United States Department of Agriculture

Forest Insect and Disease Conditions in the Southwestern Region, 2014

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Cover photo: Southwestern white pine with branch flagging caused by white pine blister rust and bark stripping damage of the bole caused by black bear.

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Forest Insect and Disease Conditions in the Southwestern Region, 2014

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Weather Summary

Moisture conditions improved across the Southwestern Region in 2014, however, the majority of precipitation came as heavy rain storms in summer or autumn. No areas in the Southwest had a good winter snowpack, which can adversely affect most tree species early in the growing season. The Standardized Precipitation Index (SPI) map for the 24-month time period ending December 2014 (Figure 1) displays near normal conditions across most of the region. For New Mexico, this is an improvement in conditions over the previous 24 month period ending December 2013 (Figures 2), when most of the state was in the moderately dry category. In Arizona, no major changes occurred. No areas in the region were in the more severe drought categories during either period.

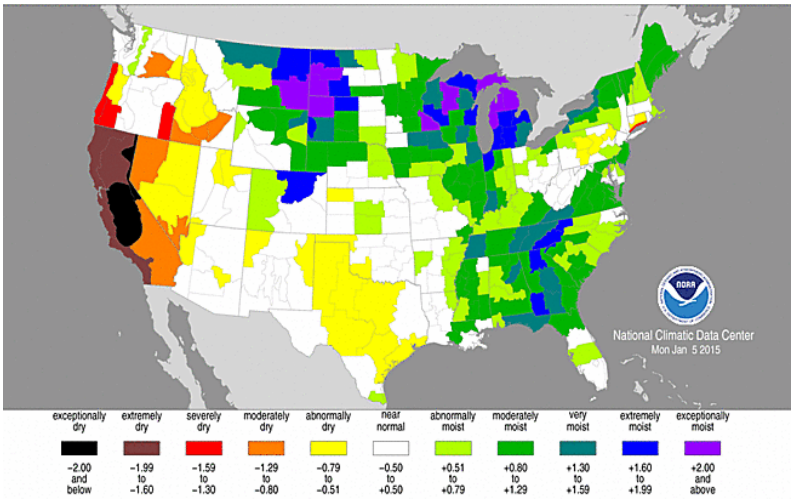

Figure 1. Standardized precipitation index for January 2013 through December 2014 (NOAA, National Climatic Data Center http://www.ncdc.noaa.gov/)

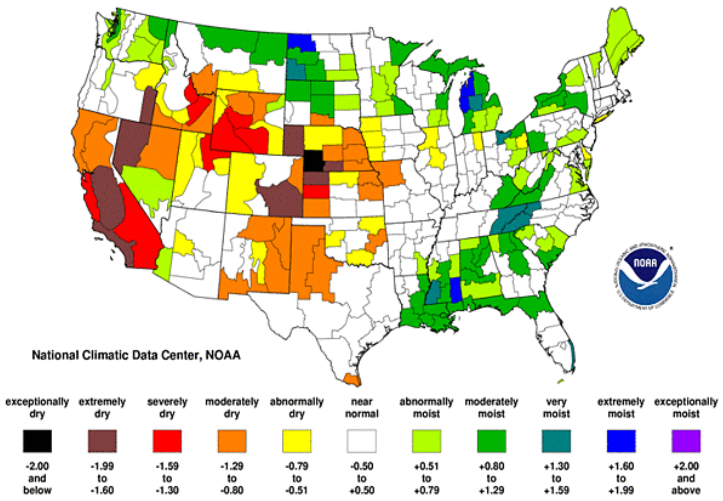

Figure 2. Standardized precipitation index for January 2012 through December 2013 (NOAA, National Climatic Data Center http://www.ncdc.noaa.gov/)

Forest Insect and Disease Summary

The area covered by the annual forest health aerial detection survey remains fairly constant from one year to the next. In 2014, aerial surveyors covered over 21 million acres (Figure 3). Overall insect activity across the Southwestern Region remains elevated, but affected acres did decrease from 2013 levels across most forest types.

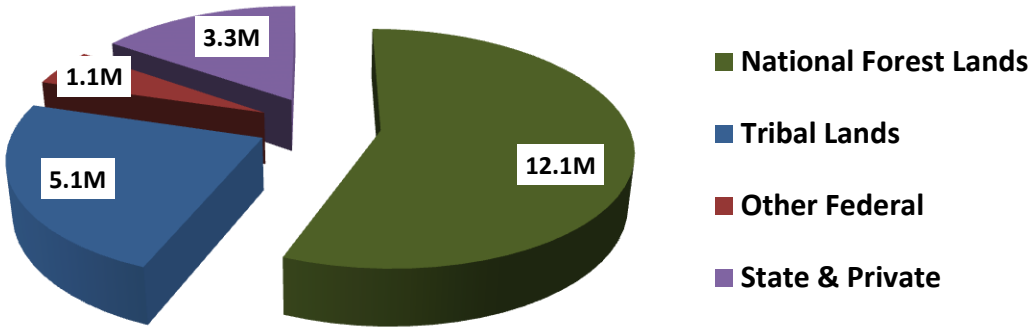

Figure 3. Aerial detection survey acres by land ownership; over 21M acres were flown in total across the Southwestern Region in 2014.

Over 337,000 acres of bark beetle activity were mapped across all forest types of the Southwestern Region in 2014, a significant decrease from the 500,000 acres detected in 2013. The greatest mortality in the Southwestern Region in 2014 occurred in ponderosa pine, with over 161,000 acres mapped (Table 1); pine engraver beetles (*Ips* spp.) were associated with nearly 140,000 acres of this mortality (Table 2). *Ips* activity in Arizona was greatest on the Apache-Sitgreaves National Forests (NF), Tonto NF, Fort Apache Reservation (R) and San Carlos Apache R, and in New Mexico activity was greatest on the Gila NF, Lincoln NF, Santa Fe NF, Mescalero Apache R, and state and private lands. *Ips calligraphus* was detected as a causal agent of Aleppo pine mortality in the Southwest after it was detected in urban forests within the city of Tucson.

Bark beetle activity increased overall in the mixed conifer forests to over 127,000 acres in 2014, from 111,000 acres in 2013. However, Douglas-fir beetle activity actually decreased from the previous year, while fir engraver beetle activity substantially increased. Mixed conifer mortality in Arizona was primarily on the Apache-Sitgreaves NFs and in New Mexico was found in all parts of the state, but especially on the Santa Fe NF, Carson NF, Cibola NF and state and private lands.

In spruce-fir forests, spruce mortality increased while subalpine fir mortality decreased. In Arizona, over 11,000 aces of spruce mortality (included in results in Table 1) is believed to be associated with spruce engraver beetle, *Ips hunteri*, not previously associated with landscape level damage in the Southwestern Region. In New Mexico, spruce mortality increased on the Carson NF and Santa Fe NF and was associated with spruce beetle.

Mortality in pinyon-juniper forests decreased for the first time in several years. Nearly 46,000 acres of pinyon mortality were observed in New Mexico in 2014, compared to over 69,000 acres in 2013. Less than 1,000 acres of pinyon mortality was detected in Arizona. Cedar bark beetle activity decreased 50% across the region in 2014, to less than 3,000 acres affected.

Mortality of southwestern white pine associated with mountain pine beetle (MPB) activity decreased by more than 50% from 2013 observations. The area affected by the 2011 Wallow Fire on the Apache-Sitgreaves NFs, in eastern Arizona, continues to have the most activity. Although MPB related mortality decreased, trap catches of beetles from monitoring traps in the Wallow Fire area were much higher in 2014 than 2013.

Defoliation as a result of insect feeding was extensive throughout the Southwestern Region in 2014 (Table 3). Western spruce budworm activity in northern New Mexico remained nearly the same in 2014, defoliating roughly 300,000 acres. Pine sawfly defoliation on ponderosa pine decreased in both states, while defoliation caused by pinyon needle scale increased slightly. Aspen defoliation and mortality decreased substantially in New Mexico and remained relatively constant in Arizona. While aspen defoliation occurs annually on many acres in the Southwest, some defoliators have periodic outbreaks. Pandora moth, a defoliator of ponderosa pine, is one of these periodic outbreak species and although the insect has been active on the Kaibab Plateau in northern Arizona since 2008, no defoliation was observed in 2014. However, a large adult population was collected in traps in 2014, which indicates potential defoliation in 2015. The last recorded outbreak of this insect occurred from 1978 to 1984.

Dwarf mistletoe is the most common and widespread pathogen in the Southwest. Over one-third of the ponderosa pine acreage and about one-half of the mixed conifer acreage has some level of infection and overall acreage affected does not change radically from year-to-year. Ponderosa pine stands severely infested with dwarf mistletoe have higher levels of mortality than uninfested stands. Root diseases are also widely distributed across the region. Mortality associated with this group of diseases is generally found in higher elevation forests where environmental conditions are more conducive to disease expansion. *Armillaria solidipes* (syn. *A. ostoyae*) is the most common and damaging root disease in the Southwest.

White pine blister rust (WPBR) continues to cause severe damage to southwestern white pine in the Sacramento Mountains of southern New Mexico. Forest health staff continues to find new areas affected by this exotic and invasive disease in Arizona and New Mexico, primarily on higher elevation sites. WPBR has now been documented in parts of every National Forest in New Mexico with the exception of the Carson NF. In Arizona, it has not been observed outside of the White Mountains in the eastern portion of the State.

Table 1. Prominent 2014 forest insect and disease activity (acres) observed during annual aerial detection survey in Arizona and New Mexico*.

Agent	State	National Forest	Tribal Lands	Other Federal	State & Private	Total
Ponderosa Type Bark Beetles	AZ	71,710	16,900	850	1,520	90,980
	NM	53,050	8,410	590	8,060	70,110
Mixed Conifer Type Bark Beetles	AZ	42,250	17,010	220	1,050	60,530
	NM	42,510	3,660	340	20,120	66,620
Spruce-Fir Type Bark Beetles	AZ	6,140	6,550	0	0	12,690
	NM	18,560	530	0	2,450	21,550
Western Spruce Budworm	AZ	0	10	0	0	10
	NM	207,550	14,120	200	80,690	302,560
Aspen Damage**	AZ	3,390	5,940	1,390	180	10,900
	NM	39,390	2,270	40	20,810	62,520
Root Disease	AZ	219,000	***	***	***	219,000
	NM	860,000	***	***	***	860,000
Dwarf Mistletoes	AZ	1,174,000	674,000	***	25,000	1,873,000
	NM	1,144,000	348,000	***	581,000	2,073,000

* Values rounded to the nearest 10; sum of individual values may differ from totals due to rounding.

** Aspen damage includes a combination of insect defoliation and other biotic and abiotic factors causing aspen decline resulting in mortality. See text for additional information.

*** Significant activity observed/known, but acreage not determined.

Table 2. Bark beetle incidence by ownership (acres) from aerial detection surveys in 2014 in Arizona and New Mexico[1].

Owner[2]	Western pine beetle	Round-headed pine beetle	Ips engraver	Mountain pine beetle[3]	Pinyon ips	Douglas-fir beetle	Spruce beetle	Western balsam bark beetle	Fir engraver
Apache-Sitgreaves NFs[4]	1,660		56,870	2,470	400	9,840		760	32,390
Coconino NF	370		1,050	540	< 5	540		20	50
Coronado NF		2,160	860	< 5	150	1,480		50	1,030
Kaibab NF	130		40		< 5	10	< 5		< 5
Prescott NF	140		10		10				
Tonto NF	10		8,420			240			590
BLM	90		< 5		< 5				
DOD		< 5			50				
NPS	30	700	30		< 5	50			210
Fort Apache R	370		8,320	880	< 5	1,080		680	16,330
Hopi R					< 5				
Hualapai R	30		< 5		< 5				
Navajo Nation R	90		20		90	100		30	110
Navajo-Hopi JUA									
San Carlos Apache R	< 5		8,170		110	100			100
State & Private	390		1,120	60	180	120			1,050
Arizona Total	**3,300**	**2,870**	**84,910**	**3,950**	**990**	**13,540**	**< 5**	**1,540**	**51,850**
Carson NF	470					7,850	4,220	4,290	3,520
Cibola NF	3,660		410		14,330	3,170		190	3,740
Gila NF	940		26,530		760	360			2,420
Lincoln NF			14,060		150	2,830	< 5	60	180
Santa Fe NF	4,340		2,120		940	8,850	9,860	2,280	13,040
Valles Caldera NP	240		570			800		< 5	70
BLM	260		< 5		1,180	< 5			70
NPS	40		280			90			180
Acoma Pueblo	1,320				100				
Isleta Pueblo	50				6,580	30			
Jemez Pueblo	580								50
Jicarilla Apache R	10		< 5			270		10	< 5
Laguna Pueblo	50								
Mescalero Apache R	60		6,170		170	1,930	10	250	< 5
Navajo Nation R	50					< 5		170	
Other Reservations	< 5								
Picuris Pueblo	70					110			180
Ramah R	< 5								
Santa Clara Pueblo			20		< 5	130			40
Taos Pueblo					< 5	530	100	< 5	530
Zia Pueblo	20				< 5				
Zuni Pueblo	< 5				< 5				
State & Private	3,170		4,890		21,750	7,510	1,460	1,020	15,360
New Mexico Total	**15,340**	**0**	**55,060**	**0**	**45,970**	**34,480**	**15,650**	**8,250**	**39,390**
SW Region Total	**18,640**	**2,870**	**139,970**	**3,950**	**46,960**	**48,020**	**15,650**	**9,790**	**91,240**

[1] Values rounded to the nearest 10, sum of individual values may differ from totals due to rounding and multiple agents occurring in the same location.

[2] Values based on landownership, thus any inholdings are summarized with their ownership category.

[3] Hosts are southwestern white pine and/or limber pine.

[4] NF is the abbreviation for National Forest and R is the abbreviation for Reservation.

Table 3. Defoliation incidence by ownership (acres) from aerial detection surveys in 2014 in Arizona and New Mexico.[1]

Owner[2]	Western spruce budworm	Aspen damage[3]	Douglas-fir tussock moth	Pine sawfly ponderosa	Pinyon needle scale
Apache-Sitgreaves NFs		1,210	30		150
Coconino NF		1,560	40	610	
Coronado NF		340	50		
Kaibab NF		270		770	
Prescott NF					
Tonto NF		10	10		600
BLM					
DOD					
NPS		1,390			920
Fort Apache R		4,470	380		110
Hopi R					430
Hualapai R					
Navajo Nation R	10	1,470			2,730
Navajo-Hopi JUA					90
San Carlos Apache R					
State & Private		180		160	220
Arizona Total	**10**	**10,900**	**510**	**1,530**	**5,250**
Carson NF	92,690	27,000			
Cibola NF	1,790	2,840	100		2,350
Gila NF	220	200			
Lincoln NF	3,430	840	820		300
Santa Fe NF	100,140	8,140	270		
Valles Caldera NP	9,280	380			
BLM	200	< 5			340
NPS		40			
Acoma Pueblo					
Isleta Pueblo					
Jemez Pueblo		10			
Jicarilla Apache R	2,750	1,380			
Laguna Pueblo					
Mescalero Apache R	2,850	60	600		1,470
Navajo Nation R	200	740			
Other Reservations					
Picuris Pueblo					
Santa Clara Pueblo		30			
Taos Pueblo	8,320	40			
Zia Pueblo					
Zuni Pueblo					
State & Private	80,690	20,810	140	990	
New Mexico Total	**302,560**	**62,520**	**1,920**	**990**	**4,480**
SW Region Total	**302,570**	**73,420**	**2,440**	**2,530**	**9,720**

[1] Values rounded to the nearest 10, sum of individual values may differ from totals due to rounding and multiple agents occurring in the same location.

[2] Values based on landownership, thus any inholdings are summarized with their ownership category.

[3] Aspen damage includes a combination of insect defoliation and other biotic and abiotic factors causing aspen decline and in some cases mortality. See text for additional information.

Status of Major Insects

Bark Beetles

Over 337,000 acres of bark beetle activity were mapped across all forest types of the Southwestern Region in 2014, a substantial decrease from the 500,000 acres detected in 2013. In New Mexico, bark beetle activity decreased from nearly 340,000 acres in 2013 to 200,000 acres in 2014. In Arizona, over 137,000 acres were mapped in 2014, down from nearly 169,000 acres in 2013. Although decreased bark beetle activity was observed for many species, bark beetle activity in spruce and white fir increased and two species of *Ips* were observed killing trees in urban forests.

Pinyon-Juniper Forest Type

Pinyon-juniper woodlands can exist as high as 7,000 ft.in elevation, with tree species composition and densities varying widely among individual sites. The pinyon-juniper forest type experienced a Region wide decrease in pinyon ips and cedar bark beetle activity between 2013 and 2014. Pinyon ips activity was found primarily in New Mexico, and is discussed below. Cedar bark beetle activity decreased significantly in New Mexico, from over 6,000 acres in 2013 to less than 1,000 acres in 2014, while increasing in Arizona from 250 acres in 2013 to nearly 1,700 acres in 2014.

Figure 4. Extensive current (red) and prior year (grey) pinyon tree mortality from pinyon ips activity in the Manzanita Mountains, Cibola NF.

Pinyon Ips

Ips confusus
Host: Pinyon pine

Pinyon ips activity occurred on nearly 47,000 acres across the Region in 2014, a decrease from 73,000 acres in 2013. Over 90% of the pinyon ips mortality occurred in New Mexico; the Mountainair and Sandia RDs of Cibola NF (Figure 4), Isleta Pueblo, and state & private lands in the mountains east of Albuquerque accounted for the majority of the damage. This concentrated area has been particularly affected the past couple of years. In Arizona, pinyon mortality caused by *Ips confusus* was less than 1,000 acres.

Ponderosa Pine Forest Type

The ponderosa pine forest type in the Southwestern Region generally ranges from 6,000 feet to 9,000 feet in elevation. Although bark beetle activity remained elevated in ponderosa pine forest types in 2014, tree mortality decreased substantially (Figure 5). Over 343,000 acres of mortality were mapped in 2013, compared to 161,000 acres in 2014. Mortality of ponderosa pine by bark beetles in the Southwest is often caused by a combination of bark beetle species. For example, *Ips* spp. and western pine beetles may be active on different sized trees within the same area or co-occurring within the same trees. In southern Arizona's sky islands, roundheaded pine beetle and southern pine beetle are often more active than western pine beetle, but the main agent can change year-to-year due to changes in climate or stand conditions (e.g. fire). Aerial surveyors label agents to the best of their knowledge, often based on previous ground checks, and the data we present here is meant for general trends and not an absolute confirmation of the specific bark beetle causal agent.

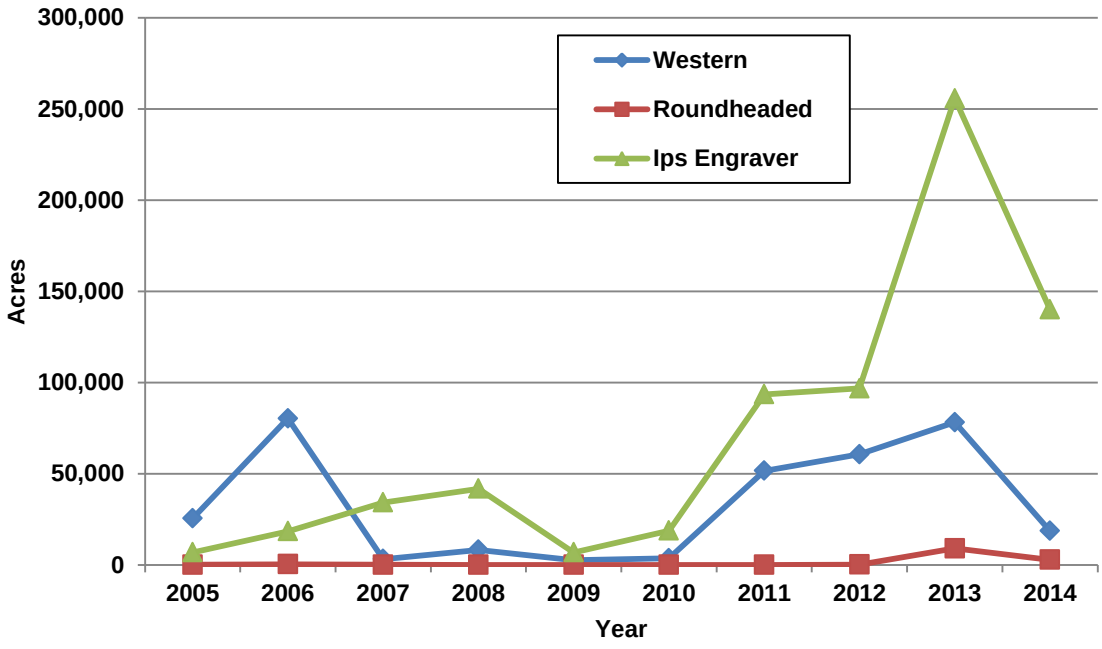

Figure 5. Acres of ponderosa pine mortality over the last decade, by bark beetle species.

Western Pine Beetle

Dendroctonus brevicomis
Host: Ponderosa pine and southwestern white pine

Western pine beetle activity decreased substantially across the region in 2014 (Figure 5). In Arizona, the affected area decreased from 34,020 acres in 2013 to only 3,300 acres in 2014. Nearly 50% of the mortality attributed to western pine beetle in 2014 was mapped on the Apache-Sitgreaves NFs (1,660 acres).

In New Mexico, acres of mortality attributable to western pine beetle decreased from 44,170 acres in 2013, to 15,340 acres 2014. The Cibola NF, Santa Fe NF and state and private land holdings were the most heavily affected in 2014, and moderate activity was observed on the Gila NF (Figure 6).

Figure 6. Western pine beetle galleries were exposed under the bark of ponderosa pine trees, Gila NF.

Ips Engraver Beetles

I. pini, I. lecontei, I. knausi, *I. cribicollis, I. calligraphus*
Host: Ponderosa pine

Elevated *Ips* mortality is typically associated with large-scale disturbances, such as drought or recent fires, where damaged or downed material create suitable habitat for brood production. Although *Ips* activity is still elevated (Figure 5), the relief of drought conditions in New Mexico may have contributed to the overall decrease in activity across the Region; from 255,650 acres in 2013 to 139,970 acres in 2014.

Figure 7. Top-killed Arizona and Chihuahua pines caused by *Ips lecontei* in Bear Canyon, Santa Catalina RD, Coronado NF (left photo) and overwintering *I. lecontei* and their galleries (right photo).

The majority of *Ips* activity in 2014 occurred in Arizona, 84,910 acres, particularly on the Apache-Sitgreaves NFs (56,870 acres). *Ips* activity also increased to over 8,000 acres on each of the Tonto NF, Fort Apache R, and San Carlos R. There were two smaller outbreaks of great concern near Tucson in 2014. Top-kill and whole tree mortality of Arizona and Chihuahua pine caused by *Ips lecontei* was observed in the high recreation use area of Bear Canyon, Santa Catalina RD, Coronado NF (Figure 7). This was the first record of *I. lecontei* causing significant mortality in the Santa Catalina Mountains. Another outbreak occurred within the city of Tucson, where mortality of large, old Aleppo pines was associated with *Ips calligraphus*. The Aleppo pines in the Tucson area were likely stressed by the severe drought conditions in that area.

In New Mexico, affected acres decreased from 173,580 acres in 2013 to 55,060 acres in 2014. Nearly 50% of the affected acres occurred on the Gila NF (26,530 acres).

Mountain Pine Beetle

Dendroctonus ponderosae
Hosts: Ponderosa, limber, southwestern white, and bristlecone pines

In contrast to Colorado and other Rocky Mountain states where landscape level mortality of ponderosa pine has been attributed to mountain pine beetle, the ponderosa pine forests in the Southwest are not significantly affected by this beetle. Historically, ponderosa pine trees were the reported host on the North Kaibab Plateau, in northern Arizona, but more recently, mountain pine beetle has been attributed to mortality of southwestern white and limber pine in Arizona. In 2014, nearly 4,000 acres of scattered southwestern white pine mortality were detected on the Apache-Sitgreaves NFs, Coconino NF, and Fort Apache R. In an attempt to limit the notable expansion of mortality caused by mountain pine beetle in the Wallow Fire area, Apache-Sitgreaves NF, a large scale suppression project utilizing the antiaggregation pheromone verbenone was implemented in recreation areas and numerous Mexican Spotted Owl Protected Activity Centers on the Springerville and Alpine RDs.

Roundheaded Pine Beetle

Dendroctonus adjunctus
Host: Ponderosa pine

Nearly 3,000 acres of ponderosa and Arizona pine mortality attributed to roundheaded pine beetle were mapped on the Coronado NF and high elevations of Saguaro NP in 2014, a large decrease from over 9,000 acres mapped in 2013 (Figure 5). Previous site visits indicated roundheaded pine beetle was the major agent of mortality in some areas (e.g. Pinaleño Mountains) while southern pine beetle was the major cause of mortality in other areas (e.g. Santa Catalina Mountains).

Although no ponderosa pine mortality was attributed to roundheaded pine beetle in New Mexico, this species has contributed to mortality of ponderosa pine trees in the Sacramento Mountains in the past. Roundheaded pine beetle has also been identified on the Jemez and Pecos/Las Vegas RDs of the Santa Fe NF in recent years.

Mixed Conifer Forest Type

Mixed conifer forests in the Southwestern Region are generally located from 8,000 to 10,000 ft. in elevation. They are primarily composed of Douglas-fir, white fir, and southwestern white pine along with pockets of aspen. Ponderosa pine is intermixed at lower elevations and spruce and subalpine fir trees are intermixed in higher elevations. Bark beetle activity increased overall in the mixed conifer forests to over 127,000 acres in 2014, from 111,000 acres in 2013 (Figure 8). While Douglas-fir beetle activity decreased from the previous year, fir engraver beetle activity substantially increased.

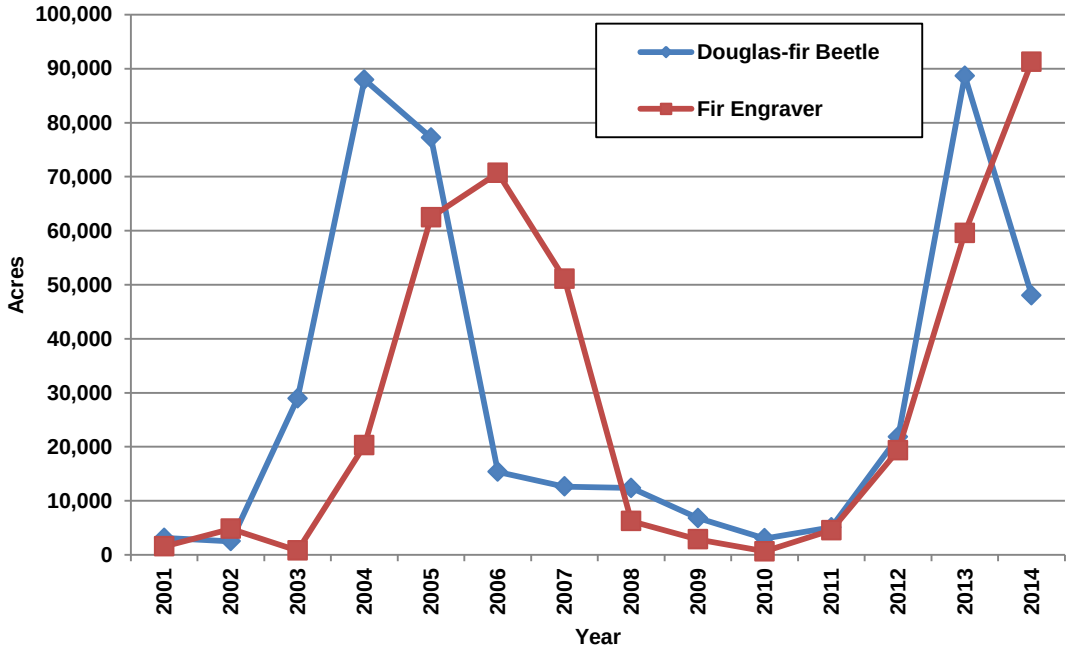

Figure 8. Acres of Douglas-fir beetle and fir engraver beetle activity since 2001.

Douglas-fir Beetle

Dendroctonus pseudotsugae
Host: Douglas-fir

Douglas-fir beetle activity remained elevated across the Region in 2014, at 48,000 acres, but had substantially decreased from the 88,000 acres reported in 2013 (Figure 8). Over 34,000 acres were impacted in New Mexico, with the greatest levels of mortality in the northern part of the state; Carson NF, Santa Fe NF, and surrounding state and private lands. Of the 13,540 acres reported in Arizona, the majority of damage was associated with wildfire areas, including nearly 10,000 acres within the Wallow Fire perimeter on the Apache-Sitgreaves NFs. Since 2012, the Apache-Sitgreaves NFs has treated portions of high-value recreation sites and Mexican Spotted Owl Protected Activity Centers with MCH, an antiaggregation pheromone, in an effort to repel Douglas-fir beetles from fire injured trees. Several hundred infested trees were also removed from the Big Lake Recreation Area to augment suppression efforts. Flatheaded fir borers likely caused or contributed to some of the Douglas-fir tree mortality reported in areas of both states.

Fir Engraver

Scolytus ventralis
Host: White fir

White fir mortality attributed to fir engraver beetle activity in the Southwest is often driven by drought stress and high stand densities that favor fir engraver beetle success. The resulting mortality is seen throughout all age classes, particularly on drier south- and west-facing slopes, and the lower elevations of north facing slopes. Fir engraver beetle caused mortality continued an upward trend in 2014; with over 91,000 acres affected, compared to 59,600 acres in 2013 (Figure 8). In Arizona, nearly 52,000 acres of fir engraver activity was detected, with over 32,000 acres occurring on the Apache-Sitgreaves NFs and 16,000 acres on neighboring Fort Apache R. Ground observations determined many fire-injured white fir trees became infested with fir engraver beetles. White fir mortality was observed throughout New Mexico, but was greatest on the Santa Fe NF and surrounding state and private lands. It should be noted that differentiating between fire-caused tree mortality and beetle-caused tree mortality within and adjacent to burned areas is challenging due to the similarity of fading crown color progression.

Spruce-Fir Forest Type

At around 9,000 ft. elevation mixed conifer forests start to transition to spruce-fir forests. Engelmann spruce and corkbark fir are the primary trees species, but blue spruce, limber and bristlecone pines, as well as aspen may also be present. Region-wide, acres affected by bark beetle activity in the spruce-fir forest type increased from 22,000 in 2013 to over 34,000 acres in 2014 (Figure 9). In addition to spruce beetle and western balsam bark beetle activity, a spruce engraver beetle, *Ips hunteri*, is believed to be associated with topkill and whole tree mortality in eastern Arizona.

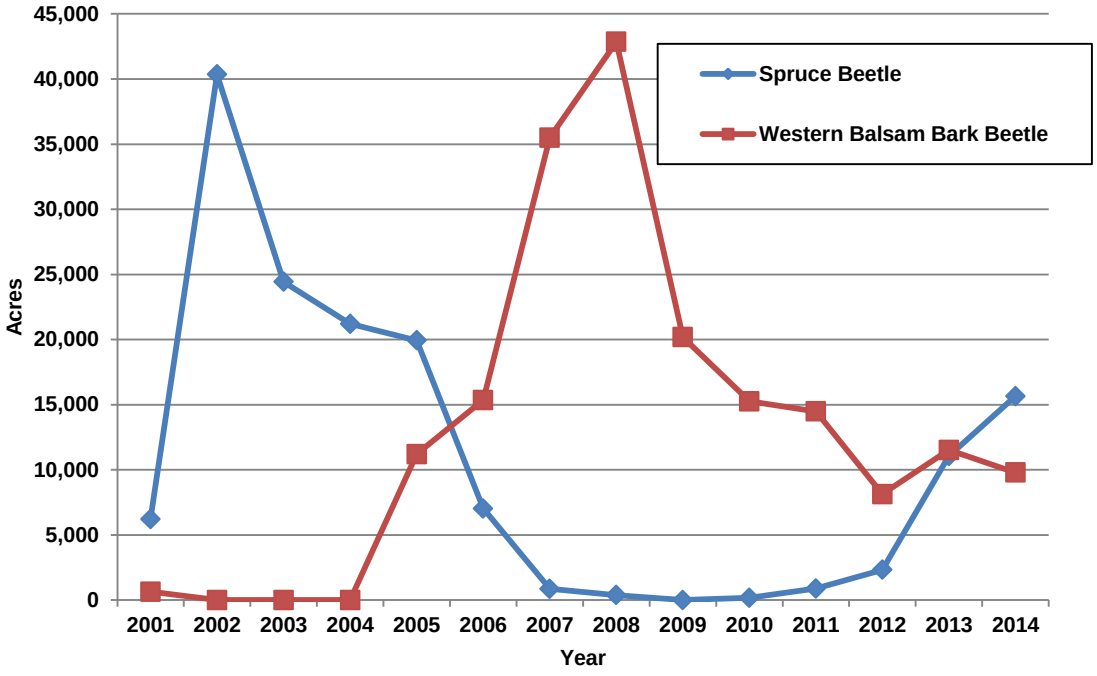

Figure 9. Acres of spruce beetle and western balsam bark beetle activity since 2001. The patterns are dissimilar between the two species.

Spruce Beetle

Dendroctonus rufipennis
Host: Spruce

Spruce beetle activity remains a concern in northern New Mexico, especially with the large landscape scale outbreak that has been occurring on the Rio Grande NF in southern Colorado. Spruce beetle caused mortality increased from, 11,000 acres in 2013 to over 15,000 acres in 2014 (Figure 9), with some activity concentrated near the Colorado border. However, the greatest spruce beetle activity is occurring in the vicinity of a large windthrow event that occurred in 2007 in the Pecos Wilderness, which is on the Carson and Santa Fe NFs.

In Arizona, spruce beetle activity was reported on <5 acres of the Kaibab NF.

Spruce Engraver Beetle

Ips hunteri
Hosts: Engelmann and blue spruce

Areas of spruce top-kill were observed during the 2013 aerial detection surveys in the White Mountains of eastern Arizona, and field visits to the affected sites found the causal agent of top-killed and whole tree mortality was spruce engraver beetle, *Ips hunteri*. In 2014, mortality believed to be associated with *I. hunteri* was reported on 5,420 acres on the Apache-Sitgreaves NFs and 5,760 acres on the Fort Apache R. Affected areas will be ground checked in 2015, as this is the first suspected landscape level outbreak for *I. hunteri* in the

Southwestern Region. In previous years, *I. hunteri* was associated with scattered heavily stressed trees. Drought stress and/or fire injury may be contributing to current stand level spruce mortality in Arizona.

Western Balsam Bark Beetle

Dryocoetes confusus
Hosts: Subalpine/corkbark fir

In New Mexico, the number of acres observed with western balsam bark beetle activity decreased from 10,400 acres in 2013 to 8,250 acres in 2014 (Figure 9). Activity was primarily in high elevation areas along the Sangre de Cristo mountain range, affecting the Carson and Santa Fe NFs (Figure 10).

Western balsam bark beetle activity in Arizona increased in to 1,540 acres in 2014 compared to 1,130 acres in 2013. Most of the acres mapped were on the Apache-Sitgreaves NFs and neighboring Fort Apache R.

Figure 10. Corkbark fir trees killed by western balsam bark beetle were observed in southern New Mexico.

Defoliators

Western Spruce Budworm

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

Western spruce budworm (WSBW) activity covered over 302,000 acres in the Southwestern Region in 2014, similar to the 299,000 acres mapped in 2013. Nearly all WSBW activity occurs in northern New Mexico, due to prevalence of susceptible host type and stand conditions. In 2014, the majority of defoliation was split between the Carson NF, Santa Fe NF and adjacent state and private lands. Defoliation was also observed on tribal lands and the Valles Caldera National Preserve.

In Arizona, just 10 acres of WSBW activity was observed in 2014, occurring in the Chuska Mountains, Navajo R. Chronic defoliation was observed in ground surveys on the North Kaibab RD, Kaibab NF, but this was not detectable during aerial flights.

Douglas-fir Tussock Moth

Orgyia pseudotsugata
Hosts: White fir, Douglas-fir, and spruce

Douglas-fir tussock moth (DFTM) (Figure 11) activity increased substantially to over 2,400 acres in 2014, from 600 acres mapped in 2013. Nearly 2,000 acres was observed in New Mexico (Figure 12), mostly on the Lincoln NF and adjoining Mescalero Apache Reservation. New outbreaks were detected on the Magdalena and Sandia Mountains of the Cibola NF, and on the southern portion of the Sangre de Cristo Mountains on the Santa Fe NF. Damage along the road going up to the Santa Fe Ski Area, Santa Fe NF, was first observed aerially. A ground check to the site was conducted to confirm the presence of this insect. Defoliation and pupal casings were very evident in Douglas-fir, white fir and spruce trees. There were also pockets of western spruce budworm defoliation interspersed with the DFTM defoliation. Activity on state and private lands was low (140 acres).

Figure 11. Douglas-fir tussock moth larvae were found on the Lincoln NF.

Over 500 acres of DFTM defoliation was mapped in Arizona in 2014, with 380 acres detected on the Fort Apache R. These sites will be ground verified for presence of DFTM in 2015. Small patches of light defoliation were also detected along the Mogollon Rim in central Arizona.

Figure 12. Heavy defoliation by Douglas-fir tussock moth was observed on the Sacramento RD, Lincoln NF.

In addition to aerial detections surveys, the Southwestern Region participates in the Early Warning Trapping program to monitor DFTM populations. The objective of the monitoring system is to identify areas with increasing Douglas-fir tussock moth populations prior to visible defoliation, allowing land managers time to apply a mitigation treatment before extensive damage occurs. Sites averaging 25 or more male moths per trap indicate that Douglas-fir tussock moth populations may cause visible defoliation within 1-2 years. In New Mexico, trapping results on the Sacramento RD have not predicted building populations, yet small pockets of damage have transpired over the last two to three years. On the Cibola NF, trapping results indicated that populations were building, and 100 acres were aerially detected in 2014, but they were located on the other side of the mountain from the traps. No DFTM outbreaks have occurred in Arizona since 2007. All early warning trapping locations monitored in Arizona in 2014 had average moth catches far below the threshold of 25 male moths, including sites recently added where light defoliation had been recently observed.

Pine Sawflies

Neodiprion spp., *Zadiprion* spp.
Hosts: Ponderosa and pinyon pines

Pine sawfly defoliation decreased substantially to 2,530 acres in 2014, compared to 4,460 acres in 2013. In Arizona, over 1,500 acres of defoliation occurred on Kendrick Mountain, which co-occurs on the Coconino NF and Kaibab NF. This was the 5th consecutive year of recorded outbreak in this area. Defoliation began in the northwest foothills of the mountain and has spread

eastward, along the pine belt. According to monitoring data from long-term permanent plots on the Williams RD, Kaibab NF, mortality is confined to trees that have 90 to 100% of the older foliage removed. Sawfly defoliation of ponderosa pine in New Mexico was mapped on less than 1,000 acres of state and private lands in 2014.

Pandora Moth

Coloradia pandora
Host: Ponderosa pine

Defoliation caused by Pandora moth larval feeding was not detected during aerial surveys in 2014. This is due to the two year life cycle of Pandora moth where larvae and defoliation occur in odd numbered years in the Southwest, followed by adult (non-feeding) insect emergence from the soil in even numbered years. Approximately 1,800 acres of moderate to severe defoliation was mapped on the Kaibab Plateau in 2013. Most of the damage was mapped just east of Orderville Canyon. A substantial adult population emerged from the soil over many thousands of acres in 2014. Since 2010 we have monitored the adults and larval populations via a collaborative project with Northern Arizona University. We anticipate a substantial increase in acres defoliated in 2015, relative to what occurred in 2013.

Pinyon Needle Scale

Matsucoccus acalyptus
Host: Pinyon pine

Pinyon needle scale (Figure 13) is a chronic defoliator of pinyon pine in several locations in the woodlands of Arizona and New Mexico, with intensities varying from year-to-year. Approximately 9,700 acres of pinyon pine defoliation was recorded in 2014, an increase from 8,000 acres in 2013. In Arizona, a significant increase in pinyon needle scale was mapped on the Navajo Nation Reservation, Canyon De Chelly National Monument, and Tonto NF. Pinyon needle scale activity appears to be expanding to new areas, including urban areas around Prescott, Payson, Sedona, Blue Ridge and Flagstaff. The infestation near Payson, AZ, has grown from around 100 acres in 2007 to an estimated 4,000–5,000 acres in 2014. Thin crowns caused by pinyon needle scale have also been observed in the woodlands around the Tusayan RD near the south rim entrance to Grand Canyon NP.

Figure 13. Pinyon needle scales and damage.

In New Mexico, the majority of damage occurred on the Cibola NF and the Mescalero Apache R. The aerial detection of this pest is complicated by drought; as drought-thinned crowns are often indistinguishable from the effects of needle scale during aerial survey flights.

Aspen Defoliation and Decline

Western tent caterpillar, *Malacosoma californicum*
Large aspen tortrix, *Choristoneura conflictana*
Complex of drought and other insects and diseases

Aspen damage decreased substantially across the Region in 2014 to 73,420 acres, compared to 139,240 acres in 2013 (Figure 14). Total acreage in Arizona was nearly 11,000 acres, and was attributed to western tent caterpillar defoliation. No new acres of mortality were detected in 2014. Most defoliation occurred in the eastern White Mountains, especially on the Fort Apache R (4,470 acres).

Approximately 62,000 acres of aspen damage was detected in New Mexico in 2014. The majority of damage was defoliation by western tent caterpillar, which was greatest on the Carson NF and Santa Fe NF, especially the Canjilon and Tres Piedras RDs of the Carson NF. Defoliation was also observed on the Cibola NF, Santa Fe NF and state and private lands. Aspen mortality, associated with drought and secondary insects and diseases, was mapped on 2,600 acres in New Mexico. Mortality occurred in small patches, spread throughout the state, especially on the Cibola NF and Santa Fe NF.

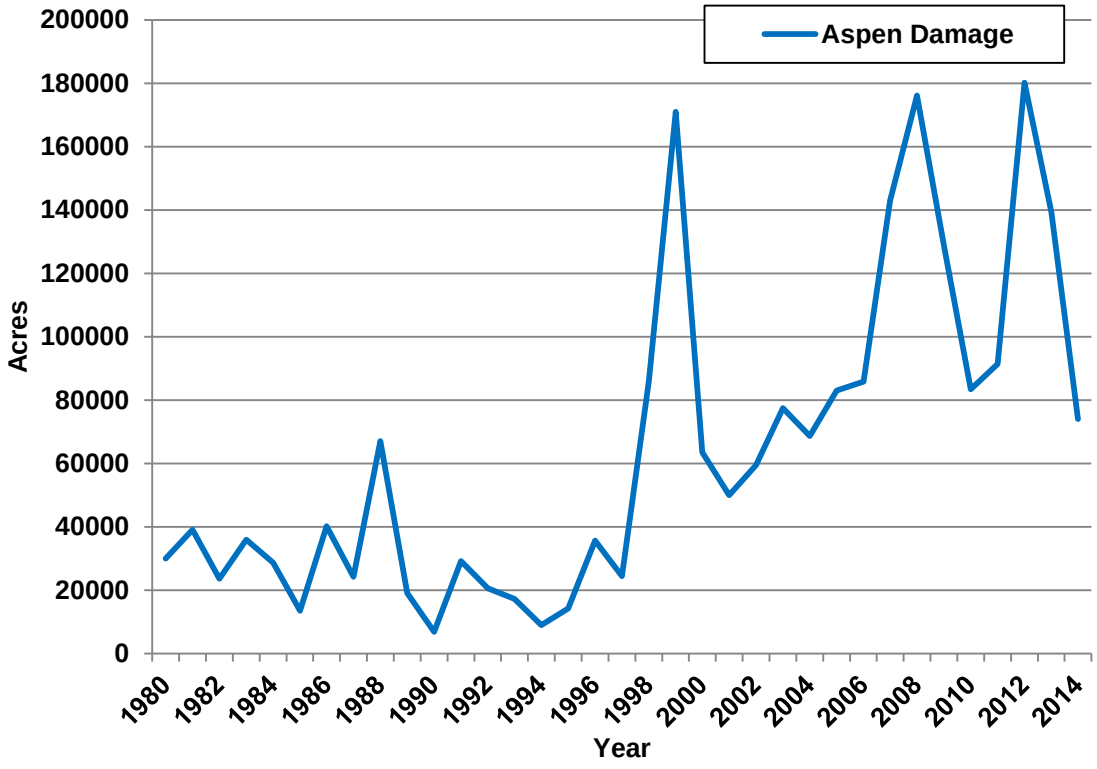

Figure 14. Acres of aspen damaged from both insect defoliation and mortality associated with drought and secondary organisms since 1980.

Status of Major Diseases

Mistletoes

Dwarf Mistletoes

Arceuthobium spp.
Hosts: All conifers

Dwarf mistletoes are the most widespread and damaging forest pathogens (disease-causing organisms) in the Southwest; over one-third of the ponderosa pine type, and up to one-half of the mixed conifer type, has some level of infection. Damage from dwarf mistletoe infection includes growth reduction, deformity (especially the characteristic witches' broomsa), and decreased longevity. Severely infested areas have much higher mortality rates than uninfested areas. Weakened trees can be killed by other damaging agents, like bark beetles or root disease. Dwarf mistletoes have an ecological role, e.g., providing bird roosting habitat and as a food source for some mammals and birds. Of seemingly greater importance, dwarf mistletoes provide an indirect food source for birds that 1) feed on insects that feed on the mistletoe shoots, and 2) that feed on bark beetles that attack weakened infected trees.

Figure 15. Three recently killed Douglas-fir trees with signs of severe dwarf mistletoe infestations.

Figure 16. Ripe berries of the desert mistletoe are an important winter food source of the northern phainopepla.

There are eight species of dwarf mistletoe in the Southwest, each with a primary tree host. The three species affecting ponderosa pine, pinyon, and Douglas-fir (Figure 15) are found throughout most of their respective host's range, while the other species have more limited distributions.

True Mistletoes

Phoradendron spp.
Hosts: Junipers and various hardwoods

Eight species of true mistletoe occur in the Southwest. These mistletoes are less damaging to their hosts than dwarf mistletoes, but heavy infestations reduce host longevity during periods

of drought. *Phoradendron juniperinum* on Utah juniper is probably the most widespread and abundant species. True mistletoes are also common on oaks in southern portions of the Region, abundant on mesquite and palo verde in desert woodlands (Figure 16) and common on most hardwood species in lower elevation riparian areas. There is also a true mistletoe species on white fir that, in the Southwest, only occurs in the Santa Catalina Mountains on the Coronado NF in Arizona.

Root Diseases

Root diseases are fairly common in forests of the Southwest, and are often associated with mortality attributed to bark beetles. They also predispose trees to root failure, a concern in campgrounds and other recreation areas. In the Southwest, root diseases are usually more common in mixed conifer and spruce-fir forests than in ponderosa pine forests, and can also be common in hardwood trees (Figure 17). Like dwarf mistletoes, root diseases spread slowly, so overall incidence changes little from year to year. Root disease is often described as a "disease of the site" as it continues to exist in the soil after host trees are removed or killed by fire.

Figure 17. A fungal fruiting body is located at the base of a Gambel oak tree, indicating root rot that is likely caused by *Pseudoinonotus dryadeus* (syn. *Inonotus dryadeus*).

Armillaria Root Disease

Armillaria solidipes (= *A. ostoyae*)
Hosts: Spruce, true firs, Douglas-fir, ponderosa pine, and aspen

Armillaria root rot is the most common root disease in the Southwest, where it is estimated to account for up to 80 percent of root disease associated mortality. Although all conifer species and size classes can be infected, root disease is more common in old growth mixed conifer and spruce-fir forests. *Armillaria solidipes* (syn. *A. ostoyae*) is the major *Armillaria* species in southwestern coniferous forests, but *A. mellea* has been found in oaks, especially live oaks in southern Arizona. *A. gallica* has also been identified in mixed conifer forests in Arizona. It is typically considered a saprophyte of dead trees. Previous surveys in mixed conifer forests on the North Kaibab RD found *Armillaria* spp. on about 30 percent of standing live trees.

Heterobasidion Root Disease (Formerly Annosus Root Disease)

Heterobasidion irregulare and *H. occidentale*
Hosts: Most conifers

Heterobasidion root disease is the second most common root disease in the Southwest, where it is found in higher elevation ponderosa pine forests and wet mixed conifer forests throughout Arizona and New Mexico. Fruit bodies are commonly found inside stumps and, sometimes on

downed logs and upturned roots. *Heterobasidion occidentale* is common in white fir in the Southwest, but also occurs on subalpine fir and Engelmann spruce. *H. irregulare* is found in ponderosa pine, and although not common it is widely distributed throughout the Region. Like *Armillaria* spp., *Heterobasidion* spp. are known as saprophytes, decayers of dead woody material, as well as pathogens.

Other Common Root Diseases

Other common root diseases in the Southwest include Schweinitzii root/butt rot, caused by the fungus *Phaeolus schweinitzii*, which is often found on older Douglas-fir and occasionally ponderosa pine; Tomentosus root/butt rot, caused by *Onnia tomentosus* (syn. *Inonotus tomentosus*), is found on spruce and Douglas-fir; and Ganoderma root and butt rot, caused by *Ganoderma applanatum*, which is found in aspen. Black Stain root disease, caused by *Leptographium wageneri,* appears to be rare in the Southwest.

Figure 18. Two fruiting bodies of the fungus *Porodaedalea pini* were observed on Douglas-fir during a plot survey.

Stem Decays

Stem decays are common in older trees throughout the region. Decay represents an economic loss in terms of timber production and can increase hazard on developed sites, but decayed trees provide important cavity habitat for many wildlife species, especially birds. The most common stem decays in the Southwest include red rot, *Dichomitus squalens*, of ponderosa pine; red ring rot, *Porodaedalea pini* (syn. *Phellinus pini*) (Figure 18), affecting most conifers; Indian paint fungus, *Echinodontium tinctorium*, on white fir; aspen trunk rot, *Phellinus tremulae*; on aspen; and *Phellinus everhartii* and *Inonotus dryophilus* on oak.

Stem Rusts

White Pine Blister Rust

Cronartium ribicola
Hosts: Southwestern white pine, limber pine, and *Ribes* spp.

White pine blister rust (WPBR) (Figure 19) continues to cause heavy damage to white pines in the Sacramento Mountains of southern New Mexico, where the disease has been established for about 40 years. Based on a set of representative monitoring plots, roughly 45 percent of the white pines in this area, which includes the Mescalero-Apache Reservation and most of the Lincoln NF, are infected. WPBR also occurs in the Gila NF, Cibola NF, and Santa Fe NF of New Mexico.

Many thousands of acres of mesic mixed conifer forest have severe WPBR infection, while more xeric sites generally have low to moderate infection. Top-kill is very common in severely infected areas.

Figure 19. Evidence of a white pine blister rust canker with signs of rodent chewing, Apache-Sitgreaves NFs.

In Arizona, WPBR was first detected in 2009 on the Fort Apache R and neighboring Apache-Sitgreaves NFs. Age estimation of older cankers suggest the WPBR pathogen may have been present for 20 years, but at undetectable levels. Since 2009, favorable weather conditions for the pathogen have allowed for continued disease expansion into new areas, including into more moderate hazard sites throughout most of the White Mountains. However, there are many areas where disease is still absent in both States. In collaboration with Northern Arizona University, permanent monitoring plots have been established throughout the host type in the Region. The 2011 Wallow Fire burned through some of the established plots, and the reproduction of both southwestern white pine and orange gooseberry, the alternate host, is being monitored.

Broom Rusts

Melampsorella caryophyllacearum
Hosts: True fir and chickweed

Chrysomyxa arctostaphyli
Hosts: Spruce and kinnikinnick

There are two species of broom rust that occur in relatively low incidence in their respective hosts' in the Southwest. However, higher infestations of fir broom rust occur in the Sandia and Manzano Mountains of central New Mexico and a few other locations. Damage from this easily recognized disease has not been well quantified; however, infection can result in top-kill, especially in spruce. Locally, falling brooms or stem breakage at the point of infection present a hazard in developed recreation sites.

Limb Rust and Western Gall Rust

Cronartium arizonicum and Peridermium harknessii
Hosts: Ponderosa pine

There are two rust diseases on ponderosa pine in the Region. Limb rust is common in portions of Arizona and can be quite damaging to individual trees. Limb rust incidence in New Mexico is infrequent. The fungus causes orange colored pustules on dying branches with progressive upward and downward branch mortality, generally initiating from the center of the crown. Waves of new infection typically occur at intervals of several years.

A white-spored race of western gall rust of ponderosa pine occurs in the Southwestern Region. This disease is quite uncommon. White-spored pustules form on spindle-shaped galls that form on branches and main stems of infected trees (Figure 20), in contrast to the traditionally orange aecia of *P. harknessii*.

Figure 20. White-spored western gall rust is a rare disease of ponderosa pine in the Southwest. The flanging of bark indicates this is a rust gall and not a burl.

Figure 21. Thick black stripes on an aspen bole indicate infection by *Encoelia pruinosa*, sooty bark disease.

Canker Fungi

Canker fungi are often the primary cause of aspen mortality due to the soft living tissue of the bark, which makes it extremely susceptible to wounding and subsequent infection. Regional disturbances such as drought or local activities like selective logging, campsite construction, and carving injury can increase the incidence of canker disease in aspen. Sooty bark canker caused by *Encoelia pruinosa* is the most lethal canker of older mature aspen trees (Figure 21).

Abiotic Damage

Salt

De-icing salt use has contributed to increasing ponderosa pine mortality along state highways over the last decade, especially in central Arizona. The greatest tree decline and mortality occurs along Highway 260 near Forest Lakes; Highway 87 near Clint's Well; Interstate 40 from Flagstaff to Williams; and Highways 180 and 89A near Flagstaff. Deicing salt damage has also been observed along county and city roadways as municipalities increase their use of de-icing salts. Use of dust abatement salt is also associated with mortality of ponderosa pine along dirt roads in rural housing areas.

Drought

For the past few years, scattered mortality of small ephedra trees were observed on the northwest side of the Hualapai Mountains near Kingman, AZ. Most of the mortality has occurred at the lower elevations on the slopes of the mountain. Drought may be the principal stressor triggering the mortality but other causal agents have not been ruled out.

Other Forest Insects and Diseases

Other Insects

Goldspotted oak borer (GSOB)

(Agrilus auroguttatus)

No new GSOB caused tree mortality in evergreen oak woodlands was detected during aerial surveys in 2014. Field observations in the Santa Rita Mountains (Madera Canyon) estimated silver leaf oak mortality of mid-sized trees (4 to 8 inch DBH) at <1 tree per acre.

Aphids

A number of aphid species were observed on pinyon and ponderosa pines in Arizona, in the Payson and Prescott areas. Infested pines produce copious resin that often coats stems, twigs and foliage. Secondary discharge of excess fluids by the aphids, called honeydew, contributes to the unsightly appearance of affected trees. The resinous fluids often became a medium for the development of a black sooty-mold fungus, covering the needles and twigs with a black patina.

Figure 22. Feeding damage of Gambel oak leaves by the western tent caterpillar. Pupal cases are located on the underside of leaves.

Tent Caterpillars

In addition to the western tent caterpillar activity on aspen discussed earlier, tent caterpillars (Figure 22) were active in Arizona in and around the towns of Globe, Payson and Prescott. Host species included chokecherry, cottonwood and purple-leaf plums. Their tents were also noticeable on Emory and Arizona white oaks near Strawberry, and detected in the Catalina Mountains on aspen and willows in Summerhaven and Mt Lemmon Ski area.

Fall webworm

(Hyphantria cunea)

In Arizona, fall webworm populations were observed in late summer on a number of hosts. Feeding on Arizona walnut was noted along highway 87 south of the town of Pine and found on coyote willow and white poplar in Strawberry. Fall webworm was again found on Arizona alder in the community of Summerhaven in August, along with Arizona walnut near the Palisades visitor center. They were found for the third year in a row feeding on a blue elderberry west of the Blue Ridge area in Coconino County.

Oak Twig Pruner

In spring of 2014, larger dead Emory oak branches were noted on several trees in and around Prescott, Arizona. Branches up to an inch in diameter and over three feet long were found scattered on the ground near infested trees. Larvae of oak twig pruner beetles feed between the phloem and xylem, leaving only the bark intact. The internally girdled branches can break from the main stem. Efforts are underway to identify the species of branch pruner causing the damage.

Other Diseases

Elytroderma needle cast

An abundance of the characteristic elytroderma needle cast witches' brooms were observed in the lower half of the canopy of several ponderosa pine trees in Greer, Arizona, in late March. Dead (red) 1-year-old needles within the brooms are classic symptoms of disease. The trees are growing along the edge of a meadow bordered by a stream. Fungal spores initiate infection on new needles and the fungus then travels within infected needles to establish in the cambium of twigs, becoming perennial and causing annual needle infection. Elytroderma is an unusual needle cast fungus because it causes sprouting of adventitious buds of the host branch, resulting in the formation of witches' brooms.

Pinyon needle cast

This disease was noted mainly on the north side of Nutrioso near a reservoir in June. Banded and discolored 1-year needles were visible on infected pinyons (Figure 23), along with extensive needle loss on some trees. The presence of needle cast disease was barely noticeable in the summer following the flush of new needles. Infection of needle cast fungi typically takes place the prior year, with discoloration apparent the following spring.

Figure 23. Pinyon needle cast disease was observed on 1-year old needles in Nutrioso, AZ, in 2014.

Invasive Species

Invasive Species Threats in the Southwest

Invasive species are an all-too-common threat to forests and woodlands throughout Region 3. In FY14, approximately 15,000 acres infested by invasive plants were treated on the 11 national forests and 3 national grasslands in Region 3. Table 4 shows some of the major invasive species that pose the greatest threats to terrestrial and aquatic systems on National Forest System lands. Many other invasive species found in the Southwest—such as amphibian diseases, crustaceans, and introduced fish species—can also seriously impact native species.

Table 4. Major invasive species threatening National Forest System lands in Arizona and New Mexico.

Agent Type	Species
Terrestrial Plants	Buffelgrass (*Cenchrus ciliaris*) Musk thistle (*Carduus nutans*) Cheatgrass (*Bromus tectorum*)
Vertebrates	Feral hog (*Sus scrofa*)
Pathogens	White pine blister rust (*Cronartium ribicola*) Whirling disease (*Myxobolus cerebralis*)
Aquatic organisms	Quagga mussel (*Dreissena rostriformis bugensis*) Rock snot (*Didymosphenia geminata*)

Possibly the greatest threat to Region 3 by an invasive species is buffelgrass which was introduced as a forage grass from Africa into the southwestern U.S. The species has since spread into the Sonoran Desert where it presents a fire hazard for Saguaro cactus (*Carnegiea gigantea*), palo verde (*Parkinsonia microphylla*), and other native plants that are unadapted to fire (Figure 24). The Coronado NF and other agencies have had to use extensive management projects to control invasive buffelgrass on a landscape basis. Further information on invasive species associated with Region 3 may be found at http://www.fs.usda.gov/main/r3/forest-grasslandhealth/invasivespecies.

Forest Service Programs and Publications for Managing Invasive Species

In FY14, the Southwestern Region's FHP program provided a combined total of $126,000 to Arizona and New Mexico as assistance for detection, treatment, and monitoring of invasive plants on State and private lands. Funding for the invasive plant program is made through a consolidated grant to the State Forester's office which is responsible for administering the program. Announcement of available funding for invasive plant management under the program is made by a Request for Proposal (RFP) sent out by the State Forester. Applicants for treatment projects involving invasive plants generally are typically Cooperative Weed Management Areas (CWMAs) or Resource Conservation Districts (RCDs), but other organizations can qualify if they are able to treat invasive plants on a cooperative basis. Priority for funding is given to applicants with projects that propose to treat invasive plants (normally weed species on the State's noxious

weed list) that threaten forests and woodlands within the State. Funding through S&PF's grant program has been used to treat buffelgrass, starthistles, thistles, saltcedar, knapweeds, toadflaxes, and other noxious weeds within the two States. Applicants should contact John Richardson (602-771-1420) in Arizona or Shannon Atencio (505-425-7472) in New Mexico for further information.

Figure 24. Buffelgrass (light-colored vegetation) is an invasive species that is threatening native vegetation in the Sonoran desert.

Region 3 now has an expanded website (home page: http://www.fs.usda.gov/main/r3/forest-grasslandhealth/invasivespecies) for invasive species in the Southwest. In addition to invasive plants, the website provides information on invasive species topics such as aquatic invasive species, terrestrial invasive animals, invasive diseases affecting fish and wildlife, and invasive insects and diseases affecting forest health. The publication *Invasive Plants and Weeds of the National Forests and Grasslands in the Southwestern Region* is available on the website for identifying invasive weed species in the Southwest. A series of field guides for managing many invasive and common weed species according to integrated weed management (IWM) principles is also available. The field guides are intended to address management of weeds on public and private lands in the Southwestern Region and may be used by private landowners, government agencies, tribal nations, and organizations such as CWMAs.

A technical report entitled "Review and Assessment of Programs for Invasive Species Management in the Southwestern Region, 2012" discusses current conditions and challenges for invasive species programs across national forests and grasslands in Region 3 and includes recommendations for improving program operations. Information for the report was compiled from survey information submitted by Regional staff for invasive species and pesticide use. The report may be found at http://www.fs.usda.gov/main/r3/forest-grasslandhealth/invasivespecies and is also available from Allen White, Regional Coordinator for Invasive Species and Pesticide Use, at (505) 842-3280.

Biological Evaluations and Publications

Biological Evaluations and Technical Assistance

Arizona Zone

1. Evaluation of sanitation treatment, Big Lake Recreation Complex, Springerville RD. 5/6/2014.
2. Evaluation of bark beetle activity & impacts within the Wallow Fire, Apache-Sitgreaves NFs, 10/29/14.
3. Biological evaluations of a silvicultural certification demonstration stand, Safford RD, Coronado NF, 10/30/14.
4. 2014 update of Schultz Fire aspen regeneration monitoring, Flagstaff RD, 10/31/2014.
5. Site visit to proposed Forest Health Project areas, Black Mesa RD, 11/24/2014.
6. Site visit letter for Bear Canyon, Santa Catalina RD, Coronado NF, 12/03/14.
7. Post treatment site visit to Heber-Overgaard WUI Forest Health Improvement Project, 12/19/2014.
8. Post treatment evaluation of Cherry Creek Watershed Forest Health Improvement Project, 12/19/2014.

New Mexico Zone

1. Insect and Disease Management in Virgin Mesa WUI Projects, 3/19/2014.
2. Evaluation of Douglas-fir tussock moth activity in and around the Village of Cloudcroft, 4/3/2014.
3. Proposed FY15 Forest Health Suppression Project, Alamo Navajo, 9/30/2014.
4. Potential FY15 Forest Health Project, Sandia RD, 9/29/2014.
5. Proposed Forest Health Projects, Pueblo of Picuris and Pueblo of Tesuque, 9/26/2014.
6. Proposed Forest Health Project, Mescalero Apache Reservation, 9/22/2014.
7. Proposed FY15 Forest Health Suppression Project, San Felipe Pueblo, 10/03/2014.
8. Hazard trees and vegetation Management Planning for Canjilon Lakes Recreation Areas, Canjilon RD (Carson NF), 10/06/2014.

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Kane, J.M., T.E. Kolb, and J.D. McMillin. 2014. Stand-scale tree mortality factors differ by site and species following drought in southwestern mixed conifer forests. For Ecol and Manage 330: 171-182.

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Other Entomology and Pathology Activities in 2014

Activities

Tornado Damage

On Saturday, September 27th, 2014, a small tornado touched down twice near Prescott, AZ. Damage to Forest Service land, including tree blow-down and stem breakage (Figure 25), occurred approximately six miles southeast of Prescott near Groom Creek. Aerial surveys over the area in December confirmed the damage was confined to approximately 50 acres. Since some species of bark beetles are known to build up in storm-damaged and wind-thrown trees and then threaten adjacent live standing trees, we visited the site to assess the risk of future tree mortality from bark beetle attacks. There was no evidence of bark beetle activity in the damaged material (downed or standing) during this December site visit. In addition, some of the damage occurred on adjacent private land which was visited by Arizona State Lands, Forest Health personnel who also reported minimal bark beetle activity. The Prescott NF anticipates felling, bucking and burning the majority of the damaged material over the winter. If treatment of the downed material occurs as scheduled, bark beetle activity in the vicinity should not increase due to the tornado damage. FHP, Arizona Zone will continue to monitor the area.

Figure 25. A swath of crownless trees resulting from tornado damage located near Groom Creek on the Prescott NF.

For more information, contact Monica Gaylord.

Walnut Twig Beetle Flight Activity

The walnut twig beetle (WTB), *Pityophthorus juglandis* (Coleoptera: Scolytinae), is presumed to be native to the southwestern United States (Arizona and New Mexico), as well as Mexico, where it feeds on and breeds in the branches and main stem of Arizona walnut, *Juglans major*. In recent decades, the beetle has increased its range substantially, carrying with it a newly described fungus, *Geosmithia morbida*. The combined effect of the beetle and fungus has been named "thousand cankers disease" (TCD), because this complex has been found to be fatal to infected black walnut trees, *Juglans nigra,* in Western urban areas, where the host has been planted outside of its native range. From 2012 through 2014, Forest Health Protection in the Southwest Region has partnered with the University of California-Davis and the Pacific Southwest Research Station to better understand the flight periodicity of WTB in its native range across an elevational gradient and between two host species (*J. major* and *J. microcarpa*) in southeastern New Mexico. We conducted comparative studies of the biology of WTB in California and New Mexico, and we used aggregation pheromone-baited *J. hindsii* branches and flight traps to document WTB flight patterns and life history. An additional aspect of this project was to determine the host preference of WTB for five different hosts (*J. major*, *J. microcarpa*, *J. hindsii*, and *J. nigra*, native species of walnut in the USA, as well as *J. regia*, which is a Eurasian native that has been planted widely in California for nut production).

We were able to determine that in New Mexico, WTB has two major flight peaks during the year: a spring flight and a late summer/fall flight. In general, there was greater WTB flight activity at the higher elevation sites in the trapping transect, with the exception of the two highest elevation sites where walnut was intermixed with conifers. Greater flight activity was associated with sites with *J. major*; flight activity was largely absent at sites with *J. microcarpa*. In the host preference study for WTB in New Mexico, attack density was higher on *J. major* (local host) than it was for the WTB population in California. With the exception of the most recent study in New Mexico, the highest attack densities for WTB were recorded on *J. nigra* and J. *hindsii*. The goal of this project is to better understand the impacts of this insect and disease in their native range while gaining a better understanding of their potential impacts outside of their native range.

For more information, contact Andrew Graves.

Conservation of Southwestern White Pine Resistant to White Pine Blister Rust

We are partnering with New Mexico State University's (NMSU) John T. Harrington Forestry Research Center located in Mora, NM; the USDA Forest Service Dorena Genetic Resource Center (DGRC; Cottage Grove, OR); and researchers at Northern Arizona University (NAU) to conserve southwestern white pine (SWWP) found to be resistant to the non-native fungal pathogen *Cronartium ribicola*, the cause of white pine blister rust (WPBR). To that end, we are attempting to identify individual resistant trees within the native range of SWWP in the United States, as well as gain an understanding of the relative resistance present within the Region. Forest stands containing resistant trees can then be recommended as high-value priorities for treatments that decrease the risk of catastrophic wildfire. The process takes many years (7+) to progress from identification and seed collection, to testing at DGRC, and finally implementation of management activities within stands. We are working with NMSU to graft and conserve select individual trees as they are identified as resistant (Figure 26). Many resistant trees have already been identified on the Lincoln NF in New Mexico and they will be the initial trees grafted and planted at the NMSU facility in FY2015.

Figure 26. Following resistance testing, small branch tips from candidate trees are grafted to SWWP root stock at New Mexico State University's John T. Harrington Forestry Research Center.

We have also collaborated with NAU on southwestern white pine cone and seed collection for the past several years, for genetic conservation with the Agricultural Research Service and greenhouse and field-based studies related to adaptive traits. Collaboration was further enhanced with NAU and DGRC in FY2014, 154 half-sib seedling families (seed collected from a single parent tree) from throughout the Region were sown and will be inoculated with *C. ribicola* in FY2015. This is the single largest and most diverse collection of SWWP seedling families to be subjected to a resistance screening procedure to date. Monitoring of each seedling family will take place at DGRC for up to 7 years post-inoculation or until each seedling family has reached 100% mortality. Trees from this screening endeavor will be added to the grafted conservation orchard if they are identified as possessing desirable traits related to their reaction to WPBR.

For more information, contact James Jacobs.

Monitoring the Pandora Moth

Pandora moth (*Coloradia pandora)* as native to the western United States, and are currently in an outbreak cycle on the Kaibab Plateau. Pheromone lures have been synthesized to monitor Pandora moth populations in other areas and this study sought to refine a lure specific to the Southwestern Region by examining the population of adult Pandora moths that emerged in 2014 on the Kaibab Plateau. We monitored populations using "catch and release" traps with trial lure treatments in recently burned and unburned plots. The pheromone blend was optimized in a series of iterative trials, holding the ratio of two compounds constant while varying the proportion of the third compound. Our results demonstrate that pheromone-baited traps are a simple and effective method for monitoring this important defoliator.

For more information, contact Amanda Grady

Training

Insect and Disease Workshops

At least once a year the Southwestern Region's Forest Health staff offers training sessions on forest insects and diseases in the Southwest. The workshop generally occurs over 2 ½ days and covers the biology, ecology, effects, and management of major insects and diseases affecting southwestern forest ecosystems. Emphasis is placed on the roles of these organisms as disturbance agents and their relationship to forest health. The workshop is open to Forest Service personnel, as well as other Federal, State, and Tribal resource management agencies. In 2014 this workshop was conducted in Springerville, Arizona with twenty-four participants. Participants came from four National Forests (Apache-Sitgreaves, Tonto, Kaibab, and Lincoln), San Carlos Tribal Forestry, the Bureau of Indian Affairs Fort Apache Agency, and the Arizona State Forestry Division. Field trips to examine insects and disease were conducted in mixed conifer, ponderosa, and pinyon-juniper sites. Highlights of the field trips included observations of white pine blister rust and a visit to a high use recreation area with an ongoing bark beetle suppression project.

For more information, contact the Arizona or New Mexico Zone Leader

Hazard Tree Workshop

We conduct a workshop titled Hazard Tree Detection, Evaluation, and Management in Recreation Areas, to assist district personnel with responsibilities to reduce hazard trees in developed sites and along forest roads (Figure 27). At least one training/workshop is offered annually. It alternates between New Mexico and Arizona to provide the opportunity for local staff to attend, without regard for training or travel costs. We discuss the Forest Service Manual direction on hazard tree identification and removal in developed sites, and an attorney with the Office of General Council provides an understanding of the agency's legal responsibilities and actions that decrease liability. In 2014, the workshop was held on the Safford RD, Coronado NF.

Figure 27. Wood structure is compromised on a southwestern white pine that was severely burned during the Schultz fire, Coconino NF.

For more information, contact the AZ or NM Zone Leader

Forest Health Staff

Arizona Zone

John Anhold (928) 556-2073

John is the supervisory entomologist/Arizona Zone leader. Duties include: supervisory and managerial duties for Arizona Zone staff, oversight of Arizona Cooperative Forest Health program of the State Forester's office, Region 3 representative for the National Forest Health Monitoring program. He has interest in western bark beetle technology development and transfer. John's previous work experience is in Region 4, working with bark beetles and coordinator for the Utah gypsy moth eradication project, and in the Northeast Area, working with state cooperators regarding defoliator issues.

Mary Lou Fairweather (928) 556-2075

Mary Lou became a plant pathologist with the Arizona Zone in 1989, providing technical assistance on forest diseases to land managers. Her current focus is on distribution and impacts of white pine blister rust; aspen regeneration ecology and browse impacts; root disease species distribution and impacts; dwarf mistletoe ecology and management; and hazard tree identification and mitigation training.

Amanda Grady (928) 556-2072

Amanda became a forest entomologist with the Arizona Zone in October 2011 from Forest Health Protection, Pacific Southwest Region. Primary responsibilities are providing technical assistance on forest defoliators to land managers across all land ownerships, providing entomological technical assistance on all non NFS lands, conducting insect and disease aerial detection surveys and monitoring native and exotic insects in the state. Technology transfer interests include bark beetle and defoliator semiochemical work, fire and forest insect interactions and climate change effects on forest insects and restoration efforts.

Monica Gaylord (928)556-2074

Monica Gaylord became a forest entomologist with the Arizona Zone in July 2014. Her primary responsibility is providing technical assistance on bark beetle management to land managers. Previously she was assistant research professor at Northern Arizona University. Forest Health interests include how drought and restoration treatments impact tree susceptibility to southwestern pine bark beetles, fire-bark beetle interactions, and single tree protection against bark beetle attacks.

Biological Technician (928) 556-2071

Position was vacant in 2014.

New Mexico Zone

Debra Allen-Reid (505) 842-3286

Deb was a supervisory entomologist/New Mexico Zone leader since 1996, and retired at the end of 2014. Aside from zone staff supervision and unit management, duties included administrative oversight for the State of New Mexico Cooperative Forest Health program, and Region 3 point-of-contact for the FHP International Activities program. Previous work experience is in defoliator aerial suppression, NEPA compliance, southern pine beetle management, and silviculture. Debra worked in short-term assignments in Mexico and a long-term assignment with USAID in Haiti.

Andrew Graves (505) 842-3287

Andrew has been a forest entomologist, New Mexico Zone since October 2010. Primary responsibility is providing technical assistance on forest insects to federal land managers throughout the state. Interests include bark beetle/fungal interactions, the response of insects to drought stressed hosts, pheromones, and DNA analysis of bark beetle species.

Daniel Ryerson (505) 842-3285

Dan has been a forest health and GIS specialist, New Mexico Zone since 2003. Responsibilities include GIS program for New Mexico, aerial detection surveys, data analysis, technical support, and field assistance. Dan is involved with the national insect and disease risk map project modeling future risk of forest mortality from insect and disease activity.

Crystal Tischler (505) 842-3284

Crystal has been the Forest Health Coordinator, New Mexico Zone, and Forest Health unit aviation officer. She arrived in the Region in September 2008. Responsibilities include aerial detection surveys, aviation safety and training coordination, and field assistance to staff. She is involved with educational outreach and implementation. Crystal is ICS-qualified as a Wildfire Incident GIS Specialist. Her previous work experience is in forest management, fuels reduction, timber sale administration and community wildfire protection planning.

James Jacobs (505) 842-3288

James has been a plant pathologist with the New Mexico Zone since February 2013. Primary responsibility is providing forest disease technical assistance to federal land managers. Current focus: white pine blister rust resistance in southwestern white pine; hazard tree mitigation; root rot distribution and fungal genetic diversity.

Regional Staff

Allen White (505) 842-3280

Allen has been the Regional coordinator for invasive species and pesticide-use since 2006. Duties include coordination and management of Region 3 programs: (1) National Forest System Invasive Species, (2) State & Private Pesticide-Use, and (3) State & Private Invasive Plant Grants. Also serve as Region 3 representative for the Biological Control of Invasive Plants (BCIP) grant program managed by the Forest Health Technology Enterprise Team (FHTET). Current work in Region 3 includes production of field guides for managing invasive plants and development of methodology to control invasive buffelgrass in southern Arizona.

Visit Us Online

In an effort to better serve the Internet user, we continue to expand our online information base. The Forest Service Southwestern Region hosts a Forest Health web site at http://www.fs.usda.gov/goto/r3/foresthealth. Technical information posted on this site includes annual forest insect and disease conditions reports, literature on pest biology and management, and general information on forest health in the Southwest. Additionally, our Forest Health Protection national office maintains a web site at http://www.fs.fed.us/foresthealth/ that includes program overviews and publications links.

New forest health information web portal

http://foresthealth.fs.usda.gov/portal

The following information was copied from the Southern Region's website. "A new website is now available making insect and disease information more accessible and timely. This website brings together a wide range of complex tabular and spatial databases via 5 interfaces. The first 3 are accessible by anyone and provide access to insect and disease occurrence data in a consistent fashion with relative ease. The latter two are accessible only by forest health professionals for reporting and using data to enhance their work.

1. The **Forest Pest Conditions** page is built on the latest flex and ArcGIS 10 technology and is designed to be a companion to the annual Major Forest Insect and Disease Conditions reports. It provides:
    - A simple mapping interface through which the distribution of damaging forest insect and disease populations and their biological range can be viewed for the last five years.
    - An overview of biology, current conditions, trends, and survey methods, along with photos and web links for each forest insect and disease.
    - The ability to generate reports, maps, and download tabular information.
2. The **Data Summaries** interface provides the ability to review, query, and download tabular data for all forest insects and diseases recorded across the United States since 1997.
3. The **Insect and Disease Explorer** provides for download of a wide array of forest Insect and Disease Survey (IDS) maps depicting past, present, and potential future activity across the United States through the Insect and Disease Explorer. Other functionality includes:
    - Download IDS data in ArcGIS 9.2, 9.3, and 10 file geodatabase formats.
    - Create large format PDF maps with the quad map tool that can be printed on a plotter.
    - Query, navigate, and learn about local level forest pest activity.
4. Annual insect and disease detection and damage reports are entered in the **Pest Event Reporter** and made accessible via the Forest Pest Conditions interface.

5. The Forest Disturbance Mapper (FDM) is designed specifically for the FHP survey community to enhance their evaluation of potential forest disturbance in near real-time (16 day composites updated every 8 days) over large areas and provide critical information for survey resource allocation. The FDM web application allows the user to quickly explore and evaluate forest disturbance data and download areas for use in aerial or ground survey. Some of the main elements of the FDM are:

    - Simple interface with powerful spatial functions.
    - Download of data that can be uploaded into a digital aerial sketch mapping system.
    - Ability to upload survey data.

Appendix

Instructions for Submitting Insect and Disease Specimens for Identification

Both zone offices are equipped to receive forest insect or disease specimens submitted from the field for identification. Specimens may be shipped to the appropriate zone office as listed on the title page of this report. The following procedures for collecting and shipping specimens should be used.

Collecting

1. Adequate material should be collected

2. Adequate information should be recorded, including:
   a. location of collection
   b. when collected
   c. who collected the specimen
   d. host description (species, age, condition, etc.)
   e. area description (forest type, site conditions, etc.)
   f. unusual conditions (frost, poor drainage, etc.)

3. Personal opinion of the cause of the problem may be helpful.

Packing

1. **Larvae and other soft-bodied insects** should be shipped in small screw-top vials or bottles containing at least 70 percent isopropyl (rubbing) alcohol. Use only enough alcohol to fully immerse the specimens; shipping regulations limit the amount to 30 ml (2 tablespoons or about 1 ounce) per vial. Make sure lids are well sealed. Place all vials in a sealed plastic bag, using packing materials between vials to minimize movement. Ship in a sturdy box.

2. **Pupae and hard-bodied insects** may be shipped either in alcohol or in small boxes. Specimens should be placed between layers of tissue paper in the boxes. Pack carefully and make sure there is little movement of material within the box. Do not pack insects in cotton.

3. **Needle or foliage diseases**: Do not ship in plastic bags as condensation can become a problem. Use a paper bag or wrap in newspaper. Pack carefully and make sure there is little movement within the box.

4. **Mushrooms and conks**: Do not ship in plastic bags. Either pack and ship immediately or air-dry and pack. To pack, wrap specimens in newspaper and pack into a shipping box with more newspaper. If on wood, include some of the decayed wood.

A fillable pdf specimen label is available on our website that can be used to submit with samples for identification. (http://www.fs.usda.gov/Internet/FSE_DOCUMENTS/stelprdb5207859.pdf). A screen shot of the label is shown on the next page.

R3-FS-3400-1 (2/2010)
For Federal Use Only

USDA - Forest Service

Forest Health Protection
Submission Label for Specimen Identification

Check Enclosures:
- ☐ Appropriate Maps
- ☐ Damage Samples
- ☐ Insect Specimens

Action Requested:
- ☐ Information Only
- ☐ Identification
- ☐ Field Examination

Instructions: Fill out and send copy of worksheet, along with any maps, samples or specimens to the USDA Forest Service,

Forest Health Rm 228,
333 Broadway Blvd SE
Albuquerque, NM 87102
(If in New Mexico)

or

Forest Health - AZ Zone
2500 S. Pine Knoll Drive
Flagstaff, AZ 86001
(If in Arizona)

Administrative Unit

Sub-Unit

Date of Observation

Observed by

Location of Damage (attach map)

GENERAL INFORMATION

Host

Average DBH

Size class affected:
- ☐ Poles
- ☐ Seedlings
- ☐ Sawtimber
- ☐ Saplings
- ☐ Overmature timber

Damaged standing stems/acre

Down stems/acre

Acres affected

GPS Coordinates:
Lat
Long

Damage to:
- ☐ Single trees
- ☐ Groups (# of) (# per)

TREE DAMAGE SYMPTOMS (Check all that apply)

Crown:	Damage to:	Tree Foliage:	Needles or leaves:	Tree Bole:	Branches:
☐ Top	☐ New Foliage	☐ Green	☐ Chewed	☐ Cracked	☐ Broken
☐ Middle	☐ Old Foliage	☐ Fading	☐ Mined	☐ Stuffed bark	☐ Swollen
☐ Lower	☐ Both	☐ Sorrel	☐ Webbed	☐ Boring dust	☐ Discolored
☐ Entire	☐ Cone or seed	☐ Red	☐ Spotted	☐ Pitch tubes	☐ Cankers
☐ Single branch or branch tips		☐ Brown	☐ Discolored	☐ Canker	☐ Mistletoe
		☐ Black	☐ Missing	☐ Conks	☐ Girdled
				☐ Woodpecker feeding	

Unusual Weather Conditions:	Associated Disturbances:
☐ Wind	☐ Fire
☐ Rain	☐ Logging
☐ Hail	☐ Thinning
☐ Sleet	☐ Blowdown
☐ Snow	☐ Insects
☐ Flood	☐ Disease
☐ Drought	☐ Road construction

Remarks:

Forest Health Comments:

Received by

Date

Submit by Email | Print Form | Reset Form