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Forest Insect and Disease Conditions in the Southwestern Region, 2008

Cover photo: Pandora moth caterpillar collected on the North Kaibab Ranger District, Kaibab National Forest.

Forest Insect and Disease Conditions in the Southwestern Region, 2008

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Conditions in Brief

Based on aerial detection surveys conducted in 2008, both tree mortality from bark beetles and damage caused by defoliators declined compared with 2007. Total bark beetle activity decreased from 146,000 acres in 2007 to 111,000 acres in 2008. About 49,000 acres of ponderosa pine were affected; of which nearly 29,000 acres were located on the Gila National Forest and were associated with post-fire related mortality. Mountain pine beetle activity in southwestern white pine was detected from ground surveys for the first time on the Apache-Sitgreaves National Forests and for only the second time on the Pinaleño Mountains in Arizona. Fir engraver beetle and Douglas-fir beetle caused mortality on about 19,300 acres of mixed conifer forest, which was a significant decrease from the 70,000 acres reported in 2007. Increased mortality in spruce-fir forests (43,500 acres) was mostly attributed to western balsam bark beetle; a very significant die-off of corkbark fir has occurred over the past several years. Relatively little piñon mortality (790 acres) was observed in the piñon-juniper type in 2008.

A variety of defoliators were active throughout region in 2008, but the overall area impacted decreased from more than 860,000 acres in 2007 to approximately 560,000 acres in 2008. Most of this decrease was due to the lack of piñon needle cast disease mapped in New Mexico for 2008 compared with more than 200,000 acres in 2007. Continued needle cast was observed in some locations, but no new affected areas were visible during survey flights. Western spruce budworm activity continued to be high in 2008 with more than 360,000 acres of defoliation recorded. Most of the activity was in the mountains of north-central New Mexico. Douglas-fir tussock moth outbreaks collapsed in the Sandia Mountains, Santa Clara Pueblo and Tonto National Forest. The looper (*Nepytia janetae*) outbreak in the Sacramento Mountains also collapsed in 2008; however, another looper (*Enypia griseata*) defoliated about 2,300 acres of spruce in Arizona's White Mountains. In addition, more than 15,000 acres of mixed conifer defoliation occurred by an unknown agent in the White Mountains on the Apache-Sitgreaves National Forests. Pandora moth was detected in ponderosa pine stands during ground surveys on the North Kaibab Ranger District, Kaibab National Forest. Larval sampling indicates the widespread distribution of low population levels and likely the early stages of an outbreak. Nearly 8,000 acres of an unidentified needle cast were detected in ponderosa pine stands on the Coconino National Forest. Aspen defoliation and/or dieback continued to increase across the region with about 176,000 acres recorded in 2008.

Dwarf mistletoes continue to have a major impact on growth and mortality of conifers in the Southwest. Over one-third of the ponderosa pine acreage and about one-half of mixed conifer acreage has some level of infection. Bark beetle activity is often associated with severe dwarf mistletoe infection. The incidence of dwarf mistletoe changes little from year to year, but is thought to have increased over the past century. Root diseases are widely distributed across the region, especially in higher elevation forests. Root disease increases mortality in all size classes and creates hazards in heavily used areas. No new outbreak areas of white pine blister rust were detected in 2008. This rust was discovered for the first time on the Santa Fe National Forest and in the Zuni Mountains in 2007, and found at several new locations on the Gila National Forest. Blister rust occurs throughout the Sacramento Mountains of southern New Mexico, where it is causing severe damage to southwestern white pine.

Table 1. Prominent 2008 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	4,670	1,190	80	30	5,960
	NM	35,130	2,310	220	5,150	42,800
Ips beetle in piñon pine	AZ	10	20	10	10	50
	NM	240	470	20	10	740
Douglas-fir beetle	AZ	2,080	80	30	--	2,200
	NM	2,160	2,820	320	4,880	10,180
True fir beetles	AZ	2,390	--	--	--	2,390
	NM	38,780	730	50	8,090	47,640
Western spruce budworm	AZ	--	2,160	--	--	2,160
	NM	262,120	23,900	80	73,910	360,010
Aspen damage***	AZ	80,790	13,860	28,480	--	123,130
	NM	33,990	1,050	210	17,770	53,010
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 2008*.

	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	80			3,180	< 5	840	< 5	1,390	650	6,140
Coconino NF	70			560		700		1,000		2,310
Coronado NF	< 5	< 5	30	< 5	< 5	300		< 5	< 5	350
Kaibab NF	90			340	< 5	110		20		560
Prescott NF	10			240	< 5	60			< 5	330
Tonto NF	< 5			50	< 5	70				130
Grand Canyon NP	10			30	< 5	20				60
Saguaro NP			< 5	< 5						10
Walnut Canyon NM	< 5					10				10
BLM	20			10	< 5				< 5	40
Fort Apache Tribal	100			890	< 5	20	< 5		10	1,020
Hualapai Tribal	10			< 5	< 5				< 5	10
Navajo Tribal	40			60	< 5	60	< 5		10	170
San Carlos Tribal	30			70	10	< 5			< 5	110
Navajo-Hopi JUA					< 5					< 5
State & Private				30	10					30
Arizona Total	**460**	**< 5**	**40**	**5,470**	**30**	**2,200**	**< 5**	**2,390**	**670**	**11,250**
Carson NF	50			< 5	< 5	390		17,850		18,300
Cibola NF	590			1,600	10	20		1,110		3,310
Gila NF	2,310			30,670	10	110	< 5	940		32,550
Lincoln NF	50			670	220	70		430		1,440
Santa Fe NF	470			10		1,550	380	18,420		20,840
Valles Caldera NP	< 5					20		20		50
BLM	< 5			60	< 5	300		50		370
Bandelier NM						20				20
El Malpais NM				150						150
Other Federal	< 5			< 5	20	< 5				20
Acoma Pueblo	20			10	< 5					30
Isleta Pueblo	< 5			250		< 5				250
Jemez Pueblo	< 5									< 5
Jicarilla Apache	20			< 5		2,350		60		2,420
Mescalero Apache	160			1,210	20			100	20	1,500
Navajo Tribal				< 5						< 5
Other Tribal				190						190
Picuris Pueblo										0
Ramah Navajo				< 5	< 5					< 5
Santa Clara Pueblo						100				100
Taos Pueblo						360		570		940
Zuni Pueblo				450	450	< 5				460
State & Private	4,120			1,020	10	4,880		8,090		16,980
New Mexico Total	**7,790**	**< 5**	**0**	**36,310**	**740**	**10,180**	**380**	**47,640**	**20**	**99,930**
SW Region Total	**8,250**	**< 5**	**40**	**41,780**	**770**	**12,380**	**380**	**50,030**	**690**	**111,180**

* Values rounded to the nearest 10; 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 2008*.

	Western Spruce Budworm	Unknown Defoliator**	Aspen Damage***	Loopers (*Enypia* & *Nepytia*)	Needle Cast	Drought	Defoliation Total****
Apache-Sitgreaves NFs		12,540	8,820	480			21,840
Coconino NF			6,670		7,940	130	14,740
Coronado NF			100				100
Kaibab NF			65,200			1,740	66,940
Prescott NF							0
Tonto NF							0
Grand Canyon NP			28,480				28,480
Saguaro NP							0
Walnut Canyon NM							0
BLM							0
Fort Apache Tribal		3,210	10,180	1,870			15,260
Hualapai Tribal							0
Navajo Tribal	2,160		3,680				5,840
San Carlos Tribal							0
State & Private							0
Arizona Total	**2,160**	**15,750**	**123,130**	**2,350**	**7,940**	**1,870**	**153,260**
Carson NF	162,340		18,270				180,610
Cibola NF	3,660		1,210				17,440
Gila NF	2,410	100	4,120				6,760
Lincoln NF	11,880		1,090				12,970
Santa Fe NF	73,160		8,300				81,460
Valles Caldera NP	8,670		990				9,660
BLM	80		50				130
Bandelier NM			160				160
El Malpais NM							0
Other Federal							0
Acoma Pueblo							0
Isleta Pueblo							0
Jemez Pueblo	90						90
Jicarilla Apache	3,410		170				3,580
Mescalero Apache	10,710		170				10,890
Navajo Tribal							0
Other Tribal	30						30
Picuris Pueblo			50				50
Ramah Navajo							0
Santa Clara Pueblo	430		30				460
Taos Pueblo	9,230		630				9,860
Zuni Pueblo							0
State & Private	73,910		17,770				91,250
New Mexico Total	**360,010**	**100**	**53,010**	**0**	**0**	**0**	**425,390**
SW Region Total	**362,170**	**15,850**	**176,140**	**2,350**	**7,940**	**1,870**	**578,650**

* Values rounded to the nearest 10; 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").

** Defoliation of Douglas-fir and white fir was observed during aerial surveys, but ground surveys were unable to identify the damaging agent.

*** 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 Insects

Bark Beetles

Nearly all conifer mortality mapped during aerial survey is attributed to bark beetles. While bark beetles are primary tree killers in the region, mortality is most often a result of multiple factors, which may include disease, other insects, and abiotic factors such as drought. An additional consideration in interpreting aerial survey results is that the acreages reported represent areas where significant tree mortality occurred; often the mortality within these areas is quite scattered. The proportion of host trees actually killed within each area (polygon) 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; in New Mexico, western pine beetle. Since both *Ips* and western pine beetle (and others, including roundheaded pine beetle) are often active in the same area and frequently attack the same tree, the "mortality agent" attributed to a particular area is often a matter of interpretation. In the mixed conifer and spruce-fir forest types, distinguishing host trees and hence, the particular beetle, can be difficult during aerial surveys. The accuracy of our determinations may vary—both from area to area and year to year—and are influenced by how much ground checking was accomplished.

The narratives which follow describe overall conditions and trends; site and landowner information is summarized in tables 2 and 3. In addition to reporting damage estimates for individual bark beetle species, we include summaries and recent trends by major forest type, which overcomes some of the difficulties inherent in identifying species from an airplane.

Western Pine Beetle

Dendroctonus brevicomis
Primary host: Ponderosa pine

Tree mortality attributed to this beetle more than doubled in 2008, with about 8,300 acres of activity mapped compared with about 3,300 acres in 2007; however, this level of activity is still well below what occurred annually between 2000 and 2006. Most of the western pine beetle-caused tree mortality was reported on the Gila National Forest (2,310 acres) and State and private lands (4,120 acres) in New Mexico.

Note that some of the apparent decrease in 2007 is a result of attribution: about 30,000 acres of scattered pine bark beetle activity on the Gila National Forest was attributed to *Ips* beetles rather than western pine beetle as in previous years.

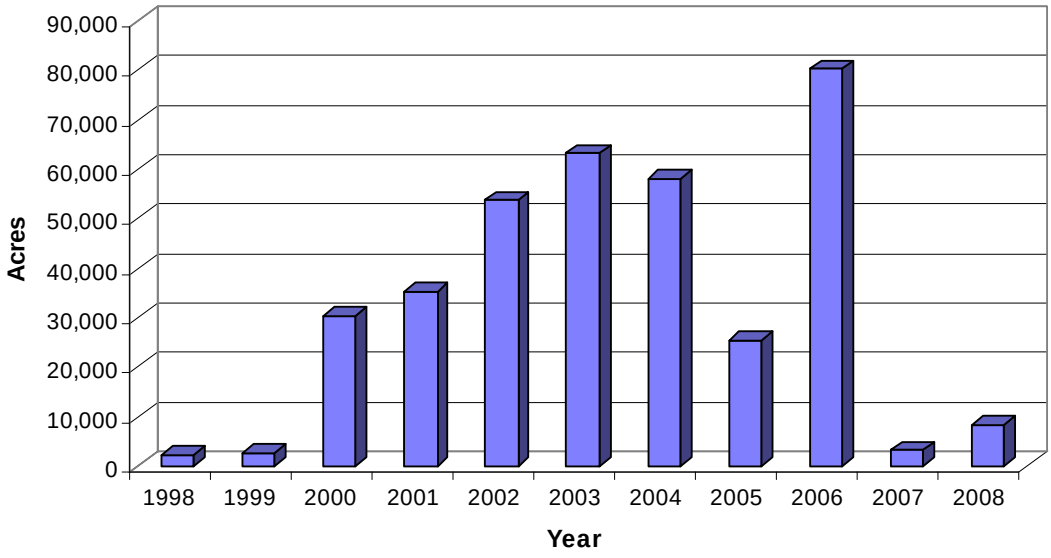

Figure 1. Western pine beetle activity in Arizona and New Mexico, 1998-2008.

Mountain Pine Beetle

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

Only 3 acres of activity was reported in the region and that occurred on the Coronado National Forest in Arizona. This was the first report of mountain pine beetle activity on the Coronado since the early 1970s, which occurred in the Riggs Lake area on the Safford Ranger District. In addition, mountain pine beetle was found attacking fire-scorched southwestern white pine near the border of the Alpine and Clifton Ranger Districts, Apache-Sitgreaves National Forests during a 2008 site visit. This was the first known report of mountain pine beetle on that forest.

Figure 2. Egg and larval galleries of mountain pine beetle in southwestern white pine attacked on the Apache-Sitgreaves National Forests.

Historically, mortality caused by this insect was limited primarily to the Kaibab Plateau in northern Arizona, although some activity affecting limber pine has been observed from the ground on the San Francisco Peaks and Kendrick Mountain near Flagstaff. Its occurrence in New Mexico has been infrequent; some of the 1998-2002 activity indicated in figure 3 from northern New Mexico was probably western pine beetle and roundheaded pine beetle.

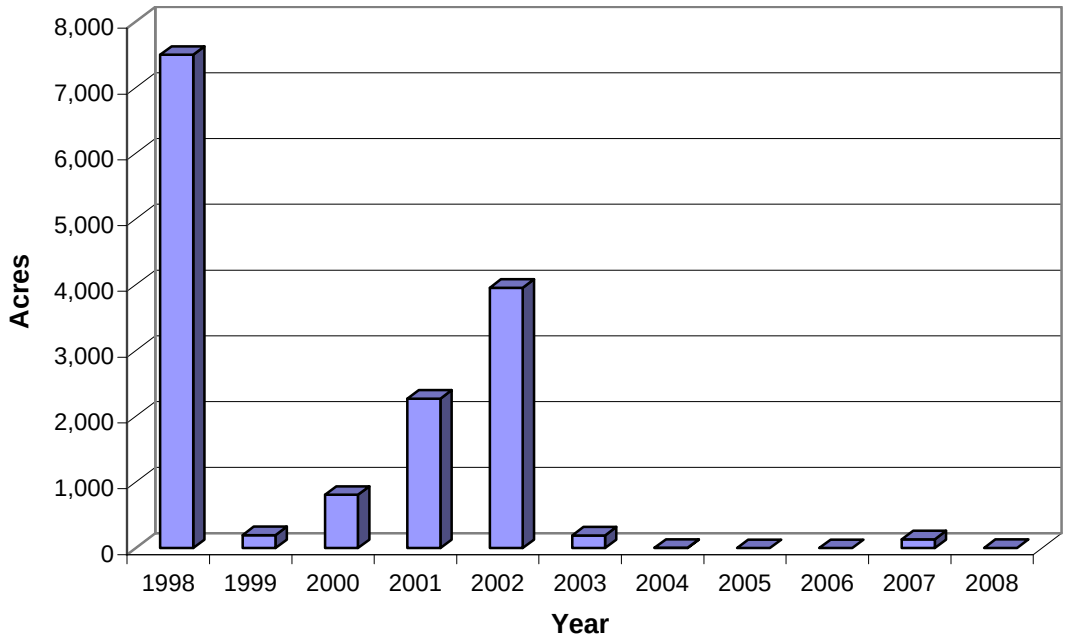

Figure 3. Mountain pine beetle activity in Arizona and New Mexico, 1998-2008.

Roundheaded Pine Beetle

Dendroctonus adjunctus
Primary host: Ponderosa pine

Tree mortality caused by roundheaded pine beetle remained at low levels, with only about 40 acres of activity observed in 2008 compared with 120 acres in 2007. All areas affected were in southeastern Arizona, including the Coronado National Forest and Saguaro National Park (Rincon Mts.). Roundheaded pine beetle has a fairly wide distribution in the region, is often associated with other bark beetles, and may be active in areas where mortality is attributed to other species. However, southeastern Arizona and the Sacramento Mountains of southern New Mexico have been the primary foci of this insect. In addition, roundheaded pine beetle activity has been observed in dense, second-growth stands west of the San Francisco Peaks, Coconino National Forest from 2006 through 2008.

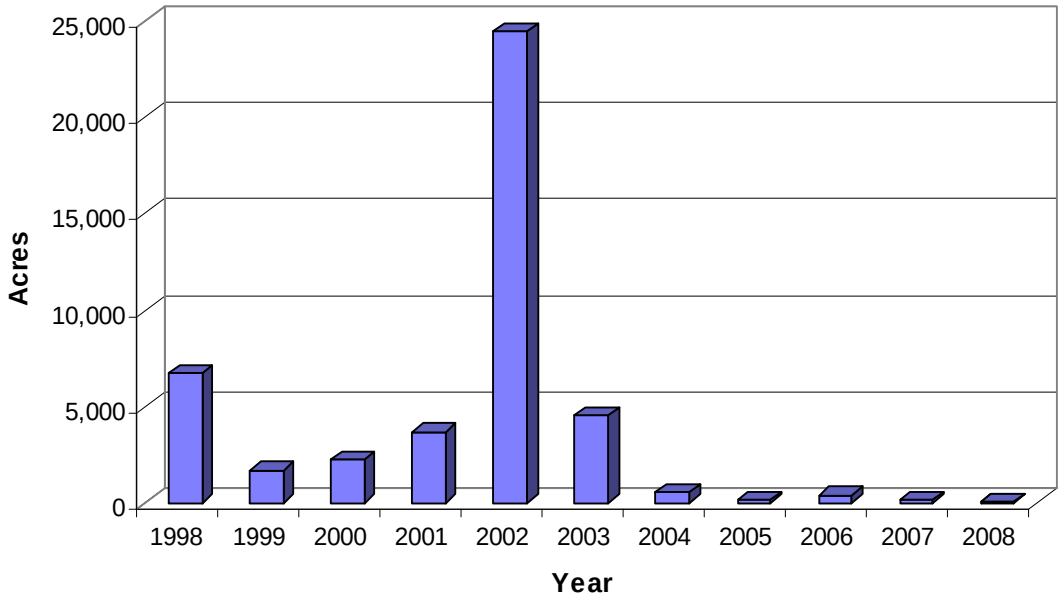

Figure 4. Roundheaded pine beetle activity in Arizona and New Mexico, 1998-2008.

Ips Beetles

Ips spp.
Primary hosts: Ponderosa pine, piñon

Ponderosa pine mortality attributed to *Ips* beetles increased across the region in 2008, with about 42,000 acres mapped vs. 34,000 acres in 2007. Most of this activity occurred on areas recently impacted by fire within the Gila National Forest in New Mexico, but there was also an increase in activity on the Apache-Sitgreaves National Forests in Arizona. An increase in activity of *I. lecontei* was observed from the ground on the Prescott National Forest during the fall of 2007 and early 2008.

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*, *I. latidens*, and *I. knausi*.

Figure 5. *Ips lecontei* activity in ponderosa pine on the Prescott National Forest in Arizona.

Piñon mortality, caused primarily by *Ips confusus*, was detected on about 770 acres across the region compared with 4,500 acres in 2007. Most of the recorded activity in 2008 occurred on the Lincoln National Forest and Zuni Pueblo in New Mexico. Piñon mortality decreased substantially in most other areas.

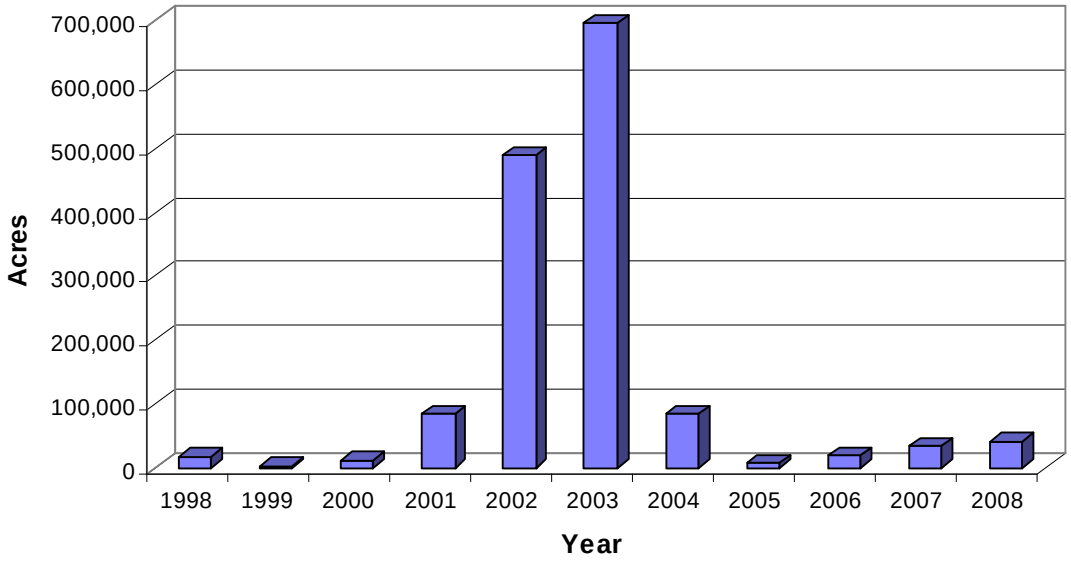

Figure 6. Ips beetle activity in ponderosa pine in Arizona and New Mexico, 1998-2008.

Douglas-fir Beetle

Dendroctonus pseudotsugae
Host: Douglas-fir

Douglas-fir beetle activity continued at nearly the same level regionwide, with about 12,400 acres of activity observed in 2008 versus 14,000 acres the previous year. Overall, activity decreased in Arizona, but increased in New Mexico. The largest increase occurred on Jicarilla Apache tribal lands.

Note that some acreage depicted in figure 7 from peak years (2003-2005) was later determined to represent fir engraver beetle activity (white fir mortality) rather than Douglas-fir beetle. Also note that while Douglas-fir mortality is generally attributed to Douglas-fir beetle, other agents including dwarf mistletoe, armillaria root disease, Douglas-fir engraver (*Scolytus monticolae*), and Douglas-fir pole beetle (*Pseudohylesinus nebulosus*) may also contribute significantly on some sites.

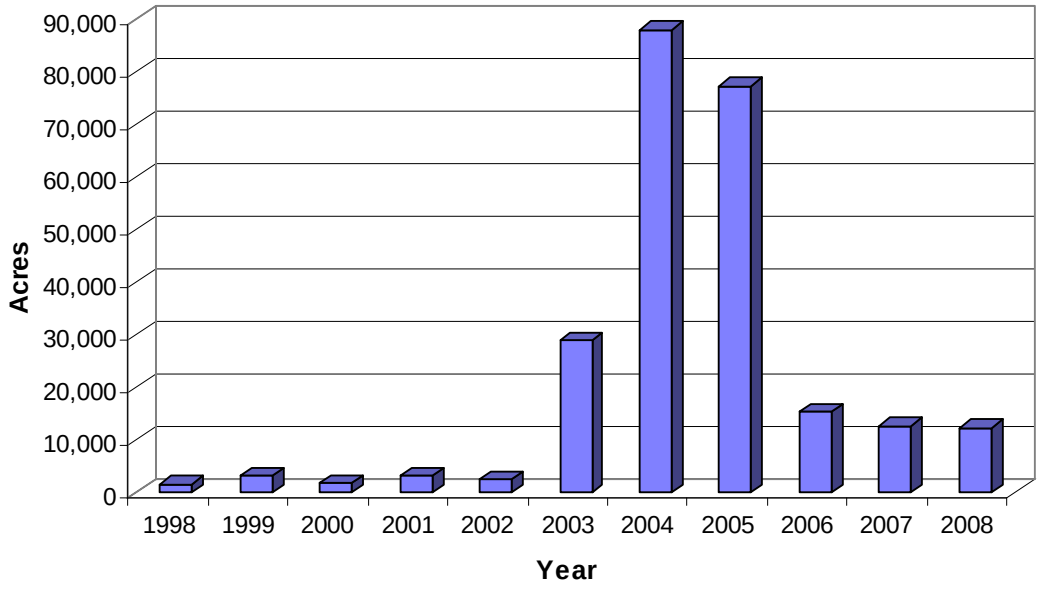

Figure 7. Douglas-fir beetle activity in Arizona and New Mexico, 1998-2008.

True Fir Beetles

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

Figure 8. Corkbark fir mortality in the Sandia Mountains.

Mortality of true firs decreased throughout the region in 2008 to 50,000 acres affected compared with 92,500 acres in 2007. True fir mortality had been increasing over most of the last decade and 2008 numbers are the lowest since 2002. More than 90 percent of this mortality occurred in New Mexico. There was a significant decrease in fir engraver activity in New Mexico from 49,000 acres in 2007 to about 4,800 acres in 2008; however, there was also a slight increase in western balsam bark beetle activity to about 43,000 acres from 35,000 acres. Mortality of true firs occurred most frequently on the Carson and Santa Fe National Forests in northern New Mexico. In Arizona, most true fir mortality was observed on the Apache-Sitgreaves National Forests. Past studies have shown that fir mortality may be associated with root disease.

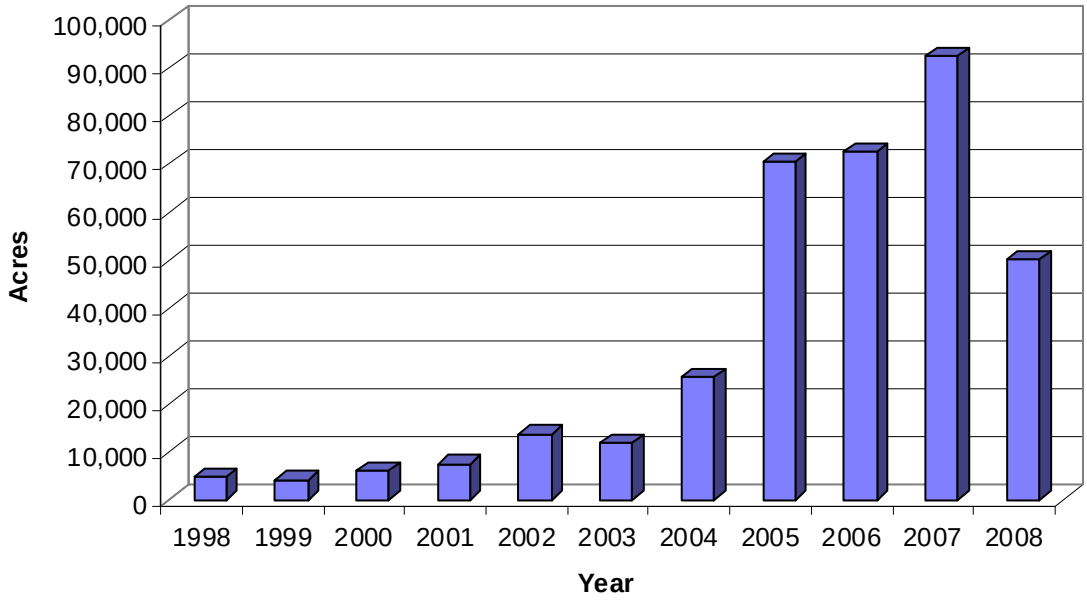

Figure 9. Fir engraver and western balsam bark beetle activity in Arizona and New Mexico, 1998-2008.

Spruce Beetle

Dendroctonus rufipennis
Host: Spruce

Spruce beetle activity continued to decrease across the region from 870 acres in 2007 to approximately 380 acres in 2008. Some of the recent decrease is a result of attribution: recent ground checking in New Mexico has confirmed that faders in spruce-fir type have usually been corkbark fir rather than spruce. Nearly all of the spruce beetle activity mapped in 2008 was on the Santa Fe National Forest, in northeastern portion of the Pecos Wilderness. A high wind event on the San Francisco Peaks of the Coconino National Forest during October 2007 resulted in windthrow of large diameter spruce, which became infested in 2008. However, aerial detection surveys in 2008 did not report any new spruce beetle activity in this area.

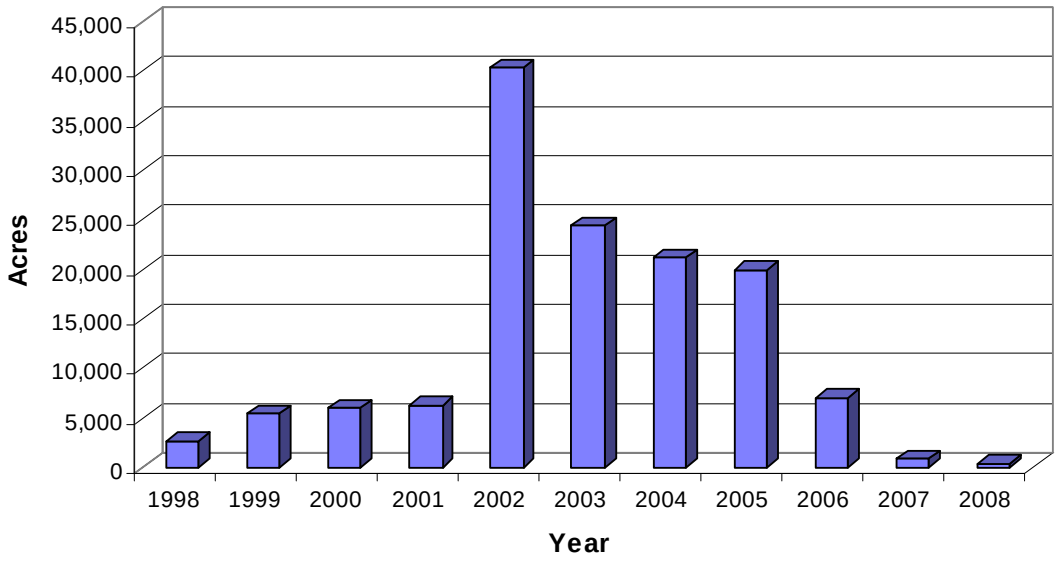

Figure 10. Spruce beetle activity in Arizona and New Mexico, 1998-2008.

Summary by Major Forest Types

In comparing damage (acres affected) and trends within and among forest types, one should keep in mind the relative proportion of land within each type. In Region 3, 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: Regionwide, ponderosa pine mortality increased in 2008 with about 49,000 acres mapped compared to 38,000 acres in 2007. These levels are well below what occurred in 2003 when 763,000 acres were mapped. As in recent years, much of the mortality observed was widely scattered, affecting large areas but relatively few trees. Similar to 2007, more than onehalf of the affected area in 2008 was on the Gila National Forest with post-fire mortality from bark beetles and other agents continuing in recent fire locations.

Figure 11. Ponderosa pine mortality on Gila National Forest following a 2006 wildfire.

Mixed conifer: Mixed conifer forests continued to experience high mortality levels in 2008 compared with late 1990 levels; however, both Douglas-fir and white fir mortality levels decreased from 2007. An estimated 19,300 total acres were affected in 2008 compared with 66,000 acres in 2007. A peak level of about 141,000 areas was mapped in 2005. New Mexico—which has the greater share of this forest type—has sustained most of this damage, although both states have seen similar trends. Over the past few years white fir has experienced more mortality, but in 2008 more Douglas-fir mortality was recorded.

Mortality in the mixed conifer type across the region has occurred at perhaps the highest rate ever observed over the past 4 to 5 years. Interestingly, as mortality in the ponderosa pine and piñon types generally tapered off to pre-drought levels after 2003, mortality in the higher elevation forests accelerated—and has remained at relatively high levels to the present. In general, heavy mortality in the higher elevation forests was somewhat delayed compared to that in the lower elevation forests (which peaked in 2002-2003), but has been more prolonged.

Spruce-fir: Mortality was mapped on about 43,500 acres of spruce-fir type in 2008, an increase from 38,000 acres in 2007. Ground checking on both national forest and private lands in New Mexico has confirmed that most faders observed from the air have been corkbark fir, rather than spruce. High levels of corkbark fir mortality have occurred throughout much of the region the past few years, more or less synchronous with that observed in white fir. Most of this damage has occurred in New Mexico (which has the most host type), but high elevation forests of Arizona have also been affected.

Defoliators

Western Spruce Budworm

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

Budworm activity continued to be high in 2008, with about 362,170 acres of defoliation mapped regionwide compared with 455,000 acres in 2007. The bulk of the activity occurred in northern New Mexico, which has the largest share of the region's host type and where budworm has been chronic for decades. The outbreak on the Sacramento Mountains in southern New Mexico continued, although aerial detection identified activity on approximately 12,000 acres compared to 26,500 in 2007. An outbreak on Navajo tribal lands (Chuska Mountains) declined from 8,000 acres in 2007 to about 2,160 acres in 2008.

Figure 12. Western spruce budworm defoliation in northern New Mexico.

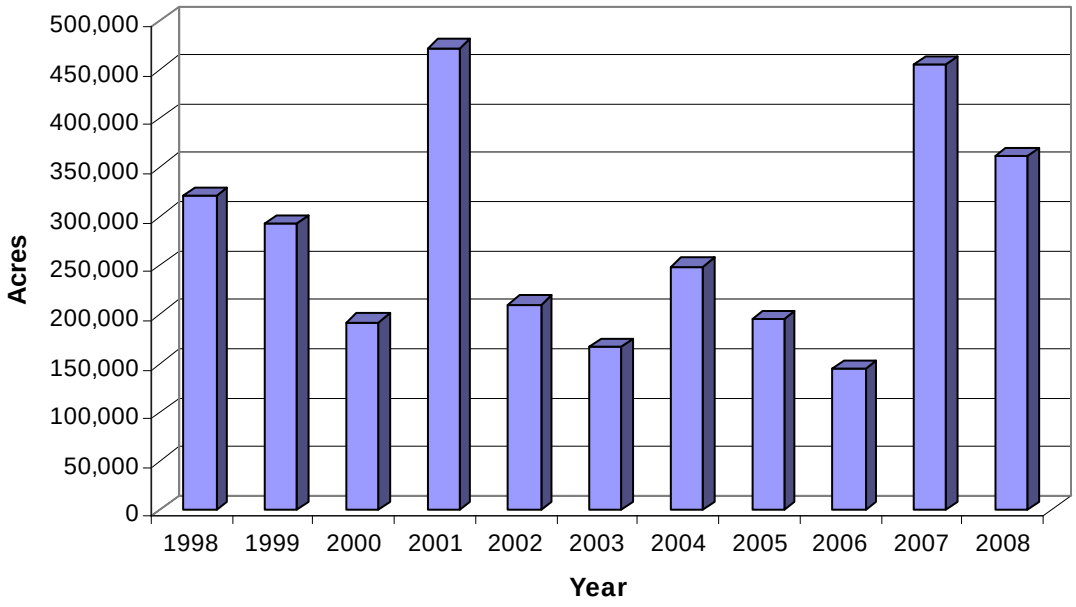

Figure 13. Western spruce budworm activity in Arizona and New Mexico, 1998-2008.

Douglas-fir Tussock Moth

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

No new acres of Douglas-fir tussock moth defoliation were recorded in 2008. The outbreaks on the Tonto and Cibola National Forests and on Santa Clara Pueblo all collapsed.

Nepytia janetae

Hosts: Douglas-fir, white fir

The recent outbreak in the Sacramento Mountains in New Mexico collapsed and no new defoliation was observed during the 2008 surveys. Outbreaks of this looper have also caused considerable mortality on Mount Baldy in the White Mountains of Arizona in the middle to late 1990s and damage and mortality in the Pinaleño Mountains in the 1990s.

Mountain Girdle

Enypia griseata
Host: Engelmann spruce

During the last decade, there have been outbreaks by native defoliators in high elevation forests of the region that have not previously had recorded outbreaks. These defoliators are primarily geometrids (also called inchworms or loopers). The latest outbreak is being caused by a looper called the mountain girdle, *Enypia griseata*, now defoliating spruce and fir trees on Mt. Baldy. The common name presumably refers to the shape of the lines on the adult forewings that

reminded someone of the shape of a woman's girdle. This insect is known to occur from Arizona into Canada. The defoliation in Arizona was first recorded on 500 acres during our 2007 aerial detection surveys. Looper larvae were observed feeding on spruce and fir trees. Described as innocuous in other areas where it is endemic, tree mortality (especially in spruce) is occurring in Arizona where heavily defoliated trees are subsequently attacked and killed by spruce beetle. Aerial detection survey in 2008 showed that the impacted area had increased to 2,355 acres. Study plots have been initiated to determine the impacts and biology of this insect in Arizona.

Figure 14. *Enypia* looper defoliation in the White Mountains of Arizona (foreground). Mortality along the ridge and mountaintops was caused by prior *Nepytia janetae* defoliation.

Spruce Aphid

Elatobium abietinum
Host: Spruce

Although a notable upswing in activity was detected in 2007, with almost 900 acres of damage mapped on the Apache-Sitgreaves National Forests in Arizona, no new activity was reported in 2008. An outbreak was also observed from the ground on the south side of Bearwallow Mountain in 2007 on the Gila National Forest in New Mexico, where at least a few hundred acres were affected.

Ponderosa Pine Needle Miner

Coleotechnites ponderosae

For the second year in a row, no needle miner activity was detected by aerial survey in Arizona or New Mexico.

Pine Sawflies

Neodiprion spp., *Zadiprion* spp.

Pine sawfly defoliation of ponderosa pine continued in 2008 on the Apache-Sitgreaves NFs, Arizona. The species primarily responsible appeared to be *Neodiprion ventralis*. More than 700 acres along Highway 260 between Pinedale and Overgaard were affected in 2007. Several hundred acres of ponderosa pine on San Carlos tribal lands were also defoliated by pine sawflies in 2007.

Piñon Needle Scale

Matsucoccus acalyptus

Piñon needle scale is a chronic defoliator of piñon at several locations in the woodlands of Arizona and New Mexico, with intensities varying from year to year. About 12,800 acres of defoliation attributed to needle scale were mapped in 2008 on the Magdalena Ranger District of the Cibola National Forest and adjacent private lands in New Mexico. This is a decrease in area from the 33,000 acres impacted in 2007.

In Arizona, there was an increase in 2007 scale populations in the Payson area based on ground observations. Additional spread of this population occurred in areas near this community in 2008, with an estimated 360 acres of piñon infested in the Upper and Lower Round Valley areas south of Payson.

Pandora moth

Coloradia pandora

An increase in pandora moth activity was detected from ground surveys on the North Kaibab Ranger District, Kaibab National Forest in late summer 2008. Numerous adult moths were observed at Jacob Lake apparently attracted to lights at the service station and lodge. Subsequent ground surveys found pandora moth larval colonies widespread throughout forested areas on the district. This insect overwinters in the larval stage and will complete its feeding by mid-June 2009. The New Mexico zone office also received reports of pandora moth occurring in piñon woodlands during 2008.

Figure 15. Female pandora moth with eggs on gas pump at Jacob Lake, AZ (above). Early instar caterpillars feeding on ponderosa pine on the North Kaibab Ranger District, Kaibab National Forest (right).

Aspen Dieback/Defoliation/Decline

Weather-related Damage
Western Tent Caterpillar, *Malacosoma californicum*
Other Insects and Diseases

Aspen damage was detected on about 176,000 acres regionwide in 2008, which is an increase from 143,000 acres reported in 2007. Arizona again suffered the majority of this damage (123,130 acres), some of which has been a continuing problem related to the severe drought of recent years. Significant mortality has occurred in central Arizona, particularly in aspen stands located below 8,500 feet elevation.

Figure 16. Aspen defoliation caused by western tent caterpillar in northern New Mexico in 2008.

Defoliation in New Mexico was detected on 34,560 acres, including some caused by western tent caterpillar. However, over the past couple of years, especially in 2007, discrete patches of aspen mortality were observed throughout the State. Efforts were made during the 2007 and 2008 aerial surveys in New Mexico to distinguish these areas from those affected by defoliation alone. Aspen mortality/dieback was mapped on 18,500 acres in 2008, up from almost 7,000 acres in 2007. More than half of these acres (9,820 acres) occurred on the Carson National Forest.

Status of 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 region, each with a different primary tree host. Three species—those affecting ponderosa pine, piñon, 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.

Damage from dwarf mistletoes includes growth reduction, distortion (i.e. witches' brooms), and decreased longevity. Essentially, these parasites re-allocate growth to infected portions of the tree at the expense of the rest of the tree. Severe infection can kill trees directly or predispose them to other agents, especially bark beetles. All size classes are affected; effects on regeneration can be substantial.

Regionwide, dwarf mistletoes cause an estimated 25 million cubic foot loss in timber production annually. In most years, dwarf mistletoe infestation represents more loss to timber resources in the Southwest than do insects. Extensive dwarf mistletoe infestation can also increase fire hazard. On the other hand, as a natural part of the forest, dwarf mistletoes play an important ecological role and benefit some wildlife species.

Figure 17. Male and female (with fruit) ponderosa pine dwarf mistletoe plants.

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, and overall incidence changes little from year to year. Thus, infestation is best described as a chronic situation rather than an outbreak or epidemic. However, because of fire suppression and selective cutting, the overall incidence of dwarf mistletoes has probably increased over the past century.

True Mistletoes

Phoradendron spp.
Hosts: Junipers, various hardwoods

Several species of true mistletoe occur in the Southwest. *P. 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 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 generally 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. In addition to causing disease, the fungus is a common decayer of dead woody material (a saprophyte).

Annosus Root Disease

Heterobasidion annosum
Hosts: Most conifers

Annosus root disease is likely the second most common root disease in the Southwest. There are two variants of this fungus; one has a regional host range that includes white fir, subalpine fir, and Engelmann spruce and is known as the "S" type, and the other variant has been found only in ponderosa pine and is known as the "P" type. Overall losses from annosus in the Southwest are low and observed mainly in true fir. 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.

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 hazards 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; **rust-red stringy rot**, *Echinodontium tinctorium*, on white fir; **aspen trunk rot**, *Phellinus tremulae*; and *Inocutis dryophilus* on oak.

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

No new outbreak areas were detected in 2008. However, recent detection of blister rust in northern and western New Mexico suggests that a major expansion may occur over the next several years. Blister rust continues to cause heavy damage to white pines in the Sacramento Mountains of southern New Mexico. It has yet to be found in Arizona, despite ongoing surveys.

Cones were collected from 54 white pines on the Lincoln, Cibola, and Santa Fe National Forests in 2008 for resistance testing—see "Activities" section for more details.

Figure 18. White pine blister rust infection.

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 these easily recognized diseases 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.

Limb Rust

Cronartium arizonicum
Host: Ponderosa pine

This disease is common in parts 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.

Limb rust was seen at several locations in the Jemez Mountains of northern New Mexico in 2008. It was especially common in the Borrego Canyon area, about 3 miles northeast of Paliza Campground. Symptoms were mostly observed on older trees. It appears that a major wave of infection occurred in this area several years ago, resulting in the recent visible damage.

Figure 19. Limb rust infection on ponderosa pine.

Comandra Blister Rust

Cronartium comandrae
Host: Pines

This disease has caused extensive branch dieback and mortality of nonnative Mondell/Afghan pine (*Pinus eldarica*) in the Prescott, Payson, and Sedona areas of central Arizona. It occasionally infects small, native ponderosa pines in this area, but has caused minimal damage to this species.

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.

Foliage Diseases

Piñon Needle Cast

No new acres of piñon needle cast were observed during the 2008 aerial surveys; however, a major outbreak of piñon needle cast was observed in southern New Mexico in 2007. It occurred throughout most of the host type in the Sacramento Mountains and was also widespread on the Gila National Forest. It was seen much less frequently in northern and central New Mexico, but was found as far north as Raton. Entire landscapes near Ruidoso, Mescalero, Mayhill, and Weed (Sacramento Mts.) were affected. Overall, more than 200,000 acres with damage were mapped during the aerial surveys. Some continued needle cast activity was observed on the ground in 2008.

Little is known about this disease, and the taxonomy of the causal agent(s) has been obscure. Signs and symptoms resemble those of the better known *Dothistroma* needle blight on hard pines (subgenus *Pinus*); the primary pathogen appears to be a previously undescribed species within this genus. Another fungus, a *Pestalotia* sp., has also been consistently found in samples and may well be an accomplice.

A very wet summer in 2006 may have provided ideal conditions for this outbreak, with symptoms becoming most apparent the following spring. Most affected trees are expected to recover. A similar, but somewhat less severe outbreak of piñon needle cast occurred in New Mexico in the early 1990s.

We thank Roger Peterson, Amy Rossman and Jack Rogers for helping us identify the fungi.

Ponderosa Pine Needle Cast

Lophodermella cerina and other species

Nearly 8,000 acres of an unidentified needle cast on ponderosa pine was detected in an area extending from Kendrick Mountain northeastward to Fern Mountain, Coconino National Forest. Within this area, approximately 1,000 acres bordering meadows were severely impacted.

No needle cast was detected in New Mexico in 2008. About 4,900 acres of affected area were mapped in 2007, mostly on State and private lands in northeastern

Figure 20. Ponderosa pine needle cast on the Coconino National Forest near Flagstaff, AZ.

New Mexico. Ground checking in some of these areas confirmed that a fungal disease was the most likely cause of the discoloration and defoliation.

Figure 21. Elytroderma infections on ponderosa pine.

Elytroderma Needle Cast

Elytroderma deformans

A significant localized outbreak of Elytroderma was observed on the Jicarilla Apache Reservation in 2008. The affected site was in Wells Canyon, about 7 miles south of Dulce. Most of the ponderosa pines within a 5- to 10-acre area along the canyon bottom were infected. These trees displayed characteristic curved, upturned branching and other deformities. A few trees had dense, globular witches' brooms. Little, if any, tree mortality has been associated with this outbreak.

Abiotic Damage

Salt

Salt damage is widespread in Arizona. Damage from dust abatement salt (magnesium chloride) was noted in the White Mountains of Arizona, affecting ponderosa pines, spruces, aspens, and other species near the communities of Greer, Nutrioso, and Alpine. Deicing salt damage is common in ponderosa pine located along roadways on the Apache-Sitgreaves, Coconino, and Kaibab National Forests and White Mountain Apache Reservation, causing defoliation and mortality.

Drought

Discoloration and damage of ponderosa pine and other vegetation attributed to drought was mapped on approximately 1,870 acres during 2008 in Arizona, which was down from 9,400 acres in 2007. This damage was mapped primarily on the Coconino and Kaibab National Forests.

Other Forest Insect and Disease Reports

Cypress/juniper bark beetle (*Phloeosinus* spp.) activity was recorded from aerial surveys recorded on 650 acres on the Apache-Sitgreaves National Forests and in low numbers across tribal lands of eastern Arizona.

Juniper twig pruner (*Styloxus bicolor*) activity was common in south-central New Mexico in 2008, following a dry winter.

Juniper rust (*Gymnosporangium* spp.) infections appeared to be causing considerable branch flagging on rocky mountain juniper along Canjilon Creek on Carson National Forest.

Tiger moth (*Lophocampa ingens*) activity was low throughout the Southwest in 2008.

Fall webworm (*Hyphantria cunea*) defoliation occurred on many different host trees at several locations in Arizona in 2008, including in Gila County on walnuts. This insect was also found at several locations above the Mogollon Rim, and has perhaps increased its range in recent years in response to mild winters. In New Mexico, notable webworm activity continued to be seen on riparian hardwoods and landscape trees in many areas.

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

Dwarf mistletoe (*Arceuthobium vaginatum* subsp. *cryptopodum*) was found on an Austrian pine in Strawberry, Arizona, only the second report of infection on this species. Other nonnative landscape trees with known susceptibility include Mugho and Scotch pines.

Twig beetles (*Pityophthorus* spp., *Pityogenes* spp., *Pityotrichus* spp, *Pithocanthus erectus*), which, along with *Ips confusus*, caused extensive damage to piñon during drought years, have generally been much less active the past 2 to 3 years. About 260 acres of activity was mapped during 2008 aerial surveys in New Mexico on national forest, tribal and state and private lands. Both ponderosa pine and piñon were damaged throughout portions of central New Mexico in 2008.

Biological Evaluations and Technical Assistance

Arizona Zone

1. Aspen decline on the Coconino NF, Coconino National Forest; 1/28/08.
2. Insects and pathogens in Silviculture Certification Stand, Springerville Ranger District, Apache-Sitgreaves National Forests; 3/04/08.
3. Dwarf mistletoe and other insect and disease activity in the Rim Lakes Forest Health Project Area, Black Mesa Ranger District, Apache-Sitgreaves National Forests; 3/10/08.
4. Insect and disease activity in piñon-juniper woodlands along Williamson Valley Road, Praying Mantis Termite and Pest Control; 3/24/08.
5. Browse damage to trees and shrubs on the Tusayan Ranger District, Kaibab National Forest; 5/19/08.
6. Dwarf mistletoe infection in CEEMS Certification Stand, Tusayan Ranger District, Kaibab National Forest; 5/23/08.

Figure 22. Forest health project to improve tree and stand vigor and reduce fire danger on Coconino National Forest.

7. ADOT Winter Storm Management Environmental Overview Project, Arizona Department of Transportation; 6/11/08.
8. Insect and disease activity in Hall Ranch WUI, Springerville Ranger District, Apache-Sitgreaves National Forests; 6/26/08.
9. Heckethorn Forest Health Project, Peaks and Mormon Lake Ranger Districts, Coconino National Forest; 7/10/08.
10. Wagon Tire/MC Canyon Juniper Project, Prescott National Forest; 7/15/08.
11. Pinaleño Ecosystem Restoration Project, Safford Ranger District, Coronado National Forest; 9/12/08.
12. Prairie Knolls Forest Health Project, Williams Ranger District, Kaibab National Forest; 10/03/08.
13. Herold Ranch Forest Health Project, Peaks and Mormon Lake Ranger Districts, Coconino National Forest; 10/03/08.

14. Hazard tree survey at Montezuma Castle National Monument; 10/23/08.
15. Big Saddle Forest Health Project on the North Kaibab Ranger District, Kaibab National Forest; 10/24/08.
16. Pandora moth on the North Kaibab Ranger District, Kaibab National Forest; 11/20/08.
17. Dwarf mistletoe infestation in the McCracken Project area, Williams Ranger District, Kaibab National Forest; 12/1/08.
18. Brookbank Thinning Project, Black Mesa Ranger District, Apache-Sitgreaves National Forests; 12/05/08.
19. 2009 Forest Health projects on the Mogollon Ranger District, Coconino National Forest; 12/18/08.
20. Insect activity in the Chitty Fire Salvage Sale, Alpine Ranger District, Apache-Sitgreaves National Forests; 12/22/08.

New Mexico Zone

1. Summary of Douglas-fir tussock moth pheromone trapping results in the Sacramento Mountains, Sacramento Ranger District, Lincoln National Forest; 1/02/08.
2. Palomas Trailhead hazard tree report, Cuba Ranger District, Santa Fe National Forest; 1/09/08.
3. *Nepytia janetae* post-suppression followup sampling, Sacramento Ranger District, Lincoln National Forest; 2/28/08.
4. Sandia Mountain Douglas-fir tussock moth site visit, Sandia Ranger District, Cibola National Forest; 3/17/08.
5. Hazard tree occurrences, Jemez Ranger District, Santa Fe National Forest; 4/10/08.
6. Testing of Acecap implanted trees for pesticide residue, Sacramento Ranger District, Lincoln National Forest; 4/22/08.
7. FY 2008 Taos Canyon bark beetle prevention project, Camino Real Ranger District, Carson National Forest; 6/18/08.
8. White pine blister rust in Zuni Mountains, Mount Taylor Ranger District, Cibola National Forest; 7/07/08.
9. Potential forest health project, Mountainair Ranger District, Cibola National Forest; 8/11/08.
10. Proposed FY2009 dwarf mistletoe control project, Picuris Pueblo; 8/25/08.
11. Evaluation of Santa Clara Canyon 2007 Douglas-fir tussock moth suppression project; Santa Clara Pueblo; 9/03/08.
12. Proposed FY 2009 Forest Health projects, Pecos/Las Vegas Ranger District, Santa Fe National Forest; 10/20/08.

13. Proposed FY 2009 Forest Health Project, Camino Real Ranger District, Carson National Forest; 10/23/08.
14. Proposed FY 2009 Forest Health Project, Cuba Ranger District, Santa Fe National Forest; 10/24/08.
15. 2008 Douglas-fir tussock moth male moth trapping survey, Santa Clara Canyon, Santa Clara Pueblo; 12/8/08.
16. Pinos Altos Project, Bureau of Land Management; 12/11/08.
17. Elytroderma needle cast outbreak, Jicarilla Apache Indian Reservation; 12/15/08.
18. 2008 Douglas-fir tussock moth male moth trapping survey, Sandia Ranger District, Cibola National Forest; 12/22/08.

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Other Entomology and Pathology Activities in 2008

White Pine Blister Rust Resistance Testing

We have been locating potentially resistant trees on the Lincoln National Forest since 1994. So far, progeny of 45 candidate trees have been tested at the Institute of Forest Genetics (IFG) in Placerville, California. Six of the parent trees have major gene resistance (MGR), based on a hypersensitive reaction in the needles. Southwestern white pine is thus the third white pine species (after sugar pine and western white pine) in which MGR has been found. Longer-term testing of some of these trees at the Dorena Genetic Resource Center in Cottage Grove, Oregon, appears to have shown additional resistance traits in southwestern white pine.

In 2008, seeds were collected from 54 white pines for testing at IFG and Dorena. These include additional candidate trees from the Lincoln, and phenotypically desirable (but not rust-challenged) trees from the Santa Fe and Cibola National Forests. Seed from known resistant trees could eventually become the basis for a planting program to supplement natural populations of white pine in New Mexico and Arizona.

For more information, contact Dave Conklin

Effects of Underburning on Dwarf Mistletoe

Fire has long been considered an important natural control of dwarf mistletoe, although little quantitative information has been available. Monitoring conducted on the Santa Fe and Cibola National Forests since 1995 has quantified (1) survival of scorched ponderosa pine and (2) reduction in tree and stand dwarf mistletoe severity, following low intensity fire (underburning). A sanitation model—based on the mortality and scorch pruning observed on 14 study plots—provides an "expected reduction" in average DMR for a given average crown scorch and initial DMR. For example, the model estimates that a group/stand with an initial DMR of 3.0 experiencing 50 precent average crown (needle) scorch will show a reduction of about 0.7 three years after fire. Longer-term monitoring indicates that 50 percent average crown scorch should provide about 10 years of control, i.e., 10 years of stand growth before average DMR returns to its pre-burn level. Burns generating little or no crown scorch can be expected to have little or no effect on mistletoe, and may also have little effect on fuel loading or other forest conditions. Results of this study should apply generally for both management-ignited and wildland fires that burn at relatively low intensity.

A lightning-ignited wildfire burned through one of our original study areas on the Espanola Ranger District in early August 2008. The fire burned a total of about 300 acres, at low to moderate intensity. Average crown scorch on our 3 study plots (308 live ponderosa pine) was 36 percent. Scorch generally increased with increasing mistletoe severity, as it had during the original prescribed fire here in October 1995. This fire has provided an excellent opportunity to test our scorch pruning and sanitation models. It should also provide a good comparison of survival of ponderosa pine following dormant season vs. growing season fires.

For more information, contact Dave Conklin

Thousand Cankers Disease of Walnut

The Forest Health Protection staff is working with researchers from Colorado State University on the newly described thousand cankers disease of black walnut (*Juglans nigra*) that has killed outplantings of black walnut in several western states. The disease is produced by the transmission of a previously undescribed canker-producing *Geosmithia* spp. by the walnut twig beetle (*Pityophthorus juglandis*). The insect, and likely the *Geosmithia* spp. fungus, are native to Arizona walnut (*J. major*). Outbreaks in the West outside of Arizona are thought to have occurred by dispersal of the vector from native stands of walnuts in New Mexico and Arizona. Thousand cankers disease currently is restricted to states west of and including Colorado. Our efforts are aimed at working on the life history of the beetle, and possibly the fungus, in Arizona walnut.

For more information, contact Mary Lou Fairweather

Figure 23. Thousand cankers disease on black walnut (left) and close up of cankers (above) (Photographs courtesy of Whitney Cranshaw, Colorado State University, Bugwood.org)

Contribution of Landscape Level Bark Beetle Outbreaks to Fuel Loading and Fire Behavior in Pine Forests of the Southwest

Previous studies suggest that bark beetle outbreaks in high elevation forests can cause increases in fuel loads, influence fire behavior, and perhaps increase the severity of fires; however, these relationships have not been rigorously examined in pine forests of the southwestern United States. Landscape-level bark beetle outbreaks occurred in ponderosa pine forests and piñon-juniper woodlands throughout Arizona during 2002-2003 in response to severe drought and suitable forest stand conditions, causing significant biological impacts. A network of plots was established across a wide range of stand conditions and site characteristics in 2003 – 2004 to document bark beetle impacts. Using funding provided by Forest Health Monitoring Evaluation Monitoring, we revisited these plots in 2007 (ponderosa pine forests) and 2008 (piñon-juniper woodlands) to measure fuel loading and model potential fire behavior. Plots containing pine mortality were

paired with plots having no mortality with respect to site (elevation, topography, percent ponderosa pine or piñon). Data on canopy and surface fuels were collected from the Prescott, Kaibab, Coconino, Apache-Sitgreaves and Tonto National Forests. Analysis of data from ponderosa pine forests revealed mortality plots had (1) decreased tree density and basal area, but increased crown base height, (2) increased fuel bed depth and surface fuels in all size classes, and (3) decreased canopy fuel loadings. When weather, topographic and surface fuel loading were held constant, torching and crowning indices were higher in mortality stands, primarily in response to increased crown base height. When differences in surface fuels and basal areas were accounted for, no difference was detected in torching index between mortality and no mortality stands. These findings suggest that there is a trade-off between increased canopy base heights and increased surface fuel loadings as a result of bark beetle outbreaks in ponderosa pine 4 to 5 years post-tree mortality. Either with or without beetle-caused mortality, a surface fire can transition into the canopy; however, the physical properties driving this mechanism have switched from low surface fuels and low crown base heights to higher surface fuels and higher crown base heights.

For more information, contact Joel McMillin

LiDAR Applications for Habitat Conservation of Endangered Red Squirrel, Pinaleño Mountains, AZ

Changes in forest composition and structure have led to large and severe wildfires and devastating insect outbreaks in the Pinaleño Mountains, Coronado NF, Arizona. The risk of additional wildfires and insect outbreaks has prompted a forest restoration effort aimed at habitat conservation for the Mount Graham red squirrel (*Tamiasciurus hudsonicus*) (MGRS), a federally listed endangered species. Airborne LiDAR technology is being pursued as a more practical and cost effective way to derive forest structure and biomass information for this restoration effort. The project is being completed in three phases: Phase I - the technical specifications to acquire LiDAR data for this study area were developed and completed by RSAC April 2008, a contract was awarded and data acquisition was completed September 2008, and data were processed and delivered to the Forest Service in January 2009. Phase II – Develop field data collection protocol. Approximately 160-180 field plots will be established within the study area to collect tree and site variable in support of LiDAR model development. Field crews will establish plots and collect data during summer 2009. Phase III – RSAC, under a 2009 RSSC project, will evaluate acquired LiDAR and field data, apply image analysis techniques, and derive several forestry-based GIS data layers. LiDAR derived layers will contribute or allow for finer grained mapping of MGRS habitat; assist with mortality assessments; provide data layers that comply with established fire model parameters; and help generate FVS tree list information. Funding provided by Forest Health Monitoring Evaluation Monitoring.

For more information, contact John Anhold

Bugs and Burns: Effects of Fire on Ponderosa Pine Bark Beetle

Objectives of this monitoring project are to: quantify long-term effects of operational prescribed fire on bark beetle attacks in ponderosa pine-dominated stands of Arizona and New Mexico; identify the species of bark beetles in prescribed burned and unburned ponderosa-pine dominated stands in Arizona and New Mexico; assess the utility of using measures of pre-fire bark beetle populations as predictors of future bark beetle-caused mortality at prescribed fire sites; and quantify species of beetles and stand conditions in ponderosa pine dominated stands prior to

igniting control burns. The project has two parts. Part I consists of four sites that were burned in the fall of 2003 or spring of 2004 and then monitored in 2004, 2005, 2006, 2007, and 2008. Part II is four additional sites that were established in the summer of 2007 with bark beetle trapping with Lindgren funnel traps in July and August of 2007 and 2008, and controlled burning occurring in the fall of 2007 (two plots) and 2008 (one plot). In 2007, Part I sites were monitored for crown scorch and consumption, tree mortality, and sampling bark beetle attack activity by removing bark samples from dead trees. At the Part I sites, bark beetle-induced ponderosa pine mortality had returned to low levels 3 years post burning, with no statistically significant difference between the burned and unburned plots. At the Part II study sites, we collected individual tree and stand level data in 2008. Crown scorch and consumption, as well as beetle attacks, were measured in spring 2008 on the two plots that were burned in the fall of 2007. These two plots were monitored in the fall of 2008 for bark beetle induced mortality and very low levels were found. Funding provided by Forest Health Monitoring Evaluation Monitoring.

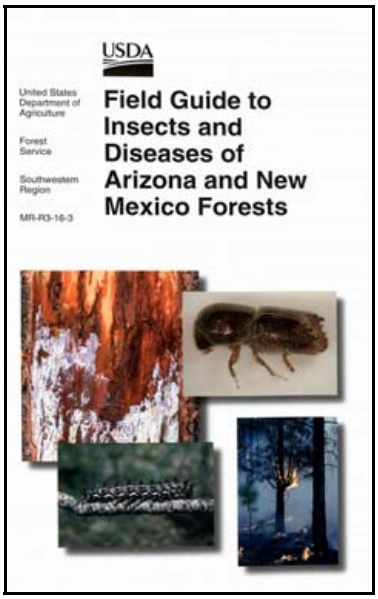
For more information, contact John Anhold

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.fed.us/r3/resources/health

The Web version contains all of the photographs and information of the printed guide. Access to PDFs of individual sections of the guide are 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. Primary responsibility is providing technical assistance on forest diseases to land managers. Current focus: agents involved in aspen dieback and decline; impacts on aspen regeneration; dwarf mistletoe ecology and management; and hazard tree identification and mitigation.

Bobbe Fitzgibbon (928) 556-2072

Forest entomologist, Arizona Zone since 1998. Primary responsibility is providing technical assistance on defoliator outbreaks to all Federal land managers and forest health issues on other Federal lands. Acts as the unit aviation officer for the Regional Aerial Detection Survey program and regional representative to the Aerial Survey Working Group in addition to flying survey in Arizona. Previous work experience in Region 8 (Southeastern Region), working with bark beetles and defoliators. Federal project manager for the Plumlee gypsy moth eradication project in northern Arkansas.

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 diseases and insects; general forest management; and plant identification.

Terry Rogers (505) 842-3287

Forest entomologist, New Mexico Zone since 1979. Primary responsibility is providing technical assistance for insect related forest health issues to all Federal land managers. Manages insect monitoring program through trapping and as a backup aerial detection surveyor. Special interests in plant pathology and fire effects.

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. Manages the Forest Health Web site.

Crystal Tischler (505) 842-3284

Forest health coordinator, New Mexico Zone since September 2008. Responsibilities include aerial detection surveys, aviation safety and training coordination, and field assistance to staff.

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.fed.us/r3/resources/health*. 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.

Appendices

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.

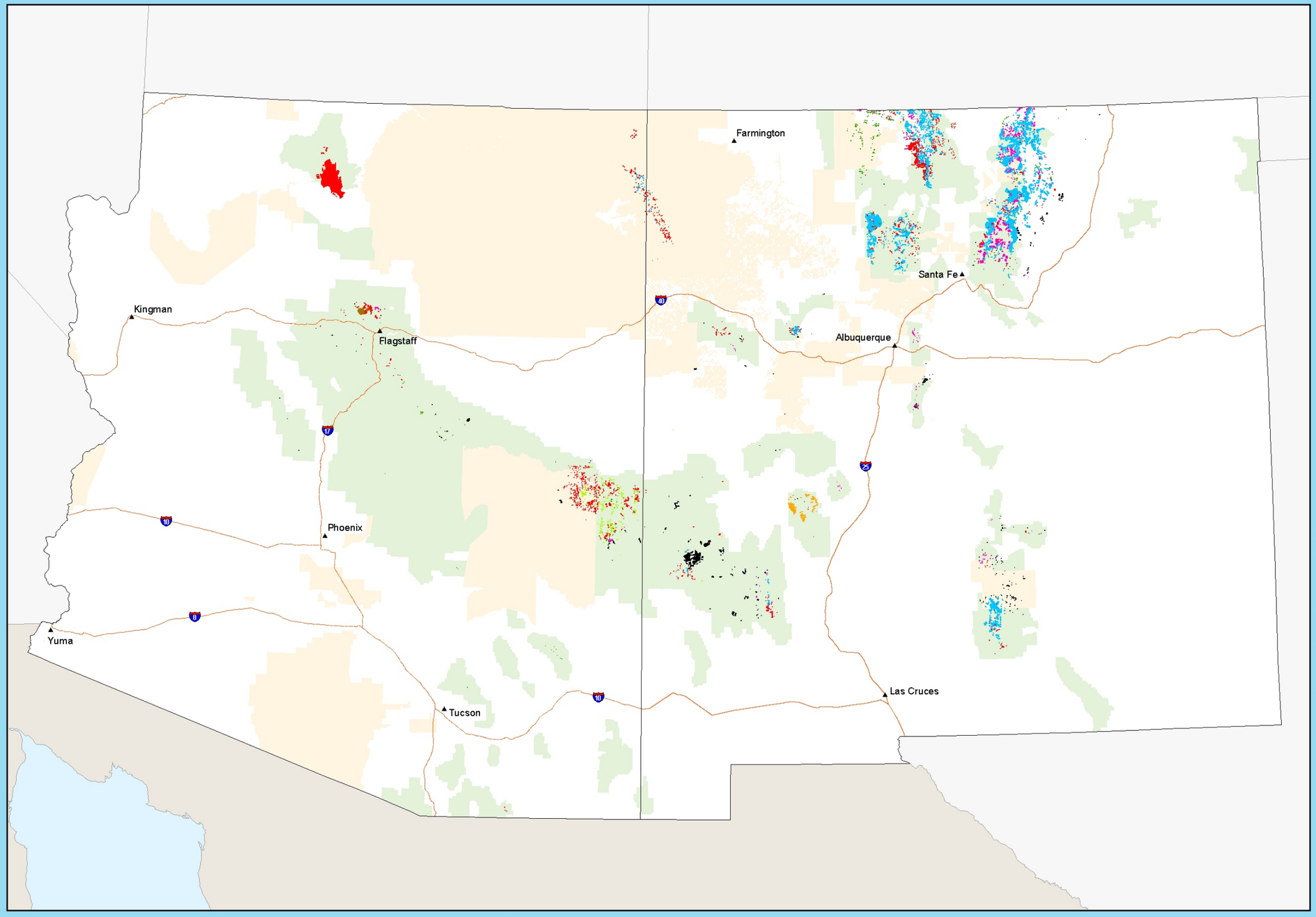
Packing

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 lands

Tribal lands

Damage Agent*

- Western spruce budworm defoliation
- Aspen defoliation and mortality
- True fir mortality from bark beetles
- Bark beetles in ponderosa pine
- Unknown defoliator(s)
- Piñon needle scale
- Douglas-fir beetle
- Needle cast

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

N W E S

0 25 50 100 Miles

The forest mortality and defoliation depicted here is based on aerial detection surveys and should only be used as a general indicator of incidence. This map represents the mortality and defoliation that has occurred since the previous surveys in 2007. 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. Areas of particular concern should be ground-checked for precise determination of location and causal agent.

Arizona

Surveys conducted July through September, 2008, by Steve Dudley, Bobbe Fitzgibbon, 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, 2008 by Daniel Ryerson and Bobbe Fitzgibbon, Forest Health Office, Southwestern Region, US Forest Service; Stephani Sandoval, New Mexico State University Cooperative Extension Service; William Ciesla, Forest Health Management International.

Significant Forest Mortality and Defoliation Detected through Aerial Survey

Southwestern Region - 2008

Forest Health Staff
Southwestern Region
US Forest Service
15 December 2008