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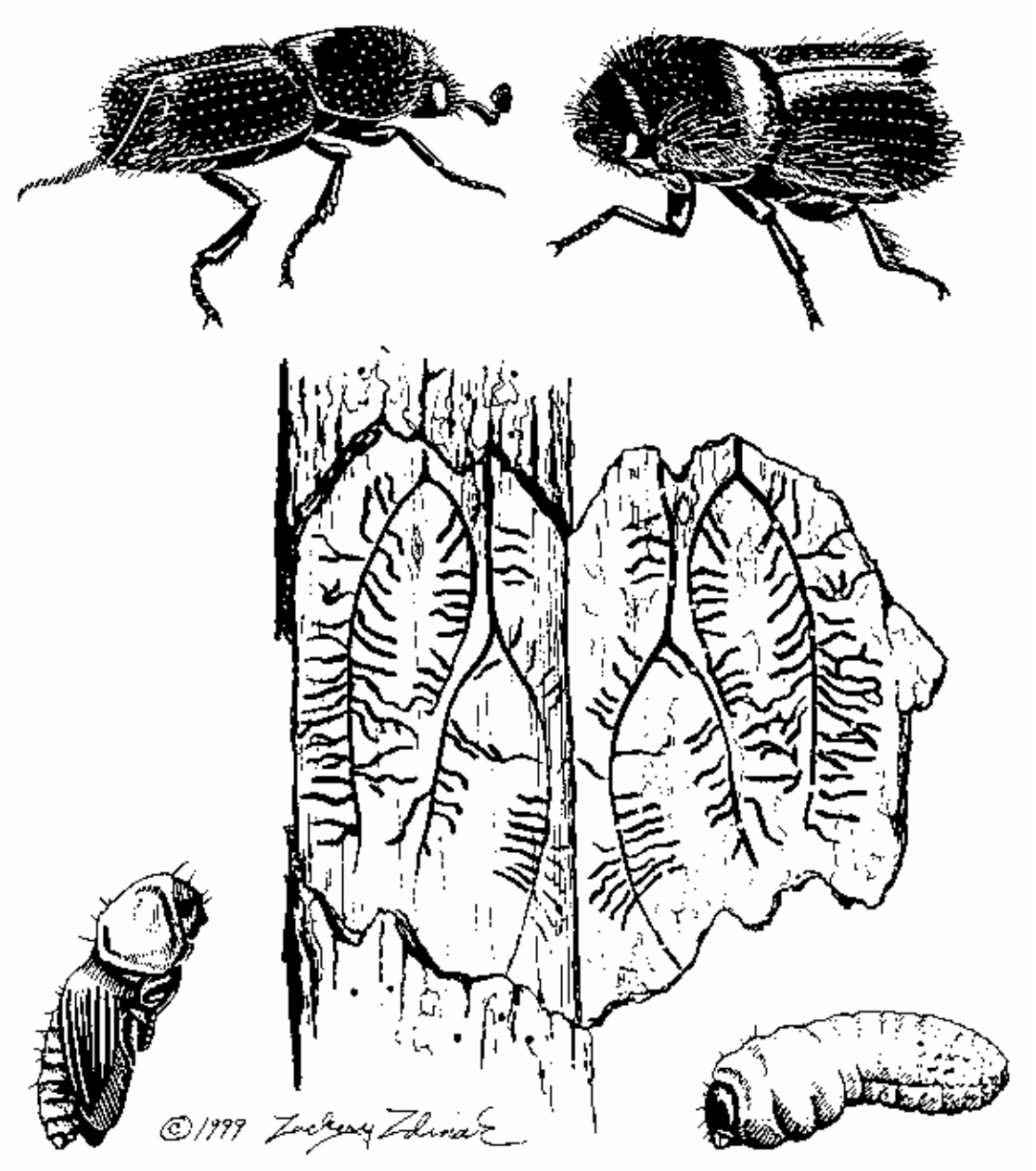
Forest Insect and Disease Conditions in the Southwestern Region, 2000



Insect and Disease Conditions in the Southwestern Region, 2000

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Introduction

Insect activity in the Southwest in 2000 was undoubtedly affected by weather. The two preceding winters – 1998-1999 and 1999-2000 – were warm and dry. Dry conditions have persisted in the Southwest since late 1998, and there was very little moisture anywhere over the 1999-2000 winter. The Palmer Drought Severity Index (PDSI) has been negative, indicating abnormal dryness for most of Arizona since late summer or early autumn 1998, and since January 1999 for most of New Mexico. Conditions have been especially dry in the southern areas of the region.

Many bark beetle species thrive in drought conditions, especially if a disturbance such as windthrow or landslide provides suitable beetle habitat prior to or coincident with dry conditions. *Dendroctonus* and *Ips* beetles in pine (western pine beetle, mountain pine beetle, roundheaded pine beetle and pine engraver) can be associated with drought conditions, and this year's increased damage from these insects is likely associated with the predominantly warm, dry conditions. Douglas-fir beetle was the only major bark beetle species in Region 3 that had mortality on fewer acres in 1999 than in 2000. The greatest increases in tree mortality occurred in western yellow pines in the southern-most forests – southern pine beetle on the Coronado National Forest; and western pine beetle on the Gila National Forest and Lincoln National Forest. PDSI remained negative or very low in those areas for the period from autumn or early winter 1998 to late summer or autumn 2000. Beetle populations probably increased in 1999, even though the annual survey did not detect an increase in tree mortality.

Less prone to disturbance, high elevation forests, particularly spruce and spruce-fir types, form stable communities that can persist for centuries. The character of these communities depends on their age and origin. Catastrophic wildfire tends to produce fairly even-aged stands, while bark beetle outbreaks preferentially remove mature trees of the host species. If a bark beetle epidemic occurs in a single-species stand, the result will be a residual stand of less-susceptible younger trees of the host species. If a mixed-species stand incurs the epidemic, the resulting residual stand will contain the younger, less-susceptible host species, plus a mix of age classes of non-host species. Over several centuries, these mixed-age stands of single or mixed species may develop and persist as old-growth communities for hundreds of years. These communities are very resistant to fire, primarily because of the cool, humid climate at high elevations.

Eventually, conditions develop in which a disturbance event replaces the old-growth community. Bark beetle outbreaks and wildfire are the typical disturbance agents in spruce and spruce-fir forests. Although the high elevation forests are resistant to fire, once fire occurs both Engelmann spruce and corkbark fir are very susceptible to damage. Few such wildfires have occurred in the Southwest in contemporary times, so not much is known about conditions leading to these events. Dry conditions in the spruce-fir forests and forests at lower elevations, and mortality from insect outbreaks are assumed to potentially predispose high elevation forests to wildfire.

Because these tree species, especially Engelmann spruce, are so long-lived, and because many high-elevation spruce-fir forests are known to be ancient, the temporal scale for community-replacing disturbances is thought to be on the order of many centuries, usually given as a range anywhere between 3 and 8 centuries. Research in the last decade at the Laboratory of Tree-Ring Research at the University of Arizona, and by others, indicates that Southwestern forests are near the end of that scale.

Spruce beetle, typically present in small numbers in weak or damaged trees, can develop aggressive outbreaks that kill most mature spruce, down to trees as small as 6-inches dbh. Outbreaks usually originate from disturbances such as windthrow, landslides and avalanches,

which make available large numbers of down green spruce. Western balsam bark beetle populations seem to behave similarly to spruce beetle, in that they are typically present in small numbers in weak or damaged trees, and occasionally incur aggressive outbreaks. Western balsam bark beetle has not been studied as much as other important bark beetles, especially in the Southwest, so it's biology and ecology are not well understood. However, large outbreaks have occurred during sustained periods (4-7 year) of drought conditions.

Many Southwestern high-elevation forests are at high-risk to bark beetle attack. A multitude of insect species have recently been active in high elevation forests, including spruce beetle, spruce *Ips*, western balsam bark beetle, *Nepytia janetae*, and spruce aphid. Both spruce beetle and western balsam bark beetle populations are increasing or at outbreak levels in many areas in the Intermountain West. This activity appears to be associated with recent weather trends, especially warm, dry winters. Although the total high elevation acreage affected by bark beetles within the Southwestern Region remains fairly low (about 12,000 ac), acreage has shown a steady increase in recent years, and local effects have been severe. Acreage affected has increased on the Apache-Sitgreaves, Coconino, Coronado, Carson, Cibola, Lincoln, and Santa Fe National Forests, as well at on the Fort Apache, Navaho, and Taos Reservations. Activity has decreased only on the Kaibab and Gila National Forests.

It is unclear how defoliation history has contributed to bark beetle activity, however studies are underway to determine whether or not there are any connections. Both *Nepytia janetae* and spruce aphid have caused severe defoliation to corkbark fir, Engelmann spruce, and Colorado blue spruce in recent years, especially in Arizona. The *Nepytia* populations collapsed in 1998, but the most widespread and severe spruce aphid outbreak on record occurred over the autumn and winter of 1999-2000. Defoliation was particularly severe in the Pinaleños, where the majority of Engelmann spruce was severely defoliated (foliage loss exceeded 70 percent). Spruce aphid activity declined during the winter 2000-2001. Spruce aphid activity appears to be related to warm winters and/or prolonged autumns. Several research studies will be completed this year, increasing the knowledge base pertaining to spruce aphid in Southwestern forests.

This coincidence of insect activity has created hazardous fire conditions in many high elevation forests. Conditions today probably resemble conditions that preceded forest-replacing fire events in the past. There are two significant differences between pre-settlement and contemporary forest conditions. First, there is no evidence of spruce aphid outbreaks prior to contemporary times. At least at this time, mortality from bark beetles is much greater than from the aphid. However, in the past, frequent ground fires maintained stand densities in the pine and mixed-conifer forest at lower densities. These forests, which exist below the spruce-fir forests, effectively buffered the higher elevation forests from catastrophic wildfire. Crown fires occurred infrequently at the lower elevations, and seldom reached the spruce-fir forests. This is not the case today. Land use history and fire exclusion have created grossly overdense forest conditions throughout much of the West, and the Southwest is no exception. The loss of this buffering capability of the lower elevation forests greatly increases fire risk at the higher elevation, while insect related mortality and defoliation has greatly increased fuel loading in the high elevation forests.

The purpose of this report is to summarize the status of insect and disease activity and population trends in the Southwest, particularly with regard to observations during 2000. This report is derived from annual aerial detection results as well as ground observations. Information on state and private lands is provided through our Cooperative Forest Health Program by Bob Celaya, Forest Pest Specialist, Arizona State Land Department, and Bob Cain, Forest Entomologist, New

Mexico State University, Cooperative Extension Service. We have also included a list of staff evaluations and reports prepared in 2000. The final section describes several special forest entomology and pathology projects and activities currently being conducted by the region.

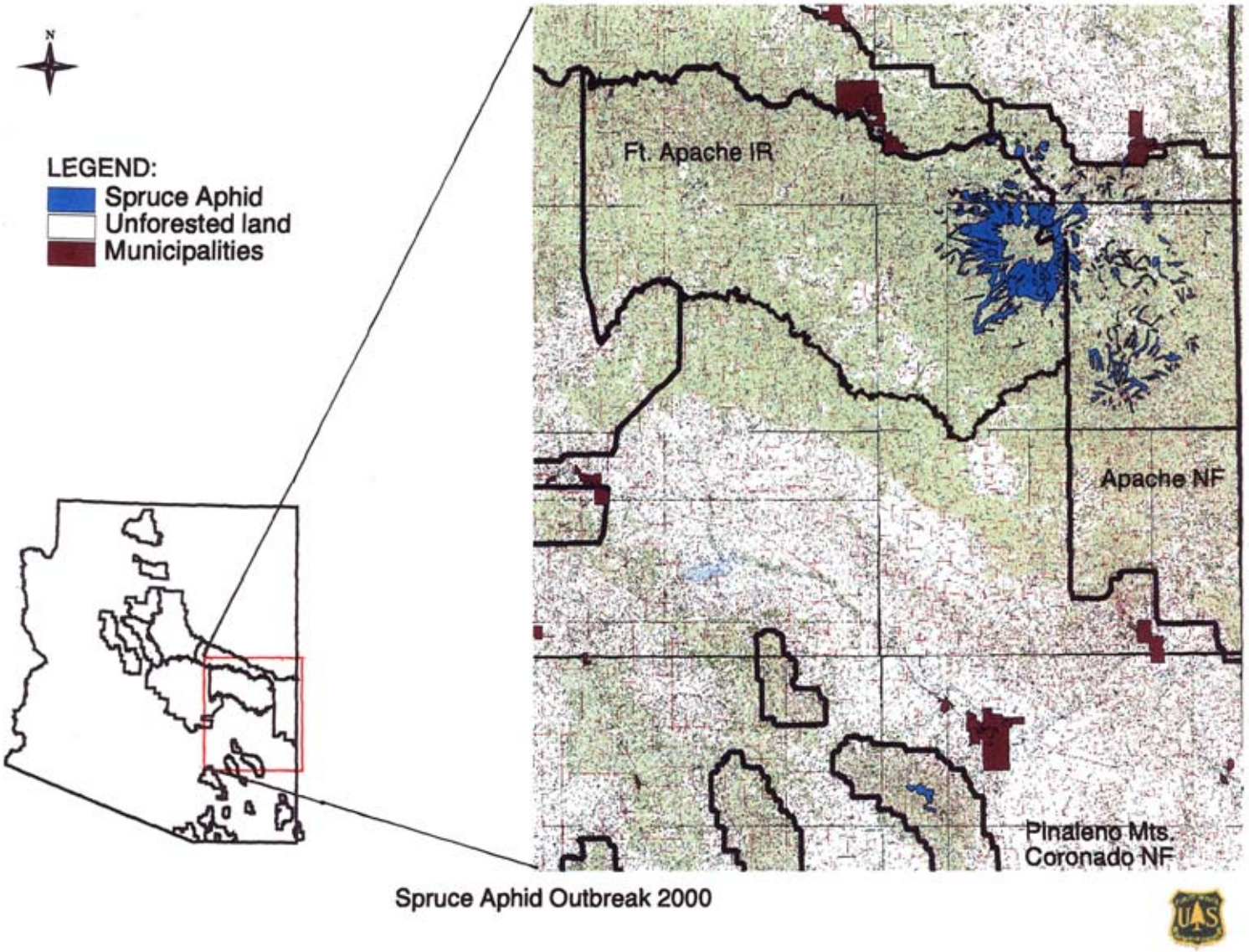

Figure 1. Map of spruce aphid outbreak in Arizona in 2000.

Conditions in Brief

In the Southwest, significant tree mortality from bark beetles was detected on approximately 71,000 acres in 2000, an increase from approximately 19,000 acres in 1999. Pines were killed by western pine beetles (30,000 acres), *Ips* engraver beetles (12,000 acres), roundheaded pine beetles (2,000 acres), mountain pine beetle (1,000 acres) and southern pine beetle (12,000). In the mixed conifer and spruce-fir cover types, trees were killed by spruce beetles (6,000 acres), fir engraver beetles (6,000 acres), and Douglas-fir beetles (2,000 acres). Most of the mortality listed occurred in ponderosa pine, however the majority of the southern pine beetle activity occurred in Chihuahua pine and some Apache pine. The data for the ponderosa pine type may be artificially low due to very late season fading of *Ips* infested trees.

Western spruce budworm defoliation in 2000, showed a decrease for the second year to approximately 192,000 acres, from about 293,000 acres in 1999 and about 321,000 in 1998. Significant defoliation of spruce was caused by spruce aphid, *Elatobium abietinum*, detected on about 157,000 acres in 2000, after no defoliation by this insect was recorded in 1999. Aspen defoliation decreased nearly three-fold to about 64,000 acres in 2000, compared to over 171,000 acres the previous year. Ponderosa pine needle miner activity increased slightly from about 57,000 acres defoliated in 1999, to approximately 68,000 acres in 2000.

Dwarf mistletoes continue to be the primary cause of growth loss (other than overly dense stocking) in both the ponderosa pine and mixed-conifer cover types. In commercial ponderosa pine cover types, the estimated annual volume loss from southwestern dwarf mistletoe is 25 million cubic feet. The incidence of all mistletoes has probably increased over the past century due to fire suppression and some other management activities.

Root diseases cause an estimated 5 million cubic feet of volume loss annually and create hazard trees in campgrounds and along roadways. The most common root diseases in the Southwest are armillaria and annosus. Incidence is higher in mixed-conifer and spruce-fir forests than in ponderosa pine forests.

White pine blister rust occurs throughout most of the range of southwestern white pine on the Lincoln National Forest and the Mescalero-Apache Indian Reservation in southern New Mexico. There are also infected white pines on Gallinas Peak, Cibola National Forest, 50 plus miles north of the main outbreak area.

Status of Insects

Bark Beetles

Western Pine Beetle

Dendroctonus brevicomis
Primary Host: Ponderosa pine

Tree mortality in the region attributed to this insect increased significantly in 2000 to 30,385 acres vs. 2,605 acres the previous year. In Arizona, it occurred on the Apache-Sitgreaves (305 acres), Coconino (35 acres), Kaibab (5 acres), and Tonto (10 acres) National Forests; the Fort Apache (295 acres), Navajo (390 acres), and San Carlos (210 acres) Indian Reservations; Grand Canyon National Park (5 acres), Canyon de Chelly (10 acres) and Bureau of Land Management lands (45 acres); and 25 acres of state and private land. In New Mexico, significant activity was detected on the Gila National Forest (12,215 acres) and 135 acres of state and private lands. Western pine beetle in combination with *Ips* beetles, killed trees on 13,050 acres of the Lincoln National Forest and 3,650 acres of the Mescalero Apache Tribal Lands.

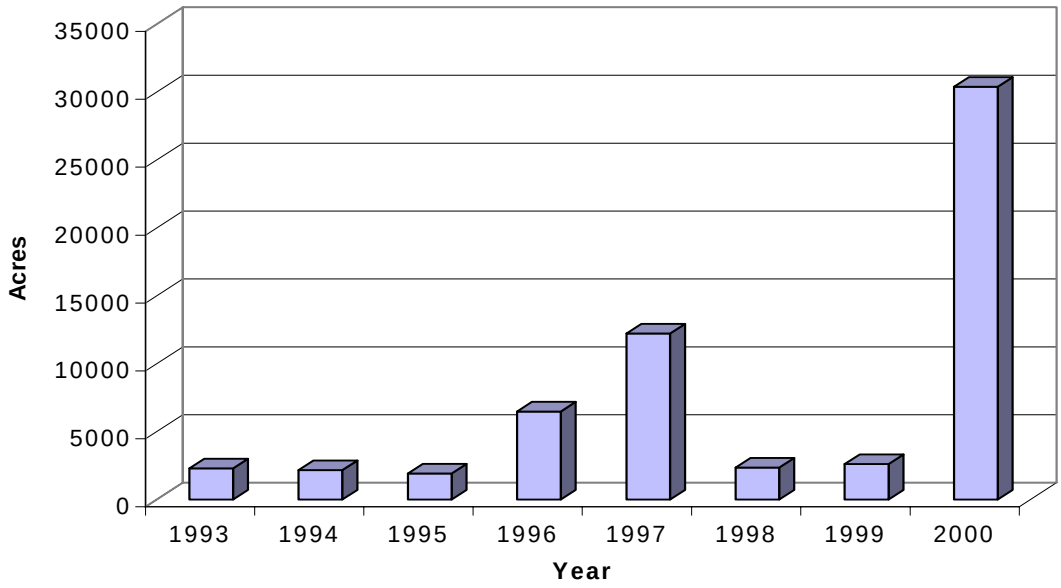

Figure 2. Western pine beetle mortality in Arizona and New Mexico, 1993 – 2000.

Mountain Pine Beetle

Dendroctonus ponderosae
Primary Host: Ponderosa pine

Mountain pine beetle mortality increased slightly region-wide, with 810 acres detected in 2000 compared to 195 acres in 1999. All of the tree mortality in 2000 was detected in New Mexico. Mortality was detected on the Carson (585 acres) and Santa Fe (195 acres) National Forests; Taos Pueblo Tribal lands (20 acres) and 10 acres of state and private lands.

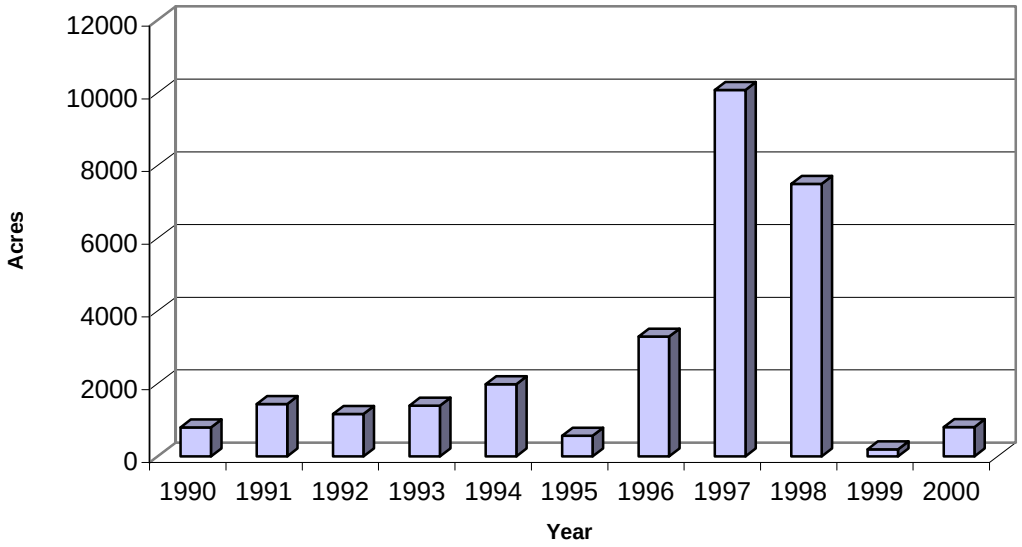

Figure 3. Mountain pine beetle mortality in Arizona and New Mexico, 1990 – 2000.

Roundheaded Pine Beetle

Dendroctonus adjunctus
Primary Host: Ponderosa pine

Tree mortality in the region increased slightly, from 1,700 acres in 1999 to 2,235 acres in 2000. All roundheaded pine beetle activity was detected in Arizona, mortality occurred on the Coronado National Forest (2,235 acres). The large outbreak in the Sacramento Mountains of New Mexico has subsided and no roundheaded pine beetle mortality was recorded in New Mexico in 2000.

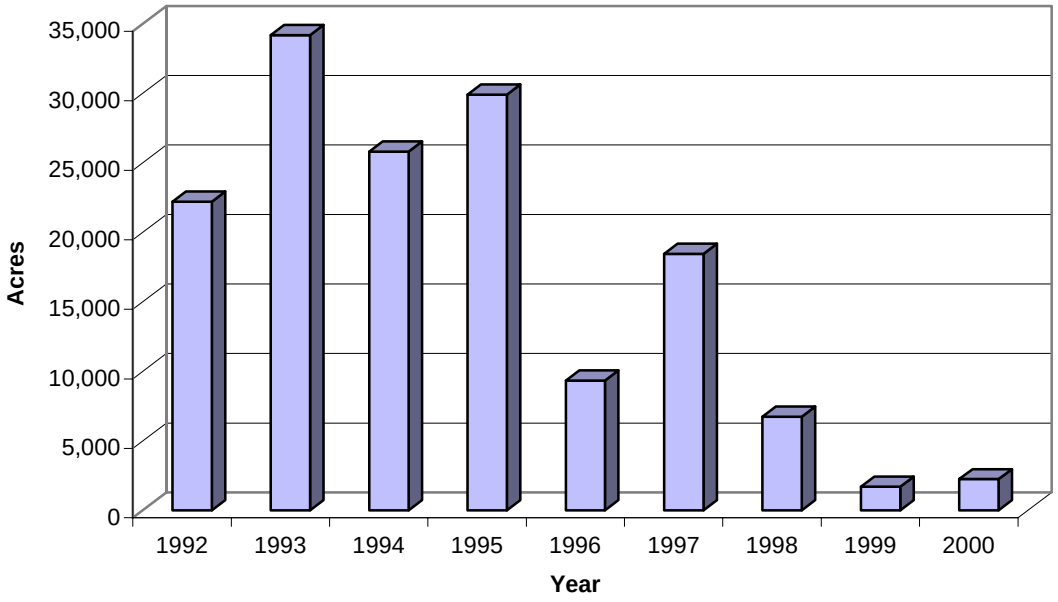

Figure 4. Ponderosa pine mortality from roundheaded pine beetle in Arizona and New Mexico, 1992 – 2000.

Ips Beetles

Ips spp.
Primary Hosts: Ponderosa pine, piñon pine

Ponderosa pine mortality caused by *Ips* beetles increased significantly in 2000, with 11,965 acres detected compared to 2,520 acres the previous year. In Arizona, *Ips* activity occurred on the Apache Sitgreaves (475 acres), Coconino (15 acres), Coronado (2115 acres), Kaibab (10 acres), Prescott (145 acres), and Tonto (725 acres) National Forests; Saguaro National Monument (285 acres); the Fort Apache (120 acres), Haulapai (5 acres), Navajo (35 acres), and San Carlos (210 acres) Indian Reservations; and 20 acres of state and private lands. These figures may be artificially low for Arizona due to the late season fading of many trees after the aerial detection survey was completed. In New Mexico, mortality was detected on the Gila National Forest (6,360 acres); Jicarilla Apache (340 acres) Tribal Lands; and 1,105 acres of state and private land.

Piñon *Ips* was recorded on 2,075 acres in 2000 after no significant activity was recorded in 1999. In Arizona, mortality was recorded on the Navajo Indian Reservation (100 acres) and 10 acres on the Canyon de Chelly National Monument within the reservation. In New Mexico, 1,965 acres of mortality were recorded on the Gila National Forest.

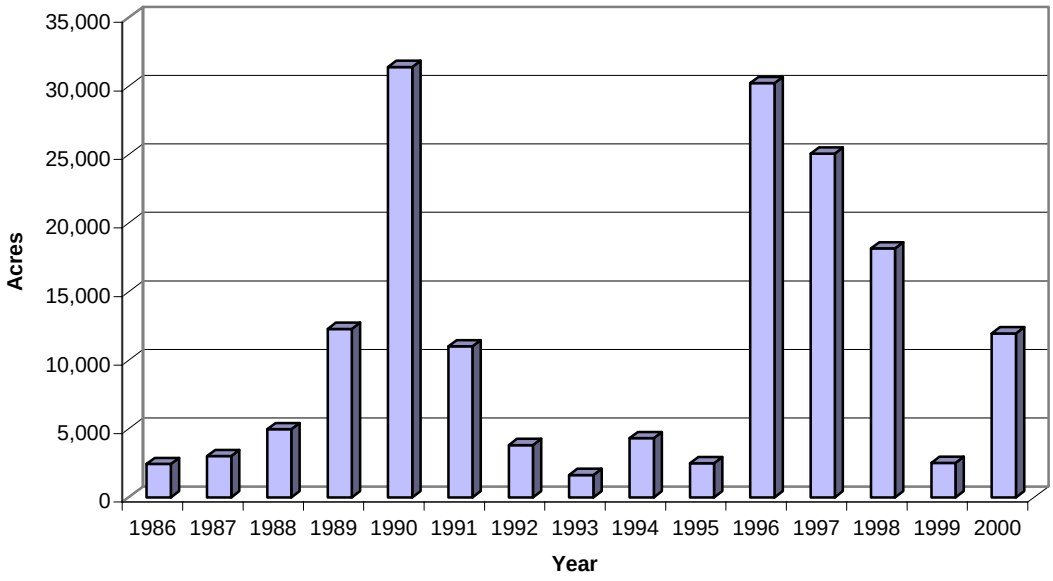

Figure 5. Ponderosa pine mortality from *Ips* beetles in Arizona and New Mexico, 1986 – 2000.

Southern Pine Beetle

Dendroctonus frontalis
Hosts: Apache pine, Chihuahua pine

Southern pine beetles, along with engraver beetles were found infesting Chihuahua and Apache pines in southern Arizona in 2000. Southern pine beetle caused tree mortality on the Coronado National Forest (11,620 acres); Chiricahua National Monument (20 acres) and 65 acres of private land. This is the largest outbreak associated with southern pine beetle ever recorded in Arizona. No southern pine beetle activity was recorded in New Mexico.

Figure 6. Southern pine beetle mortality in Chihuahua pine on the Coronado National Forest.

Figure 7. Typical Southern pine beetle galleries.

Douglas-fir Beetle

Dendroctonus pseudotsugae
Host: Douglas-fir

Douglas-fir beetle-caused tree mortality in the southwest decreased from 3,315 in 1999 to 1,815 in 2000. Tree mortality on federal lands in Arizona was detected on the Apache-Sitgreaves (50 acres), Coconino (1,545 acres), Coronado (10 acres), and Kaibab (35 acres) National Forests; Fort Apache Indian Reservation (5 acres); and 5 acres of private lands. In New Mexico, Douglas-fir beetle-related mortality was detected on the Carson (40 acres), Gila (30 acres), and Santa Fe (95 acres) National Forests.

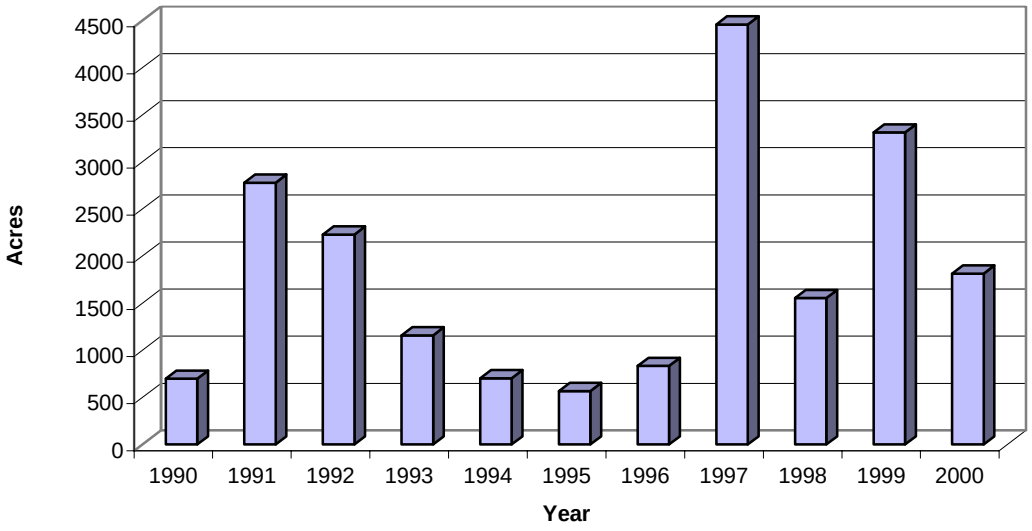

Figure 8. Douglas-fir beetle mortality in Arizona and New Mexico, 1990 – 2000.

Spruce Beetle

Dendroctonus rufipennis
Host: Spruce

Tree mortality increased slightly in the region in 2000, with 5,990 acres affected compared to 5,015 acres in 1999. In Arizona, mortality was present on the Apache-Sitgreaves (60 acres), and Coronado (730 acres) National Forests; and Fort Apache (35 acres), and Navajo (265 acres) Indian Reservations. In New Mexico, spruce beetle related mortality was detected on the Carson (955 acres), Cibola (245 acres), Gila (140 acres), Lincoln (795 acres) and Santa Fe (2,480 acres) National Forests; Mescalero Apache Tribal Lands (40 acres); Santa Clara (25 acres), and Taos (170 acres) Pueblo Lands; and 50 acres of state and private lands.

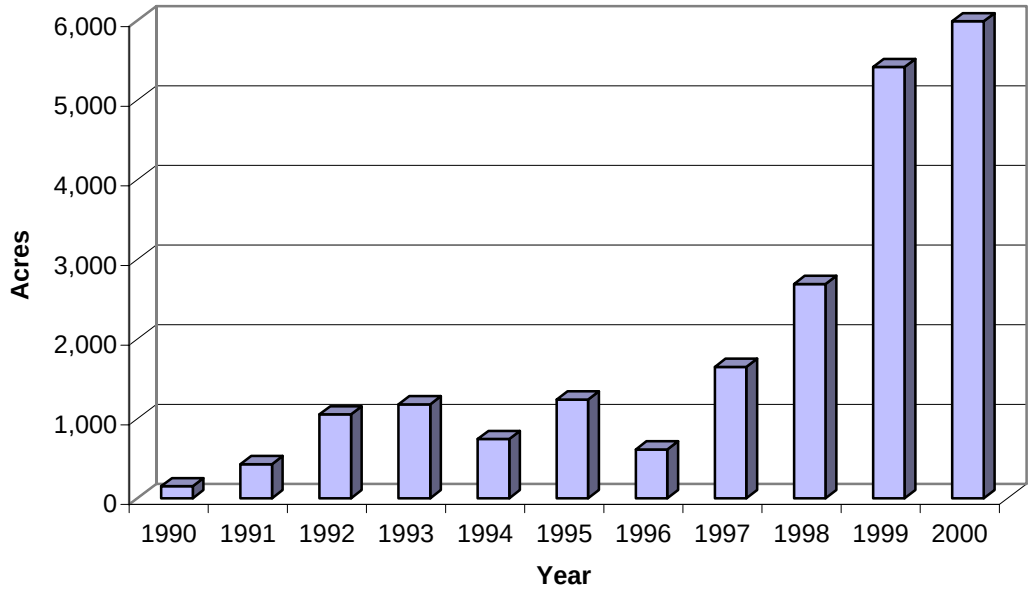

Figure 9. Mortality from spruce beetle in Arizona and New Mexico, 1990 – 2000.

True Fir Beetles

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

Tree mortality in the region increased somewhat in 2000 to 6,150 acres vs. 3,770 acres in 1999. In Arizona, activity was detected on the Apache-Sitgreaves (1,160 acres), Coconino (2,840 acres), Coronado (70 acres), and Tonto (45 acres) National Forests. In New Mexico, mortality is reported on the Carson (85 acres), Gila (1,020 acres), Lincoln (45 acres) and Santa Fe (670 acres) National Forests; Jicarilla Apache Tribal Lands (10 acres) and 205 acres of state and private lands.

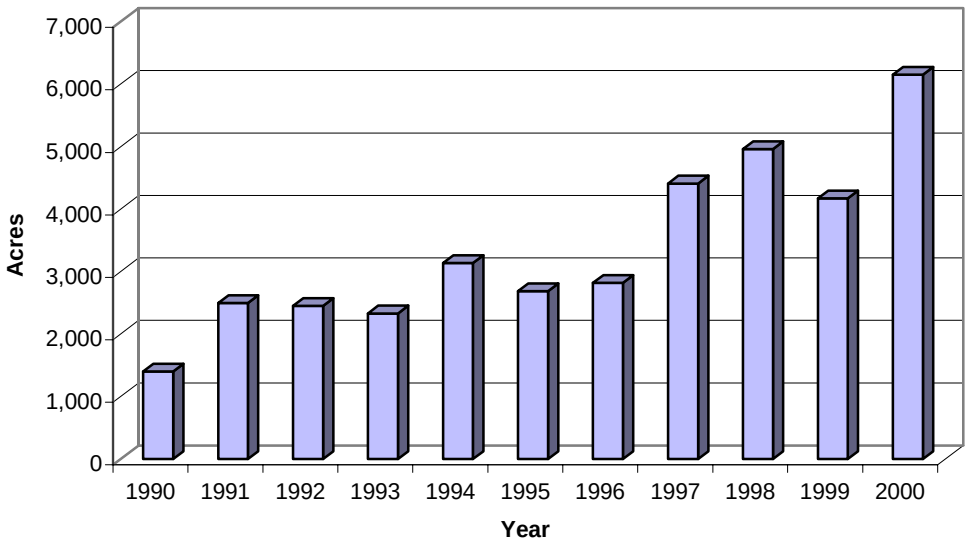

Figure 10. True fir mortality from fir engraver and western balsam bark beetles in Arizona and New Mexico from 1990 – 2000.

Defoliators

Western Spruce Budworm

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

A total of 192,220 acres were defoliated by this insect in 2000, down from 292,925 acres in 1999. In Arizona, activity was heaviest in the northern and northeastern part of the state, with defoliation occurring on the Kaibab National Forest (1,525 acres), Grand Canyon National Park (5,170 acres); Canyon de Chelly National Monument (40 acres) and the Navajo (20,400 acres) Indian Reservation. In New Mexico, defoliation was detected on the Carson (79,160 acres), Cibola (2,965 acres), Gila (2,310 acres), Lincoln (1,075 acres), and Santa Fe (21,915 acres) National Forests; on the Jicarilla Apache (3,925 acres), and Mescalero Apache (165) Tribal Lands; Santa Clara Pueblo (90 acres), and Taos Pueblo (3,560 acres) Tribal Lands; and on about 49,925 acres of state and private lands. The most notable increase on private land occurred in Lincoln County where Douglas-fir infected with dwarf mistletoe was severely impacted by the budworm feeding.

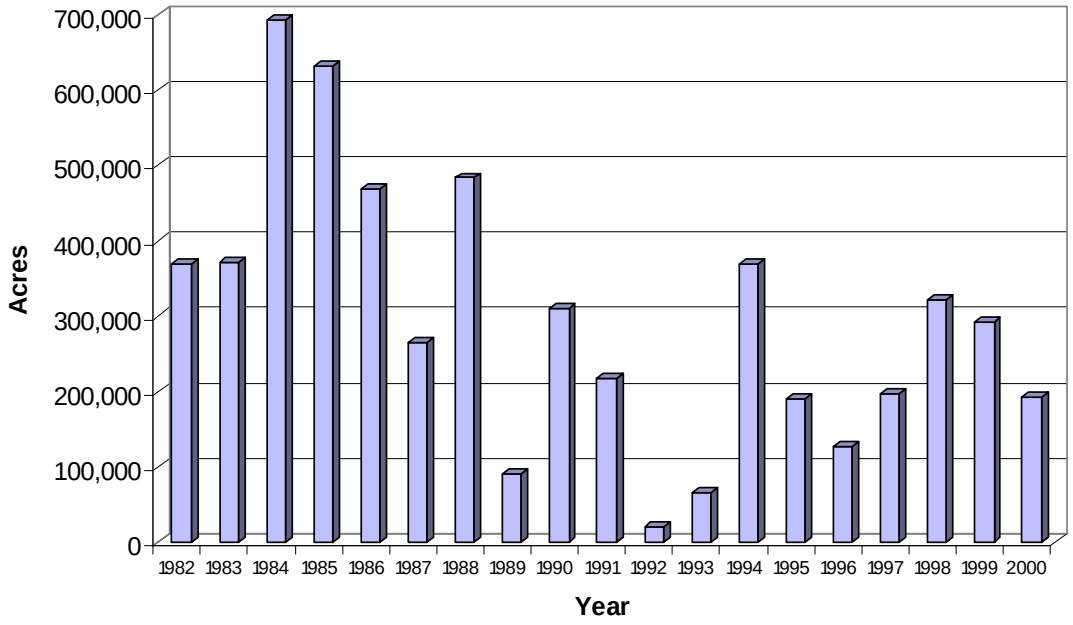

Figure 11. Western spruce budworm activity in Arizona and New Mexico, 1982 – 2000.

Douglas-fir Tussock Moth

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

In Arizona, pheromone trap surveys indicate that a small outbreak is peaking in the Pinal Mountains, Tonto National Forest, and that populations are rising on West Peak, Pinaleño Mountains on the Coronado National Forest. In New Mexico, a small infestation near Cloudcroft was responsible for several scouts having to seek medical attention due to a reaction to the insect hairs. Douglas-fir tussock moth activity in New Mexico was also reported in Ruidoso, Alto, White Rock, Santa Fe, Espanola and Los Alamos.

Nepytia janetae

Host: Spruce and true firs

No defoliation by this looper (inchworm) was detected by aerial survey in Arizona or New Mexico in 2000. In Arizona, some light defoliation was noted during ground surveys on Mt. Graham, Coronado National Forest.

Spruce Aphid

Elatobium abietinum
Host: Spruce

Spruce aphid was active in Arizona in 2000 with 156,880 acres defoliated. No defoliation had been recorded in 1999. Defoliation was recorded on the Apache-Sitgreaves National Forest (69,290 acres); Fort Apache Indian Reservation (87,510 acres); 65 acres of State Trust Land and 15 acres of private lands. This insect was first seen in the southwest defoliating ornamental spruce in the Santa Fe area in the late 1970's. Spruce aphid was reported in the Pinaleño Mountains for the first time in late 1999. In the spring of 2000, populations were discovered in the city of Flagstaff and on the San Francisco Peaks, also for the first time. No spruce aphid activity was recorded in New Mexico in 2000.

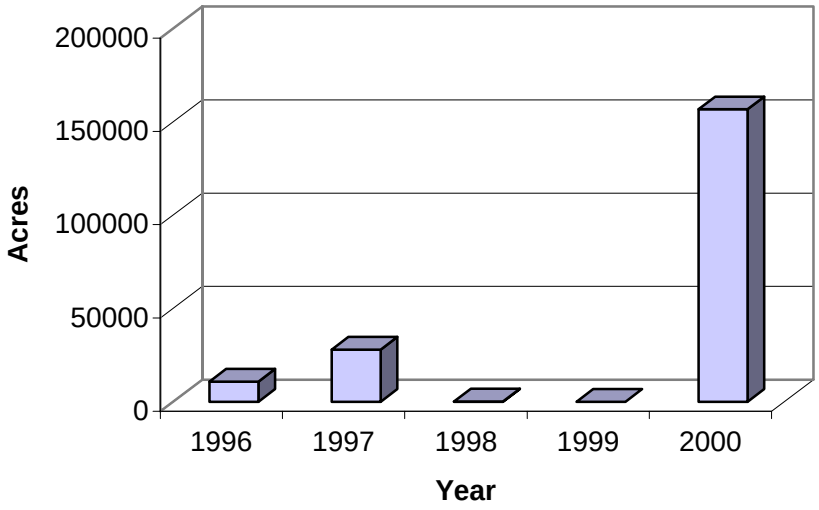

Figure 12. Spruce aphid activity in Arizona 1996-2000.

Ponderosa Pine Needle Miner

Coleotechnites ponderosae

Needle miner activity was detected during aerial surveys in 2000 on about 67,770 acres up from 57,000 acres in 1999. In Arizona, defoliation was detected on Apache-Sitgreaves (14,170 acres), and Kaibab (19,275 acres) National Forests; Fort Apache (1,805 acres) and San Carlos (325 acres) Indian Reservations; and 4,985 acres of state and private land. Discoloration of ponderosa pines continued on private land around Nutrioso, Arizona, although it was not as severe as in 1999. In New Mexico, defoliation was recorded on the Gila (14,205 acres), and Santa Fe (500 acres) National Forests and on about 12,505 acres of state and private land mainly in the eastern foothills of the Sangre de Cristo Mountains.

Piñon Sawfly

Zadiprion rohweri

In Arizona, activity continued to decline on the Navajo Indian Reservation, with only 25 acres of piñon defoliation detected in 2000 vs. 145 acres in 1999. In New Mexico, insignificant damage was detected near Sapello.

Piñon Needle Scale

Matsucoccus acalyptus

Scale continues to affect piñon at several locations in Arizona. For the second consecutive year, activity in the Prescott area was reported in January. In New Mexico, 4,510 acres of damage was detected on the Gila (325 acres) and Lincoln (4,185 acres) National Forests. Damage to landscape piñons continues to be common statewide in New Mexico.

Aspen Defoliation

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

Aspen defoliation, caused by a combination of insects, disease, and abiotic factors, decreased about three-fold, from about 171,000 acres of defoliation detected by aerial survey in 1999, compared to 63,510 acres in 2000. In Arizona, defoliation was recorded on the Apache-Sitgreaves (11,990 acres), Coconino (815 acres), Kaibab (7,530 acres) Prescott (5 acres), and Tonto (290 acres) National Forests; Fort Apache (9,145 acres), Navajo (8,125 acres) and San Carlos (80 acres) Indian Reservations; Bureau of Land Management (20 acres) and Grand Canyon National Park (355 acres); and about 90 acres of private land. In New Mexico, defoliation was detected on the Carson (4,480 acres), Cibola (760 acres), Gila (635 acres), Lincoln (560 acres), and Santa Fe (6,970 acres) National Forests; Jicarilla Apache (260 acres) Mescalero Apache (315) and Taos Pueblo (20 acres) tribal lands; and about 11,060 acres of state lands in central and northern New Mexico.

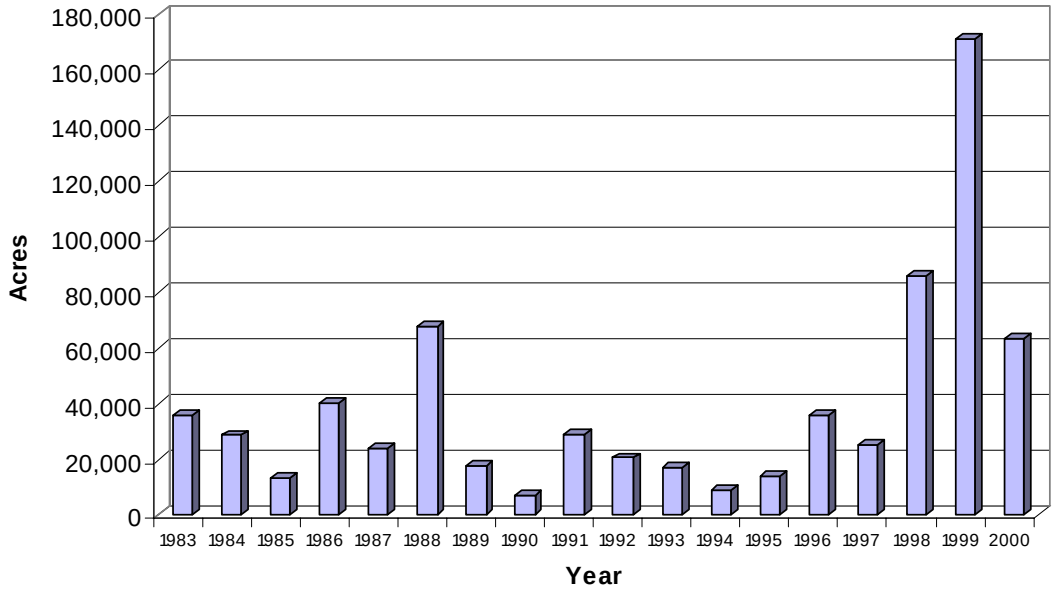

Figure 13. Aspen defoliation complex in Arizona and New Mexico 1983 – 2000.

Miscellaneous Insects

Ash bark beetles (*Hylesinus aculeatus*), native to the eastern U.S., were reported occurring on ornamentals in New Mexico in 2000.

Banded clearwing ash borers (*Podosesia aureocincta*) have been reported on ash in 2000 in New Mexico.

Bagworms (family *Psychidae*) (*Thyriodopteryx* spp.) continue cause problems in the Albuquerque area on junipers, cypress, and a number of hardwood trees.

Bull pine sawfly (*Zadiprion townsendii*) continued to defoliate ponderosa pine at low but detectable levels in several chronically infested areas of Santa Fe, New Mexico. Reports from other areas of New Mexico include Mountainair, Las Vegas, and Cedar Crest.

Conifer aphids (*Cinara* spp.) were abundant for the second year in central Arizona in 2000, following another mild, dry winter.

Cottonwood leaf beetles (*Chrysomela scripta*) continued at endemic levels in 2000 in the Rio Grande valley in Corrales and Albuqueque's north valley in New Mexico, following an outbreak in 1998.

Elm leaf beetles (*Xanthogaleruca luteola*) continued at high levels throughout New Mexico in 2000.

Smaller European elm bark beetle (*Scolytus multistriatus*) continued to cause mortality of Siberian elms in eastern New Mexico and to a lesser extent statewide in the spring of 2000.

Fall webworm (*Hyphantria cunea*) populations in Arizona increased in 2000 in the Payson area, and were most noticeable on Arizona walnut between Payson and Strawberry. In New Mexico, fall webworm was common on landscape and lower elevation riparian hardwoods, especially Siberian elms, mulberries, poplar hybrids and cottonwoods.

Genista caterpillars (*Uresiphita reversalis*) caused defoliation in 2000 on Texas mountain laural and brooms in Las Cruces area landscapes in New Mexico.

Juniper twig pruner (*Styloxus bicolor*) was recorded in Piñon Pine Estates in the Haulapai Mountains southeast of Kingman.

Nantucket pine tip moth (*Rhyacionia frustrana*) and **western pine tip moth** (*Rhyacionia bushnelli*), along with other *Rhyacionia* spp., continued to damage landscape pines, particularly ponderosa pine in New Mexico during 2000. Public service announcements in Albuquerque, Santa Fe, and Los Lunas regarding effective spray dates for control of pine tip moths were made with the cooperation of NM Master Gardeners.

Piñon needle miner (*Coleotechnites edulicola*) heavily defoliated about 100 acres of piñon south of Santa Fe, New Mexico and several small pockets north of the city in 2000.

Piñon sawfly (*Neodiprion edulicolus*) was noted in pockets of infestation totaling about 25 acres between Santa Fe and Espanola, New Mexico in 2000.

Piñon webworm (*Tetralopha* spp.) was observed in Payson, Arizona in 2000. It has also been found in the Village of Oak Creek, Prescott, and the Hualapai Mountains.

Prescott scale (*Matsucoccus vexillorum*) flagging was visible on ponderosa pine mainly in the Overgaard area of Arizona in 2000.

Red turpentine beetle (*Dendroctonus vallens*) were found at low levels in ponderosa pine stands throughout New Mexico in 2000. In Arizona, these beetles were found in association with *Ips* beetles in trees showing late season fading, especially in the east central area of the state, in and around Show Low.

Spruce engraver beetles (*Ips* spp.) caused mortality on neglected landscape spruce in Albuquerque, Santa Fe, and Los Alamos in 2000.

Tiger Moth (*Halisidota* spp.) caterpillars were common in forests and woodlands on ponderosa pine, pinyon pine and Douglas-fir in New Mexico and in the Forest Lakes area of Arizona in 2000.

Twig beetle (*Pityophthorus* spp., *Pityogenes* spp., *Pityotrichus* spp.) caused extensive outbreaks in association with other bark beetles in late summer in New Mexico due to drought conditions. High populations were seen statewide with the most notable areas being near Ruidoso, Quemado and Pecos.

Whitemarked Tussock Moth (*Orgyia leucostigma*) was observed feeding on Arizona sycamores in Oak Creek canyon. Other host species included Arizona alder, box elder, and various species of willow.

Status of Diseases

Mistletoes

Dwarf Mistletoes

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

Dwarf mistletoes are the most significant tree pathogens (disease-causing organisms) in forests of the Southwest. There are eight species in the region, each with a different primary tree host. Three species – those affecting ponderosa pine, pinyon pine, and Douglas-fir – are found throughout most of the ranges of their hosts, while the other species have more limited distributions. Regionally, over one-third of the commercial ponderosa pine acreage has some level of infection, with roughly 4 million acres affected (see Table 1).

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 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. Infection reduces tree growth and longevity; severe infection can kill trees directly, or predispose them to other agents such as bark beetles.

True Mistletoes

Phoradendron spp.
Hosts: Numerous

Seven different species of true mistletoe occur on trees and shrubs in the Southwest. They are especially common on junipers throughout the woodland type in the region, and are often found on cottonwoods, sycamores, and other hardwoods in lower riparian areas, as well as on oak, palo verdes, and mesquite in desert shrublands. Although generally thought to be less damaging to their hosts than dwarf mistletoes, heavy infections do develop over time, weakening the host and eventually leading to death.

Root Diseases

Armillaria Root Disease

Armillaria spp.
Hosts: Most conifers, aspen

Root diseases are associated with roughly one-third of the conifer mortality in the region. They 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 recreation 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 disease changes little from year to year.

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. Recent 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 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**, caused by varieties of the fungus *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. Conversely, 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

Sooty Bark Canker, *Encoela pruinosa*
Cryptosphaeria Canker, *Cryptosphaeria populina*
Cytospora Canker, *Cytospora chrysosperma*
Host: Aspen.

Several different canker diseases affect aspen in the Southwest. One or more of these fungal diseases are common in most aspen stands. They damage the living bark and cambium and are one of the reasons aspens are relatively short-lived trees.

Stem Rusts

White Pine Blister Rust

Cronartium ribicola
Host: Southwestern white pine

This damaging, non-native disease occurs throughout most of the range of its host in the Sacramento and adjoining White Mountains of southern New Mexico. Infected white pines have also been found in the nearby Capitan Mountains, and more recently, on Gallinas Peak, just west of Corona, New Mexico.

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 Mountains of New Mexico and a few other locations. The disease is often quite noticeable, although damage is usually minimal. 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 portions of Arizona, and can be quite damaging to individual trees. The fungus causes progressive branch mortality, usually from the center of the crown. Waves of new infection typically occur at intervals of several years.

Comandra Blister Rust
Cronartium comandrae
Host: Pines

This disease has caused branch dieback and mortality on non-native Eldarica/Afghan pine in the Prescott, Payson, and Sedona areas. It occasionally infects ponderosa pines in this area, but has caused minimal damage.

Foliage Diseases

(see also Aspen Defoliation in Insect section)

Ponderosa Pine Needle Cast
Lophodermella cerina and other species

Discoloration and/or defoliation attributed to needle cast fungi was detected during aerial surveys on 2,175 acres of Federal lands in the region in 2000, vs. 9,400 acres in 1999. This defoliation was observed solely on the Santa Fe National Forest (2,175 acres).

A total of 16,070 acres of discolored ponderosa pine were detected on state and private lands in New Mexico. Not all of the discoloration is thought to be due to needle cast but includes the effects of severe drought stress and ponderosa needle miner. Nearly 14,000 acres were in Colfax County, primarily in the Moreno Valley and on the Vermejo Ranch. Other counties include: Cibola (503 acres), Mora (508 acres), Rio Arriba (958 acres), and Sandoval (163 acres).

Abiotic Damage

Drought
Discoloration believed to be due to drought occurred on 124,634 acres in Arizona. Damage occurred in ponderosa pine and shrubland habitats. Discoloration occurred on the Apache-Sitgreaves (11,945 acres), Coconino (28,968 acres), Coronado (4,628 acres), Kaibab (31,164

acres), Prescott (32 acres), and Tonto (4,828 acres) National Forests; Hualapai (90 acres), Navajo (30,397 acres), White Mountain Apache (7,086 acres), and San Carlos (15 acres) Tribal Lands; Bureau of Land Management (27 acres); Grand Canyon National Park (2,818 acres) and Canyon de Chelly (129 acres) and Walnut Canyon (82 acres) National Monuments; Navajo Army Depot (64); and state (152) and private lands (2,209).

Salt Damage

Discoloration and mortality of ponderosa pine caused by magnesium chloride (MgCl) occurred along dirt roads in the Pinetop-Lakeside, Show Low, and Overgaard areas. MgCl is used for dust abatement and the chemical was likely washed off the roads during heavy rains during the summer of 1999. The following fall and winter months were unseasonably dry, which further concentrates salts in the soils. The affected trees were found within approximately 30 feet of the roadway, especially in drainage areas.

Table 1. Region 3: 2000 forest insect conditions

	WPB	MPB	RPB	*Ips* PP	*Ips* Py	SPB & Sclyts	DFB	SB	FEB& WBBB	BB Total	WSBW	DFTM	Nj	Spruce Aphid	PP Needle Miner	Pinyon Sawfly	Pinyon Needle Scale	Aspen Defolia-tionl	Defol Total
R3	30385	810	2235	11965	2075	11705	1815	5990	6150	73130	192225	0	0	156880	67760	25	4510	171000	587890
AZ total	1335	0	2235	4455	110	11705	2760	1350	4115	28065	25915	0	0	156880	40550	25	0	148655	372025
A/S	305			475			1160	60	1160	3160				69290	14170			3285	86745
Coconino	35			15			1545		2840	4435				yes				6045	6045
Coronado			2235	2115		11620	10	730	70	16780				yes					0
Kaibab	5			10			35			50	250				19270			77560	97080
Prescott				145						145									0
Tonto	10			725					45	780									0
GCNP	5									5	5170							37150	42320
Chiricahua						20				20									0
Saguaro				285						285									0
BLM	45									45									0
CdeC	10				10					20	40								40
Fort Apache	295			120			5	295		715				87510	1805			3180	92495
Hualapai										0									0
Navajo	390			35	100			265		790	20395					25		20755	41175
San Carlos	210			210						420	60				325				385
Walnut										0									0
St & Priv	25			320		65	5			415				80	4980			680	5740
Other										0									0
NM Total	29050	810	0	6585	1965	0	165	4900	2035	45510	165095	0	0	0	27210	0	4510	22545	214850
Carson		585					40	955	85	1665	79165							4700	83865
Cibola								245	1020	1265	2965							1560	4525
Gila	12215			6360	1965		30	140		20710	2310				14205		325	245	16760
Lincoln	13050						95	795	45	13985	1075						4185	260	1335
Santa Fe		195		195				2480	670	3540	21915				500			4785	27200
Jicarilla									10	10	3925								3925
Mecalero	3650							40		3690	165								165
Picuris										0									0
Santa Clara								25		25	90								90
Taos		20		20				170		210	3560							805	4365
St & Priv	135	10		10				50	205	410	49925				12505			10190	72620

Table 2. Prominent 2000 forest insect and disease activity in Arizona and New Mexico.

Agent	State	National Forest	Tribal Lands	Other Federal	State & Private	Total
Roundheaded pine beetle	AZ	2,235	0	0	*	2,235
	NM	0	0	0	0	0
Ips beetle (ponderosa pine)	AZ	3,485	370	285	20	4,160
	NM	6,360	340	0	1,105	7,805
Douglas-fir beetle	AZ	1,640	5	0	5	1,650
	NM	165	0	0	0	165
Mountain pine beetle	AZ	0	0	0	0	0
	NM	780	20	0	10	810
Southern pine beetle	AZ	11,620	0	20	65	11,705
	NM	0	0	0	0	0
Spruce beetle	AZ	790	560	0	*	1,090
	NM	4,615	235	0	50	4,900
Western pine beetle	AZ	355	895	60	25	1,335
	NM	25,265	3,650	0	135	29,050
True fir beetles	AZ	4,115	0	0	0	4,115
	NM	1,820	10	0	205	2,035
Western spruce budworm	AZ	1,525	20,400	5,210	*	27,130
	NM	107,425	7,740	0	49,925	165,090
Spruce Aphid	AZ	69,290	87,510	0	80	156,880
	NM	0	0	0	0	0
Ponderosa pine needle miner	AZ	33,445	2,130	0	4,985	40,560
	NM	14,705	0	0	12,505	27,210
Ponderosa pine needle cast	AZ	0	0	0	*	0
	NM	2,175	0	0	16,070	18,245
Aspen defoliation	AZ	20,635	17,350	375	90	38,450
	NM	13,405	595	0	11,060	25,060
Root disease	AZ	219,000	**	**	**	219,000
	NM	860,000	**	**	**	860,000
Dwarf mistletoes	AZ	1,040,000	25,000	**	674,000	1,739,000
	NM	1,114,000	581,000	**	348,000	2,069,000

* No information available.

** Significant activity observed, but acreage not determined.

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 these services to the Forest Service and other land management agencies. The following letters/reports document much of this work done in 2000:

Arizona Zone

1. Douglas-fir tussock moth monitoring results for Arizona. 1/00.

2. Biological evaluation of the 1999 and 2000 Ritter prevention projects. 2/00.

3. Infestation of elm leaf beetles at the North Kaibab District office. 3/00.

4. Evaluation of juniper dieback on the Kaibab Band of Paiute Reservation. 5/00.

5. Evaluation of tree discoloration and damage on Forest Road 182, Lakeside Ranger District, Apache-Sitgreaves National Forest. 6/00.

6. Evaluation of hazard trees in the Outlet fire area, Grand Canyon National Park. 8/00.

7. Evaluation of *Dendroctonus frontalis* outbreak in Chiricauhau National Monument. 8/00.

8. Second evaluation of hazard trees in the Outlet fire area, Grand Canyon National Park. 10/00.

9. Southern pine beetle infestation in the Chiricauhau Mountains. 10/00.

10. Biological evaluation of hazard tree conditions at Seven Springs Campground (CG), Cave Creek Ranger District (RD), Tonto National Forest. 11/00.

11. Pretreatment biological evaluation for the FY 2001 Proposed Malay Gap Dwarf Mistletoe (DM) Suppression Project, San Carlos Apache Reservation. 11/00.

12. Biological evaluation of the Maggie Jones Nantucket Pine Tip Moth Project. 1/00.

13. Pretreatment biological evaluation of the FY 2001 Proposed Bear Ridge Dwarf Mistletoe Suppression Project, White Mountain Apache Reservation. 12/00.

14. Douglas-fir tussock moth monitoring results for Arizona. 12/00.

New Mexico Zone

1. Forest disease and insect considerations for silvicultural certification stand on Borrego Mesa, Jemez Pueblo. 2/00.

2. Potential survival of scorched ponderosa pines in the Anderson Fuelwood Area, Mountainair Ranger District, Cibola National Forest. 3/00.

3. White pine blister rust monitoring plot update, Mescalero Apache Indian Reservation. 5/00.

4. Hazard tree evaluation, Mount Taylor Ranger District, Cibola National Forest. 5/00.

5. Dwarf mistletoe management in Sheep Basin portion of Negrito area, Reserve Ranger District, Gila National Forest. 6/00.

6. Hazard tree survey, Glenwood Ranger District, Gila National Forest. 6/00.

7. Remeasurement of Upper Elk dwarf mistletoe monitoring plot, Mescalero Apache Indian Reservation. 7/00.

8. Ponderosa pine discoloration at McGaffey Lake, Mt. Taylor Ranger District, Cibola National Forest. 7/00.

9. Piñon pine mortality at El Morro National Monument. 8/00.

10. Caterpillars at Dale Resler Boy Scout Camp, Sacramento Ranger District, Lincoln National Forest. 8/00.

11. Insect and disease concerns at Mescalero Apache Indian Reservation. 8/00.

12. Proposed FY 2001 Inde-Taazhe forest health projects, Mescalero Apache Indian Reservation. 9/00.

13. Proposed FY 2001 insect and disease prevention/suppression projects, Tres Piedras, El Rito, and Canjilon Ranger Districts, Carson Nation Forest. 10/00.

14. Proposed FY 2001 insect and disease prevention/suppression projects, Smokey Bear Ranger District, Lincoln National Forest. 11/00.

15. Monitoring of scorched ponderosa pines in the Cerro Grande Fire area (Garcia Canyon), Espanola Ranger District, Santa Fe National Forest. 12/00.

16. Forest insect and disease considerations for Organizational Camps: Camp Shaver as a case study, Jemez Ranger District, Santa Fe National Forest. 12/00.

17. Bark beetle and budworm activity at Mescalero Apache Indian Reservation. 12/00.

Publications

Conklin, D.A. 2000. Dwarf mistletoe management and forest health in the Southwest. USDA Forest Service, Southwestern Region, unnumbered report. 30 p.

Negron, J. F., J. L. Wilson, & J. A. Anhold. 2000. Stand conditions associated with roundheaded pine beetle (Coleoptera: Scolytidae) Infestations in Arizona and Utah. Environ. Entomol., 29(1):20-27.

Rogers, T.J. 2000. Biological evaluation of Douglas-fir tussock moth activity in the Sacramento Mountains, New Mexico. USDA Forest Service, Southwestern Region, R3-01-01. 8 p.

Other Entomology and Pathology Activities in 2002

Training

The Forest Health Zone Offices offer annual training on forest insect and disease identification, biology, and management. These sessions are open to personnel from the USDA Forest Service, USDI Bureau of Indian Affairs and National Park Service, as well as other interested Federal and state agencies and tribal resource managers. In the spring, we offer a workshop for recreation managers and their staffs, which emphasizes hazard tree management. In the fall, we offer a workshop for resource managers and specialists covering the entire forest ecosystem. We also offer informal training on request, particularly for field crews.

The Role of Wildland Fire and Subsequent Insect Attack on Ponderosa pine Mortality

This project will define the impact caused by insects when interacting with another disturbance agent, wildfire. This will allow us to more accurately assist land managers in predicting potential tree mortality in post-fire situations. Currently, there is little information regarding fire/insect impact in ponderosa pine ecosystems. For example, there are no written or visual guidelines for field personnel to determine what tree will live or die in the near-future in relation to the amount of damage caused by fire or the probability of injured trees being killed by insects. Furthermore, the probability of fire-damaged trees providing the source of an insect outbreak that subsequently spreads to uninjured trees remains unknown. This project will address the lack of adequate information by formulating models and creating visual guides and, therefore, permit land managers to make more informed decisions regarding salvaging and insect control. This information will also be useful in the development of prescriptions for prescribed burning. This is a three-year, multi-regional (Regions 1, 2 and 3) study that will examine fires that occurred in 2000. Transects and permanent plots will be established in 2001. The Pumpkin Fire on the Coconino NF will be monitored in Region 3.

Contact John Anhold for more information.

Field Evaluation of the Efficacy of Two Types of Pheromone Release Devices

The objective of this field evaluation is to test the feasibility of using a precise and continuous release device to improve the effectiveness of MCH in influencing Spruce Beetle behavior in Arizona and Utah. The prototype Med-E-Cell device will be tested against the conventional bubble cap while releasing MCH at the same target rate. The prototype pheromone delivery system will be tested in a field bioassay utilizing Lindgren funnel traps. The test sites are located on the Coronado NF, Safford RD in Arizona and on the Dixie NF, Cedar City RD in Utah.

Contact John Anhold for more information.

Spray Aircraft GPS Guidance Test and Demonstration

A test and demonstration of spray aircraft guidance systems for (USFS) Forest Health and other Agency personnel was conducted in May of 2001 near Salt Lake City, Utah in the deep narrow canyons of the Wasatch Front. The objective was to evaluate and demonstrate current Global Positioning System (GPS) spray aircraft guidance systems and determine if these systems will give accurate position data to a pilot during a typical spray project. Three different guidance systems (Dyna Nav, Trimble & Ag Nav) were placed in a helicopter and flown to a test block to

evaluate how they perform. The information obtained from this test is currently being analyzed and a technical report is forthcoming.

Contact John Anhold for more information.

Effects of Prescribed Fire on Dwarf Mistletoe

We are continuing to monitor the effects of several prescribed fires (underburns) on dwarf mistletoe infection in ponderosa pine. In 2000, we completed analyses for three burns conducted on the Española Ranger District of the Santa Fe National Forest in 1995, 1996, and 1997. A total of 877 trees on six plots were used to monitor these three fires. Average crown scorch on the plots ranged from 28 to 77 percent. Infection levels (DMR's) were reduced on all plots, with reductions ranging from 0.3 to 1.6, compared to projected values, three to four years after the fires. In two of these fires (timber litter models), heavily infected trees had higher mortality rates than other trees, and reductions in plot DMR increased with increasing average scorch. In the third fire (a timber slash model), reductions in plot DMR were less, relative to scorch, than in the other fires. On each of the plots, reductions in plot DMR occurred through a combination of tree mortality and scorch pruning.

In 2000, we also collected data on more recent prescribed burns conducted on the Jemez Ranger District of the Santa Fe National Forest, and on the Mountainair and Mount Taylor Ranger Districts of the Cibola National Forest.

Contact Dave Conklin for additional information on these monitoring efforts.

Spruce Beetle

Spruce beetle related tree mortality has increased in a number of locations in the region. The outbreak on the Coronado NF, Safford RD, Pinaleño Mountains, was started during a defoliation event in spruce by the spruce looper, *Nepytia janetae*. The defoliation weakened the spruce and allowed the spruce beetle to successfully attack and colonize susceptible spruce. In 2000 there was another defoliation event in spruce, this time by the spruce aphid, *Elatobium abietinum*. This defoliation was more wide spread in the Pinaleño mountains and the potential for accelerated spread and impacts from the spruce beetle are likely. Spruce beetle activity is expected to increase throughout the spruce type over the next several years. Spruce beetle outbreaks can cause extensive tree mortality and modify stand structure by reducing the average tree diameter, height, and stand density. Spruce beetle outbreaks can affect non-timber resources as well. For example, as mature spruce are killed, forage may increase benefiting some wildlife species. However, species that depend on mature spruce or clumps of spruce to meet habitat requirements may be adversely affected.

Contact John Anhold for more information on monitoring activities.

Southern Pine Beetle

An outbreak of southern pine beetle was discovered on the Chiricahua National Monument and the Douglas Ranger District of the Coronado National Forest in 2000. Multiple infestations were detected covering 11,705 acres of federal and private land in southeastern Arizona. Pheromone trapping in the fall using southern pine beetle lure, harvested only southern pine beetles. Examination of infested trees revealed a mix of bark beetles, including *Ips* spp. and 2 species of *Dendroctonus* beetles, including southern pine beetle, *D. frontalis*, Mexican pine beetle *D.*

mexicanus. This is the first record of Mexican Pine beetle in the United States. The coexistence of these two *Dendroctonus* species in the same bolt is not a new record; two previous records were found, one from Honduras and another from Mexico. We believe that the infestation was initiated by an outbreak of *Ips* spp. with the *Dendroctonus* spp. coming into the trees secondarily. Further study of the situation is being conducted to determine the conditions that led to the outbreak and what can be done to prevent future outbreaks. Spring trapping in the Chiricahua Mountains has been set up using southern pine beetle lure and western pine beetle lure. To date we have only harvested Mexican pine beetle in these traps. Identification of the insects and their associates is being done by John Moser of the Southern Research Station.

Contact Bobbe Fitzgibbon for more information.

Hazard Tree Surveys

In addition to training recreation managers in a formal setting how to survey, document, and manage hazard trees in recreation sites, we also work individually with managers at their own local sites. There were two big projects undertaken in Arizona in FY 2000. The first was Seven Springs CG, Cave Creek RD, Tonto NF, where many trees on the site had dieback of large limbs and were threatening public safety. In addition to the natural aging of trees, the floods of 1993 and ongoing soil compaction are factors contributing to the dieback at Seven Springs CG. Sixty-two hazardous trees were identified. Twenty-four trees had dead limbs or tops, so removal of only these parts, and not whole trees would negate the hazards. Twenty-eight whole trees were considered structurally unsound, seven of which were dead trees, and targeted for removal. The district treated these trees following the survey. The remaining 10 trees will be monitored closely. The second project was involvement in the Burned Area Emergency Rehabilitation (BAER) plan for the Outlet Fire on the North Rim of Grand Canyon NP. Many public access areas affected by the fire were assessed for trees standing within falling distance that could pose a hazard to the public or damage property. Drive-by or windshield surveys were used along roads. In parking areas and along trails, trees were visually scanned for hazards and potential flaws while walking through an area. Information was provided to the park on the expected degradation of trees following death by fire, including differences between species and size classes.

Contact Mary Lou Fairweather for more information.

Web Site

The Arizona Zone and New Mexico Zone offices continue to maintain an active web site on the internet. This site provides a public forum for reporting past and present insect and disease conditions, biology, training opportunities, and mission statement. Hosted by the Northern Arizona University School of Ecosystem Science and Management, it can be accessed at http://www.for.nau.edu/usfs/r3_fpm. It is linked to the USDA Forest Service, Region 3 homepage and the Washington Office Forest Health homepage. Steve Dudley of the Arizona Zone is the webmaster.