United States Department of Agriculture

Forest Insect and Disease Conditions in the Rocky Mountain Region, 2019

Forest Service | Rocky Mountain Region | Forest Health R2–RO–20-01 | January 2020

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The information shown is based upon data compiled as of October 2019.

Cover photos: Spruce beetle caused tree mortality on Monarch Pass, Colorado. Photo by Suzanne Marchetti, USDA Forest Service.

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Conditions in Brief

2019 Weather Summary for the Rocky Mountain Region

In 2019, the Rocky Mountain Region (Colorado, Wyoming, South Dakota, Nebraska, and Kansas) experienced above-average precipitation during the winter and spring across much of the area. According to the National Weather Service, the spring snowfall in southwest Colorado produced many severe avalanches across the high country (Figure 1 and 2). Damaging wind events, hail and late season cold temperatures were also recorded across much of the region (Figure 3). The heavy late snowpack and cool weather impact aerial surveys of forest damage by delaying the drying of the foliage of affected trees. The drying foliage is what causes the trees to change color and be recognized as damaged from the air. This delay will result in under-estimating the acres of damage.

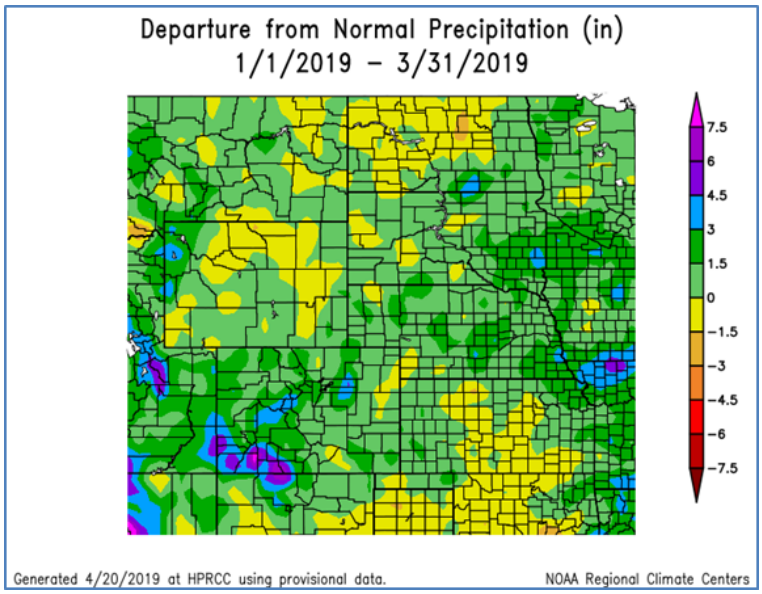

Figure 1. Departure from normal precipitation (inches) in portions of the Western U.S. Source: High Plains Regional Climate Center.

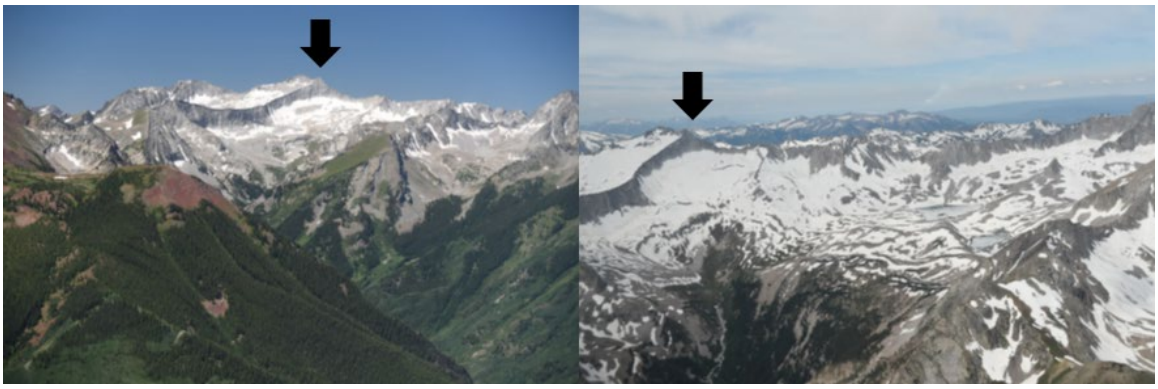

Figure 2. Photographs depicting the snowpack differences near Snowmass Mountain in June 2018 (left) vs July 2019 (right). Photos by Dan West, Colorado State Forest Service.

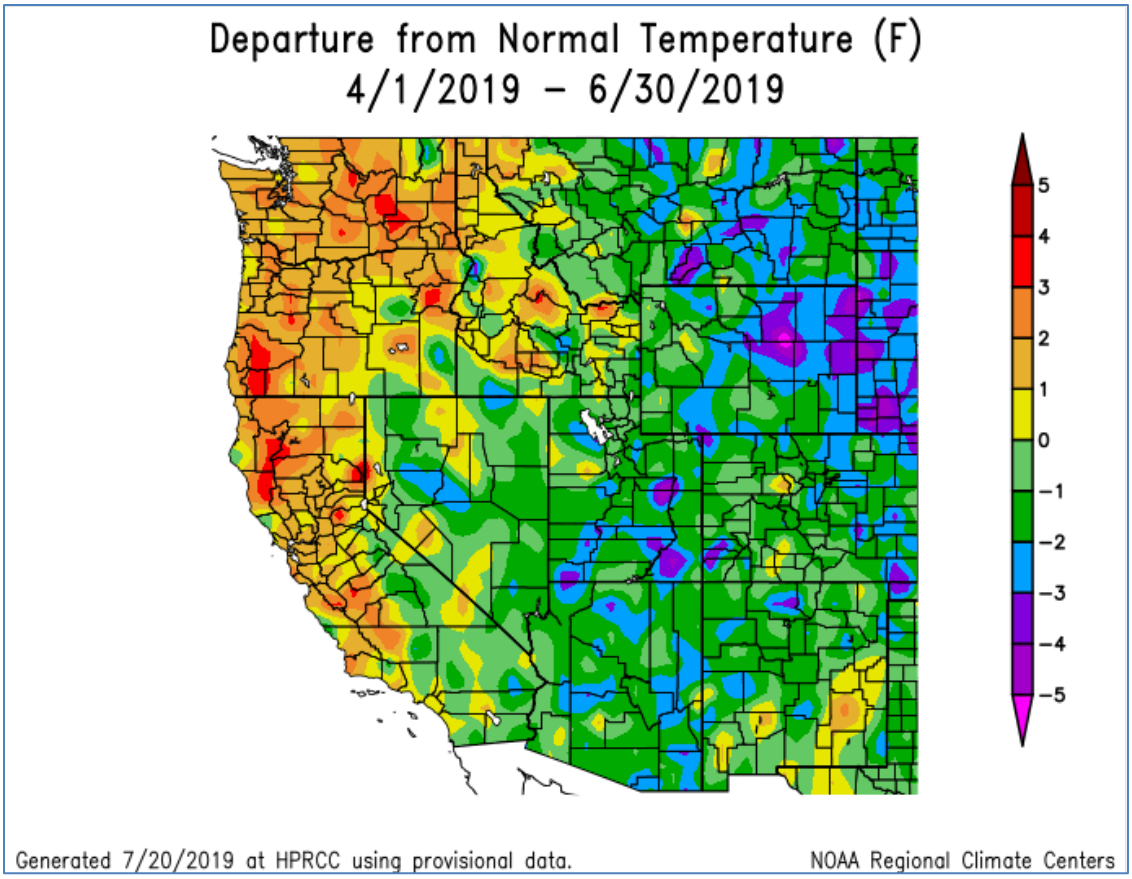

Figure 3. Departure in degrees (F) from normal temperature in the Western U.S. for 2019. Source: High Plains Regional Climate Center.

The remainder of the year proceeded with mostly normal temperatures. Departures from normal precipitation varied across the region. Normal to dry in the southwest and normal to wet in the northeast of the region.

Aerial Survey Summary

Each year during the summer and early fall Forest Health Protection and its partners conduct aerial surveys to map forest insect and disease activity in Region 2. In 2019 aerial surveys were conducted over 44.5 million acres across all ownerships. Aerial surveys provide an annual snapshot of forest health conditions over large areas more efficiently and economically than other methods. To conduct the survey, observers in small aircraft record areas of activity using a digital aerial sketchmapping system that incorporates a tablet computer, geographic information systems, and global positioning system technology. Aircraft used for these flights in the Rocky Mountain Region are typically small high-wing planes such as the Quest Kodiak 100 and Cessna T206. Aircraft fly in either a grid pattern over relatively flat terrain or following the contours of the terrain in mountainous or deeply dissected landscapes (Figure 4). The US Forest Service partners with State Cooperating Agencies in conducting the annual survey.

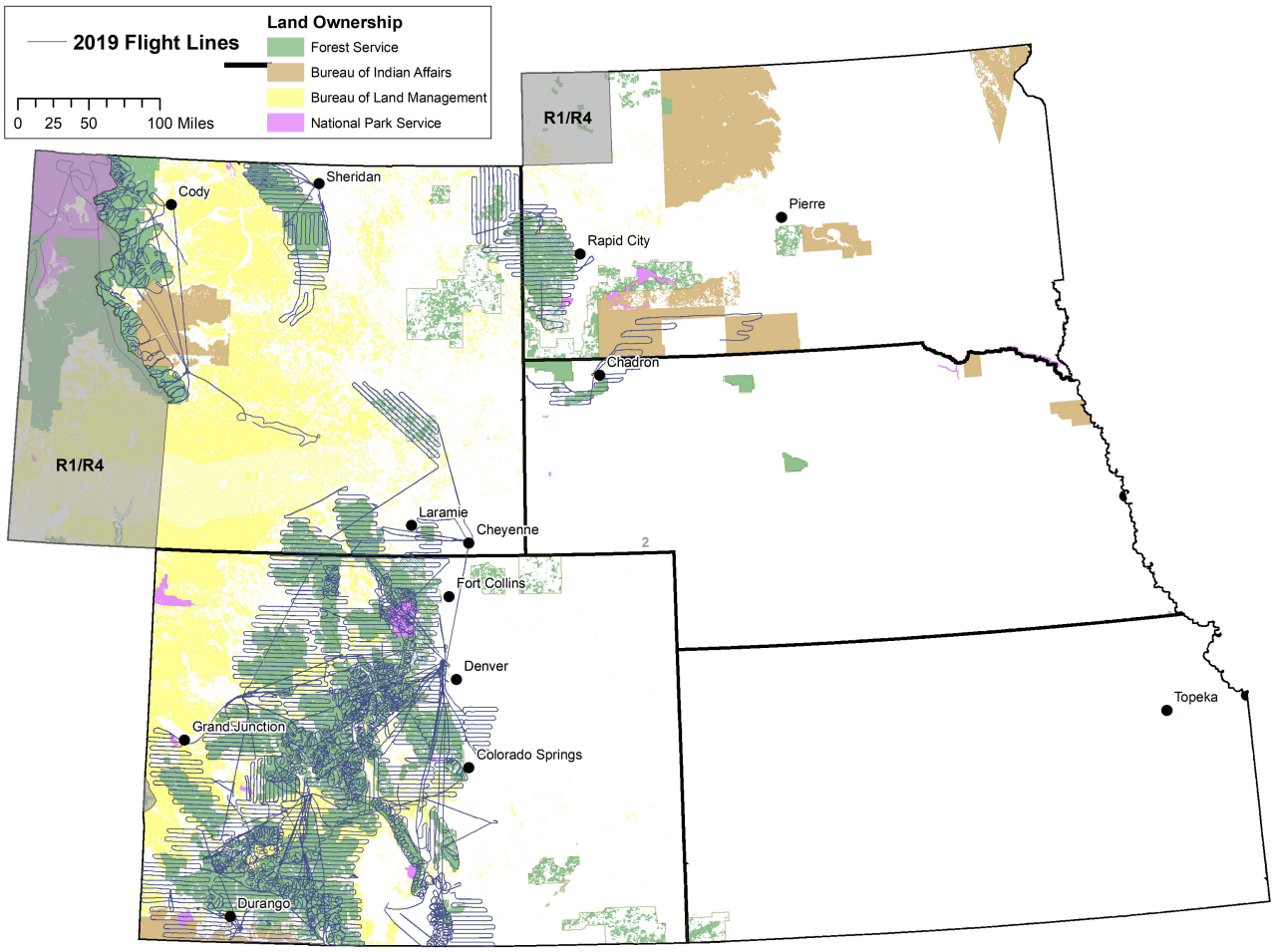

Figure 4. Flight lines from the 2019 aerial detection survey.

Bark Beetle Summary

Region-wide, total acres mapped with new tree mortality attributed to bark beetles declined but large epidemics of spruce beetle and roundheaded/western pine beetles in Colorado continue to expand. Aerial survey numbers reported in tables 1 and 2 reflect acres with varying numbers of fading trees that were attacked in 2018.

Table 1. Bark beetle[1] activity by state (acres) from aerial detection surveys in 2019 in Region 2[2].

State	Spruce Beetle	Mountain Pine Beetle	Douglas-fir Beetle	Western Balsam Bark Beetle	Roundheaded/ western pine beetles	Pinyon ips
Colorado	89,000	720	7,400	23,000	22,400	3,300
Nebraska						
South Dakota		8				
Wyoming[3]	4,300	50	40	5,700		
Region 2 Total	**94,000**	**780**	**7,400**	**28,000**	**22,400**	**3,300**

[1]Only major bark beetle and mortality agents show. Agents detected with lesser activity may not be represented in the table.
[2]Sum of individual values may differ from totals due to rounding and multiple agents occurring in the same location; a blank cell indicates no damage was observed.
[3]Includes only the Region 2 portion of Wyoming.

Table 2. Bark beetle[1] activity by National Forest (acres) from aerial detection surveys in 2019[2]

National Forest[3]	Spruce Beetle	Mountain Pine Beetle	Douglas-fir Beetle	Western Balsam Bark Beetle	Roundheaded pine beetle
Arapaho NF	3,300			3,900	
Bighorn NF	60	20		610	
Black Hills NF		20			
Grand Mesa NF	6		5	150	
Gunnison NF	3,400	610	420	840	
Medicine Bow NF	<5	<5	<5	3,900	
Nebraska NF					
Pike NF	11,000	<5	920	330	
Rio Grande NF	6,700	30	670	10	
Roosevelt NF	860	<5	<5	2,300	
Routt NF	1,700	<5	<1	2,700	
San Isabel NF	10,000	30	860	350	
San Juan NF	16,000		1,100	160	22,000
Shoshone NF	4,200	5	<5	250	
Thunder Basin NG					
Uncompahgre NF	7,500		210	160	200
White River NF	90	<5	1,000	7,200	

[1]Only major bark beetle and mortality agents are shown. Agents detected with lesser activity may not be represented in the table.
[2]Sum of individual values may differ from totals due to rounding and multiple agents occurring in the same location; a blank cell indicates no damage was observed.
[3]Values based on proclamation boundaries, thus any inholdings are summarized with the Forest boundary.

Defoliation and Abiotic Injury Summary

Defoliation from insects generally decreased across the region but tree damage and mortality where defoliators have been active for multiple years is significant (Tables 3 and 4). Cool, wet spring and early summer conditions in 2019 were widespread and favored the development of leaf and needle diseases that can be difficult to distinguish from insect defoliation from the air. Avalanches were abundant in 2019 and may warrant monitoring for bark beetle activity depending on the species and size of trees taken down and in adjacent stands. One notable windthrow event was observed on the Bighorn National Forest.

Table 3. Major defoliators, diseases, and abiotic [1] activity by state (acres) from aerial detection surveys in 2019[2].

State	Aspen Defoliation and Discoloration[3]	Western Spruce Budworm	Avalanches	Pine Shoot Blight
Colorado	64,000	147,000	1,400	
Nebraska				2,100
South Dakota	<5			4,200
Wyoming[4]	600	35,000		370
Region 2 Total	**64,000**	**182,000**	**1,400**	**6,700**

[1]Only major defoliators, diseases, and abiotic agents are shown. Agents detected with lesser activity may not be represented in the table.
[2]Sum of individual values may differ from totals due to rounding and multiple agents occurring in the same location; a blank cell indicates no damage was observed.
[3]Aspen defoliation and discoloration includes damage primarily by marssonina leaf spot, western tent caterpillar and large aspen tortrix.
[4]Includes only the Region 2 portion of Wyoming.

Table 4. Major defoliators, diseases, and abiotic[1] activity by National Forest (acres) from aerial detection surveys in 2019[2].

National Forest[3]	Aspen Defoliation and Discoloration[4]	Western Spruce Budworm	Avalanches	Pine Shoot Blight
Arapaho NF	80		30	
Bighorn NF	120	6,500		
Black Hills NF	20			340
Grand Mesa NF	3,000	50		
Gunnison NF	10,000	24,000	310	
Medicine Bow NF	680	300		
Nebraska NF				<5
Pike NF	2,000	4,200	10	
Rio Grande NF	6,700	27,000	330	
Roosevelt NF				
Routt NF	2,400	230		
San Isabel NF	190	11,000	20	
San Juan NF	17,000	25,000	430	
Shoshone NF	90	8,300		
Thunder Basin NG				90
Uncompahgre NF	13,000	13,000	90	
White River NF	3,300	350	140	

[1]Only major defoliators, diseases, and abiotic agents are shown. Agents detected with lesser activity may not be represented in the table.

[2]Sum of individual values may differ from totals due to rounding and multiple agents occurring in the same location; a blank cell indicates no damage was observed.

[3]Values based on proclamation boundaries, thus any inholdings are summarized with the Forest boundary.

[4]Aspen defoliation and discoloration includes damage primarily by marssonina leaf spot, western tent caterpillar and large aspen tortrix.

Disease Summary

Most tree diseases in the Rocky Mountain Region are persistent and broadly dispersed, including dwarf mistletoes, stem, rusts, and root diseases. A dry 2018 and a cool wet spring 2019, drove the incidence of some diseases, such as leaf blights, needle casts, and juniper mortality.

Status of Major Bark Beetles

Region-wide, total acres mapped with new tree mortality attributed to bark beetles declined but large epidemics of spruce beetle and roundheaded/western pine beetles in Colorado continue to expand.

Spruce Beetle

Dendroctonus rufipennis
Host: Spruce

Spruce beetle (Figure 5) epidemics continue to expand in Colorado and Western Wyoming. Separate spruce beetle epidemics beginning in the early 2000s have moved through mixed spruce forest types on 2,437,000 acres (Figure 6 and 7). There are many areas where the epidemic is declining due to most of the overstory spruce having been killed. Larger diameter trees are necessary for epidemics to grow. Aerial surveys detected new fading spruce killed by spruce beetle on 93,300 acres in Colorado and Wyoming in 2019.

In Colorado, epidemics have slowed where host trees have been depleted (Figure 7) and increased where adjacent stands of uninfested green spruce exist. Notable areas of spruce beetle activity detected in 2019 aerial surveys include: areas in and adjacent to Rocky Mountain National Park in Northern Colorado and areas in and around the Buffalo Peaks Wilderness, the Collegiate Peaks, the Uncompahgre Wilderness, and portions of the Southwestern Weminuche Wilderness in Southern Colorado (Figure 8).

Figure 5. Adult spruce beetles observed on the Gunnison National Forest. Photo by Justin Backsen, USDA Forest Service.

In Wyoming, aerial surveys detected spruce beetle activity on over 4,000 acres in areas south of Togwotee Pass where much of the overstory has already been killed by the ongoing outbreak. On the Bighorn National Forest where spruce forest types are still largely unaffected by spruce beetle, 60 acres with new spruce beetle-killed trees were detected in Sheridan County.
Dying spruce fades slowly and spruce beetle mortality can be difficult to detect from the air when lighting conditions are poor or when the timing of flights is too early. The cold late winter and spring and large late snowpack (Figure 2) across much of the region appears to have delayed the spruce fading based on ground observations. Acres of mortality throughout the region may have been underestimated in 2019 as a result.

Figure 6. Spruce beetle mortality and salvage on Slumgullion Pass on the Gunnison NF. Photo by Suzanne Marchetti, USDA Forest Service.

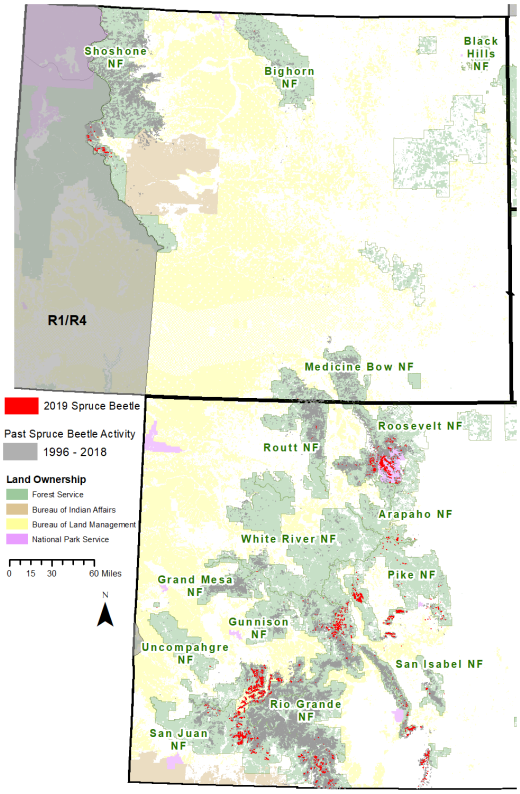

Figure 7. Spruce beetle activity in Colorado and Wyoming (R2) as observed from the 2019 aerial detection survey.

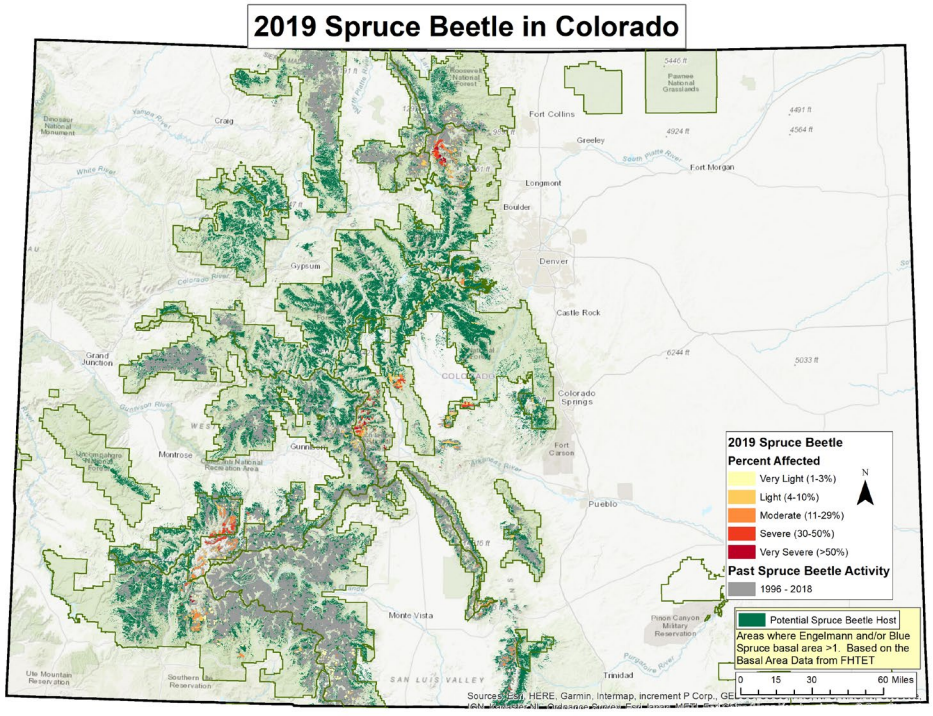

Figure 8. Spruce beetle activity in Colorado as observed from the 2019 aerial detection survey

Other beetles in spruce:

Ips spp. and Polygraphus rufipennis

Spruce trees downed by avalanche or windthrow are favorable breeding areas for spruce beetle and several associated bark beetles including spruce engravers such as *Ips pilifrons and Ips borealis* and the four-eyed spruce beetle, *Polygraphus rufipennis* have been observed on down green spruce trees. These beetles typically do not move into standing green trees and in some situations compete with spruce beetle for available resources.

Mountain Pine Beetle

Dendroctonus pondereosae
Hosts: Ponderosa pine, lodgepole pine, limber pine, whitebark pine, bristlecone pine

Mountain pine beetle remains at low (endemic) levels across most of the Region after a large outbreak which peaked in 2009. A new outbreak was detected on the Gunnison Ranger District on about 600 acres. Ground surveys show an increasing population near the Wilder subdivision in Taylor Canyon with abundant larger diameter lodgepole pines that could support a growing outbreak (Figure 9). The Gunnison Service Center Forest Health Protection staff will continue to monitor this area and the Gunnison Ranger District is working collaboratively adjacent private landowners to remove infested trees. Ground surveys on the Dolores Ranger District on the San Juan National Forest also show that mountain pine beetle is an active component of a complex of western bark beetles in ponderosa pine. In this area, mountain pine beetle is not the primary tree mortality agent but is mixed with more abundant roundheaded pine beetle and western pine beetle.

Figure 9. Lodgepole pine mortality caused by mountain pine beetle in the Taylor Canyon area of the Gunnison National Forest, Colorado. Photo by Justin Backsen, USDA Forest Service.

Roundheaded Pine Beetle and Western Bark Beetle Complex in Ponderosa Pine

Dendroctonus adjunctis
Dendroctonus brevicomis

The northern range of the roundheaded pine beetle extends into southern Colorado where it occurs with western pine beetle and mountain pine beetle in ponderosa pine. An outbreak of roundheaded pine beetle and to a lesser extent western pine beetle on the San Juan National Forest has continued to expand since 2011. While roundheaded pine beetle outbreaks are typically shorter in duration in southwestern forests, this outbreak has continued to increase in intensity with abundant pine hosts available. Aerial detection surveys recorded over 22,000 acres on the Dolores Ranger District in 2019 with varying intensity of beetle caused tree mortality (Figure 10). The area affected is within the San Juan National Forest suitable timber base and is a valuable resource for local mills (Figure 11).

Figure 10. Roundheaded and western pine beetle caused tree mortality in southwest Colorado. Photo by Dan West, Colorado State Forest Service.

USFS FHP entomologists in partnership with the Colorado State Forest Service are tracking the extent/intensity of the outbreak, bark beetle flight times and determining bark beetle species killing trees. Unlike other *Dendroctonus* species, flight times of adult roundheaded pine beetles occur primarily in the fall with a smaller percentage of beetles flying in spring. Forest health funding assisted San Juan National Forest with removing infested trees and thinning 628 acres in 2019.

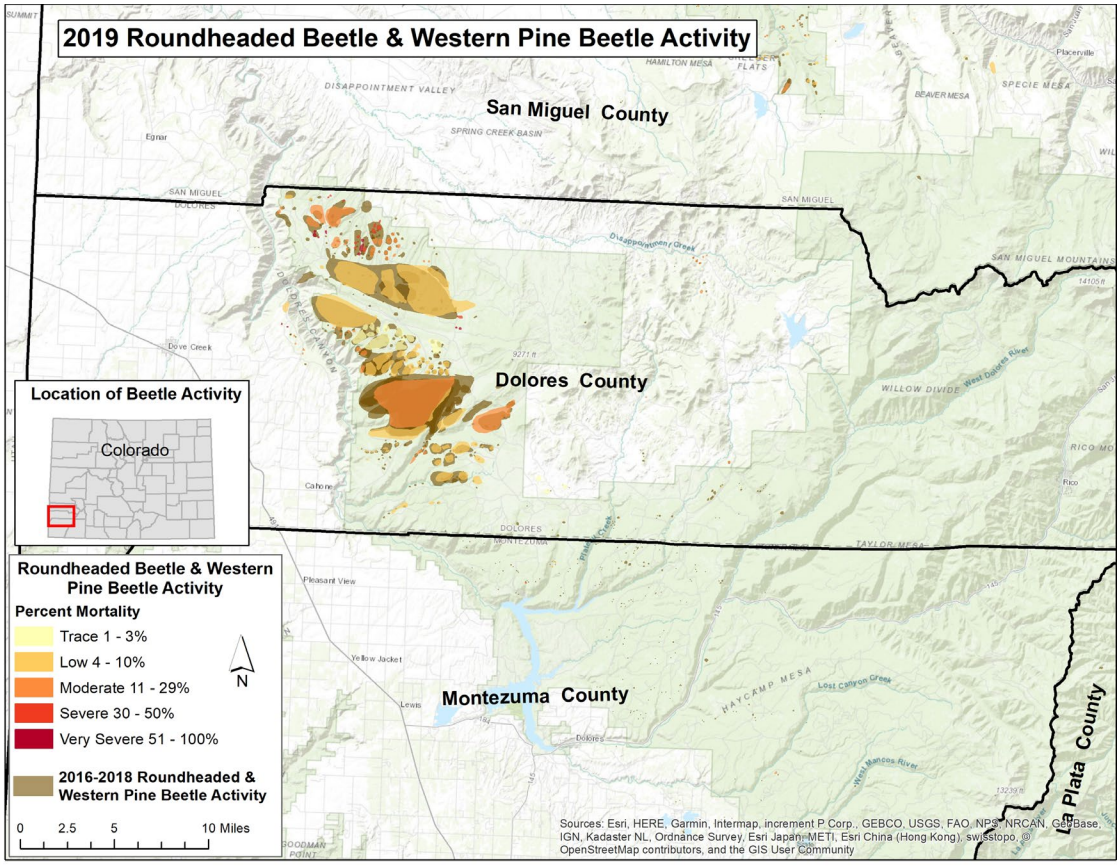

Figure 11. Roundheaded and western pine beetle activity in southwestern Colorado as observed from the 2019 aerial detection survey.

Douglas-fir Beetle

Dendroctonus pseudotsugae
Host: Douglas-fir

In 2019, Douglas-fir beetle activity was detected on 7,400 acres and expanded onto 6,000 new acres in CO. In recent years, levels of Douglas-fir tree mortality have varied widely from scattered mortality in some stands to almost total loss of mature Douglas-fir in others. The mortality is geographically widespread and affects Douglas-fir in almost all locales throughout Colorado (Figure 12). Notable areas affected include portions of Gunnison, Rio Grande, Uncompahgre, San Juan, and White River National Forests. In Wyoming, Douglas-fir beetles have been at low levels following large outbreaks in the early 2000s. Areas on the north zone of the Shoshone National Forest and south of the Bighorn National Forest are at increased risk due to consecutive years of heavy western spruce budworm defoliation.

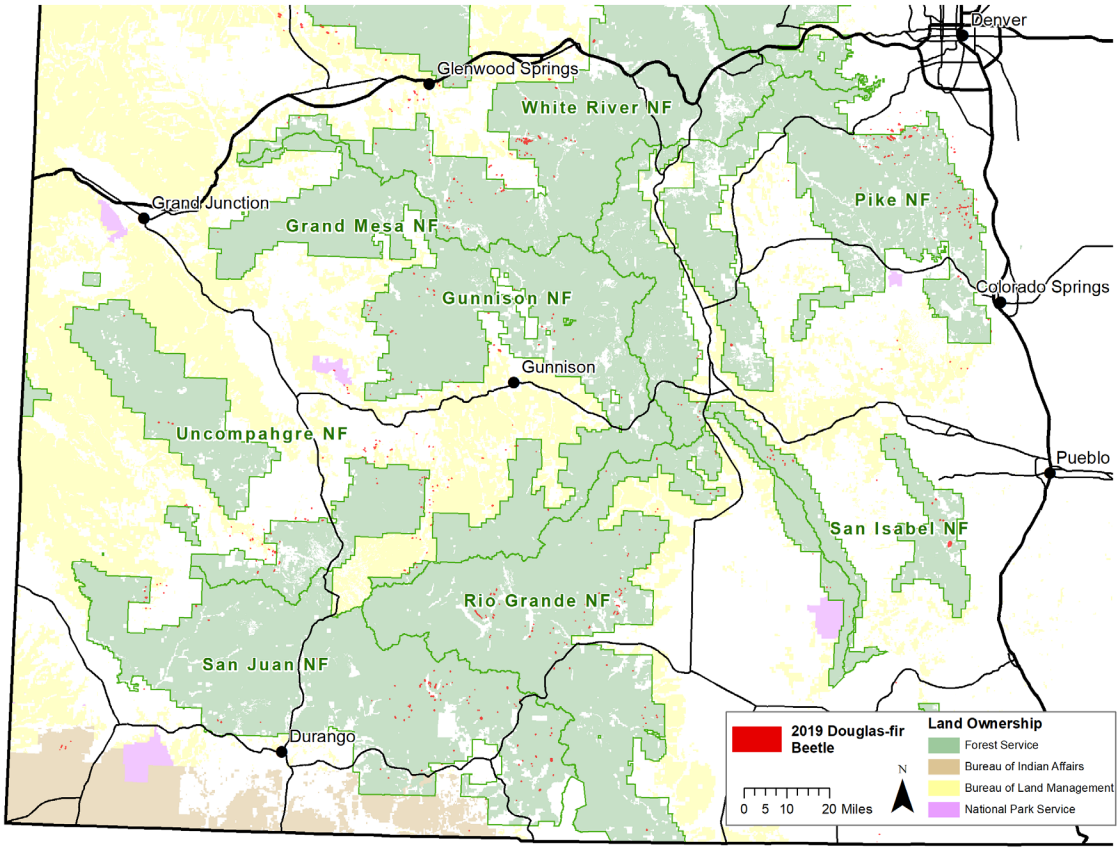

Figure 12. Douglas-fir beetle activity in southwestern Colorado as observed from the 2019 aerial detection survey.

Fir Engraver

Scolytus ventralis
Host: white fir

Acres affected by fir engraver on white fir continue to decrease in southern Colorado from a high outbreak year in 2015 with approximately 19,000 acres affected to 890 acres in 2019. Outbreaks of fir engraver beetle are often associated with localized drought conditions and may occur in areas where white fir has matured on sites more favorable to ponderosa pine. Stands heavily defoliated by western spruce budworm are also highly susceptible to fir engraver. Fir engraver beetle's excavate distinctive horizontal egg galleries beneath the bark (Figure 13) **.**

Figure 13. Fir Engraver beetle galleries in white fir. Photo by Amy Lockner, USDA Forest Service.

Engraver Beetles in Pines

Ips spp.
Host: Ponderosa, lodgepole, limber, pinyon.

Pine engraver beetles are typically active in drought-stressed trees and the acres impacted have declined in recent years in areas where precipitation has increased. This is especially notable in the Black Hills region and on the Rosebud Indian Reservation in South Dakota where wetter conditions have prevailed for two years. Various engraver beetles in pines are locally elevated in the drier areas of southwest Colorado and are taking advantage of habitat provided by tops of trees attacked by a complex of western bark beetles. Special aerial survey flights of pinyon-juniper woodlands in southwestern Colorado also detected large areas of pinyon killed by pinyon ips on over 3,000 acres primarily in San Miguel, Montrose, Montezuma and Mesa counties (Figures 14 and 15).

Figure 14. Fading pinyon foliage on a tree killed by pinyon ips in Black Canyon National Park in early 2019. Photo by Suzanne Marchetti, USDA Forest Service.

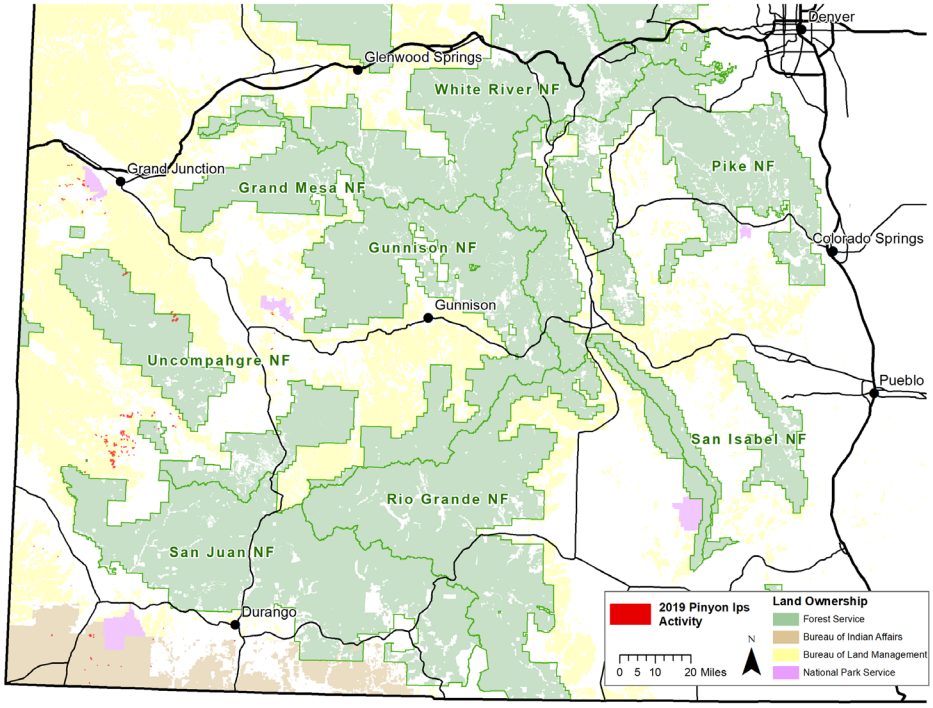

Figure 15. Pinyon ips activity in southwestern Colorado as observed from the 2019 aerial detection survey.

Western Balsam Bark Beetle

Dryocoetes confusus
Hosts: Subalpine fir

Western balsam bark beetle activity was detected on 23,000 acres in subalpine fir across Colorado and 5,700 acres in the Region 2 portions of Wyoming (south and east of the Absoroka and Wind River Divide). These infestations are generally widespread but kill fewer trees per acre than other bark beetles currently active in the state (Figure 16).

Figure 16. Western balsam bark beetle activity in subalpine fir in northern Colorado as observed from the 2019 aerial detection survey. Photo by Justin Backsen, USDA Forest Service.

- This tree mortality is often associated with root disease in high elevation forests.
- Where western balsam bark beetle occurs in spruce beetle affected stands overall stand mortality is increased.

Lodgepole Pine Beetle

Dendroctonus murrayanae
Host: Lodgepole pine

Lodgepole pine beetle is an elusive minor bark beetle of lodgepole pine that resembles spruce beetle in appearance. These beetles along with red turpentine beetles, *D. valens,* and ips engraver beetles were found infesting lodgepole pines that had been mechanically girdled on the Bighorn National Forests (Figure 17). Although not a management concern, the finding is notable. Identification was confirmed by National Entomologist Bob Rabaglia.

Figure 17. Pitch tubes from lodgepole pine beetles and turpentine beetles at the base of a girdled Lodgepole pine. Photo by Kurt Allen, USDA Forest Service.

Status of Major Defoliators

Defoliation from insects generally decreased across the region but tree damage and mortality where defoliators have been active for multiple years is significant. Cool, wet spring and early summer conditions in 2019 were widespread and favored the development of leaf and needle diseases that can be difficult to distinguish from the air from insect defoliation. Such conditions can also be favorable to the development of diseases in insect defoliators, but this was not observed.

Western Spruce Budworm

Choristoneura freemani
Hosts: True firs, Douglas-fir, and spruce

Western spruce budworm activity but was locally abundant in northern Wyoming and across southern Colorado (Figure 18). Aerial surveys detected 182,000 defoliated acres in R2 in 2019.

This insect feeds on the new needles of white fir, Douglas-fir and less notably on spruce and subalpine fir. Drying needles webbed to twigs impart a brown cast to infested trees. Areas on the north zone of the Shoshone National Forest and the Rio Grande National Forest have had consecutive years of heavy defoliation that has killed trees. The Shoshone National Forest is thinning Douglas-fir stands and salvaging timber in response to the heavy defoliation. The Wyoming State Forestry Division, Bureau of Land Management and private landowners are cooperatively managing budworm south of the Bighorn National Forest (Figure 19).

Budworm activity was most notable on the Shoshone, Bighorn, Pike, San Isabel, Gunnison, San Juan, Rio Grande, and Uncompahgre National Forests and adjoining lands.

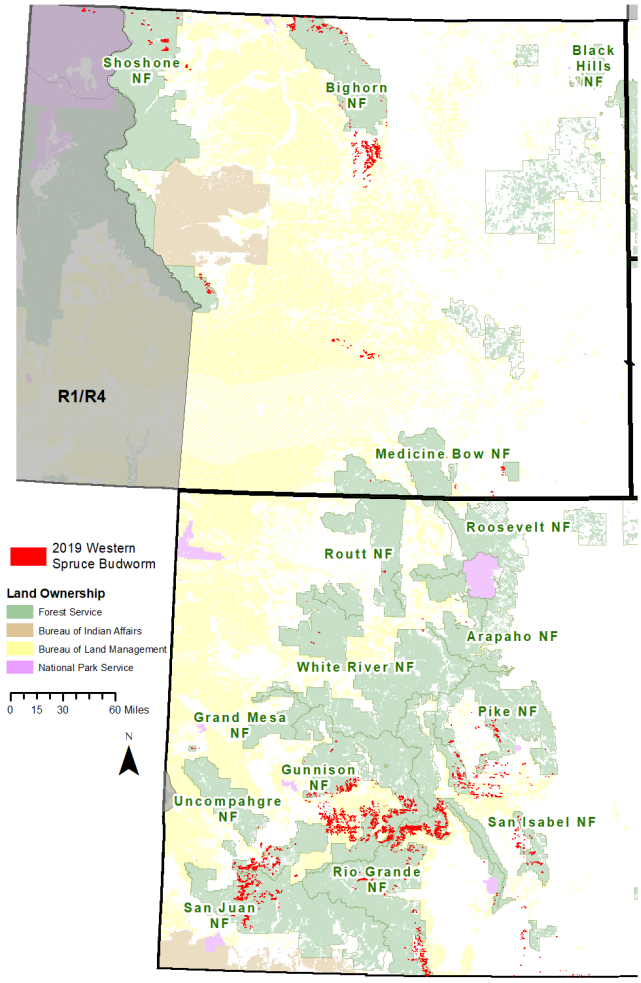

Figure 18. Map showing western spruce budworm defoliation in 2019.

Figure 19. Tree mortality (left) and forest management response to salvage and thin stands affected by western spruce budworm on the Clarks Fork, Shoshone National Forest (right) Photos by Kurt Allen, USDA Forest Service.

Aspen Defoliation

Large aspen tortrix, *Choristoneura conflictana*
Western tent caterpillar, *Malacosoma californicum*
Marssonina leaf spot, *Marsonina brunnea* and/or *M. populi*
Abiotic damage agents

In 2019 aspen defoliation/foliar damage caused by a combination of defoliators and other biotic and abiotic causal agents was observed over 65,000 acres, primarily in Colorado (Figure 20). Aspen defoliation can be caused by the large aspen tortrix, western tent caterpillar, Marssonina leaf spot and abiotic damage caused by such events as late spring frosts or high winds. All of these produce similar aerial signatures and must be ground-checked to verify specific damage-causing agent in a particular stand. In 2019 much of the observed damage was caused by Marssonina leaf spot which is common after a wet spring (see below). Aspen typically survives defoliation events, however, repeated defoliation over several years can cause mortality.

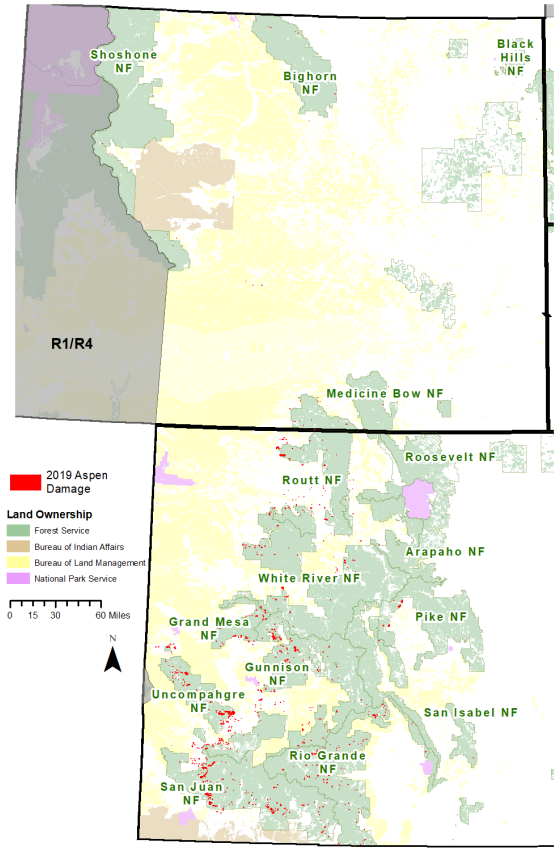

Figure 20. Aspen damages as observed in the 2019 aerial detection survey.

Other Insects

Gambel oak looper

Lambdina Punctata
Host: Gambel oak

Several hundred acres of Gambel oak on the Crown Recreation Area on BLM land in Pitkin County were defoliated by oak loopers in July and August (Figure 21). Gambel oak is resilient to this late-season defoliation. This insect is one of several oak defoliators that can contribute to Gambel oak defoliation. It caught the attention of the Sopris Sun Newspaper in mid-August. Similar patches of Gambel oak defoliation were observed during aerial surveys in 2019 in other areas of southern Colorado.

Figure 21. Gambel oak loopers skeletonize leaves (left) and defoliated Gambel oaks in Pitkin County (right). Photos by Amy Lockner, USDA Forest Service.

Ponderosa pine needle miner

Coleotechnites ponderosae
Host: ponderosa pine

Although no acres were mapped of ponderosa pine needle miner in aerial detection surveys, the insect was noted on the Black Hills in 2019. In the Rocky Mountain Region, this tiny needle mining moth is most frequently encountered in southern and central Colorado.

Juniper twig borer

Styloxus bicolor
Hosts: Junipers

Juniper twig pruners have contributed to noticeable branch mortality (flagging) in Utah junipers in southwestern Colorado. These tiny roundheaded wood borers mine out the twigs leaving a characteristic round exit hole (Figure 22). Drought in 2017 and 2018 likely created favorable conditions for the juniper twig pruner population increases.

Figure 22. Juniper twig pruner exit hole. Photo by Amy Lockner, USDA Forest Service.

Juniper borers

Semanotus spp (roundheaded borers) and an unidentified flatheaded borer
Host: Juniper

Wood boring beetles on the trunks and larger diameter parts of drought-stressed junipers contributed to widespread juniper mortality observed in southwestern Colorado in 2019 (Figure 23).


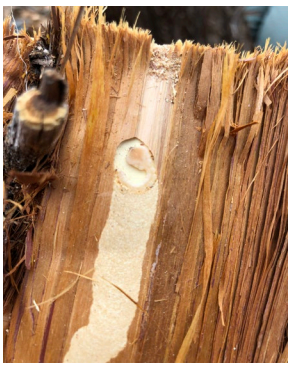

Figure 23. An adult roundheaded juniper borer, Semanotus spp (left) and an unidentified flaheaded juniper borer (right) Photos by Amy Lockner, USDA Forest Service.

Status of Major Diseases

Dwarf Mistletoes

Arceuthobium spp.
Hosts: Pines and Douglas-fir

Dwarf mistletoes (Figure 24) are among the most widespread and damaging forest pathogens of conifers, in the Rocky Mountain Region. Impacts associated with dwarf mistletoe infection include growth reduction, deformity (especially from the characteristic witches' brooms), and decreased longevity. Tree mortality is common in severely infested areas and weakened trees are often killed by other damaging agents, such as bark beetles or root disease. The incidence and severity of dwarf mistletoe infections are closely related to the fire regime in many of our forest types.


Figure 24. Limber pine dwarf mistletoe plants with seeds (left) and a heavily infected limber pine with many witches' brooms (right) Photos by Jim Blodgett, USDA Forest Service.

Dwarf mistletoes are important ecologically as well. Witches' brooms are used by a variety of animals for nesting, denning, hiding, and caching, and dwarf mistletoe shoots and fruits by many insects, birds, and mammals.

Five species of *Arceuthobium* occur in the Rocky Mountain Region, each with a specific set of susceptible hosts. Pines and Douglas-fir are commonly infected in at least parts of their ranges. Spruces and true firs are not, or only rarely, hosts of mistletoes in the Region (Table 5). Region-wide estimates of incidence and severity of dwarf mistletoes are limited. In 2018, a survey was initiated of the incidence of lodgepole pine dwarf mistletoe along roadways in Wyoming. Results indicated that 49% of lodgepole pine trees and 80% of plots on the Bighorn National Forest and 47% of lodgepole pine trees and 70% of plots on the Shoshone National Forest were infected with lodgepole pine dwarf mistletoe (RCSC-19-01, RCSC-19-02). In 2018 on the Gunnison Ranger District, drought impacts were amplified by extensive mistletoe brooming in isolated areas of lodgepole pine. This likely increased vulnerability to mountain pine beetle attacks.

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. Forest health funding was used by the Shoshone and the Medicine Bow Routt National Forests in 2019 to remove dwarf mistletoe infested lodgepole pine trees within areas salvaged after recent mountain pine beetle epidemics. The management and salvage within the rounded headed pine beetle management area, on the Dolores Ranger District, has created an opportunity to include mistletoe management to increase the resilience of ponderosa regeneration post-beetle outbreak. Gunnison Ranger District is also continuing to reduce mistletoe loads on lodgepole pine slated for timber management. A dwarf mistletoe management guide is available for the Region (Dwarf Mistletoes: Ecology and Management in the Rocky Mountain Region).

Table 5. Dwarf mistletoes and their hosts in the Rocky Mountain Region.

Dwarf mistletoe (DM)	Primary host [a]	Other hosts [a]
Lodgepole pine DM *Arceuthobium americanum*	Lodgepole pine	Secondary: ponderosa pine Occasional: whitebark and limber pines Rare: Engelmann and blue spruces, bristlecone pine
Limber pine DM *A. cyanocarpum*	Limber pine, whitebark pine, bristlecone pine	Rare: ponderosa and lodgepole pines
Piñon DM *A. divaricatum*	Piñon pine	None
Douglas-fir DM *A. douglasii*	Douglas-fir	Rare: subalpine fir, blue and Engelmann spruces
Southwestern DM *A. vaginatum* subsp. *cryptopodum*	Ponderosa pine	Occasional: bristlecone pine, lodgepole pine; Rare: limber and southwestern white pines, blue spruce

[a] Hosts are in the following categories:
Primary: More than 90% infection when close to heavily infected trees.
Secondary: Frequently attacked (50–90% infection) when close to heavily infected primary hosts.
Occasional: Occasionally attacked (5–50% infection) when close to heavily infected primary hosts.
Rare: Rarely attacked (≤ 5% infection), even when close to heavily infected primary hosts.

True Mistletoes

Phoradendron juniperinum
Host: Juniper spp.

Juniper mistletoe (*Phoradendron juniperinum*) is the only member of the true mistletoes that occurs within the Rocky Mountain Region. Juniper mistletoe is found in the pinyon-juniper woodlands of southwestern Colorado and can infect all juniper species that occur there. Impacts associated with juniper mistletoe are generally minor. However, during periods of drought, when the host trees have shut down their transpiration to conserve water, juniper mistletoes continue to transpire, causing further drought stress on the host. Drought-killed juniper on the Colorado Plateau was not associated with true mistletoe.

Root Diseases

Root diseases, caused by pathogenic fungi, occur on all tree species in the Rocky Mountain Region. The most common pathogens causing serious root diseases are *Armillaria* spp. and *Heterobasidion* spp. Other root disease pathogens occur occasionally and create hazards in recreational areas.

Armillaria root disease

Armillaria spp., primarily *A. solidipes* (A. ostoyae)
Hosts: Almost all tree species in the Rocky Mountain Region are susceptible

Heterobasdion irregulare (*H. annosum* s.s.)
Hosts: Ponderosa pine and eastern redcedar

Armillaria root disease is the Region's most common root disease pathogen and occurs on every tree species in the Region depending on the pathogenicity of the Armillaria species. It frequently causes resin to be produced around the base of conifers and occasionally produces honey-colored mushrooms in root disease centers. When infected trees are excavated, the trees contain resinous lesions, string-like wood fibers with zone lines, and dark, root-like rhizomorphs growing in the soil. If tree bark is removed from the infected portions of the tree base and roots, thin, white sheets of fungal tissue (mycelial fans) are often present.

Annosus root disease

H. occidentale (*H. parviporum*)
Hosts: White fir and occasionally Engelmann and blue spruce within the distribution of white fir

Heterobasidion irregulare is a pine specialist. In this Region, it has been found causing disease on ponderosa pine and eastern redcedar only on the Bessey Ranger District of the Nebraska National Forest. Colorado, Wyoming, and South Dakota have been surveyed but *H. irregulare* has not been detected.

Heterobasidion occidentale favors species of spruce and fir but has been found only in mixed conifer forests within the range of white fir in southern Colorado. The disease is common on white fir and occasionally on co-occurring Engelmann spruce.

Figure 25. *Heterobasidium occidentale* rot in a tree stump. Photo by Jim Worrall, USDA Forest Service.

It also likely occurs rarely subalpine fir, Douglas-fir, and blue spruce within white fir's range but has not been detected on those species in R2 to date. Annosus root disease has not been detected in spruce-fir forests outside the range of white fir in the region. Disease incidence has increased in white fir as a result of fire exclusion and selective harvesting of more valuable timber species.

Annosus root disease can create significant hazards in campgrounds and recreation areas. Infection is difficult to confirm in live trees, but root failure is common. Fresh stumps are highly susceptible infection courts, so care should be taken whenever cutting in known annosus root disease centers to reduce the chance of infection (Figure 25). In recent years, foresters on the GMUG and Rio Grande National Forests have managed areas with extensive annosus root disease by treating newly cut stumps with a borax solution and converting cover type away from white fir.

Rusts

Damage from stem rusts is variable and may include galls, brooms, stem deformities, branch death (flagging), top kill, and/or mortality. In recreation sites, stem rusts create hazards by weakening and/or deforming the stem, increasing the risk of failure. Most rusts have an obligate alternate host, requiring both species in the same area to spread the disease.

Comandra blister rust

Cronartium comandrae
Hosts: Lodgepole and ponderosa pine
Alternate host: Bastard toadflax and northern comandra

Comandra blister rust is one of the more important diseases of lodgepole pine in the region (Figure 26). The disease is less common on ponderosa pine. The pathogen, *Cronartium comandrae*, requires an alternate host to complete its life cycle. Disease impacts include stem deformities, growth reduction, and cankers that girdle branches or stems, resulting in top-kill or tree mortality. Infection is occasionally heavy, causing high volume losses in stands. It is especially severe in Wyoming and areas of northern Colorado. A 2018 survey of in lodgepole pine found that 16% of trees and 60% of plots were infected on the Bighorn National Forest, and 35% of trees and 80% of plots were infected on the Shoshone National Forest (RCSC-19-01, RCSC-19-02).

Figure 26. Comandra blister rust stem canker in lodgepole pine. Photo by Jim Blodgett, USDA Forest Service.

White pine blister rust

Cronartium ribicola
Hosts: Limber, whitebark, and Rocky Mountain bristlecone pine
Alternate hosts: Currants and gooseberries in the genus *Ribes* and, occasionally, species of *Pedicularis* and *Castilleja*

White pine blister rust (WPBR, Figure 27) continues to spread and intensify in the Rocky Mountain Region. The disease is well established in whitebark and limber pine throughout Wyoming where it has been present for nearly 70 years. Disease incidence is greatest on the Shoshone, Bighorn, and Medicine Bow (Pole Mountain and Laramie Peak units) National Forests. In South Dakota, white pine blister rust is common and damaging throughout the very small population of limber pine in the Black Hills National Forest and Custer State Park. Limber pine is a species of local concern on the Black Hills National Forest.

Figure 27. White pine blister rust infection on a limber pine branch. Photo by Dr. Anna Schoettle, USDA Forest Service.

White pine blister rust was discovered on limber pine in Colorado south of the Wyoming border in 1990. Since then, the disease has spread and intensified in limber pine throughout the state and is now causing decline and mortality on the Roosevelt, Pike and San Isabel (Pikes Peak and San Carlos Ranger Districts), and Rio Grande (Saguache and Conejos Peak Ranger Districts) National Forests. Disease incidence is particularly high along Mosca Creek and around Mosca Pass in the Great Sand Dunes National Park and Preserve and adjacent San Isabel National Forest. Rocky Mountain bristlecone pines are also infected in this area. In 2017, a new infestation was discovered in Rocky Mountain National Park; disease incidence is greatest in the Beaver Ponds area but infections have also been observed at higher elevations in krummholz limber pines. In 2018 and 2019, the Park surveyed the outbreak area and pruned out visible cankers in an effort to reduce inoculum levels. A survey will be conducted in 2020 to determine treatment effectiveness. We are also actively working with the Park to explore and exploit natural disease resistance.

During a 2017-2018 survey of southwestern Colorado, an infestation was detected on private land in the Culebra Mountains on both limber and Rocky Mountain bristlecone pine. This is only the second location where rust has been found infecting bristlecone pine in its natural habitat and is the southernmost infestation in the state. The disease still has not been detected in many areas of Colorado including the Arapaho, White River, Gunnison, and San Juan National Forests.

In collaboration with Rocky Mountain Research Station and Colorado State University, permanent monitoring plots have been established throughout the host type in the region. Limber and Rocky Mountain bristlecone pine cones and seeds have been collected for gene

conservation and white pine blister rust screening at the Dorena Genetic Resource Center in Oregon. Results suggest that some resistance is present in these populations. Proactive intervention will be needed on sites with low regeneration density or high infection levels to sustain the species on the landscape. In collaboration with Rocky Mountain Research Station, a conservation strategy has been developed for limber pine (Schoettle et al. 2019) 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 also available (Casper et al. 2016, Jacobi et al. 2017).

Broom rusts

Melampsorella caryophyllacearum
Hosts: White and subalpine firs
Alternate host: Chickweeds

Chrysomyxa arctostaphyli
Hosts: Engelmann and Colorado blue spruce
Alternate hosts: Bearberry or kinnickinnick, but manzanitas are occasional alternate hosts on the Uncompahgre National Forest

Two species of broom rust are common in the Rocky Mountain Region (Figure 28). Both pathogens require an alternate host to complete their life cycles. Broom rusts may cause stem cankers and deformations, growth loss, top-kill, and tree mortality. Trees weakened by broom rust may be more susceptible to other insects and diseases. Rust brooms are especially damaging when they occur near stems. Stem breakage may occur at the point of infection, creating hazards in recreation areas. Portions of the San Juan and Rio Grande National Forests have high levels of infection (up to 29%) in spruce. Fir broom rust is also common on the San Juan National Forest, with some sites having 40% infection. The average incidence in Colorado is 4.2% for spruce and 2.3% for fir. The incidence of broom rust is associated with the distribution and abundance of hosts, microclimatic conditions, and host susceptibility.

Figure 28. Broom rust infection on Engelmann spruce (left). A snag that failed at the point of the broom rust infection (right). Photos by Jim Blodgett (left) and Kelly Burns (right), USDA Forest Service.

Western gall rust

Endocronartium harknesii
Hosts: Lodgepole and ponderosa pines

Western gall rust is a pine-to-pine rust with no alternate host. The disease is common on lodgepole and ponderosa pine throughout the region. Western gall rust affects trees of all ages, causing growth loss, branch death, and deformity (Figure 29). Mortality is most common in seedlings and saplings because galls can quickly girdle the small stem. Stem cankers can severely deform larger trees lowering/reducing timber volume/quality, and wind snapping at cankers is common. Mass infection tends to occur during wave years when conditions are particularly favorable.

Figure 29. Western gall rust stem canker in ponderosa pine (left) and branch gall in lodgepole pine (right). Photos by Kelly Burns, USDA Forest Service.

Diplodia shoot blight and canker disease

Diplodia sapinea
Hosts: Pines and some other conifers

Diplodia shoot blight (Figure 30) was discovered in ponderosa pine in eastern Wyoming in 2019 (RCSC-20-03). This is the first report of the disease in Wyoming although it is common and damaging in South Dakota and Nebraska. Damage was initially picked up by aerial detection surveys. Approximately 4,100 acres of trees were affected, all within Crook County, Wyoming. Ground-checks found symptoms consistent with Diplodia shoot blight and canker disease *D. sapinea*.

Figure 30. Symptoms of Diplodia shoot blight and canker disease in mature ponderosa pine (left) and blue-stained wood in a Diplodia canker (right). Photos by Jim Blodgett, USDA Forest Service.

Management options in forested sites are limited. Reducing water stress and maintaining tree vigor are the best options to control Diplodia shoot blight and canker disease. In forested sites, this can be done by stand thinning and/or managing competing vegetation. The selection of non-host species might be an option in some areas.

Other Disease Issues

Major damage agents in aspen

Encoelia pruinosa (sooty bark canker)
Cytospora spp. (cytospora canker)
Phellinus tremulae (aspen trunk rot)
Host: Quaking aspen

Aspen is susceptible to a variety of diseases that are common and damaging throughout the Rocky Mountain Region. Specific estimates on incidence and severity are limited. Forest Health Protection has monitored aspen health on the Bighorn, Shoshone, and Black Hills National Forests since 2008. Mean tree mortality has remained low, indicating no significant tree mortality events are occurring on those forests. Similarly, recent aerial detection surveys have reported no major mortality events in aspen.

Although many damage agents were observed in monitoring plots, only three agents, Cytospora canker, sooty-bark canker, and aspen trunk rot were weakly correlated with tree mortality (Fig. 31). Although Cytospora canker was the most common and is causing some mortality, the majority of cankers were small, already healed, or likely to heal. Sooty bark canker was the second most common damage agent, often with large expanding cankers, and was the most significant factor causing tree mortality. Aspen trunk rot caused stem breakage of larger trees due to extensive internal decay. Overall, aspen regeneration was common and relatively dense (>1,000 stems per acre) across all forests, but there were stands with low regeneration, especially in the Black Hills National Forest. Browsing damage is the likely entry point for these damaging pathogens.

Figure 31. Sooty bark (left) and cytospora (right) cankers are the most common canker diseases in aspen. Photo by Jim Blodgett, USDA Forest Service.

There were spotty increases in aspen bark beetle in southwest Colorado. The drought of 2018 caused scattered leaf scorch in aspen, indicating high drought severity. In prior years, drought-related stress caused increases in insects and pathogens, eventually leading to widespread mortality. Aspen bark beetle became difficult to find in the southwest in the past 5 years until this year. This could be an indicator of a resurgence of aspen mortality.

Marssonina leaf blight

Marssonina brunnea and/or *Marssonina populi*
Host: Quaking aspen

Marssonina leaf blight (Figure 32) was common in Colorado, Wyoming, and South Dakota in 2019. Wet spring conditions favored the development of the disease. Initial symptoms include tiny blisters or lesions on leaves. Severe outbreaks cause large brown leaf spots and premature defoliation. Urban trees were affected as well. Disease resistance varies with clones. Although this pathogen rarely kills trees on its own, affected trees may be more susceptible to other damage agents, and growth reduction can be significant. Some areas had extensive Marssonina leaf blight that was visible during aerial surveys in 2019. *Marssonina brunnea* was the pathogen associated with the blight in Colorado.

Figure 32. Aspen leaves infected with marssonina leaf blight (left). The disease leads to leaf discoloration and pre-mature defoliation (right). Photos by Jim Blodgett, USDA Forest Service.

Shepard's crook

Venturia tremulae var. *grandidentatae*
Host: Quaking aspen

Shepard's crook (Figure 33) was damaging almost 100% of the aspen regeneration in some stands and was even affecting the lower crowns of large trees. As with Marssonina leaf blight, the unusually large outbreak and severity of this disease was likely due to the unusually wet years. It was killing most terminal shoots and affected most seedlings, saplings, and even the lower crowns in several aspen stands in the Bighorns, Black Hills, and Shoshone National Forests. This will result in reduced height growth and smaller seedlings may be killed. However, the effect is temporary, and most trees recover.

Figure 33. Shepard's crook in young quaking aspen. Photos by Jim Blodgett, USDA Forest Service.

Conifer Foliage Diseases

Lophodermium needlecast

Lophodermium spp.
Host: Lodgepole pine

A lophodermium needlecast outbreak was discovered in lodgepole pine on the Powder River Ranger District of the Bighorn National Forest in 2019 (Figure 34). The disease caused extensive browning of pine crowns in some stands. This may be a previously unreported species. Follow up surveys of the disease and its impacts are planned for 2020.

Figure 34. Lophodermium needlecast disease on lodgpole pines in the Bighorn National Forest. Photos by Jim Blodgett, USDA Forest Service.

Lophodermella needlecast

Lophodermella montivaga and *L. concolor*
Host: Lodgepole pine

Since 2011, the incidence of lophodermella needlecast has been fluctuating on the Gunnison, White River, and San Isabel National Forests. This year was unique. The incidence of *L. montivaga* was minimal and the incidence of *L. concolor* was lower than in previous years. This reduction was likely the result of an extremely dry year in 2018, which limited spread and infection.

Abiotic Damage

Downed Trees from Avalanches and Wind

Depending on the tree species and the size of trees broken and uprooted, avalanches or windthrow can create habitat for damaging beetles. Spruce beetle, Douglas-fir beetle, and western balsam bark beetle are all attracted to downed trees and could potentially build up populations in their respective hosts, Engelmann spruce, Douglas-fir or subalpine fir. Beetle populations built up in downed trees can move to adjacent standing host trees. Mountain pine beetle is not attracted to downed trees so the risk of bark beetle outbreaks is less where avalanches occur in lodgepole pine. The risk from bark beetles increases with the increasing size of host trees toppled and increasing abundance of standing host trees in adjacent stands. Other beetles such as engraver beetles also attack downed trees and can compete with potentially more serious bark beetles for space beneath the bark. In areas where avalanches are frequent, trees tend to be smaller and present less risk. In new avalanche runs (Figure 35) there may be larger diameter trees taken down creating habitat. Weather conditions, stand age and composition all influence the potential for bark beetles moving into downed trees and eventually adjacent trees.

Figure 35. Avalanche damage near Gulley Creek on the White River National Forest, Colorado. Photo credit: Justin Backsen, USDA Forest Service.

Avalanches

Aerial surveys routinely document forest damages associated with avalanche activity severe enough to cause tree fall. In 2019 Colorado experienced an unusually high number of severe avalanches, particularly in March. Eighty such events were documented covering a total of 1,400 acres in the forests of Colorado (Figures 35 and 36). Less severe avalanches or avalanches that occur in areas that regularly experience them or in areas where large trees are not impacted are not mapped by aerial surveys.

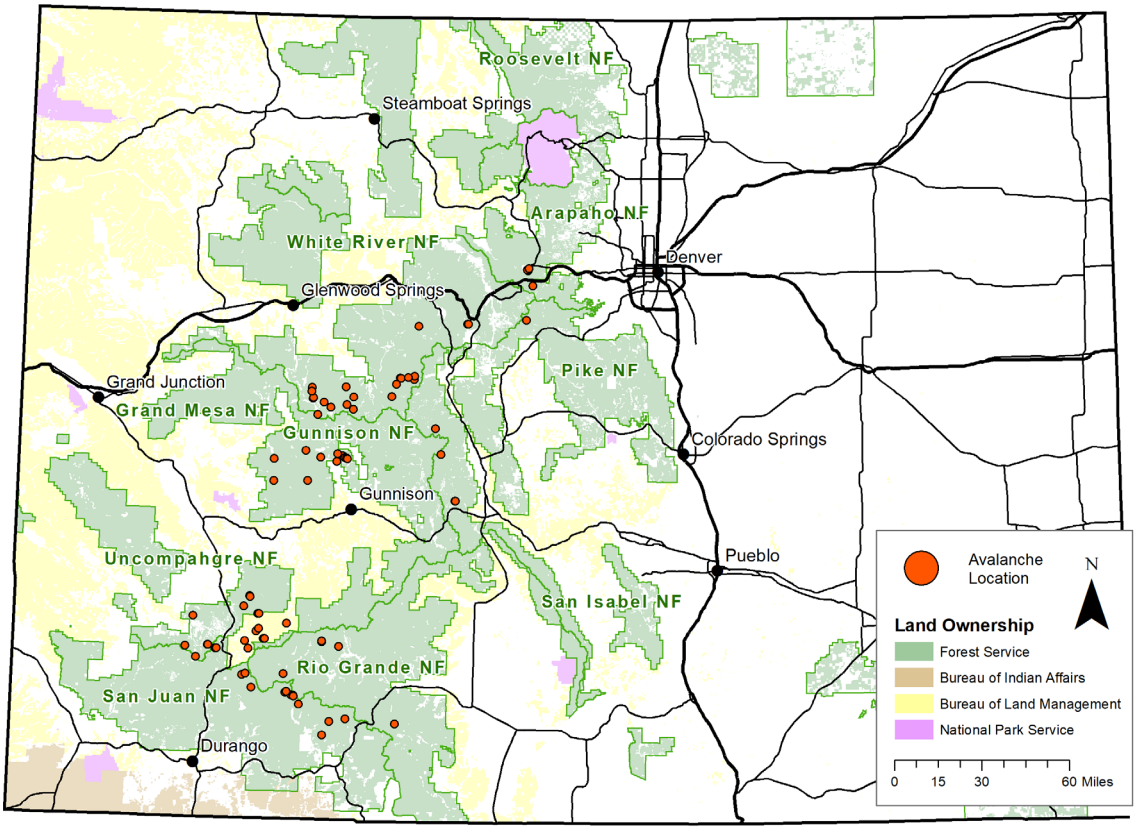

Figure 36. Location of 80 avalanches in Colorado recorded in the 2019 aerial detection survey.

Wind

In 2018, a wind event blew down trees over near the Paintrock Lakes area of on the Bighorn National Forest (Figure 37). The majority of the affected trees were lodgepole pine with scattered spruce and fir. As of late summer 2018, there was no incidence of high beetle infestation in blowdown material.

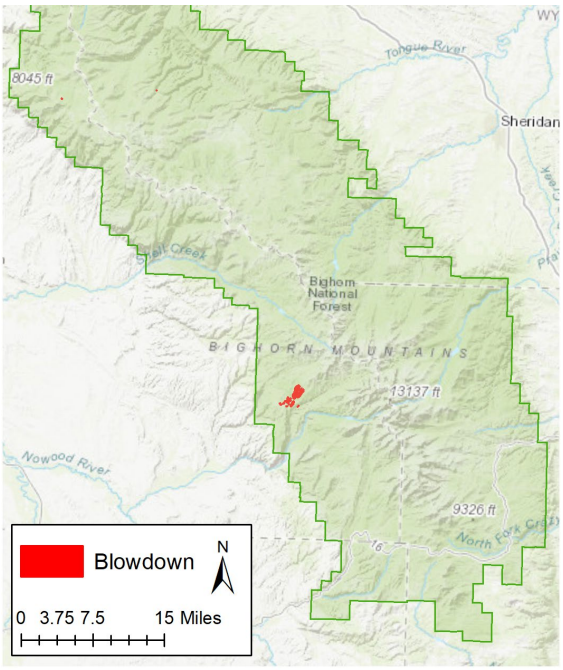

Figure 37. A large blowndown event was recorded on the Bighorn National Forest by the 2019 aerial detection survey.

Drought/Freeze

Widespread juniper die-off due to drought in the four corners area received local attention (Figure 38). The damage was most extensive in southeastern Utah, but impacted low elevation juniper in Paradox and Disappointment canyons, as well as isolated areas west of Cortez on national recreation areas. Drought possibly combined with unseasonably cold weather may have contributed to the mortality and dieback. Juniper borers identified above were present but no agent appeared to be driving this event. There was little expansion of the mortality from Spring 2019 to Fall 2019, with some partially dead trees fully succumbing but no new mortality.

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Figure 38. Juniper dieback in southwestern Colorado. Photo by Suzanne Marchetti, USDA Forest Service.

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Other Entomology and Pathology Activities in 2019

Forest Health Regional Trainings

The Forest Health Protection staff provides training opportunities to enhance the resource manager's knowledge of forest health issues. Typically, the staff offers two courses annually with timing and frequency based on need:

1. Forest Insect & Disease Identification & Management, and
2. Hazard Tree Management.

Rocky Mountain Region's Hazard Tree Management Program and Updates

Several new hazard tree management products were recently developed or updated. These include a new *Guide to Hazard Tree Management* and *Hazard Tree Management Training Supplement*. The guide provides guidelines, advice, and procedures for the identification, prioritization, and mitigation of hazard trees in developed sites of the Rocky Mountain Region. The supplement provides additional material for the guide and is used in the Rocky Mountain Region's *Hazard Tree Management* training classes. Two new electronic forms were developed for collecting and managing hazard tree survey data. The forms run on the *Survey123* App for ArcGIS which can be run on any smartphone, tablet, or computer; and they support real-time database updating. They include the *HT_EvaluationForm*, an electronic form for the inspection of trees in developed forest sites; and the *TreeFailureForm*, an electronic form for documenting tree failures on national forests. More information is available on our hazard tree website.

In 2019, three separate Hazard Tree Management courses were offered including one in Florissant, Colorado in May; Sheridan, Wyoming in June; and in Del Norte, Colorado in August. Each 16-hour course included one day in the classroom and one day in the field. Trainings are attended by USDA Forest Service employees and various other federal agencies (APHIS, BIA, BLM, DOD, NPS, NRCS); state, tribal, and local agencies; universities; and private industry. The course focuses on how to identify and manage hazard trees in recreation areas and administrative sites. Topics include: concepts and components of hazard; an overview of defects and diseases that increase the likelihood of tree failure; the biology of trees, defects and diseases; legal issues and policy decisions regarding hazard tree inspections and mitigation; procedures for hazard tree inspections; and options for vegetation management and hazard tree mitigation.

The Divide District, Rio Grande National Forest, took an innovative approach to hazard tree management this year. The district put together a proposal to manage their back log of hazard trees. Maximilian Maas, a German student with a strong background in forestry, was recruited from the International Forestry Fellows Program- IFFP to lead the effort. Max and a seasonal crew attended the R2 hazard tree training to ensure everyone understood the protocols. Crews spent the fall surveying and marking trees at their top priority recreation sites. Overall, the project was a success and recreation staff felt more prepared to continue hazard tree management into the future.

For more information regarding Regional training please visit our updated training web page.

Limber Pine Plantings

Limber pine planting on the Black Hills National Forest

As part of the Limber Pine Restoration Project, a new limber pine population was established in 2017 in the Norbeck Wildlife Preserve, Black Hills National Forest (RCSC-20-01). In South Dakota, limber pine (a Black Hills National Forest species of local concern) occurs in isolated areas scattered over a small geographic area of about 2 square miles in the Black Elk Wilderness of the Black Hills National Forest and adjacent Custer State Park. Recently most of these pines over 5 inches DBH were killed by mountain pine beetle and white pine blister rust (RCSC-20-02). Container grown two-year-old limber pine seedlings, using local seed, were planted in 2017 and 2018 at 7 areas. Vexar tubes (i.e., animal protectors) were staked around seedlings to protect them from herbivory.

Seedling survival was better than expected (97%). This might be due, in part, to the higher than average precipitation in 2018/2019, compared to average precipitation for the area. Most of the seedlings are growing well and the Vexar tubes appear to be protecting seedlings. We will be planting additional limber pines in this area in the spring of 2021.

Refining restoration planting options for limber pine

A project to develop forest-scale limber pine planting methods was initiated in 2009 (Casper et al. 2016). Two thousand one hundred and sixty limber pine seedlings were planted at 6 sites (Pilot Hill, Medicine Bow NF; Killpecker, Roosevelt NF; Columbine, Arapaho NF; Buffalo Peak, Pike NF; Trout Creek, San Isabel NF; and Mosca Pass, Great Sand Dunes NPP). Various techniques to promote growth and survival were evaluated (using hydrogel and/or nurse objects and planting under varying canopy densities). Seedling growth, health, and survival were assessed the following 4 growing seasons. Transects were installed around planting sites to assess stand structure and determine density and periodicity of natural regeneration.

Seedling survival was good after 4 growing seasons. While initial results are promising – overall survival rate was greater than 50% and was better on the north and west sides of nurse objects and under denser canopy cover – longer-term data is vital to understanding the effectiveness of planting methods. Recent site visits (10 growing seasons after planting) will be used to refine the planting guidelines.

Greater Yellowstone Ecosystem White Pine Survey

Region 2 Forest Health Protection (FHP) Aviation, in collaboration with R1 FHP, R4 FHP, WSFD, Utah State University and the Greater Yellowstone Ecosystem Coordinating Committee, completed fieldwork on a study to assess cumulative mortality in high elevation whitebark and limber pine caused by mountain pine beetle and white pine blister rust in the 22 million-acre Greater Yellowstone Ecosystem. Data collected for this study consists of thousands of oblique aerial photos of stands of primarily whitebark pines in high elevation catchments. Each catchment will be analyzed individually to determine whitebark mortality levels (Figure 39). Results will inform priority restoration work. Resulting publication expected in 2020.

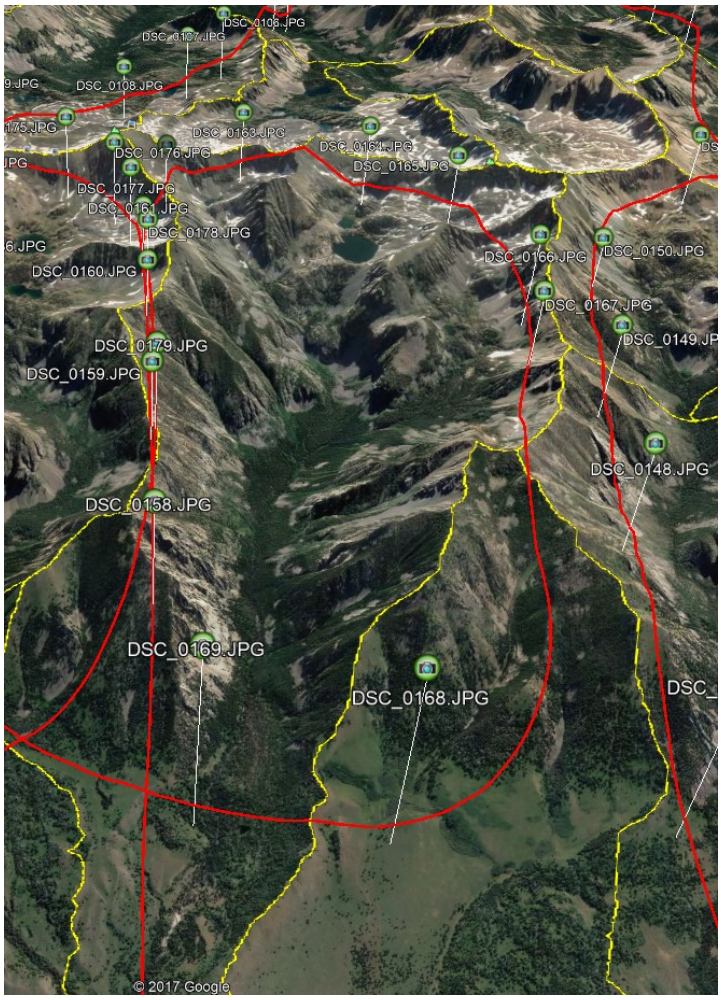

Figure 39. High elevation catchment-level sample design. Catchment boundaries delineated in yellow, actual flightlines are red and photo points are green.

Special Evaluation Monitoring, Research and Technology Development Projects

Evaluation Monitoring

- Health & abundance of limber pine in southern Colorado & northern New Mexico – Kristy Duran (Adams State University) and Kelly Burns
- Effects of spruce beetle (*Dendroctonus rufipennis*) outbreaks on Rocky Mountain spruce-fir stand characteristics - Donna Shorrock, Amy Chambers, and Jim Kruse
- Defense traits and resistance to mountain pine beetle – Barbara Bentz (RMRS) and Sky Stephens

Research and Technology Development

- Rangewide vulnerability of limber pine: white pine blister rust resistance and climate interactions. Western Wildland Environmental Threat Center. Anna Schoettle, Richard Sneizko, and Kelly Burns.

- Climate change projections of five needle pines and disease risk in the Great Basin. Western Wildland Environmental Threat Center. Anna Schoettle, Jane Stewart, Sparkle Malone, and Kelly Burns.

- Mapping the distribution, spread, and risk of the newly identified white pine blister rust and comandra blister rust hybrid in the Rocky Mountains. FHP Emerging Pests Program. Jane Stewart, Kelly Burns, Anna Schoettle.

- Southern Rockies Rust Resistance Trial. Anna Schoettle, Bill Jacobi, and Kelly Burns.

- Developing molecular tools to identify emerging conifer foliage pathogens. STDP-17-03. Jane Stewart, Jim Worrall, Suzanne Marchetti, and Kelly Burns.

- DNA-based identification and characterization of forest root disease pathogens in western USA. STDP-18-01. Ned Klopfenstein, Jane Stewart, Mee-Sook Kim, Jim Blodgett.

NFS FHP Prevention - Suppression Projects

In 2019, FHP contributed funding to insect and disease prevention and suppression projects on six National Forests. Project proposals are submitted at the end of September and funded with formula-based funding from the WO and ranked by FHP and Regional priorities. Accomplishments are reported in the ForHealth database. Contact the Regional Entomologist for details.

FHP Programs and Information for Managing Invasive Species

The most notable invasive forest pest of our native trees in the Rocky Mountain Region the Eurasian disease white pine blister rust, which is expanding its range in five needled pines.

Many more invasive tree insect and disease pests affect nonnative trees in our urban and planted landscapes. Some are devastating urban tree pests such as emerald ash borer, walnut twig beetle and Dutch elm disease. On our National Forest System (NFS) lands, invasive plants are a serious threat to our rangelands and native plant communities. SPF- FHP does not have funding for invasive plant treatments on NFS lands.

Invasive Plant Grants to States

State and Private Forestry (S&PF) FHP provides limited grant funding to state agencies for assistance with local management of invasive plants on state and private forest lands to limit the spread of priority weeds on all forest lands.

Invasive Grasses - Ventenata and Medusahead

FHP Emerging Pest Funds were received to assist North East Wyoming Invasive Grass Working Group (NEWIGWG) in Sheridan County with monitoring and treating two new invasive grasses, medusahead and ventenata, discovered in 2016. The proposal was submitted by the Bighorn National Forest on behalf of the organization. The medusahead sites are relatively restricted in size and ventenata is more widespread but still possibly manageable. The goal is to identify and treat these infestations while they are still manageable and protect National Forest Lands.

Publications

Biological Evaluations and Service Trips

Gunnison Service Center

GSC-19-01 Forest Health Issues San Isabel - Lockner
GSC-19-02 Forest Health Issues Spruce Beetle Trap Trees, Grand Mesa NF – Lockner/Marchetti
GSC-19-03 Forest Health Issues, Roundheaded Pine Beetle Transects, San Juan NF – Lockner/Marchetti
GSC-19-04 Forest Health Issues, Black Canyon National Park – Lockner/Marchetti

Lakewood Service Center

LSC-19-01, Forest Health Review at the Air Force Academy - Powell/Stephens
LSC-19-02, Forest Health Review at Rocky Mountain National Park - Powell/Stephens
LSC-19-03, Decay Fungus at Topaz Point - Stephens/Powell/Burns
LSC-19-04, Dillion Ranger District Recreation Site Review- Stephens/Powell
LSC-19-05, Forest Health Review at Fort Carson - Stephens/Powell
LSC-19-06, Forest Health Assessment at Cheyenne Mountain Air Force Station - Stokes
LSC-19-07, FHP Site Visit - Fort Larned, KS - Stephens/Stokes
LSC-19-08, FHP Site Visit - Tallgrass Prairie, KS - Stephens/Stokes
LSC-19-09, FHP Site Visit - KFS Larry Biles Letter - Stephens
LSC-19-10, FHP Site Visit - Fort Scott, KS - Stokes/Stephens
LSC-19-11, FHP Site Visit - Fort Riley, KS - Stokes/Stephens
LSC-19-12, FHP Site Visit - Fort Leavenworth - Stokes/Stephens
LSC-19-13, Douglas-fir Beetle at Kelsey Campground, South Platte Ranger District, Pike NF - Stephens
LSC-19-14, Spruce Beetle Guanella Pass Campground, Clear Creek Ranger District, ARNF - Stephens
LSC-19-15, Forest Health Assessment of Chris Kuennen's Silvicultural Certification Stand on the South Park Ranger District - Stephens/Burns
LSC-19-16, Sheep Project Landowner Forest Health Visit - Stephens
LSC-19-17, Subalpine Fir Decline at Big Creeks Lake Campground, Parks Ranger District, Routt National Forest - Stokes/Davenport

Rapid City Service Center

RCSC-19-1 Black Hills National Forest Log Deck Inspection: Christmas POL, Hell Canyon Ranger District - Schotzko
RCSC-19-2 Black Hills National Forest Log Deck Inspection: Superman POL, Hell Canyon Ranger District - Schotzko
RCSC-19-3 Bark Beetle Activity on the Black Hills National Forest – Allen/Schotzko/Dymerski

RCSC-19-4 Pine Engraver Beetle Activity on the Nebraska National Forest - Allen/Schotzko/Dymerski
RCSC-19-5 Conditions in White Spruce Stands on the Black Hills National Forest - Allen/Schotzko/Blodgett/Dymerski
RCSC-19-6 Condition of Limber Pine Stands on the Bighorn National Forest - Allen/Schotzko/Blodgett/Dymerski
RCSC-19-7 Condition of Limber Pine Stands on the Shoshone National Forest - Allen/Schotzko/Blodgett/Dymerski
BE RCSC-19-1 Plot Survey of Dwarf Mistletoe and Comandra Blister Rust Diseases in Lodgepole Pine on the Bighorn National Forest: 2018 - Blodgett/Schotzko/Allen/Dymerski
BE RCSC-19-2 Plot Survey of Dwarf Mistletoe and Comandra Blister Rust Diseases in Lodgepole Pine on the Shoshone National Forest: 2018 - Blodgett/Schotzko/Allen/Dymerski

Technology Reports & Peer-Reviewed Publications

Hansen, E.M., A.S. Munson, D. Wakarchuk, D.C. Blackford, A.D. Graves, S.S. Stephens, and J.J.E. Moan. 2019. Advances in semiochemical repellents to mitigate host mortality from the spruce beetle (Coleoptera: Curculionidae). Journal of Economic Entomology.112(5): 2253-2261.

Jacobi WR, Kearns HSJ, Cleaver CM, Goodrich BA, Burns KS. Epidemiology of white pine blister rust on limber pine in Colorado and Wyoming, ForPath.2018;48:e12465.

Negrón JF, Cain R. Mountain pine beetle in Colorado: a story of changing forests. Journal of Forestry 117: 144-151

Schoettle A., et al 2019. Regeneration Resilience Framework Proactive limber pine conservation strategy for the Greater Rocky Mountain National Park Area

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South Dakota Resource Conservation and Forestry: Anthony Seidl, Forest Health Program Coordinator
Wyoming State Forestry Division: Harrison Brookes, Forest Health Specialist, Ryan De Santis, Forest Health Specialist (former)

Online Resources

For more information on forest health related topics please visit the following websites:

- The Region 2 Forest Health Protection homepage
- Field Guide to Diseases & Insects of the Rocky Mountain Region
- Aerial Detection Survey Maps (please see link on the page to current year's draft data)
- Trainings offered by Region 2 Forest Health Protection Personnel
- Hazard Tree information and further resources