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Forest Insect and Disease Conditions in the Southwestern Region, 2003

Cover photo: Piñon mortality near village of La Madera in northern New Mexico, 2003.

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Insect and Disease Conditions in the Southwestern Region, 2003

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Introduction

Insects and diseases act as both indicators and regulators of the condition (health) of southwestern forests. This has been abundantly clear in recent years, as extreme drought conditions have resulted in the highest level of bark beetle activity seen in several decades, dramatically affecting forest conditions in many parts of the region.

This report summarizes the current known status of insects and diseases in the forests of Arizona and New Mexico. Most of the insect information is based on annual aerial detection surveys. Most of the disease information included in this report is based on ground observations and surveys. Bark beetles and defoliating insects cause sudden, visually dramatic damage readily seen from the air, while most pathogens cause gradual, insidious damage that is less easily detected. This year's report includes results from special surveys flown over much of the woodland type in Arizona and New Mexico, in response to the massive die-off of piñon at many locations.

Bark beetles—the primary tree killers in the region—tend to be host specific. Moreover, most conifers (excluding ponderosa pine) are normally attacked and killed by a single species of bark beetle. A group of recent Douglas-fir "faders," for example, is most often a result of attack by the Douglas-fir bark beetle, *Dendroctonus pseudotsugae*. In contrast, ponderosa pines are attacked and killed by several different bark beetles. Thus, ground surveys may be needed to confirm the species responsible for ponderosa pine mortality seen from the air. Where ground checking is not conducted, assignment of causal species is based on previous history/experience for a given location.

This report also includes a record of technical assistance provided by Arizona and New Mexico zone personnel and brief descriptions (abstracts) of several special activities conducted in 2003. Much of the information for State and private lands was provided through our State Cooperative Forest Health Program.

Conditions in Brief

As extreme drought conditions continued, bark beetle activity remained very high in many parts of the region in 2003. Conifer mortality attributed to bark beetles was mapped on about 2,700,000 acres. This includes over 1,900,000 acres in the woodland type affected by piñon *Ips*. These acres of piñon mortality are not directly comparable to those detected in previous years (only about 148,000 acres were mapped in 2002), since a much greater proportion of the woodlands were surveyed in 2003. Nevertheless, piñon mortality did increase dramatically in many areas in 2003. As in 2002, most of the piñon mortality occurred in northern New Mexico and in northern and central Arizona.

Bark beetle activity also increased in the ponderosa pine type, with mortality detected on about 763,000 acres in 2003 vs. 570,000 acres in 2002. As in 2002, most of this mortality occurred in Arizona, where it was primarily attributed to *Ips* species, although *Dendroctonus* species were also involved in some locations. Note that a significant proportion of the ponderosa pine mortality detected in Arizona in 2003 actually occurred in late 2002, following that year's aerial survey. Overall, ponderosa pine bark beetle activity decreased in New Mexico in 2003, although activity increased considerably in the Sacramento Mountains.

Ponderosa pine mortality is reported as follows: western pine beetle - 63,315 acres; mountain pine beetle - 190 acres; roundheaded pine beetle - 4,530 acres; and *Ips* engraver beetles - 695,130 acres. In the higher elevation forests, trees were killed by spruce beetle (24,435 acres), fir engraver and western balsam bark beetles (11,715 acres), and Douglas-fir beetle (28,955 acres). Compared to 2002, Douglas-fir mortality increased considerably, while spruce and true fir mortality decreased.

Western spruce budworm activity continued to decrease in most outbreak areas, with 167,325 acres of defoliation detected vs. 210,335 acres in 2002. Spruce aphid defoliation was mapped on 121,120 acres, mostly in the White Mountains of eastern Arizona, following 2 years with none detected. New Mexico fir looper defoliation increased to 7,205 acres in the Sacramento Mountains of southern New Mexico, and an unknown looper continued to defoliate subalpine conifers (1,035 acres) in the White Mountains of Arizona. Aspen defoliation and decline, largely a result of abiotic factors, was mapped on about 77,420 acres in 2003 compared to 59,490 acres the previous year. Significant aspen mortality occurred in northern and eastern Arizona.

Dwarf mistletoes continue to be the most widespread and damaging forest pathogens in the Southwest. Over one-third of the ponderosa pine acreage and about one-half of the mixed conifer acreage has some level of infection. The incidence of dwarf mistletoe changes little from year to year, but is thought to have increased over the past century. These parasites cause an estimated annual volume loss of 25 million cubic feet.

Root diseases are widely distributed in the region, causing an estimated 5 million cubic foot volume loss annually and creating hazard trees in campgrounds and along roadways. Incidence is usually higher in mixed-conifer and spruce-fir forests than in ponderosa pine forests.

The incidence of white pine blister rust continues to increase in the Sacramento Mountains of southern New Mexico. An estimated 40 percent of the white pines within this area are presently infected with this often-fatal disease. Smaller blister rust outbreaks have been detected to the north in the Capitan and Gallinas Mountains.

Status of Insects

Bark Beetles

Western Pine Beetle

Dendroctonus brevicomis
Primary host: Ponderosa pine

Tree mortality attributed to western pine beetle continued to increase regionwide, with 63,315 acres of activity recorded in 2003 vs. 53,782 acres in 2002. In Arizona, western pine beetle activity was mapped on the Apache-Sitgreaves (35 acres) and Kaibab (7,835 acres) National Forests, and the Fort Apache (60 acres) and Navajo (55 acres) Indian Reservations. Note that no western pine beetle activity was recorded in Arizona in 2002. In both 2002 and 2003 most of the ponderosa pine mortality detected in Arizona was attributed to *Ips* beetles; however, western pine beetle and other *Dendroctonus* species were active in many of these areas, often attacking the lower boles of trees initially attacked by *Ips*.

In New Mexico, most of the ponderosa pine mortality detected in 2003 was attributed to western pine beetle. Overall, pine mortality decreased in 2003, although a notable increase occurred in the Sacramento Mountains. Western pine beetle activity was mapped on the Carson (3,325 acres), Cibola (2,390 acres), Gila (27,235 acres), Lincoln (10,715 acres), and Santa Fe (3,065 acres) National Forests; BLM lands (130 acres); Valles Caldera National Preserve (40 acres); Jicarilla Apache (120 acres), Mescalero Apache (6,780 acres), Picuris Pueblo (35 acres), Taos Pueblo (240 acres), Laguna Pueblo (85 acres), Santa Clara Pueblo (165 acres), and 110 acres of other tribal lands identified by the BLM as Indian owned, but not within the boundaries of any reservation or tribal area provided by the BIA. Approximately 890 acres of western pine beetle-caused tree mortality was also recorded on State and private lands in New Mexico.

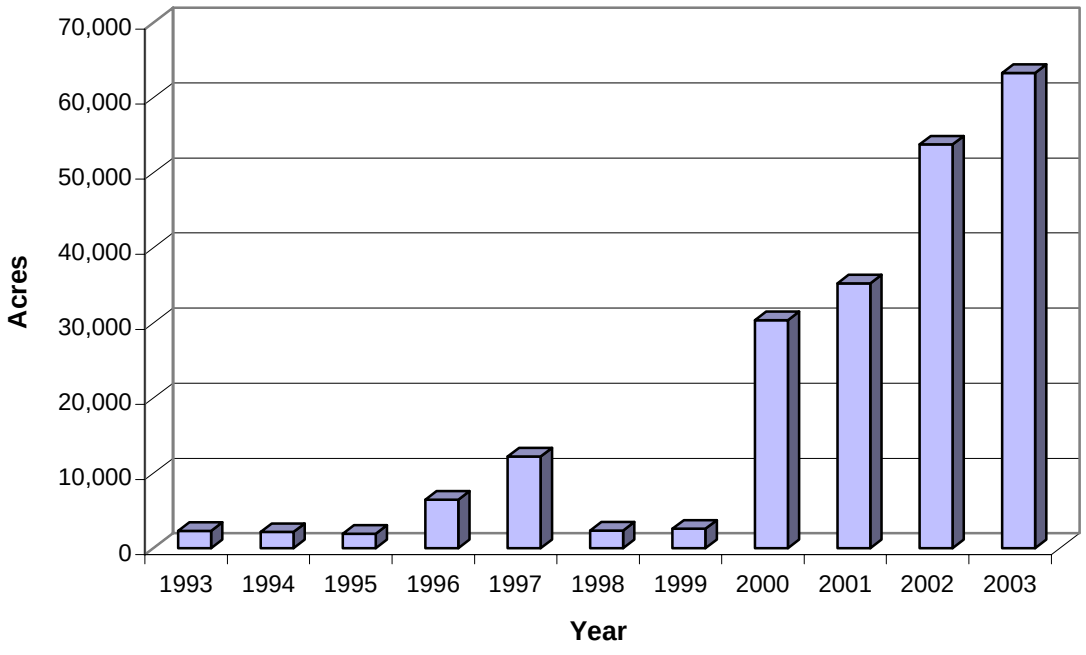

Figure 1. Western pine beetle activity in Arizona and New Mexico, 1993 – 2003.

Mountain Pine Beetle

Dendroctonus ponderosae
Primary hosts: Ponderosa, limber and bristlecone pine

Mountain pine beetle activity was detected over 190 acres in Arizona in 2003: on the Kaibab National Forest (80 acres) and on 110 acres of the Grand Canyon National Park. Although not detected by aerial survey, mountain pine beetle continued to kill small pockets of limber pine on the San Francisco Peaks and on Kendrick Peak near Flagstaff. No mountain pine beetle activity was detected in New Mexico.

Note that much of the 2002 mortality displayed in Figure 2 (as well as some from previous years) has now been confirmed to be a result of western pine beetle rather than mountain pine beetle. This change affects acreages reported previously in northern New Mexico, particularly on the Carson and Santa Fe National Forests. Large outbreaks of mountain beetle apparently did occur on the Kaibab Plateau of northern Arizona in 1996-1998, although ground checking of these area was limited.

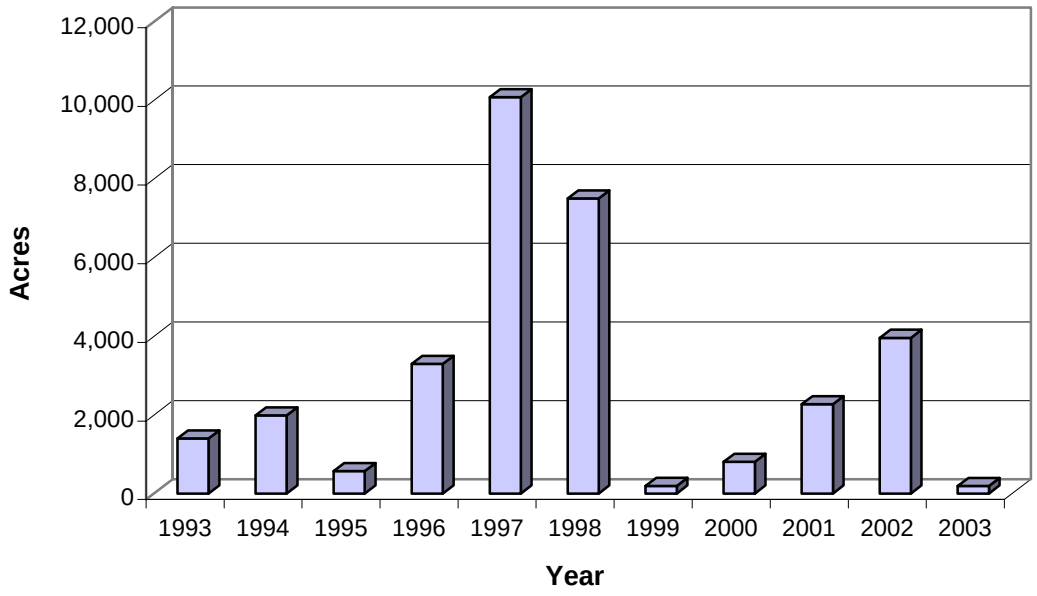

Figure 2. Mountain pine beetle activity in Arizona and New Mexico, 1993 – 2003.

Roundheaded Pine Beetle

Dendroctonus adjunctus
Primary host: Ponderosa pine

Tree mortality attributed to roundheaded pine beetle decreased considerably in 2003, with 4,530 acres recorded, compared to 11,120 acres in 2002. All of this 2003 activity occurred on the Coronado National Forest in Arizona. This insect, which 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. Note that the 2002 data in Figure 3 includes about 13,000 additional acres in New Mexico affected by a combination of roundheaded and western pine beetle.

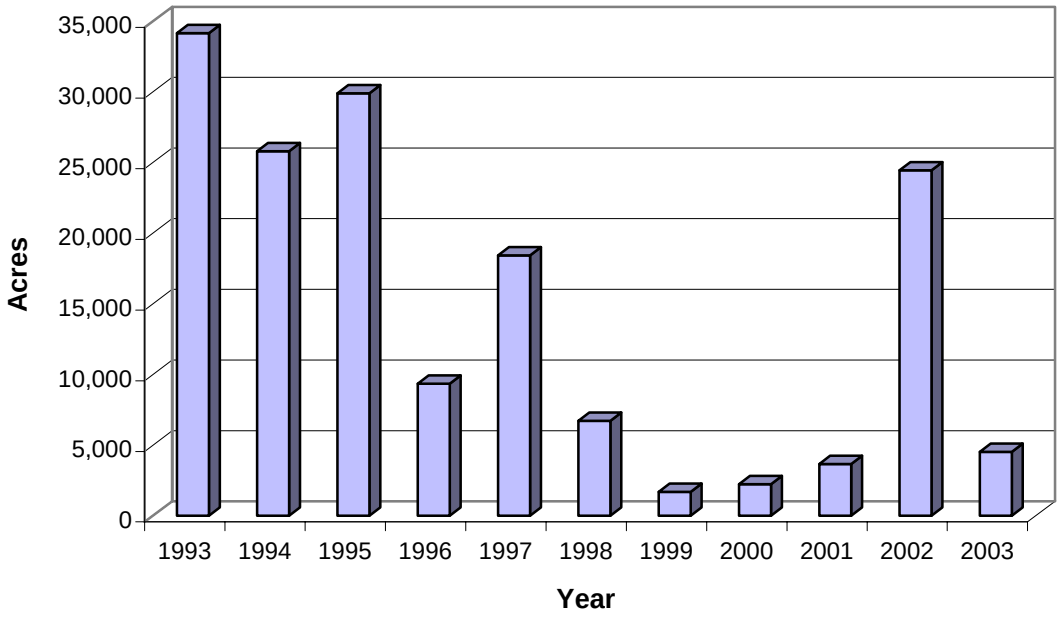

Figure 3. Roundheaded pine beetle activity in Arizona and New Mexico, 1993 – 2003.

Ips Beetles

Ips spp.
Primary hosts: Ponderosa pine, piñon pine

Ponderosa pine mortality attributed primarily to *Ips* beetles was detected on 695,130 acres regionwide in 2003 compared to 448,105 acres in 2002. Almost all of this 2003 acreage is in Arizona. As previously noted, a significant proportion of this mortality actually occurred in late 2002, after that year's aerial survey. 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.

Ips activity in ponderosa pine was mapped on the Apache-Sitgreaves (122,575 acres), Coconino (71,815 acres), Coronado (1,070 acres), Kaibab (64,195 acres), Prescott (93,110 acres), and Tonto (161,180 acres) National Forests; Grand Canyon National Park (985 acres); Saguaro (140 acres) and Walnut Canyon (1,805 acres) National Monuments; BLM lands (2,085 acres); Fort Apache (81,020 acres), Hualapai (615 acres), Navajo (33,175 acres), and San Carlos (28,820 acres) Indian Reservations; and 32,160 acres of State and private lands.

In New Mexico, only 380 acres of *Ips* beetle-killed ponderosa pine were mapped, all on the Santa Fe National Forest. Most of the ponderosa pine mortality detected in New Mexico in 2003 was attributed to other bark beetles (primarily western pine beetle), although *Ips* were active in many of these areas as well.

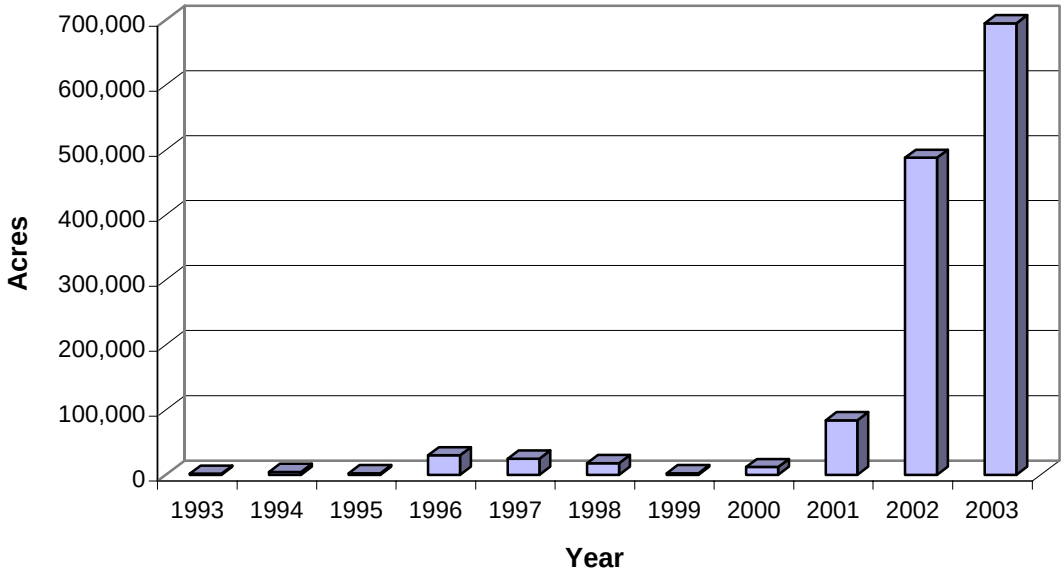

Figure 4. Ips beetle activity in ponderosa pine in Arizona and New Mexico, 1993 – 2003.

Piñon mortality, caused primarily by *Ips confusus*, was detected on 1,914,345 acres regionwide in 2003. This figure is not comparable to the 148,370 acres reported in 2002 because this year's aerial survey flights included large areas of piñon-juniper woodlands not flown in 2002. Nevertheless, piñon mortality did increase dramatically in many areas in 2003. As in 2002, most of this damage occurred in northern New Mexico and northern and central Arizona.

In Arizona, piñon mortality was recorded on the Apache-Sitgreaves (145,890 acres), Coconino (148,485 acres), Coronado (815 acres), Kaibab (158,950 acres), Prescott (30,145 acres), and Tonto (23,895 acres) National Forests; Grand Canyon National Park (5,345 acres); Wupatki (375 acres) and Walnut Canyon (45 acres) National Monuments; BLM lands (32,055 acres); Fort Apache (8,240 acres), Hopi (14,585 acres), Hualapai (29,585 acres), Navajo (256,220 acres), Nav-Hopi JUA (131,350 acres), and San Carlos (37,265 acres) Indian Reservations; and 120,285 acres of State and private lands.

In New Mexico, piñon mortality was detected on the Carson (277,615 acres), Cibola (9,930 acres), Gila (3,510 acres), Lincoln (6,130 acres) and Santa Fe (64,820 acres) National Forests; Jicarilla Apache (1,770 acres), Mescalero Apache (150 acres), Ute Mountain (135 acres), Taos Pueblo (50 acres), Laguna Pueblo (60 acres), Cochiti Pueblo (1,825 acres), Jemez Pueblo (6,295 acres), Nambe Pueblo (2,160 acres), San Ildefonso Pueblo (310 acres), Santa Clara Pueblo (3,385 acres), Santo Domingo Pueblo (5,300 acres), Tesuque Pueblo (2,650 acres), and Zia Pueblo (385 acres) tribal lands; 4,790 acres of other tribal lands identified by the BLM as Indian owned, but not within the boundaries of any reservation or tribal area provided by the BIA; 199,880 acres of State and private ownerships; and Bandelier (2,230 acres) and El Malpais (25 acres) National Monuments. Piñon mortality was also detected on Bureau of Land Management (170,165 acres), Bureau of Reclamation (2,675 acres), and Department of Energy (4,570 acres) lands in New Mexico.

Douglas-fir Beetle

Dendroctonus pseudotsugae
Host: Douglas-fir

Tree mortality attributed to this insect increased dramatically in 2003, to its highest level in over a decade. Activity was detected on 28,955 acres, compared to only 2,500 acres the previous year. In Arizona, Douglas-fir mortality was recorded on the Apache-Sitgreaves (1,445 acres), Coconino (5,515 acres), Coronado (50 acres), Kaibab (1,280 acres), and Tonto (1,280 acres) National Forests; Grand Canyon National Park (70 acres); Fort Apache (135 acres) and Navajo (375 acres) Indian Reservations; and 215 acres of State and private lands. In New Mexico, Douglas-fir mortality occurred on the Carson (6,235 acres), Cibola (705 acres), Gila (2,610 acres), Lincoln (665 acres), and Santa Fe (4,330 acres) National Forests; Jicarilla Apache (195 acres), Mescalero Apache (510 acres), Taos Pueblo (365 acres), Jemez Pueblo (20 acres), Santa Clara Pueblo (340 acres), and Zia Pueblo (30 acres) tribal lands; the Valles Caldera National Preserve (170 acres); and 2,415 acres of State and private lands.

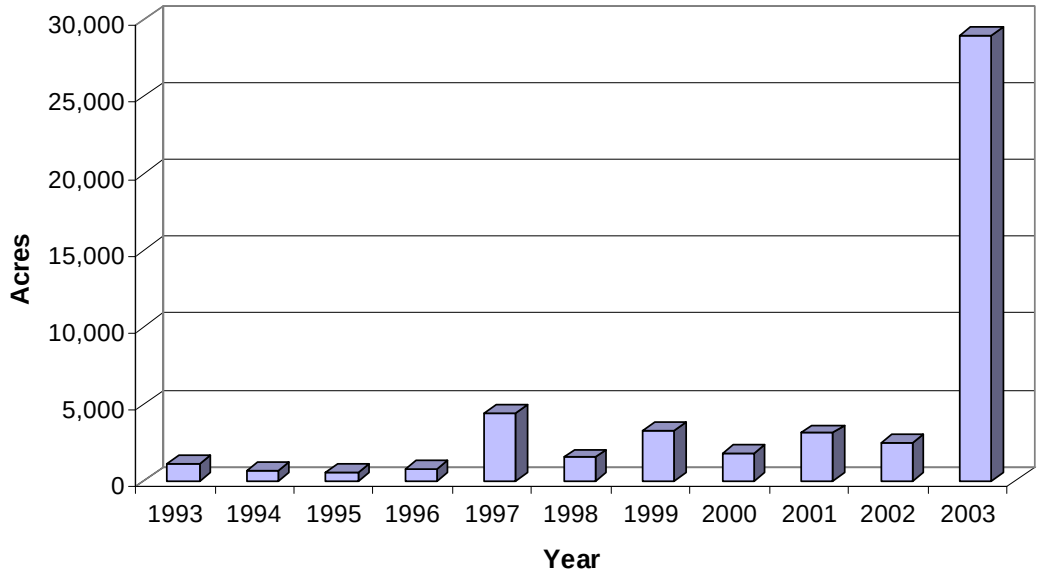

Figure 5. Douglas-fir beetle activity in Arizona and New Mexico, 1993 – 2003.

Spruce Beetle

Dendroctonus rufipennis
Host: Spruce

Spruce beetle activity decreased in the region in 2003, following a dramatic increase the previous year. Spruce mortality was mapped on 24,435 acres in 2003 compared to 43,350 acres in 2002. In Arizona, activity occurred on the Apache-Sitgreaves (6,110 acres) National Forests; Fort Apache (395 acres) and Navajo (3,560 acres) Indian Reservations; and 80 acres of private lands. In New Mexico, spruce beetle-killed trees were mapped on the Carson (5,840 acres), Cibola (90 acres), Gila (5 acres), Lincoln (115 acres), and Santa Fe (3,285 acres) National Forests; Jicarilla Apache (170 acres), Mescalero Apache (65 acres), and Taos Pueblo (2,825 acres) tribal lands; Valles Caldera National Preserve (20 acres), and 1,875 acres of State and private lands.

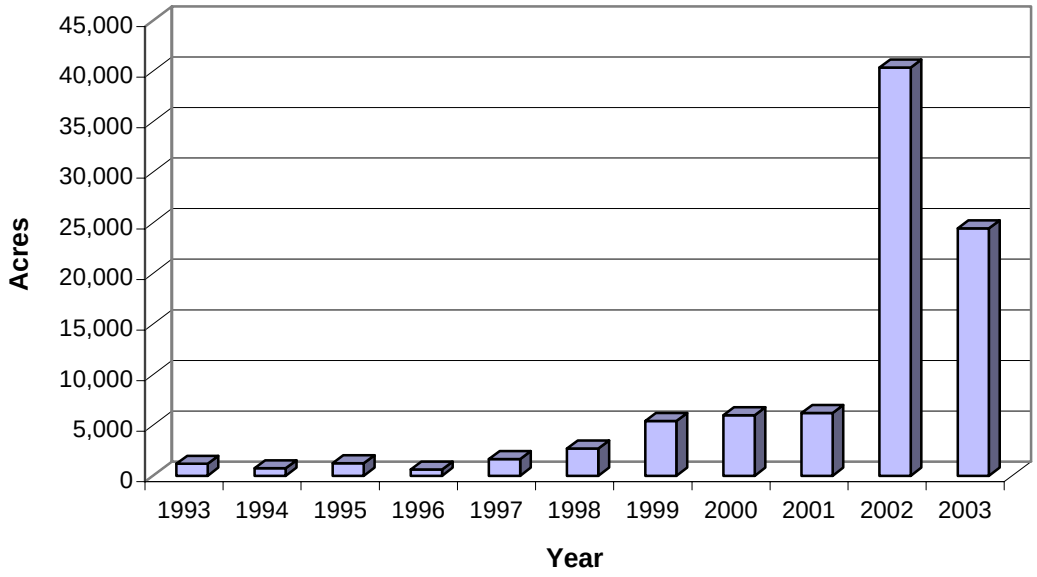

Figure 6. Spruce beetle activity in Arizona and New Mexico, 1993 – 2003.

True Fir Beetles

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

True fir mortality decreased slightly in 2003, with 11,715 acres affected regionwide vs. 13,725 acres in 2002. In Arizona, fir mortality was recorded on the Apache-Sitgreaves (5,455 acres), Coconino (2,630 acres), Coronado (750 acres), Kaibab (365 acres), Prescott (70 acres), and Tonto (15 acres) National Forests; Grand Canyon National Park (1,140 acres); Fort Apache (335 acres) and San Carlos (110 acres) Indian Reservations; and 70 acres of State and private lands. In New Mexico, fir mortality was detected on the Carson (85 acres), Cibola (490 acres), Gila (20 acres), and Santa Fe (45 acres) National Forests, and on 135 acres of Jicarilla Apache tribal lands. Note that root diseases may be associated with much of the fir mortality in the region.

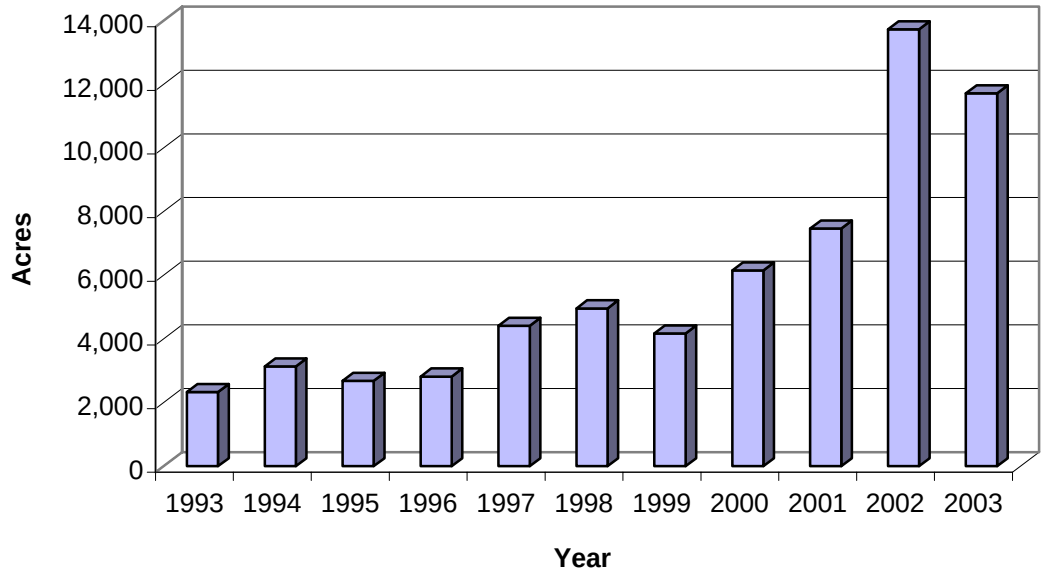

Figure 7. Fir engraver and western balsam bark beetle activity in Arizona and New Mexico, 1993 – 2003.

Juniper and Cypress Bark Beetles

Phloeosinus spp.

Although more drought-resistant than piñons, junipers have also succumbed to extreme moisture stress in some parts of the region. *Phloeosinus* bark beetles have been associated with at least some of this mortality, although in some instances it has been unclear whether they colonized the trees before or after they died. In addition, dead and dying junipers near Flagstaff were often infested with western cedar borers (*Trachykele blondeli*), and to a more limited extent by juniper twig pruners (*Styloxus bicolor*). In both 2002 and 2003, juniper mortality was generally more common and widespread in the woodlands of Arizona than those in New Mexico.

Extensive mortality of native Arizona cypress has occurred in both the central and southeastern Arizona populations the past 2 years. *Phloeosinus* spp. have also attacked landscape Leyland cypress in both Arizona and New Mexico.

Defoliators

Western Spruce Budworm

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

Western spruce budworm activity continued to decrease in 2003, with 167,325 acres of defoliation detected vs. 210,335 acres in 2002. In Arizona, defoliation was recorded in Grand Canyon National Park (1,210 acres) and on the Navajo Indian Reservation (22,860 acres). In New Mexico, budworm defoliation was detected on the Carson (62,700 acres), Cibola (205 acres), Gila (1,195 acres), Lincoln (15 acres), and Santa Fe (18,675 acres) National Forests; the Jicarilla

Apache (5,520 acres), Mescalero Apache (20 acres), and Taos Pueblo (1,385 acres) tribal lands; and 53,540 acres of State and private lands. Although budworm activity decreased in most areas, including chronically-affected areas of northern New Mexico, a notable increase occurred on the Navajo Reservation in 2003.

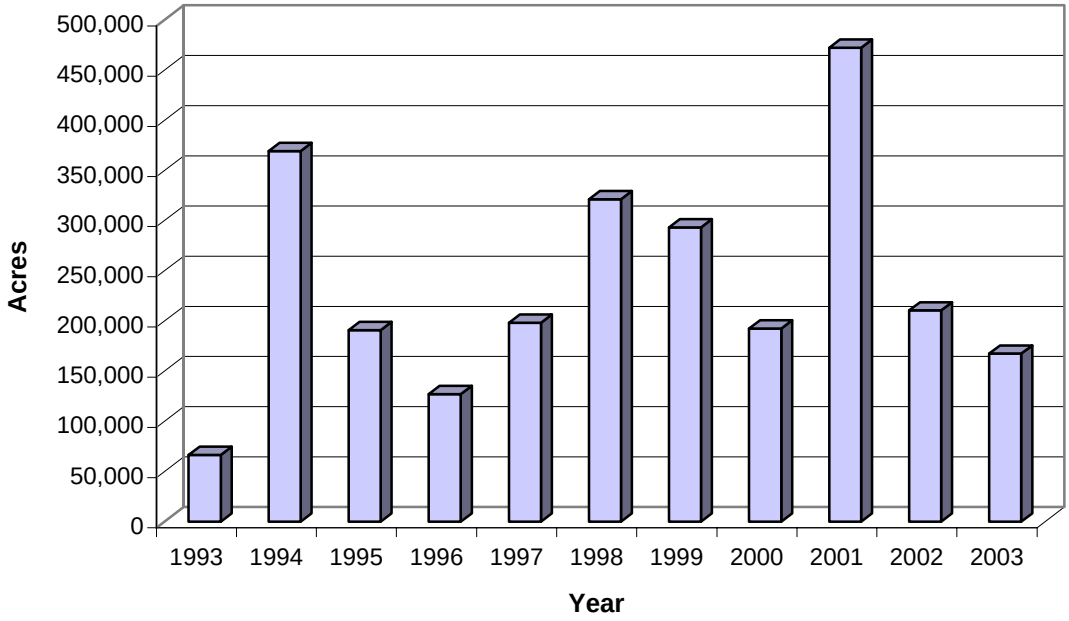

Figure 8. Western spruce budworm activity in Arizona and New Mexico, 1993 – 2003.

Douglas-fir Tussock Moth

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

No Douglas-fir tussock moth defoliation was detected in the region by aerial survey in 2003. However, several white fir that appear to have been defoliated by tussock moth were observed from the ground in the Sandia Mountains, Cibola National Forest.

New Mexico Fir Looper

Galenara consimilus
Hosts: Douglas-fir and white fir

New Mexico fir looper activity increased in the Sacramento Mountains in 2003, with 7,205 acres of defoliation detected vs. 3,865 acres in 2002. Defoliation was detected on the Sacramento (6,615 acres) and Smokey Bear (200 acres) Ranger Districts of the Lincoln National Forest, and on the Mescalero Apache Indian Reservation (390 acres).

Unknown Looper

Host: Spruce and true firs

Defoliation from an unidentified looper continued but decreased in the White Mountains in 2003, with 1,035 acres affected compared to 6,615 acres in 2002. All the 2003 activity was recorded on the Fort Apache Indian Reservation.

Spruce Aphid

Elatobium abietinum
Host: Spruce

Over 120,000 acres of spruce aphid defoliation is reported from Arizona in 2003, following 2 years in which none was detected. Activity was observed on the Apache-Sitgreaves National Forests (49,385 acres); the Fort Apache (71,585 acres) and San Carlos (90 acres) Indian Reservations; and 60 acres of State and private lands. No spruce aphid activity was detected in New Mexico.

Ponderosa Pine Needle Miner

Coleotechnites ponderosae

No needle miner activity was detected in Arizona or New Mexico in 2003.

Piñon Needle Scale

Matsucoccus acalyptus

Scale continues to affect piñon at several locations in the woodlands of Arizona and New Mexico, although none was mapped during the 2003 aerial surveys. Ongoing outbreaks covering thousands of acres occur on Federal lands in the San Mateo and Datil Mountains, in Lincoln County near the Capitan Mountains, and in smaller pockets south of Capitan. Other woodlands with reported damage include private lands south of Willard, east of El Rito, south of Corona, and east of Silver City. Damage to landscape piñon continues to be common statewide in New Mexico. In Arizona, moderate to heavy defoliation of piñon was observed from the ground on the Prescott, Coconino, and Apache-Sitgreaves National Forests.

Aspen Defoliation/Decline

Aspen Defoliator Complex:
Western Tent Caterpillar, *Malacosoma californicum*
Large Aspen Tortrix, *Choristoneura conflictana*
Black Leaf Spot, *Marssonina populi*
Weather-related Damage

Aspen defoliation, decline, and mortality caused by one or more of the above insects, disease, and abiotic factors increased in 2003, with damage recorded on 77,420 acres vs. 59,490 acres in 2002. Aspen has been declining throughout the northern half of Arizona since a frost event in June 1999, followed by several years of drought. Many areas in northern and eastern Arizona experienced widespread mortality in 2002 and 2003, particularly on lower elevation sites. See "Activities" section in this report for additional information.

In Arizona, aspen defoliation/decline was detected on the Apache-Sitgreaves (30,720 acres), Coconino (5,845 acres), Kaibab (950 acres), and Tonto (20 acres) National Forests; BLM lands (15 acres); Fort Apache (21,000 acres) and Navajo (13,945 acres) Indian Reservations; and 430 acres of State and private lands. In New Mexico, aspen defoliation was mapped on the Carson (680 acres), Cibola (1,175 acres), Gila (220 acres), Lincoln (315 acres), and Santa Fe (1,605 acres) National Forests; Mescalero Apache (60 acres) and Taos Pueblo (25 acres) tribal lands; Valles Caldera National Preserve (35 acres); and 380 acres of State and private lands.

Miscellaneous Insects

Large populations of the **giant conifer aphid** (*Cinara* spp.) were found on ponderosa pine throughout the Flagstaff area and elsewhere in Arizona in 2003. Infested trees were exuding such copious quantities of honey-dew that vehicles and streets beneath them were glazed. Populations decreased with increasing populations of lady bugs and the monsoon rains.

Extensive **twig beetle** (*Pityophthorus* spp., *Pityogenes* spp., *Pityotrichus* spp.) outbreaks continued on pine species in association with other bark beetles, especially *Ips*, throughout both Arizona and New Mexico in 2003.

Sawflies (*Zadiprion rohweri*) were observed in early October defoliating piñon in the Manzanita Hills area of Gila County, Arizona.

An outbreak of **wooly oak aphids** (Eriosomatidae) was observed in the Payson area. Many Emory oaks (an evergreen species) were turning brown in January and February. The infestation was severe enough to cause some mortality of the drought-stressed trees, although most recovered with the onset of spring and summer rains.

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.

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.

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. They are common in piñon-juniper woodlands throughout the region, and are locally abundant in lower riparian areas and desert shrublands. Heavy infection contributes toward host mortality, especially during periods of drought.

Root Diseases

Root diseases are associated with roughly one-third of the conifer mortality in the region each year. (Note that this estimate was based on surveys conducted in the 1980s, a period when bark beetle activity was relatively low.) Root diseases kill some trees outright and are often associated with bark beetle attack. They can also predispose trees to windthrow, an obvious concern in heavily-used areas. Root diseases are generally more common in mixed conifer and spruce-fir forests than in ponderosa pine forests. Like mistletoes, the incidence of root diseases changes little from year to year. However, on some sites thinning activities can increase the incidence of root disease because these fungi can build up in the roots and stumps of cut trees.

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 mortality in the region. Previous surveys on the North Kaibab Ranger District found the fungus in 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).

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. 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 hazard on developed sites. On the other hand, decayed trees provide important habitat for some 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; and **aspen trunk rot**, *Phellinus tremulae*.

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

This very damaging, nonnative disease occurs throughout most of the range of its host in the Sacramento and adjoining White Mountains of southern New Mexico. This area probably contains the largest population of white pine in the region. Blister rust appears to have arrived in this area by the early 1970s, but was not detected until 1990. The disease has since spread to the nearby Capitan Mountains and Gallinas Peak, located about 50 miles north of the Capitans. The disease has not yet been detected in northern New Mexico or in Arizona.

We have been monitoring blister rust incidence and damage using a small set of permanent plots. Forty percent (238 of 600) of our sample trees in the main outbreak area in the Sacramento/White Mountains are presently infected. Stem cankers occur on 18 percent of the sample trees; these have resulted in topkill on 10 percent of the sample trees. Blister rust incidence (percent of trees infected) has increased considerably on most plots since installation, with an average increase of 2.6 percent per year on the 12 oldest plots. Although not statistically representative of the white pine population, these plots may provide a reasonable estimate of overall rust incidence and damage in the outbreak area. A strong correlation between rust incidence and elevation is demonstrated on the plots. Infection is relatively high in most stands above 8,000 feet and tapers off steadily at lower elevations.

Broom Rusts

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.

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 elderica*) 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 disease, more common in other parts of the West, is occasionally found on ponderosa pine in the Southwest. A new infestation of gall rust was detected in the Davis Mountains of west Texas in 2003.

Foliage Diseases

(see also Aspen Defoliation in Insect section)

Ponderosa Pine Needle Cast

Lophodermella cerina and other species

Relatively little needle cast was detected in the region during the 2003 aerial surveys. Affected areas were mapped on the Lincoln (70 acres) and Gila (60 acres) National Forests, and on 1,790 acres of private lands in Colfax and Mora Counties of New Mexico.

Lophodermella appears to be the most common of several fungi that cause needle cast of ponderosa pine in the Southwest. Needle miner (an insect) and drought stress can produce symptoms very similar to those of needle cast. It can be difficult to determine the actual cause of discolored foliage during aerial surveys; assessments from the ground are often needed. The acreages reported here are based on limited ground checking and past experience.

Piñon needle rust (*Coleosporium ribicola*) was detected at two locations in the Manzanita Mountains south of Tijeras, New Mexico in 2003. Wax current (*Ribes cereum*), a presumed alternate host for this disease, occurred near the infected trees at both locations.

Abiotic Damage

Drought

Discoloration of various shrubs and woody plants attributed to drought was mapped on 39,935 acres in 2003, down from 79,490 acres in 2002. As in 2002, all of this recorded damage occurred in Arizona. Affected areas include the Coconino (4,165 acres), Coronado (17,480 acres), Kaibab (2,520 acres), Prescott (8,070 acres), and Tonto (190 acres) National Forests; Grand Canyon National Park (125 acres); Saguaro (10 acres) and Wupatki (95 acres) National Monuments; Hualapai (935 acres) and Navajo (170 acres) tribal lands; BLM lands (2,800 acres); and 3,375 acres of State and private lands.

Table 1. Prominent 2003 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	7,870	115	0	0	7,985
	NM	46,770	7,535	135	890	55,330
Roundheaded pine beetle	AZ	4,530	0	0	0	4,530
Ips beetle (ponderosa pine)	AZ	513,945	143,630	5,015	32,160	694,750
	NM	380	0	0	0	380
Ips beetle (piñon pine)	AZ	508,180	477,245	37,820	120,285	1,143,530
	NM	362,005	29,265	179,665	199,880	770,815
Douglas-fir beetle	AZ	9,570	510	70	215	10,365
	NM	14,715	1,460	0	2,415	18,590
Spruce beetle	AZ	6,110	3,955	0	80	10,145
	NM	9,355	3,060	0	1,875	14,290
True fir beetles	AZ	9,285	445	1,140	70	10,940
	NM	640	135	0	0	775
Western spruce budworm	AZ	0	22,860	1,210	0	24,070
	NM	82,790	6,925	0	53,540	143,255
New Mexico fir looper	NM	6,815	390	0	0	7,205
Aspen defoliation	AZ	37,535	34,945	15	430	72,925
	NM	4,030	85	0	380	4,495
Drought effects on shrubs	AZ	32,425	1,105	3,030	3,375	39,935
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

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

Table 2. 2003 Forest Insect and Disease Incidence by Site (in acres). [As detected by aerial survey. Does not include the major diseases in the region]

	Western Pine Beetle	Mountain Pine Beetle	Round-headed Pine Beetle	Ponderosa *Ips*	Piñon *Ips*	Douglas-fir Beetle	Spruce Beetle	True Fir Beetles	Bark Beetle Totals
Apache-Sitgreaves NFs	35			122,575	145,890	1,445	6,110	5,455	281,510
Coconino NF				71,815	148,485	5,515		2,630	228,445
Coronado NF			4,530	1,070	815	50		750	7,215
Kaibab NF	7,835	80		64,195	158,950	1,280		365	232,705
Prescott NF				93,110	30,145			70	123,325
Tonto NF				161,180	23,895	1,280		15	186,370
Grand Canyon NP		110		985	5,345	70		1,140	7,650
Wupatki NM					375				375
Saguaro NM				140					140
Walnut Canyon NM				1,805	45				1,850
BLM				2,085	32,055				34,140
Fort Apache Tribal	60			81,020	8,240	135	395	335	90,185
Hualapai Tribal				615	29,585				30,200
Navajo Tribal	55			33,175	256,220	375	3,560		293,385
San Carlos Tribal				28,820	37,265			110	66,195
Hopi Tribal					14,585				14,585
Nav-Hopi JUA					131,350				131,350
State & Private				32,160	120,285	215	80	70	152,810
Arizona Total	**7,985**	**190**	**4,530**	**694,750**	**1,143,530**	**10,365**	**10,145**	**10,940**	**1,882,435**
Carson NF	3,325				277,615	6,235	5,840	85	293,100
Cibola NF	2,390				9,930	705	90	490	13,605
Gila NF	27,235				3,510	2,610	5	20	33,380
Lincoln NF	10,715				6,130	665	115		17,625
Santa Fe NF	3,065			380	64,820	4,330	3,285	45	75,925
Valles Caldera NP	40					170	20		230
BLM	130				170,165				170,295
Bureau of Reclamation					2,675				2,675
Department of Energy					4,570				4,570
National Park Service	5				2,255				2,260
Cochiti Pueblo					1,825				1,825
Jemez Pueblo					6,295	20			6,315
Jicarilla Apache Tribal	120				1,770	195	170	135	2,390
Laguna Pueblo	85				60				145
Mescalero Apache	6,780				150	510	65		7,505
Nambe Pueblo					2,160				2,160
Other Tribal	110				4,790				4,900
Picuris Pueblo	35								35
San Ildefonso Pueblo					310				310
Santa Clara Pueblo	165				3,385	340			3,890
Santo Domingo Pueblo					5,300				5,300
Taos Pueblo	240				50	365	2,825		3,480
Tesuque Pueblo					2,650				2,650
Ute Mountain					135				135
Zia Pueblo					385	30			415
State & Private	890				199,880	2,415	1,875		205,060
New Mexico Total	**55,330**	**0**	**0**	**380**	**770,815**	**18,590**	**14,290**	**775**	**860,180**
SW Region Total	**63,315**	**190**	**4,530**	**695,130**	**1,914,345**	**28,955**	**24,435**	**11,715**	**2,742,615**

Table 2. 2003 Forest Insect and Disease Incidence by Site (in acres) (continued).

	Western Spruce Budworm	Unknown Geometrid	Aspen Damage	NM Fir Looper	Needle Cast	Spruce Aphid	Drought	Defoliation Total
Apache-Sitgreaves NFs			30,720			49,385		80,105
Coconino NF			5,845				4,165	10,010
Coronado NF							17,480	17,480
Kaibab NF			950				2,520	3,470
Prescott NF							8,070	8,070
Tonto NF			20				190	210
Grand Canyon NP	1,210						125	1,335
Wupatki NM							95	95
Saguaro NM							10	10
Walnut Canyon NM								0
BLM			15				2,800	2,815
Fort Apache Tribal		1,035	21,000			71,585		93,620
Hualapai Tribal							935	935
Navajo Tribal	22,860		13,945				170	36,975
San Carlos Tribal						90		90
Hopi Tribal								0
Nav-Hopi JUA								0
State & Private			430			60	3,375	3,865
2002 Arizona Total	**24,070**	**1,035**	**72,925**	**0**	**0**	**121,120**	**39,935**	**259,085**
Carson NF	62,700		680					63,380
Cibola NF	205		1,175					1,380
Gila NF	1,195		220		60			1,475
Lincoln NF	15		315	6,815	70			7,215
Santa Fe NF	18,675		1,605					20,280
Valles Caldera NP			35					35
BLM								0
Bureau of Reclamation								0
Department of Energy								0
National Park Service								0
Cochiti Pueblo								0
Jemez Pueblo								0
Jicarilla Apache Tribal	5,520							5,520
Laguna Pueblo								0
Mescalero Apache	20		60	390				470
Nambe Pueblo								0
Other Tribal					5			5
Picuris Pueblo								0
San Ildefonso Pueblo								0
Santa Clara Pueblo								0
Santo Domingo Pueblo								0
Taos Pueblo	1,385		25					1,410
Tesuque Pueblo								0
Ute Mountain								0
Zia Pueblo								0
State & Private	53,540		380		1,790			55,710
New Mexico Total	**143,255**	**0**	**4,495**	**7,205**	**1,925**	**0**	**0**	**156,880**
SW Region Total	**167,325**	**1,035**	**77,420**	**7,205**	**1,925**	**121,120**	**39,935**	**415,965**

Biological Evaluations and Technical Assistance

Our staff is “on call” to provide information on forest insect and disease activity, including input for resource planning and management activities. We provide this information to the Forest Service and other land management agencies. The following letters/reports document much of this work done in 2003.

Arizona Zone

1. Bark beetle evaluation at Grand Canyon National Park; 1/13/03.
2. Cypress bark beetle infestation at Tuzigoot National Monument; 3/11/03.
3. Hazard tree and bark beetle observations in selected developed sites and administrative sites, Blue Ridge and Long Valley Ranger Districts, Coconino National Forest; 3/18/03.
4. Hazard tree evaluation at Lockett Meadow, Peaks Ranger District, Coconino National Forest; 5/21/03.
5. Forest insect and disease conditions and effects in mixed conifer, transition, and spruce-fir forests of the Pinaleño Mountains, Safford Ranger District, Coronado National Forest; 6/03.
6. Root disease report for De Motte Campground Reconstruction Project, North Kaibab Ranger District, Kaibab National Forest; 7/24/03.
7. Spruce beetle activity on the Pinaleño Mountains, Safford Ranger District, Coronado National Forest; 8/14/03.
8. Bark beetle activity in fuels reduction projects on the Springerville Ranger District, Apache-Sitgreaves National Forests; 9/12/03.
9. Bark beetle activity in recreation sites on the Williams Ranger District, Kaibab National Forest; 9/16/03.
10. Bark beetle activity in recreation sites, Lakeside and Black Mesa Ranger Districts, Apache-Sitgreaves National Forests; 10/05/03.
11. Bark beetle activity in Oak Creek recreation sites, Red Rock Ranger District, Coconino National Forest; 10/21/03.
12. Spruce beetle at Snowbowl Ski Area, Peaks Ranger District, Coconino National Forest; 10/21/03.
13. Forest health evaluation of recreation and restoration sites, Bradshaw Ranger District, Prescott National Forest; 10/29/03.
14. Douglas-fir beetle activity in Rodeo-Chediski Fire, Black Mesa Ranger District, Apache-Sitgreaves National Forests; 10/30/03.
15. Proposed Williams followup mistletoe treatment project, Williams Ranger District, Kaibab National Forest; 11/19/03.

New Mexico Zone

1. Effects of prescribed fire on dwarf mistletoe, Mountainair Ranger District, Cibola National Forest; 1/06/03.

2. Ponderosa pine and piñon mortality on the Jicarilla Apache Indian Reservation; 4/18/03.

3. White fir mortality along the Crest National Scenic Byway, Sandia Ranger District, Cibola National Forest; 6/18/03.

4. Proposed FY 2004 Fence Line North dwarf mistletoe control project, Jicarilla Apache Indian Reservation; 7/25/03.

5. Preventing the spread of white pine blister rust in New Mexico; 8/14/03.

6. Proposed FY 2004 forest insect and disease prevention/suppression projects on the Mescalero Apache Indian Reservation; 10/10/03.

7. Proposed Los Griegos and Pinabetosa insect and disease prevention/suppression projects, Jemez and Coyote Ranger Districts, Santa Fe National Forest; 11/3/03.

8. Proposed Rendija Canyon insect and disease prevention/suppression project, Espanola Ranger District, Santa Fe National Forest; 11/06/03.

9. Dwarf mistletoe management on Borrego Mesa, Camino Real Ranger District, Carson National Forest; 12/03/03.

10. Update on dwarf mistletoe monitoring plots in the Whitetail A & B treatment area, Mescalero Apache Indian Reservation; 12/05/03.

11. Post-treatment evaluation of bark beetle prevention spraying at Paliza family and group campgrounds, Jemez Ranger District, Santa Fe National Forest; 12/22/03.

Publications

Conklin, D. A. 2003. Comparison of dwarf mistletoe behavior and stand development in treated and untreated areas: 10-year monitoring on Jarita Mesa. USDA Forest Service, Southwestern Region, R3-03-02. 11 pp.

Conklin, D. A.; Rogers, T.J. 2003. Tree survival and insect activity in partially scorched ponderosa pine in the Cerro Grande wildfire, New Mexico. USDA Forest Service, Southwestern Region, R3-03-03. 10 pp.

McMillin, J. D. and K. K. Allen. 2003. Effects of Douglas-fir beetle (Coleoptera: Scolytidae) infestations on forest overstory and understory conditions in western Wyoming. Western North American Naturalist 63: 498-506.

McMillin, J. D., K. K. Allen, D. F. Long, J. L. Harris and J. F. Negrón. 2003. Effects of western balsam bark beetle on spruce-fir forests of north-central Wyoming. Western Journal of Applied Forestry 18: 259-266.

Other Entomology and Pathology Activities in 2003

Insect and Disease Management Workshops

A workshop held in September on the Fort Apache Indian Reservation, Hon Dah, Arizona, was well attended and well received. We periodically offer these 2- to 3-day workshops on forest insect and disease identification, biology and management. These sessions are typically attended by Forest Service, Bureau of Indian Affairs, and National Park Service personnel, as well as by tribal resource managers and employees from other Federal and State agencies. In the spring, we usually offer a workshop for recreation managers and their staffs that emphasizes hazard tree management. We also offer more informal training upon request, particularly for field crews.

Piñon Mortality Assessment

In response to the extensive, drought-driven piñon ips (*Ips confusus*) epidemic, special aerial surveys covering much of the piñon-juniper woodland type were conducted in both Arizona and New Mexico in 2003.

In New Mexico, input on priority areas to be included was solicited from the BIA, BLM, New Mexico Forestry Division District Offices, and national forest ranger districts. These priority piñon-juniper woodlands were surveyed in March, June, July, August and September. In all, 6.6 million acres (about 70 percent of the host type in NM) were surveyed by zone staff and the New Mexico Forestry Division across Federal, tribal, State, and private ownerships. While all quadrants of the state were surveyed, 98 percent of the mapped activity occurred in the northern half of the state. Some level of piñon mortality (30 or less trees per acre up to more than 80 trees per acre) was mapped on more than 770,000 acres. Aerial observers estimate more than 44 million trees have died. To learn the proportion of piñon being affected across the landscape, 34 ground plot clusters for a total of 102 tenth-acre plots were installed randomly across the distribution of piñon in New Mexico. Mortality in these plots ranged from 0 to 100 percent, with an average 15 percent. One encouraging measurement was the excellent regeneration, which averaged 320 stems per acre.

Over 1,100,000 acres of piñon mortality were mapped in Arizona, with mortality more evenly distributed across the state than in New Mexico. Additional information on ground sampling in Arizona is included in the writeup below. Efforts in both states were part of a multistate assessment funded in part by Forest Health Monitoring.

Contact Daniel Ryerson (New Mexico) or Bobbe Fitzgibbon (Arizona) for additional information.

Impacts of *Ips* and *Dendroctonus* Bark Beetles in Northern Arizona Pine Types

Forest Health Monitoring, Evaluation Monitoring funds are being used to: (1) quantify the impact, extent and severity of bark beetles on ponderosa and pinyon pine at the stand level through an extensive plot network on a portion of Arizona's northern national forests; (2) describe the forest conditions in areas that have experienced moderate to high levels of mortality induced by recent drought and bark beetles; and (3) look for correlations between stand and site conditions and pine mortality.

A GIS approach was used to populate sample points for each national forest and forest type. The Prescott, Kaibab, and Coconino were sampled in 2003, with the Apache-Sitgreaves and Tonto scheduled for 2004. A total of 172 clusters containing 668 single plots, plus an additional 188 single plots were installed in 2003. Site and stand data are collected along with bark beetle occurrence. In addition to this "on the ground" work, we have collaborated with the Forest Health Technology Enterprise Team (FHTET), the Remote Sensing Application Center (RSAC), and ITT Industries to analyze different remote sensing applications for the extent and severity of piñon mortality across the Southwest. Satellite and multispectral imagery were collected from the same areas where we have installed our ground plots.

Contact John Anhold for additional information.

Aspen Decline Monitoring in Arizona

We have also received Forest Health Monitoring, Evaluation Monitoring funds to evaluate the decline of aspen in northern Arizona. This event began with defoliation of aspen during an unusual snowstorm in early June 1999. Aerial surveys that year detected the most severe and extensive aspen defoliation ever recorded. Since then, drought has resulted in additional aspen decline. In 2002, aspen sites across the State showed signs of water stress marked by marginal necrosis and dieback of branches; some lower elevation aspen clones experienced severe mortality.

In 2003, 84 plots were established on 9 sites on the Coconino National Forest to better quantify these effects throughout the elevational range of aspen. Higher elevation sites had a large mixed-conifer component, while stands below 7,500 feet were dominated by aspen. Significant aspen mortality occurred on all sites, exceeding 50 percent on some of the low elevation sites. Although sprouting of dying overstory trees was occurring, ungulate browsing is heavy and expected to limit successful regeneration. We will be installing additional plots in eastern Arizona in 2004, and plan to monitor all plots for at least 10 years in order to describe the expected vegetation conversion.

Contact Mary Lou Fairweather for additional information.

Dwarf Mistletoe Behavior and Stand Development in Treated and Untreated Areas

Ten-year results were reported from a set of plots installed in 1992 following a dwarf mistletoe sanitation-thinning treatment on the Carson National Forest. From 1992 to 2002, average dwarf mistletoe ratings (DMRs) increased from 1.2 to 2.12 (0.92) in the treated area, and from 2.2 to 2.44 (0.24) in an adjacent untreated area. The greater increase on the treated plot was a function of both a more rapid intensification of mistletoe on infected trees on that plot and the death of several heavily-infected trees on the untreated plot. Average diameter growth over the 10-year period was 2.2 inches on the treated plot and 1 inch on the untreated plot; growth was markedly reduced on both plots in the second 5-year period because of drought. Tree mortality was four times higher on the untreated plot, and mortality was strongly correlated with dwarf mistletoe infection on this plot. Regeneration was healthier and more abundant on the treated plot.

Contact Dave Conklin for additional information.

Effects of Chipping Fresh Slash on Bark Beetle Attraction

A relatively new method for treating green thinning slash is to chip or shred the material onsite. Although bark beetles cannot use wood chips as food, anecdotal information and a preliminary study suggest that they can be attracted to volatiles emanating from fresh chips, resulting in increased residual tree mortality. To examine these relationships further, the Arizona Zone FHP staff and Chris Fettig of the Pacific Southwest Research Station designed a study to determine: (1) the effects of slash management treatments (chipping versus lop-and-scatter) on bark beetle-caused ponderosa pine mortality; (2) the effects of timing (spring, summer) of thinning and stand density on bark beetle-caused ponderosa pine mortality; (3) the effect of distance between chipped material and potential host trees on bark beetle-caused ponderosa pine mortality; and (4) the relationship between volatile terpenes emanating from chipped material and attraction to bark beetles. Slash treatments and controls were installed on replicated 1-acre plots at three study sites (two in Arizona and one in California) in August and September 2003. The same treatments will be repeated in the spring of 2004. This study, funded through the FHP Special Technology Development Program, will help us develop guidelines for mitigating unwanted tree mortality associated with chipping slash.

Contact Joel McMillin for additional information.

White Pine Blister Rust Monitoring

We continued to monitor the incidence and effects of blister rust in southern New Mexico using a small set of permanent plots. Three of these plots—two on the Mescalero Apache Indian Reservation and one on the Sacramento Ranger District of the Lincoln National Forest—were remeasured in 2003. We also made initial rust observations on a new plot installed in the relatively dry southeastern portion of the Sacramento District. Results to date from all 14 plots are summarized in the "Status of Disease" section of this report. Blister rust scouting was also conducted at several locations in 2003, including the Manzano and Magdalena Mountains of central New Mexico. No new outbreaks of blister rust were detected.

Contact Dave Conklin for additional information.

Blister Rust Resistance Efforts

Preliminary results from tests conducted recently at the Institute of Forest Genetics in Placerville, California were available in 2003. These indicate that several of our southwestern white pine "resistant candidates" on the Lincoln National Forest carry major gene resistance (MGR) to the disease. Initial testing in 1998 had found MGR in a single tree; results from the more recent tests appear more encouraging, since a higher proportion of the tested seed proved resistant. Testing of additional trees is planned, which should provide a better understanding of resistance, helping us better predict the long-term impacts of this disease in the Southwest. Eventually we may be able to develop resistant planting stock and/or encourage natural regeneration of resistant parent trees. These efforts complement a National focus on managing white pine species to reduce the impacts of this nonnative disease.

Contact Dave Conklin for additional information.

Piñon *Ips* Monitoring in New Mexico Using Pheromone Traps

In March of 2003, Lindgren funnel traps were placed in five locations throughout the State to get a better understanding of how initial emergence dates and numbers of generations per year vary by latitude for the piñon ips bark beetle, *Ips confusus*. The bait is a three-component lure made up of Ipsdienol, cis-Verbenol, and Ipsenol, each in a bubble cap emitter. Trapping sites included the Burro Mountains, Magdalena, Capitan, Santa Fe, and La Madera. Because of expanding beetle activity, three additional sites were added in November: Cimarron, Las Vegas, and the Manzanita Mountains. Santa Fe also added a second site in November. Initial emergence dates will be useful in planning preventive spray treatments. Because of a record-setting warm January in 2003, trapping was continued through the fall of 2003 and into the winter to determine if beetles could become active on warm winter days. Two peak flights in the northern half of the State were recorded in mid-April and mid-October with some activity persisting into November. There was an absence of catches through the summer months in the northern populations. It is unclear if the lack of catches is a function of aestivation, competition from natural pheromone, or lack of dispersal behavior during the warm months. The Capitan traps in the southeastern quadrant of the state exhibited three distinct flight periods, producing a summer flight not detected in the northern locations. The traps in the Burro Mountains in the southwestern quadrant of the State exhibited asynchronous overlapping flights. We are indebted to our field cooperators which include the City of Santa Fe, the New Mexico Forestry Division, and the Carson, Gila, and Cibola National Forests. Monitoring is planned to continue through 2004.

Contact Deb Allen-Reid for additional information.

Tree Survival and Insect Activity in Partially Scorched Ponderosa Pine

Three year post-fire results were determined from a set of plots installed in the Cerro Grande (Los Alamos) wildfire area. Four rectangular plots containing a sample of 232 ponderosa pine were installed a few weeks after the May 2000 fire in an area that burned at low to moderate intensity. Sample trees had an average crown (needle) scorch of about 80 percent and most had moderate to heavy bole char. Seventy-six percent were alive in May 2003, 3 years after the fire. Survival varied greatly by plot, with 95 percent of the mortality occurring on two of the four plots. About 75 percent of the trees that died had some sign of bark beetle attack. Nearly all of the bark beetle activity occurred in year two and three after the fire, a period of extreme drought. About one-third of the live trees on these plots became infested with wood borers; on one plot, a borer/woodpecker complex appeared to increase tree mortality. Over half the trees that received 100 percent crown scorch survived the 3-year period.

Contact Dave Conklin or Terry Rogers for additional information

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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 these sites includes annual forest insect and disease conditions reports, literature on pest biology and management, and general information on the forest types of the Southwest. Administrative information includes roles, activities, and organizational staffing. Additionally, our Forest Health Protection national office maintains a Web site at http://www.fs.fed.us/foresthealth/ which includes program overviews as well as excellent publications links.

Appendix

Instructions for Submitting Insect and Disease Specimens for Identification

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

Collecting

1. Adequate material should be collected

2. Adequate information should be recorded, including:

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

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

Packing

1. **Larvae and other soft-bodied insects** should be shipped in small screw-top vials or bottles containing at least 70 percent isopropyl (rubbing) alcohol. Make sure bottles are well sealed.

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.

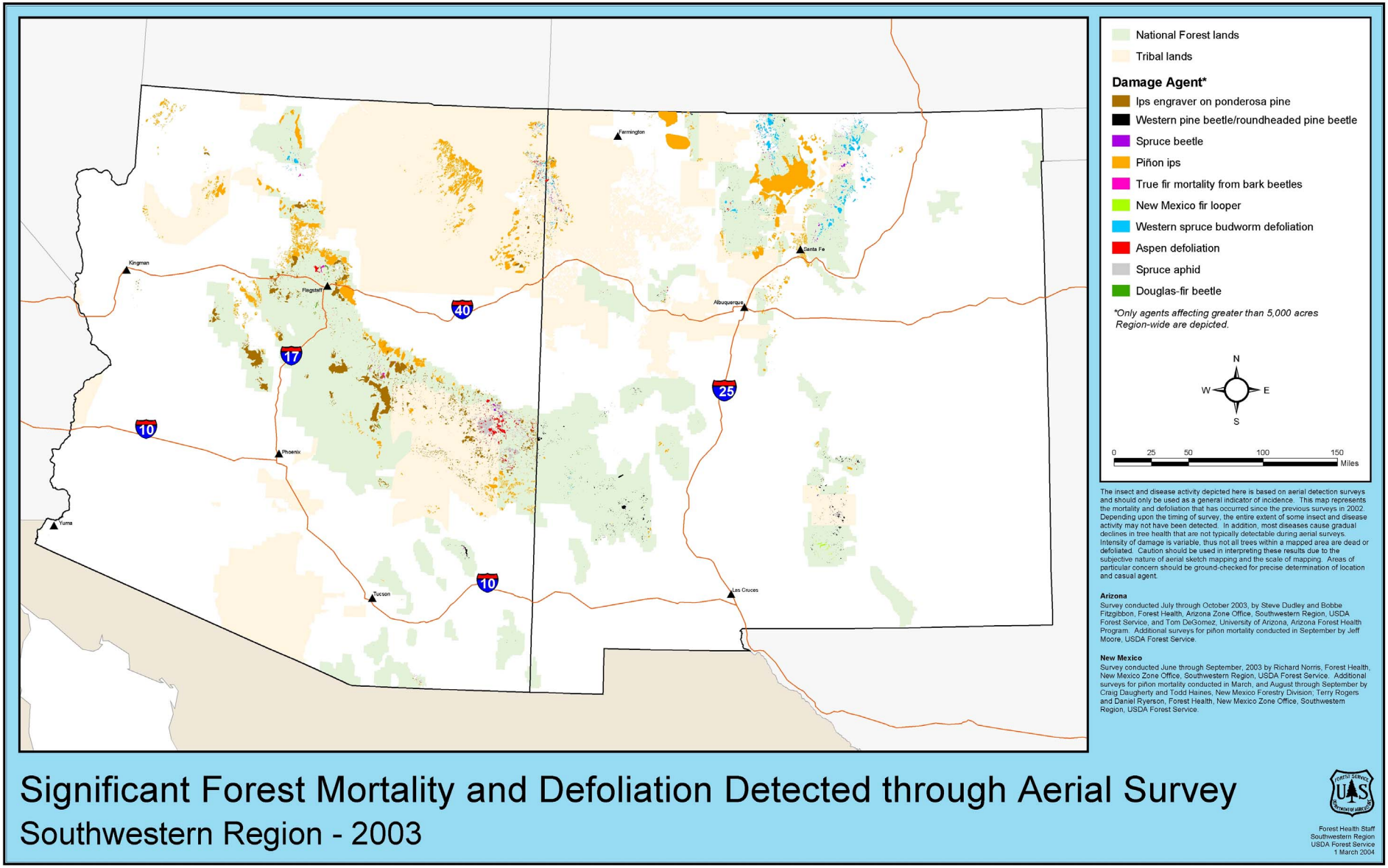

Figure 9. Significant Forest Insect Activity Detected through Aerial Survey Map.