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Forest Insect and Disease Conditions in the Southwestern Region, 2006

Cover photos: Ganoderma butt rot in aspen

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Conditions in Brief

Dry winter weather during the 2005-2006 season was followed by an unusually wet 2006 spring in Arizona and mid-summer in New Mexico. Overall bark beetle mortality of conifers increased slightly in 2006 to just over 211,000 acres compared to 206,000 acres observed in 2005. Although the area with ponderosa pine mortality increased significantly, slightly over half of the affected area was due to widely scattered mortality, some post-fire related, on the Gila National Forest. Piñon mortality continued to decrease throughout the region. High elevation mortality decreased overall with a slight increase in true fir mortality.

Ponderosa pine mortality was attributed to western pine beetle (80,270 acres), Ips engraver beetles (18,460 acres), and roundheaded pine beetle (380 acres). The Cibola, Kaibab and Gila National Forests along with Mescalero Apache tribal lands were most affected. While the Gila National Forest had the largest area affected by western pine beetle (56,600 acres), much of the mortality was light and widely scattered across large areas. Several of these areas were in locations burned by recent fires.

Higher elevation forests experienced mortality attributed to Douglas-fir beetle (15,360 acres), true fir complex (72,210 acres), and spruce beetle (7,030 acres).

Juniper and Arizona cypress mortality caused by *Phloesinus* bark beetles was recorded on about 11,000 acres regionwide. The majority of the damage was recorded in Arizona, mainly in the White Mountains of east central Arizona. In New Mexico, most of the damage was recorded in the west central part of the state on the Gila National Forest adjacent to the White Mountains of Arizona.

Defoliation by western spruce budworm activity continued to decrease in 2006, with about 145,000 acres detected. Northern New Mexico continues to be the primary area impacted by this defoliator. A Douglas-fir tussock moth outbreak on the Sandia Mountains continued in 2006, moving to the east side of the mountain. New defoliation was mapped on 1,230 acres.

Looper-caused defoliation continues on the Lincoln National Forest, Mescalero Apache tribal lands, and adjacent state and private lands in New Mexico. New defoliation was mapped on 7,130 acres during two aerial surveys. While defoliation in prior years was the result of the New Mexico fir looper, this year the active looper was identified as *Nepytia janetae*. It is uncertain when the switch between the outbreaks of the two insects occurred. The larvae of this looper differed in appearance and host preference from the insect identified as *Nepytia janetae* in an Arizona outbreak between 1997 and 1999. A more intense identification process is planned; revision of the genus *Nepytia* may be required.

Aspen defoliation or dieback was widely distributed across the region over 85,880 acres. In Arizona much of the damage was a continuing problem related to weather extremes. In New Mexico, damage has been typically attributed to western tent caterpillars, but Marssonina leaf spot was responsible for defoliation at locations in the central part of the state. While western tent caterpillar activity is declining in New Mexico, areas of Arizona have seen population increases during the last 2 years.

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 related to dwarf mistletoe

infection severity. 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. The most common, *Armillaria ostoyae*, and other root diseases increase tree mortality in all size classes and create hazards in heavily used areas.

White pine blister rust was detected on the Santa Clara Pueblo (Jemez Mountains) in 2006, the first report of this disease in northern New Mexico. In 2005, it was detected for the first time on the Gila National Forest, on a site only 3 miles from the Arizona border. Blister rust occurs throughout most of the range of southwestern white pine in the Sacramento Mountains, the adjoining White Mountains, and the nearby Capitan Mountains of southern New Mexico. No infections have been detected in Arizona.

Table 1. Prominent 2006 forest insect and disease activity (acres) in Arizona and New Mexico*.

Agent	State	National Forest	Tribal Lands	Other Federal	State & Private	Total
Western pine beetle	AZ	560	240	130	100	1,020
	NM	62,920	360	20	15,940	79,250
Ips beetle (ponderosa pine)	AZ	9,810	790	1,250	320	12,170
	NM	2,780	2,330	–	1,190	6,290
Ips beetle (piñon pine)	AZ	40	3,210	–	–	3,250
	NM	900	1,500	30	130	2,550
Douglas-fir beetle	AZ	3,160	20	40	110	3,320
	NM	8,580	1,630	1,350	480	12,040
Spruce beetle	AZ	–	–	70	–	70
	NM	4,220	80	–	2,660	6,960
True fir beetles	AZ	1,170	20	–	–	1,200
	NM	42,840	12,790	80	15,610	71,330
Western spruce budworm	AZ	–	2,540	–	–	2,540
	NM	100,900	5,040	20	36,560	142,500
Aspen defoliation	AZ	38,460	10,870	17,380	170	66,870
	NM	8,130	730	40	10,110	19,010
Drought effects on ponderosa pine	AZ	4,920	50	–	340	5,310
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 ten; sum of individual values may differ from totals due to rounding.
** Significant activity observed/known, but acreage not determined.
– No acreage detected.

Table 2. 2006 Bark beetle incidence by site (acres) from aerial detection surveys*.

	Western Pine Beetle	Mountain Pine Beetle	Round-headed Pine Beetle	Ponderosa Ips	Piñon Ips	Douglas-fir Beetle	Spruce Beetle	True Fir Beetles	Cypress & Cedar Bark Beetles	Bark Beetle Totals
Apache-Sitgreaves NFs	150		20	850	20	300		300	710	2,350
Coconino NF				1,300		1,780		740		3,830
Coronado NF			230	120		150		30		520
Kaibab NF	410			6,850	20	850		100		8,230
Prescott NF				170		20				190
Tonto NF				520		70				590
Grand Canyon NP				250		40				290
Chiricahua NM										0
Saguaro NM				50						50
Walnut Canyon NM										0
BLM	130			950						1,080
Fort Apache Tribal	80		20	390	10	20		20	40	570
Hualapai Tribal	110			160	1,860				2,130	4,260
Navajo Tribal	30			100	1,320		70		4,620	6,140
San Carlos Tribal	10		10	140	10				2,020	2,190
Hopi Tribal					10					10
Nav-Hopi JUA										0
State & Private	100		100	320		110				630
Arizona Total	**1,020**	**0**	**380**	**12,170**	**3,250**	**3,320**	**70**	**1,200**	**9,510**	**30,920**
Carson NF	240					4,600	2,220	8,260		15,320
Cibola NF	2,400			1,130	400	290	40	3,710		7,970
Gila NF	56,600			1,320	500	60		17,750	1,570	77,800
Lincoln NF	1,860			100			80	8,810		10,850
Santa Fe NF	1,830			230		3,540	1,870	4,310		11,780
Valles Caldera NP						80				80
BLM	20				30	1,340		20		1,400
Bandelier NM						20		60		80
Alamo Navajo Tribal					30					30
Jemez Pueblo								30		30
Jicarilla Apache Tribal						1,310		1,090		2,400
Mescalero Apache	360			2,330	50		80	10,350		13,170
Santa Clara Pueblo						320				320
Taos Pueblo								1,330		1,330
Zuni Pueblo					1,420					1,420
State & Private	15,940			1,190	130	480	2,660	15,610	40	36,040
New Mexico Total	**79,250**	**0**	**0**	**6,290**	**2,550**	**12,040**	**6,960**	**71,330**	**1,610**	**180,030**
SW Region Total	**80,270**	**0**	**380**	**18,460**	**5,800**	**15,360**	**7,030**	**72,520**	**11,120**	**210,950**

* Values rounded to the nearest ten; sum of individual values may differ from totals due to rounding. Totals for federal administrative units include only federally owned lands (state and private inholdings summarized in State & Private).

Table 3. 2006 Defoliation incidence by site (acres) from aerial detection surveys*.

	Western Spruce Budworm	Spruce Aphid	Aspen Damage	*Nepytia janetae***	Needle Cast	Douglas-fir Tussock Moth	Drought	Defoliation Total
Apache-Sitgreaves NFs			8,990				130	9,120
Coconino NF			1,040				4,410	5,450
Coronado NF							100	100
Kaibab NF			28,420				210	28,620
Prescott NF								0
Tonto NF			20				70	90
Grand Canyon NP			17,300					17,300
Chiricahua NM								0
Saguaro NM								0
Walnut Canyon NM								0
BLM			80					80
Fort Apache Tribal			4,290				50	4,340
Hualapai Tribal								0
Navajo Tribal	2,540		6,580					9,110
San Carlos Tribal								0
Hopi Tribal								0
Nav-Hopi JUA								0
State & Private			170				340	500
Arizona Total	**2,540**	**0**	**66,870**	**0**	**0**	**0**	**5,310**	**74,710**
Carson NF	53,430		1,520					54,960
Cibola NF	530		630			1,230		2,380
Gila NF	1,070		2,830					3,900
Lincoln NF	690		90	6,660				7,440
Santa Fe NF	42,710		3,010					45,720
Valles Caldera NP	2,480		50					2,530
BLM	20		40					50
Bandelier NM								0
Alamo Navajo Tribal								0
Jemez Pueblo								0
Jicarilla Apache Tribal	2,370		50					2,430
Mescalero Apache	760			40				810
Santa Clara Pueblo	60		30					90
Taos Pueblo	1,840		650					2,480
Zuni Pueblo								0
State & Private	36,560		10,110	430				47,090
New Mexico Total	**142,500**	**0**	**19,010**	**7,130**	**0**	**1,230**	**0**	**169,870**
SW Region Total	**145,040**	**0**	**85,880**	**7,130**	**0**	**1,230**	**5,310**	**244,580**

* Values rounded to the nearest ten; sum of individual values may differ from totals due to rounding. Totals for federal administrative units include only federally owned lands (state and private inholdings summarized in State & Private).

** This insect is different than the *Nepytia janetae* reported during the 1997 to 1999 outbreak in Arizona. They are probably very closely related, but differ in host preference, elevational range, and slightly in appearance. Acres shown include both the supplemental June survey and the August surveys.

Status of Insects

Bark Beetles

Nearly all conifer mortality mapped during aerial survey is attributed to bark beetles. While bark beetles are the primary tree killers in the region, mortality is most often a result of multiple factors, which may include disease, defoliators, and especially drought. An additional consideration in interpreting aerial survey results is that acreages reported represent areas where significant tree mortality occurred. 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 may be 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. While we expect that the overall trends displayed for particular bark beetles are meaningful, some year-to-year fluctuations reflect differences in attribution.

The narratives that follow describe overall conditions and trends; site and landowner information is summarized in tables 1 and 2 (on the preceding pages). We include damage summaries and recent trends for the major forest types.

Western Pine Beetle

Dendroctonus brevicomis
Primary host: Ponderosa pine

The area affected by this insect increased regionwide in 2006 to about 80,000 acres vs. 25,000 acres affected in 2005. As in recent years, most of the reported activity occurred in New Mexico. While the Gila National Forest had the largest area affected (56,600 acres), most of the mortality was light and widely scattered across large areas. Several of these areas were in locations recently burned by the Boiler, Bull, Fork, and Johnson fires. It is probable that this mortality is insect-caused as a result of fire, but in some cases may be directly fire-induced. Activity was reported to have more than doubled in 2006 on state and private lands in New Mexico, where about 16,000 acres were affected. Western pine beetles on state and private lands were found primarily west of Las Vegas in the Sangre de Cristo Mountains and on Vermejo Park in Colfax County.

In Arizona, the largest reported concentration of western pine beetle activity was on the Kaibab National Forest (410 acres). Note that this insect was probably more widespread in Arizona than reported in tables 1 and 2, since it often attacks ponderosa pine initially attacked by *Ips* engraver beetles.

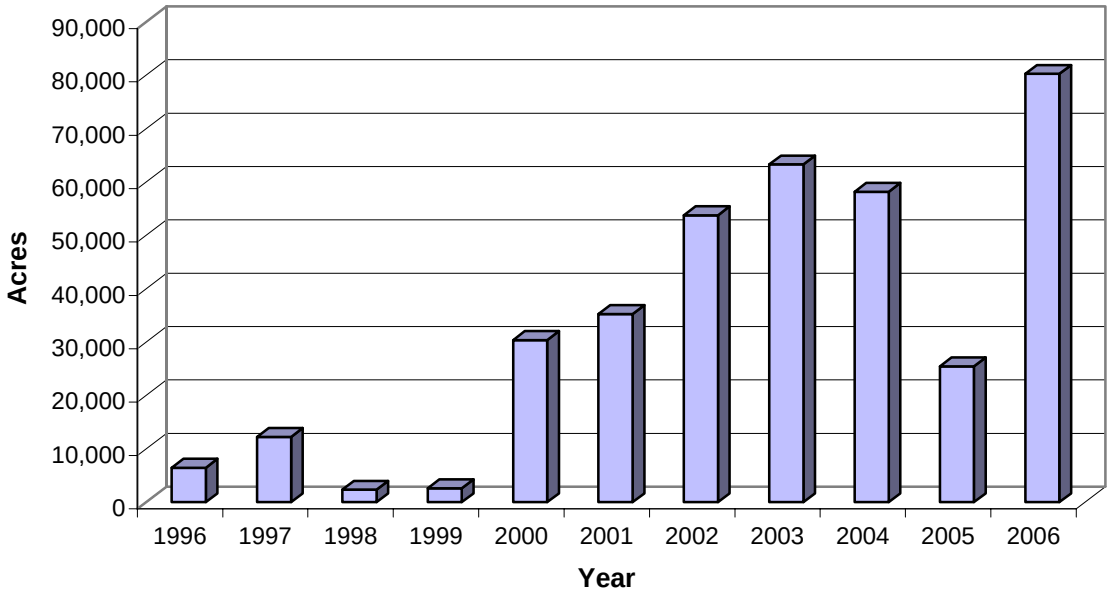


Figure 1. Western pine beetle activity in Arizona and New Mexico, 1996-2006.

Mountain Pine Beetle

Dendroctonus ponderosae
Primary hosts: Ponderosa, limber and bristlecone pine

No mountain pine beetle activity was detected in the region in 2006. Activity in previous years has mostly been limited 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. All damage previously attributed to mountain pine beetle in northern New Mexico—and included in figure 2 below—was later confirmed to be a result of western pine beetle.

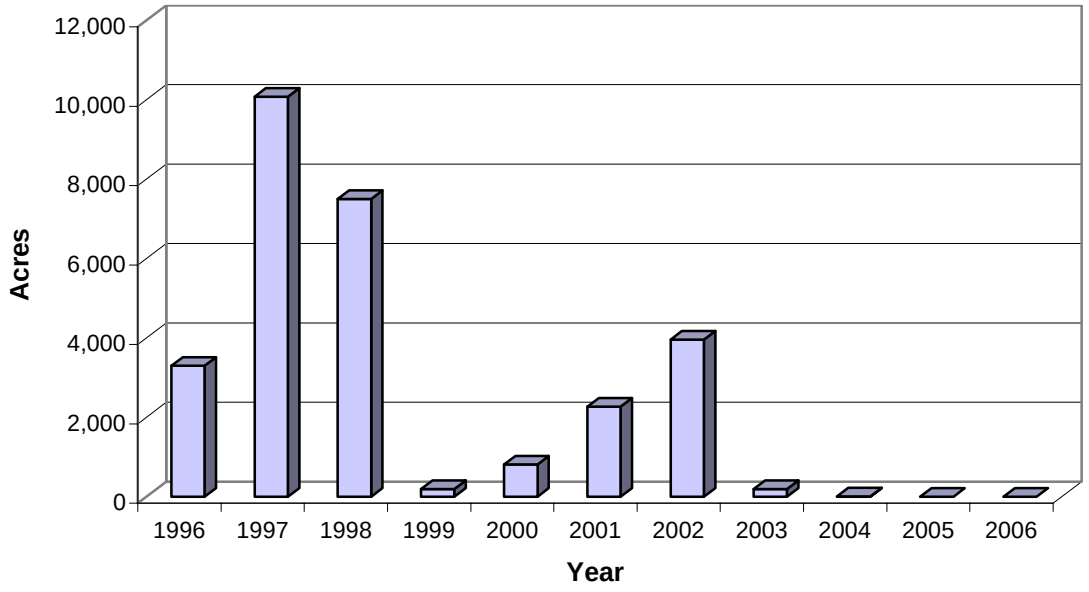


Figure 2. Mountain pine beetle activity in Arizona and New Mexico, 1996-2006.

Roundheaded Pine Beetle

Dendroctonus adjunctus
Primary host: Ponderosa pine

Tree mortality attributed to this insect increased in 2006, with 380 acres affected compared to 120 acres in 2005, but was still less than in 2004 when 525 acres were recorded. In contrast to previous years, no activity was observed on the Chiricahua National Monument. Activity was scattered over southeastern Arizona. 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. In previous years, the largest outbreaks occurred in the Sacramento Mountains of southern New Mexico.

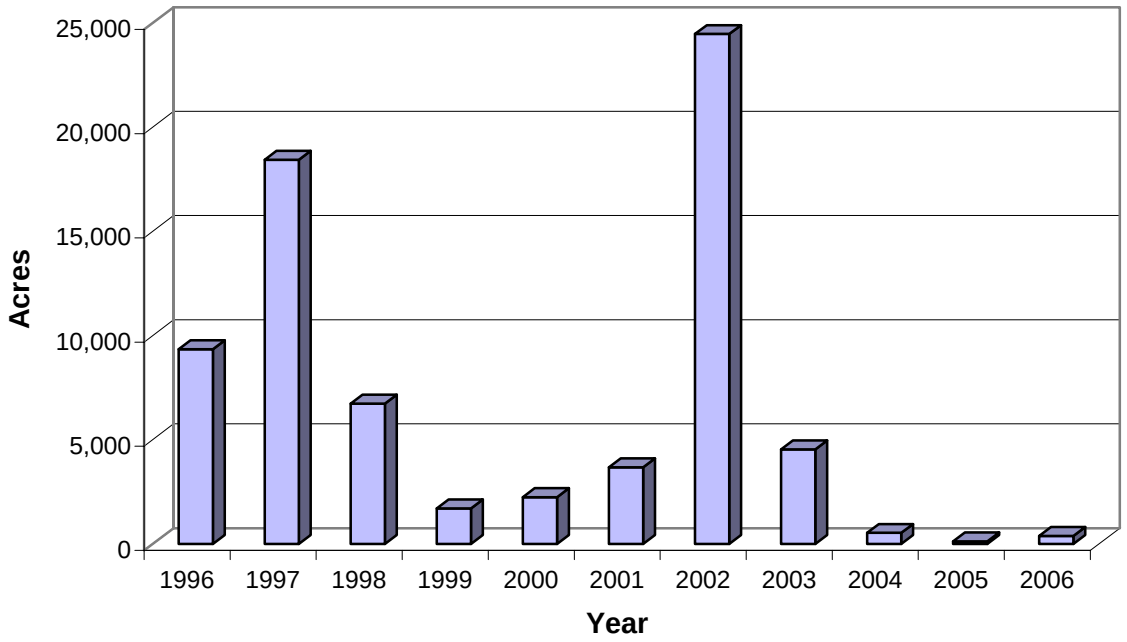


Figure 3. Roundheaded pine beetle activity in Arizona and New Mexico, 1996-2006.

Ips Beetles

Ips spp.
Primary hosts: Ponderosa pine, piñon pine

Ponderosa pine mortality attributed to *Ips* beetles more than doubled in 2006 with 18,000 acres infested vs. 6,900 in 2005. This has been the first increase since populations began to decline from outbreak proportions in 2002 and 2003. Two-thirds of the activity reported in 2006 occurred in Arizona, with the greatest number of acres recorded on the Kaibab National Forest (6,850 acres). In New Mexico, *Ips* beetles on ponderosa pine, especially *I. pini,* are frequently associated with *Dendroctonus* throughout the state. In 2006, damage was recorded on 6,290 acres in New Mexico with the highest concentration found on Mescalero Apache tribal lands (2,330 acres).

In recent years, several species of *Ips* have been found attacking ponderosa pine in Arizona, including *I. lecontei*, *I. pini*, *I. calligraphus*, *I. latidens*, *I. knausi,* and *I. integer*. Frequently, multiple *Ips* species have been identified from a single infested tree and/or in combination with western pine beetle and other *Dendroctonus* species.

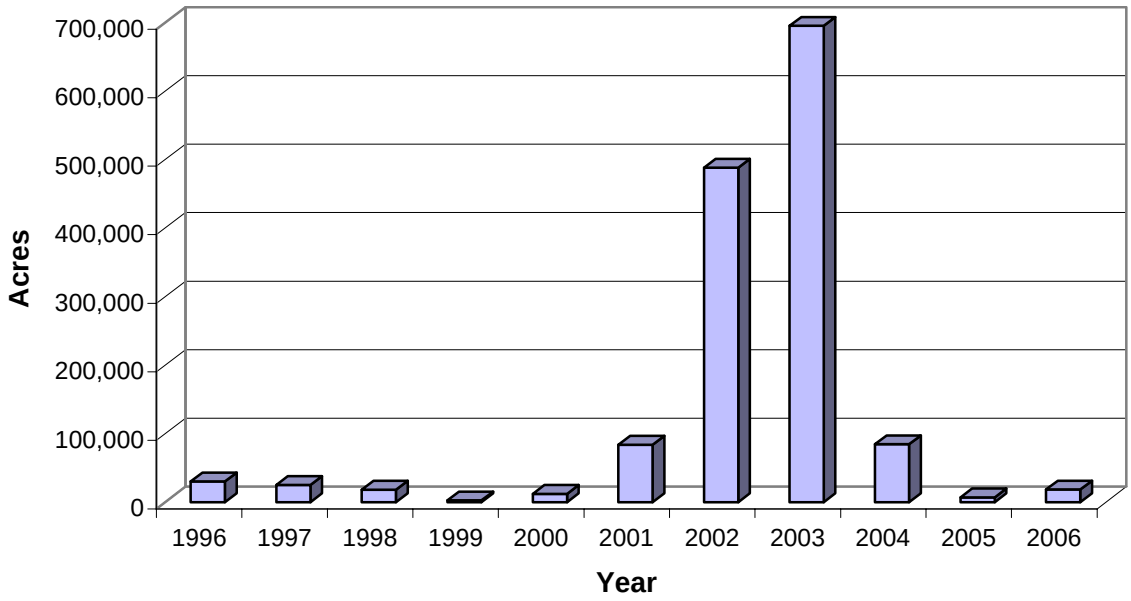


Figure 4. *Ips* beetle activity in ponderosa pine in Arizona and New Mexico, 1996-2006.

Piñon mortality, caused primarily by pinyon ips, declined slightly in 2006. In 2005, 6,130 acres were detected vs. 5,800 acres in 2006. While scattered throughout the region, the majority of the mortality in Arizona was recorded on Hualapai and Navajo tribal lands. In New Mexico, piñon mortality was observed on Zuni Pueblo lands and scattered throughout the southwestern portion of the state.

Douglas-fir Beetle

Dendroctonus pseudotsugae
Host: Douglas-fir

Douglas-fir beetle activity sharply declined in 2006, although infestations continued at many locations in both Arizona and New Mexico. Reported activity encompassed about 15,000 acres regionwide compared to 77,000 acres in 2005. As in 2005, northern New Mexico had the most extensive damage in 2006. On state and private land in New Mexico, several high elevation pockets of Douglas-fir and white fir were killed by Douglas-fir beetle and fir engraver, respectively near Taos, Rio Arriba, and Colfax Counties, and areas surrounding Ruidoso.

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.

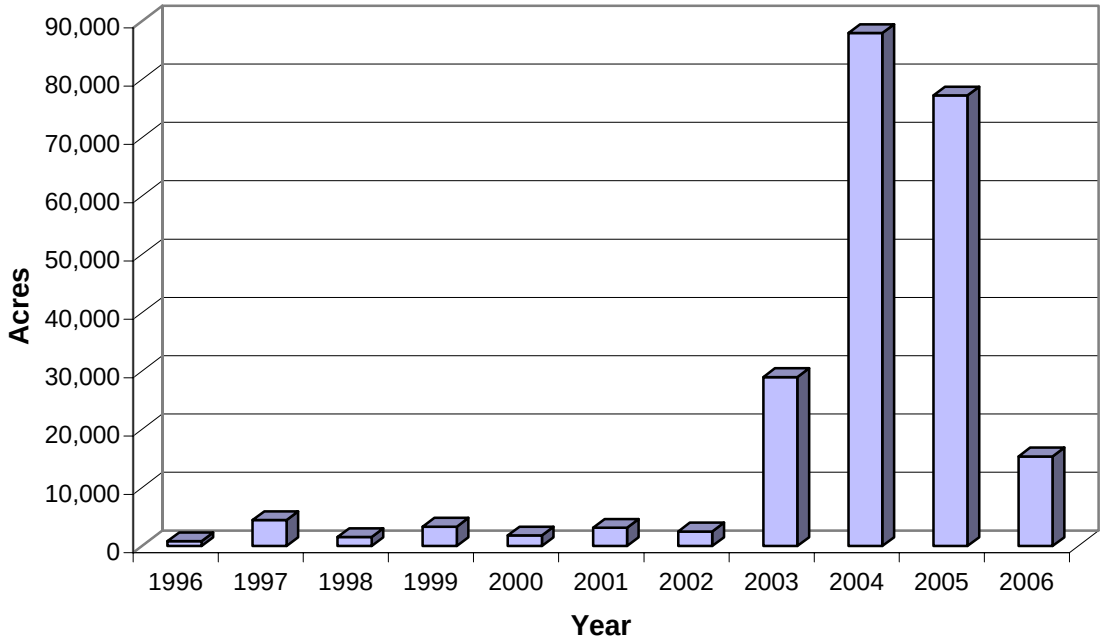


Figure 5. Douglas-fir beetle activity in Arizona and New Mexico, 1996-2006.

True Fir Beetles

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

Regionwide, we attributed 72,520 acres with damage to fir engraver and western balsam bark beetle up from 70,510 in 2005. Significant fir engraver activity occurred generally throughout the region within the mixed conifer type, with the largest outbreaks on the Carson, Lincoln and Gila National Forests, Mescalero Apache tribal lands, and state and private lands in New Mexico. Western balsam bark beetle activity was generally widespread in the spruce-fir forests of both states; however, the majority of the damage was recorded in New Mexico (which has the greater share of the host type). In New Mexico, increased ground checking has been initiated in this type and recent mortality in the spruce-fir type has been found to be primarily fir.

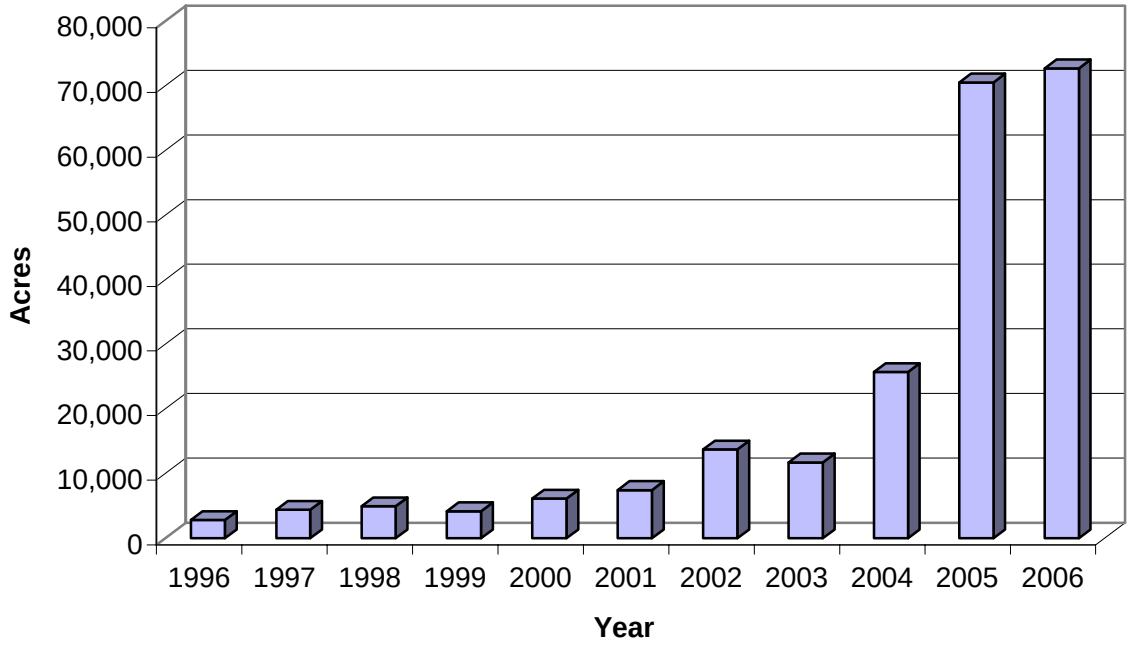


Figure 6. Fir engraver and western balsam bark beetle activity in Arizona and New Mexico, 1996-2006.

Spruce Beetle

Dendroctonus rufipennis
Host: Spruce

Tree mortality attributed to spruce beetle in 2006 declined to about 7,000 acres vs. about 20,000 acres in 2005. This decline is partially the result of correction in identification due to increased ground checking in 2006 that revealed primarily fir mortality in the spruce-fir type. Most of this damage occurred on the Carson and Santa Fe National Forests and state and private lands in New Mexico. Spruce beetle and western balsam bark beetle on state and private lands in New Mexico were primarily found in northern parts of the Sangre de Cristo Mountains and in areas surrounding Chama.

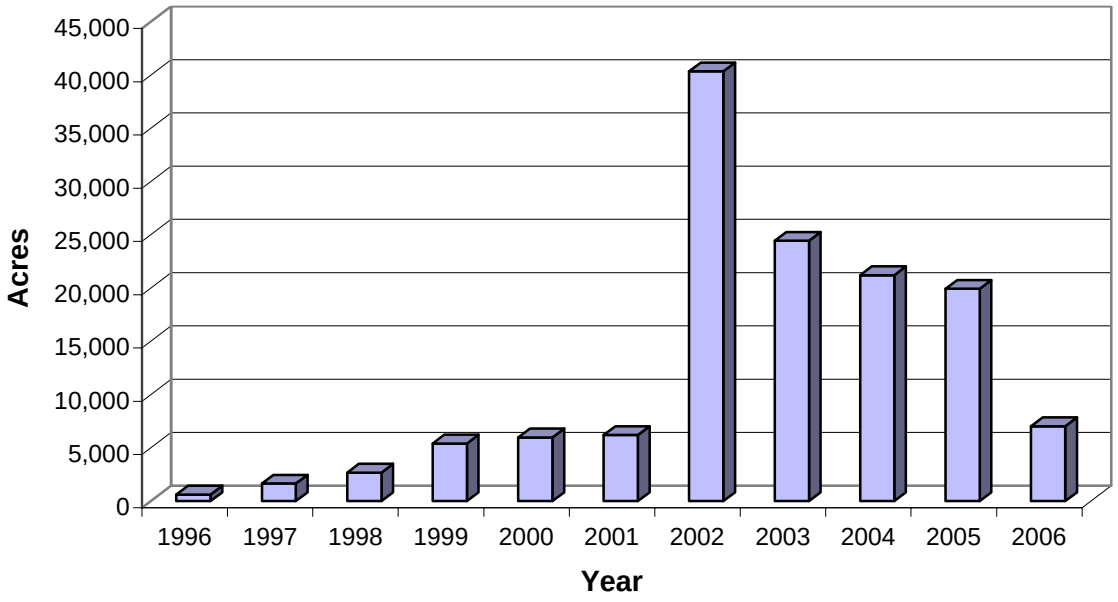


Figure 7. Spruce beetle activity in Arizona and New Mexico, 1996-2006.

Summary by Major Forest Types

Ponderosa pine: Regionwide, ponderosa pine mortality increased to more than 99,000 acres vs. about 32,000 acres mapped in 2005. While this is an increase from the previous year, beetle populations are still low compared to 2003-2004. Some of the mortality observed was widely scattered, affecting large areas, but relatively low numbers of trees.

Mixed conifer: Over the past 3 to 4 years, mixed conifer forests have experienced high levels of tree mortality (possibly the most ever recorded), affecting both Douglas-fir and white fir. In some areas, the bulk of the mortality has been of a single species, e.g., white fir throughout much of southern New Mexico, and Douglas-fir in portions of northern New Mexico. In some areas, both species have been affected.

Figure 8. White fir mortality in the wildland-urban interface near Ruidoso, NM.

Spruce-fir: Regionwide, damage in this type has slightly decreased between 2005 and 2006, but remained relatively high with about 23,000 acres affected. Past observations indicate that spruce

mortality has been overestimated and corkbark/subalpine fir mortality underestimated in some areas, especially in New Mexico.

Figure 9. Corkbark fir mortality in the Sandia Mountains.

Defoliators

Western Spruce Budworm

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

Regionwide, budworm activity decreased in 2006, with about 145,000 acres affected vs. 195,000 acres the previous year. Most of the activity occurred in higher elevation forests of northern New Mexico, where budworm has remained chronic for many years. Significant activity also continued on Navajo tribal lands (Chuska Mountains) in both states.

Ground observations indicate that a significant outbreak may be developing in the Sacramento Mountains of southern New Mexico, although relatively little damage was detected during aerial survey.

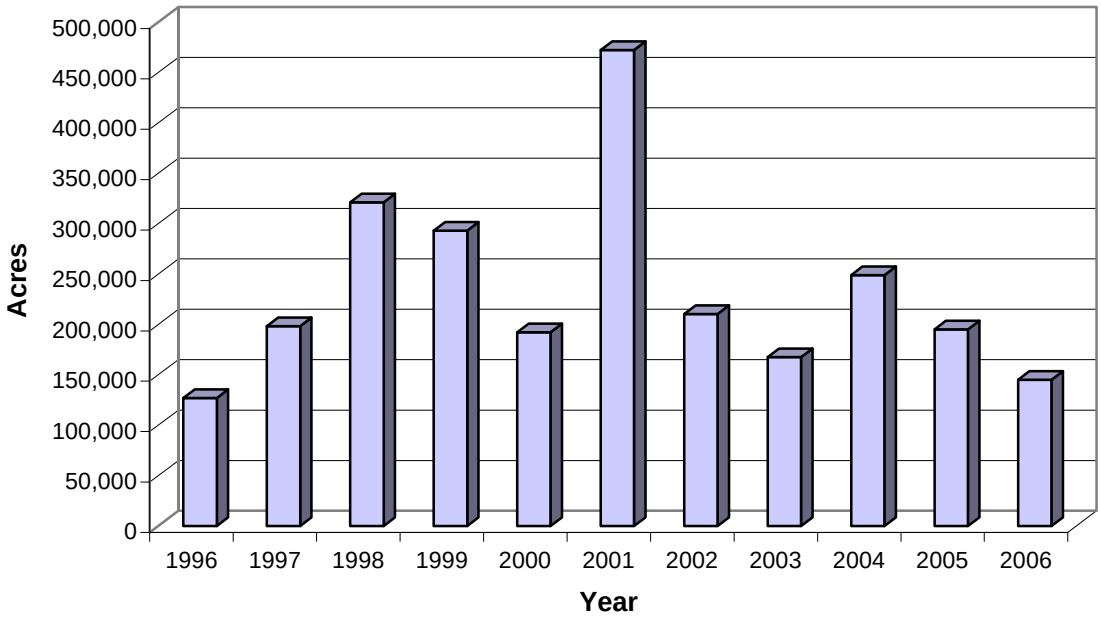


Figure 10. Western spruce budworm activity in Arizona and New Mexico, 1996-2006.

Douglas-fir Tussock Moth

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

The Douglas-fir tussock moth outbreak in the Sandia Mountains expanded onto the eastern slopes in 2006. The outbreak on the west side – concentrated in Pino Canyon – collapsed due to several parasites and a naturally occurring virus. New defoliation was observed on 1,230 acres east of the outbreak location in Pino Canyon. Several areas with heavy defoliation are visible along the lower portions of the Crest Highway between Doc Long Picnic Ground and the Tree Spring trailhead.

Nepytia janetae

Hosts: Douglas-fir, white fir

The caterpillar stage of a native geometrid moth, *Nepytia janetae*, was determined to be the causal agent which defoliated extensive areas of white fir and Douglas-fir in the Sacramento Mountains of southeastern New Mexico during 2006. Defoliation was observed on 7,090 acres of the Lincoln National Forest and 40 acres of the Mescalero Apache Indian Reservation in 2006. The late winter/early spring feeding of this species distinguishes it from the New Mexico fir looper and Douglas-fir tussock moth, both summer feeders which have been active in the Sacramentos in recent years. In response to concerns by Sacramento Ranger District personnel, a

Figure 11. *Nepytia janetae* larva with damaged needles.

Figure 11. Looper damage along Scott Able Canyon, Sacramento RD, Lincoln NF.

special aerial survey conducted June 7 revealed over 4,300 acres with red-needled trees. Additional mortality was later mapped during regular detection flights during the summer. Caterpillar specimens were reared to adulthood and submitted to Dr. Cliff Ferris, Emeritus Professor from the University of Wyoming, who made the identification (see appendix A).

An insect also identified as *Nepytia janetae* in Arizona caused significant defoliation and tree mortality in the spruce-fir type from 1997 to 1999. Due to differences in appearance of the larvae and host preferences, the identification will be further reviewed.

Spruce Aphid

Elatobium abietinum
Host: Spruce

No spruce aphid damage was reported in the Southwest in 2006.

Figure 13. Spruce aphid.

Ponderosa Pine Needle Miner

Coleotechnites ponderosae

No needle miner activity was detected by aerial survey in Arizona or New Mexico in 2006.

Pine sawflies

Neodiprion spp., *Zadiprion* spp.

In New Mexico populations of the winter feeding bull pine sawfly larvae, *Zadiprion townsendii*, continued at low levels in localized infested trees in the Santa Fe area. These insects have also been reported from Las Vegas, Cedar Crest and Mountainair, and likely occur throughout the range of ponderosa pine. The observed populations of this insect have been in the lower elevational distribution of ponderosa pine usually near the interface with piñon woodlands.

Defoliation from piñon sawfly, *Neodiprion edulicolus,* was low this year in New Mexico with no observed outbreaks reported. *Zadiprion rohweri* is occasionally detected on landscape piñons but no records of this insect were recorded in 2006.

Piñon Needle Scale

Matsucoccus acalyptus

Scale is a chronic defoliator of piñon at several locations in the woodlands of Arizona and New Mexico. Only about 3,000 acres with damage were observed in 2006. Most of the defoliation was recorded on the Cibola National Forest.

Twig Beetle

Pityophthorus spp., *Pityogenes* spp., *Pityotrichus* spp.

Extensive outbreaks of twig beetle in association with other bark beetles, especially *Ips* spp. became apparent in late 2000. Conditions between 2001 and 2004 favored continued buildup of these beetles. In 2005 populations had declined coinciding with the decline of pinyon ips. The most significant damage done in previous years has been seen in piñon woodlands. However, in 2006 some damage was mapped in ponderosa pine in the Moreno Valley affecting approximately 160 acres. Twig beetle damage is common statewide in New Mexico in all pine species. Trees on dry rocky slopes, overcrowded stands, heavily infected with dwarf mistletoe or injured by construction activities are most frequently attacked. Twig beetles are a common cause of tree mortality in transplanted pines.

Aspen Dieback/Defoliation

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

Figure 14. Aerial view of mortality and crown dieback in aspen due to drought.

Aspen damage was detected on about 86,000 acres in 2006, an increase from 83,000 acres reported in 2005. In Arizona, much of the damage, which includes dieback and mortality, is a continuing problem related to the severe drought of recent years. An upswing in western tent caterpillar activity was also reported in the state in 2005 with populations continuing into 2006. In New Mexico, most of the damage was attributed to tent caterpillar. Marssonina leaf spot was also observed on the Cibola NF in 2006.

In general, a well documented decrease in aspen cover type over the last several decades is a direct result of fire exclusion. In addition, browsing by ungulates has had a deleterious effect on aspen regeneration in many parts of the region.

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.

Figure 15. Piñon with severe dwarf mistletoe infection.

Dwarf mistletoes are considered to be pathogens of trees because of their damaging effects—growth reduction, distortion (i.e. witches' brooms), and decreased longevity. Essentially, they 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. Trees of all size classes are affected by mistletoe; 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 far more loss to timber resources in the Southwest than do insects. Extensive dwarf mistletoe infestation also increases overall forest flammability. On the other hand, as a natural part of the forest, dwarf mistletoes have an ecological role and benefit some species.

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 especially common on oaks in southern portions of the region and are locally abundant in desert woodlands and lower elevation riparian areas. Heavy infection contributes toward host mortality, especially during periods of drought.

Figure 16. Oak mistletoe, *Phoradendron coryae*.

Root Diseases

Root diseases are often associated with mortality attributed to bark beetles and other agents. 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 year to year. Root diseases are often described as "diseases 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 the standing live trees. In addition to causing disease, the fungus is a common decayer of dead woody material (a saprophyte).

Figure 17. Armillaria mushrooms have a ring on the stem and dark scales on the stem and cap.

Annosus Root Disease

Heterobasidion annosum
Hosts: Most conifers

Annosus root disease is probably the second most common root disease in the Southwest. It is found most often on true firs, although most conifers are susceptible. All size classes can be affected. 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**, *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**, *Phellinus pini*, affecting most conifers; **rust-red stringy rot**, *Echinodontium tinctorium*, on white fir; **aspen trunk rot**, *Phellinus tremulae*; and *Inonotus dryophilus* on oak.

Figure 12. Phellinus pini causes heartrot in several conifer species.

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

In 2006 blister rust was detected on the Santa Clara Pueblo, the first report of this invasive fungal disease in northern New Mexico. In the spring, a single infected white pine was found during a general insect and disease survey of Santa Clara Canyon. Later in the year we found 8 to 10 more infected trees and some infected *Ribes* bushes in this area. Following the initial discovery at Santa Clara, we surveyed other locations in the Jemez Mountains, including the Valles Caldera National Preserve, but no additional rust was detected. It is worth noting that most of the rust infections found at Santa Clara were only 3 to 4 years old and relatively inconspicuous. The oldest infections found there were about 7 years old.

Figure 19. White Pine Blister Rust infection on the Santa Clara Pueblo.

Plans for a survey of the Gila National Forest, where blister rust was detected in 2005, were postponed due to the severe drought in the spring and early summer of 2006. We now plan to determine the extent and distribution of the Gila outbreak in the spring of 2007. Rust damage continues to increase in the Sacramento Mountains of southern New Mexico, where the disease

has now been established for over 30 years, and which probably contains the largest population of white pines in the region.

Broom Rust

Melampsorella caryophyllacearum
Host: True firs

Chrysomyxa arctostaphyli
Host: Spruces

Broom rusts are found at low levels throughout much of the ranges of their hosts in the Southwest. High concentrations of fir broom rust occur in the Sandia and Manzano Mountains of central New Mexico and at a few other locations. Damage from these easily recognized diseases has not been well quantified; however, infection can result in topkill, particularly in spruce. Occasionally, falling brooms or stem breakage at the point of infection present a hazard.

Figure 20. Fir broom rust infection.

Limb Rust

Cronartium arizonicum
Host: Ponderosa pine

This disease is fairly 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. This disease is uncommon in New Mexico.

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 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.

Foliage Diseases

Black Leaf Spot

Marssonina populi

A large outbreak of black leaf spot was observed throughout much of the aspen host type of the Sandia Mountains and Magdalena Mountain ranges of the Cibola NF in late summer of 2006. This outbreak was most likely related to the record-setting summer rains that occurred in central (and southern) New Mexico. Fall colors were negatively affected by this disease in some locations.

Figure 21. Black leaf spot on aspen in the Sandia Mountains of New Mexico.

Ponderosa Pine Needle Cast

Lophodermella cerina and other species

No needle cast activity was detected in 2006.

Abiotic Damage

Drought

Discoloration of ponderosa pine attributed to drought was mapped on about 5,000 acres in Arizona in 2006, the majority on the Coconino National Forest. A very dry 2005-2006 winter caused extensive discoloration of foliage mainly at the lower elevations in the chaparral and oak-juniper vegetation types. The continuing drought has taken a serious toll on the mature cottonwoods, willows and hackberry trees growing along a stretch of the Santa Cruz River near Rio Rico, Arizona.

Wind Damage

Wind damage was widespread in Arizona in 2006. Windthrow and windbreak of ponderosa pine was noted in the Catalina Mountains. Pines that survived the Aspen Fire in these mountains were

left more exposed to damage by the heavy winds. Piñon ips killed pines in the Doney Park area near Flagstaff, Arizona were also knocked down by strong winds, increasing the fire hazard.

Hail Damage

Hail damage in the Prescott, Arizona, area impacted pines, oaks and Arizona cypress.

Miscellaneous Pests

Figure 22. Cedar bark beetle caused juniper mortality near Show Low, Arizona.

Cypress bark beetles (*Phloesinus* spp.) continued to damage Arizona cypress and juniper in many locations. In 2006, about 11,000 acres with damage were attributed to these insects. Damage in previous years had significantly reduced the amount of Arizona cypress in some areas. Activity in juniper increased in 2006.

Red Turpentine Beetles (*Dendroctonus valens*) were found at low levels in ponderosa pine stands statewide in New Mexico. High numbers of turpentine beetles are often seen in association with thinning and logging activities. No significant tree mortality is usually seen in association with turpentine beetles.

Smaller European Elm bark beetles (*Scolytus multistriatus*) continued to cause mortality in drought stressed Siberian elms in eastern New Mexico, and to a lesser extent, statewide.

Pine tip moths (*Rhyacionia* spp.) continue to severely damage landscape pines in New Mexico, particularly ponderosa pine. Several tip moth species of the genus *Rhyacionia* are responsible for this damage. Nantucket pine tip moth and western pine tip moth appear to be causing the most severe injury to ornamental pines. Several other tip moth species are routinely caught in pheromone traps. Public service announcements regarding effective spray dates for control of pine tip moth in the Albuquerque, Santa Fe, and Los Lunas areas were made with the cooperation of area Master Gardeners. In Arizona, pine tip moth activity was concentrated in the Lakeside-Pinetop area in midsummer while late summer to early fall damage was detected in the Prescott area.

Piñon tip moth (*Dioryctria albovittella*) damage continues at low levels statewide in New Mexico.

Pitch nodule moth (*Petrova arizonensis*) is locally common throughout New Mexico.

Elm leaf beetles (*Xanthogaleruca luteola*) were noticeable regionwide on Siberian elms growing in urban and rural areas. In Window Rock, Arizona, these beetles were found on all age classes of elms.

American hornet moth (*Sesia tibialis*) although not a problem in native stands, continues to kill aspen of most age classes in urban landscapes. Larval feeding in the root crown destroys the vascular tissue and stability of the tree. This insect is responsible for trees being windthrown at this time of year.

Tiger moth (*Lophocampa ingens*) activity was high throughout much of the region during late winter and spring of 2006. Tents were frequently observed in the tops of ponderosa pine, piñon, southwestern white pine, and other conifers. In Arizona, the tents were especially visible in the Flagstaff area in May. In New Mexico, it was found from the Sacramento Mountains north along

the Sangre de Cristo Mountains to the Colorado border feeding primary on ponderosa pine. Allergic reactions to caterpillar hairs afflicted many outdoor workers and citizens engaged in recreational activities in both states.

Tent caterpillars (*Malacosoma californicum*) were noted on other tree species in addition to aspen, common chokecherry along Highway 87 between Payson and Pine, Arizona, white oak in Prescott, three leaf sumacs in Flagstaff and on currants in Parks, Arizona.

Bagworms (*Thyriodopteryx* spp.) continue to be primarily an aesthetic problem in the Albuquerque area on junipers, cypress and a number of hardwood trees.

Fall webworm (*Hyphantria cunea*) was common in New Mexico, on landscape and lower elevation riparian hardwoods, especially Siberian elms, mulberries, cottonwoods and poplar hybrids. It has been noticed near Embudo along the Rio Grande. In Arizona this insect was most visible on cottonwoods in Sedona, the Village of Oak Creek, and the Camp Verde area.

Leafhoppers (Cicadellidae) were noted on walnut in the Prescott and Payson, Arizona, areas in September.

Aphid (*Cinara* spp.) activity increased dramatically in the lower elevation vegetation types in Arizona due to the mild winter temperatures.

Oystershell scale (*Lepidosaphes ulmi*) is found commonly in urban landscapes throughout northern Arizona on aspen. It feeds on the phloem of mature trees and if left unchecked can cause tree mortality.

Eriophyid mites (*Trisetacus ehmanni*) were found on the yellowed needles of ponderosa pine in the Flagstaff area. This tiny mite feeds gregariously within the needle sheath on the current year's needles causing yellowing and premature drop. Twigs on repeatedly attacked trees may become twisted.

***Cryptosphaerua* canker** was commonly reported in the Flagstaff area on aspen in urban landscapes.

Juniper rust (*Gymnosporangium* spp.) was suspected to be the cause of numerous broom-like growths on juniper in the Prescott, Arizona, area in April 2006.

Sapsucker damage was very common on many tree species throughout northern Arizona.

Walnut anthracnose (*Gnomonia leptostyla*) in Prescott and Payson, Arizona, was largely due to the heavy monsoonal rainfall.

Figure 23. Walnut anthracnose in Prescott, Arizona.

Biological Evaluations and Technical Assistance

Arizona Zone

1. Evaluation of Siberian elm dieback in a historic housing area on the Navajo Reservation; 1/13/06.
2. Evaluation of the FY2007 Turkey Creek West dwarf mistletoe management projects 1 and 2, Fort Apache Indian Reservation; 7/27/06.
3. Evaluation of the FY2007 Anderson Flat dwarf mistletoe suppression project, San Carlos Apache Reservation; 7/31/06.
4. Insect and disease conditions in Mt. Elden section of the Eastside Fuel Reduction and Forest Health Project, Peaks Ranger District, Coconino National Forest; 8/22/06.
5. Post-treatment evaluation of *Cupressus arizonica* sprayed with carbaryl to prevent cedar bark beetle, *Phloeosinus cristatus*, infestation, Chiricahua National Monument; 10/25/06.
6. Proposed 2006 Williams followup mistletoe treatments, Williams Ranger District, Kaibab National Forest; 10/25/06.
7. Bark Beetle Activity in Forest Health Projects on the Williams Ranger District, Kaibab National Forest; 10/19/06.
8. Eastside Forest Health Project on Peaks Ranger District, Coconino National Forest; 10/20/06.
9. Proposed Forest Health projects on the North Kaibab Ranger District, Kaibab National Forest; 10/21/06.
10. Insect and disease conditions in the Willow Canyon area, Santa Catalina Ranger District, Coronado National Forest; 11/16/06.
11. Evaluation of pest conditions in the West Chevelon riparian restoration project area, Black Mesa Ranger District, Apache-Sitgreaves National Forests; 11/21/06.
12. Proposed 2007 Pinaleño ecosystem management restoration project – Blocks K and L, Safford Ranger District, Coronado National Forest; 11/27/06.
13. Spruce beetle at Snowbowl Ski Area, Peaks Ranger District, Coconino National Forest; 12/05/06.
14. Bark beetle activity in recreation sites on the Black Mesa Ranger District, Apache-Sitgreaves National Forests; 12/07/06.
15. Bark beetle activity on the Alpine Ranger District, Apache-Sitgreaves National Forests; 12/07/06.
16. Bark beetle activity in recreation sites on the Lakeside Ranger District, Apache-Sitgreaves National Forests; 12/11/06.

New Mexico

1. Douglas-fir beetle risk evaluation and possible MCH treatment, Santa Clara Pueblo; 3/31/06.
2. Evaluation of proposed FY 2007 dwarf mistletoe control/thinning project, Jicarilla Apache Indian Reservation; 6/27/06.
3. Evaluation of Forest Health funded projects in Mesa Poleo WUI, Coyote Ranger District, Santa Fe National Forest; 7/19/06.
4. Looper-caused mixed conifer defoliation, Sacramento Ranger District, Lincoln National Forest; 8/9/06.
5. Proposed FY 2007 dwarf mistletoe suppression project, Mescalero Apache Indian Reservation; 8/16/06.
6. Summary of Douglas-fir tussock moth activity, Sandia Ranger District, Cibola National Forest; 8/17/06.
7. Proposed FY 2007 dwarf mistletoe control/thinning project, Picuris Pueblo; 10/12/06.
8. Dwarf mistletoe and bark beetle risk reduction in Pinos Altos project area, Bureau of Land Management; 12/1/06.
9. Summary of Douglas-fir tussock moth activity, Sandia Ranger District, Cibola National Forest; 11/15/06.

Publications

DeGomez, T. E., C. J. Hayes, J. A. Anhold, J. D. McMillin, K. M. Clancy, and P. P. Bosu. 2006. Evaluation of Insecticides for protecting Southwestern ponderosa pine from attack by engraver beetles (Coleoptera: Curculionidae: Scolytinae). J.Econ. Entomol. 99(2): 393-400.

Fairweather, M. L., J. D. McMillin, T. J. Rogers, D. A. Conklin, and R. Fitzgibbon. 2006. Field guide to insects and diseases of Arizona and New Mexico Forests. USDA Forest Service, Southwestern Region, Albuquerque, NM. 269 p.

Fettig, C. J., J. D. McMillin, J. A. Anhold, S. M. Hamud, R. R. Borys, C. P. Dabney, and S. J. Seybold. 2006. The effects of mechanical fuel reduction treatments on the activity of bark beetles (Coleoptera: Scolytidae) infesting ponderosa pine. Forest Ecology and Management. 230, 55-68.

Hull Sieg, C., J. D. McMillin, J. F. Fowler, K. K. Allen, J. F. Negron, L. L. Wadleigh, J. A. Anhold, and K. E. Gibson. 2006. Best predictors for postfire mortality of ponderosa pine trees in the Intermountain West. Forest Science. 52(6): 718-728.

Negrón, J. F., K. K. Allen, J. D. McMillin, and H. Burkwhat. 2006. Testing verbenone for reducing mountain pine beetle attacks in ponderosa pine in the Black Hills, South Dakota. USDA Forest Service, RMRS-RN-31. 8 p.

Sniezko, R. A., A. Kegley, B. Danchok, and D. Conklin. 2006. Variation in white pine blister rust resistance among nine seedling families of southwestern white pine-early results. Third Rusts of Forest Trees Conference, IUFRO Unit 7.02.05. Kings Beach, CA.

Other Entomology and Pathology Activities in 2006

Stand Hazard Rating Southwestern Douglas-fir Mortality Complex

Stand hazard rating systems developed for Douglas-fir beetle in the western U.S. and Canada are primarily centered on stand basal area, percent Douglas-fir in a stand, and Douglas-fir age and diameter and are not suitable for use with the Douglas-fir component of our mixed conifer stands in the Southwest. In 2006, we began investigating the role Douglas-fir beetle, Douglas-fir dwarf mistletoe, root disease, and their interactions play in Douglas-fir mortality by using existing Pest Trend Impact Plot System (PTIPS) permanent plots and establishing new plots throughout areas of Arizona that represent a range of stand and site conditions. This information is being used to further develop insect and disease impact models of Douglas-fir stands in the Southwest. Validation of models will be conducted by collecting data from mixed conifer stands throughout the Southwest that were not included in original data collection areas.

Previous mechanistic explanations for why pine bark beetles may prefer dwarf mistletoe or root disease infected pine trees include pathogen-induced host tree chemical alterations leading to attraction cues and/or possibly reductions in primary tree defense systems such as lowered resin production. Similar studies using Douglas-fir have not been conducted. Therefore, in collaboration with Rick Kelsey of USDA-FS Pacific Research Station, we measured potential chemical cues (ethanol, alpha-pinene production) on trees having different levels of dwarf mistletoe infection in 2006. We plan to measure host defense (resin flow) on these same trees in 2007 just prior to Douglas-fir beetle flight.

Being able to predict stand level tree mortality allows land managers to better develop forest plans or to implement short- and long-term management strategies that can mitigate potential mortality impacts.

For more information, contact Joel McMillin.

New Insect and Disease Field Guide

The Southwestern Region's Forest Health Protection staff has recently completed the "Field Guide to Insects and Diseases of Arizona and New Mexico Forests." The guide is currently being distributed to the region's national forests, districts and other state and Federal forest land management agencies. The 269-page guide features color coded page headings of the major forest insect and disease categories, over 300 color pictures and figures to help with field identification, and is printed on high quality, plastic stock. This guide is meant to be a practical, field-use handbook for forest land managers and others needing to identify the major forest insects and diseases of this region and understand their biology. The Southwest has a complex and diverse array of forest insects and diseases and we attempted to include those having significant ecological and/or economic

Figure 24. Southwestern Region Insect and Disease Field Guide.

impacts on forest resources. An e-guide is forthcoming and will be posted on our Forest Health Web site, http://www.fs.fed.us/r3/resources/health .

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 for the 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. Act 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 D. 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 and Special Technology Development Program Steering Committee. 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 1979. 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.

Rick Norris

Biological technician. Retired. Entomology and pathology field assistance with a primary focus on aerial detection survey.

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, technical support, and field assistance. Involved with the national insect and disease risk map project to project future risk of forest mortality from insect and disease activity. Manages the Forest Health Web site.

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.

Appendix A

Additional *Nepytia janetae* Photographs

Nepytia janetae life stages collected as late instar larvae near Cloudcroft, NM, in June, 2006 and reared. Photos by Cliff Ferris (adults) and Daniel Ryerson (larva and pupae).

Appendix B

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.

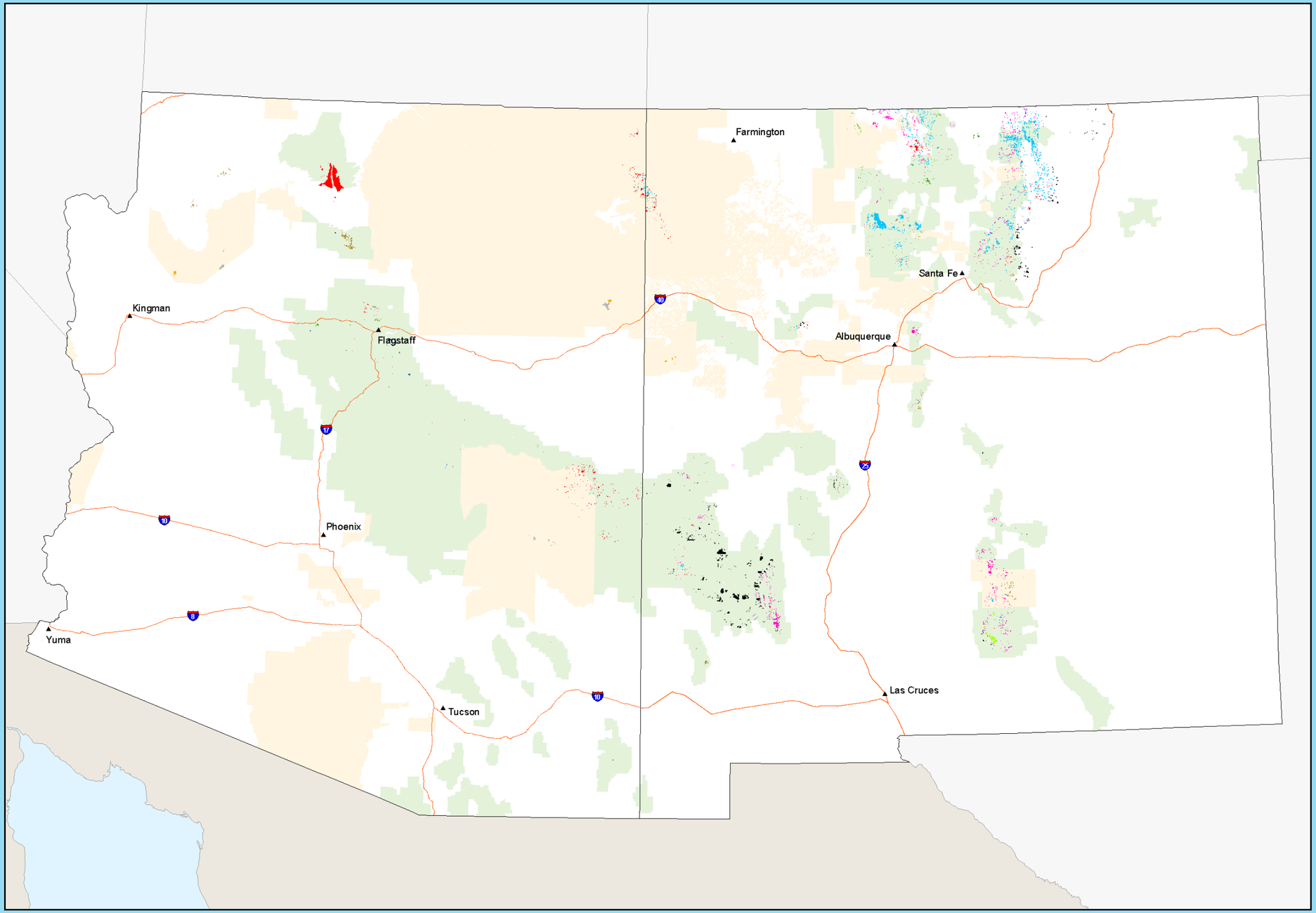
Packing

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*

- Ips engraver on ponderosa pine
- Western pine beetle
- Piñon ips
- Douglas-fir beetle
- Spruce beetle
- True fir mortality from bark beetles
- Cedar bark beetles
- Western spruce budworm defoliation
- Aspen defoliation
- *Nepytia janetae*
- Defoliation from drought

**Only agents affecting greater than 5,000 acres Region-wide are depicted.*

N W E S

0 25 50 100 Miles

The insect and disease activity 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 2005. 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 subjective nature of aerial sketch mapping and the scale of mapping. Areas of particular concern should be ground-checked for precise determination of location and causal agent.

Arizona

Surveys conducted July through September, 2006, by Steve Dudley and Bobbe Fitzgibbon, Forest Health, Arizona Zone Office, Southwestern Region, USDA Forest Service; Tom DeGomez, University of Arizona, Arizona Forest Health Program.

New Mexico

Surveys conducted July through September, 2006 by Richard Norris and Daniel Ryerson, Forest Health, New Mexico Zone Office, Southwestern Region, USDA Forest Service; Stephani Sandoval, New Mexico State University Cooperative Extension Service.

Significant Forest Mortality and Defoliation Detected through Aerial Survey

Southwestern Region - 2006

Forest Health Staff
Southwestern Region
USDA Forest Service
30 January 2007