United States
Department of
Agriculture

Forest
Service

Southwestern Region

Forestry and
Forest Health

August 2011
PR-R3-16-7

Forest Insect and Disease Conditions in the Southwestern Region, 2010

Cover photo: Pinyon sawflies at the Golden Open Space area in New Mexico, 2010.

Forest Insect and Disease Conditions in the Southwestern Region, 2010

Southwestern Region
Forest Health

Don Bright, Director

Arizona Zone
John Anhold, Zone Leader
Mary Lou Fairweather, Pathologist
Ryan P. Hanavan, Entomologist
Joel McMillin, Entomologist
Steve Dudley, Biological Technician

2500 South Pine Knoll Drive
Flagstaff, AZ 86001

New Mexico Zone
Debra Allen-Reid, Zone Leader
Andrew D. Graves, Entomologist
David Conklin, Pathologist
Daniel Ryerson, Forest Health/GIS Specialist
Crystal Tischler, Forest Health Coordinator

333 Broadway Blvd., SE
Albuquerque, NM 87102

http://www.fs.usda.gov/goto/r3/foresthealth

State Insect and Disease Specialists

Arizona: Robert Celaya (bobcelaya@azsf.gov)

New Mexico: Daniel Norlander (Daniel.Norlander@state.nm.us)

Contents

List of Tables

Conditions in Brief

Overall, insect and disease activity in the Southwestern Region was moderate in 2010. Bark beetle activity increased slightly, while defoliator activity decreased. Significant new outbreaks observed in 2010 include pinyon needle scale in the pinyon-juniper woodlands and a complex of bark beetles and canker fungi affecting ponderosa pine along the Mogollon Rim in northern Arizona.

Aerial detection surveys mapped bark beetle activity on nearly 42,000 acres regionwide in 2010 compared to 38,600 acres the previous year. Bark beetle activity in ponderosa pine was mapped on 21,800 acres which was up from the 9,300 acres mapped in 2009. A significant increase in activity was along the Mogollon Rim in central Arizona. Mortality in mixed conifer forests was down in 2010 with only 3,000 acres of Douglas-fir beetle activity compared to the 6,800 mapped in 2009. Spruce-fir mortality also decreased in 2010. Corkbark fir mortality from western balsam bark beetle continued for the 8th consecutive year, with slightly less affected acreage observed in 2010 than in 2009. The bulk of this mortality was limited to northern New Mexico. Pinyon ips activity increased to 380 acres in the pinyon-juniper woodlands in 2010, up from 170 acres in 2009.

Western spruce budworm activity decreased in 2010 after 5 years of increased activity. Defoliation from this insect was mapped on approximately 318,000 acres in 2010, down from 560,000 acres in 2009. Western spruce budworm activity continues to persist in northern New Mexico and eastern Arizona. Douglas-fir tussock moth activity was mapped over 740 acres in Arizona and 5,200 acres in New Mexico. Widespread pinyon needle scale defoliation has been reported across several western states in the pinyon-juniper woodlands and was apparent over more than 68,000 acres of pinyon in Arizona and New Mexico. Aspen defoliation and decline continue to be a concern in parts of the region with slightly less overall acreage mapped in 2010; 58,900 acres in New Mexico and 20,900 acres in Arizona during 2010, down from 83,700 acres and 46,400 acres, respectively.

Dwarf mistletoes continue to be 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. Bark beetle mortality is often associated with severe dwarf mistletoe infection. Root diseases are also widely distributed across the region, especially in higher elevation forests. White pine blister rust continues to cause severe damage to southwestern white pine in the Sacramento Mountains of southern New Mexico. This invasive disease has been found more recently in several other parts of New Mexico and in the White Mountains of eastern Arizona.

Table 1. Prominent 2010 forest insect and disease activity (acres) in Arizona and New Mexico*.

Agent	State	National Forest	Tribal Lands	Other Federal	State & Private	Total
Bark beetles in ponderosa pine	AZ	13,120	5,460	140	210	18,920
	NM	3,000	360	< 5	140	3,510
True fir beetles	AZ	80	250	--	--	330
	NM	13,850	540	--	1,180	15,560
Western spruce budworm	AZ	--	270	120	--	390
	NM	228,000	23,580	180	65,460	317,230
Aspen damage***	AZ	6,680	13,510	660	20	20,870
	NM	22,500	11,800	60	24,550	58,910
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 (primarily in New Mexico) 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 2010*.

	Western Pine Beetle	Mountain Pine Beetle	Round-headed Pine Beetle	Ponderosa Ips	Pinyon Ips	Douglas-fir Beetle	Spruce Beetle	True Fir Beetles	Cypress & Cedar Bark Beetles	Bark Beetle Totals
Apache-Sitgreaves NFs	550			2,130	10	70	< 5	20	< 5	2,780
Coconino NF	<5			6,370		90		60		6,510
Coronado NF	<5			310	< 5	60		< 5		430
Kaibab NF	20		50	1,070	< 5	50		10		1,140
Prescott NF	10			1,030	10	40				1,090
Tonto NF	1,000			580	< 5	60			< 5	1,640
Canyon de Chelly NM	< 5			20	< 5	20				40
Chiricahua NM			< 5	< 5						
Grand Canyon NP	< 5			80	< 5	30				120
Lake Mead NRA	< 5			< 5	< 5					
Saguaro NP	< 5		20							20
BLM	10			<5	< 5					10
DOD			< 5	< 5	< 5					
Fort Apache Tribal	100		<5	910	10	20	10	220	10	1,280
Hopi Tribal					< 5					
Hualapai Tribal	10			<5	< 5					10
Navajo Tribal	70			470	120	1,100		< 5		1,770
Navajo-Hopi JUA				< 5	< 5					
San Carlos Tribal	10			3,890	10			30	50	3,990
State & Private	30			180	< 5	10			< 5	220
Arizona Total	**1,810**	**0**	**80**	**17,040**	**170**	**1,540**	**10**	**330**	**60**	**21,050**
Carson NF	10					100	30	11,620		11,760
Cibola NF	100			220	10	< 5		310		650
Gila NF	1,520			670	200	10	20	10	10	2,370
Lincoln NF	10			340		< 5	< 5	20		370
Santa Fe NF	80			110		1,160	110	1,880		3,340
Valles Caldera NP	< 5					110				110
BLM	< 5			< 5	< 5	10				20
Bandelier NM										
El Malpais NM	< 5									
Acoma Pueblo	< 5			< 5						
Isleta Pueblo				< 5	< 5					
Jicarilla Apache	< 5					10				10
Mescalero Apache	< 5			150		< 5	< 5	10		160
Navajo Tribal	60			120	< 5	20		360		560
Picuris Pueblo						< 5				
Santa Clara Pueblo	< 5			20		< 5				20
Taos Pueblo						50		170		220
Zuni Pueblo	< 5			< 5	< 5					
State & Private	20			120	10	20	< 5	1,180	< 5	1,340
New Mexico Total	**1,800**	**0**	**0**	**1,760**	**210**	**1,490**	**170**	**15,560**	**10**	**20,940**
SW Region Total	**3,600**	**0**	**80**	**18,800**	**390**	**3,030**	**180**	**15,900**	**70**	**41,990**

* Values rounded to the nearest 10; sum of individual values may differ from totals due to rounding. Multiple counting of acres may occur between damage agents if an area is observed to have simultaneous multiple damage agents. Totals represent the "footprint" or affected area on the ground with no multiple counting. Values for federal administrative units include only federally owned lands (state and private inholdings summarized in "State & Private").

Table 3. Defoliation incidence by site (acres) from aerial detection surveys in 2010*.

	Western Spruce Budworm	Aspen Damage**	Douglas-fir Tussock Moth	Sawflies	Needle Cast	Pinyon Needle Scale	Defoliation Total***
Apache-Sitgreaves NFs		2,090	740			10,190	13,060
Coconino NF		1,730		60	20		1,840
Coronado NF		50				30	80
Kaibab NF		2,810		1,140			3,960
Prescott NF							
Tonto NF						2,680	2,690
Canyon de Chelly NM	120						120
Chiricahua NM							
Grand Canyon NP		580					580
Lake Mead NRA							
Saguaro NP		10					10
BLM		70					70
DOD							
Fort Apache Tribal		2,790				14,910	17,730
Hopi Tribal							
Hualapai Tribal							
Navajo Tribal	270	10,730				29,320	40,310
Navajo-Hopi JUA						110	110
San Carlos Tribal						2,120	2,120
State & Private		20				10	210
Arizona Total	**390**	**20,870**	**740**	**1,210**	**20**	**59,370**	**82,910**
Carson NF	98,750	12,980					110,370
Cibola NF	3,730	240		580			4,700
Gila NF		1,800				7,270	9,090
Lincoln NF	21,760	910	4,530				33,910
Santa Fe NF	87,410	6,160		30			91,300
Valles Caldera NP	16,350	410					16,750
BLM		50				430	480
Bandelier NM	180	10					200
El Malpais NM							
Acoma Pueblo				< 5			
Isleta Pueblo							
Jicarilla Apache	450	420					880
Mescalero Apache	6,730	320	< 5				7,150
Navajo Tribal	2,980	10,480					17,990
Picuris Pueblo		10					10
Santa Clara Pueblo	2,240	30					2,270
Taos Pueblo	11,180	540					11,720
Zuni Pueblo							
State & Private	65,460	24,550	630	< 5		1,650	90,390
New Mexico Total	**317,230**	**58,910**	**5,160**	**620**	**0**	**9,350**	**397,230**
SW Region Total	**317,620**	**79,780**	**5,900**	**1,820**	**20**	**68,720**	**480,140**

* Values rounded to the nearest 10; sum of individual values may differ from totals due to rounding. Multiple counting of acres may occur between damage agents if an area is observed to have simultaneous multiple damage agents. Totals represent the "footprint" or affected area on the ground with no multiple counting. Values for federal administrative units include only federally owned lands (state and private inholdings summarized in "State & Private").

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

*** Defoliation total includes agents not shown in the table; see text for additional agents.

Status of Major Insects

Bark Beetles

Conifer mortality mapped during aerial surveys is often attributed to bark beetles. Bark beetles are a primary source of tree mortality in the region. However, mortality is often a result of multiple factors including disease, other insects, and abiotic factors. Drought is an especially important factor in the Southwest and often the cause of bark beetle outbreaks. An additional consideration in interpreting aerial survey results is that the acreages reported represent areas where significant tree mortality has occurred; the mortality within these areas varies from site to site.

Several different bark beetles attack ponderosa pine in the Southwest. In recent years, most of the pine mortality in Arizona has been attributed to *Ips* engraver beetles, and western pine beetle in New Mexico. Since *Ips*, western pine beetle, and other bark beetles are often active in the same area and frequently attack the same tree, it can be difficult to code the agent during initial aerial observation. Emphasis should be placed on mortality within a particular forest type rather than on an individual mortality agent. The narratives which follow describe overall conditions and trends. In addition to reporting damage estimates for individual bark beetle species, we include summaries and recent trends by major forest type.

Western Pine Beetle

Dendroctonus brevicomis
Primary host: Ponderosa pine

Tree mortality attributed to western pine beetle increased slightly from 2,700 acres in 2009 to 3,600 acres in 2010. The majority of the damage occurred on the Gila National Forest (1,500 acres) in New Mexico and the Tonto National Forest (1,000 acres) in Arizona.

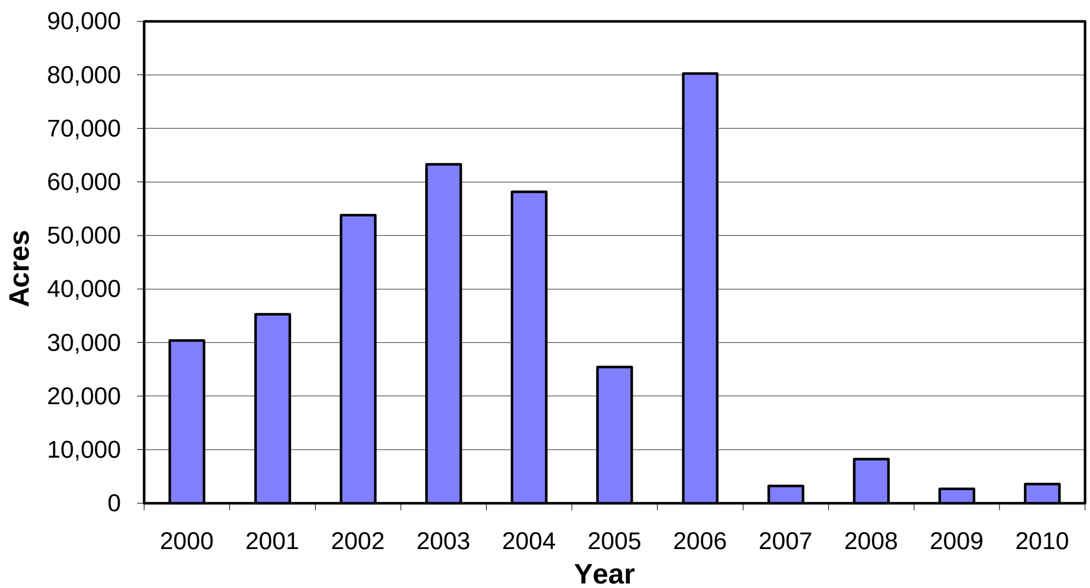


Figure 1. Western pine beetle activity in Arizona and New Mexico, 2000 - 2010.

Figure 2. Western pine beetle caused tree mortality on the Coconino National Forest, 2010.

Mountain Pine Beetle

Dendroctonus ponderosae
Primary hosts: Ponderosa, limber, southwestern white, and bristlecone pine

No mountain pine beetle activity was detected during aerial surveys in 2010. Historically, this insect has had much less impact in the Southwest than in other western regions. It has occasionally reached outbreak levels on the Kaibab Plateau in northern Arizona, and is observed infrequently in other parts of the region.

Limited mountain pine beetle activity was observed from ground surveys in 2009 within a recently burned area (2007 Chitty wildfire) on the Apache-Sitgreaves National Forests and Pinaleño Mountains of the Coronado National Forest.

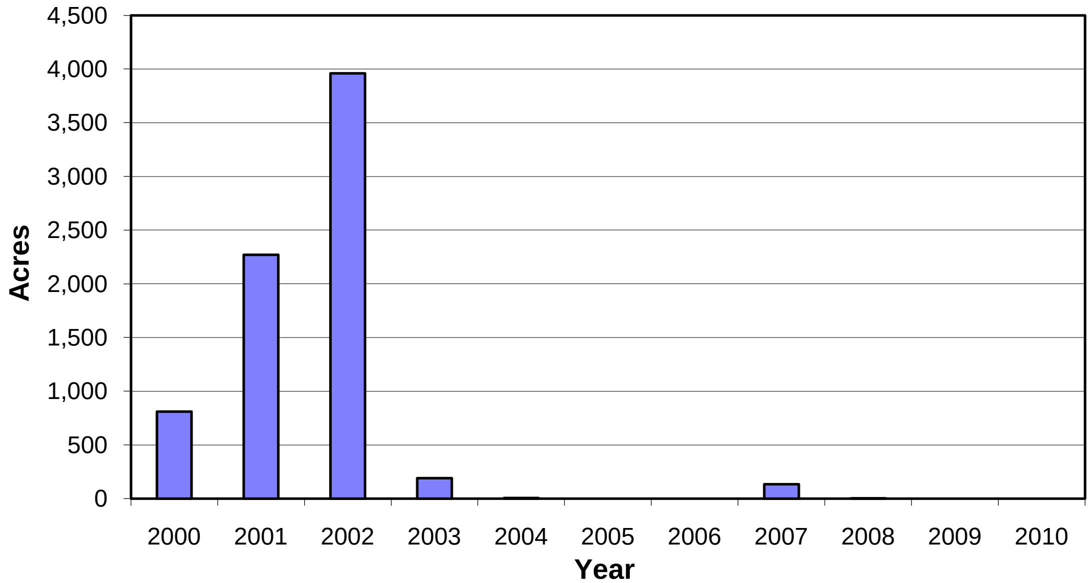


Figure 3. Mountain pine beetle activity in Arizona and New Mexico, 2000 - 2010.

Roundheaded Pine Beetle

Dendroctonus adjunctus
Primary host: Ponderosa pine

Roundheaded pine beetle activity remained at very low levels in 2010 with only 80 acres of mortality mapped in Arizona, primarily on the Kaibab National Forest and on Saguaro National Monument in the Rincon Mountains.

This insect has a fairly wide distribution in the region and is often associated with other bark beetles. It is possible that roundheaded pine beetle mortality observed during aerial surveys is attributed to other bark beetles. Historically, most activity has been in southeastern Arizona and the Sacramento Mountains of southern New Mexico.

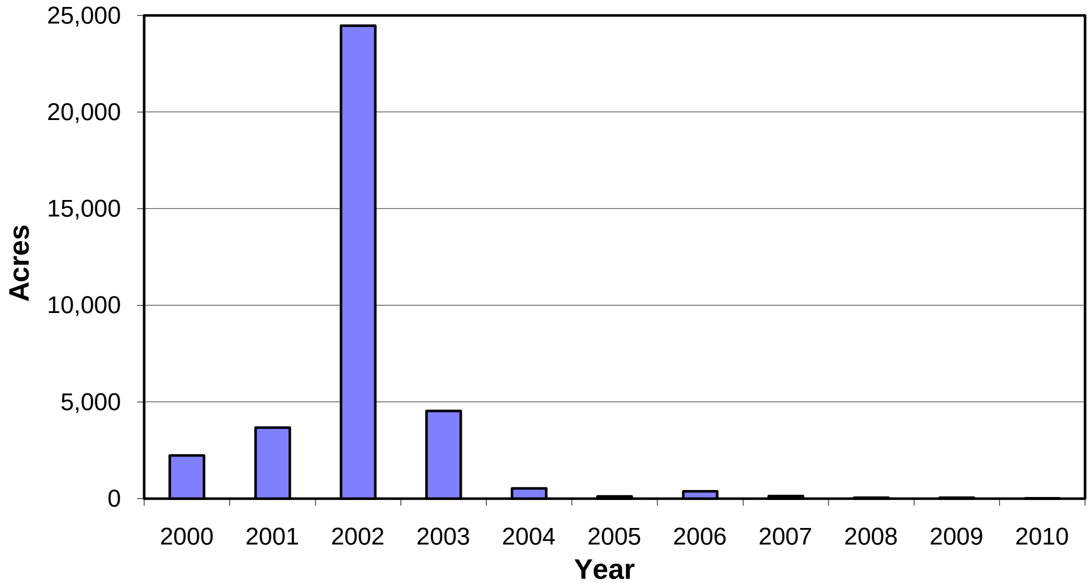


Figure 4. Roundheaded pine beetle activity in Arizona and New Mexico, 2000 - 2010.

Figure 5. Ips caused tree mortality on the Coconino NF, 2010.

Ips Beetles

Ips spp.
Primary hosts: Ponderosa pine, pinyon

Ponderosa pine mortality attributed to *Ips* increased from 6,900 acres in 2009 to 18,800 acres in 2010. The increase in 2010 is still significantly less than the 42,000 acres mapped in 2008. The majority of activity was mapped along the Mogollon Rim country in Arizona with 2,100 acres on the Apache-Sitgreaves National Forests, 6,400 acres on the Coconino National Forest, and 3,900 acres on the San Carlos Tribal Lands.

Ips and *Dendroctonus* beetles frequently occur in the same area and often attack the same tree. In recent years, several species of *Ips* have been found attacking ponderosa pine in Arizona, including: *I. lecontei*, *I. pini*, *I. calligraphus*, and *I. knausi*.

Pinyon mortality, caused primarily by *Ips confusus*, increased slightly from 170 acres region-wide in 2009 to 390 acres in 2010. Most of the detected activity (200 acres) was mapped on the Gila National Forest in New Mexico. Note that aerial surveys typically include only portions of the woodland type, so these figures probably underestimate the total area affected.

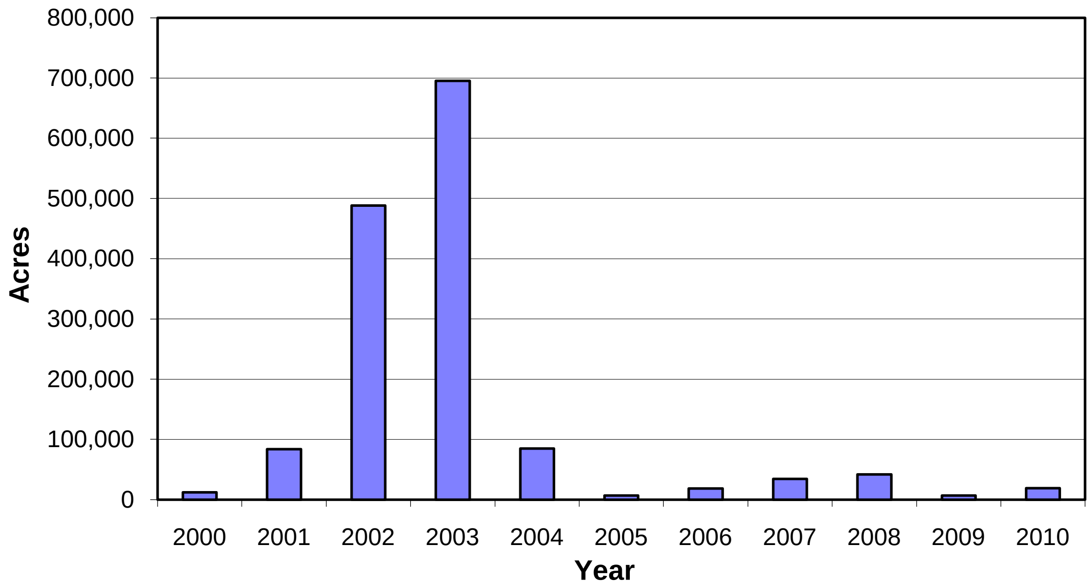


Figure 6. *Ips* engraver beetle activity in ponderosa pine in Arizona and New Mexico, 2000 - 2010.

Douglas-fir Beetle

Dendroctonus pseudotsugae
Host: Douglas-fir

Douglas-fir beetle activity continued to decrease region-wide with 3,000 acres mapped in 2010. This is down from the 6,800 acres mapped in 2009 and 12,400 acres mapped in 2008. The majority of area mapped to Douglas-fir beetle occurred on Navajo Tribal Lands in Arizona and the Santa Fe National Forest in New Mexico.

Note that while Douglas-fir beetle activity clearly peaked between 2003 and 2005, some of the area mapped during this period (as shown in figure 8) was later determined to represent white fir mortality caused by fir engraver beetle rather than Douglas-fir beetle activity.

Figure 7. Douglas-fir bark beetle activity on the Coconino National Forest.

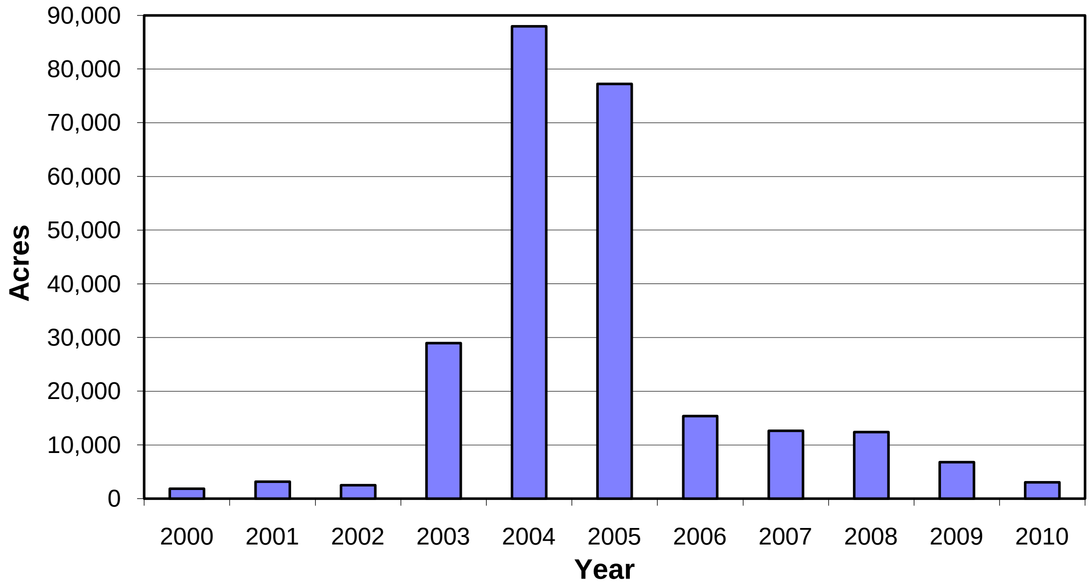


Figure 8. Douglas-fir beetle activity in Arizona and New Mexico, 2000 - 2010.

True Fir Beetles

Fir Engraver, *Scolytus ventralis*, Western balsam bark beetle, *Dryocoetes confusus*
Hosts: White fir, subalpine/corkbark fir

True fir mortality continued to decrease region-wide in 2010, with approximately 16,000 acres mapped compared to the 23,000 acres mapped in 2009 and 50,000 acres mapped in 2008. Most of the 2010 mortality was mapped in the spruce-fir forests of the Carson National Forest in northern New Mexico. Corkbark fir mortality is typically attributed to western balsam bark beetle during our aerial surveys, but more likely due to a number of factors, including root disease. This mortality event has continued for 8 consecutive years but the amount of acres affected continues to decline. Since corkbark fir trees can hold their needles for multiple years after dying, discerning new versus old mortality from the air can be a challenge. Clearly, the amount of new fading trees in the spruce-fir forests is waning. Fir engraver beetle activity continues to drop and has reached its lowest level in several years. Mortality of true firs is often associated with root disease.

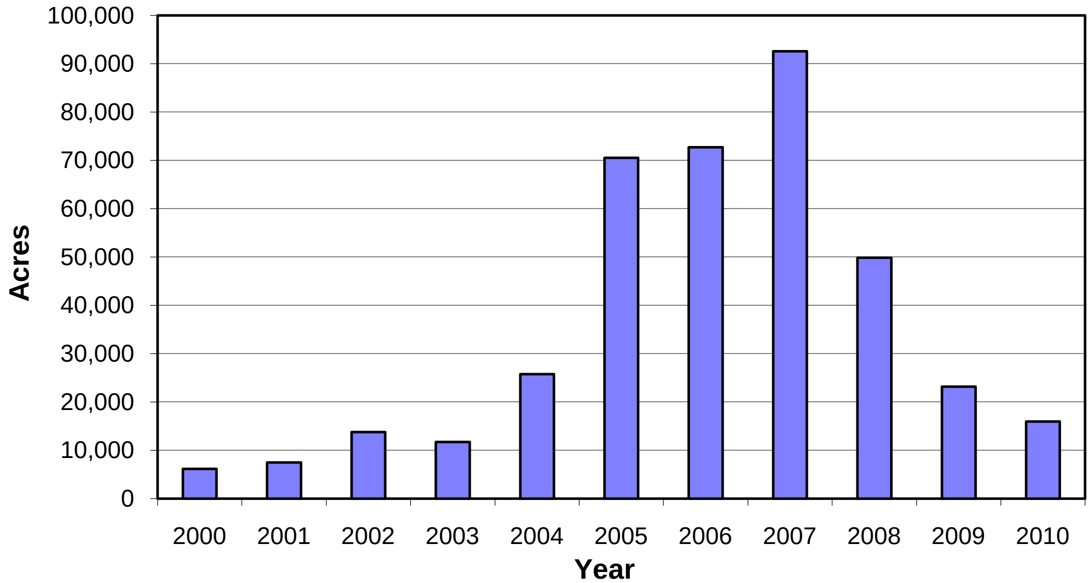


Figure 9. Fir engraver and western balsam bark beetle activity in Arizona and New Mexico, 2000 - 2010.

Spruce Beetle

Dendroctonus rufipennis
Host: Spruce

Spruce beetle mortality increased from less than 5 acres regionwide in 2009 to 180 acres. The majority of current spruce beetle activity was mapped on the Santa Fe National Forest (110 acres). Note that some of the damage mapped in previous years (see figure 10) was later determined to have been corkbark fir mortality rather than spruce mortality.

To date, no significant spruce beetle activity has been detected following a large 2007 windthrow event in the Pecos Wilderness of northern New Mexico. Activity on the San Francisco Peaks in northern Arizona following another 2007 windthrow event may have been minimized by a suppression project implemented in 2008-2009.

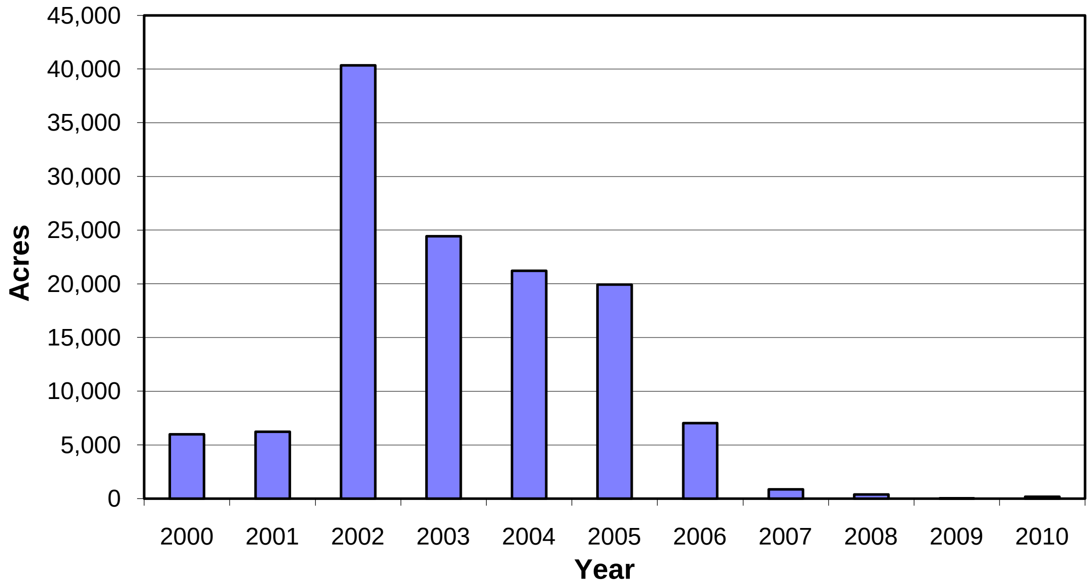


Figure 10. Spruce beetle activity in Arizona and New Mexico, 2000 - 2010.

Summary by Major Forest Types

Tree mortality/bark beetle activity is summarized here by major forest type, which overcomes some of the difficulties inherent in identifying tree and associated bark beetle species from the air. In comparing the acres affected and trends within and among forest types, one should keep in mind the relative proportion of land within each type. In the Southwest, these are approximately: 70 percent ponderosa pine, 25 percent mixed conifer, and 5 percent spruce-fir. Clearly 1,000 acres of damage in the mixed conifer or spruce-fir type represents greater relative damage (a higher mortality rate) than 1,000 acres in the ponderosa pine type.

Ponderosa pine. There were 22,400 acres of ponderosa pine mortality mapped across the region in 2010, up from the 9,300 acres mapped in 2009 but still well below the 49,000 acres mapped in 2008. Pine bark beetle activity remains relatively low following the peak in activity (763,000 acres) in 2003. The increased mortality in 2010 was primarily located along the Mogollon Rim country in Arizona and associated with recent fires.

Mixed conifer: Tree mortality continued to decrease from 8,800 acres in 2009 to 3,700 acres in 2010. The most severe mortality recorded in the mixed conifer forests of the southwest occurred from 2003 to 2007, with a peak of approximately 141,000 acres in 2005. Most of the 2010 mortality occurred on the Santa Fe National Forest in New Mexico and the Navajo Tribal Lands in Arizona.

Spruce-fir: The area with mortality mapped decreased from 20,300 acres in 2009 to 15,500 acres in 2010. A very significant die-off of corkbark fir has occurred in both Arizona and New Mexico the past several years. Spruce mortality has generally been light and widely scattered in recent years, and has often not been detected by aerial survey.

Defoliators

Western Spruce Budworm

Choristoneura occidentalis
Hosts: True firs, Douglas-fir, spruce

Western spruce budworm activity decreased from 560,000 acres mapped in 2009 to nearly 318,000 acres in 2010. The majority of defoliated acres were mapped on the Carson and Santa Fe National Forests in New Mexico. Chronic budworm defoliation continues on the North Kaibab Ranger District of the Kaibab National Forest and the Chuska Mountains on Navajo Tribal Lands in northern Arizona.

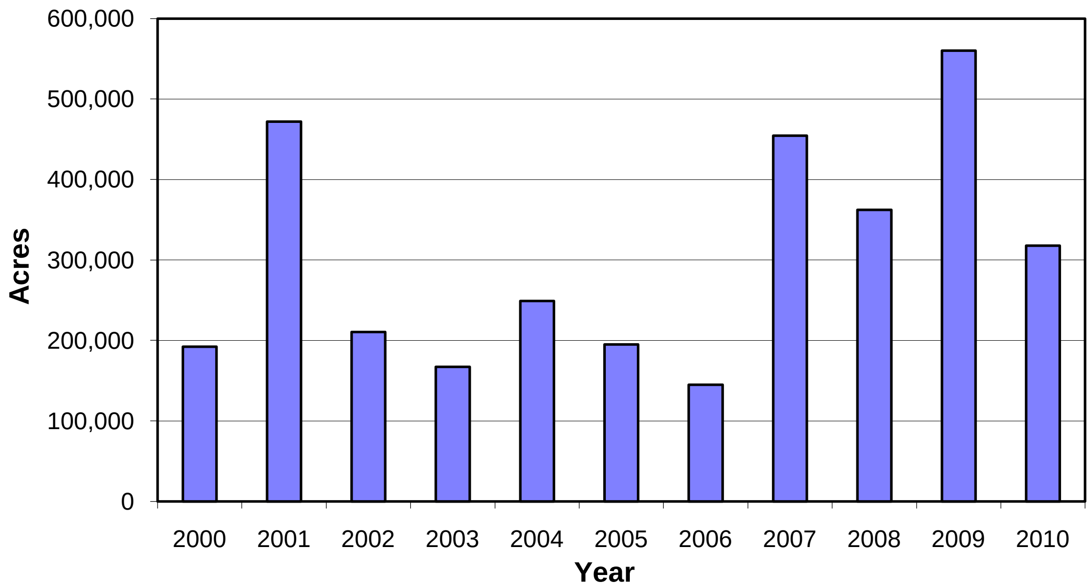


Figure 11. Western spruce budworm activity in Arizona and New Mexico, 2000-2010.

Douglas-fir Tussock Moth

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

Douglas-fir tussock moth defoliation increased from no mapped defoliation in 2009 to 5,900 acres in 2010. New defoliations were mapped on the Lincoln National Forest (4,600 acres) in New Mexico, and Apache-Sitgreaves National Forests (740 acres) in Arizona. Trace evidence of tussock moth defoliation was also recorded on Mescalero Apache tribal lands in New Mexico. Recent outbreaks on the Tonto National Forest in Arizona and the Cibola National Forest and the Santa Clara Pueblo in New Mexico all appear to have collapsed after 2007 with no new defoliation mapped during 2010.

Trap collections on the Coronado National Forest in 2009 indicated a potential increase in tussock moth on the west peak of the Pinaleño Mountains. However, 2010 traps resulted in lower levels and no new defoliation was detected.

Mountain Girdle

Enypia griseata
Host: Engelmann spruce

No new *Enypia*-caused defoliation was mapped in 2010. There were 660 acres of defoliation mapped during 2009, but the population appears to be on the decline.

Spruce Aphid

Elatobium abietinum
Host: Spruce

Defoliation from spruce aphid was reported on the White Mountain Apache tribal lands during the fall of 2010. Large populations were confirmed near the Sunrise Ski Area in the White Mountains of Arizona. Trapping is planned for the upcoming field season.

Pine Sawflies

Neodiprion spp., *Zadiprion* spp.

Pine sawfly defoliation was mapped on nearly 2,000 acres region-wide during the 2010 aerial detection survey. Peak defoliation appears to have occurred during 2009. The population on Kendrick Mountain on the Williams Ranger District of the Coconino National Forest caused significantly less defoliation in 2010.

Figure 12. Pine sawfly larvae feeding on ponderosa pine, Kaibab National Forest.

Damage from late 2009 sawfly activity in the Zuni Mountains (Cibola National Forest) was mapped on 580 acres in 2010 (ground reconnaissance in late 2009 had estimated that about 700 acres were affected). Although larvae were abundant in the affected area in late July 2010, little additional damage was observed later in the year.

Defoliation of pinyon by sawflies has been observed during the past two years in the City of Albuquerque's Golden Open Space area east of the Sandia Mountains. Varying levels of defoliation were observed. A general estimate from the ground indicates more than 300 acres were affected, though the density of pinyon varies widely within the affected area.

Pinyon Needle Scale

Matsucoccus acalyptus

Figure 13. Pinyon needle defoliation on the Prescott Nation Forest.

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. Aerial surveys mapped nearly 69,000 acres of pinyon with thin crowns in 2010. Much of this area is probably from needle scale defoliation, but potentially includes other causes as well. During the 2009 surveys, 7,100 acres were mapped specifically with needle scale activity. Pinyon needle scale has been reported across the southwestern United States throughout the range of pinyon. The pinyon-juniper woodlands are not typically intensively surveyed. However, greater effort was made to include these woodlands and map thin-crowned pinyon in 2010 as a result of increased reports of pinyon defoliation regionwide.

Figure 14. First instar pandora moth feeding on ponderosa pine on the North Rim of the Grand Canyon.

Pandora moth

Coloradia pandora

No pandora moth caused defoliation was recorded during the 2010 aerial detection survey. Light and pheromone traps were placed near Jacob Lake on the North Kaibab Ranger District of the Kaibab National Forest during 2010. Trap catches peaked at >1,000 adult moths per night suggesting increased populations in 2011. Light and pheromone traps will be placed in the same locations during 2011 and increased larval and ground surveys will take during the summer. Adult moths were also detected in large numbers near Tusayan in 2010 and ground surveys on the Tusayan Ranger District of the Kaibab National Forest have been scheduled for 2011.

Aspen Defoliation and Decline

Drought-related damage
Western tent caterpillar, *Malacosoma californicum*
Other insects and diseases

Aspen damage was mapped on nearly 80,000 acres region-wide during the 2010 aerial survey. The 2010 acreage was less than the 142,000 acres mapped during 2009 and 176,000 acres mapped during 2008. In particular, defoliation activity decreased in several areas during 2010 that may have been attributed to a late season frost that caused population crashes of western tent caterpillar.

Drought related aspen mortality has been severe over the last decade throughout central and northern Arizona. Although several years ago it was difficult to distinguish drought related aspen mortality from insect defoliation, aerial surveyors are now better able to distinguish the difference because aspen stands defoliated by insects and diseases still maintain a greenish cast to the overall crown and have vibrant white bark. Stands with lots of accumulated mortality have grey stems from bark sloughing, and there is an absence of green foliage.

Figure 15. Aspen decline and dieback in low elevation stands in northern Arizona has been severe over the past decade.

Status of Major Diseases

Mistletoes

Dwarf Mistletoes

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

Dwarf mistletoes are the most widespread and damaging forest pathogens (disease-causing organisms) in the Southwest. There are eight species in the Southwest, each with a different primary tree host. Three species—those affecting ponderosa pine, pinyon, and Douglas-fir—are found throughout most of the ranges of their respective hosts, while the other species have more limited distributions. Regionally, over one-third of the ponderosa pine type, and up to one-half of the mixed conifer type, has some level of infection.

Figure 16. Squirrel feeding damage on dwarf mistletoe infected limbs was common in Arizona in 2010.

On both the stand and landscape level, the distribution of dwarf mistletoes is usually patchy, with more or less discrete infection centers surrounded by areas without the disease. Infection centers expand very slowly, so overall incidence changes little from year to year. Because of their slow rate of spread, the *distribution* of dwarf mistletoes on the landscape is probably similar to that in the 1800s. The *abundance* of dwarf mistletoe has probably increased considerably since the 1800s, largely due to increases in tree densities.

Damage from dwarf mistletoes includes growth reduction, deformity—especially the characteristic witches' brooms, and decreased longevity. Infected areas often have much higher mortality rates than uninfected areas. Infection is often a major factor in mortality attributed to other damaging agents. For example, severely infected trees are often attacked by bark beetles. As a natural part of the forest, dwarf mistletoes have an ecological role and appear to benefit many species.

True Mistletoes

Phoradendron spp.
Hosts: Junipers, various hardwoods

Several species of true mistletoe occur in the Southwest. *Phoradendron juniperinum* on juniper is probably the most widespread and abundant mistletoe (true or dwarf) in the region. Mistletoes are common on oaks in southern portions of the Region and are locally abundant in desert woodlands and lower elevation riparian areas. Heavy infection reduces host longevity, especially during periods of drought.

Root Diseases

Root diseases are fairly common in the forests of the Southwest, and are often associated with mortality attributed to bark beetles. They can also predispose trees to windthrow, an obvious concern in campgrounds and other heavily used 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 spp.
Hosts: Most conifers, aspen

Armillaria is the most common root disease in the Southwest and may account for up to 80 percent of the root disease associated mortality in the region. All size classes can be affected. Previous surveys on the North Kaibab Ranger District found the fungus on about 30 percent of standing live trees.

Armillaria was observed girdling the root collar of dead and dying subalpine fir trees in the Pinaleño Mountains of southern Arizona in 2009. Samples from the Pinaleño Mountains and White Mountains of eastern Arizona were identified as *Armillaria solidipes* (synonym *A. ostoyae*), the same species found in the northern mountains of New Mexico.

In addition to causing disease, this fungus is a common decayer of dead woody material (a saprophyte).

Figure 17. Armillaria root disease "fan" found beneath the bark of a recently killed ponderosa pine on the Alpine RD in eastern Arizona.

Annosus Root Disease

Heterobasidion annosum and *H. parviporum*
Hosts: Most conifers

Annosus root disease is probably the second most common root disease in the Southwest. Based on recent genetic work, two species are now recognized in the western U.S.: *H. annosum*, which infects ponderosa pine, and *H. parviporum* (formerly known as the "S type" of *H. annosum*), which mostly infects true firs and spruces. In the Southwest, *H. parviporum* appears to be much more common than *H. annosum*, with annosus root disease often observed on true firs. Like *Armillaria*, *Heterobasidion* is a common decayer of dead woody material as well as a pathogen.

Other Common Root Diseases…

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

Figure 18. Schweinitzii fruiting body, Sacramento Mts, New Mexico, August 2010.

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. On the other hand, decayed trees provide important habitat for many wildlife species, particularly cavity nesters. 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 *Inonotus dryophilus* on oak.

Figure 19. Indian paint conk on white fir.

Aspen Stem Cankers

The soft, living bark of aspen is highly susceptible to canker-causing fungi. One or more of these diseases are common in most aspen stands. The most common include sooty bark canker, *Encoelia pruinosa*; black canker, *Ceratocystis fimbriata*; Cryptosphaeria canker, *Cryptosphaeria populina*; and Cytospora canker, *Cytospora chrysosperma*. Cankers are one of the main reasons that aspen is a relatively short-lived tree.

Stem Rusts

White Pine Blister Rust

Cronartium ribicola
Host: Southwestern white pine

Figure 20. White pine blister rust branch canker, Jemez Mountains, New Mexico, June 2010.

Blister rust continues to cause heavy damage to white pines in the Sacramento Mountains of southern New Mexico, where it has now 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 National Forest, are currently infected. Many thousands of acres of mesic mixed conifer forest here have severe blister rust infection, while more xeric sites generally have low to moderate rates of infection. Topkill is very common in the severely infected areas.

Survey/scouting efforts in New Mexico in 2010 focused on the central Jemez Mountains, especially areas surrounding Del Norte Canyon where the disease had been detected in 2007. These surveys found no new blister rust locations, confirming that overall incidence remains very low in this area.

In Arizona, white pine blister rust was first detected in 2009, in the White Mountains on the eastside of the state. The oldest cankers found were from around 1990. More recent waves of infection have greatly expanded the distribution and severity of this outbreak. In 2010, ground surveys indicated that although infection is concentrated in high hazard sites, like moist canyon bottoms, upslope infections do exist in a few locations. Damage to white pines in the White Mountains is expected become increasingly evident in the coming years.

Broom Rust

Melampsorella caryophyllacearum
Host: True firs

Chrysomyxa arctostaphyli
Host: Spruces

Broom rusts are found at low levels throughout most of their host's 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 topkill, especially in spruce. Occasionally, falling brooms or stem breakage at the point of infection present a hazard in developed recreation sites.

Limb Rust

Cronartium arizonicum
Host: Ponderosa pine

This disease is common in portions of Arizona and can be quite damaging to individual trees. The fungus causes progressive branch mortality, usually from the center of the crown. Waves of new infection typically occur at intervals of several years.

Overall, limb rust is less common in New Mexico than in Arizona. However, this disease has been observed frequently in the Jemez Mountains of northern New Mexico in recent years, following a wave of infection.

Comandra Blister Rust

Cronartium comandrae
Host: Pines

Relatively little damage from this native blister rust has been observed in recent years. In the past, it has caused extensive branch dieback and mortality of nonnative Mondell/Afghan pine (*Pinus eldarica*) in the Prescott, Payson, and Sedona areas of central Arizona. Young native ponderosa pines in these areas are also occasionally infected.

Western Gall Rust

Peridermium (Endocronartium) harknessii
Host: Pines

This is an occasional disease of ponderosa pine in the Southwest, where it is usually found as the white-spored form, rather than the orange-spored form common in other parts of the West.

Abiotic Damage

Salt

De-icing salts continue to damage roadside trees (especially ponderosa pines) along many high-elevation highways in the Region. Mortality from de-icing salt use has increased in northern Arizona and the Arizona department of transportation removes salt damaged trees annually. Additional damage from dust abatement salts was also observed in 2010, mostly in eastern Arizona.

Drought

Discoloration commonly associated with drought stress was mapped on 27,000 acres in northern Arizona during the 2010 aerial detection survey. This is up from the 2,800 acres mapped during 2009 and 1,900 mapped during 2008.

Tornado Damage

Six tornadoes touched down west and south of Flagstaff on October 6, 2010, affecting more than 5,000 acres of forest. Large paths of blown down trees were reported and bark beetle monitoring is currently underway.

Figure 21. Tornado damage on the Mogollon Rim Ranger District, Coconino National Forest, October 2010.

Other Forest Insects and Diseases

Aspen blotchminer, (*Lithocolletis tremuloidiella*) was observed in the Ojitos Canyon area on the Cuba Ranger District of the Santa Fe National Forest in New Mexico in 2010. The activity was widespread throughout the aspen regeneration in the area. Blotchminer activity was also observed in 2009 on Cebollita Mesa, four miles to the southwest of Ojitos Canyon.

Figure 22. Aspen blotchminer, Santa Fe National Forest, 2010.

Elm leaf beetle, *Pyrrhalta luteola*, defoliation was noticeable on Hopi tribal lands during the summer of 2010. All elm along riparian corridors had a scorched brown appearance. Similar defoliation was reported near Payson, Arizona.

Eriophyid mites were identified on Afghan pines along a windbreak in Socorro, New Mexico. Damage has caused abnormal growth that results in needle clusters on the tips of the branches.

Fall webworm (*Hyphantria cunea*) defoliation continued in 2010 in Oak Creek Canyon and near Prescott and Payson, Arizona. Tents were observed on Arizona sycamore, Arizona alder, walnut, chokecherry, and birch. In New Mexico, notable webworm activity continues to be observed on riparian hardwoods and landscape trees in many areas throughout the State.

Juniper twig pruner (*Styloxus bicolor*) damage was widespread throughout the central portion of New Mexico in 2010. Activity was particularly notable in the Sandia Mountains (foothill areas and in the East Mountains), in the El Malpais area by Grants, around Mt. Taylor, along Highway 60 through the Magdalena area, and along Highway 380 near the Valley of Fires State Park.

Walnut anthracnose (*Gnomonia leptostyla*) infections were notable for the 5th consecutive year in central Arizona, especially in the Prescott area.

Walnut leafhopper (*Dikrella readionis*) has caused severe "hopper burn", a brown scorched appearance, to Arizona walnut in the town of Payson, Arizona and other surrounding towns in 2009 and 2010. The defoliation occurs late season and appears to be more of an aesthetic problem.

Walnut leaf pouch mite (*Aceria erinoea*) was identified on walnut leaves in Portal, Arizona. High densities of these galls can lead to aesthetic problems.

Biological Evaluations and Technical Assistance

Arizona Zone

1. Mortality of ponderosa pine regeneration on Bradshaw RD; 1/6/10.
2. Bark beetle activity associated with the revegetation plan at Grand Canyon National Park; 8/26/10.
3. Mountain pine beetle activity in Chitty Fire Salvage Sale and Bear Wallow Wilderness, Alpine Ranger District, Apache-Sitgreaves National Forests; 7/15/10.
4. Forest insect and disease activity in the Long Valley experimental restoration project area; 8/18/10.
5. Forest health visit, silvicultural certification stand for Jodi Stevens; 9/2/10
6. Forest health visit, silvicultural certification stand for Kurt Wetzstein; 9/8/10
7. North Kaibab field visit – Dry Park; 9/8/10.
8. Dry Lake Dwarf Mistletoe Suppression Proposal; 9/20/10.
9. Forest health site visit Safford and Santa Catalina Ranger Districts; 9/20/10.
10. Forest insect and disease activity in the Beaver Creek forest restoration project area; 10/5/10.
11. Assessment of bark beetle risk related to October tornados; 10/22/10.

New Mexico Zone

1. Proposed FY 2011 dwarf mistletoe control project, Mescalero Apache Reservation; 7/8/10.
2. Potential FY 2011 forest health project, Sandia Ranger District, Cibola National Forest; 8/10/10.
3. Potential FY 2011 forest health project, Mount Taylor Ranger District, Cibola National Forest; 8/16/10.
4. Proposed FY 2011 forest health project, Tesuque Pueblo; 8/20/10.
5. Proposed FY 2011 forest health project, Picuris Pueblo; 8/26/10.
6. Potential FY 2011 forest health project, Mountainair Ranger District, Cibola National Forest; 8/30/10.
7. Potential FY 2011 forest health project, Sacramento Ranger District, Lincoln National Forest; 9/8/10.
8. Aspen leaf damage on Cuba Ranger District, Santa Fe National Forest, 9/20/10.
9. Potential FY 2011 forest health projects, Santa Fe National Forest; 9/28/10.
10. Potential FY 2011 forest health project, Magdalena Ranger District, Cibola National Forest; 10/8/10.
11. Sandia Ranger District 2010 Douglas-fir tussock moth trapping results, Cibola National Forest; 10/25/10.

12. Sacramento Ranger District 2010 Douglas-fir tussock moth trapping results, Lincoln National Forest; 10/25/10.
13. Potential forest health project, Cuba Ranger District, Santa Fe National Forest; 11/1/10.
14. Santa Clara Douglas-fir tussock moth trapping follow-up site visit, Santa Clara Pueblo; 11/17/10.
15. Proposed FY 2011 forest health project, Coyote Ranger District, Santa Fe National Forest; 11/19/10.

Publications

Ciesla, W.M., Eglitis, A., and R.P. Hanavan. 2010. Pandora Moth (FIDL). Forest Insect and Disease Leaflet 115. U.S. Department of Agriculture, Forest Service.

Ciesla, W.M., and R.P. Hanavan. 2011. Boxelder Bug (FIDL). Forest Insect and Disease Leaflet 95. U.S. Department of Agriculture, Forest Service.

Fowler, J.F., Hull Sieg, C., McMillin, J.D., Allen, K.K., Negrón, J.F., Wadleigh, L.L., Anhold, J.A., and K.E. Gibson. 2010. Development and validation of postfire crown damage mortality thresholds in ponderosa pine. International Journal of Wildland Fire. 19:583–588.

Hansen, E.H., J.F. Negron, A.S. Munson, and J.A. Anhold. 2010. A retrospective assessment of partial cutting to reduce spruce beetle-caused mortality in the Southern Rocky Mountains. West. J. Appl. For. 25(2), 81-87.

Lynch, A.M., J.A. Anhold, J.D. McMillin, S.M. Dudley, R.A. Fitzgibbon, and M.L. Fairweather. 2010. Forest insect & disease activity on the Apache-Sitgreaves N.F., and Fort Apache Indian Reservation, 1918-2009. Formal report submitted to Apache-Sitgreaves NF. 40 p.

Conklin, D.A. and M.L. Fairweather. 2010. Dwarf mistletoes and their management in the Southwest. USDA Forest Service, Southwestern Region, R3-FH-10-01. 23p. http://www.fs.usda.gov/goto/r3/foresthealth

Worrall, J.J., Harrington, T.C., Blodgett, J.T., Conklin, D.A., and M.L. Fairweather 2010. *Heterobasidion annosum* and *H. parviporum* in the southern Rocky Mountains and adjoining states. Plant Disease 94:115–118.

Other Entomology and Pathology Activities in 2010

Bark Beetle Monitoring in Recent Tornado Affected Stands in Arizona

The National Oceanic and Atmospheric Administration and National Weather Service confirmed that at least six tornados occurred during the morning of October 6, 2010 in northern Arizona. The Coconino National Forest, State Trust Lands, Camp Navajo, and various private lands were affected. Four of the tornados occurred approximately 10 miles to the west of Flagstaff traversing in south to north direction. Another significant tornado took place near Highway 87 south of Flagstaff near Clints Well. Preliminary analysis of LANDSAT 7 imagery found approximately 5,868 acres of moderate high to severe damage caused by the tornados over some 50 miles of tornado paths, plus additional areas of low to moderate levels of damage. There was an array of tree damage including windthrown trees with roots still attached to soil, trees snapped off at various heights, and partially windthrown trees that are leaning at various degrees. Certain species of bark beetles are known to infest and have populations increase in storm-damaged trees. Engraver beetles (*Ips* species) in particular are most likely to colonize damaged and down ponderosa pine, have successful brood production, and threaten neighboring undamaged trees. The tornados have created an almost unlimited supply of host material for brood development of Ips over the next couple years. We will be monitoring bark beetle flight and attack activity through the use of pheromone trapping and permanent plots during 2011. Bark beetle flights will begin in April and they will continue to infest storm damaged trees throughout the summer and potentially reach epidemic levels by the end of the summer. If this occurs, adjacent stands could be at risk to mortality from bark beetles.

For more information, contact Joel McMillin.

Monitoring Blister Rust in Arizona

White pine blister rust was first detected in Arizona in 2009, where its current known distribution is limited to the White Mountains in eastern Arizona. Although it is most common in high hazard sites, such as moist canyon bottoms, infected trees were also found in upslope areas in 2010. A project was launched in 2010 in collaboration with Northern Arizona University to establish permanent plots across all National Forests and tribal lands where white pines are present to monitor the progress and impacts of this disease.

For more information, contact Mary Lou Fairweather.

Aspen Monitoring in Arizona

Widespread mortality of aspen occurred across Arizona over the past decade, due largely to long-term drought but also to the advanced age of aspen stands that have not been able to regenerate over the past 100+ years. Permanent survey plots were established in 2003 and 2004 on the Coconino and Apache-Sitgreaves National Forests, respectively, to monitor the impacts on aspen. Mortality was initially very high in lower elevation sites, and continued for several years in mid-elevation sites, before tapering off. Although regeneration through root sprouting occurred to some degree across the study area, browse damage was persistent and no sprouts achieved a meter in height. More recently, permanent plots were established in aspen stands on the south side of the Kaibab National Forest in collaboration with Northern Arizona University. Compared to high elevation sites, low elevation sites have more aspen mortality in all size classes, more aspen mortality in the overstory, more aspen crown dieback, and less density of live overstory aspen.

For more information, contact Mary Lou Fairweather.

Armillaria Root Disease

Our office is collaborating with Rocky Mountain Research Station Research (RMRS) and Northern Arizona University to collect armillaria root rot samples across a wide range of habitat types and identify the species of armillaria using DNA sequencing. Some species of armillaria are known root pathogens while others are merely saprophytes, decaying dead wood. This project will help us to better understand where armillaria are acting as root pathogens causing growth loss and mortality. RMRS will use the host pathogen information to model for future root disease related impacts in connection with the stresses of a changing climate.

For more information, contact Mary Lou Fairweather.

Pandora Moth

A project was initiated in 2010, in collaboration with Northern AZ University, to develop technologies to better monitor, predict and quantitatively assess the risk of pandora moth, *Coloradia pandora* Blake, outbreaks under changing climate and land use patterns that have ultimately resulted in different patterns of fire intensity at a landscape scale. This work will assist in: predicting when and where moth epidemics occur, better understanding of fire characteristics and post-fire effects on this major forest defoliator, and identify an effective sex-pheromone for monitoring pandora moth in the Southwest.

For more information contact Joel McMillin.

Insect and Disease Workshop

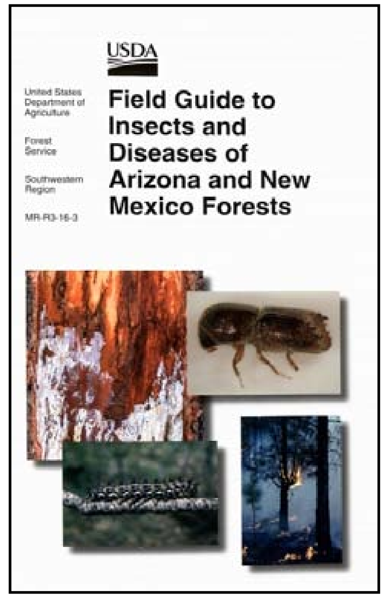
Forest Health Protection staff offers training sessions on the Identification, Effects, and Management of Forest Insects and Diseases in the Southwest at least once a year. In 2010 this workshop was held in Alamogordo, New Mexico. This 2 to 2½-day workshop covers the biology, ecology, effects, and management 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.

Hazard Tree Workshop

We also conduct a workshop titled Hazard Tree Detection, Evaluation, and Management in Recreation Areas, which was launched in 1990 in order to assist Region personnel with responsibilities to reduce hazard trees in developed sites. At least one training/workshop is offered annually, with the location alternating not only between New Mexico and Arizona, but also alternating locations within the states. This has provided the opportunity for each District in the Region to send staff for training, 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 FS legal responsibilities and what does and does not increase the agencies liability. Students really appreciate the question/answer period with the attorney.

For more information, contact Mary Lou Fairweather.

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.

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 (928) 556-2071

GIS program coordinator, Arizona Zone since 1990. Collection, processing, analysis and map production of current year forest insect and disease activity survey data remains the primary GIS task. 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.

Ryan Hanavan (928) 556-2072

Forest entomologist with the Arizona Zone office since 2009. Primary responsibility is providing technical assistance on forest defoliators to land managers. Currently serving as the regional coordinator for the Early Detection Rapid Response Program. Research and technology development interests include using remote sensing, GIS applications, and geostatistics to improve early pest detection and prevention techniques, and for monitoring the impacts of climate change on insect pest activity.

Joel McMillin (928) 556-2074

Forest entomologist, Arizona Zone since 2001. Primary responsibility is providing technical assistance on bark beetle management to land managers. Currently serving on Western Forest Insect Work Conference Executive Committee, Special Technology Development Program Steering Committee, and Asian Lymantriidae Monitoring Program team. Research and technology development interests include: short- and long-term impacts of bark beetles on forest condition, 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 New Mexico Cooperative Forest Health program; Region 3 representative to the STDP Insect Management Working Group; and Region 3 point-of-contact for the FHP International Activities program. Previous work experience in gypsy moth suppression, NEPA compliance, southern pine beetle management, and silviculture.

Dave Conklin (505) 842-3288

Forest pathologist, New Mexico Zone since 1990. Key interests: dwarf mistletoe ecology and management, including effects of fire; white pine blister rust ecology and management; other forest diseases and insects; general forest management. Work experience includes dwarf mistletoe research and monitoring, and involvement in almost 200 forest management projects on National Forest and Tribal lands.

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. Research interests include walnut twig beetle distribution and its role in the spread of thousand canker disease, 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 & FH unit aviation officer, New Mexico Zone since September 2008. Responsibilities include aerial detection surveys, aviation safety and training coordination, and field assistance to staff. Involved with New Mexico Forestry Camp planning, 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.

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/ which includes program overviews and publications links.

Appendix

Instructions for Submitting Insect and Disease Specimens for Identification

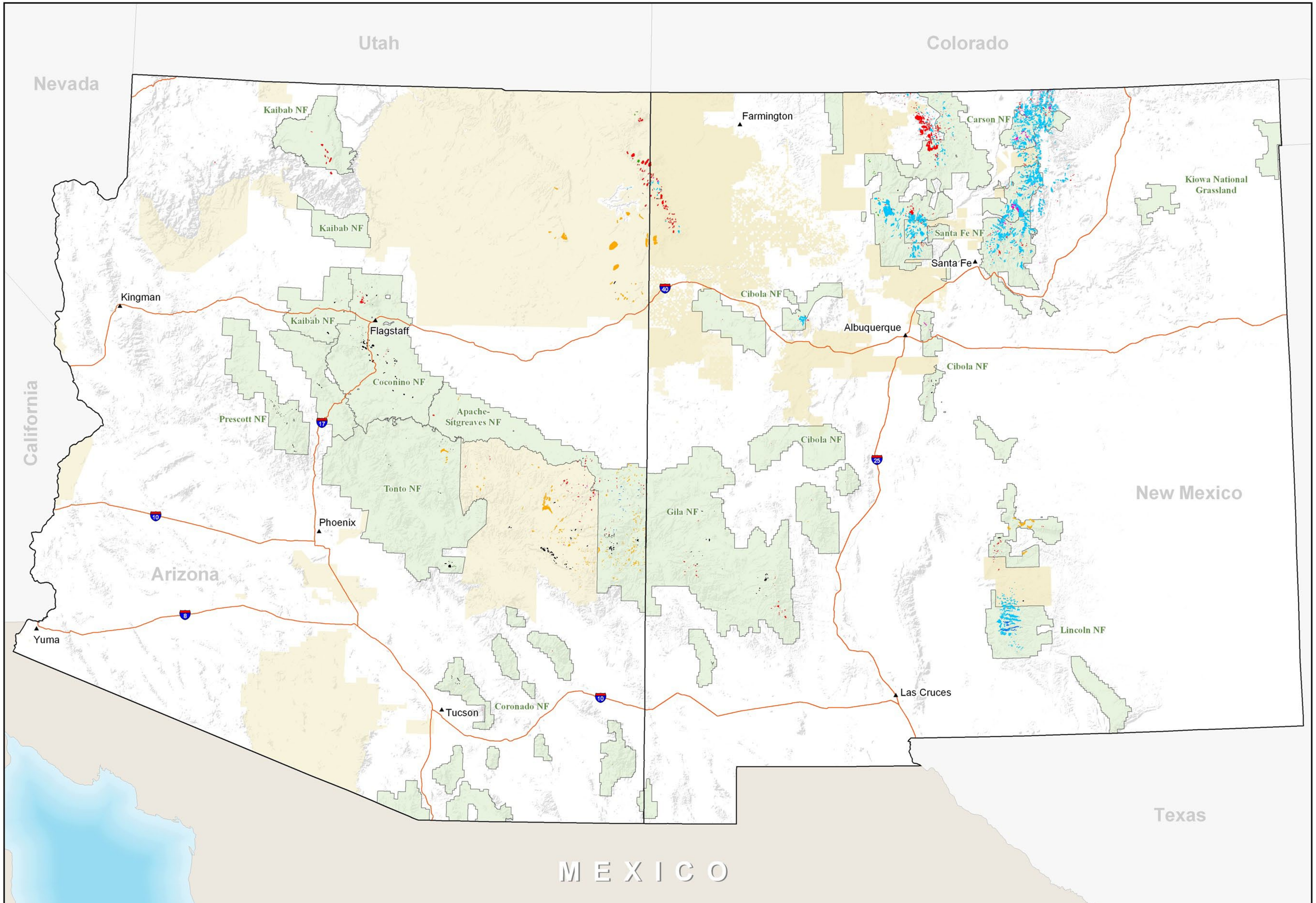
Both zone offices are equipped to receive forest insect or disease specimens submitted from the field for identification. Specimens may be shipped to the appropriate zone office as listed on the title page of this report. The following procedures for collecting and shipping specimens should be used.

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.



National Forest

Tribal lands

Damage Agent*

Western spruce budworm defoliation

Aspen defoliation and mortality

Pinyon needle scale

Ponderosa pine bark beetles

True fir mortality from bark beetles

Douglas-fir tussock moth

Douglas-fir beetle

**Only agents affecting greater than 5,000 acres Region-wide are depicted. Additionally, individual small areas (< 2 acres) not visible at this scale.*

N W E S

0 25 50 100 Miles

Aerial Detection Survey Data Disclaimer

Forest Health Protection (FHP), Arizona State Forestry Division, and the New Mexico State University Cooperative Extension Service strive to maintain an accurate Aerial Detection Survey (ADS) dataset, but due to the conditions under which the data are collected, FHP and its partners shall not be held responsible for missing or inaccurate data. ADS are not intended to replace more specific information. An accuracy assessment has not been done for this dataset; however, ground checks are completed in accordance with local and national guidelines:

http://www.fs.fed.us/foresthealth/aviation/qualityassurance.shtml

Maps and data may be updated without notice. Please cite "USDA Forest Service, Forest Health Protection, Arizona State Forestry Division, and New Mexico State University Cooperative Extension Service" as the source of this data in maps and publications.

This map represents the mortality and defoliation that has occurred since the previous surveys in 2009. Depending upon the timing of survey, the entire extent of some insect and disease activity may not have been detected. In addition, most diseases cause gradual declines in tree health that are not typically detectable during aerial surveys. Intensity of damage is variable, thus not all trees within a mapped area are dead or defoliated. Caution should be used in interpreting these results due to the scale and subjective nature of aerial sketch mapping mapping.

Arizona

Surveys conducted July through September, 2010, by Steve Dudley, Ryan Hanavan, and Daniel Ryerson, Forest Health Office, Southwestern Region, US Forest Service; Aaron Green, Arizona State Land Department, Forestry Division.

New Mexico

Surveys conducted June through September, 2010 by Ryan Hanavan, Daniel Ryerson and Crystal Tischler, Forest Health Office, Southwestern Region, US Forest Service.

Significant Forest Mortality and Defoliation Detected through Aerial Survey

Region 3 - Southwestern Region - 2010

14 March 2010