United States Department of Agriculture

Forest Insect and Disease Conditions in the Southwestern Region, 2013

Forest Service | Southwestern Region | Forest Health PR-R3-16-12 | January 2015

Cover photo: Clockwise from upper left – Damage from excessive deicing salt application; "jackstrawing" aspen to protect suckers from elk browse; Douglas-fir tussock moth egg mass and pupal cases on underside of spruce branch; juniper killed by ongoing drought conditions; walnut witches broom on Arizona walnut.

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Forest Insect and Disease Conditions in the Southwestern Region, 2013

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Weather Summary

Total precipitation in 2013 was near normal (Figure 1), but not nearly adequate to make up for previous below average years (Figure 2). Although precipitation was measured as near normal or slightly above normal for the 12-month period, the majority of this precipitation fell as heavy rains in a short period in the autumn, not as winter snowpack and summer monsoon rains; thus it was not available when growing season moisture demands of the forest are greatest. The ongoing drought in the Southwest is beginning to cause damage to many trees species traditionally tolerant of low moisture such as juniper and pinyon.

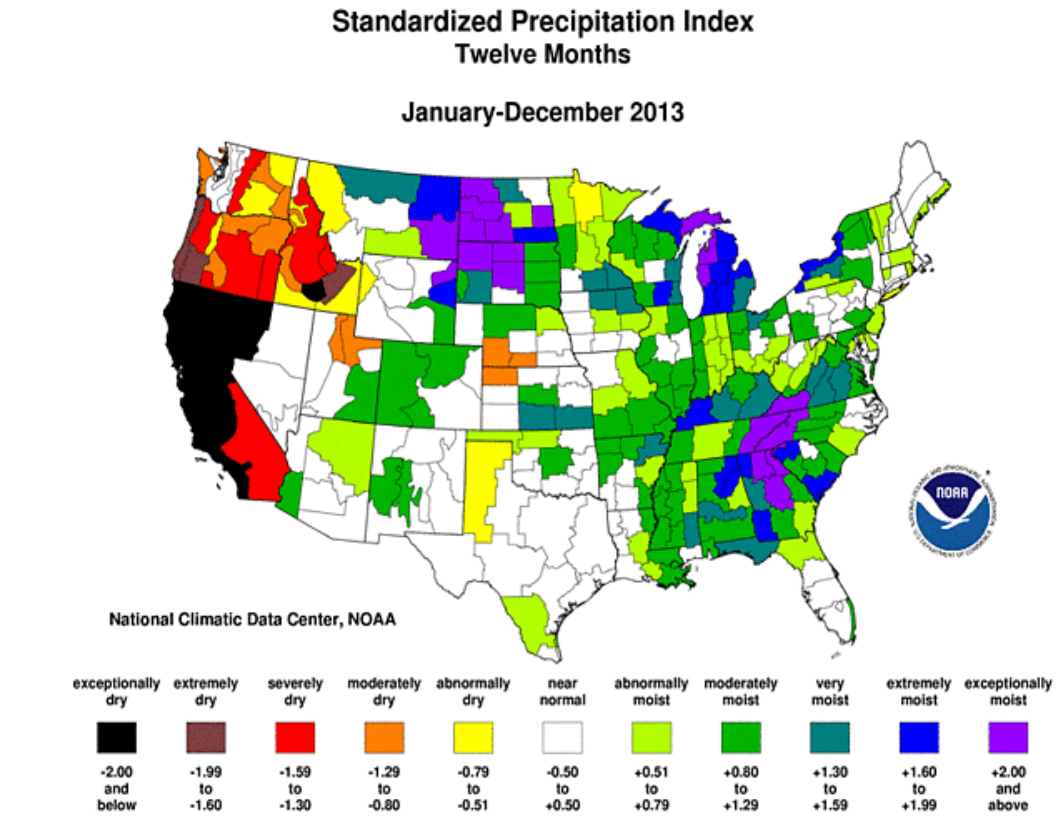

Figure 1. Standardized precipitation index for January through December 2013 (NOAA, National Climatic Data Center, http://www.ncdc.noaa.gov/).

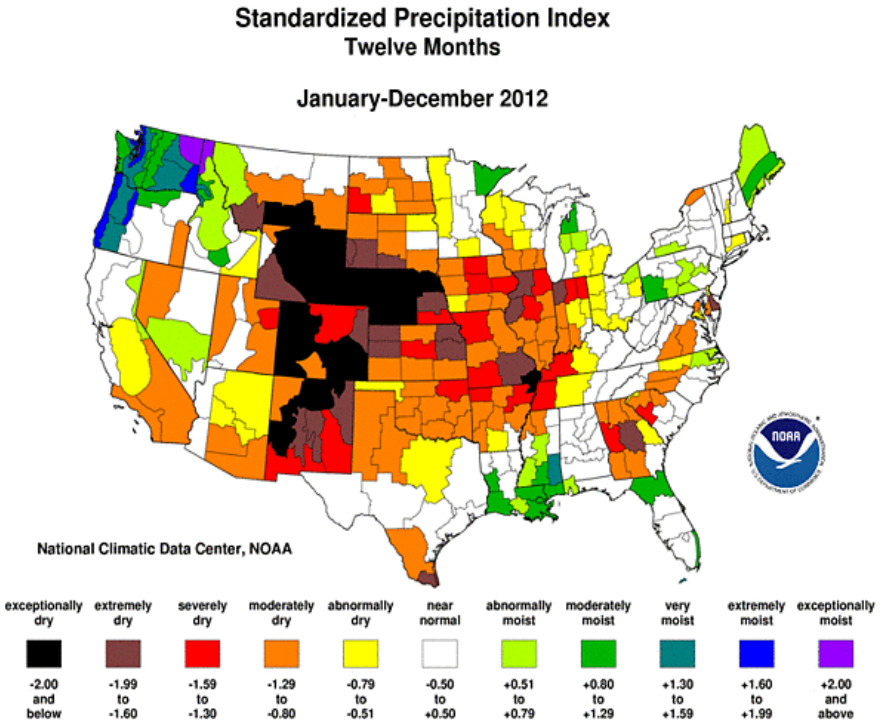

Figure 2. Standardized precipitation index for January through December 2012 (NOAA, National Climatic Data Center, http://www.ncdc.noaa.gov/).

In addition, like 2012, above normal temperatures were recorded across the Southwestern Region for 2013. This exacerbated the effects of ongoing drought, in particular for New Mexico.

Forest Insect and Disease Summary

The area covered by the annual forest health aerial detection surveys stayed nearly constant from 2012 to 2013 (Figure 3). Overall insect activity increased from the levels observed in 2012, likely as a result of continued drought in the Southwest and outbreaks associated with previous fire activity.

Mortality was primarily confined to the ponderosa pine forests of the Southwest. Ponderosa pine mortality caused by bark beetles was most abundant on the Apache-Sitgreaves and Coconino National Forests in Arizona, and in the southern half of New Mexico on the Gila and Lincoln National Forests. Mixed conifer mortality in Arizona was primarily on the Apache-Sitgreaves National Forests and in New Mexico was found in all parts of the state, but especially on the Carson, Santa Fe, and Lincoln National Forests. Pinyon-juniper forests throughout the Southwest continued to incur increased mortality as a result of drought and pinyon ips activity, with nearly 70,000 acres affected in New Mexico.

Bark beetle-caused tree mortality increased from the levels observed in 2012 across most forest types in the Southwest. This was likely exacerbated by sustained drought region-wide. In ponderosa pine, bark beetle mortality increased markedly in 2013, doubling in total acreage in New Mexico and increasing by nearly 270% from 2012 in Arizona. The increase in bark beetle

mortality in Douglas-fir and white fir was the most striking with nearly 90,000 acres observed in Arizona (primarily on the Apache-Sitgreaves National Forests). Mountain pine beetle activity was observed unusually far south in Arizona on the Apache-Sitgreaves National Forests during the 2013 aerial survey, causing damage on nearly 10,000 acres. Historically this insect has been observed in Arizona only north of the Grand Canyon.

Defoliation as a result of insect feeding was extensive throughout the Southwestern Region in 2013. The spruce budworm outbreak in northern New Mexico tapered off slightly from the nearly 500,000 acres recorded in 2012, down to roughly 300,000 acres (the same general pattern was observed from 2011 to 2012). Pine sawfly defoliation on ponderosa pine was present in both states on nearly 4,500 acres across all ownerships. Pinyon needle scale was also a defoliator of note in 2013, defoliating nearly 8,000 acres of this already environmentally stressed species. Aspen defoliation was recorded on over 130,000 acres and remains a concern when combined with damage to aspen from other biotic and abiotic factors. While aspen defoliation is present annually on many acres in the Southwest, some defoliators have periodic outbreaks. Pandora moth is one of these periodic outbreak species and was observed in 2013 defoliating 2,000 acres of ponderosa pine on the Kaibab Plateau in northern Arizona. This relatively small outbreak is significant because 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. White pine blister rust continues to cause severe damage to southwestern white pine in the Sacramento Mountains of southern New Mexico. Forest health staff in both Arizona and New Mexico continue to find new areas affected by this invasive disease, primarily on higher elevation sites. The disease has now been documented in parts of every national forest in New Mexico with the exception of the Carson NF. In Arizona, it is still apparently confined to the White Mountains on the eastern portion of the State.

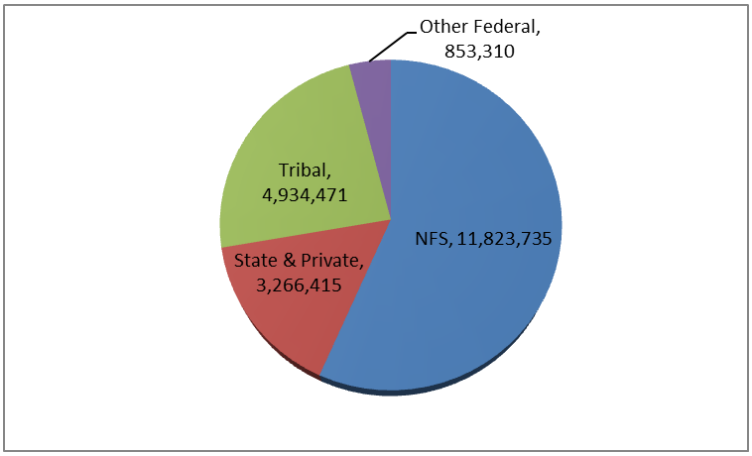

Figure 3. 2013 Aerial detection survey acres flown by land ownership (20,877,931 total acres flown).

Table 1. Prominent 2013 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
Bark beetles in ponderosa pine	AZ	107,850	12,470	1,670	2,690	126,490
	NM	126,910	40,800	1,120	48,960	217,800
Douglas-fir & white fir beetles	AZ	50,160	1,440	100	240	51,930
	NM	36,100	13,890	10	8,390	58,400
Western spruce budworm	AZ	360	710	--	30	1,100
	NM	178,260	11,290	20	108,280	297,850
Aspen damage***	AZ	6,550	3,440	50	50	10,090
	NM	81,150	6,000	150	41,850	129,150
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.

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

*** 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.

-- No acreage detected.

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

Owner[2]	Western pine beetle	Round-headed pine beetle	Ips engraver	Mountain pine beetle	Pinyon ips	Douglas-fir beetle	Spruce beetle	Western balsam bark beetle	Fir engraver
Apache-Sitgreaves NFs	810		68,800	9,700	1,160	38,740	420		42,940
Coconino NF	15,960		3,000	510		2,350	60	780	< 5
Coronado NF	90	7,770				930		170	
Kaibab NF	2,870		2,270		< 5	370	< 5	130	
Prescott NF	2,280		140		< 5	60			
Tonto NF	3,960		280		20	190			
BLM	10		< 5		< 5				
DOD	430		10						
NPS	60	1,140	20		< 5	< 5	< 5		100
White Mountain Fort Apache Tribal	390		500	30	20	140	400	< 5	970
Hopi Tribal					< 5				
Hualapai Tribal	10		< 5		< 5				
Navajo Tribal	590		3,030		1,890	130	90	50	240
Navajo-Hopi JUA					< 5				
San Carlos Apache Tribal	5,700		2,300		740				60
State & Private	850	130	1,710		130	230	< 5		210
Arizona Total	**34,020**	**9,040**	**82,070**	**10,240**	**3,970**	**43,140**	**960**	**1,130**	**44,520**
Carson National Forest	330		< 5		< 5	8,280	2,020	6,490	1,580
Cibola National Forest	8,690		3,400		12,280	2,250	< 5	200	1,700
Gila National Forest	11,730		37,440		7,720	1,250			750
Lincoln National Forest	1,760		50,070		6,830	11,240		50	800
Santa Fe National Forest	5,250		7,490		40	6,560	7,700	1,380	2,680
Valles Caldera NP	< 5		750			210			
BLM	280		500		1,890	10	< 5		< 5
NPS	170		170		270				
Acoma Pueblo	1,040		< 5		70				
Isleta Pueblo	10		20		1,820	40			
Jemez Pueblo	580		3,630			< 5			
Jicarilla Apache Tribal	50		< 5		< 5	190	170		
Laguna Pueblo	30		< 5						
Mescalero Apache Tribal	120		34,290		1,890	9,420		160	2,200
Nambe						< 5			
Navajo (NM side only)[3]	690		160		< 5	80	30	80	220
Other Tribal	70		< 5						
Picuris Pueblo	< 5					240			60
Santa Clara Tribal	110								50
Taos Pueblo	< 5					2,140	160	< 5	90
Zia Pueblo	< 5								
Zuni Pueblo	< 5				< 5	< 5			
State & Private	13,270		35,660		36,480	3,650	30	2,040	4,920
New Mexico Total	**44,170**	**0**	**173,580**	**0**	**69,300**	**45,540**	**10,100**	**10,400**	**15,060**
SW Region Total	**78,190**	**9,040**	**255,650**	**10,240**	**73,270**	**88,680**	**11,060**	**11,540**	**59,580**

[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] Activity on Navajo tribal lands in New Mexico summarized from Arizona surveys.

Table 3. Defoliation incidence by site (acres) from aerial detection surveys 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	360	4,080			300
Coconino NF		1,410	180	180	
Coronado NF		800		120	
Kaibab NF		250		1,880	
Prescott NF					
Tonto NF		10	30		
BLM					
DOD					
NPS		50			
White Mountain Fort Apache Tribal	380	430			2,370
Hopi Tribal					260
Hualapai Tribal					
Navajo Tribal	330	3,010			320
Navajo-Hopi JUA					250
San Carlos Apache Tribal					940
State & Private	30	50	30	210	20
Arizona Total	**1,100**	**10,090**	**240**	**2,400**	**4,460**
Carson National Forest	96,810	68,140			
Cibola National Forest	3,190	1,570		1,980	1,710
Gila National Forest		170			
Lincoln National Forest		1,230	250		500
Santa Fe National Forest	75,750	10,000			
Valles Caldera NP	2,500	30			
BLM	20	150			640
NPS					
Acoma Pueblo					
Isleta Pueblo					
Jemez Pueblo					
Jicarilla Apache Tribal	2,290	3,020			
Laguna Pueblo					
Mescalero Apache Tribal		560			
Nambe Pueblo					
Navajo (NM side only)[5]	200	2,050			
Other Tribal					
Picuris Pueblo	50				
Santa Clara Pueblo	200	20			
Taos Pueblo	8,560	350			
Zia Pueblo					
Zuni Pueblo					
State & Private	108,280	41,850	120	80	720
New Mexico Total	**297,850**	**129,150**	**370**	**2,070**	**3,570**
SW Region Total	**298,950**	**139,240**	**610**	**4,460**	**8,030**

[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.

[5] Activity on Navajo tribal lands in New Mexico summarized from Arizona surveys.

Status of Major Insects

Bark Beetles

Aerial detection surveyors mapped slightly over 500,000 acres of bark beetle activity across the Southwestern Region in 2013. In New Mexico, bark beetle activity increased to more than 350,000 acres in 2013 from the previous level observed in 2012 of over 172,000 acres. This increase in total acres affected can be attributed to a substantial increase in the observed acres of pinyon ips and ips engraver beetle activity. From 2012 to 2013 population increases were observed for most species of bark beetles, but ips engraver activity was markedly higher on the Apache-Sitgreaves, Gila, and Lincoln National Forests. The area affected by pinyon ips increased substantially on state & private lands compared to 2012. Furthermore, significant increases in bark beetle caused tree mortality were recorded during aerial detection surveys in 2013 in mixed-conifer, particularly in Arizona. However, the area affected by western balsam bark beetle remained relatively static. Spruce mortality caused by bark beetles increased in New Mexico on the Santa Fe and Carson National Forests.

Several species of bark beetles have continued to impact many forest types throughout southern New Mexico and the Apache-Sitgreaves National Forests in Arizona. Drought has continued to affect overly dense forests and beetles have responded to this condition. This was observed throughout all age classes particularly on south- and west-facing drier slopes. In some cases, mortality can be attributed directly to drought and wood borers, even though bark beetles may be present in the area. Descriptions of conditions for individual bark beetle species are grouped below by forest type.

Pinyon-Juniper Forest Type

Pinyon-juniper woodlands can exist as high as 7,000 ft and tree densities can vary widely depending on individual sites. The pinyon-juniper forest type experienced an increase in pinyon ips activity from 2012 to 2013. As in most recent years, pinyon ips activity was almost exclusively recorded in New Mexico, though a notable increase in acreage affected was recorded on the Apache-Sitgreaves National Forests and Navajo Tribal lands in Arizona.

Pinyon Ips

Ips confusus
Host: Pinyon pine

Pinyon ips activity increased throughout the Southwestern Region. On state and private land in New Mexico, a tenfold increase in area affected by pinyon ips was observed during the 2013 aerial detection survey. Most of the affected area was in the southern and central regions of the state, which have been experiencing continued severe drought (Figure 4). In Arizona, pinyon mortality caused by *Ips confusus* remained low.

Figure 4. Pinyon mortality in southern New Mexico.

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. Ponderosa pine mortality significantly increased across the region as a whole with more than 343,000 acres mapped in 2013, up from nearly 157,000 acres in 2012. The number of acres affected by bark beetle activity in ponderosa pine was the highest recorded since the peak in activity (763,000 acres) in 2003 which was also associated with an extended drought. This increase was mainly centered in the forested areas of southern New Mexico. However, a substantial increase in *Ips* activity occurred on the Apache-Sitgreaves National Forests in Arizona.

Western Pine Beetle

Dendroctonus brevicomis
Host: Ponderosa pine and southwestern white pine

Aerial detection surveys in Arizona recorded a large increase in area affected by western pine beetle during 2013 (34,020 acres) compared to 2012 (10,620) and has grown dramatically from a low year in 2011 of just under 300 acres. The overall size of mortality pockets rose again from 2012 to 2013. More than 90 percent of the activity occurred on the Coconino National Forest and on San Carlos Apache tribal lands (Figure 5).

In New Mexico, acres of mortality attributable to western pine beetle fell from 2012 (50,030 acres) to 2013 (44,170 acres). State and private land holdings, the Gila National Forest and the Cibola National Forest were the most heavily affected. The extensive ponderosa pine mortality that occurred in the Sacramento Mountains has been attributed primarily to *Ips* spp. However, western pine beetles likely contributed to the overall extent. The ponderosa pine mortality occurring in southern New Mexico (Gila National Forest, Sacramento Mountains) was primarily the result of dry conditions and subsequent insect activity.

Figure 5. Bark beetle-caused ponderosa pine mortality, Brushy Mountains, Gila National Forest

Ips Engraver Beetles

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

Ips activity in the region increased dramatically from 2012 (96,780 acres) to 2013 (255,650 acres). Although the majority of activity (173,580 acres) was recorded in New Mexico, Arizona also saw a large increase from just over 20,000 acres in 2012 to 82,000 acres in 2013, mostly confined to areas affected by the Wallow Fire in the White Mountains which occurred in 2011.

Figure 6. Bark beetle activity in drought-stressed ponderosa pine on the Lincoln National Forest.

Elevated mortality was typically associated with large-scale disturbances such as recent fires, where damaged and downed material created a source for brood production. The continued drought conditions in the Southwest are also contributing to the population increases in the various species of *Ips* engraver beetles (Figure 6).

Ponderosa pine mortality in the Southwestern Region is often caused by a combination of *Ips* spp. and western pine beetles, either in different trees within a stand or co-occurring within the same tree.

Mountain Pine Beetle

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

In contrast to Colorado and other Rocky Mountain states, the Southwest has typically experienced only minor mountain pine beetle-caused tree mortality. Occasionally, individual white and ponderosa pines have been observed with mountain pine beetle attacks in prior years (Figure 7), but no major outbreaks have occurred recently.

Figure 7. Mortality of southwestern white pine caused by mountain pine beetle in the Pinaleño Mountains of Arizona.

The 2013 aerial survey in Arizona, however, found just over 10,200 acres affected by mountain pine beetle compared to nearly zero acres affected in 2012. The beetle was found attacking southwestern white pine scattered throughout the 2011 Wallow Fire on the Apache-Sitgreaves National Forests in eastern Arizona,

most notably on the Springerville Ranger District. In an attempt to limit this notable expansion of mortality, a large scale suppression project utilizing the antiaggregation pheromone verbenone was implemented in the Big Lake Recreation Area and numerous Mexican Spotted Owl Protected Activity Centers on both the Springerville and Alpine Ranger Districts. A limited number of large diameter limber pines near the base of the San Francisco Peaks outside of Flagstaff also were observed to be infested with mountain pine beetle.

Roundheaded Pine Beetle

Dendroctonus adjunctus
Host: Ponderosa pine

In 2013, as in other years, ponderosa pine mortality from the roundheaded pine beetle was primarily limited to the sky islands in southeastern Arizona on the Coronado National Forest, with just over 9,000 acres affected. Most damage occurred in the Pinaleño, Santa Teresa, Santa Catalina, and Santa Rita mountains.

No ponderosa pine mortality was attributed to roundheaded pine beetle in New Mexico. It is not clear to what degree these beetles have influenced the overall mortality in the Sacramento Mountains of New Mexico, but they are part of the bark beetle community in this area and are likely contributing to elevated levels of mortality. Roundheaded pine beetle has also been identified on the Jemez and Pecos/Las Vegas Ranger Districts of the Santa Fe National Forest in recent years.

Mixed Conifer Forest Type

Mixed conifer forests in the Southwestern Region are generally found from 8,000 to 10,000 ft. They are primarily composed of Douglas-fir, white fir, and southwestern white pine along with pockets of aspen, and at lower elevations include a ponderosa pine component. Overall, bark beetle (fir engraver and Douglas-fir beetle) activity in the mixed conifer forests of the Southwest increased dramatically from 38,030 acres in 2012 to over 111,000 acres in 2013. Both states saw increased acreage affected in this forest type.

Douglas-fir Beetle

Dendroctonus pseudotsugae
Host: Douglas-fir

Douglas-fir mortality caused by the Douglas-fir beetle was observed throughout New Mexico and in parts of Arizona during the 2013 aerial detection surveys (Figure 8). The affected area mapped in 2013 (88,680 acres) was dramatically higher than the acreage mapped in 2012 (21,860 acres). Activity was observed on the Carson National Forest in northern New Mexico, but also on the Lincoln National Forest and Mescalero Apache tribal lands in the southern part of the state. In Arizona the

Figure 8. Douglas-fir mortality caused by Douglas-fir beetle Coconino National Forest.

majority of the acreage identified was located on the Apache-Sitgreaves National Forests. Contributing to the increase in recorded Douglas-fir mortality were increased flatheaded fir borer and Douglas-fir beetle activity in trees injured in the Wallow Fire, as well as improvement in aerial observer skill in discerning Douglas-fir among the mixed conifer species. In New Mexico, many severely drought-stressed Douglas-fir trees in the Sacramento Mountains were heavily infested with flatheaded fir borers that likely caused or contributed to some of the tree mortality. Since 2012, the Apache-Sitgreaves National Forests have treated portions of high-value recreation sites in the Big Lake Recreation Area and within Mexican Spotted Owl Protected Activity Centers with the volatile antiaggregation chemical MCH (3-methylcyclochex-2-en1-one) in an effort to repel Douglas-fir beetles from trees weakened by the Wallow fire. Following the application of MCH in 2013, several hundred infested trees were removed from the Big Lake Recreation Area and plans were developed to continue suppression treatments in 2014.

Fir Engraver

Scolytus ventralis
Host: White fir

Fir mortality from fir engraver beetle activity in the Southwest is often driven by the tree-weakening effects of drought. The amount of tree mortality caused by fir engraver observed during aerial detection surveys continued its upwardly trend which began during the most recent drought. In 2013, approximately 59,600 acres were observed compared to the 2012 survey where less than 20,000 acres were mapped. White fir mortality was observed on all of the National Forests in New Mexico, but was greatest on the Lincoln National Forest. In southern New Mexico, drought and excessive forest densities have created conditions that favor fir beetle reproductive success. The resulting mortality was seen throughout all age classes, particularly on drier south- and west-facing slopes. In some cases, mortality can be attributed directly to drought, mainly in the smaller trees.

In Arizona, the area mapped with fir engraver activity increased dramatically from only 80 acres in 2012 to over 44,000 acres in 2013, mostly on the Apache-Sitgreaves National Forests. Ground observations determined many fire-injured white firs were infested with fir engraver beetles which in previous years were not mapped since our surveyors attempt to avoid mapping mortality caused directly by fire. Discerning fire-caused tree mortality from beetle-caused tree mortality within and adjacent to burned areas is challenging due to the similarity of crown color progression.

Spruce-Fir Forest Type

At about 9,000 ft. elevation, mixed conifer forests 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, western balsam bark beetle activity in corkbark fir was mapped on more than 11,500 acres during 2013. Spruce beetle was mapped affecting approximately 11,000 acres in 2013, an increase from 2,320 acres in 2012.

Spruce Beetle

Dendroctonus rufipennis
Host: Spruce

Spruce beetle activity remains a concern, especially with the outbreak that has been occurring adjacent to the New Mexico border along the Rio Grande National Forest in Colorado. The year to year increase between 2012 and the survey in 2013 may be an indication of building populations.

In New Mexico, areas with spruce beetle activity were mapped from aerial detection surveys on the Carson and Santa Fe National Forests. The largest concentration of activity was located in the Pecos Wilderness on the Santa Fe National Forest, although the amount mapped on the Carson National Forest increased twofold from the previous year.

In Arizona, spruce beetle activity was reported on only 960 acres; however, this is a significant increase over the levels observed in 2012 (<5 acres). Some of this mortality might be attributable to spruce ips (*Ips hunteri*) which also has been observed causing spruce mortality in Arizona.

Spruce Engraver Beetle

Ips hunteri
Hosts: Engelmann and blue spruce

During the 2013 Arizona aerial detection surveys in the White Mountains areas of spruce top-kill were observed. Field visits to the affected sites found that the damage was caused by the spruce engraver, *Ips hunteri*. In 2013, approximately 80 acres were designated with this type of damage. In previous years, *I. hunteri* has been observed in scattered heavily stressed trees, but in 2013 this beetle was observed causing stand level 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 during 2013 increased slightly from the amount mapped in 2012. Activity was primarily in high elevation areas along the Sangre de Cristo mountain range, affecting the Carson and Santa Fe National Forests.

While only minor activity was observed in Arizona in 2013 (1,130 acres) it was still an increase from the 10 acres reported in 2012. Most of the acres mapped were on National Forest lands, particularly on the Coconino National Forest.

Defoliators

Western Spruce Budworm

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

Western spruce budworm activity in the Southwestern Region continued the downward trend observed in the previous 2 years, decreasing from approximately 503,000 acres mapped in 2011 to about 478,000 acres mapped in 2012 and down to nearly 299,000 acres in 2013. Most of the western spruce budworm activity in the Southwest has occurred in northern New Mexico on the Carson and Santa Fe National Forests as well as adjacent State and Private lands due to prevalence of the susceptible host type in these areas. In Arizona, chronic budworm activity has been reported in the Chuska Mountains, Navajo Tribal Lands, in the White Mountains around Mount Baldy, White Mountain Fort Apache Tribal Lands and on the North Kaibab Ranger District of the Kaibab National Forest (Figure 9). In 2013, light budworm defoliation was also documented on the San Francisco Peaks of the Coconino National Forest.

Figure 9. Western spruce budworm defoliation of Engelmann spruce on the North Kaibab Ranger District

Douglas-fir Tussock Moth

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

For the third year in a row, Douglas-fir tussock moth damage was minimal throughout the Southwestern Region. Nearly 600 acres were mapped in 2013, which was slightly more than in 2012 and 2011. In addition to aerial detections surveys, the Southwestern Region has participated in the Early Warning Trapping program to monitor Douglas-fir tussock moth populations since the early 1990's (Table 4). The objective of the monitoring system is to identify areas with increasing Douglas-fir tussock moth populations prior to visible defoliation to allow managers to apply a mitigation treatment to sites before extensive damage has occurred. Sites averaging 25 or more male moths per trap signal that Douglas-fir tussock moth populations have the potential of causing visible defoliation within 1-2 years. Trap catches in Arizona and New Mexico indicate few locations where populations of Douglas-fir tussock moth are at levels able to cause visible damage, with the exception of trap sites the Cibola National Forest.

In New Mexico, defoliation from Douglas-fir tussock moth was observed on 370 acres of the Sacramento Ranger District of the Lincoln National Forest. Trap catches in the Sacramento Mountains continued a slow increase from previous years (0.5 moths per trap in 2012 to 0.6 moths per trap in 2013). In 2012, district staff discovered numerous pupal casings in the far southern portions of the Sacramento Mountains and three trapping sites were established in the

area during the 2013 moth flight season. Heavily stripped pockets of Douglas-fir and white fir were observed on private lands all around the town of Cloudcroft, NM during aerial detection surveys. Trap catches on the Sandia Mountains of the Cibola National Forest remain high but did slightly decrease from an average of 22.6 in 2012 to 20 moths per trap in 2013. A ground survey was conducted in the vicinity of the traps, but no significant numbers of egg masses could be located, nor was any visible defoliation observed. Santa Clara Canyon within Santa Clara Pueblo has participated in the early warning system since 2008, after they experienced heavy defoliation and conducted aerial spray operations in 2007. Since the Las Conchas fire in 2011, Santa Clara Canyon has lost most of the tussock moth's primary host tree species and access to the canyon has been intermittent due to heavy monsoon flooding that has washed out the road every year since 2011. This has made trapping difficult, and therefore trapping efforts will be abandoned after 2013.

In Arizona, supplemental egg mass sampling occurred during the spring at the West Peak early warning trapping location following high average trap catches recorded in 2012; however, only a few egg masses were located and very light defoliation had occurred. In 2013, the average trap catch fell to 16.7 at the West Peak location. Light defoliation in mixed conifer was recorded during aerial detection surveys over the Black Mesa Ranger District along the Mogollon Rim near Bear Canyon Lake on the Apache-Sitgreaves National Forests. This location will be added to the early warning monitoring system in 2014.

Pine Sawflies

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

Pine sawfly defoliation in 2013 decreased slightly from 2012 levels with 4,460 acres recorded in the aerial survey compared to nearly 7,500 acres detected during the 2012 survey.

Sawfly defoliation of ponderosa pine in New Mexico was mapped on the Gallinas and Zuni Mountains of the Cibola National Forest where it has not been recorded for some time.

In Arizona, the Kaibab National Forest had the greatest amount of damage mapped (1,880 acres), nearly the same level of damage observed in 2012 (1,850 acres). According to monitoring data from long-term permanent plots, mortality is confined to trees that have 90 to 100% of the older foliage removed.

Figure 10. Pandora moth defoliation. Kaibab National Forest

Pandora Moth

Coloradia pandora
Host: Ponderosa pine

Defoliation by pandora moth larval feeding has not been recorded in the Southwestern Region since the last outbreak occurred on the Kaibab Plateau in Arizona from 1978-1984. There has been a notable increase in the adult pandora moth population since 2008. For more information see "Other Entomology and Pathology Activities in 2013" pg. 34.

Table 4. Early warning trapping results for Douglas-fir tussock moth in the Southwestern Region.

Plot	Location	Avg # of Male Moths 2011	Avg # of Male Moths 2012	Avg # of Male Moths 2013
Apache-Sitgreaves National Forests				
Alpine	White Mountains	*	*	0
Big Lake	White Mountains		0[3]	0
Greer	White Mountains	*	0	0
Hannagan Admin. Site	White Mountains		0.2[3]	0
Cibola National Forest				
Balsam Glade	Sandia Mountains		18	29.2
Capulin Snow Play Area	Sandia Mountains	6.6	10	10
Dry Camp	Sandia Mountains	30.2[2]	34	22.8
Las Huertas Rd #1	Sandia Mountains	12.4	24	23
Las Huertas Rd #2	Sandia Mountains	11.4	31	38
Las Huertas Rd #3	Sandia Mountains	18.6	34	28.4
Nine Mile Picnic Area	Sandia Mountains	0.8	1	1.2
Tree Springs	Sandia Mountains	24.8[2]	28	7.8
Coconino National Forest				
Baker Butte	Mogollon Rim	*	*	*
Coronado National Forest				
Cunningham	Pinaleño Mountains	*	4.8	0.2
Marshall Gulch	Catalina Mountains	7.25	9.6	7.4
West Peak	Pinaleño Mountains	9.2	49.4[4]	16.7
Lincoln National Forest				
Apache CG	Sacramento Mountains	0	0	0
Apache Canyon CG	Sacramento Mountains		0[3]	*
Apache Observatory	Sacramento Mountains	0	0	*
Bailey Canyon	Sacramento Mountains	0	0.7	0
Bluff Springs	Sacramento Mountains	0	0	0
Cathey Vista	Sacramento Mountains	0	0	0
FS Road 5661	Sacramento Mountains	0	2	0.33
FS Road 64	Sacramento Mountains		0[3]	*
James Ridge Lookout	Sacramento Mountains	0	1.4	0
Upper Karr Canyon	Sacramento Mountains	0	0.2	0
Wills Canyon	Sacramento Mountains	1.2	1	1.25
Carissa Lookout	Sacramento Mountains	*	*	5
Jim Lewis Canyon	Sacramento Mountains	*	*	0
Perk Canyon	Sacramento Mountains	*	*	0
Prescott National Forest				
Mount Union	Bradshaw Mountains	0	0	0
Spruce Mountain	Bradshaw Mountains	0	0	0
Santa Clara Pueblo				
Below Site 11	Jemez Mountains	†	55	*
Site 12	Jemez Mountains	†	4.5	*
Above 4th Pond	Jemez Mountains	†	1	*
Cerro Toledo	Jemez Mountains	†	0	*
Site 16	Jemez Mountains	†	5.7	*
Southside	Jemez Mountains	†	3	*
Northwest Boundary	Jemez Mountains	†	0	*
Northside	Jemez Mountains	†	3.3	*
Tonto National Forest				
Icehouse	Pinal Mountain	0	1.8	10.6
Lower Pinal	Pinal Mountain	0	15	3
Reynolds Creek	Sierra Ancha Mountains	0	0	*
See Canyon	Mogollon Rim		0.2[3]	7.8
Washington Park	Mogollon Rim	0.2	0	0.2
White Mountain Fort Apache Tribe (BIA)				
Sunrise	White Mountains	0	0	0

* Not monitored
† Not monitored due to the Las Conchas Fire
[2] Fall ground sampling for larvae or egg masses, with no significant population observed
[3] Trapping location added in 2012
[4] Egg mass sampling to occurred spring of 2013.

Pinyon Needle Scale

Matsucoccus acalyptus
Host: Pinyon pine

Pinyon needle scale is a chronic defoliator of pinyon at several locations in the woodlands of Arizona and New Mexico, with intensities varying from year to year. Approximately 8,000 acres of pinyon defoliation was recorded in 2013 for the Southwestern Region, an increase of just over 3,000 acres from the aerial survey conducted in 2012. In New Mexico, the majority of damage occurred on the Cibola National Forest and state and private lands in the central part of the state. Pinyon needle scale was not detected in 2011, but was observed in 2012. The aerial detection of this pest is complicated by drought which can thin pinyon crowns (Figure 11). These drought-thinned crowns are often indistinguishable from the effects of needle scale during aerial survey flights.

Figure 11. Drought-induced thin crowns of pinyon pine in New Mexico.

In Arizona, a significant amount of pinyon needle scale was mapped on White Mountain Fort Apache and San Carlos Apache tribal lands. Pinyon needle scale has also been chronic in the Prescott area for years and in 2013 it was observed causing damage on private property near Sedona.

Aspen Defoliation and Decline

Weather related damage
Western tent caterpillar (Figures 12 and 13), *Malacosoma californicum*
Large aspen tortrix, *Choristoneura conflictana*
Complex of other insects and diseases.

The area with aspen damage mapped from aerial detection surveys in 2013 (139,240 acres) decreased slightly from the levels observed in 2012 (180,180 acres). Most of the defoliation in New Mexico was mapped on the Carson National Forest and state and private land holdings. Heavy defoliation was mapped on the west half of the El Rito, and Tres Piedras Ranger Districts of the Carson National Forest (Figure 12). Some large stands composed of mixed conifer and aspen continued to be affected by both western spruce budworm and aspen defoliation.

Figure 12. Large scale aspen defoliation. Tres Piedras Ranger District, Carson National Forest.

In Arizona, the area of aspen damage decreased substantially from nearly 38,000 acres in 2012 to slightly more than 10,000 acres in 2013. Most aspen dieback and decline was noted on the Coconino and Apache-Sitgreaves National Forests, as well as Navajo tribal lands. A substantial amount of aspen mortality on Escudilla Mountain on the Apache-Sitgreaves National Forests was directly caused by fire and thus was not reported as defoliation or dieback. Regeneration from sprouting is occurring following the disturbance. In other burned areas in Arizona (Shultz Fire Coconino National Forest), aspen seedlings as well as sprouts from established clones are contributing to post-fire regeneration.

Figure 13. Characteristic western tent caterpillar larvae and tenting near Flagstaff, Arizona.

Status of Major Diseases

Mistletoes

Dwarf Mistletoes

Arceuthobium spp.
Hosts: Most conifers, especially pines and Douglas-fir

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—are found throughout most of their host's range, while the other species have more limited distributions. 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 mistletoes includes growth reduction, deformity, especially the characteristic witches' brooms, 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 some mammals and birds. Of seemingly greater importance, dwarf mistletoe provides an indirect food source for birds that 1) feed on insects that feed on mistletoe, and 2) that feed on bark beetles that attack weakened infected trees.

True Mistletoes

Phoradendron spp.
Hosts: Junipers and various hardwoods

Several species of true mistletoe occur in the Southwest. These mistletoes are less damaging to their hosts than dwarf mistletoes, but heavy infection can reduce host longevity, especially during periods of drought. *Phoradendron juniperinum* on Utah juniper is probably the most widespread and abundant (Figure 14). True mistletoes are also common on oaks in southern portions of the Region, and locally abundant in desert woodlands (on mesquite and palo verde) and in lower elevation riparian areas (on most hardwood species). There is also a true mistletoe species on white fir that is only found in the Santa Catalina Mountains on the Coronado National Forest in Arizona.

Figure 14. *Phoradendron* mistletoe on juniper. Upper: *P. juniperinum*. Lower: *P. capitellatum*.

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, an obvious concern in campgrounds and other recreation areas. Root diseases are usually more common in mixed conifer and spruce-fir forests than in ponderosa pine forests. 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" and can be exacerbated by certain activities.

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, 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*, a saprophyte that only decays dead wood, has also been identified in mixed conifer forests. Previous surveys in mixed conifer forests on the North Kaibab Ranger District 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 distributed throughout the Region. Like *Armillaria* spp., *Heterobasidion* spp. are 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* (*Inonotus tomentosus*), is found on spruce and Douglas-fir; and Ganoderma 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 15. Conk of *Phellinus everhartii* on Gambel oak near Prescott, Arizona.

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* (*Phellinus pini*), affecting most conifers; Indian paint

fungus, *Echinodontium tinctorium*, on white fir; aspen trunk rot, *Phellinus tremulae*; and *Phellinus everhartii* (Figure 15) and *Inonotus dryophilus* on oak.

Stem Rusts

White Pine Blister Rust

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

Figure 16. White pine blister rust on southwestern white pine.

Blister rust continues to cause heavy damage to white pines in the Sacramento Mountains of southern New Mexico, where the disease has been established for nearly 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 National Forest, are infected. Blister rust can also be found in the Gila, Cibola, and Santa Fe National Forests of New Mexico. Many thousands of acres of mesic mixed conifer forest have severe blister rust infection (Figure 16), while more xeric sites generally have low to moderate infection. Top-kill is very common in the severely infected areas.

In Arizona, white pine blister rust was first detected in 2009 in the White Mountains on both the Apache-Sitgreaves National Forests and White Mountain Fort Apache tribal lands. The oldest cankers dated to approximately 1990. More recent waves of infection have greatly expanded the distribution and severity of this outbreak. The 2011 Wallow Fire burned through rust infected areas. It is not clear what effect the fire had on the rust infection levels. In 2012, infected white pines and gooseberry were observed in more moderate hazard sites in the White Mountains of Arizona.

Broom Rust

Melampsorella caryophyllacearum
Hosts: True fir and chickweed

Chrysomyxa arctostaphyli
Hosts: Spruce and kinnikinnick

Broom rusts are found at low levels throughout most of their hosts' ranges in the Southwest. High concentrations 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.

Abiotic Damage

Salt

De-icing salt use along high elevation highways has caused increasing ponderosa pine mortality over the last decade, especially in central Arizona. National Forest lands most impacted include the following forested roadways: Highway 260 near Forest Lakes; Highway 87 near Clint's Well; Interstate 40 from Flagstaff to Williams; and Highways 180 and 89A near Flagstaff. More recently, the damage is appearing along county and city roadways as municipalities are increasing the use of de-icing salts (Figure 17). Additional damage from dust abatement salts was also observed in 2012, mostly in eastern Arizona.

Figure 17. Salt caused damage to aspen in Flagstaff, Arizona.

Frost and Winter Injury

Figure 18. Frost damage to live oak near San Carlos, Arizona.

Many conifers can be affected by winter injury associated with extreme cold events and the drying effects of wind. Characteristic red foliage is often retained into the subsequent growing season.

Hardwoods are often damaged by late frost events in the spring after foliage has emerged and shoots have elongated. Symptoms include browned and curled leaves, and branch mortality (Figure 18).

Drought

An ongoing drought throughout the Southwestern Region continues to affect vegetation of all types. All forest types are affected by these climatic events; however the effects of drought are generally limited in high elevation mixed conifer stands. Drought can cause increases in aspen decline and bark beetle activity. Riparian areas throughout the region have been adversely affected by the continued stress caused by drought.

Over the past couple of years in New Mexico, a significant amount of drought-related juniper mortality and dieback has been reported through aerial surveys and phone calls from concerned land owners. Mortality of younger juniper trees was noted in 2013 in the central region of the state.

Other Forest Insects and Diseases

Lophodermella needle cast of pines – Occurs throughout the Southwest, but typically at very low levels. Ponderosa pine is the primary host, and pinyon and southwestern white pine are occasional hosts. The primary symptoms associated with this disease are yellowing and discoloration of second year needles (Figure 19).

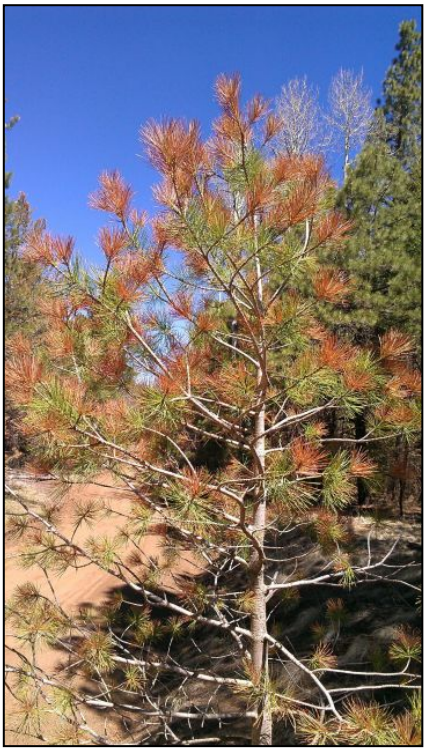

Figure 19. Lophodermella needle cast on southwestern white pine north of Flagstaff, Arizona.

Other needle casts of conifers –*Lirula* needle cast on white fir and Rhizosphaera needle cast of spruce are generally observed at low levels annually.

Goldspotted oak borer (*Agrilus auroguttatus*) **–** Based on ground surveys, large diameter Emory oaks were fading and dying due in part to drought effects combined with goldspotted oak borer activity in Madera and Gardener Canyon of the Santa Rita Mountains in southeastern Arizona. During a site visit to the Santa Rita Mountains, all fading large diameter Emory oaks encountered were currently infested with goldspotted oak borer. Oak mortality associated with goldspotted oak borer was mapped during aerial detection surveys for the first time in 2012. Three acres of evergreen oak mortality were detected in the Santa Rita Mountain Range. Additional areas may have been affected as the oak woodlands are not extensively surveyed. The activity was scattered almost exclusively within the Mount Wrightson Wilderness; specifically near Madera Canyon, Josephine Canyon and Robinson Spring. Additionally, large to mid-diameter Emory and Mexican blue oaks have been dying in Gardener Canyon and Hog Canyon for the past few years.

Flatheaded fir borer (*Phaenops drummondi*) – Evaluation of Douglas-fir mortality on the Mescalero Apache tribal lands and Lincoln National Forest in New Mexico and on the Chiricahua Mountains in Arizona found wood borers (Buprestidae) were the primary causal agent in Douglas-fir mortality. These wood borers were occurring in severely drought-stressed trees across mid to large diameter classes. The wood borer population and resulting activity in the Chiricahua Mountains has been increasing due to post-fire conditions from the Horseshoe II fire.

Elm leaf beetle (*Xanthogaleruca luteola*) – The central Rio Grande valley saw an increase in the amount of defoliation to many urban elm trees caused by the elm leaf beetle. This beetle has moved into the region along with the exotic elm species that were planted and have sprouted throughout much of the last century. While this small, greenish beetle can always be found at some level, the dry conditions and warm temperatures experienced over the last few years have allowed the populations and the amount of defoliation to increase.

Lepidopteran species - Several species of Lepidoptera were observed feeding on trees, shrubs and herbaceous vegetation in Arizona and New Mexico in 2012.

- **Fall webworm** (*Hyphantria cunea*) – Continues to defoliate an assortment of trees throughout northern Arizona. Walnuts and other hosts in the Show Low, Heber-Overgaard, Payson and upper Oak Creek Canyon areas have been defoliated for the past few years. Tents were also observed on Arizona sycamore, Arizona alder, walnut, chokecherry, and birch. Fall webworm was detected in August on the Santa Catalina Mountains for the first time on New Mexico locust. A larger population was found later in the area on Arizona walnuts. The insect was also found in Eagar and Star Valley feeding on a new host – lilac bush. In New Mexico, notable webworm activity continues to be observed on riparian hardwoods and landscape trees in many areas throughout the state.

- **Leuschners Tussock Moth** (*Orgyia leuschneri*) Defoliation caused by Leuschner's tussock moth was not recorded during the 2013 aerial detection surveys near Sedona as it was in 2012. However, egg masses and pupal cases were found near Red Rock State Park and heavy defoliation of box elder (*Acer negundo*) was reported in the Chiricahua Mountains on the Coronado National Forest.

Invasive Species

Invasive Species Threats in the Southwest

Invasive species are an all-too-common threat to forests and woodlands throughout Region 3. In FY13, approximately 15,000 acres infested by invasive plants were treated on the 11 national forests and 3 national grasslands in Region 3. A report provided in 2011 by Region 3 to the Office of Inspector General (OIG) identified the following list of invasive species as the greatest threats to terrestrial and aquatic systems on National Forest System lands:

Terrestrial plants

- buffelgrass (*Cenchrus ciliaris*)
- leafy spurge (*Euphorbia esula*)
- brome grasses (*Bromus* spp.)

Vertebrates

- feral hogs (*Sus scrofa*)

Invertebrates

- walnut twig beetle (*Pityophthorus juglandis*)

Aquatic plants

- Eurasian watermilfoil (*Myriophyllum spicatum*)

Aquatic organisms

- quagga mussels (*Dreissena rostriformis bugensis*)
- rock snot (*Didymosphenia geminata*)

Pathogens

- white pine blister rust (*Cronartium ribicola*)
- whirling disease (*Myxobolus cerebralis*)

Of the invasive species threats identified in the OIG report, buffelgrass is probably the greatest single threat to forests and woodlands in Southwestern Region (Figure 20). Buffelgrass is an invasive grass species from Africa that was developed in the U.S. as a drought-tolerant forage grass. Although it was originally planted in Texas and Mexico for forage, buffelgrass now threatens the Sonoran Desert ecosystem through its expansion into southern Arizona and most of the State of Sonora in Mexico. The threat from buffelgrass comes from its ability to outcompete native desert vegetation for water, nutrients, and sunlight and also by the formation of dense patches that allow fires to spread across the landscape. The Sonoran Desert evolved without fire, and most of its native plants such as the iconic saguaro cactus (*Carnegiea gigantea*) are fire intolerant.

Both the Coronado and Tonto National Forests in southern Arizona have been infested by this invasive grass species. In particular, the Coronado National Forest has extensive stands of buffelgrass along the southwestern foothills of the Santa Catalina Mountains. The Coronado National Forest has engaged in a number of activities to control buffelgrass including hosting community events such as an annual Beat Back Buffelgrass Day. Buffelgrass is also a concern for the Tonto National Forest in central Arizona with infestations occurring on four of its six ranger districts.

One of the most widely dispersed invasive species in Southwestern Region is saltcedar (*Tamarix* spp.) which commonly occurs as either a shrub or tree in thick stands along waterways. In New Mexico, saltcedar is listed as a Class C noxious weed species, which allows management decisions for the species to be determined at the local level, based on feasibility of control and level of infestation. Saltcedar can affect native riparian systems by altering stream flow (through evapo-transpiration processes) and the ecology (e.g., soil salinity and microbial activity). During the last decade, several species of the tamarisk leaf beetle (*Diorhabda* spp.) from Asia and the Mediterranean region in Europe were released as a host-specific biological control agent for saltcedar (Figure 21). Both adult beetles and larvae feed on the foliage of saltcedar which can damage or kill the plant over a period of several years. Different subspecies of this beetle with specific biotic requirements for climate and day length were released in Utah and Colorado. The beetle has since migrated south into northern parts of Arizona and New Mexico from the original release states. The advancing migration of the beetle threatens some nesting habitat used by the federally listed southwestern willow flycatcher (*Empidonax traillii extimus*), which nests in saltcedar-dominated areas that have replaced the original communities of native willow species (*Salix* spp.).

Figure 20. Buffelgrass, an invasive species threatening grassland ecosystems in the Southwest.

Figure 21. Tamarisk leaf beetle on foliage of salt cedar.

Although further releases of *Diorhabda* beetles have been suspended by the USDA Animal and Plant Health Inspection Service (APHIS), the rapid expansion of the beetle under natural conditions may remove saltcedar as a troublesome invasive species in many parts of the Southwest. However, this expansion may potentially be at the temporary cost of some flycatcher habitat in areas where invasive saltcedar dominates the vegetative community. In addition, other invasive weed species may replace the saltcedar.

Recent Developments in Forest Service Programs for Invasive Species and Pesticides

In FY13, Region 3's FHP program in State & Private Forestry provided a combined total of $121,000 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 plants under the program is made by a Request for Proposal (RFP) sent out by the State Forester. Applicants for treatment projects involving invasive plants are generally 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 and Shannon Atencio (505-425-7472) in New Mexico for further information.

A new series of field guides for managing invasive and non-invasive weeds in the Southwest is now available on the region's Forest Health website at http://www.fs.usda.gov/main/r3/forest-grasslandhealth/invasivespecies. The field guides contain information for managing invasive and non-invasive weeds according to integrated weed management (IWM) principles (Figure 22). The 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.

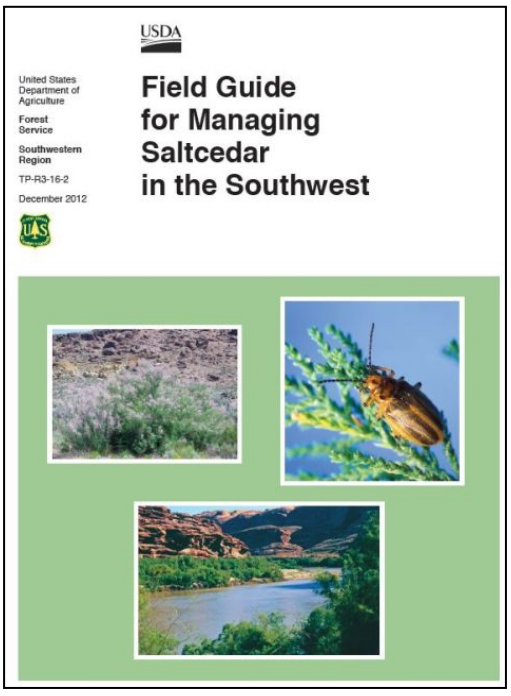

Figure 22. Cover of field guide for managing saltcedar in the Southwest.

A technical report entitled "Review and Assessment of Programs for Invasive Species Management in the Southwestern Region, 2012" was released in August of 2012. The report discusses current conditions and challenges for invasive species programs across national forests and grasslands in the Southwestern Region and includes recommendations for improving program operations. Information for the report was compiled from surveys submitted by forest 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 Technical Assistance

Arizona Zone

1. Douglas-fir Tussock Moth monitoring results for Arizona. 1/4/2013.
2. Biological evaluation of potential hazard trees in Bull Pen Dispersed Camping and West Clear Creek Trailhead areas, 6/14/2013.
3. Review of Silvicultural Certification Stand, Apache-Sitgreaves NF, 9/5/2013.
4. Deicing Salt Impacts along Roads on the Flagstaff Ranger District, Coconino National Forest, Arizona, 8/15/2013.
5. McCracken Forest Health Project, 7/24/2013.
6. 2013 Aspen Regeneration Monitoring in the 2010 Schultz Fire Area, Coconino NF, 11/19/2013.
7. Forest Insect and Disease Activity in the Rincon Mountains, Saguaro National Park, 11/19/2013.
8. Annual Gypsy Moth Trapping – Trap Retrieval, 10/22/2013.
9. Forest Health Projects on the Coronado National Forest, 12/18/2013.
10. Spruce Ridge Forest Health Improvement Project, 12/17/2013.
11. Evaluation of Bark Beetle Activity and Impacts within the Wallow Fire, 12/4/2013.

New Mexico Zone

1. Forest Health Staff Assistance – Cottonwood Mortality, Santa Ana Pueblo, 6/3/2013.
2. Santa Clara Pueblo 2012 Douglas-fir Tussock Moth Trapping Results, 6/3/2013.
3. Forest Health Visit to Cerro Pelado Lookout Tower, 5/14/2013.
4. Gypsy Moth Detection Trapping in New Mexico, 4/29/2013.
5. Dwarf Mistletoe Site Visit, Sacramento RD, Lincoln NF, 7/23/2013.
6. Sandia RD, Cibola NF 2013 Douglas-fir Tussock Moth Trapping Results, 11/1/2013.
7. Sacramento RD, Lincoln NF 2013 Douglas-fir Tussock Moth Trapping Results, 11/1/2013.
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Other Entomology and Pathology Activities in 2013

Post-fire Aspen Browse Monitoring

We continued to monitor permanent plots within the 2010 Schultz fire area on the Coconino NF. Total aspen stems per acre (<5" DBH) decreased significantly in 2013 to ≈4,000 TPA, compared to >10,000 TPA in 2011 and 2012 (See Table). The 2013 average is greater than the 1,300 TPA reported in 2009 (pre-fire). The total aspen stem count is for both suckers and seedlings. Although aspen regeneration is dominated by suckers that sprout along lateral roots of burned trees, aspen seedlings (i.e., those that originate from seed) were also identified in 2011 (Figure 23). Beginning in 2012, aspen seedlings were counted together with aspen suckers because the two are only distinguished by root excavation, or destructive sampling of seedlings (off-plot sampling). Ungulate browse damage is likely to have contributed to the decrease in regeneration density, as impacts had increased from 58% browsed stems in 2012 to 77% in 2013. Although density decreased in 2013, recruitment of aspen stems to taller size classes was again observed in 2013, with the tallest saplings nearly 7 ft. in height. The taller aspen were found in plots closest to Waterline Road, where less browse activity occurs.

Figure 23. Aspen seedling regenerating in Los Conchas fire scar

Table 5. Aspen regeneration densities (trees/acre) in permanent plots located in 2010 Schultz Fire area.

Average Aspen/Acre	2009 (Prefire)	2011	2012	2013
<1'/acre	1,361	9,849	8,805	2,983
1.1-2'/acre	0	866	900	500
2.1-3'/acre	0	150	266	294
3.1-4'/acre	0	0	94	255
4.1-5'/acre	0	0	50	55
5.1-6'/acre	0	0	0	11
6.1-7'/acre	0	0	0	22
Total/acre	1,361	10,865	10,115	4,087
Browsed	95%	94%	58%	77%
Seedlings	0	3000+/acre	*Seedlings counted with suckers	*Seedlings counted with suckers

For more information, contact Mary Lou Fairweather.

Deicing Salt Impacts along Roads in Northern Arizona

Salt damaged ponderosa pine trees are observed across northern Arizona, adjacent to where deicing salts are applied on roads. Aerial surveyors have been mapping in thousands of acres along the same areas of highway every year. Salt damage to ponderosa pine is mainly by absorption through saline soils, resulting in symptoms throughout the entire crowns of trees. Needles accumulate salt over time, which is why needles are green immediately following bud break but turn brown (tip burn) by the following spring. Symptoms progress to branch dieback, topkill, and tree mortality. Since dead trees are not structurally sound, salt-induced mortality of trees along roadways results in hazard trees. In the spring of 2013, we evaluated symptomatic and

asymptomatic ponderosa pine trees located along the major highways surrounding Flagstaff, AZ, through needle and soil sampling. Brown symptomatic trees averaged 6 times more sodium and 3.5 times greater chloride levels than green asymptomatic trees (P = <0.001). Levels of magnesium and calcium were static. Soil from symptomatic areas averaged five times greater levels of both sodium and chloride compared to asymptomatic areas (P = <0.001). Symptomatic trees averaged 40 ft. from the road, compared to 111 ft. for healthy trees (P = <0.001). The accumulation and impact of deicing salts on ponderosa pine are expected to continue where products are applied and trees are in close proximity to roads.

For more information, contact Mary Lou Fairweather

Pandora Moth Monitoring

Northern Arizona University and the USDA-FS Forest Health Protection (Arizona Zone) have been conducting systematic adult moth monitoring in Arizona since 2010 using light traps and since 2012 using pheromone-baited traps. In 2010, during the peak flight period (mid-August) nearly 2,500 moths were trapped in a light trap during a single night. In 2012, during the peak flight only 250 moths were trapped in a single night. Although trap catches significantly decreased the following spring (2013) severe defoliation was observed at the stand level. A special early aerial survey flight was conducted in May 2013 over the area to determine the extent of defoliation. During that flight nearly 1,800 acres of defoliation were mapped (Figure 10). In mid-June, larvae migrated down the boles to pupate in mineral soil. Up to 10 larvae can be found pupating within one square foot in heavily defoliated stands. In Arizona, defoliation by larvae occurs in odd years and adults appear in even-numbered years. A large adult population is anticipated in 2014 and continuation of pheromone blend monitoring and adjustment is planned.

The population is still building as indicated by the low level of naturally occurring nuclear polyhedrosis virus (NPV) and parasitoids within the monitored portion of the population. One of the major milestones of the monitoring work has been the refinement of the pandora moth lure for the Southwest. The entomology lab at the University of California, Riverside has been critical in the development of a better blend of compounds for monitoring pandora moth populations in Arizona. Another round of field testing will be required before a southwestern pandora moth lure will be available commercially. In addition to lure development, we have also documented the presence of the pandora moth on the south side of the Grand Canyon. During previous outbreaks, pandora moth impacts had only been documented north of the Grand Canyon. A light trap on the Tusayan Ranger District verified the presence of an adult population on the south side. Fewer adults were trapped on the south side than on the north. Peak flights on the south side occurred approximately two weeks later than peak flights on the north side around Jacob Lake.

For more information, contact Amanda Grady

Cone and Seed Insects of Southwestern White Pine, Arizona & New Mexico

Cone and seed insects represent a diverse guild of forest pests that can cause significant damage on annual seed crops. We conducted a survey to identify the cone and seed insects of southwestern white pine (*Pinus strobiformis*), one of the least studied five-needle pines in western North America and quantify their damage. We collected 1,314 mature insect-infested pine cones from 44 sites across Arizona and New Mexico in August and September of 2012 and 2013. Cones were caged individually and 7 month rearing trials were conducted to collect emerging insects.

Mean (±SE) insect infestation rate per site for 2013 was estimated to be 26.6% ± 2.3. Infestation was highly variable between sites, ranging from 0-100%; while within-site variation was considerably lower. To date, 330 insects have been collected representing the majority of tree families and populations sampled. Insect genera represented in collections include *Megastigmus* (seed chalcid), *Leptoglossus* (western conifer seed bug), *Dioryctria* (pine cone worm), and *Conophthorus* (pine cone beetle) species. Several hymenopteran and dipteran parasitoid species have also been collected. The most common pest observed was *Dioryctria* spp., representing 90% and 51% of collections in 2012 and 2013, respectively. Future work will involve caging immature cones *in situ* throughout the summer of 2014. Final results will be synthesized into an identification guide on cone and seed insects of southwestern white pine.

For more information, contact John Anhold

Insect and Disease Workshops

The Southwestern Region's Forest Health staff offers training sessions on forest insects and diseases in the Southwest at least once a year. This 2 to 2½-day workshop 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 2013 this workshop was conducted in Santa Fe, New Mexico. Thirty participants attended representing the four National Forests, the National Park Service, Santa Clara Pueblo and the Arizona State Forestry Division. Field trips to examine insects and diseases were conducted in pinyon-juniper woodlands and ponderosa pine, mixed conifer, aspen and spruce-fir forest types (Figure 24).

Figure 24. Field trip to discuss insect and disease identification and management in the Southwest.

For more information, contact the AZ or NM Zone Leader

Hazard Tree Workshop

In 2013 we hosted the 7th Western Hazard Tree Workshop in Sedona, AZ. This meeting brought together hazard tree specialists and mycologists from throughout the western U.S. to discuss hazard tree identification and removal as well as new technological developments to aid these tasks. Attendees were also exposed to recent taxonomic changes in the Kingdom Fungi.

At least one hazard tree training/workshop is offered annually, generally alternating between various sites in New Mexico and Arizona. The main purpose of these annual training sessions is to provide an 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.

For more information, contact Mary Lou Fairweather

Fly-in Calibration and Conformity Session

In 2013 the Southwestern Region hosted the annual western Calibration and Conformity Session in Flagstaff Arizona. The training provides the opportunity for western aerial surveyors to calibrate their eyes to forest pest damage signatures as well as discuss reporting standards. A total of 23 surveyors participated. Two aircraft were utilized to conduct flights along a pre-designated flight path. National Park Service pilot, Galen Howell and Forest Service Pilot, Gracie Moore flew two surveyors per flight until all surveyors had documented the damage along the transect.

For more information, contact Amanda Grady or Crystal Tischler

Web Version of Insect and Disease Field Guide

A Web version of the "Field Guide to Insects and Diseases of Arizona and New Mexico Forests" is available on our Forest Health Web site: http://www.fs.usda.fed/goto/r3/foresthealth

The Web version contains all of the photographs and information of the printed guide. Access to PDFs of individual sections of the guide is available for users to print sections of the guide. Note: the field guide has recently been updated. This updated version will be available electronically in 2015.

For more information, contact Mary Lou Fairweather

Forest Health Staff

Arizona Zone

John Anhold (928) 556-2073

Supervisory entomologist/Arizona Zone leader since 2000. 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. Interest in western bark beetle technology development and transfer. Previous work experience 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.

Steve Dudley

GIS program coordinator, Arizona Zone since 1990 **(Retired January 2014)**. Collection, processing, analysis and map production of current year forest insect and disease activity survey data. Insect and disease detection aerial surveyor. Annual detection of mortality, defoliation and abiotic factors across Arizona.

Mary Lou Fairweather (928) 556-2075

Plant pathologist, Arizona Zone since 1989. Provides technical assistance on forest diseases to land managers. Current focus: distribution and impacts of white pine blister rust; aspen diseases and browse impacts on aspen regeneration; dwarf mistletoe ecology and management; and hazard tree identification and mitigation.

Amanda Grady (928) 556-2072

Forest entomologist, Arizona Zone arrived 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. Research interests include bark beetle and defoliator semiochemical work, fire and forest insect interactions and climate change effects on forest insects and restoration efforts.

Joel McMillin

Forest entomologist, Arizona Zone since 2001 **(Boise, ID FHP field office group leader as of January 2014)**. Primary responsibility is providing technical assistance on bark beetle management to land managers. He serves as Southwestern Region representative to the Special Technology Development Program. Technology development interests include: short- and long-term impacts of bark beetles on forest health, bark beetle semiochemicals, stand hazard rating systems for bark beetles, fire-bark beetle interactions, single tree protection against bark beetle attack, and slash management strategies for reducing bark beetle impacts.

New Mexico Zone

Debra Allen-Reid (505) 842-3286

Supervisory entomologist/New Mexico Zone leader since 1996. Aside from zone staff supervision and unit management, duties include 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 in defoliator aerial suppression, NEPA compliance, southern pine beetle management, and silviculture. Has worked in short-term assignments in Mexico and a long-term assignment with USAID in Haiti.

Andrew Graves (505) 842-3287

Forest entomologist, New Mexico Zone since October 2010. Primary responsibility is providing technical assistance on forest insects to federal land managers throughout the state. Additional responsibilities include managing the hazard tree program for New Mexico, and insect population monitoring. 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

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. Involved with the national insect and disease risk map project to model future risk of forest mortality from insect and disease activity.

Crystal Tischler (505) 842-3284

Forest Health Coordinator & Forest Health unit aviation officer since September 2008. Responsibilities include aerial detection surveys, aviation safety and training coordination, and field assistance to staff. Involved with educational outreach and implementation. ICS-qualified as a Wildfire Incident GIS Specialist. Previous work experience in forest management, fuels reduction, timber sale administration and community wildfire protection planning.

James Jacobs (505) 842-3288

Plant pathologist, 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

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

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)

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

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

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:
- ☐ Top
- ☐ Middle
- ☐ Lower
- ☐ Entire
- ☐ Single branch or branch tips

Damage to:
- ☐ New Foliage
- ☐ Old Foliage
- ☐ Both
- ☐ Cone or seed

Tree Foliage:
- ☐ Green
- ☐ Fading
- ☐ Sorrel
- ☐ Red
- ☐ Brown
- ☐ Black

Needles or leaves:
- ☐ Chewed
- ☐ Mined
- ☐ Webbed
- ☐ Spotted
- ☐ Discolored
- ☐ Missing

Tree Bole:
- ☐ Cracked
- ☐ Stuffed bark
- ☐ Boring dust
- ☐ Pitch tubes
- ☐ Canker
- ☐ Conks
- ☐ Woodpecker feeding

Branches:
- ☐ Broken
- ☐ Swollen
- ☐ Discolored
- ☐ Cankers
- ☐ Mistletoe
- ☐ Girdled

Unusual Weather Conditions:
- ☐ Wind
- ☐ Rain
- ☐ Hail
- ☐ Sleet
- ☐ Snow
- ☐ Flood
- ☐ Drought

Associated Disturbances:
- ☐ Fire
- ☐ Logging
- ☐ Thinning
- ☐ Blowdown
- ☐ Insects
- ☐ Disease
- ☐ Road construction

Remarks:

Forest Health Comments:

Received by
Date

Submit by Email | Print Form | Reset Form