leaf blight seems to be most common on a subspecies of bur oak *Q. macrocarpa* var. *oliviformis*, found on higher, drier sites.

Some bur oaks may be declining from other factors: possibly a combination of bur oak blight, herbicide exposure, disturbance of native woodlands, oak wilt (*Ceratocystis fagacearum*), root decays, and borers. In the city of Oakland, a fluctuating water table may have been playing a role in the decline of several bur oaks in the city park.

[Table of Contents](#)

More information on Nebraska Forest Health

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State of South Dakota

Forest Health Highlights 2018

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Anthony Seidl, Forest Health Forester

Marcus Warnke, Forest Health Program Coordinator

South Dakota Department of Agriculture, Division of Resource Conservation and Forestry

General Overview:

The most common tree species from which samples were submitted (either by mail or as pictures sent by email or text) or inspected during site visits was green ash (*Fraxinus pennsylvanica*) (47%). Green ash is one of the most common trees in South Dakota community forests and windbreaks. The discovery of emerald ash borer in Sioux Falls this past spring increased awareness and concern regarding the insect so more tree owners were looking for symptoms and signs of emerald ash borer infestations in their ash trees.

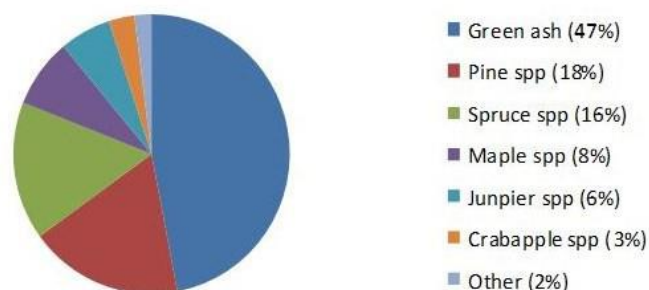
Most of these samples came from the Sioux Falls area, but samples came from throughout the state. The most common insect identified by site visits to these trees was either the banded or redheaded ash borer, followed by the clearwing ash borer and the ash bark beetle. No emerald ash borers were identified in any trees that tree owners or tree services thought were infested. Approximately 6% of the trees thought to be infested were not even ash. The most common tree thought to be an ash was boxelder (*Acer negundo*), followed by black walnut (*Juglans nigra*).

Pine - Austrian (*Pinus nigra*), ponderosa (*P. ponderosa*), and Scotch (*P. sylvestris*) - was the second most common genera for diagnosis (18%). Austrian and Scotch pine are common trees in windbreaks throughout the southern half of the state and are planted in communities through the state. Ponderosa pine is native to the Black Hills and adjacent regions to the north and east. It is also a common windbreak and community tree through the state. The most common pests associated with these trees was Zimmerman pine moth and pine wilt disease on the Austrian and Scotch pines, and either diplodia tip blight, dothistroma needle blight, or pine engraver beetle on ponderosa pine samples.

Spruce was the third most common genera submitted for diagnosis (16%). Most of these samples were from Colorado spruce (*Picea pungens*), followed by white spruce (*P. glauca*). Colorado spruce is common to communities and windbreaks throughout the state. White spruce, commonly referred to as Black Hills spruce, is also planted throughout the state and is native to the Black Hills. The most common pests diagnosed were cytospora canker, spruce needlecast diseases, and spruce needleminer.

Other tree genera submitted as samples were maples (*Acer*) (8%), juniper (*Juniperus*) (6%), crabapple (*Malus*) (3%).

Tree Species Submitted as Samples or Site Visits



Pie graph showing the percentage of trees submitted by species during FY2018.

CONFIRMED INSECTS & MITES

BY SAMPLES SUBMITTED OR PHOTOS VIA EMAIL OR TEXT

- | | | |
|--|--|---|
| <ul style="list-style-type: none"> • Apple maggot (<i>Rhagoletis pomonella</i>) • Ash/lilac borer (<i>Podosesia syringae</i>) • Ash bark beetle (<i>Hylesinus spp</i>) • Ash grey blister beetle (<i>Epicauta fabricii</i>) • Ash plant bug (<i>Tripodostepes amoenus</i>) • Ash seed weevils (<i>Lignyodes bischoffi</i>) • Banded elm bark beetle (<i>Scolytus chevrewi</i>) • Banded ash borer (<i>Neoclytus caprea</i>) • Boxelder bug (<i>Boisea trivittata</i>) • Bronze birch borer (<i>Agrilus anxius</i>) • Butternut woollyworm (<i>Eriocampa juglandis</i>) • Carpenterworm (<i>Prionoxystus robiniae</i>) • Chokecherry midge (<i>Contarina virginianae</i>) • Codling moth (<i>Cydia pomonella</i>) • Cotonest leaf crumpler (<i>Acrobasis indigenella</i>) • Cottonwood borer (<i>Plectrodera scalator</i>) • Cottonwood leaf beetle (<i>Chrysomela scripta</i>) • Cottony ash psyllid (<i>Psyllopsis discipans</i>) | <ul style="list-style-type: none"> • Dogwood sawfly (<i>Macremphytus tarsatus</i>) • Dusky birch sawfly (<i>Croesus latitarsus</i>), • Eastern tent caterpillar (<i>Malacosoma Americanum</i>), the western tent caterpillar (<i>M. californicum</i>) and the forest tent caterpillar (<i>M. disstria</i>) • Elm sawfly (<i>Cimbex americana</i>) • Emerald ash borer (<i>Agrilus planipennis</i>) • Fall webworm (<i>Hyphantria cunea</i>) • Fall cankerworm (<i>Aisophila pometaria</i>) • Flatheaded appletree borer (<i>Chrysobothris femorata</i>) • Fruittree leaf roller (<i>Archips argyospila</i>) • Hackberry nipple gall maker (<i>Pachypsylla celtidismamma</i>) • Honeylocust pod midge (<i>Dasineura gleditschiae</i>) • Japanese beetle (<i>Popillia japonica</i>) • Lecanium soft scales (<i>Parthenolecanium</i>) • Maple bladder gall mite (<i>Vasates quadripedes</i>) • Metallic wood-borer (<i>Buprestis confluenta</i>) • Mourningcloak butterfly (<i>Nymphalis antiopa</i>) | <ul style="list-style-type: none"> • Northern ash sphinx (<i>Sphinx chersis</i>) • Pear slug (<i>Caliroa cerasi</i>) • Pine engraver beetle (<i>Ips pini</i>)* • Pine leaf adelgid (<i>Pineus pinifoliae</i>) • Plum curculio (<i>Conotrachelus nenuphar</i>) • Poplar borer (<i>Sapera calcarata</i>) • Poplar vagabond aphid (<i>Mordvilkoja vagabunda</i>) • Spotted wing drosophila (<i>Drosophila suzukii</i>) • Spruce bud scale (<i>Physokermes piceae</i>) • Spruce needleminer (<i>Endothenia albolineana</i>) • Turpentine beetle (<i>Dendroctonus valens</i>)* • Twolined chestnut borer (<i>Agrilus bilineatus</i>) • Velvet erineum gall mite (<i>Aceria aceris</i>) • Willow sawfly (<i>Nematus ventralis</i>) • Zimmerman pine moth (<i>Dioryctria spp</i>) |
|--|--|---|

*Although calls were responded to regarding mountain pine beetle (*Dendroctonus ponderosae*), this insect was nearly undetectable this year. Calls were typically pine engraver or turpentine beetles.



Spiny-elm caterpillar (mourningcloak butterfly) feeding on hackberry leaves. (Dr. Ball Pest Update, July 5, 2017; Vol. 15, no. 21)

CONFIRMED DISEASES

BY SAMPLES SUBMITTED OR PHOTOS VIA EMAIL OR TEXT

• Apple scab (<i>Venturia inaequalis</i>) • Ash anthracnose (<i>Plagiostoma fraxini</i>) • Ash rust (<i>Puccinia sparganioides</i>) • Bacterial blight of lilac (<i>Pseudomonas syringae</i> pv. <i>syringae</i>) • Black knot (<i>Apiosporina morbosa</i>) • Bur oak blight (<i>Tubakia iowensis</i>) • Cedar-apple rust (<i>Gymnosporangium juniperivirginianae</i>), cedar-hawthorn rust (<i>G. globosum</i>), and cedar-quince rust (<i>G. clavipes</i>) • Cereal rust fungus (<i>Puccinia coronata</i>) • Coral nectria canker (<i>Nectria cinnabarina</i>)	• Diplodia tip blight (<i>Diplodia pinea</i>) • Dothistroma needle blight (<i>Dothistroma pini</i>) • Dutch elm disease (<i>Ophiostoma novo-ulmi</i>) • Fireblight (<i>Erwinia amylovora</i>) • Guignardia blotch (<i>Guignardia aesculi</i>) • Juniper broom rust (<i>Gymnosporangium nidus-avis</i>) • Kabatina twig blight (<i>Kabatina juniperi</i>) • Marssonina blight (<i>Marssonina populi</i>)	• Peach leaf curl (<i>Taphrina deformans</i>) • Phomopsis twig blight (<i>Phomopsis juniperovora</i>) • Plum pockets (<i>Taphrina communis</i>) • Tar spot (<i>Rhytisma acerinum</i>) • Spruce needlecast (<i>Stigmina lautii</i> and <i>Rhizosphaera kalkhoffii</i>) • Sycamore anthracnose (<i>Apiognomonina veneta</i>) • Valsa (cytospora) canker (<i>Valsa kunzei</i>) • Walnut anthracnose (<i>Ophignomonina leptostyla</i>) • Willow scab (<i>Venturia saliciperda</i>)
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SAMPLE PHOTOS SUBMITTED, WITH FOLLOW-UP SITE VISITS

- Chlorosis (*Acer rubrum*, *Betula nigra* and *Quercus palustris*)
- Hail damage (numerous species)
- Winter- burn (*Abies*, *Taxus* and *Thuja*)

Hail damage on ponderosa pine near Piedmont, SD from a storm in 2018. (Anthony Seidl, 2018)

WOODY PLANT IDENTIFICATION

- Common chokecherry (*Prunus virginiana*)
- Common buckthorn (*Rhamnus cathartica*)
- Green ash (*Fraxinus pennsylvanica*)
- Tatarian honeysuckle (*Lonicera tatarica*)



HIGHLIGHTED INSECT CONDITIONS: BORERS

EMERALD ASH BORER (*AGRILUS PLANIPENNIS*)

Emerald ash borer was confirmed in Sioux Falls this past spring. A mature ash tree was being pruned for clearance away from a building. The arborist made a tear cut on a limb which exposed galleries and a larva once the sapwood was exposed. The possible find of emerald ash was reported to Dr. John Ball, and he visited the site within an hour. Larvae were collected from the site and submitted to APHIS for confirmation. The larvae were confirmed as emerald ash borer within three days of submission.

A walking survey of the area was made the following week to identify any ash trees that were presenting symptoms of being infested by the emerald ash borer. The most common symptoms presented were woodpecker pecks within the limbs in the upper canopy of mature trees. Many of these trees also had patches – often several feet long – of bark that was removed by woodpecker activity, a symptom referred to as blanding. The trees were beginning to leaf out and many of the trees with extensive woodpecker activity also had some minor dieback and areas of the canopy with leaves that were smaller than normal.

Over 250 infested trees were identified within a mile area surrounding the initial find. Most were in the north side of Sioux Falls. The infestation appears to be recent – perhaps 3 or 4 years old – and concentrated within about a 1 square mile area. Most were concentrated within the core, but there were two satellite areas within ¼ mile of the core.

Branch sampling was conducted in trees within this core area that were presenting symptoms. The sampling was performed from an aerial lift and followed the procedure developed by the Canadian Forest Service. Two branches, about 3 to 6 inches in diameter, were selected mid-canopy and in a sun-lite portion of the crown. The branches were pruned off at their base and thrown to the ground. The lower two feet of these branches were stripped of their bark. The branch sampling easily revealed emerald ash borers and their galleries. Every branch sample had signs of being infested, e.g. galleries or insects, though on many of these trees the only symptoms were scattered blanding in the upper canopies and woodpecker pecks.

A survey of street and park trees was conducted during late May. City blocks were randomly selected through a numbered grid system. A walking survey of the ash was conducted on the selected blocks. Trees with possible symptoms of an emerald ash borer infestation – blanding, woodpecker pecks, suckering – were noted on the survey. These trees were inspected from an aerial lift and branches were sampled. We were not able to find any signs of an infestation. No galleries or emerald ash borers were detected in any tree.

RCF Foresters and interns survey the area of EAB infested trees in Sioux Falls, SD (SDDA, June 2018)





Blonding caused by woodpecker activity on an EAB infested tree in Sioux Falls, SD (SDDA, June 2018)

Purple panel traps were installed at the end of May. The core that includes the satellites was identified as our exclusionary zone (highlighted by the dashed lines) where trapping was no longer necessary, though four traps were placed in infested trees as a check to determine whether the traps would catch the adults. During the first week of June – when black locust trees were beginning to flower – the adults began to emerge.

A systematic grid of panel traps was established outside of this zone extending out about a mile with eight traps placed per square mile where ash trees are accessible. This required about 32 panel traps. These were checked weekly during the flight period.

The only emerald ash borer adults caught in the traps were the four placed in the infested trees within the core area.

Public outreach efforts

Public meetings were held in the Sioux Falls area beginning in early June. Nine meetings have been held by the end of September. Ash tree owners were told that if they lived within 15 miles of the northern

part of Sioux Falls, they did not need to have anyone come out to inspect their ash trees. They could assume that their tree would become infested soon – within 2 to 10 years – or might even already be infested. If they were within this area the public was told to either plan on removing their ash tree or begin treatments by hiring a commercial applicator.

Since the insect was discovered near the beginning of emergence, there was a ban on the removal and pruning of ash within Sioux Falls until after Labor Day, the time when adults would no longer be emerging.

A quarantine was established in late May for Minnehaha County, the northern half of Lincoln County and the northeastern corner of Turner

County. Any ash – tree, log, wood – cannot be moved out of these areas.

Commercial outreach efforts

There were three injection workshops held in Sioux Falls during May and June. Product distributors were given an opportunity to discuss their line of injection equipment and products. The workshops were well attended as most of the companies were lawn care companies and had not been involved in tree care. This was an opportunity to learn how to treat ash trees by trunk injection. The city of Sioux Falls was not allowing any soil treatments for emerald ash borer. The only approved method for licensed companies was trunk injection.

The influx of companies providing injection is resulting in some misapplications – made a couple of feet high rather than at the flare and we have had some problems with other trees, walnut and hackberry, being misidentified as ash.



Dr. John Ball presenting at an EAB workshop for the public in Sioux Falls, SD (SDDA, May 2018)

EMERALD ASH BORER (*AGRILUS PLANIPENNIS*)

Street tree inventory

Sioux Falls had an inventory of all their park trees, but not their street trees. We began a street tree inventory with the assistance of Master Gardeners and GPS units provided by the Division.

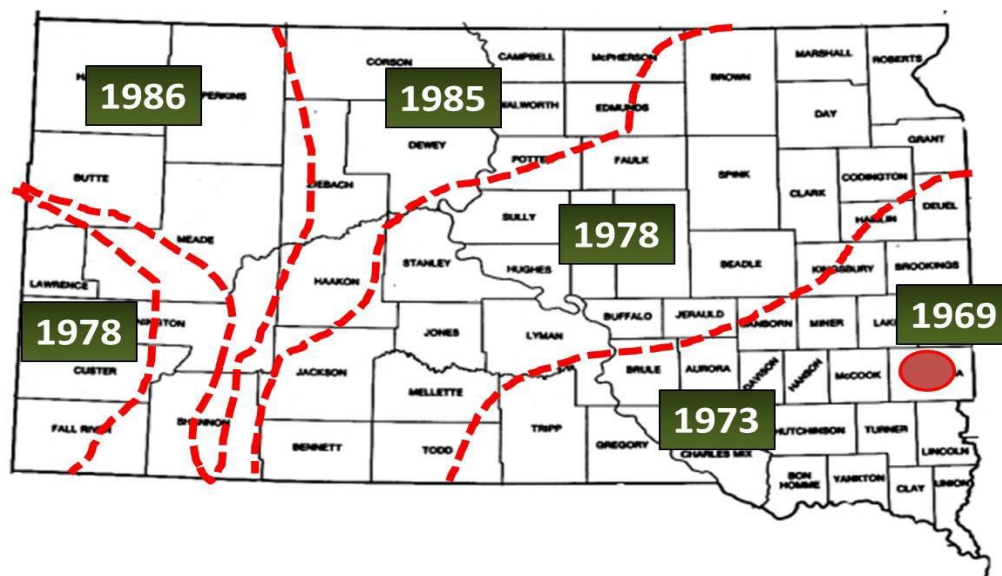
The state has had great success in using these volunteers in collecting street tree inventory data in other communities. During the past six weeks, the volunteers have inventoried about 5,000 trees, about 15% of the estimated street tree population. Approximately 36% of the street trees are ash, while another 31% are maple. The third highest is linden at 5%. The inventory efforts will continue in 2019. The estimated total population of ash trees in the city, counting public and private, is 85,000.

Possible spread pattern of emerald ash borer across the state

There is considerable interest in the potential long-distance spread pattern to emerald ash borer across the state. Since this depends on anthropogenic variables, e.g. raw ash wood movement, it is difficult to predict. However, a look at the historic spread of Dutch elm disease across the state may provide a guide. While Dutch elm disease is a pathogen, and emerald ash borer an insect, Dutch elm disease depends on raw wood and beetles for long distance spread. The insects can travel on infested firewood much as emerald ash borer does.

Interestingly both Dutch elm disease and emerald ash borer were first confirmed in Sioux Falls. Dutch elm disease spread out from Minnehaha County and it reached most of southeastern South Dakota within five years. It spread across all East River and parts of West River within 10 years. The disease showed up in the Black Hills sooner than some other western locations since this is a popular camping spot and campers carry firewood. The last county to have Dutch elm disease confirmed was Harding County in 1986.

While the spread of Dutch elm disease may differ from emerald ash borer, this map may be a reasonable pattern for the loss of our ash across the state.



A map depicting the spread of Dutch elm disease across South Dakota. (Dr. John Ball, January 2019)

VELVET LONGHORNED BEETLE (*TRICHOFERUS CAMPESTRIS*)

Earlier this spring an adult beetle emerged from a new walnut table and the owner sent some pictures of the holes coming from the table and the adult beetle. It appears to be the velvet longhorned beetle (*Trichoferus campestris*) and after adult specimens were collected and sent on through APHIS it was confirmed as the adult. A visit to the local saw mill permitted examination of the some of the logs from which the table was constructed and larvae were collected from this material.

During late August, another suspicious larva was found in an air-dried walnut board in Sioux Falls. The tree was harvested in Minnesota this spring, cut into boards, air-dried and shipped to South Dakota. We collected larvae and wood samples and these were sent through APHIS for identification. We have not received further information at this time.

The velvet longhorned beetle is a wood boring insect from East Asia, native to China, Korea and Russia. It was first detected in North America in Quebec (2002) and since then in 14 states including Colorado (2013) and Minnesota (2010). The insect is typically detected in traps and in warehouses, not trees, but it is established in fruit orchards in Utah.

The larval stage of the insect can continue developing in raw timber and even dry wood. The preferred living host is apple/crabapple (*Malus*) and peaches (*Prunus*). But it has been found in birch (*Betula*), honeylocust (*Gleditsia*), mulberry (*Morus*), pine (*Pinus*), spruce (*Picea*), walnut (*Juglans*), and willow (*Salix*). Infested trees usually present with declining canopies and epicormic shoots. There will also be pencil size oval holes on the trunk and frass (sawdust-like pellets) at the base of the tree. Finding these symptoms and signs does not positively identify the tree as infested by the velvet longhorned beetle as infestations by our native longhorned beetle will present the same.

This insect has the potential to be a significant pest in apple and peach orchards. It also can become a structural problem in rustic furniture, any wood product with some bark retained on the edge. The insect has been known to live 18 months in furniture before emerging.

HIGHLIGHTED INSECT CONDITIONS: DEFOLIATORS

ASH PLANT BUG (*TROPIDOSTEPTES AMOENUS*)

Ash plant bugs and other plant bugs seem to be more of a problem this year than in the past decade. Plant bugs, both the nymphs and adults, insert their piercing-sucking mouthparts into the leaf and secrete a toxic substance into the tissue while pulling chlorophyll out of the tissue. This injury results in white to brownish black dots referred to as stippling. Usually the extent of the injury is just a few random light-colored dots on the leaves, but high populations of plant bugs can result in the leaves curling and turning brown before falling prematurely.

There is more than one ash plant bug, *T. amoenus*, which is the species native to eastern US, and *T. ilitus* and *T. pacificus* are native to the western US. The widespread shipping of ash trees back and forth across this country has mixed these populations but the dominant one is *T. amoenus*. This insect has two generations per year and that seems to be the situation here in South Dakota where we saw a large population of nymphs in late May and another peak in late August. The insect overwinters as eggs which hatch as the leaves begin to expand. The nymphs move out onto this tender foliage to suck sap from the undersides of the leaves. They feed for about five weeks before becoming adults.

These adults lay eggs in late July which hatch in early August with the second generation of nymphs feeding during August. The adults, which also suck sap from the leaves, lay eggs and continue feeding until they are killed by the frost.

BUTTERNUT WOOLLYWORM (*ERIOCAMPA JUGLANDIS*)

Butternut woollyworm was found defoliating black walnuts in several areas of the state. The adult sawfly is a small wasp-like insect that lays in eggs along the leaflet margins in early summer. Once the eggs hatch, the larvae feed on the leaflets until late summer when they drop to the ground to pupate before emerging the following spring.

The populations fluctuate from year to year so finding them this year is not a good predictor that they will be found on the same trees next year. They also do not usually cause enough defoliation to be a concern.

DOGWOOD SAWFLY (*MACREMPHYTUS TARSATUS*)

Dogwood sawfly resulted in defoliation of redosier dogwoods in the eastern half of the state. They have almost completely defoliated some shrub beds. There are two generations per year with the second generation (appearing in August) causing the most defoliation.

FRUITTREE LEAF ROLLER (*ARCHIPS ARGYOSPILA*)

Fruittree leaf roller is becoming a serious defoliator of the birchleaf spirea (*Spiraea betulifolia*), a shrub that is becoming a popular

ornamental and a replacement for other spireas.

The fruittree leaf roller infests a wide range of hosts from ash to willow but seems to really like birchleaf spirea (as well as apple trees). While the fruittree leaf roller causes much of this damage in South Dakota, a similar appearing insect, the obliquebanded leaf roller (*Choristoneura roseaceana*), can also roll the leaves of spirea.

PEAR SLUGS (*CALIROA CERASI*)

Pear slugs defoliation was higher than average this year. Pear sawfly is also known as pear slug because of the slimy appearance to the larvae. The olive-green larvae are the damaging stage and feed

on the leaves of pears (hence the name) as well as cherries and even an occasional plum or apple. They feed on only one surface of the leaf, a type of damage known as a window-pane. The damage is usually not severe enough to warrant treatments.

There are two generations per year of this insect. The adults emerge in the spring from cocoons in the soil. The adults are a non-stinging wasp about 3/16-inch long. The adult female cuts slits in the edge of the leaves with her saw-like ovipositor with the eggs hatching within two weeks. The young larvae move out and feed on the upper surface of the leaves for about a month before dropping to the soil and forming cocoons. The second-generation adults emerge in early July to start the life cycle over again. The second-generation larvae cause the most defoliation.

DUSKY BIRCH SAWFLY (*CROESUS LATITARSUS*)

Dusky birch sawfly is an occasional pest of birch, especially river birch. Dusky birch sawfly has two generations per year and the second generation larvae will feed for a week or two in late summer before dropping to the soil to overwinter as pre-pupae. The adults will emerge from the soil next spring to lay eggs along the margins of the newly unfolded leaves.

The reports came from the central and eastern part of the state and there were only a few trees that had significant defoliation.



Pear slug feeding on a leaf. (Dr. John Ball, Pest Update, Sep. 19, 2018; Vol. 16 no. 32)

HIGHLIGHTED DISEASE CONDITIONS: FOLIAGE DISEASES

GUIGNARDIA LEAF BLOTCH (*GUIGNARDIA AESCULI*)

Guignardia leaf blotch is appearing on buckeyes in the state. This is a common disease of horsechestnut (but we have few of these trees) and can also occur on buckeyes. The disease first appears as small water-soaked blotches in the leaves. These quickly develop into reddish-brown spots with a yellow margin. Eventually the blotches expand and coalesce. The entire leaf may become one big blotch and these infected leaves curl, become dry and brittle and fall prematurely.

The browning and curling – the final symptoms – may be confused with scorching. This environmental problem, the result of drying summer winds, is usually concentrated on the south side of the tree while Guignardia blotch will be throughout the tree.

Guignardia leaf blotch is common on Ohio buckeye (*Aesculus glabra*), but not on the two common hybrids planted in the state, 'Autumn Splendor' and



Guignardia leaf blotch on an Ohio buckeye leaf. (Dr. John Ball, Pest Update, Jul. 18, 2018; Vol. 16, no. 23)

the 'Homestead' buckeyes. These two trees are noted for their attractive spring flowers, sparse nut production, and autumn foliage color. The lack of leaf blotch is just another reason to plant these hybrids rather than the species.

BUR OAK BLIGHT (*TUBAKIA IOWENSIS*)

Bur oak blight (*Tubakia iowensis*) disease reports typically occur in late summer. This disease was first noticed on bur oaks in southern Minnesota, Iowa and eastern Nebraska back in the 1990s where it became associated with declining bur oak (*Quercus macrocarpa*). It has been reported in most of the South Dakota counties bordering Minnesota and Iowa. The disease is more prevalent on the bur oak botanical variety *Q. macrocarpa* var. *oliviformis* which is more common to dry, upland sites. This variety produces slightly smaller acorns than most other bur oaks. This botanical variety is found in woody draws and along rolling hills of eastern South Dakota and includes the draws that are incorporated into Sioux Falls. There are many land-owners in this community that are treating their oaks.

HIGHLIGHTED DISEASE CONDITIONS: WILTS

DUTCH ELM DISEASE (*OPHISTOMA NOVI-ULMI*)

Dutch elm disease reports were low during 2018. Communities with a significant elm population, more than 10% of their street tree population, are becoming fewer and even in these communities the elms are spread out enough to limit root graft infections. The American elm population continues to decline due to disease (Dutch elm disease and verticillium wilt), storms, and construction. While American elm is still one of the most common community trees in the state, comprising more than 5% of the total street tree population, this is a drop from more than 10% two decades ago. There are some new street plantings of Princeton elm (*Ulmus americana* 'Princeton'), but most of the elms being planted are Accolade (*U. x 'Morton'*), Discovery (*U. davidiana* var. *japonica* 'Discovery') and Triumph (*U. x 'Morton Glossy'*).

PINEWOOD NEMATODE (*BURSAPHELENCHUS XYLOPHILUS*)

Pinewood nematode is native to North America and feeds on the living cells surrounding the resin canals in the sapwood and blue stain fungi within pine. In a native host, such as ponderosa pines, the nematode does little harm, but in an exotic pine such as Scotch (*P. sylvestris*) or Austrian (*P. nigra*) pine, it becomes a killer. The nematode and perhaps a bacterial associate, colonizes the vascular system, restricting water transport and causing a wilt disease known as pine wilt. The disease usually kills a tree the same season symptoms appear.

Pine wilt disease was first noted in Missouri in 1979, at first it was thought to be an exotic threat but when the disease was only observed on exotic pines, not the native, the thought turned to the nematode being native. The disease was soon found in the much of the Midwest from Michigan to Nebraska. It was first noted in South Dakota in the Lake Andes-Yankton area during the mid-1980s.

The occurrence of pine wilt disease is associated with dry and warm summer (a mean temperature above 70°F). If the summers are not warm enough, the disease does not appear despite the appearance of the nematode. South Dakota summers have been warmer in the past decade and this has permitted the disease to advance north. It was once restricted to the southern tier of counties, then I-90, then Hwy 14 and now Hwy 212. While we have not confirmed the disease in the northern third of the state, it is likely only a matter of time.

Pines usually die the same year that symptoms appear though occasionally death is delayed until the weather warms the following spring. When the dead tree is felled, the stump will have blue stain in the sapwood. Logs from infested trees are very light as the wood has also dried due to the plugging of the vascular system.

The disease is carried by sawyer beetles (*Monochamus*) from an infected tree to a healthy host, usually through the maturation feeding by the newly emerged beetle. The nematode may be transported to drought-stressed pines during oviposition by the beetles as they are attracted to stressed trees.

The management of this disease is prompt removal and disposal of the dead, infested trees. This should be done from autumn through early spring. We look at April 1 being the finish date as after that time the longhorned beetles emerge and can carry the nematode to nearby healthy trees. The disease does not move quickly through a group of trees or windbreak. Some trees may carry a small population of nematodes for a year or two before the population expands and the tree presents symptoms. It can take a decade or more before the entire belt dies from the disease.



Scotch pine killed by pine wilt disease on a golf course in Rapid City. (SDDA, 2017)

FOREST HEALTH CONDITIONS WITH OTHER DAMAGING AGENTS

Hail

A hail storm moved through the Black Hills and east into the plains during the past summer. The storm resulted in mechanical damage to many trees within its path. There has also been an increase in pines presenting diploia tip blight symptoms within the path.



Hail damage on ponderosa pine in the Black Hills near Piedmont, SD (SDDA, 2018)

Herbicide

There have been numerous reports of herbicide injury to windbreak trees and shrubs adjacent to soybean fields. The typical symptoms were leaf cupping, curling and abnormal elongation of the leaf. The foliage analysis of these plants showed a dicamba concentration of 6 to 70 ppb.

Tornado

On Friday, June 29th, a tornado touched down in the Northwestern corner of the Black Hills. It started near the Wyoming border, not far from the area known as Cement Ridge, and continued South and East until it hit Spearfish Canyon. The tornado tracked nearly 20 miles and destroyed acres of ponderosa pine, Black Hills spruce, aspen, and birch stands on both public and private land.

Following the storm salvage harvesting operations were completed to remove much of the ponderosa pine blown down during the storm that was marketable and accessible. Other areas were opened up for free fire permits to the public to help reduce the down woody material that was less suitable for timber harvest.

Although tornadoes are not common in the Black Hills, they have also been confirmed in recent years near Hill City, SD, and near Pactola reservoir. However, this most recent tornado was far more destructive.



Area near Tinton, SD hit hard by the June 29th tornado. (SDDA, 2018)



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CONSERVATION- FORESTRY/



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ANNUAL INSECT & DISEASE TRAINING

The Division of Resource Conservation & Forestry's strategic plan requires one insect and disease training be held annually for division personnel to improve diagnoses of common problems of trees in South Dakota. These trainings are also open to other agencies and individuals looking to expand their knowledge of tree insect and diseases. This year's training was held in Brookings on June 5th & 6th, 2018. The training was attended by all field foresters for the division, staff, and forestry interns. Dr. Ball presented on the most common insect, disease, and other damaging agents of trees. Other topics included soil health and tree species suitable for South Dakota plantings.



Forestry intern, Nathanael Burkhardt, hangs a purple prism trap for EAB during I & D training.

The second day of the training included a field portion walking around the area in Sioux Falls where emerald ash borer was first confirmed only a month earlier. Purple prism traps were inspected for adult catches, and some adults were found during emergence.

[Table of Contents](#)

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2018 Wyoming Forest Health Highlights

Mountain pine beetle (MPB) activity declined from 34,000 acres detected by aerial survey in 2015 to 6,300 acres in 2016 to 3,300 acres in 2017 to 470 acres in 2018.

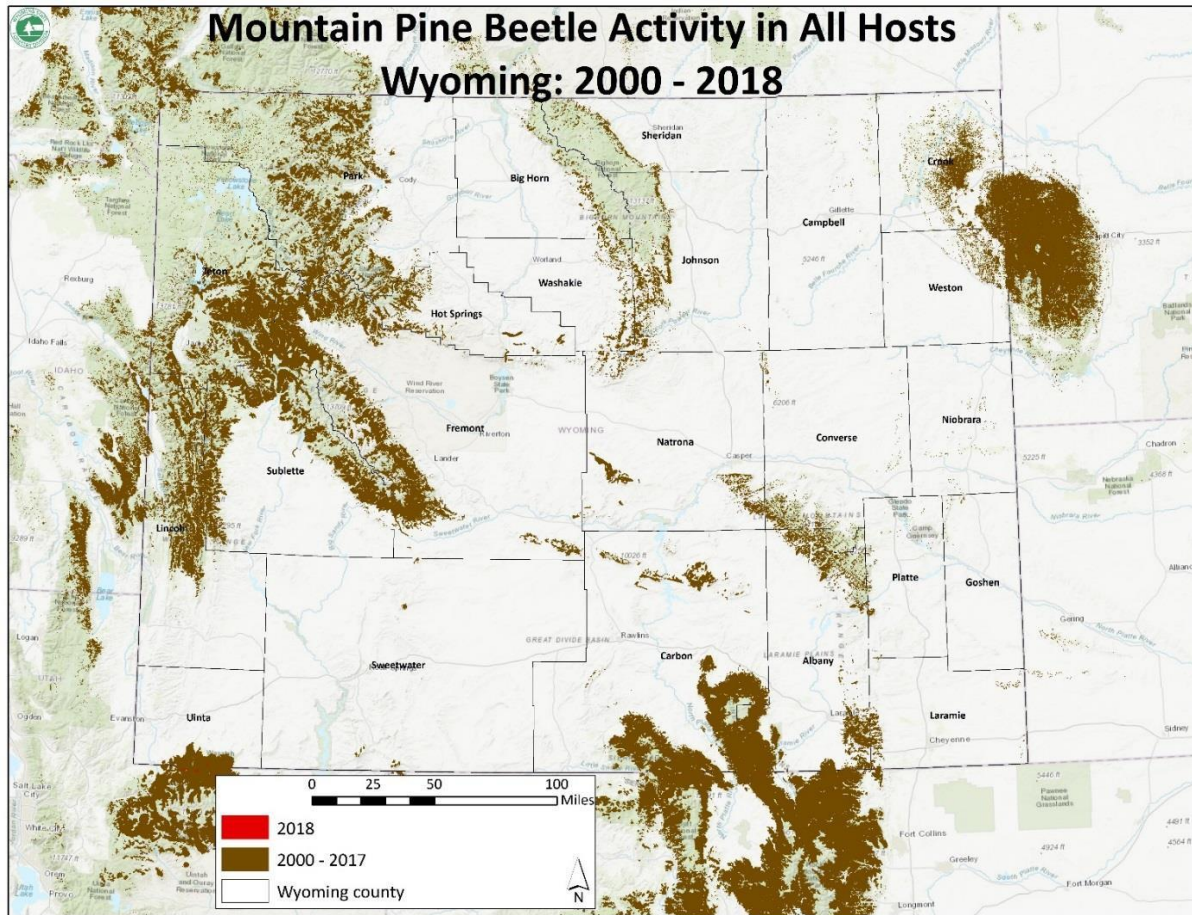


Figure 1. Bark beetle activity in Wyoming. While most affected areas in western Wyoming shown here depict mountain pine beetle damage, northeastern Wyoming has had substantial engraver beetle activity. Not all areas are surveyed every year. Due to the nature of aerial surveys, this data will only provide rough estimates of location, intensity and the resulting trend information for agents detectable from the air. Many of the most destructive diseases are not represented in the data because these agents are not detectable from aerial surveys. The data presented should only be used as a partial indicator of insect and disease activity, and should be validated on the ground for actual location and causal agent. The insect and disease data is available digitally from the U.S. Forest Service, Region Two Forest Health Management group. The cooperators reserve the right to correct, update, modify or replace GIS products. Using this data for purposes other than those for which it was intended may yield inaccurate or misleading results. Map courtesy U.S. Forest Service & Wyoming State Forestry Division

The most recent epidemic has ended across Wyoming. Black Hills forest land was examined by Wyoming State Forestry Division to detect MPB activity. There has been a noticeable decline of MPB observed over the past few years. Ips activity and infrequent single-tree hits were remotely scattered and no large mortality pockets or beetle outbreaks were observed. In western

Wyoming, high elevation five needle pines have been affected by MPB and white pine blister rust. In some areas, most of the mature five needle pines have been killed.



Figure 2. Dead standing whitebark pine killed by mountain pine beetle and live whitebark pine affected by white pine blister rust, Wyoming Range, western Wyoming. Photo: Ryan DeSantis 2018

Spruce beetle activity declined from 68,000 acres detected by aerial survey in 2015 to 34,000 acres in 2016 to 28,000 acres in 2017. In 2018, 29,000 affected acres were detected by aerial survey. The vast majority of spruce beetle activity was confined to western Wyoming.

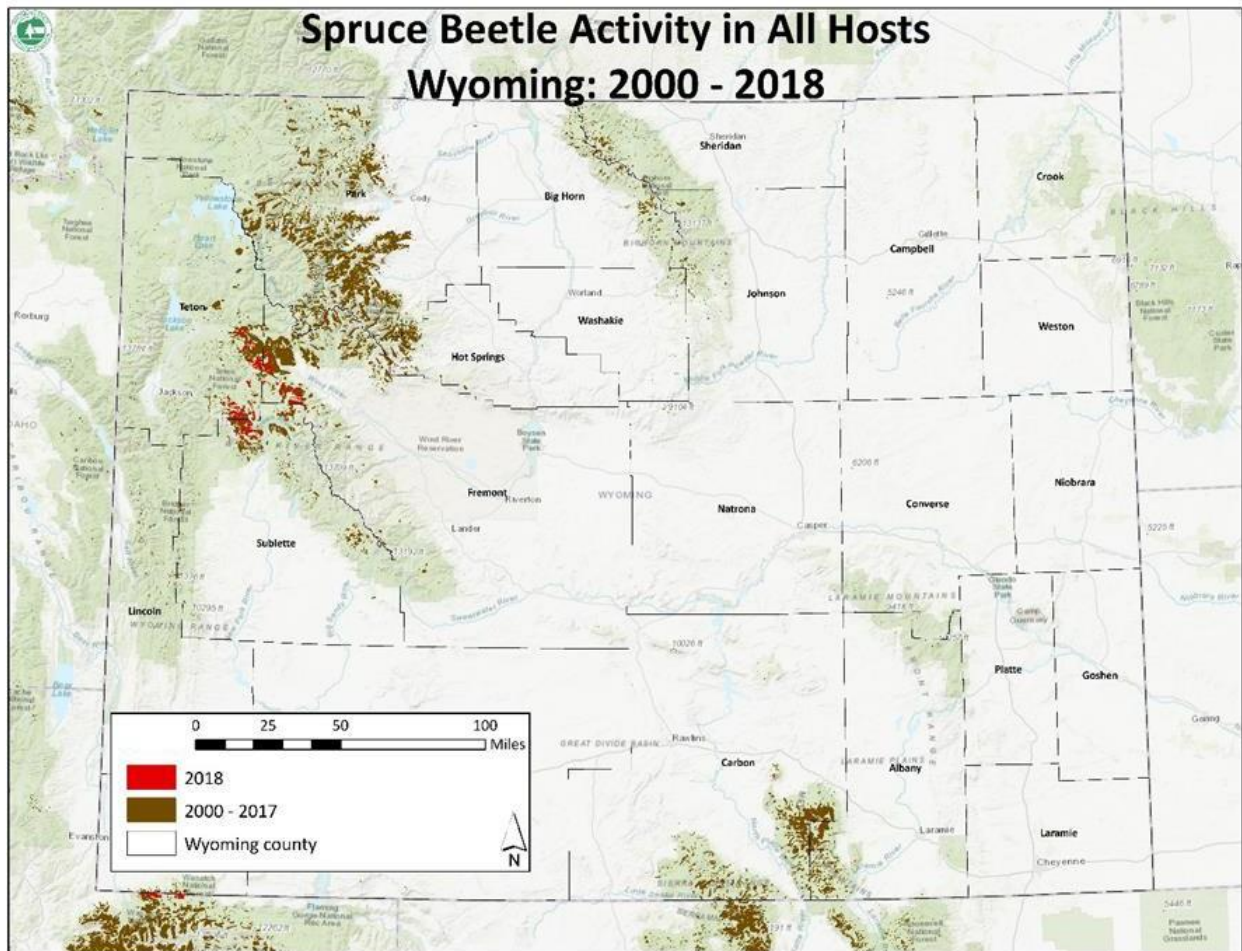


Figure 3. Spruce beetle activity in Wyoming. Due to the nature of aerial surveys, this data will only provide rough estimates of location, intensity and the resulting trend information for agents detectable from the air. Many of the most destructive diseases are not represented in the data because these agents are not detectable from aerial surveys. The data presented should only be used as a partial indicator of insect and disease activity, and should be validated on the ground for actual location and causal agent. The insect and disease data is available digitally from the U.S. Forest Service, Region Two Forest Health Management group. The cooperators reserve the right to correct, update, modify or replace GIS products. Using this data for purposes other than those for which it was intended may yield inaccurate or misleading results. Map courtesy U.S. Forest Service & Wyoming State Forestry Division

Since 1996, over 700,000 acres have been affected by spruce beetle in Wyoming, leaving many dead standing spruce trees in higher elevations.

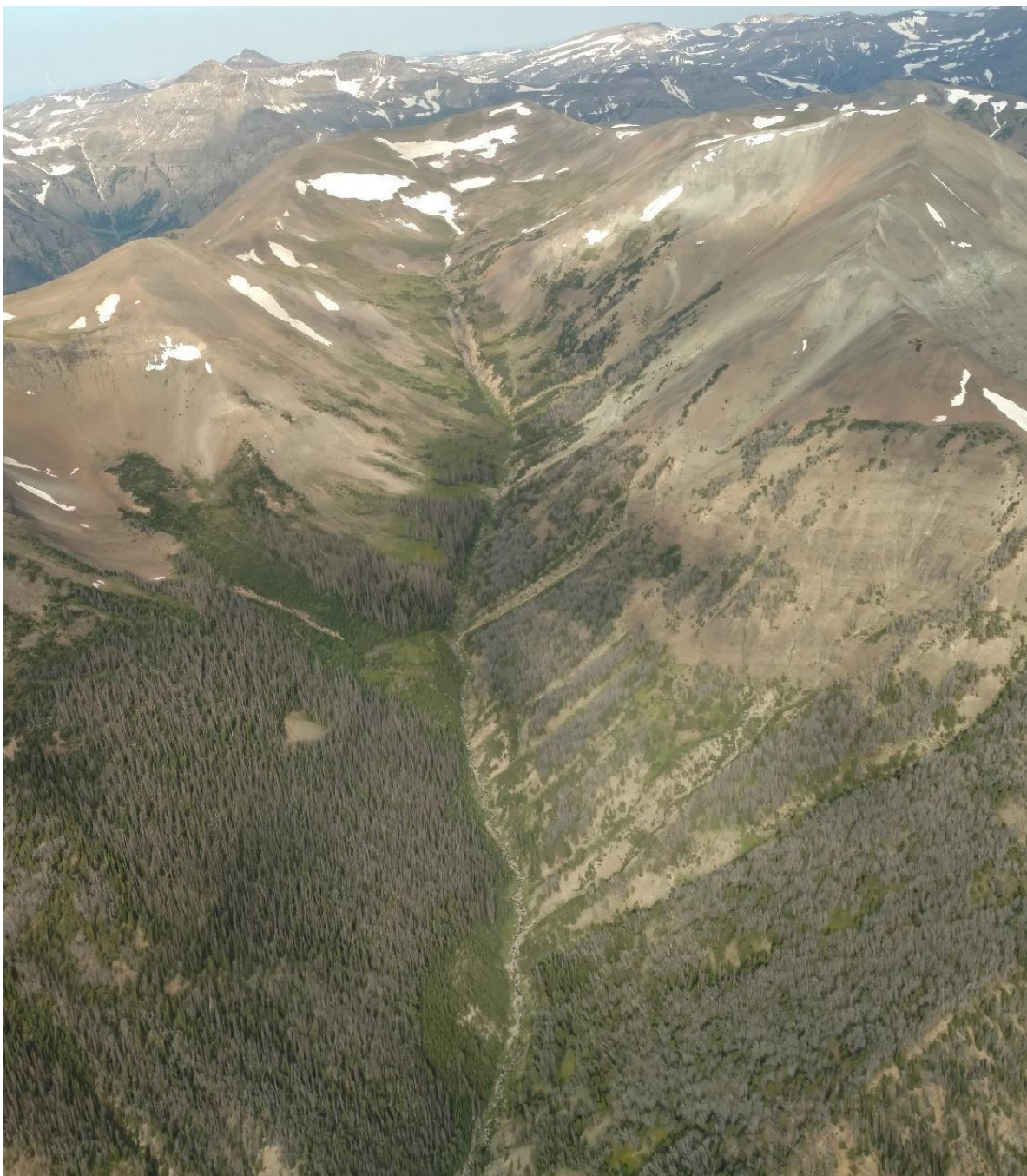


Figure 4. Whitebark pine mortality caused by mountain pine beetle on right side of drainage, Engelmann spruce mortality caused by spruce beetle on left, Absaroka Range, northwestern Wyoming. Photo: Ryan DeSantis 2018

Douglas-fir beetle mortality has been detected on over 433,000 acres across Wyoming since the early 2000s. Recently it has returned to endemic levels. Only 30 acres affected by Douglas-fir beetle were detected by aerial survey in 2018.

Western spruce budworm defoliation of Douglas-fir and Engelmann spruce was detected on over 67,000 acres by aerial survey in 2018, with large budworm-caused mortality polygons mapped primarily in the southern Bighorns and western Wyoming. Western spruce budworm larvae feed

on Douglas-fir, Engelmann spruce, and subalpine fir foliage in the spring. Larval feeding can decrease growth, kill the tops of trees, or kill trees outright if heavy defoliation occurs across multiple years. Defoliation of large areas can lead to a brownish cast to the forest.



Figure 5. Discolored Douglas-fir from western spruce budworm feeding. Photo: Justin Backsen 2018

Subalpine fir decline can be found throughout Wyoming's high elevation forests, although mortality of subalpine fir is often less intense than in associated spruce. Mortality often becomes more noticeable after successive years.

Monitoring for non-native invasive insects continues. Balsam woolly adelgid has caused substantial subalpine fir mortality in the northwestern U.S. It has been positively identified nearby in northern Utah, southeastern Idaho and southwestern Montana, but not yet in Wyoming. No damage caused by gypsy moth was observed during 2018 aerial detection survey, although gypsy moths were found in traps in Lovell in 2015, Casper in 2016 and Yellowstone National Park in 2018. Subsequent delimiting trapping in Lovell and Casper did not detect any additional moths. Wyoming State Forestry Division assists USDA-APHIS PPQ with gypsy moth detection efforts. Emerald ash borer (EAB) has not been detected in Wyoming but Wyoming State Forestry Division continues coordinating EAB detection efforts.

Diplodia damage on ponderosa pine followed severe hail storms in Crook County near the Belle Fourche River along the South Dakota border. This damage is probably minor and effected Black Hills ponderosa pine will likely recover.

Winter injury/red belt effect was detected in many areas. This is caused by a combination of higher winter temperatures with no moisture, frozen soils, dessicating winds, and inversion layers. Areas affected included large areas in the Absaroka Range just northwest of Cody and in the Bighorn Mountains just west of Dayton. There was also a small but prominent area affected on the north slope of Casper Mountain with recurring red belt, and stressed trees there may be quickly killed by bark beetles.



Figure 6. Discolored ponderosa pine from red belt effect, Casper Mountain, Wyoming. Photo: Ryan DeSantis 2018

Wyoming State Forestry Division is committed to providing professional forestry service, information, and education to the citizens of Wyoming to achieve resilient forests and communities. In 2018, Wyoming State Forestry Division treated nearly 4,000 acres in Wyoming, predominantly on private and state lands, as part of forest management and forest health efforts.

For more information or for assistance, please contact:

[Table of Contents](#)



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Section 3: Acknowledgements & Extra Documentation:

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

- Colorado State Forest Service: **Mike Lester**, and **Dan West**.
- Kansas Forest Service: **Larry Biles**, and **Ryan Armbrust**
- Nebraska Forest Service: **John Erikson**, and **Laurie Stepanek** & Rachel Allison
- South Dakota Conservation and Forestry: **Greg Josten**, and Brian Garbisch, Marcus Warnke, **Anthony Seidl**, and John Ball
- Wyoming State Forestry Division: **Bill Crapser**, and **Ryan De Santis**

Rocky Mountain Region (R2) - Forest Health Protection Group in 2018	
Regional Office	Roy Mask - Forest Health Protection Group Leader (and acting Director of State and Private Forestry and Tribal Relations) (<i>retired</i>)
"	Bob Cain -- Regional Entomologist
"	Jeri Lyn Harris - Forest Health Monitoring Coordinator
"	Brian Howell - Aerial Survey Program Manager and supervisor
"	Justin Backsen - Region 2 Aerial Surveyor
"	Jennifer Ross - Region 2 Geographic Information Systems Specialist
Gunnison Service Center	Jim Worrall - Leader and Supervisory Plant Pathologist (<i>retired</i>)
"	Amy Lockner - Entomologist
"	Suzanne Marchetti - Biological Technician
Lakewood Service Center	Jim Kruse - Leader and Supervisory Entomologist
"	Kelly Burns - Plant Pathologist
"	Amy Chambers - Biological Technician
"	Rebecca Stokes (Powell) - Entomologist
"	Sky Stephens - Entomologist
Rapid City Service Center	Kurt Allen - Leader and Supervisory Entomologist
"	Jim Blodgett - Plant Pathologist
"	Al Dymerski - Forestry Technician and Aerial Surveyor
"	Kendra Schotzko - Entomologist

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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](#).

Reference for Citation:

Harris J.L. (comp.); R2 FHP staff, and States' Forest Health specialists 2018. **2018 Forest Health Conditions of the Rocky Mountain Region (R2)**. USDA Forest Service. State & Private Forestry & Tribal Relations, Forest Health Protection, R2-SPF&TR_19-RO-31. 117pp.

[Table of Contents](#)