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Forest Insect and Disease Conditions in the Southwestern Region, 1998

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Introduction

Disturbances such as wildfire, insect outbreaks and chronic disease conditions are a part of the normal functioning of the forest. The levels of these disturbances can be greatly influenced by climatic and weather events. The impact of such events on forest insect and disease populations is not only dependent on the ability of the insect or disease to tolerate the changes in its environment but also on the stress level of its host plant and the reaction of the plant to the event.

Additional stresses have been put on the southwestern forests by changing conditions attributed to increasing human influence. Since the time of European settlement, the forests have become more dense, often overstocked with small to midsize slowly growing trees. Changes in species composition and decreasing plant diversity have been seen throughout the region. The resultant forests are more susceptible to larger and more intense disturbance regimes.

Unusual weather patterns may stimulate or deter the development of epidemics, depending on the causal agent involved. While drought increases tree mortality due to bark beetle attack, above normal precipitation favors the western spruce budworm, a defoliator. Some moisture-loving pathogens may also thrive under wet conditions while others become more successful when hosts are drought stressed. Extremely cold winter or spring temperatures can account for significant insect mortality; overwintering mountain pine beetles may succumb to sub-zero temperatures and newly hatched forest tent caterpillars can be killed by a spring cold snap.

Late in 1997, a climatic event called El Niño began and persisted for about 8 months. This weather pattern occurs when trade winds diminish over the Pacific allowing warm water to flow eastward toward the coasts of North and South America. This changes the weather pattern across the equatorial Pacific and has far reaching climatic impacts. In Arizona and New Mexico, El Niño effects include cooler, more moist winter conditions than we normally experience. El Niños have become more frequent over the last 100 years and it is believed that this trend may be due to global warming. As sometimes happens, the El Niño was followed in June of 1998 by a La Niña event which is continuing into 1999. A La Niña event occurs when the trade winds are much stronger than normal and warm water flows westward in the Pacific followed by an upwelling of colder deep-sea water along the Pacific coastal Americas. This results in warmer, drier conditions in the southwestern United States.

It is difficult to predict what impacts the current La Niña event will have on the forests of the Southwest. Changes may be seen not only in insect populations, but in the incidence and intensity of fire and disease and the forests' response to them. Maintaining healthy forests can lessen the impact of weather events by reducing stress on the trees.

Staff specialists in the Arizona and New Mexico Zone Offices use detection, monitoring and evaluation to keep land managers informed of current conditions and potential future impacts. By maintaining and using the data from historic maps of pest conditions we can evaluate population changes over time to identify trends. Our goal is to assist Federal, tribal and state land managers in making better land management decisions based on continuously updated information.

This report summarizes the status of insects and diseases in the forests of the Southwest for 1998. Much of the insect information is based on our annual aerial detection surveys over forested Federal and tribal lands. Most of the disease information is based on ground observations and surveys. The information on state and private lands was contributed by Bob Celaya, Forest Pest Specialist, Arizona State Land Department; and Bob Cain, Extension Forest Entomologist, New Mexico State University Cooperative Extension Service.

Conditions in Brief

In the Southwest, bark beetle-caused tree mortality decreased from 91,235 acres in 1997 to 43,880 acres in 1998. Tree mortality in the lower elevation piñon-juniper forest cover type (woodlands) was caused by piñon engraver beetles (65 acres); in the ponderosa pine forest cover type, tree mortality was caused by the roundheaded pine beetle (6,730 acres), pine engraver beetles (18,165 acres), western pine beetle (2,340 acres), and mountain pine beetle (7,500 acres). In the higher elevation mixed conifer and spruce-fir forest cover types, tree mortality was caused by Douglas-fir beetle (1,555 acres), fir engraver/western balsam bark beetle complex (4,835 acres), and spruce beetle (2,690 acres).

Insect defoliator activity Region-wide increased from 266,395 acres in 1997 to 321,135 acres in 1998. This defoliation was caused by the western spruce budworm (320,665 acres), spruce aphid (170 acres), and *Nepytia janetae* (300 acres), a defoliator of spruce and fir.

A complex of large aspen tortrix, western tent caterpillar, marssonina leaf spot, and/or abiotic factors occurred on 85,905 acres.

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. The estimated annual volume loss from these parasites is 25 million cubic feet. Their incidence has probably increased over the past century.

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. Like other native diseases including mistletoes, root and butt rots can be beneficial for some wildlife species.

The incidence of white pine blister rust continues to increase in the Sacramento and adjoining White Mountains of southern New Mexico.

Table 1. Prominent 1998 Forest Insect and Disease Activity (acres) in Arizona and New Mexico.

Agent	State	National Forests	State & Private	Other Federal	Tribal Lands	Total
Roundheaded Pine Beetle	AZ	10	**	0	0	10
	NM	4,020	**	0	2,700	6,720
Ips Beetle (ponderosa pine)	AZ	16,380	500	0	1,145	18,025
	NM	35	**	0	105	140
Douglas-fir Beetle	AZ	1,205	40	0	35	1,280
	NM	275	**	0	0	275
Mountain Pine Beetle	AZ	10	**	7,425	0	7,435
	NM	65	**	0	0	65
Spruce Beetle	AZ	295	**	0	155	450
	NM	2,085	**	0	155	2,240
Western Pine Beetle	AZ	235	15	0	230	480
	NM	1,860	**	0	0	1,860
True Fir Beetles	AZ	2,790	5	15	35	2,845
	NM	1,990	**	0	0	1,990
Piñon Pine Needle Scale	AZ	++	**	0	++	++
	NM	1,985	**	++	0	1,985
Ponderosa Pine Needle Miner	AZ	0	**	0	0	**
	NM	2,440	**	0	0	2,440
Western Spruce Budworm	AZ	5,890	**	1,440	2,805	10,135
	NM	248,015	62,515	0	0	310,530
Spruce Aphid	AZ	0	**	0	170	170
	NM	0	**	0	0	**
Nepytia janetae	AZ	175	0	0	125	300
	NM	0	**	0	0	**
Piñon Sawfly	AZ	0	**	0	52,000	52,000
	NM	0	++	0	0	**
Aspen Defoliation	AZ	41,140	80	11,590	5,840	58,650
	NM	18,210	9,045	0	75	27,330
Ponderosa Pine Needle Cast	AZ	0	**	0	0	**
	NM	0	**	0	425	425
Root Disease	AZ	219,000	**	**	**	219,000
	NM	860,000	**	**	**	860,000
Dwarf Mistletoes	AZ	1,040,000	674,000	**	25,000	1,739,000
	NM	1,114,000	348,000	**	581,000	2,069,000

***** = No information available.***

****++ = Significant activity observed, but no acreage figures determined.***

Status of Insects

Bark Beetles

Cypress Beetles

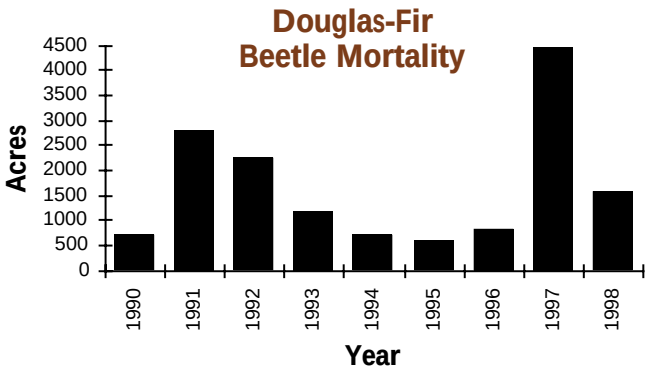
Phloeosinus spp.
Host: Arizona cypress

Cypress beetles caused scattered mortality to Arizona cypress around Sedona, Arizona, and were found in urban areas in New Mexico.

Douglas-fir Beetle

Dendroctonus pseudotsugae
Host: Douglas-fir

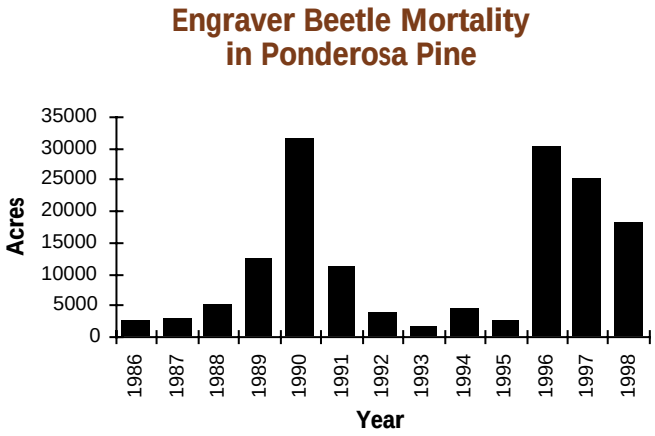
Tree mortality caused by this insect decreased in the region, with 1,555 acres impacted in 1998 compared to 4,460 acres affected in 1997. Mortality occurred on the Apache-Sitgreaves (405 acres), Coconino (425 acres), Coronado (10 acres), Kaibab (25 acres), Prescott (275 acres), and Tonto (65 acres) National Forests; on the Fort Apache (5 acres) and Navajo (30 acres) Indian Reservations and 40 acres of private land. Activity increased in New Mexico from no mortality reported in 1997 to 275 acres affected in 1998. Mortality occurred on the Gila (165 acres) and the Lincoln (110 acres) National Forests.



Ips Beetles

Ips spp.
Primary Hosts: Ponderosa pine, piñon pine

Ponderosa pine mortality caused by ips beetles occurred on approximately 18,165 acres in 1998, down somewhat from 1997 (25,085 acres). In Arizona, mortality was detected on the Apache-Sitgreaves (110 acres), Coconino (820 acres), Coronado (40 acres), Kaibab (820 acres), Prescott (1,655 acres), and Tonto (12,935 acres) National Forests; Fort Apache (155 acres), Navajo (35 acres), and San Carlos (955 acres) Indian Reservations; and on about 500 acres of state and private lands. In New Mexico, mortality was detected on the Gila (10 acres) and Lincoln (25 acres) National Forests and on the Mescalero Apache Indian Reservation (105 acres).



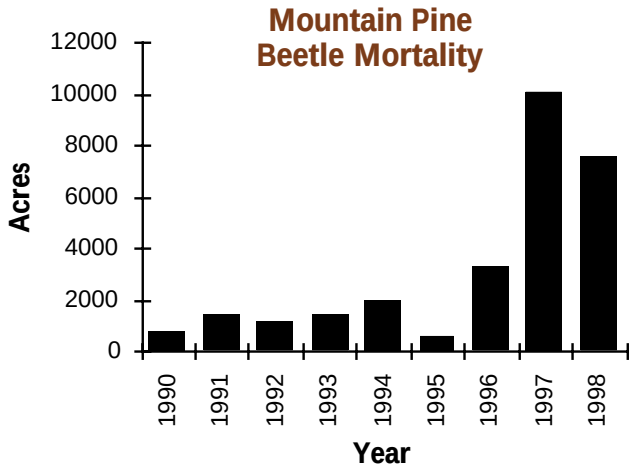
Piñon pine mortality caused by piñon ips, *Ips confusus*, in the woodlands, decreased from 17,390 acres in 1997 to only 65 acres in 1998. The largest declines were seen in Arizona when the piñon ips population on the Coconino National Forest near Twin Arrows and two populations near Tusayan, Arizona crashed. The 1998 acreage on the Coconino was only 35 acres, down from 12,810 in 1997. Elsewhere in Arizona piñon ips mortality was recorded on Walnut Canyon National Monument (20 acres) and the Hualapai Indian Reservation (10 acres). No piñon ips activity was detected in New Mexico in 1998.

Spruce ips is common at high elevations in northern Rio Arriba County, New Mexico and were detected during ground surveys of areas heavily defoliated by western spruce budworm on private lands in northern Taos County, New Mexico.

Mountain Pine Beetle

Dendroctonus ponderosae
Primary Host: Ponderosa pine

Overall, tree mortality decreased in 1998 with 7,500 acres affected compared to 10,080 acres in 1997. Most of the mortality (7,425 acres) occurred in Grand Canyon National Park. This activity occurred on the north side of the park in a relatively inaccessible area. Other mortality was reported on the Kaibab National Forest (10 acres) in Arizona, and on the Santa Fe National Forest (65 acres) in New Mexico.

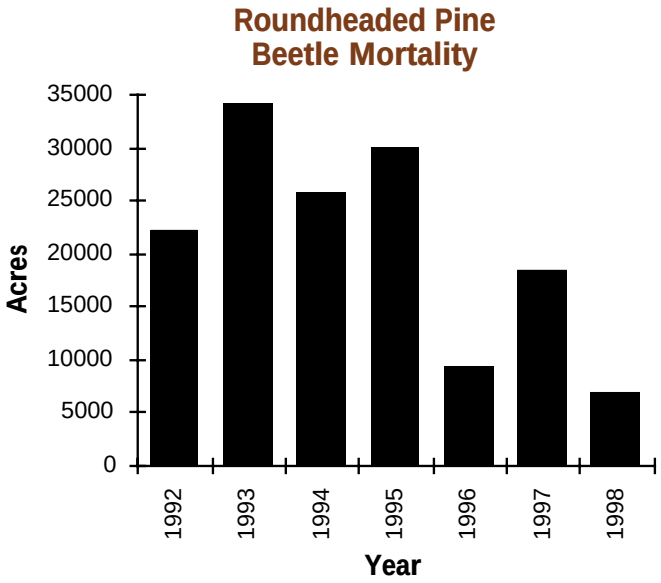


Red Turpentine Beetles

Dendroctonus valens

Primary Host: Pines

Low levels of red turpentine beetles were found in ponderosa pine throughout New Mexico. High levels of turpentine beetle activity were often associated with thinning and logging on private lands. No significant tree mortality is usually seen in association with turpentine beetles.



Roundheaded Pine Beetle

Dendroctonus adjunctus

Primary Host: Ponderosa pine

Tree mortality due to roundheaded pine beetle declined substantially in 1998 to 6,730 acres, after almost doubling between 1996 (9,340 acres) and 1997 (18,435 acres). In Arizona, activity occurred on the Coronado National Forest (10 acres). Activity continued in the Sacramento Mountains of southern New Mexico, on both the Lincoln National Forest (4,020 acres) and the Mescalero Apache Indian Reservation (2,700 acres); the largest concentrations of mortality occurred south of Mayhill and from Timberon to Sunspot.

Spruce Beetle

Dendroctonus rufipennis

Host: Spruce

Tree mortality increased to 2,690 acres in 1998, from 1,650 acres in 1997. In Arizona, mortality was detected on the Apache-Sitgreaves (50 acres), Coconino (5 acres), and Kaibab (240 acres) National Forests; and on the Fort Apache (15 acres) and Navajo (140 acres) Indian Reservations. In New Mexico, mortality was detected on the Carson (440 acres), Cibola (145 acres), Gila (10 acres), Lincoln (290 acres) and Santa Fe (1,200 acres) National Forests, and on the Mescalero Apache Indian Reservation (155 acres).

True Fir Beetles:
Fir Engraver Beetle

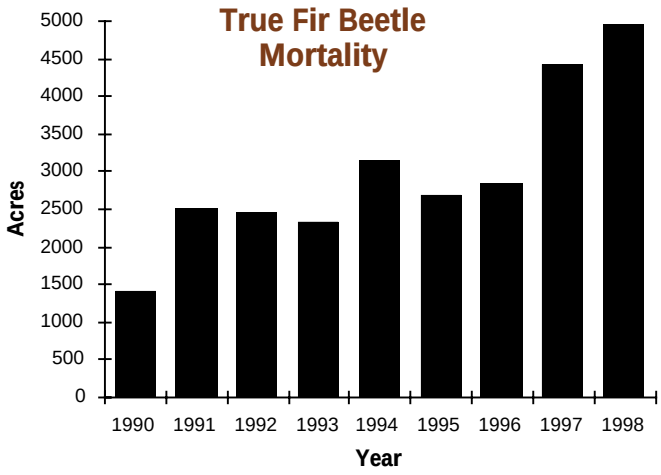
Scolytus ventralis

Western Balsam Bark Beetle

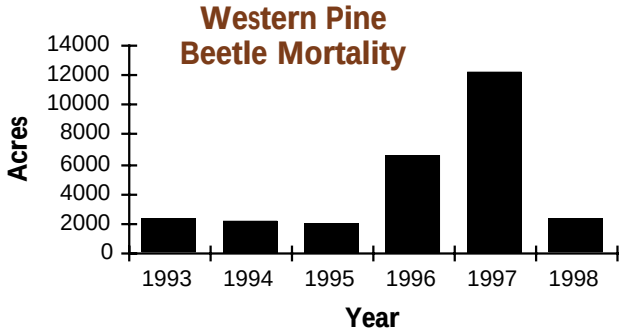
Dryocoetes confusus

Host: White and Subalpine/Corkbark fir

Tree mortality increased slightly in 1998, occurring on 4,960 acres compared to 4,410 acres the previous year. In Arizona, activity was detected on the Apache-Sitgreaves (345 acres), Coconino (1,830 acres),



Coronado (65 acres), Kaibab (545 acres) and Tonto (5 acres) National Forests; on the Fort Apache (30 acres) and Navajo (5 acres) Indian Reservations; in Grand Canyon National Park (15 acres) and on 5 acres of private land. In New Mexico, activity was found on the Carson (20 acres), Cibola (155 acres), Gila (1560 acres), Lincoln (15 acres) and Santa Fe (240 acres) National Forests; and 125 acres on the Santa Clara Indian Reservation.



Western Pine Beetle

Dendroctonus brevicomis

Primary Host: Ponderosa pine

Activity decreased significantly to 2,340 acres in 1998, 12,225 acres were affected in 1997. In Arizona, mortality occurred on the Apache-Sitgreaves (85 acres), Coconino (35 acres), Coronado (5 acres), Kaibab (105 acres) and Tonto (5 acres) National Forests; on the Fort Apache (60 acres), Navajo (125 acres) and San Carlos (45 acres) Indian Reservations; and on 15 acres of state and private land. In New Mexico, mortality from this beetle was only detected on the Gila (1,860 acres) National Forest.

Defoliators

Bull Pine Sawfly

Zadiprion townsendi

Host: Ponderosa pine

Bull pine sawfly continued on ponderosa pine at low but detectable levels in several chronically infested areas of Santa Fe. These insects are also common minor defoliators in Las Vegas, Cedar Crest, and Mountainair, New Mexico.

Douglas-fir Tussock Moth

Orgyia pseudotsugata

Hosts: White fir, Douglas-fir

No defoliation was detected in Arizona in 1998. Pheromone trap catch information from the Early Warning Detection Program suggests that populations are rising in the Pinal Mountains on the Tonto National Forest in Arizona, approaching levels observed in 1992, the last time visible defoliation was observed. Populations continue to decline on West Peak in the Pinaleno Mountains, Coronado National Forest, where visible defoliation was observed in 1995. Elsewhere in Arizona populations are at low levels.

This insect continues to be an urban problem in northern New Mexico. In 1998 defoliation continued at detectable levels in the communities of White Rock, Los Alamos, Santa Fe, and Espanola. Occasional defoliation of landscape trees has also been found in Cedar Crest, Raton, Alto, Glorietta, Pecos and Ruidoso.

Fall Webworm

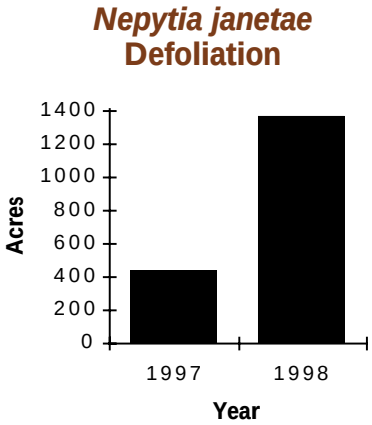
Hyphantria cunea

Host: Hardwoods

Fall webworm defoliation continued to be common in landscape and lower elevation riparian hardwoods, especially elms and cottonwoods. The visual impacts of this insect have been a concern at the Nambe Falls Recreation Area, Nambe Pueblo Indian Reservation, in northern New Mexico.

Nepytia janetae

Host: Spruce and True Fir



Nepytia janetae, a looper with no common name, was first discovered feeding on both spruce and fir on Mt. Graham on the Coronado National Forest in 1997 (437 acres). Defoliation decreased to 176 acres in 1998. However, another much larger infestation was discovered in 1998, spanning both the Apache-Sitgreaves National Forests (175 acres) and the Fort Apache Indian Reservation (1,013 acres). Total defoliation for *Nepytia janetae* in 1998 is 1,364 acres.

Piñon Needle Scale

Matsucoccus acalyptus
Host: Piñon pine

In Arizona, this scale continues to affect piñon at several locations. Defoliation was observed in the Prescott area, as well as at Canyon De Chelly where it was associated with the piñon sawfly. In New Mexico, some 1,985 acres were again affected on the Carson (1,025 acres) and Cibola (960 acres) National Forests. Other woodland damage from this insect was observed on private lands south of Willard, east of El Rito, south of Corona, and east of Silver City. Damage to landscape piñons was common statewide.

Piñon Sawfly

Zadiprion rohwerii
Neodiprion edulicolus
Host: Piñon pine

Light to moderate piñon defoliation by *Zadiprion rohweri* was detected on about 52,000 acres of the Navajo Indian Reservation in 1998, compared to 2,995 acres in 1997. The increase may be partially attributed to a more extensive survey conducted in 1998. The most heavily affected area is located in and around Canyon De Chelly in northeast Arizona. Insect populations on the south rim of the canyon have declined and defoliation was found to be light. Moderate defoliation was noted on the north rim and to the north and east of the canyon in the vicinity of Tsaile Lake. Trees in all size classes have been affected. Diseased larvae were found throughout the infested area, an indication that the populations will decline. In New Mexico, minor defoliation was detected in Albuquerque in 1998. Defoliation by *Neodiprion edulicolus* on piñon pine was detected in Bernalillo, Santa Fe and Sandoval Counties and probably occurred at low levels throughout New Mexico. An unidentified summer feeding sawfly was also detected causing heavy defoliation on mature ornamental ponderosa pines in Albuquerque and Corrales.

Ponderosa Pine Needleminer

Coleotechnites ponderosae
Host: Ponderosa pine

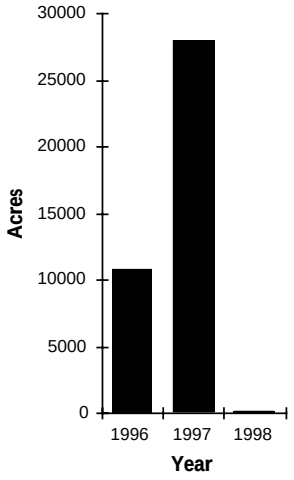
In New Mexico, ponderosa pine needle miner defoliation decreased from 19,400 acres in San Miguel and Mora Counties in 1997 to approximately 2,440 acres in 1998 on the eastern foothills of the Sangre de Cristo Mountains in San Miguel County only. The intensity of the discoloration of the infested trees was less severe than during the peak outbreak years in the late 1980's and mid 1990s. Ponderosa pine needle miner also continues to be a common ornamental tree problem in Los Alamos, NM

Spruce Aphid

Elatobium abietinum
Host: Spruce

Spruce aphid defoliation detected by aerial survey decreased substantially from 27,970 acres in 1997 to 170 acres in 1998. All of this defoliation occurred on the Fort Apache Indian Reservation (170 acres) in Arizona.

Spruce Aphid Defoliation



Tiger Moth

Halisidota spp.
Host: Hardwoods and Conifers

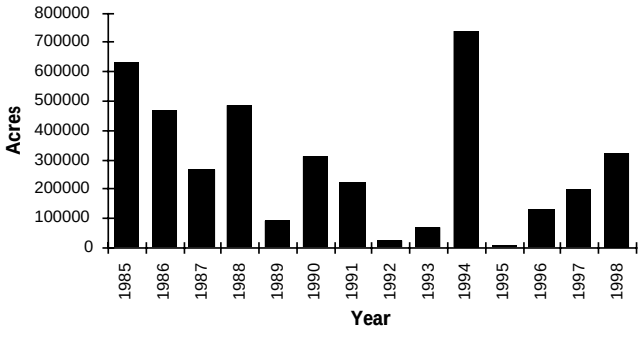
Tiger moth caterpillars were common in forests and woodlands on ponderosa pines, piñon pines and Douglas-fir in New Mexico. The 1997 outbreak recorded for Albuquerque has declined.

Western Spruce Budworm

Choristoneura occidentalis
Host: True firs, Douglas-fir, Spruce

Regional defoliation increased in 1998 for the second year, with a total of 321,015 acres detected compared to 198,165 acres in 1997 and 126,985 acres in 1996. In Arizona, activity was more

Western Spruce Budworm Defoliation



widespread including the Apache-Sitgreaves (490 acres) and Kaibab (5,400 acres) National Forests; Grand Canyon National Park (1,440 acres); and the Navajo Indian Reservation (2,805 acres). In New Mexico, defoliation occurred on the Carson (174,470 acres), Cibola (1,330 acres), Gila (85 acres), and Santa Fe (72,130 acres) National Forests; on the Santa Clara Indian Reservation (350 acres), and on about 62,515 acres of State and private lands in northern New Mexico most notably in Colfax County.

Complex

Aspen Defoliation

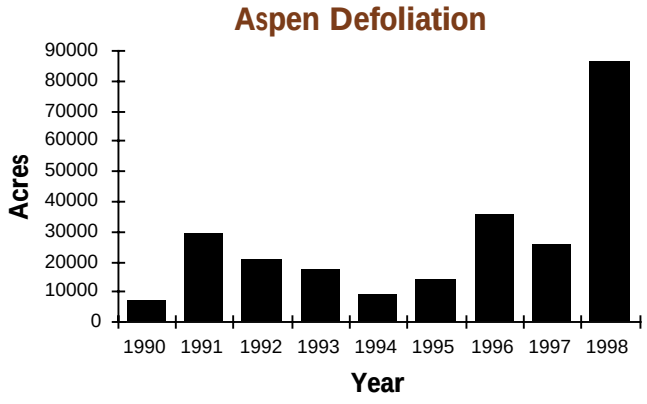
Western Tent Caterpillar, *Malacosoma californicum*

Large Aspen Tortrix, *Choristoneura conflictana*

Black Leaf Spot, *Marssonina populi*

Host: Aspen

These agents, alone or in combination, accounted for approximately 85,980 acres of defoliation in 1998, considerably more than the previous year (25,465 acres). Defoliation was detected in Arizona on the Apache-Sitgreaves (4,440 acres), Coconino (785 acres), Kaibab (35,905 acres), and Prescott (10 acres) National Forests; on the Fort Apache (1,510 acres) and Navajo (4,330 acres) Indian Reservations; Grand Canyon National Park (11,590 acres) and on about 80 acres of state and private land. In New Mexico, it was found on the Carson (12,500 acres), Cibola (3,230 acres), Gila (70 acres), Lincoln (235 acres) and Santa Fe (2,175 acres) National Forests; on the Santa Clara Indian Reservation (75 acres); and on about 9,045 acres of state and private lands in northern New Mexico in Cibola, Colfax, Mora, Rio Arriba, Sandoval, and Taos Counties.



Miscellaneous Insects

Bagworms (family *Psychidae*) have become an increasing problem in the Albuquerque area on junipers, cypress, and a number of hardwoods, particularly sycamores, but populations decreased somewhat in 1998.

Boxelder Leaf Roller (*Archips negundanus*) caused Boxelder defoliation in June along the Tesuque River in New Mexico.

Conifer Aphids (*Cinara* spp.) were observed feeding on terminal and lateral shoots and trunks of ponderosa pine saplings in southwest Prescott in May. Needle discoloration was noted later in summer on pines in the area and was presumed to be caused by the aphids.

Cottonwood Leaf Beetles (*Chrysomela scripta*) were at outbreak numbers, defoliating cottonwood trees in Corrales, Albuquerque, and along the Rio Grande in New Mexico.

Elm Leaf Beetles (*Xanthogaleruca luteola*) were at high levels throughout New Mexico, defoliating Siberian elms growing in urban and rural areas.

Genista Caterpillars (*Uresiphita reversalis*) caused defoliation of Texas mountain laurel and ornamental brooms in Las Cruces, New Mexico area landscapes.

Oystershell Scale (*Lepidosaphes ulmi*) was seen in urban areas of New Mexico in 1998. Both ornamental and naturally growing aspens can be affected.

Pine Tip Moths (*Rhyaciona* spp.) continued to damage ornamental pines in Albuquerque and Santa Fe. The most severe injury appears to be from the Nantucket and western pine tip moths, although several other species are routinely caught in pheromone traps used to monitor these pests. Nantucket pine tip moth has continued to expand its range in Santa Fe.

Piñon Pine Tip Moth (*Dioryctria albovittella*) caused considerable tip dieback in natural stands and on ornamentals in Coconino County, Arizona. Low levels of damage continue in the Santa Fe area of New Mexico, the site of an outbreak in 1994.

Pitch Nodule Moth (*Petrova arizonensis*) is common on piñon in northern Taos County in New Mexico.

Prescott Scale (*Matsucoccus vexillorum*) continues to cause branch dieback in several areas in Arizona including Ponderosa Pine Park in Prescott and Clear Creek Pines in Coconino County.

Twig Beetles (*Pityophthorus* spp.) caused scattered branch mortality on private land in northern and eastern areas of Arizona. This insect commonly causes low level damage to all pine species and Douglas-fir throughout New Mexico. Outbreaks which occurred in 1996 at numerous locations throughout the Southwest appear to have been drought related.

Status of Diseases

Dwarf Mistletoes

Arceuthobium spp.

Hosts: most conifers, especially pines and Douglas-fir

Dwarf mistletoes are the most significant tree pathogens (disease-causing organisms) in coniferous forests of the Southwest. There are eight different species in the region, each with a different primary tree host. Three species—those affecting ponderosa pine, piñon 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 ponderosa pine acreage has some level of infection, with roughly four million acres affected. Although dwarf mistletoes are capable of causing direct mortality, the disease is slow moving and trees are often predisposed to, and killed by, secondary agents such as bark beetles and root diseases.

True Mistletoes

Phorodendron 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; cottonwoods, sycamores, and other hardwoods in lower riparian areas; and palo verdes and mesquite trees in desert shrublands. Although generally thought to be less damaging to their hosts than dwarf mistletoes, heavy infections do develop over time, weakening trees and eventually leading to death.

Root Diseases

Root diseases are associated with roughly one-third of the conifer mortality in the region each year. 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 areas. Root diseases are generally more common in mixed conifer and spruce-fir forests than in ponderosa pine forests. Like mistletoes, the incidence of most root diseases changes little from year to year.

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. 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). There are several different species of *Armillaria*, some more virulent than others.

Annosus Root Disease

Heterobasidion annosum

Hosts: true firs, ponderosa pine

Annosus root disease is the second most common root disease in the Southwest. There are two "groups" of annosus root disease referred to as the S-type and P-type. In Arizona, the S-type affects mostly true firs but can be found on other species in the mixed conifer and spruce-fir forests and the P-type infects ponderosa pine. Like *Armillaria*, annosus is a common decayer of dead woody material as well a pathogen.

Other Common Root Diseases

Other 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 Southwest. Stem decayed trees are a benefit to wildlife in providing habitat for such things as cavity nesting. However, stem decay fungi can degrade timber and make trees hazardous in developed sites. The most common 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

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 reason that aspens are a relatively short-lived tree.

Stem Rusts

White Pine Blister Rust

Cronartium ribicola

Host: Southwestern white pine

This non-native disease occurs throughout most of the range of its host in the Sacramento and adjoining White Mountains of southern New Mexico. It has also been found in the nearby Capitan Mountains, which are separated from the main outbreak area by about 20 miles of high desert. Altogether, roughly one-half million acres are affected. This area contains what is probably the largest population of southwestern white pine in the region. Over time, the disease will have a major impact in much of this area. In 1998, a single gooseberry bush believed to be infected with blister rust was found on Gallinas Peak, which is approximately 50 miles north of the Capitans. See "Activities" section for additional information.

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 at a few other locations. The disease is often quite noticeable, although damage is usually minimal. Occasionally, falling brooms and stem breakage present a hazard to humans.

Limb Rust

Cronartium arizonicum

Host: Ponderosa pine

This disease is fairly common in portions of northern 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 causes branch dieback and tree mortality to plantings of the 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.

Ponderosa Pine Needle Cast

Lophodermella cerina

Discoloration attributed to this disease was detected by aerial survey on 425 acres in 1998 compared to 2,575 acres in 1997. All 425 acres were in the canyon of the Santa Clara Pueblo Indian Reservation.

Over 5,660 acres of needle cast were detected on private lands in Colfax County, New Mexico, primarily on the Vermejo Ranch west of Raton and at Raton Pass west of I-25.

An unidentified needle cast was again detected in the Valle Grande (Jemez Mountains), affecting about 4,400 acres of ponderosa pine.

Piñon Pine Needle Cast

Species unknown

A total of 2,047 acres were detected on private lands in New Mexico in 1998, with the majority in Colfax County.

Abiotic Damage

Foliage discoloration due to drought damage was detected on a total of 2,782 acres in 1998, compared with 957 acres in 1997. Most damage occurred on the Coconino (2,595 acres) National Forest, with little damage occuring on the Kaibab (89 acres) and Tonto (56) National Forests, and private (42 acres) lands.

Foliage discoloration and dieback of pines due to winter injury was detected on 159 acres in 1998, on the San Carlos Indian Reservation.

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 for the Forest Service and other land management agencies. The following letters/reports document much of this work done in 1998:

Arizona Zone

1. Douglas-fir tussock moth monitoring in Arizona, 1997. 1/98.
2. Functional assistance to the Sedona Ranger District, Coconino National Forest. Diagnosis of cypress mortality on the Sedona Ranger District. 2/98.
3. Functional assistance concerning bark beetle risk in silvicultural certification stand. 1/98.
4. Douglas-fir tussock moth report from Southwestern Region. 2/98.
5. Geometrid defoliation on Mount Graham and Hawk Peaks. 5/98.
6. Functional assistance concerning spruce and fir defoliation on the Fort Apache Indian Reservation. 11/98.
7. Functional assistance concerning spruce and fir defoliation on Mt. Graham. 11/98.
8. Biological evaluation of hazard trees along the Agassiz Chairlift, Arizona Snowbowl, Peaks Ranger District. 12/98.
9. Monitoring aspen regeneration in northern Arizona. 12/98.
10. Insect and disease input to fire use planning analysis. 12/98.
11. Bark beetle mortality on the Pleasant Valley Ranger District. 12/98.

New Mexico Zone

1. Effects of prescribed fire on dwarf mistletoe infection, Alamitos Mesa, Espanola Ranger District, Santa Fe National Forest. 5/98.
2. Monitoring of recent thinning projects on the Sacramento Ranger District, Lincoln National Forest. 6/98.
3. Western tent caterpillar defoliation on Mt. Taylor, Mt. Taylor Ranger District, Cibola National Forest. 7/98.
4. Pest management input for ecosystem management areas on the Carson National Forest. 7/98.
5. Ips bark beetle outbreak, Corral thinning area, Espanola Ranger District, Santa Fe National Forest. 8/98.
6. Proposed FY 1999 Gavilon forest health project, Tres Piedras Ranger District, Carson National Forest. 8/98.
7. Evaluation of tree mortality in Santa Clara Canyon and fall webworm activity at Nambe Falls Recreation Area, Santa Clara and Nambe Pueblos. 9/98.
8. Proposed FY 1999 Chupadero and Rendija forest health projects, Espanola Ranger District, Santa Fe National Forest. 10/98.
9. Proposed FY 99 forest health projects, Mescalero Apache Indian Reservation. 10/98.
10. Five year results of dwarf mistletoe control pruning, Santa Clara Pueblo. 11/98.
11. Proposed FY 1999 Crooked Canyon forest health project, Sacramento Ranger District, Lincoln National Forest. 12/98.
12. Monitoring of the Whitetail A&B dwarf mistletoe control project, Mescalero Apache Indian Reservation. 12/98.

Publications

Tkacz, B. M., H. H. Burdsall, Jr., G. A. DeNitto, A. Eglitis, J. B. Hanson, J. T. Kliejunas, W. E. Wallner, J. G. O'Brian, E. L. Smith. 1998. Pest Risk Assessment of the Importation into the United States of Unprocessed Pine and Abies Logs from Mexico. USDA Forest Service. Forest Products Laboratory. General Technical Report FPL-GTR-104. 116p.

VanArsdel, E.P., Conklin, D.A., Popp, J.B., Geils, B.W. 1998. The distribution of white pine blister rust in the Sacramento Mountains of New Mexico. Proceedings First IUFRO Rusts of Forest Trees Working Party Conference, Aug. 2-7, 1998, Saariselka Finland. pp. 275-283.

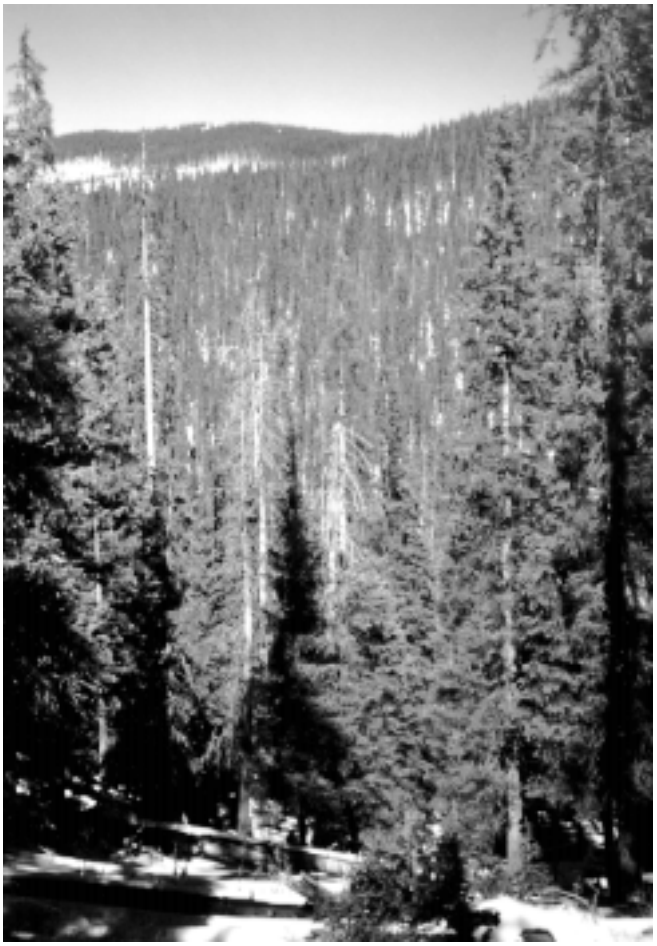
Wilson, J.L. and A.M. Lynch. 1998. Spruce Aphid in the Southwest. USDA Forest Service, Southwestern Region. 2pp.

Other Entomology and Pathology Activities in 1998

Impact Assessment of *Nepytia janetae* Defoliation on Spruce and Fir in Eastern Arizona

Nepytia janetae is a moth in the family Geometridae, loopers or inchworms. This insect was causing defoliation of Engelmann spruce and subalpine fir on the Mount Graham Red Squirrel Refugium in the Coronado National Forest in 1997 and 1998. Bark beetle activity is being detected in areas where heavy defoliation was recorded in 1997. While defoliation on Mt. Graham has declined somewhat in 1998, extensive areas of defoliation caused by this insect were detected in the White Mountains of Arizona on both Fort Apache Indian Reservation and the Apache-Sitgreaves National Forests. This little-known insect is thought to be native to Arizona and New Mexico. Impact plots will be established in 1999 on Mt. Graham and the Fort Apache Indian Reservation using evaluation monitoring funds from the Forest Health Monitoring Program. Data gathered will be used to assess the impact that this defoliator is having on the high elevation spruce and fir forests, to gain additional knowledge on the biology of this insect, and to provide information that will assist land managers in the prediction and/or prevention of future outbreaks. Contact Bobbe Fitzgibbon for more information.

An adult male Nepytia janetae *reared from a caterpillar collected at Fort Apache Indian Reservation on November 13, 1998. A number of larvae were collected and several were reared to adulthood. However, in the process of rearing adult moths for identification purposes, many parasitoids were also reared from infested caterpillars.*



One of several areas of Nepytia janetae *defoliation seen in the White Mountains of Arizona. This photo was taken during a November 13, 1998 field examination on the Fort Apache Indian Reservation near Paradise Creek. Caterpillars were found moving on the tree boles and actively feeding during this visit.*

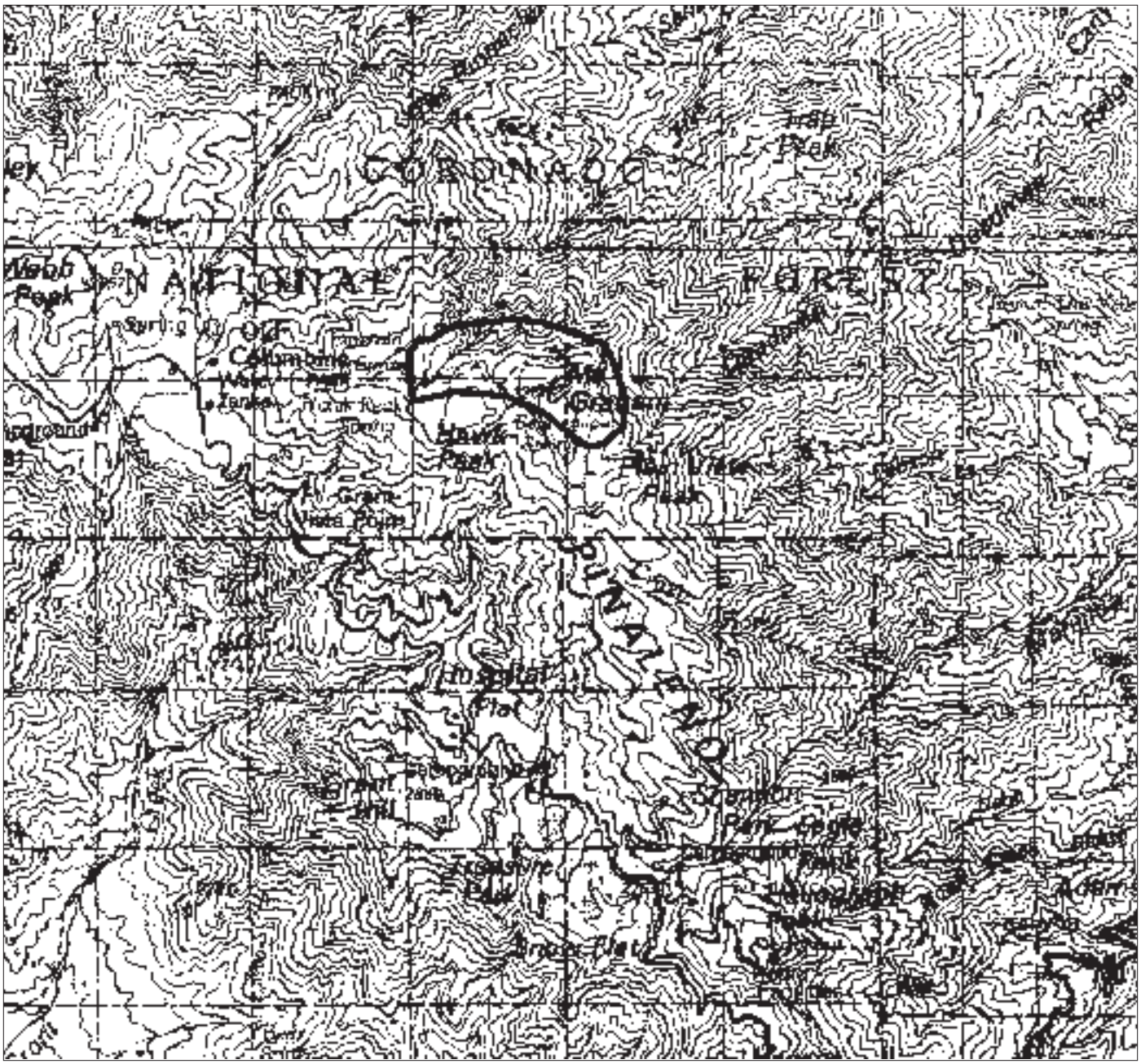


Figure 1. **Nepytia janetae** ***on Mt. Graham, 1997.***

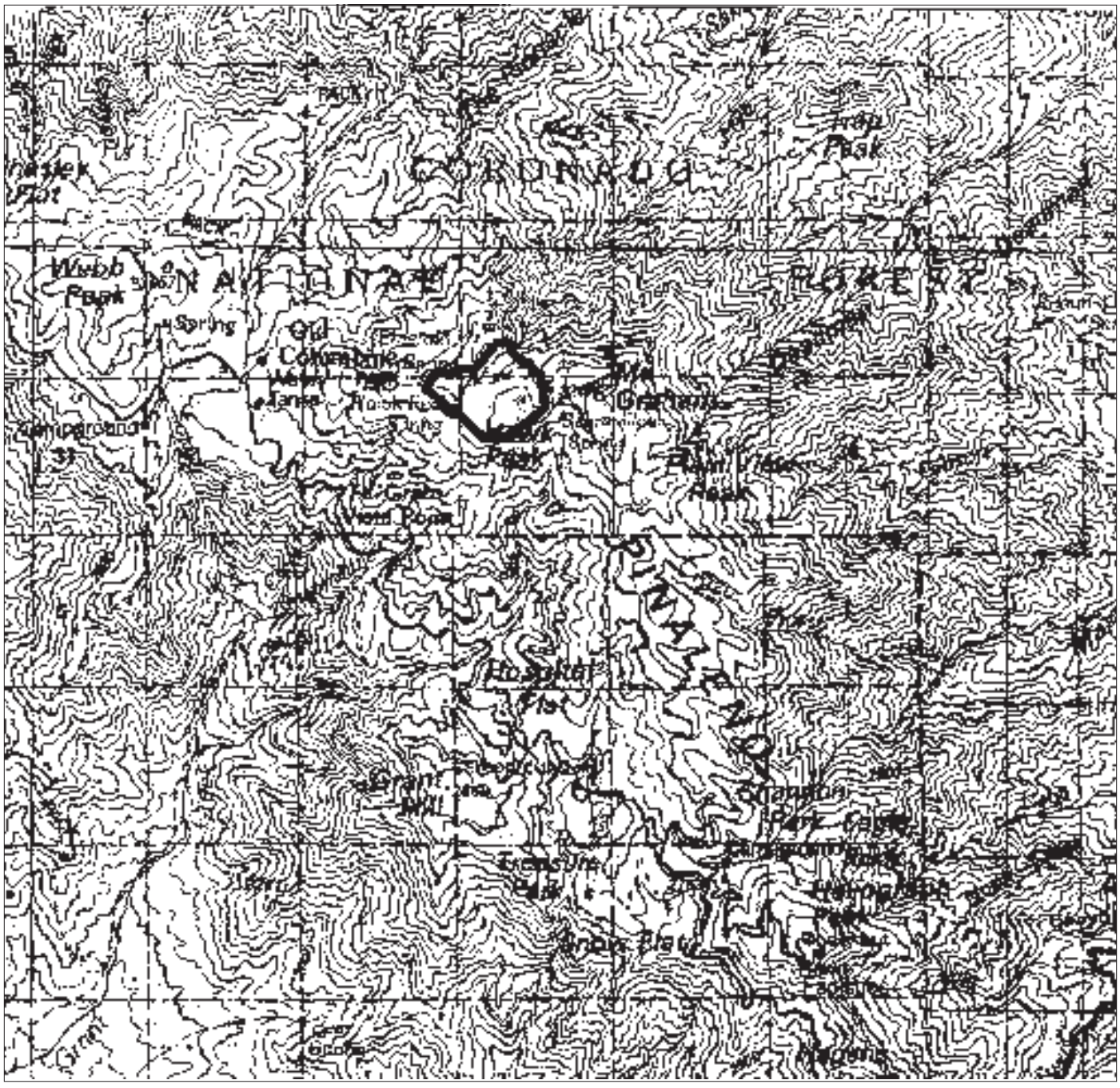


Figure 2. **Nepytia janetae** ***on Mt. Graham, 1998.***

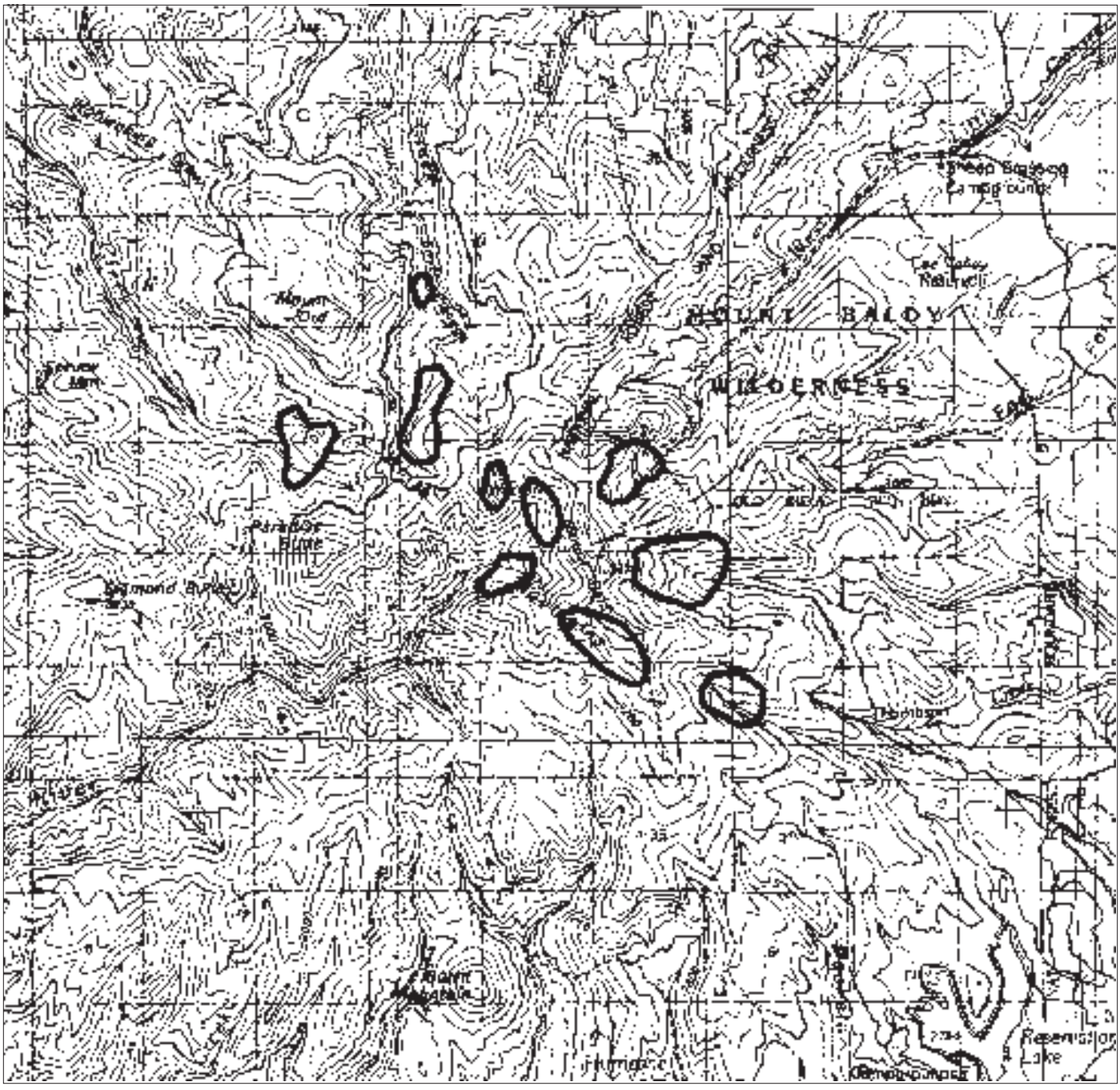


Figure 3. **Nepytia janetae** ***on Mt. Baldy, 1998.***

White Pine Blister Rust Studies

Hazard Rating System: Efforts to develop a blister rust hazard rating system for the Sacramento Mountains have been underway since 1997. Random sampling of white pines within six study areas (airsheds) is in progress. In 1998, 1,168 trees over 4.5 feet tall and 391 trees less than 4.5 feet were sampled on 96 plots. Rust was found on 32 percent of the taller trees and on 8 percent of the seedlings. Additional sampling will take place in 1999.

Preliminary analysis suggests that elevation, habitat type (series), and slope position are predictors of rust incidence and severity. Stands above 8,000 feet typically harbored more rust than lower elevation stands. On a given slope, rust incidence was generally highest near the bottom and lowest near the top. At similar elevations, white fir and blue spruce habitat types usually had more rust than Douglas-fir habitat types.

The incidence of blister rust on white pines was also closely related to the presence of *Ribes pinetorum*, the orange gooseberry. Other *Ribes* species that occur in the Sacramento Mountains do not appear to be important in the outbreak.

The hazard rating system should be useful for management of particular sites in the Sacramento Mountains, and should also help us predict where the disease could eventually become a problem in other parts of the region. The project is funded through the Forest Health Technology Development Program.

Monitoring Plots: Between 1991 and 1997, we established 12 monitoring plots to document rust incidence, and to track long-term increases and tree damage. These plots are located in easily accessible areas throughout the Sacramento and adjoining White Mountains, and include a wide range of site conditions and disease levels. Each plot includes 40-50 white pines of various sizes, from small saplings to mature trees. Observations are made on each plot every 3 years on a rotating basis, so every year 3 to 5 plots are remeasured.

Based on the latest observations, 35 percent of the sample trees are infected. Although these plots do not provide a statistical sample of the white pine population in the outbreak area, they are thought to be fairly representative of conditions, and should provide a general idea of the development of the outbreak over time at a low cost. Information from these plots was used to help develop an initial hazard model, which is being tested and refined in the technology development project described above.

For additional information on these studies, contact Dave Conklin, New Mexico Zone Office, or Brian Geils, Rocky Mountain Research Station.

Effects of Prescribed Fire on Dwarf Mistletoe Infection

We have been monitoring the effects of several prescribed fires (underburns) on ponderosa pine dwarf mistletoe infection levels on the Santa Fe National Forest. Our most recent effort involved a 200-acre fire in late October 1997 on the Espanola Ranger District. This fire burned hotter than anticipated, resulting in an average crown scorch of about 80 percent, and completely scorching 26 percent of our sample trees. Over 30 percent of the surviving infected trees appear to have been completely "sanitized" as a result of partial crown scorch. The combined effects of mortality (from complete crown scorch) and partial crown scorch appeared to have reduced the percentage of live trees infected on our plots from 64 percent to 31 percent. Despite the high levels of scorch, 71 percent of our sample trees were still alive 1 year after the fire.

A more detailed report describing the effects of this and other fires will be prepared in 1999. For additional information, contact Dave Conklin, New Mexico Zone Office.

Site and Stand Factors Associated with the Occurrence of Roundheaded Pine Beetle Outbreaks in Ponderosa Pine

In 1994, a cooperative project involving the Rocky Mountain Station (Jose Negron), Southwestern Region (AZ and NM Zones, and Lincoln and Coronado National Forests) was begun to quantify and model site and stand conditions conducive to infestations of roundheaded pine beetle in ponderosa pine in the Southwest. Results from the Sacramento Mountains, Lincoln National Forest were published in 1997 (Negron, J. 1997. Estimating probabilities of infestation and extent of damage by the roundheaded pine beetle in ponderosa pine in the Sacramento

Mountains. Can. J. For. Res. 27: p. 1936-1945.). Results for the Pinaleno Mountains on the Coronado National Forest have just been completed. As with the Sacramento model, this study indicates that susceptibility to roundheaded pine beetle infestations is increased by the availability of slow growing trees under high stocking levels. Probability of infestation models for the Pinaleno Mountains were based on periodic growth rate and ponderosa pine basal areas with reduced growth rates and higher stocking densities resulting in increased probabilities of infestation. Extent of mortality models (predicting the amount of mortality as opposed to the likelihood of infestation) picked out ponderosa pine basal area as the best predictor variable. This information will be used to build susceptibility and risk rating systems for this insect in southern Arizona and New Mexico. Managers would then be able to input specific growth, density, and species composition information from stand inventory information in order to predict likelihood of infestation and amounts of future mortality. Contact Jill Wilson at the Arizona Zone Office for more information on this study.

Piñon Ips Tree and Stand Conditions Project

A project to investigate relationships between tree and site conditions and piñon ips, *Ips confusus*, infestation characteristics was initiated in 1997 in a 12,800-acre outbreak area located southeast of Flagstaff. This project represents a cooperative effort between the Arizona Zone (Jill Wilson), and Rocky Mountain Station (Jose Negron). Preliminary results indicate that trees more likely to be attacked by piñon ips tend to be larger in diameter, and possess higher levels of dwarf mistletoe. Sites more likely to be attacked tend to be denser, have higher average dwarf mistletoe ratings, greater average diameters, and greater amounts of piñon. Overall mortality levels on the plots were very high, with 72 percent of piñons killed.

Mountain Pine Beetle Susceptibility/Risk Rating in Southwestern Ponderosa Pine

This multi-region project funded jointly through the Forest Health Technology Development Program and Rocky Mountain Research Station was initiated in 1995. Cooperators include Regions 2, 3 and 4 and the mountain pine beetle project, Rocky Mountain Station at Logan, Utah. The objective of the project is to determine significant factors affecting stand and landscape level susceptibility and risk to the mountain pine beetle, *Dendroctonus ponderosae*, in southwestern ponderosa pine. Factors being investigated include stand conditions, weather, and beetle population status. This information will be incorporated into a decision support system that will provide land managers with a landscape description of susceptibility and risk. For more information, contact Jill Wilson at the Arizona Zone.

Evaluation of Piñon Sawfly Populations in Northeast Arizona

Piñon sawfly, *Zadiprion rohweri*, has been causing significant defoliation of piñon pine in Canyon de Chelly National Monument and surrounding areas of the Navajo Indian Reservation from 1996 to the present time. Evaluation of the sawfly population and its impact is a cooperative effort between the Arizona Zone Office, Dr. Ann Lynch of the Rocky Mountain Research Station, and Dr. Michael Wagner of Northern Arizona University. During the 1997 and 1998 field seasons, piñon needle scale, *Matsucoccus acalyptus*, was found to be feeding along with piñon sawfly on the same or adjacent hosts, complicating impact assessment. Evaluation will continue in 1999. Data gathered will be used to try to predict future outbreaks and their impacts based on environmental conditions and population trends. Contact Bobbe Fitzgibbon at the Arizona Zone Office for more information.

Monitoring Aspen Regeneration

A study was established on the Peaks Ranger District, Coconino National Forest, in 1990 to monitor the causes of mortality in aspen regeneration. Many sites had been previously fenced to protect them from the impacts of ungulate browsing, but a few sites had mortality occurring of up to 4 acres. Permanent plots were established to determine the causes of mortality, and were monitored every 2 to 3 years. Mortality factors identified were rodents, topography, and root disease. By 1997, ungulates were impacting 6 of the 10 sites and the agents responsible for the original dieback became insignificant compared to the damage caused by ungulates.

Wood Import Pest Risk Assessment Team

The nationally chartered Wood Import Pest Risk Assessment and Mitigation Evaluation Team (WIPRAMET), led by Borys Tkacz, Arizona Zone Leader, is working on a pest risk assessment for the importation of *Eucalyptus* logs from South America to the United States. Delegations of WIPRAMET members and officials from the Animal and Plant Health Inspection Service (APHIS) traveled to Brazil, Chile, Argentina, and Uruguay during March and April 1998 to meet with local agricultural, quarantine, and forestry officials, entomologists, pathologists and forest industry representatives to gather information on the proposed importation and pests of *Eucalyptus* plantations. The teams also toured harvest areas, inspected processing plants and ports, and viewed pest problems in *Eucalyptus* plantations throughout the countries visited. A final PRA will be issued in 1999.

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 evaluation and management. In the Fall, we offer a workshop for resource managers and specialists covering insects and pathogens of most forest types in the region. We also offer informal training on request, particularly for field crews.