FOREST PEST CONDITIONS IN CALIFORNIA¾ 2003

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THE CALIFORNIA FOREST PEST COUNCIL

The California Forest Pest Council, a 501(3)c non-profit organization, was founded in 1951 as the California Forest Pest Control Action Council. Membership is open to public and private forest managers, foresters, silviculturists, entomologists, pathologists, biologists and others interested in the protection of forests from damage caused by biotic and abiotic agents. The Council's objective is to establish, maintain, and improve communication among individuals who are concerned with these issues. This objective is accomplished by five actions:

1. Coordinate the detection, reporting and compilation of pest damage, primarily forest insects, diseases and animal damage.

2. Evaluate pest conditions, primarily those of forest insects, diseases and animal damage.

3. Make recommendations on pest control to forest management, protection agencies and forest landowners.

4. Review policy, legal and research aspects of forest pest management and submit recommendations thereon to appropriate authorities.

5. Foster educational work on forest pests and forest health.

The California Board of Forestry recognizes the Council as an advisory body in forest health protection, maintenance, and enhancement issues. The Council is a participating member in the Western Forest Pest Committee of the Western Forestry and Conservation Association.

This report, *Forest Pest Conditions in California 2003*, is compiled for public and private forest land managers and other interested parties to keep them informed of conditions on forested land in California, and as a historical record of forest insect and disease trends and occurrences. The report is based largely on information provided by three sources: (1) information generated by Forest Health Protection, Pacific Southwest Region, USDA Forest Service, while making formal detection surveys and biological evaluations, (2) reports and surveys of conditions on private lands provided by personnel of the California Department of Forestry and Fire Protection, and (3) the statewide Cooperative Forest Insect and Disease Survey, in which federal, state, and private foresters and land managers participate.

This report was prepared by Forest Health Protection, USDA Forest Service, Pacific Southwest Region in cooperation with other member organizations of the Council, published by the California Department of Forestry and Fire Protection and distributed by the two agencies. The report is available in color at the following website: http://www.fs.fed.us/r5/spf/publications/fhp-doc.shtml.

Cover: Progression of pine mortality in the Twin Peaks area of Lake Arrowhead, California, June to September 2003.

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ABSTRACT

The important forest insect and disease conditions in California in 2003 are given. Included are bark beetles, defoliators, abiotic injury, dwarf mistletoes, declines; and root, foliage, rust and canker diseases. The section on surveys and evaluations includes summaries of the White Pine Blister Rust Screening Program, detecting vegetation changes in California using satellite imagery, a summary of aerial survey results in California, the cumulative survey of monitoring the abundance of the Douglas-fir tussock moth, and 24 years of tree mortality in eastside pine thinning plots.

Key words: California, forest diseases, forest insects, aerial surveys, tree mortality, change detection.

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INSECTS

Bark and Engraver Beetles

Outside of southern California, activity of bark beetles was variable, but reports generally indicated a slight upward trend throughout California in 2003 with the exception of Jeffrey pine beetle. Mountain and western pine beetle were widely reported, but activity by Jeffrey pine beetle was about at 2002 levels in northeastern California, but was generally down in the central and southern portions of the Sierra Nevada Range. The fir engraver caused increasing levels of white fir mortality throughout much of the state. Pine engravers were not widely reported, but activity was described as somewhat increased in the east-central and southern Sierra Nevada. The red turpentine beetle was present at rates that could be described as light to moderate.

The western pine beetle was the principle bark beetle in the intensive and extensive mortality of ponderosa and Coulter pines in southern California. Numerous pine engraver species, California flatheaded borer, mountain pine beetle, Jeffrey pine beetle and red turpentine beetle were also highly involved at various locations. The fir engraver was involved with the death of white fir, but the mortality of fir has not yet become as severe as the loss of pine.

Defoliators and Others

A wide variety of defoliators and miscellaneous insects was reported. The fall webworm was no long noticeable in the Klamath and Trinity River drainages. On the other hand, defoliation of madrone increased on the Foresthill and Georgetown Divides. The lodgepole needleminer outbreak in Yosemite National Park continued at moderate to high levels. The outbreak of pandora moth on the Inyo National Forest also continued and moderate to heavy defoliation is expected in the spring and early summer of 2004. Trap catches of the European gypsy moth remained low. However, the first capture of an Asian gypsy moth in California was recorded in Los Angeles in July 2003. Trap density was increased in a nine-mile area around the find.

Trap catches of male Douglas-fir tussock moths increased in many locations. Thirty-five percent of the plots averaged more than 25 months per trap compared with only 4% in 2002. A surge in moth activity seems indicated for 2004.

DISEASES

Abiotic

Drought, cold temperatures, fire, hail, heat, ozone and wind damage were reported in 2003. Mortality and dieback of young incense-cedar were noted at many locations in northern California. The damage is attributed to 2002 conditions – drought and a sudden cold snap in late October and early November. Drought continues to contribute to the susceptibility of pine forests in southern California to attack by the western pine and other bark beetles.

Biotic

Several canker conditions were reported in 2003. Cytospora canker of poplars and willows became more apparent. Diplodia blight is still apparent on ponderosa pine in various areas, including the upper Sacramento River Canyon and in and around the community of Paradise. *Dermea* and *Phomopsis* cankers were reported as occurring together. Several declines also were reported, and in most cases the causes were unknown.

Seven additional plant species were found to be susceptible to *Phytophthora ramorum* in California, bringing the total known susceptible species in California to 29. Additional species were also detected in Europe and Oregon; in all, 39 susceptible species have been identified. Newly recognized species include important horticultural plants and species common in the wildland and grown for Christmas trees.

Phytophthora nemorosa continued to be reported in 2003 and a third Phytophthora species has been isolated from laurel leaves and stem cankers on coast live oak – *Phytophthora pseudosyringae*. This species has been found in coastal counties from San Luis Obispo to Humboldt. Disease symptoms on California bay laurel and coast live oak are similar to those of *P. ramorum.* However, *P. pseudosyringae* does not appear to cause wide-spread mortality in oaks.

Powdery mildew is not commonly reported as a forest agent. However, both *Microsphaera alni* and *Sphaerotheca lanestris* were reported on oaks in 2003.

Reports of root disease were limited, but their abundance is not reflected in the number of reports. Port-Orford-cedar root disease continues to expand and cause tree mortality in the upper Sacramento River Canyon. No new infestations were reported. However, two eradication efforts were conducted in 2003.

SURVEYS

About 25.9 million acres of the 39.5 million acres of California forests and woodlands were aerially surveyed for tree mortality in 2003. Almost 2.5 million acres had mortality from insects and diseases above annual background amounts. In addition, about 19 million acres were aerially surveyed for Sudden Oak Death and about 8.5 million acres were aerially surveyed for pinyon pine mortality. The latter was part of a larger survey of pinyon mortality in the southwestern United States.

The final report for the North Coast Change Detection Project was published and is available over the internet. The Northern Sierra Project report and the South Coast Project report are expected in 2004.

There was a slight increase in tree mortality in the Demonstration Thinning Plots in the Eastside Pine Type on the Lassen National Forest. This is the twenty-fourth year of continuous measurement.

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FOREST INSECT CONDITIONS - 2003

BARK and ENGRAVER BEETLES, and BORERS

A SPRUCE ENGRAVER, *Ips tridens*

A windthrown Engelmann spruce was found heavily infested with engraver beetles in the Duck Lake Botanical Area in the Russian Wilderness on the Klamath National Forest (M261A). This Ips is seldom reported in California, probably because Engelmann spruce is found in only a few remote areas in the state.

CALIFORNIA FLATHEADED BORER, *Melanophila californica*

In southern California, California flatheaded borers were especially common in Jeffrey pines that were not attacked and killed by Jeffrey pine beetle. Such pines were found between Wrightwood and the Grassy Hollow Visitor Center at 6,800 to 6,900 ft elevation. Other areas with extensive mortality caused by the California flatheaded borer include Laguna Mountain, where the Jeffrey pines are infected with western dwarf mistletoe and have annosus root disease, and the San Jacinto and Santa Rosa Mountains. In the vicinity of Burro Flats (north of Barton Flats in the Santa Ana River drainage), examination of a recently killed mature Jeffrey pine revealed an active infestation of Jeffrey pine beetle larvae and recently dead, young California flathead larvae in small cambial patches at the end of the thread-like larval galleries. One hypothesis is that something associated with the bark beetle infestation–such as a yeast, fungus or other microbe introduced into the sapwood – was responsible for the flathead larval mortality. *Melanophila californica* also killed Jeffrey pines in Mil Potrero Park, Los Padres National Forest at 5,600 to 5,800 ft. Annosus root disease has previously been found in this area, and some of the affected Jeffrey pines appeared to be in root disease centers. Some of these trees were also heavily infected with dwarf mistletoe. California flathead borer was also involved in Jeffrey pine mortality at the Crystal Lake Recreation Area on the south face of the San Gabriel Mountains at 5,600 to 5,800 feet.

CEDAR BARK BEETLES, *Phloeosinus* sp.

Cedar bark beetles were found in small diameter (<4 inches dbh) incense-cedars in early summer causing branch dieback and tree mortality. Most observations were in the Moonlight Valley and Hamilton Mountain areas of the Eagle Lake Ranger District, Lassen National Forest (M261D). Cedar bark beetles were also observed in green slash this spring in the Headquarters area of Lassen Volcanic National Park (M261D).

DOUGLAS-FIR ENGRAVER, *Scolytus unispinosus*

This engraver commonly attacked and killed pole-size Douglas-firs or top-killed larger trees in Lake County and inland areas of Mendocino and Humboldt Counties. Attacks were mostly associated with trees having branch and stem cankers from *Dermea pseudotsugae* and/or *Phomopsis lokoyae*.

FIR ENGRAVER, *Scolytus ventralis*

Top-kill and whole-tree mortality of white fir were observed extensively throughout most of northeastern California. Several areas of red fir mortality were also detected. The amount of both red and white fir mortality increased from 2002 levels.

Elevated levels of white fir mortality were detected throughout the range of white fir on the Modoc National Forest with mortality being most common in areas of lower annual precipitation (M261G). Elevated white fir mortality was also detected across the Lassen National Forest. Areas of moderate to high mortality include Cone Lake to Lost Springs (off the northeast corner of Lassen Volcanic National Park) and between Philbrook Lake and Poison Springs (far south end of the Forest).

Scattered individual and small groups of white and red fir were killed by the fir engraver in Latour State Forest, Shasta County (M261D) in 2002. The amount dropped to an occasional tree killed in 2003. There was ample evidence that many trees had successfully pitched-out attacks this year. Most 2003 activity was in the pole-to-intermediate size classes. Fir engraver activity declined in the Shingletown area, Shasta County (M261D).

Elevated levels of red fir and white fir mortality were detected in several areas on the Tahoe National Forest (M261E). White fir mortality on the Truckee Ranger District was noted near Ladybug Peak (east of Stampede Reservoir) and near the Fir Crags Foot Bridge on the boundary with the Lake Tahoe Basin Management Unit. Areas of red fir mortality and top-kill were noted along Soda Springs Road (T16N, R14E, Sec 28) and along the Interstate 80 corridor between Donner Lake and Big Bend Campground on the Truckee Ranger District – also reported as Donner Summit east to the Sierra Front. White fir mortality on the Sierraville Ranger District increased substantially around Treasure Mountain and in red fir, mortality was detected on private land in Maiden Valley (T20N, R14E, S29). Areas of red fir mortality on the Downieville Ranger District include Craycroft Ridge, Gold Valley, and Saddleback Mountain.

Increasing true fir mortality and top-kill associated with the fir engraver were found in several locations in the southern part of ecoregion M261E. White fir top-kill and mortality continued to be scattered throughout the Tule River/Hot Springs and Greenhorn Districts and in the Piute Mountains, Greenhorn District, Sequoia National Forest.

Populations of the fir engraver were high in southern California. It was usually found in trees infected with true mistletoe, annosus root disease, and other insect species such as the roundheaded fir borer. Annosus root disease was found in white fir that had been attacked by the fir engraver in and around the ski areas on the north slope of Snow Summit in the San Bernardino Mountains. In other areas, mortality in white fir seemed more associated with severe sites, such as the high numbers of dead trees on the very steep south-facing slopes above the Arctic Circle, a portion of Hwy 18 just west of the Big Bear Dam. Despite these examples, white fir survived well in many areas, including the mixed conifer forests near Lake Arrowhead. Mortality was high in white fir in overstocked stands on Palomar Mountain and Hot Springs Mountain (both in San Diego County), presumably associated with the usual suite of pests that include the fir engraver.

FLATHEADED FIR BORER, *Melanophila drummondi*

The flatheaded fir borer and the Douglas-fir engraver caused mortality and top-killing of numerous Douglas-firs in the Trinity and Klamath River drainages. Mortality was most apparent from Big Flat to Willow Creek on the Trinity River and from Horse Creek to Weitchpec on the Klamath River (M261A). Most of the mortality was on shallow soils or talus slopes.

JEFFREY PINE BEETLE, *Dendroctonus jeffreyi*

Jeffrey pine beetle activity and related mortality continued near 2002 levels. Scattered large tree mortality could be found throughout northeastern California as well as a few groups of smaller diameter trees.

Jeffrey pine mortality was detected in a few areas on the Lassen National Forest (M216G). Mortality ranging from low to high was detected throughout the northeast portion of the Forest. Areas of note include east of Ashurst Lake, north of Mosquito Flat, west of Lava Peak and the area around Signal Mountain Reservoir.

Two areas of Jeffrey pine mortality on the Sierraville Ranger District, Tahoe National Forest include: 1) along Davies Creek (County Road 450) — about 4 miles east of the Upper Little Truckee Ski area off of State Hwy 89 between Sierraville and Truckee and 2) about 2 miles north of Calpine on the east side of State Hwy 89 (M261E). Jeffrey pine mortality was also detected in an area adjacent to the Calpine site, but on the Beckwourth Ranger District, Plumas National Forest, just west of McNair Meadow on the west side of State Hwy 89 (M261E).

Mortality associated with the Jeffrey pine beetle was generally down throughout the M261E region in 2003. Scattered mortality to older Jeffrey pine occurred in the vicinity of Clarks Fork east to Kennedy Meadows, Summit Ranger District, Stanislaus National Forest.

Populations of Jeffrey pine beetle were high in the San Bernardino Mountains. Of some interest was the presence of mature Jeffrey pines killed by Ips and/or California flatheaded borer in areas where Jeffrey pine beetle populations were high, suggesting that populations of this beetle were not adequate to respond to the available habitat.

Mortality in Jeffrey pine was associated with other agents in limited observations around Wrightwood in May. The nearest pine killed by the Jeffrey pine beetle was found at the Grassy Hollow Visitor Center (7,200 ft), approx 3.5 miles from Wrightwood (6,000 ft). Jeffrey pine beetles were also found killing Jeffrey pines in the Crystal Lake Recreation Area (5,700 ft).

MONTEREY PINE IPS, *Ips mexicanus*
About a dozen Bishop pines were killed on the bluffs north of the Navarro River in Mendocino County. This pine engraver was also found with red turpentine beetle attacking older knobcone pine near Mount Shasta Ski Park at McCloud.

MOUNTAIN PINE BEETLE, *Dendroctonus ponderosae*
Current as well as older lodgepole pine mortality was apparent near Martins Dairy on the Goosenest Ranger District in Siskiyou County (M261D) and an infestation of mountain pine beetle in whitebark pine continued on Goosenest Mountain (261D). Scattered groups of western white and sugar pines were killed by the mountain pine beetle in Latour State Forest, Shasta County (M261D). However, the amount was down from 2002. Most of the trees were in the pole and intermediate size classes.

Mountain pine beetle activity was elevated this year compared with several past years in northeastern California. Most mortality associated with mountain pine beetle attacks was found in sugar pine although high levels of lodgepole pine mortality were also detected in some areas. In many areas the attacked sugar pine trees are under additional stress due to white pine blister rust infection and moisture stress.

A few areas of high mortality in ponderosa pine were detected on the Modoc National Forest, mainly on the Warner Mountain Ranger District. Areas include along Highrack Creek just west of Eagleville, in Badger Canyon (T47N, R15E, Sec 4,5) and from the Buck Creek Forest Service Facility south to Blue Springs (M261G). Moderate levels of pine mortality were also detected throughout most of the Big

Valley Ranger District and within the north and southwest portions of the Devils Garden Ranger District (M261G).

Several areas of concentrated sugar pine mortality were detected on the Downieville Ranger District, Tahoe National Forest (M261E). Areas to note include Palmer Ridge (between America Hill and the Middle Yuba River); the area known as The Cups, just north of Loganville Campground along State Highway 49, east of Downieville; and between Red Oak Canyon and Craycroft Ridge (T21N, R11E, Sec 30). High levels of mortality occurred just southwest of Saddleback Mountain (T20N, R10E, Sec 5,6).

On the Nevada City Ranger District (M261E), Tahoe National Forest, two areas of low to moderate sugar pine mortality were detected between Monumental Ridge and Quartz Mountain (T16N, R12E, Sec 1,11,12,14). Low levels of sugar mortality were also noted in the Sugar Pine Point Research Natural Area. Further south on the Foresthill Ranger District, sugar pine mortality occurred around French Meadows Reservoir and along the Mumford Bar Trail between Foresthill Road and Mumford Bar (M261E).

There are several areas on the Tahoe National Forest where some level of lodgepole pine mortality is always detected. These are typically monoculture stands that are characterized by trees over 80 years of age and >8" dbh. Scattered individual lodgepole pine mortality was noted along the Little Truckee River between Sierraville and Truckee (M261E). Mortality of lodgepole pine was also detected along Interstate 80 between Donner Lake and Cisco Grove. Although abundant, most of this mortality occurs as individual trees as opposed to group kills. Many of the trees along this stretch of highway have very unhealthy looking crowns so additional mortality is expected in the future (M261E). One notable area of lodgepole pine mortality was also detected on the Lassen National Forest at the Crater Lake campground (M261D).

Mortality associated with the mountain pine beetle increased somewhat in areas of the central and southern M261E ecoregion. Increased mountain pine beetle mortality occurred in sugar pine in the following: Blue Canyon area, High Sierra District and on the South Fork Bluffs southeast of Bass Lake, Bass Lake District, Sierra National Forest; along the west shore of Lake Tahoe between Sugar Pine Point and Emerald Bay, Lake Tahoe Basin Management Unit; and scattered throughout the Greenhorn Mountains north to Ponderosa, Tule River and Hot Springs Districts, Sequoia National Forest. Mountain pine beetle activity in lodgepole pine occurred in various developed sites in the Rock Creek Drainage, White Mountain District, Inyo National Forest.

Populations were high in the San Bernardino and San Jacinto Mountains, where this species was observed attacking ponderosa, sugar, and even singleleaf pinyon pines. Fresh attacks were seen at the end of May at the Forest Service Ranger Station at Skyforest. In 2003 this insect was second only to the western pine beetle in the numbers of trees attacked and killed. The mountain pine beetle also killed sugar pine at the Crystal Lake Recreation Area in the San Gabriel Mountains.

Fire damage and mountain pine beetle

Mountain pine beetle attacks were commonly found in sugar pine located in recent wildfire areas. The 2001 Star Fire on Foresthill Ranger District, Tahoe National Forest (M261E), had a large number of dead and dying sugar pine from fire injuries and bark beetle attacks. Continued sugar pine mortality was also noted from an older fire area just west of Granite Mountain, Downieville Ranger District, Tahoe National Forest.

PINE ENGRAVER BEETLES, *Ips* spp.
Pine engraver mortality was nearly undetectable in northeastern California in 2003. One exception was in an area one to two miles east of Susanville where scattered top-kill in ponderosa and Jeffrey pine caused by *Ips pini* was evident at low levels. *I. pini* also was found infesting windthrown ponderosa and lodgepole pines on the Eagle Lake District, Lassen National Forest.

The California fivespined engraver, the pinyon ips, the pine engraver and other Ips species were epidemic in the San Bernardino Mountains and the Peninsular Ranges. Mortality in *P. californiarum* attacked by *I. confusus* exceeded 80% in some areas of the Santa Rosa Mountains. Mortality in singleleaf pinyon associated with the pinyon ips occurred in many parts of host's range along the north slopes of the Transverse Ranges. Near Lake Baldwin in the San Bernardino Mountains, black stain root disease was associated with dramatically higher mortality than that of 2002, which was considered normal. In other species of pine, pine engravers generally attacked smaller diameter trees, tops, and large branches. However, various pine engravers, often in conjunction with the California flatheaded borer, often attacked and killed mature Jeffrey pines. These Ips also were involved in high, drought-related mortality in various pine plantations in the San Gabriel Mountains, such as at Chilao. Monterey-knobcone hybrid pines were killed in Applewhite Campground, Lytle Creek, by the California fivespined engraver.

RED TURPENTINE BEETLE, *Dendroctonus valens*
The red turpentine beetle was reported from two areas in Siskiyou County. Mortality of pole-size ponderosa pine reoccurred in the Pondosa Burn plantation, but at a lower level than in the previous three years. Thinning operations, which contributed to the build-up of the beetle in fresh stumps, have nearly come to an end. Red turpentine beetle and the Monterey pine ips were found attacking older knobcone pine near the Mount Shasta Ski Park at McCloud (M261D).

Activity of red turpentine beetle was found in association with other bark beetles and/or with fire-injured trees throughout northeastern California. Areas with elevated rates of red turpentine beetle attack were in the Swain's Hole underburn and in the Cone Fire, Eagle Lake Ranger District, Lassen National Forest (M261D).

The red turpentine beetle, often in association with other bark beetle species, attacked Jeffrey and ponderosa pines on rocky, south-facing slopes along the I-80 corridor from Blue Canyon east to the Sierra Front (M261E).

Light to moderate levels of red turpentine beetle activity occurred in the southern part of M261E on trees injured to varying degrees by wildfire and prescribed burns. Low levels of red turpentine beetle activity also continued in the Diamond-O Campground, Groveland District, Stanislaus National. The red turpentine beetles were abundant in many parts of southern California, particularly where the trees were drought stressed. At the Bear Mountain Ski Area in Big Bear, property managers extricated the beetles manually in an attempt to protect old growth Jeffrey pines growing in a parking lot.

WESTERN PINE BEETLE, *Dendroctonus brevicomis*
Both as individual trees and small spots, ponderosa pine mortality caused by western pine beetle has increased in northwestern California. Although precipitation was favorable during the winter of 2002-2003, it was obvious that trees were still under drought stress. Some of the more conspicuous concentrations of mortality were on the McCloud Flats, Shasta-Trinity National Forest (M261D), and the north end of the middle Eel-Yolla Bolla Widlerness (M261A). Small mortality groups of ponderosa pine were also found upslope of Hwy 36 from Platina west to the Trinity National Forest boundary,

Shasta County (M261A). The mortality is occurring in a transitional zone between mixed conifer forest and areas of chaparral and gray pine.

An outbreak of western pine beetle in fire-damaged ponderosa pine was inspected in late fall of 2002 in the Doggett Creek area, Siskiyou County (M261A). Trees were damaged in July of 2000 during the Bark Fire. Trees under current western pine beetle attack had little or no crown damage from the fire, but did have moderate to severe cambial damage (25-30% girdling). Many of the cambial-damaged trees were killed by western pine beetle in 2002, but other trees had green crowns and were infested or were expected to be infested by western pine beetle in 2003. Tree mortality is ongoing. No beetle activity was found in adjacent, unburned areas.

Scattered individual ponderosa pines and small groups of trees were killed by the western pine beetle in the Shingletown area, Shasta County (M261D) and at various locations in Butte County (M261D,E,F). Mortality began in 2001 and apparently is drought-related. Although precipitation was above normal this past winter and spring, elevated beetle populations emerged in the spring and resulted in continued mortality. If precipitation remains above normal, beetle populations and tree mortality are expected to return to endemic levels.

Several areas of ponderosa pine mortality were recorded for the Lassen National Forest (M261D,E,G). Low levels of western pine beetle caused mortality were noted near the Swain's Hole Reservoir area and along the Hwy 44 corridor near Poison Lake. Areas of medium to high levels of mortality were noted just south of Pegleg Mountain, along Butt Creek (T27N, R6E, Sec 19,30), along Deer Creek on Hwy 32 between Potato Patch Campground and FS Rd 27N28, and south of Hole in the Ground Campground near Mill Creek. A few areas that encompassed high levels of mortality over 1,000 acres included the area south of Lassen Volcanic National Park between Feather River Meadows north to Blue Lake and west to Patricia Lake, near Huckleberry Mountain (just east of Latour State Forest), between Dudgen Butte and Dutch Flat (just north of the Hat Creek Work Center) and around Negro Camp Mountain on County Road 111 (north of Jelly Camp Campground).

Low levels of mortality caused by western pine beetle were detected in ponderosa pine on the Foresthill Ranger District, Tahoe National Forest (M261E). Mortality occurred in the recreational area east of Sugar Pine Reservoir between Shirttail Creek and Morning Star Campgrounds and a large area of low mortality was noted along Tadpole Creek (north of Skunk Springs off of Foresthill Road).

Western pine beetle activity continued in the southern Sierra Nevada (M261E) in 2003 with much of the activity occurring in scattered, small mortality groups. Continued activity was evident in the vicinity of Bass Lake, on the east side of Goat Mountain and in the Miami Creek Basin on the Bass Lake District, Sierra National Forest and on Breckenridge Mountain, Greenhorn District, Sequoia National Forest. Mortality caused by the western pine beetle also occurred in the Wawona area of Yosemite National Park.

Populations were at epidemic levels in the San Bernardino and San Jacinto Mountains, and in the mountains of San Diego County (Figs. 1, 2) The mortality acreage in the former two mountain ranges rose from about 6,000 acres in 2001 to nearly 500,000 acres in 2003. Mortality of pines in some areas, such as the mixed stands of black oak and Coulter and ponderosa pines adjacent to communities on the north shore of Lake Arrowhead, exceeded 90 percent. "Dry hits" – attacks where no resin is extruded – were observed in May in Skyforest, a symptom of how drought stressed the trees still were after a winter of average precipitation. The western pine beetle also decimated Coulter and ponderosa pines at Charlton Flat in the San Gabriel Mountains, where populations of western pine beetle and pine

Figure 1. Pine mortality at Lake Arrowhead, San Bernardino Mountains, Southern California.

Figure 2. Pine mortality on the San Bernardino National Forest adjacent to the Lake Arrowhead north shore community, May 2003.

engravers were so high in August that visitors had to brush frass off the picnic tables. The nearby War Memorial Plantation had been thinned a few years previously and mortality there was low. Western pine beetle also killed Coulter pines at Chilao (San Gabriel Mountains) and on Palomar Mountain, Hot Springs Mountain, and Laguna Mountain in San Diego County.

WESTERN OAK BARK BEETLE, *Pseudopityophthorus pubipennis*
Many tanoaks dying from Armillaria root disease were attacked by this beetle in scattered areas of Mendocino County. The root-diseased trees were often on downhill sides of rural roads where cast road berms covered the root zones.

WOOD BORERS, *Semanotus* sp.
Semanotus sp. continued attacking juniper along Hwy 395 south of Red Rock Road in 2003. Attacks resulted in mostly top kills or large branch kills (341D).

DEFOLIATORS

CALIFORNIA BUDWORM, *Choristoneura carnana californica*
Defoliation of Douglas-fir was extremely difficult to find on the east side of Trinity Lake (M261A), an area where populations have been highly variable over the past 20 years.

CALIFORNIA OAKWORM, *Phryganidia californica*
Individual coast live oak sustained defoliation in several areas of Monterey and Santa Cruz Counties. Defoliation was also observed in parts of San Luis Obispo County – Nipomo, Los Osos, Cambria (combined estimate of 500 coast live oaks) and around Lake Naciemento (about 500 coast live and blue oaks). Tanoak defoliation in Mendocino County was observed in several dozen trees in the Smithe Grove near Piercy and on about 6 acres near Comptche.

DOUGLAS-FIR TUSSOCK MOTH, *Orgyia pseudotsugata*
Average trap catches for 2003 showed increases in many plots compared to 2002 catches (see Surveys and Evaluations). Data were collected for 163 plots (5 traps/plot) during 2003. There were 106 (65%) plots with an average of <25 males per trap and 57 plots (35%) that averaged 25 or more moths per trap. In 2002, only 4 % of the plots averaged >25 males moths per trap. Plots that averaged >25 moths per

trap for 2003 were located on the following Ranger Districts: Amador, Placerville, and Pacific (Eldorado NF), Hat Creek (Lassen NF), Beckwourth and Mt. Hough (Plumas) Greenhorn and Tule River (Sequoia NF), Bass Lake (Sierra NF), Calaveras, Miwok and Summit (Stanislaus NF) and Downieville, Foresthill and Nevada City (Tahoe NF). In addition to these plots monitored on National Forest lands, there were three plots that exceeded 25 moths/trap on lands of other ownerships. One plot was located in Yosemite National Park, 1 on Bureau of Land Management land near Widow Mountain, west of Bieber in Lassen County, and 1 plot monitored by the California Department of Forestry near Hilton, Modoc County.

Catches of male moths increased for all plots on private land in Lassen, Modoc, and Shasta Counties. It was the third highest catch for this set of plots in the past 16 years. A plot in the CalPines subdivision, Modoc County (M261G) had an average catch of 31 moths per monitoring trap. Thus, monitoring on both private and public lands indicate a potential surge in activity by the Douglas-fir tussock moth in 2004.

FALL WEBWORM, *Hyphantria cunea*

Defoliation of madrones by the fall webworm was not noticeable in the Klamath and Trinity River drainages (M261A) in 2003. Most madrones have responded to the abundant precipitation from the previous winter and appear very healthy. However, there are madrones dying from a combination of insect and fungal leaf spot defoliation, a canker disease and the effects of recent drought.

Conversely, defoliation of madrone by the fall webworm was reported to have increased at various locations on the Foresthill Divide, Placer County (M261E). Defoliation was particularly noticeable in the vicinities of Michigan Bluff and Sugar Pine Reservoir. To the south across the Middle Fork of the American River, scattered light to moderate defoliation of madrone was present in localized areas along the Georgetown Divide in Eldorado County (M261E).

FRUITTREE LEAFROLLER, *Archyps argyrospila*

Defoliation by *Archyps argyrospila* continued for what may be an unprecedented fifth year in the San Bernardino Mountains. Defoliation was heavy in the same areas infested for the past four years (25,000 to 30,000 total acres).

GYPSY MOTH, *Lymantria dispar*

The California Department of Food and Agriculture (CDFA) trapped six male moths as of August 20, 2003 – by county: Los Angeles 2, Riverside1, San Bernardino 1, San Mateo 1, Santa Cruz 1. This is three more than captured in 2002.

The first capture of an Asian gypsy moth in California occurred in Los Angeles on July 9, 2003 at a site along South Avalon Boulevard. This area is considered a high risk area for introudction of Asian gypsy moth and the GM/Delta trap density in the area was at 10 traps per square mile. The CDFA has increased the trap density to 25 traps per square mile in a nine square mile area around the find (California Department of Food and Agriculture. 2003. Detection Advisory PD23-03, July 24, 1 p.)

LODGEPOLE PINE NEEDLEMINER, *Coleotechnites milleri*

The lodgepole needleminer outbreak in Yosemite National Park that started with the 1992-94 generation continued at moderate to high levels in 2003 (M261E). Aerial survey delimited 32,000 acres of defoliation. High levels of defoliation with a relatively low rate of tree mortality occurred throughout previously infested areas. The outbreak extended somewhat in the southern part of the infestation area southwest into the Sunrise and Echo Creek drainages of the upper Merced River watershed. Moderate

tree mortality continued in and around the Sunrise High Sierra Camp following continued heavy defoliation.

PANDORA MOTH, *Coloradia pandora*
The pandora moth outbreak, first detected in June 2002, continued on the Mammoth and Mono Lake Districts, Inyo National Forest (M261E). Adult flight and egg deposition were observed from late-June to mid-August. Early stage larvae and light feeding injury/defoliation on Jeffrey and lodgepole pines were observed over about 40,000 acres. Locations involved include the Crestview Roadside Rest area, an area west of Hwy 395 between the Mammoth Scenic Loop Road north to the Obsidian Dome and Hartley Springs area, south and east of Lookout Mountain, south and east of Dry Creek, and east of Hwy 395 from Wilson Butte around the Bald Mountain Road toward the Indiana Summit Research Natural Area. Moderate to heavy defoliation is expected in the spring and early summer of 2004. Pandora moth outbreaks usually last for three to four generations and pandora moth activity is anticipated at least through 2006-2007.

PINE SAWFLY, *Neodiprion fulviceps*
Defoliation was not readily apparent in a large area of ponderosa pine defoliated for the past several consecutive years near the Military Pass Road on the Shasta-Trinity National Forest (M261A).

Figure 3. *Neodiprion* sp. on knobcone pine at the edge of the Red Butte Wilderness,Klamath National Forest.

PINE SAWFLY, *Neodiprion* sp.
Stands of knobcone pine that ranged up to a section in size were defoliated in 2002 and 2003 by a sawfly in the upper drainage of Seiad Creek on the Klamath National Forest (M261A).

SAWFLY, species unknown
An unknown species of sawfly defoliated small patches of mountain alder in a few eastside riparian areas on the Eagle Lake District, Lassen National Forest.

WHITE FIR SAWFLY, *Neodiprion abietis*
White fir defoliation was not visible along the Pomeroy Road in the vicinity of Deer Mountain., Goosenest District, Klamath National Forest (M261D). The infestation that was present for several years appears to have collapsed.

OTHER INSECTS

AFRICANIZED HONEY BEE, *Apis mellifera scutellata*
The Africanized honey bee was found for the first time near Hanford and Corcoran, CA. The area now considered within the range of the bee is 62,220 square miles. Kings, Tulare and Inyo are now the northern most counties infested.

ALDER FLEA BEETLE, *Altica ambiens*
Several alders along Gold Run Creek and the East Fork of the Susan River were skeletonized by alder flea beetle larvae. Both areas are in the vicinity of Susanville.

CONEWORM, *Dioryctria* sp.
Tip dieback of lower branches was observed in white fir plantations in Placer County and in true fir Christmas tree plantations in El Dorado County. The white fir plantation had been a former Christmas tree plantation that had been abandoned. Coneworm damage was not observed in nearby true fir stands. Damage was minimal with only a loss of some branch growth.

COOLEY SPRUCE GALL APHID, *Adelges cooleyi*
Galls were visible on Brewers spruce near Paynes Lake and Little Duck Lake in the Russian Wilderness on the Klamath National Forest (M261A).

DOUGLAS-FIR TWIG WEEVIL, *Cylindrocopturus furnissi*
Scattered Douglas-fir twig mortality was noted on several pole-size trees near Garberville, Humboldt County.

Figure 4. Elm leaf beetle on elms at Fruit Growers Park, Susanville, CA.

ELM LEAF BEETLE, *Pyrrhalta luteola*
Larvae skeletonized the leaves on several elms in Susanville (Fig. 4). The leaves on several of the trees around town have dried, turned brown, and prematurely dropped.

GOUTY PITCH MIDGE, *Cecidomyia piniinopis*
The gouty pitch midge infested branch tips on many ponderosa pines in a plantation near the Shasta Forest subdivision northeast of McCloud (M261D).

HACKBERRY WOOLY ADELGID, *Shivaphis celti*
Normally found in the Central Valley, this pest was noted on common hackberry in Santa Rosa.

HONEY LOCUST POD GALL MIDGE, *Dasineura gleditchae*
Dieback of honey locust was noted in Sonoma County.

LEAF BEETLES, *Chrysomela* sp.
Hybrid poplars in a dry landscape setting within the Susanville Indian Rancheria sustained foliage damage in early summer from an unknown species of leaf beetle (*Chrysomela* sp.)

Figure 5. Maple leaf scorch in the Feather River Canyon, 2003.

MAPLE LEAFHOPPER SCORCH, unknown leafhopper(s)
Studies have shown a high correlation between leafhopper populations and scorch symptoms (Fig. 5), and these symptoms were present in many river and creek drainages in Shasta, Siskiyou, and Trinity Counties (M261A). The area from Dinsmores to Carlotta on the Van Duzen River and from Rio Dell to Leggett on the Eel River also had conspicuous symptoms (M261B). In the northern Sierra Nevada (M261E), Indian Creek, Meadow Valley, the Feather

River Canyon in Plumas County, and the North Yuba River in Sierra County had high levels of maple leaf scorch again this year. Leaf scorch was also detected in the Deer Creek area along Hwy 32.

Several years of leaf scorch appear to be contributing to branch kill and maple mortality in some areas of northern California. However, this "scorch" looks different on these bigleaf maples; there is a black zone line that outlines the shape of the leaf about 0.25 inch in from the leaf edge. These trees have the same symptoms year after year, and the cause probably is an agent other than leafhoppers.

NEEDLEMINERS, *Coleotechnites* sp.
Low numbers of pine needles with evidence of needle miner infestation were found on recently dead *P. californiarum* along the Cactus Spring Trail between Horsethief Canyon and Cactus Springs in the Santa Rosa Mountains. In 1974, a *Coleotechnites* sp. was reported mining pinyon needles on Santa Rosa Mountain.

PINE NEEDLE SCALE, *Chionaspis pinifoliae*
A minor infestation was noted on a redwood in Redwood Valley in Mendocino County.

PIÑON NEEDLE SCALE, *Matsucoccus acalyptus*
The outbreak of the piñon needle scale in the Cuddy and Lockwood Valleys on the Los Padres National Forest continued in the same areas reported in 2002. Pinyons were examined at Ozena Fire Station, where the needle scale was found in a past outbreak, but no scales were found on the trees examined. If the scale is present there numbers are very low. During the last week in May, 2003, large numbers of predatory coccinelids were observed flying through the area of the outbreak. They appeared to be feeding on the scales, though direct capture and consumption of prey was not observed.

PITCH NODULE MOTH, *Petrova* sp.
A pitch nodule moth, possibly *Petrova monophylliana*, was found in singleleaf pinyons near Onyx Peak in the San Bernardino Mountains.

RED GUM LERP PSYLLID, *Glycaspis brimblecombei*
Declining red gums were found along the Hwy 101 corridor from Ventura County north through San Luis Obispo County, and widespread mortality was observed in areas of Sonoma County.

SPIDER MITE, *Oligonychus subnudus*
In 2002 feeding by this spider mite caused injury to 2-0 ponderosa pine seedlings at the Forest Service Placerville Nursery. The feeding injury caused extensive foliage discoloration in a substantial number of seedlings. Some of these seedlings were planted on the Modoc and Mendocino National Forests in the spring of 2003. A sample of these were marked and measured in September. These will be examined over the next several years for survival and growth.

SEQUOIA PITCH MOTH, *Vespamima sequoiae*
Pitch moths are becoming an increasing problem on planted Monterey pine in the Sacramento Valley. The landscape trees are mostly older and lacking vigor. Pitch moths were also observed in permanent plots for monitoring pitch canker in coastal counties.

SPRUCE APHID, *Elatobium abietinum*
Sitka spruce continues to show thinned crowns from repeated feeding by this aphid in north coastal Humboldt County.

WESTERN PINESHOOT BORER, *Eucosma sonomana*

The western pineshoot borer continues to damage plantation ponderosa pine near Pondosa, Siskiyou and Shasta Counties (M261D) and north of Lookout, Modoc County (M261G). Damage in the form of stunted terminals varies widely across plantations, but exceeds 50% in some areas. Shoot damage is also beginning to appear in plantation ponderosa pine at the southern edge of the Fountain Fire in the upper reaches of Montgomery Creek, Shasta County.

WOOLLY OAK APHID, *Stegophylla quercicola*

An outbreak of woolly oak aphid occurred on a California black oak in August in the community of Running Springs, San Bernardino Mountains. A pest control operator had sprayed the foliage of the tree during the summer to protect it from the fruittree leafroller. The aphids were living in galls and freely on the leaf, and were confined to the sprayed tree, suggesting that the pesticide application had caused the outbreak. Other trees in the neighborhood – which had presumably not been treated – had neither the aphids nor fruittree leafrollers. This example illustrates the benefit of monitoring for the presence of a pest prior to treating for it, and of using more specific pesticides, such as those containing *Bacillus thuringiensis*.

Figure 6. Black oak leaf with woolly oak aphid.

FOREST DISEASE CONDITIONS - 2003

ABIOTIC DAMAGE

Drought

Understory and suppressed incense-cedar faded in many locations during the spring of 2003 in northern California. Specific locations include the Van Duzen River drainage (M261B), the Trinity and Klamath River drainages (M261A), along Hwy 3 near Trinity Center (M261A), and on McCloud Flats (M261D). There were minor amounts of the cedar bark beetle, and the cedar roundheaded borer present, but many trees had no sign of a biotic pest. The trees were very dry and appeared desiccated.

Drought appears to have contributed to the dieback and decline of a number of black oak on a residential property along the McCloud Arm of Lake Shasta, Shasta County (M261A). The site has a southwest exposure and thin soil.

Precipitation in drought-stricken portions of southern California (the San Bernardino Mountains, the Peninsular Ranges, and, at a less severe level, the San Gabriel Mountains and more western portions of the Transverse Ranges) was near average for the 2002-2003 rainfall year. However, extreme mortality continued in the forests of San Bernardino, Riverside, and San Diego Counties. Mortality increased in the San Gabriel Mountains, particularly in overstocked plantations, in stands of Coulter and ponderosa pines (hosts of the western pine beetle), and in the Crystal Lake Recreation Area. In some areas impacted by overstocking, drought, and bark beetles, mortality exceeded 80%. This was particularly true in stands of Coulter and ponderosa pines infested with western pine beetle. In 2003 pine and fir mortality increased dramatically on the north facing slopes south of Lake Arrowhead, in the vicinity of the Rim of the World, and in the forest surrounding Big Bear Lake. There was extreme mortality in portions of the ranges of both species of single-leaf pinyon, *Pinus monophylla* and *P. californiarum*. *P. monophylla* suffered high mortality in the eastern end of the San Bernardino Mountains and the north slope (high desert area) of the San Gabriel Mountains. In the Santa Rosa Mountains, *P. californiarum* stands in the higher altitudinal portions (at least) had 90% mortality. The latter species occurs primarily in southern California, and may have died out in most of its range this year. Drought-associated dieback occurred in other vegetation as well, including chaparral species, incense-cedar, and white fir. Where in 2001 mortality was driven by the extreme drought, in 2003 the outbreak populations of some bark beetle species drove the mortality in their hosts. Dead trees were felled within communities, along highways, around communications sites, and in strategically located stands upwind from communities, with the intent reducing fuels, and providing for safe evacuation in case of fire. The public and various government agencies are extremely concerned about potential loss of property and life should a wildfire occur under the present conditions of excessive fuel loading. Despite these efforts, anthropomorphic fires burned more than 750,000 acres in chaparral and montane forests in southern California in October and November 2003, destroying 3,640 homes.

Mortality in big-cone Douglas-fir was high in many areas of its range in southern California, especially on Yucaipa Ridge in the San Bernardino National Forest. Mortality agents in addition to drought have not been assessed.

Drought and Frost

Incense-cedar throughout northeastern California have exhibited a range of symptoms such as top-kill, branch dieback and whole-tree mortality over the past two years. These symptoms increased significantly this spring, creating great concern among many rural residents. The biggest factor in the

observed dieback is drought. As of last fall, northern California had experienced close to three years of below normal precipitation, including an extremely dry year in 2001. A second factor that may have contributed to the observed incense-cedar dieback is frost injury. On October 31 and November 1, 2002, a sudden cold snap resulted in some record low temperatures throughout northern California. In autumn, many trees are still growing and are therefore susceptible to tissue damage when there is a sudden occurrence of below-freezing temperatures. Cedars suffering from water stress during this time may be even more susceptible, particularly small cedars. Bronzed foliage suggested that many incense-cedars incurred winter damage during this cold spell and the extent of the damage was not revealed until the spring when warmer temperatures dried the needles (Fig. 5a,b,c). These symptoms were reported from many ecological subsections in Northern California, including, but not limited to: M261E – e.g. Foresthill Divide (Placer County) and in the vicinities of Concow (Butte County), Meadow Valley, Cromberg, and Graeagle (Plumas County); M261D – e.g. Burney Basin (Shasta County); M261A – e.g. Weed (Siskiyou County) and Round Mountain (Shasta County); M261B – e.g. Zenia (Trinity County). Incense-cedars in various stages of dieback in the Foresthill area in Placer County have been tagged to monitor their progress in light of the injury.

(a) **(b)** **(c)**

Figure 7. Incense-cedar branch dieback (a), top-kill (b) and whole-tree mortality (c).

Similar injury was noted in western juniper in northeastern California, particularly on the Modoc National Forest (M261G), the Modoc Plateau in general, and on the Eagle Lake Ranger District, Lassen National Forest. Some of the highest levels of mortality were noted along Hwy 139 north of Canby in the vicinity of the State Quarantine Station.

The Goosenest Ranger District, Klamath National Forest, also reported scattered dieback of western juniper due to drought and the freezing temperatures mentioned above. Similar damage in western juniper was reported in scattered areas as far north as Madras, Oregon — 200 miles from the California border.

Fire

Fire-injured trees continued to die within the boundaries of recent prescribed or wildfire areas. Mortality occurred in all species that sustained excessive injuries to cambium and/or crowns. Areas

with elevated mortality levels associated with fire injury are the Star Fire, Tahoe National Forest (M261E), the Storrie and Cone Fires, Lassen National Forest (M261D), and underburned areas near Poison Lake, Eagle Lake Ranger District, Lassen National Forest (M261D).

Many small diameter blue oaks that received cambial damage in the Jones Valley Fire, Shasta County (M261A) in October 1999 have died in the past couple of years. Recently dead and dying trees are generally <10 inches dbh, appear to have been suppressed and slow growing, and have large basal scars that are typically centered on the south side of the tree. The dead cambium on these trees was not obvious until bark began sloughing in the past couple years. Larger diameter trees exhibit less impact from the fire.

Trees damaged by fire during the fire siege in southern California in October 2003 remain to be evaluated. Most of the fires were in the chaparral vegetation type and only 5-10% of the burn was in timber on the San Bernardino National Forest. Most of the beetle-killed trees on the forest remain unburned.

Hail
Whitebark pine and foxtail pine were partially defoliated by summer hail storms near the summit of Mt. Eddy near Mt. Shasta City (M261A).

Heat
Apparent heat damage occurred on scattered sapling and pole-sized Douglas-fir south of McCloud. Cool, wet weather in May was followed by an abrupt rise in temperature in late May and early June.

Ozone
The ozone survey of the Forest Health Monitoring Program occurs annually between mid-July and mid-August. Results of this survey will be reported about every 4 to 5 years by the Forest Inventory and Analysis group at the Pacific Northwest Station, USDA-Forest Service, Portland.

Wind
Winter windstorms caused breakage of many species of trees in northern California. There was breakage of blue oak limbs around the northern end of the Sacramento Valley (M261C). Many trails in the Trinity Alps, Russian and Marble Mountain Wilderness areas were blocked by windthrow of both living and dead conifers (M261A). Research plots on the Goosenest Adaptive Management Area of the Klamath National Forest had extensive blowdown of both white fir and ponderosa pine (M261D).

Several conifer stands on the Lassen National Forest, particularly on the Almanor and Eagle Lake Ranger Districts, had substantial amounts of blowdown during the 2002-2003 winter (Fig. 8 a, b). The cause was attributed to heavy snow loads and a big wind event in December.

Miscellaneous
Various problems of blue and interior live oaks were investigated in the Redding area, Shasta County (M261C). Summer irrigation of blue oak is a common factor in the decline and death of this tree. Sunscald is a common problem among interior live oak on sites that are being developed. Damage results when stem shading is lost due to the removal of adjacent trees and/or pruning of branches.

Figure 8. (a) Piles of boring dust from *Ips pini* on lodgepole pine blow down. (Eagle Lake District, Lassen National Forest),

(b) Lodgepole and ponderosa pine blowdown. (Eagle Lake District, Lassen National Forest)

BIOTIC DAMAGE

CANKER DISEASES

BLACK KNOT OF CHERRY, caused by *Apiosporina morbosa*
Black knot galls are reducing the numbers of living choke cherry at Grizzly Station and along Indian Dick Road near Little Baldy, Covelo Ranger District, Mendocino National Forest (M261B). The disease is present, but is causing less damage nearby along the Grizzly, Anthony and Summit Roads.

BOTRYOSPHAERIA CANKER, caused by *Botryosphaeria dothidea*
Many planted redwoods, most on drier sites, had increased incidence of this canker in 2003. Sonoma County had many redwoods with branch flagging and top-kill. In Mendocino County near Ukiah, branch flagging was noted on both redwood and giant sequoia, and top-kill was noted on giant sequoia (all ornamental plantings). A planting of young giant sequoia at Turtle Bay in Redding also has Botryosphaeria canker. Raywood ash in both the Central Valley and Bay Area had increased incidence also.

CHINKAPIN CANKER, cause unknown
Chinkapins in Calaveras Big Tree State Park are dying from an unknown cankering pathogen. Cankers form on the branches and eventually girdle the stems, killing large numbers in sizeable groups. The affected areas have spread throughout the year. So far no fungus or other potential cause has been isolated from the affected plants.

Figure 9. Willow dieback attributed to *Cytospora chrysosperma*

CYTOSPORA CANKER OF POPLARS AND WILLOWS, caused by *Cytospora chrysosperma*
First detected in both poplar and willow species at lower elevations on the eastside of the Sierra Nevada and southern Cascades in 2002, dieback became more apparent in 2003 with many of willows losing all of the upper branches. Some areas have reported up to 75% mortality within clumps of willows (Fig. 9).

CYTOSPORA CANKER OF TRUE FIR, caused by *Cytospora abietis*
In northern California, many branches were killed on the red fir along Hwy 89 in Lassen Volcanic National Park, Shasta County (M261D), while at Latour State Forest, Shasta County, branch dieback due to Cytospora canker is widespread among red fir. Flagged branches typically are infected by dwarf mistletoe and affected stands tend to have higher levels of mortality caused by the fir engraver.

Branch flagging in mixed true fir stands was reported from several locations in the central Sierra Nevada. Flagging was restricted to red fir that was moderately to severely infected with dwarf mistletoe. This pattern is consistent with branch mortality caused by the canker fungus *Cytospora abietis*, which infects branches at the site of dwarf mistletoe swellings. All sizes of trees were affected, and in some cases more that 50% of the existing crown was recently killed. A few trees up to 20" dbh were completely dead. In general, white fir was not infected with dwarf mistletoe or Cytospora canker.

General locations with branch flagging on red fir included: 1) Hwy 88 corridor (Amador County), from Peddler Hill Maintenance Station to Foster Meadow Road, Silver Lake, and Lake Kirkwood; 2) Hwy 4 corridor (Calaveras and Alpine Counties), Poison Spring, Bear Valley, and Lake Alpine (at Bear Valley true fir mortality not related to Cytospora canker/dwarf mistletoe was present); 3) Hwy 108 corridor (Tuolumne County), Crabtree Trailhead and along Road 4N26 from Hwy 108 to Aspen Meadow.

DERMEA CANKER, caused by *Dermea pseudotsugae* and PHOMOPSIS CANKER, caused by *Phomopsis lokoyae*
Many pole-size and larger Douglas-fir in the interior, dry portions of Mendocino, Humboldt and Lake Counties had branch and stem cankers caused by Dermea pseudotsugae. In addition to Dermea canker, Douglas-firs of all sizes had stem and branch cankers attributed to *Phomopsis lokoyae*. Many of the trees were also attacked and killed or top-killed by the Douglas-fir engraver. Cankers also were found on the main stem of a small number of declining young Douglas-fir in a plantation near Lake Prairie in the upper Redwood Creek drainage, Humboldt County (263A). The pathogens *Dermea pseudotsugae* and/or *Phomopsis lokoyae* were likely causes for these cankers. Drought in previous years is a likely contributing factor.

DIPLODIA BLIGHT OF PINES, caused by *Sphaeropsis sapinea* (*Diplodia pinea*)
Sphaeropsis sapinea continues to kill ponderosa pine branches along the North Yuba River in the Goodyears Bar and Downieville area of Sierra County (M261E). Some of the heavily infected pines have died since this disease was reported in the summer of 2000. The disease is still prevalent in and around Paradise, Butte County (M261D). Paradise is one of the areas where the current outbreak of Diplodia blight first appeared in 1996.

Shoot dieback caused by *Sphaeropsis sapinea* was observed again this year on scattered ponderosa pines in the Sacramento River Canyon in Shasta County. Most affected trees are in the lower, southern end of the canyon. Low levels of disease were also observed in ponderosa pine south of McCloud, Siskiyou County (M261D), in an area where the disease has persisted for several years.

PITCH CANKER, caused by *Fusarium circinatum*
Pitch canker is now confirmed to occur in Ventura County, making a total 19 infested counties, all of which are within the declared Zone of Infestation (ZOI) that extends from San Diego County to

Mendocino County. Within the ZOI, new and expanding infection centers have been observed in many areas, including east bay communities such as Berkeley and Oakland, and in San Mateo County along Hwy 280. There is also increasing activity near the margins of known infestations, such as in Moraga, east of the Oakland Hills. In all these areas the disease can be seen in various stages of development, with some trees exhibiting only limited tip dieback and others having extensive damage to the canopy and, in some cases, top-kill. Many recent infections are evident in Marin County, along Hwy 1 near Muir Beach. In Monterey County, pitch canker continues to intensify in some areas, but has moderated in others. Monitoring plots in the Huckleberry Hill area of Pebble Beach indicate the severity of pitch canker has not increased significantly over the past year. Likewise in Santa Cruz County and many parts of San Luis Obispo County, the impact of pitch canker is now less evident. This reflects the removal of heavily diseased or killed trees and the recovery of others. Monterey pine remains the most commonly infected species, but both bishop and knobcone pines are affected on the Monterey Peninsula and in the Santa Cruz Mountains, respectively.

Pitch canker, mostly on Monterey pine, increased in the South San Francisco, Colma and Daly City areas. Symptoms are now commonly seen in Monterey pine in San Francisco. In Marin County, Monterey pines are dying on the campus of the Golden Gate Theological Seminary and an increasing number of symptoms occur near Stinson Beach.

An ongoing research project is monitoring the spore population levels of the fungus over time at the Swanton Pacific Ranch in Santa Cruz County and at the Presidio in San Francisco. Permanent plots in the area between Monterey and Santa Cruz also show the continuing loss of trees that have been infected for many years. However, some of the trees are showing potential signs of resistance to the disease after initial branch infections.

SEIRIDIUM CANKER, caused by *Seiridium cardinale*
Seiridium canker was found throughout a stand of incense-cedar in Nevada County near the town of Nevada City. Only younger trees were affected. Some seedlings were killed while saplings only lost some lower branches. Large trees were not affected. The concern was the potential loss of regeneration of the species in the stand.

DECLINES

ASPEN DECLINE, cause unknown
Aspen decline, first noted in 2002 at several locations in and around the Mono Lake and Mammoth Districts, Inyo National Forest, generally remained static in 2003. Aspen affected include stands west of Conway Summit, southwest of McLaughlin Spring, Kelty Canyon and south and west of Sawmill Meadow.

CHAPARRAL DECLINE, cause unknown
Surveys of chapparal dieback have not revealed any associated pathogens and drought continues to be considered the activator. Early winter precipitation in 2003-04 water year is well below normal in southern California and the influence of drought continues.

INCENSE-CEDAR DECLINE, cause unknown
Incense cedar decline and mortality has been reported from northwest of Covelo (Mendocino County), near Kettenpom (Humboldt County) and northern Del Norte County. Many of the affected cedars are in the younger age groups. One theory attributes a severe cold snap in early November 2002 (see Drought,

p.13). Affected trees probably had prior moisture stress. No pathogens were isolated from affected saplings submitted from Covelo and Kettenpom.

MADRONE DECLINE, cause unknown
Scores of madrones in the Brooktrails Township near Willits are off-color and the foliage droops from branches as if affected by a wilt. No pathogens have been recovered, and no specific environmental condition is attributed. Increased exposure from home site development and removal of the forest litter from around these trees may be contributing factors.

PINE DECLINE, cause uncertain
Pine decline continues to occur in Lassen County (M261D) north and south of State Highway 44. Dominant ponderosa, Jeffrey and lodgepole pines in the area have been progressively losing foliage over the last decade and a number of these old growth trees have died. It is suspected that overstocked young conifers surrounding these trees are out-competing the dominant pine trees for the limited available moisture. Drought is also a factor.

SUDDEN OAK DEATH, caused by *Phytophthora ramorum*
***P. ramorum* - general**
Seven new susceptible plant species were identifed in California in 2003, bringing the total of known susceptible species in California to 29. Additional species were also detected in Europe and Oregon; in all, 39 susceptible species have been identified (Tables 1a,b). Newly recognized species include important horticultural plants (*Camellia* and *Pieris*) and species common in the wildland and grown for Christmas trees.

P. ramorum was isolated from grand fir Christmas trees on a plantation in Santa Clara County. The symptoms were limited to branch tip dieback, similar to *P. ramorum* symptoms on Douglas-fir. The infected Christmas trees are growing under *P. ramorum*-infected California bay laurels. The grower reported seeing similar symptoms in this plantation for approximately 10 years. No grand fir trees from the portion of the plantation with symptoms were sold in 2002.

Reports continue to come in on possible sudden oak sites in the Sierras and Central Valley. Numerous black oaks, tanoaks, laurels, madrones and other species have been examined and sampled. Results have been negative. Thus far no incidence of *P. ramorum* has been confirmed outside of the affected coastal counties. Most symptoms have been related to several years of drought, development in previously forested areas, and other pathogens and insects.

***P. ramorum* - nurseries**
P. ramorum was detected in seven California nurseries in Stanislaus, Marin, Santa Cruz, Sacramento, Alameda and Placer Counties. *P. ramorum* was also recovered in nurseries in British Columbia, Washington, Oregon and Europe.

In May, two composite samples of *Camellia sasanqua* cult. “Bonanza” from a wholesale nursery located in Stanislaus County tested positive for *P. ramorum*. The nursery is approximately 10 miles east of Modesto and 100 miles from the coast. The *P. ramorum* detection on 1-gallon and 5-galleon varieties of *Camellia sasanqua* was the result of a trace-back survey initiated by the detection of *P. ramorum* at a Santa Cruz County nursery in April. The origin of the pathogen at the Stanislaus nursery has not been determined.

In Marin County, *Camellia japonica* and *Viburnum tinus* were detected positive in April in a nursery in Fairfax, the first U.S. report of *P. ramorum* confirmed on these species. The portion of the holding area where the symptomatic material was detected is adjacent to a stand of California laurels infected with *P. ramorum*.

In Santa Cruz County in April, a 5-gallon "Bonanza" at a nursery in Soquel tested positive of *P. ramorum*. The symptomatic plant material was detected by county inspectors during the nursery's annual inspection. A subsequent investigation revealed that the infected camellia was shipped from a nursery in Stanislaus County, three days prior to their annual inspection. The Santa Cruz nursery is a wholesale nursery with sales inside the regulated area. Host material at the nursery had been inspected extensively in 2002 with no detections of *P. ramorum*.

The nursery interceptions in Placer, Alameda and Sacramento Counties were stock traced from nurseries in coastal counties. All known *P. ramorum*-infected plants were destroyed.

Monitoring.

P. ramorum has been found approximately 10 miles north of the San Luis Obispo County line near Plaskett Creek, extending the most southern known infested area about 15 miles. Julia Pfeiffer Burns State Park previously contained the most southern infestation. About a dozen dead and dying tanoaks (Fig. 10) were detected via aerial survey, then ground-checked and confirmed by the Rizzo laboratory at UC-Davis. On the ground adjacent, infected California bay laurels were also observed, sampled and also tested positive. The aerial survey is part of the on-going aerial survey conducted by Forest Service and Cal Poly-San Luis Obispo. Investigations by the Rizzo (UC-Davis) and Garbelotto (UC-Berkeley) labs and surveys by the USDA Forest Service did not detect *P. ramorum* in the foothills of the Sierra Nevada.

Figure 10. Tan oak mortality on the Big Sur Coast of California.

Management.

The systemic fungicide AGRI-FOS® and Pentra-Bark surfactant were approved by the California Department of Pesticide Regulation to treat individual oaks and tanoaks at high-risk of contracting *P. ramorum*. Agrichem's AGRI-FOS® (EPA Reg. No. 71962-1) and Pentra-Bark were granted a Special Local Needs (Section 24c registration, SLN CA-030011). This newly approved treatment will prevent infection of oaks and tanoaks at risk of

contracting *P. ramorum*, but will not cure trees already infected by the pathogen.

Sudden Oak Death collection yards under the SOD Busters Program opened in Marin and Santa Cruz Counties. The yards accept *P. ramorum*-infested plant debris and treat and utilize it. The project's objectives are to evaluate the utilization potential of host tree species, identify best and most appropriate uses, and develop protocols for handling materials infested with *P. ramorum*. For more information on the program, visit the SOD Busters website at: http://groups.ucanr.org/sodbusters/.

Regulations.
The California Department of Food and Agriculture revised its enforcement guideline policy for *P. ramorum*. The revisions, which apply only to intrastate movement of host material, harmonize California's enforcement guideline policy with the requirements of the federal *P. ramorum* regulation and the anticipated amendments to the forthcoming revised federal regulation.

Under the revised enforcement guidelines, green waste, compost, wreaths, garland, greenery, wood products and Christmas trees are no longer regulated for movement within the 12 known infested counties (regulated area). However, host plant shipments from wholesale nurseries, both within and beyond the regulated area, will continue to be inspected.

Intrastate movement of green waste originating within the regulated area to an area outside the 12 infested counties will be permitted under compliance agreement with the originating local county agricultural commissioner. Movement will be from an origin facility to a specified facility under state permit outside the regulated area. For additional specifics, visit the Internet site http://www.suddenoakdeath.org.

Phytophthora nemorosa.
Phytophthora nemarosa (formerly referred to as *Phytophthora* ilicis-like) caused leaf spots in California bay laurel along the Avenue of the Giants between Pepperwood and Redcrest in Mendocino County and behind the Hiouchi Hamlet campground in Hiouchi, Del Norte County (263A).

A roadside survey by the California Department of Forestry in the Brooktrails Township northwest of Willits, Mendocino County detected 60 tanoaks with bleeding stem cankers. One of the sites has been sampled several times and was negative for *P. ramorum*. To date, only *P. nemorosa* has been isolated from the area. Of the cankered trees, 23 were dead (red), 16 were thinning or declining and 21 were still green.

***Phytophthora pseudosyringae*.**
Along with *P. ramorum* and *P. nemorosa*, a third *Phytophthora* species has been repeatedly isolated from trees showing similar symptoms — leaf necrosis on California bay laurel and stem cankers on coastal live oak. Colony and microscopic morphological characters of the California isolates were consistent with *P. pseudosyringae*, a recently described species recovered from rhizosphere soil of oak species and necrotic fine roots and stem necrosis on European beech and European alder in Germany and France (Jung et al. Mycological Res. 107:772-789, 2003).

P. pseudosyringae has been found in coastal California counties from San Luis Obispo to Humboldt. It has also been isolated from one location in Mariposa County in the Sierra Nevada. Disease symptoms on California bay laurel and coastal live oak are similar to *P. ramorum*, although *P. pseudosyringae* does not appear to cause wide-spread mortality in oaks. This is the first report of *P. pseudosyringae* in

North America. The relationship between European and California isolates is not clear at this time. It is unknown whether *P. pseudosyringae* is native to California or an introduction.

Phytophthora cinnamomi.
This pathogen has been found in various locations around the state. *P. cinnamomi* is a serious problem to true fir Christmas tree production in El Dorado County. It has caused the death of various oak species in the central valley that have experienced sporadic flooding or irrigation (Glenn, Tehama, Sacramento, Yolo Counties). The pathogen is also a problem in irrigated landscape trees and has caused death and decline of sycamores, oaks and camphor trees in Sacramento, Yolo, and San Joaquin Counties.

Tables 1a, b. California Plant Species Known To Be Susceptible (a) to *Phytophthora ramorum* and Associated Plant Species (b)*

a. Recognized hosts.

Scientific Name	**Common Name**
Acer macrophyllum	Big leaf maple
Aesculus californica	California buckeye
Aesculus hippocastanum +	Horse chestnut
Arbutus menziesii	Madrone
Arctostaphylos manzanita	Manzanita
Camellia japonica #	Camellia
Fagus sylvatica +	European beech
Heteromeles arbutifolia	Camellia
Lithocarpus densiflora	Tanoak
Lonicera hispidula	California Honeysuckle
Pieris formosa #	Andromeda
Pseudotsuga menziesii v. *menziesii*	Douglas-fir
Quercus agrifolia	Coast live oak
Quercus chrysolepis	Canyon live oak
Quercus kelloggii	California black oak
Quercus parvula v. *shrevei*	Shreve oak
Rhamnus californica	California coffeeberry

b. Associated Plant Species

Scientific Name	Common Name
Abies grandis #	Grand fir
Arbutus unedo #	Strawberry tree
Camellia sasanqua #	Camellia
Corylus cornuta	California hazelnut
Hamamelis virginiana +	Witch-hazel
Kalmia latifolia +	Mountain laurel
Pieris formosa x japonica #	Forest Flame Andromeda
Pieris floribunda x japonica #	Brouwer's Beauty Andromeda
Pieris japonica #	Variegated and Flaming Silver Andromeda
Pittosporum undulatum #	Victorian box
Rhamnus purshiana	Cascara
Rubus spectabilis	Salmonberry
Syringa sp. +	Lilac
Taxus baccata +	European Yew
Toxicodendron diversiloba	Poison oak
Vaccinium vitis-idaea	Lingonberry
Viburnum plicatum tomentosum #	Mariesii - Doublefile Viburnum

* The species recognized as hosts have had the pathogen isolated from plants growing under natural conditions and have been confirmed using Koch's postulates. For the plants classified as associated plants, the pathogen has been isolated under natural conditions, but Koch's postulates have not been completed. Artificially inoculated species are not included in either category.
# Reported in 2003; + Reported in 2003, only in Europe.

DWARF MISTLETOES

GRAY PINE DWARF MISTLETOE, *Arceuthobium occidentale*.
Heavily infested gray pines have been killed in Madera and Fresno Counties and around Lake Berryessa in Napa County. Dry conditions, poor sites and old age are contributing factors to the mortality of large trees.

LIMBER PINE DWARF MISTLETOE, *Arceuthobium cyanocarpum*.
Limber pine dwarf mistletoe was found infecting western white pine and whitebark pine between the Deadfall Lakes and Mount Eddy on the Mount Shasta Ranger District, Shasta-Trinity National Forest (M261 A).

MOUNTAIN HEMLOCK DWARF MISTLETOE, *Arceuthobium tsugense subsp. mertensianae*.
Abundant mountain hemlock dwarf mistletoe was observed on mountain hemlock growing near Shadow Lake on the east slope of Lassen Peak in Lassen Volcanic National Park (M261D).

FOLIAGE DISEASES

POWDERY MILDEW ON OAKS, caused by *Microsphaera alni* and *Sphaerotheca lanestris*.
A report of whitish discoloration of oak foliage in the Placerville area was submitted in the spring of 2003. The discoloration turned out to be powdery mildew and was observed from the southern edge of Placerville for over 6 miles south along Hwy 49. Another area of infestation was seen along Hwy 193 north of Placerville and a few miles past the South Fork of the American River. Both of these areas are within El Dorado County. The primary host affected was blue oak and the mildew was confined to 2003 tissue. Two species of powdery mildew affect blue oaks in California, *Microsphaera alni* and *Sphaerotheca lanestris*. The morphology of mildew found in the Placerville area corresponds to *M. alni*. All powdery mildews are obligate parasites and do not kill their host. Their spores are unique among pathogenic fungi in that most do not require free moisture or high humidity for germination and infection.

Powdery mildew caused by *Sphaerotheca lanestris* was prevalent on coast live oak in southern California coastal counties, with many reports from Ventura County and in Los Osos (about 500 trees), San Luis Obispo County.

ROOT DISEASES

ANNOSUS ROOT DISEASE, caused by *Heterobasidion annosum*.
Annosus root disease was involved in blowdown of commercial white fir stands during winter storms on the Goosenest District, Klamath National Forest (M261D) and near the headwaters of Red Cap Creek on the Six Rivers National Forest (M261A). It was associated with white fir windthrow in Crags and Lost Creek Campgrounds in Lassen Volcanic National Park in the winter of 2002 /2003 and was present in many areas in both campgrounds. Annosus root disease is also responsible for thin crowns and reduced height growth in a stand of white fir west of Goose Lake in the vicinity of Black Reservoir, Modoc County (M261G).

The pathogen continues to cause scattered pockets of mortality in ponderosa pine in several locations on McCloud Flats on the Shasta-Trinity National Forest (M261D). Mortality is particularly heavy on Forest Service land adjacent to the Shasta Forest subdivision, 6 miles northeast of McCloud. Several living ponderosa pines that were uprooted by winter storms on McCloud Flats were found to have *H. annosum* decay. Annosus root disease was also confirmed in a stand of white fir south of McCloud (M261D).

The pathogen caused the death of trees in stump culture Christmas tree plantations in Santa Cruz County near the town of Bonny Doone, and was present in dead sugar pine saplings killed on private property near Deer Valley Campground, Mendocino National Forest.

ARMILLARIA ROOT DISEASE, caused by *Armillaria* sp.
Numerous tanoaks were killed by *Armillaria mellea* in Sonoma, Mendocino and Humboldt Counties. Mortality commonly occurred down slope of rural roads where berm or fill was placed over much of the root systems, or within clumps of tanoak where previously a single stem was killed by *P. ramorum* or

another pathogen. *Armillaria mellea* was also associated with white fir windthrow in Crags and Lost Creek Campgrounds in Lassen Volcanic National Park in the winter of 2002 /2003 and was present in many areas in both campgrounds.

In a more urban area, significant damage due to "shoestring root rot" was found in Sacramento County in valley oaks along the American River Parkway.

BLACK STAIN ROOT DISEASE, caused by *Leptographium wageneri*.
This pathogen continues to kill ponderosa pine in a large area two miles east of Willow Creek Campground in Modoc National Forest, Lassen County (M261D). The disease was first reported in the area in the early 1940s and various cultural treatments have been completed in the last two decades in an attempt to limit the mortality caused by this disease. Currently, a study is being prepared to evaluate the effect stand density has on black stain root disease and the ponderosa pine in this area.

Approximately 130 Douglas-fir, ponderosa pine, white fir and sugar pine were windthrown in Tannery Campground and Fawn Group Camp in the Trinity National Recreation Area, Shasta-Trinity National Forest (M261A). Most of the blowdown occurred in Douglas-fir that was infected with black stain root disease. Black stain root disease also is causing continued scattered pockets of mortality in ponderosa pine in the Mudflow Research Natural Area northeast of McCloud and pockets of black stain root disease are present in mature ponderosa pine stands south of McCloud between Huckleberry and Mud Creeks, Siskiyou County (M261D).

PORT-ORFORD-CEDAR ROOT DISEASE, caused by *Phytophthora lateralis*.
Individual trees have been observed dying throughout the north half of Del Norte County. Most have been detected from Hiouchi eastward and up to the South Fork of the Smith River.

Port-Orford-cedar root disease continues to expand and cause tree mortality in the upper Sacramento River Canyon, Siskiyou and Shasta Counties (M261A). This condition is expected to continue for years to come along the mainstem of the Sacramento River, where the disease is well established from Dunsmuir to the mouth of Shotgun Creek. Management efforts are aimed at preventing new infestations elsewhere in the Sacramento and Trinity River drainages. When two additional infected Port-Orford-cedars were found within 50 feet of an isolated infestation found in 2001 along Scott Camp Creek, all Port-Orford-cedars were girdled or removed in September 2003. A second eradication treatment was performed in the Riverside Campground at Castle Crags State Park in September 2003 in which all Port-Orford-cedar within reach of the Sacramento River were girdled or removed.

RUST DISEASES

INCENSE-CEDAR RUST, caused by *Gymnosporangium libocedri*.
Incense-cedar rust was reported from the Scott Valley, Siskiyou County (M261A).

WHITE PINE BLISTER RUST, caused by *Cronartium ribicola*.
White pine blister rust appears to be increasing in severity in the Lake Tahoe Basin. Larger trees are showing infection of upper branches more frequently than in the past. Little regeneration is surviving due to the pathogen and the overstocked conditions of the Basin.

WESTERN GALL RUST, caused by *Peridermium harknessii*.
Western gall rust has been intensifying in ponderosa pine plantations north of Camptonville in Sierra and Yuba Counties (M261E). The disease is endemic in the old pine growing in the surrounding mixed

conifer stands. Growing almost a monoculture of ponderosa pine has favored the development of this disease.

Western gall rust was seen as severe in isolated locations in Santa Cruz, Yolo, Placer and Nevada Counties. Smaller individual trees have died; however, most severely infected trees are just showing a lack of vigor.

WILLOW-CONIFER RUST, a species complex referred to as *Melampsora epitea*.
A group of willow rust species was found on several willows in drainages in the Susanville area.

MISCELLANEOUS

BIG LEAF MAPLE ANTHRACNOSE, caused by *Discula* sp.
Several large maples were affected west of Willits in Mendocino County.

NEEDLE CAST ON MONTEREY PINE, caused by *Lophodermium* sp.
Dozens of planted Monterey pines along Hwy 101 in the vicinity of Piercy (Mendocino County) were severely affected. Many of the trees had less than 10% green crowns remaining, usually the tops only.

OAK ANTHRACNOSE, caused by *Apiognomonia quercina*.
Black oaks and Oregon white oaks were severely affected several miles west of Brooktrails in Mendocino County.

OAK LEAF BLISTER, caused by *Taphrina caerulescens*.
Severe infections were observed on Oregon white oaks in central Mendocino County. Many of the trees also had oak anthracnose.

REDWOOD DECLINE, cause unknown.
A suspected viral infection has caused branches on a few planted coastal redwood in Tulare County to turn bright yellow in color. Other than some landowner concern, the symptoms do not appear to be causing any serious damage.

SYCAMORE ANTHRACNOSE, caused by *Apiognomonia veneta*.
Effects were serious on California sycamore in many northern California locations.

ANIMAL DAMAGE

Black bear, *Ursus americanus*
Branch flagging, top-kill and tree mortality from black bear damage is by far the most visible damage to second-growth conifers in Humboldt and Del Norte Counties. Redwood is the most affected, but Douglas-fir has sustained major damage also. Significant areas of damage include Smith River, Cal-Barrel (AhPah and Surpur Creeks), and the lower Bald Hills area of Tectah, Johnson and Roach Creeks.

Douglas squirrels, *Tamiasciurus douglasii*
A few lodgepole pines were stripped of their bark throughout their upper boles by Douglas squirrels within and adjacent to the Crater Lake Campground, Lassen National Forest. Patches of stripped bark varied in size and were located mostly in the upper boles and branches. Squirrels also are suspected of

causing damage on mid-size giant sequoias and coastal redwoods planted in the Placer, Amador and El Dorado County foothills. Strips of bark are removed for nesting material.

Elk, *Cervus elaphus*

Observations are that elk populations may have increased along the north coast, but damage remains light to seedlings growing along trails. Most damage was noted in the Smith River and Bald Hills areas.

SURVEYS AND EVALUATIONS – 2003

THE 2003 DOUGLAS-FIR TUSSOCK MOTH PHEROMONE DETECTION COOPERATIVE SURVEY

Within Table 2 are the results of the 2003 cooperative Douglas-fir tussock moth (DFTM) pheromone detection survey. Average trap catches for 2003 increased in many plots compared to 2002 catches. Data collected for 163 plots (5 traps/plot) during 2003 revealed 106 (65%) plots with an average of <25 males per trap and 57 plots (35%) that averaged 25 or more moths per trap. In 2002, only 4 % of the plots averaged >25 males moths per trap. Plots that averaged >25 moths per trap for 2003 were located on the following Ranger Districts: Amador, Placerville, and Pacific (Eldorado NF), Hat Creek (Lassen NF), Beckwourth and Mt. Hough (Plumas NF), Greenhorn and Tule River (Sequoia NF), Bass Lake (Sierra NF), Calaveras, Miwok and Summit (Stanislaus NF), and Downieville, Foresthill and Nevada City (Tahoe NF). In addition to these plots monitored on National Forest lands, there were three plots that exceeded 25 moths/trap on lands of other ownership. One plot was located in Yosemite National Park, 1 on BLM land near Widow Mountain, west of Bieber in Lassen County, and 1 plot monitored by CDF near Hilton, Modoc County.

Increases and declines in trap counts are very common with DFTM populations. Based on the results of the 2003 monitoring, there may be some increases in activity by DFTM during 2004. During the field season of this year federal and state Forest Health Protection staff will monitor other life stages in the areas where DFTM activity exceeded an average of 25 males/trap. Field going personnel are urged to continue to check for evidence of feeding and defoliation on white fir throughout the susceptible host type this summer and fall.

TABLE 2. Number of Douglas-fir Tussock Moth Pheromone Detection Survey Plots by Trap Catch, 1979 to 2003.

Year	Total No. of plots	**NUMBER OF PLOTS WITH AN AVERAGE MOTH CATCH PER TRAP OF**:													
		0<10	**10<20**	**20<25**	**25<30**	**30<35**	**35<40**	**40<45**	**45<50**	**50<55**	**55<60**	**60<65**	**65<70**	**70<75**	**75+**
1979	102	97	2	1	1	0	1	0	0	0	0	0	0	0	0
	100%	95%	2%	1%	1%		1%								
1980	99	99	0	0	0	0	0	0	0	0	0	0	0	0	0
	100%	100%													
1981	93	78	10	4	1	0	0	0	0	0	0	0	0	0	0
	100%	84%	10%	4%	2%										
1982	95	93	1	0	1	0	0	0	0	0	0	0	0	0	0
	100%	98%	1%		1%										
1983	98	87	6	1	1	3	0	0	0	0	0	0	0	0	0
	100%	89%	6%	1%	1%	3%									
1984	111	51	18	11	5	7	8	4	3	4	0	0	0	0	0
	100%	46%	16%	10%	4%	6%	7%	4%	3%	4%					
1985	105	58	14	4	7	6	5	1	2	4	1	2	0	1	0
	100%	55%	13%	4%	6%	6%	5%	1%	2%	4%	1%	2%		1%	
1986	107	64	16	4	8	6	1	3	0	1	0	1	1	1	1
	100%	60%	15%	3%	7%	6%	1%	3%		1%		1%	1%	1%	1%
1987	108	80	15	4	2	1	1	3	0	1	0	0	1	0	0
	100%	74%	14%	4%	2%	1%	1%	2%		1%			1%		
1988	124	106	9	3	3	0	2	1	0	0	0	0	0	0	0
	100%	86%	7%	2%	2%		2%	1%							
1989	130	129	1	0	0	0	0	0	0	0	0	0	0	0	0
	100%	99%	1%												

1990	138	135	1	0	1	1	0	0	0	0	0	0	0	0	0
	100%	97%	1%		1%	1%									
1991	143	135	4	1	0	0	2	1	0	0	0	0	0	0	0
	100%	94%	3%	1%			1%	1%							
1992	164	156	3	0	2	1	0	0	0	0	1	0	1	0	0
	100%	95%	1%		1%	1%					1%		1%		
1993	143	135	8	0	0	0	0	0	0	0	0	0	0	0	0
	100%	94%	6%												
1994	151	139	11	1	0	0	0	0	0	0	0	0	0	0	0
	100%	92%	7%	1%											
1995	158	77	35	13	16	7	7	3	0	0	0	0	0	0	0
	100%	49%	22%	8%	10%	4.5%	4.5%	2%							
1996	149	33	26	16	8	7	12	9	5	8	6	8	5	1	5
	100%	22%	17%	11%	6%	4%	8%	6%	3%	6%	4%	6%	3%	1%	3%
1997	142	88	27	10	9	4	3			1					
	100%	62%	19%	7%	6%	3%	2%			<1%					
1998	159	81	22	11	9	6	3	10	7	5	2	1	1	1	0
	100%	51%	14%	7%	6%	3%	2%	6%	4%	3%	1%	<1%	<1%	<1%	-
1999	159	126	20	5	3	2	2	0	0	0	1	0	0	0	0
	100%	79%	13%	3%	2%	1%	1%	-	-	-	1%	-	-	-	-
2000	185	154	15	4	4	0	1	2	2	2	0	0	1	0	0
	100%	83%	8%	2%	2%		<1%	2%	1%	1%			<1%		
2001	183	95	57	13	10	6	0	1	1	0	0	0	0	0	0
	100%	52%	31%	7%	5%	3%	0	<1%	<1%	0	0	0	0	0	0
2002	168	126	31	5	3	3	0	0	0	0	0	0	0	0	0
	100%	75%	18%	3%	2%	2%									
2003	**163**	**53**	**42**	**11**	**11**	**10**	**14**	**13**	**3**	**1**	**4**	**0**	**1**	**0**	**0**
	100%	**32%**	**26%**	**7%**	**7%**	**6%**	**8%**	**8%**	**2%**	**1%**	**2%**		**1%**		

WHITE PINE BLISTER RUST RESISTANCE SCREENING PROGRAM, STATUS REPORT FOR FY 2003

During Fiscal Year 2003, the program screened 500 sugar pine families from new candidate trees suspected of carrying major gene resistance (MGR) to blister rust; 72 proved to be from MGR trees. This brings the total number of live, proven resistant trees in the Pacific Southwest Region to 1,471 families. Due to the very low frequency of the MGR gene in northern California forests, another 280 families from that area were re-screened, in order to identify additional resistant seedlings that had inherited the MGR gene from an unknown pollen parent tree; 258 seedlings from 131 parents were found to be resistant. Spring 2003 sowing contained about 800 sugar pine families; screening will occur in Winter 2003/2004. Identification of over 540 new sugar pine candidate trees was completed on the northern National Forests of California in September 2003. In addition, cones were collected from a small number of western white pines and also sugar pine from southern California. Twenty-three lots of western white, four foxtail, and four whitebark seedlings will be propagated for a second year at the Placerville nursery to evaluate the protocol for their greenhouse development.

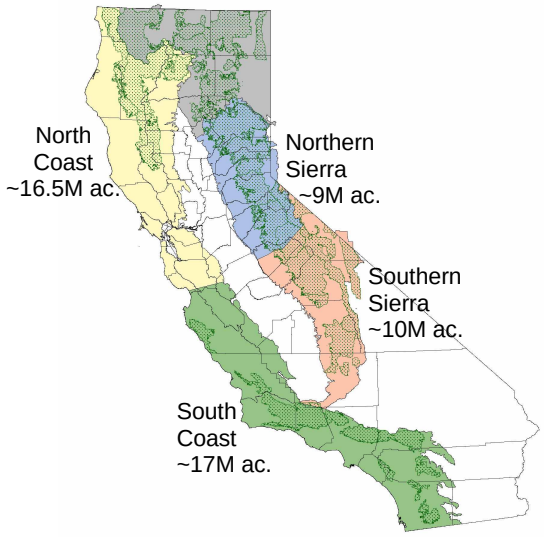
A total of 2,590 MGR sugar pine seedlings were planted at the Happy Camp Disease Garden for evaluation of multigenic, non-MGR forms of resistance, also called “slow rust resistance” (SRR). These seedlings either inherited the MGR gene from known MGR parent trees or from unknown parent trees who contributed MGR-pollen. At Happy Camp 123 individuals, from earlier plantings (1979-1982, 1991, and 1992) that contain 1,316 live plants from the 6,481 originally established, were selected for slow rust resistance traits. This material was grafted into Forest Service seed orchards and a subset into orchards private industry cooperators.

The pilot administrative study entitled *Mortality Analysis of Sugar Pine Seedlings for Identifying Heritable Slow Rusting Resistance to White Pine Blister Rust – A study to improve efficiency of screening methods* was initiated in 2001. The major objective is to identify slow rust resistance seedlings early in the greenhouse, as subsequent field tests can take 10 years to complete. Forty-eight sugar pine families were sown and cultured in spring 2001, then inoculated with rust the following fall. Rust scoring and mortality assessments have been completed for these containerized seedlings.

Survival surveys were completed for ten 2001 and 2002 sugar pine monitoring plantations on the Eldorado, Stanislaus, Sierra, and Sequoia National Forests. Five of the sites had over 80% survival. Reduced survival was noted on the other sites, and was due to gopher damage and/or droughty conditions. The plantations are comprised of MGR, SRR, and susceptible materials. With this combination of resistant types, monitoring infection levels and changes in virulence of the local rust are possible.

DETECTING VEGETATION CHANGES IN CALIFORNIA USING SATELLITE IMAGERY

In 1995, a cooperative program between the USDA Forest Service and the California Department of Forestry and Fire Protection was launched to address long-term monitoring strategies. This program is formally called the California Land Cover Mapping and Monitoring Program. The objective of the program is to create seamless vegetation and monitoring data across California's landscape for regional assessment across all ownerships and vegetation types. The program uses Landsat Thematic Mapper satellite imagery to derive land cover change over five-year time periods (Figure 11). The goal of the program is to implement a long-term, low-cost monitoring program to identify trends in forest health and assess changes in vegetation extent and composition. These monitoring data provide critical information on the impacts of vegetation change over large areas. They also provide timely data for planners, resource managers, landowners, industry, watershed groups and others for land use planning, biological diversity assessment, resource management and sustainable economic development.



Project Area	Monitoring Dates (nominal)	Change Data Complete
Project Area	**Monitoring**	**Dates**
Southern Sierra	1990 to 1995	1996
Cascade Northeast	1991 to 1996	1997
Northern Sierra	1991 to 1996	1997
South Coast	1993 to 1997	1999
North Coast	1994 to 1998	2000

Figure 11. Project areas for measuring land change over five-year periods.

In FY03 the final report for the North Coast project area was published and is available on the web at: http://www.fs.fed.us/r5/spf/publications/fhp-monitoring-pubs.shtml.

Accuracy assessment and cause collection are complete for Cascade Northeast project area and the data is available for downloading on the web site. The monitoring data for this project area have an overall accuracy of 84.5%. Results show that 95% of the vegetation in the assessed 10.8 million acres does not have a detectable change between the 1994 and 1999 change period. Decreases across all vegetation types occur on approximately 184,000 acres and increases occur on about 175,000 acres. The report of this project area will be available on the web by the end of the 2003 calendar year.

At the end of FY03, monitoring and analysis of the Northern Sierra area was completed. Results yield an estimated overall accuracy of 82%. The graph (Fig. 12) shows amounts of change by acres within the project area by change direction.

In FY04 we expect publication of the Northern Sierra Project report, completion and publication of the South Coast Project and report and initiation of the North Coast Project.

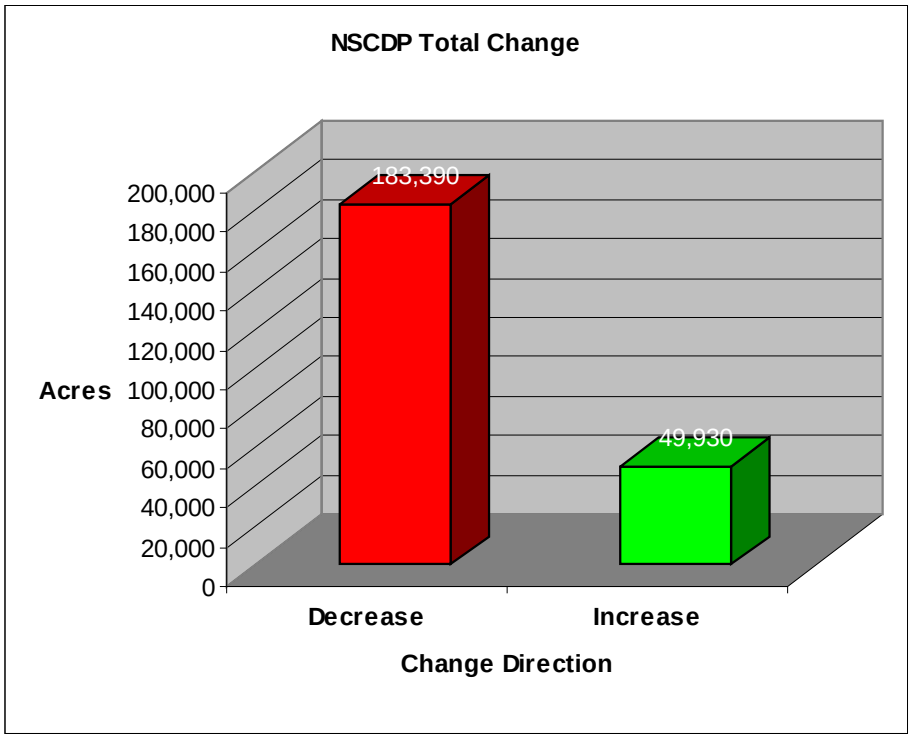


Figure 12. Land cover change in the Northern Sierra Project.

RESULTS OF 2003 AERIAL SURVEYS IN CALIFORNIA

Three large-scale surveys (Fig. 13) were conducted over California forests in 2003, including annual detection surveys over all National Forests and National Parks and two special surveys over various state, private, and federal lands specifically for pinyon pine mortality and Sudden Oak Death (SOD).

Almost 26,000,000 acres of the 39.5 million acres of California forests and woodlands were flown with increased levels of mortality observed for southern forests (Fig. 13). Almost 2.5 million acres had mortality from insects and diseases above annual background amounts. Drought and insect-induced

mortality remains active this year for the hard-hit San Bernardino National Forest and has notably increased in other areas such as Palomar and the Laguna Mountains on the Cleveland National Forest and nearby Santa Ysabel and Los Coyotes Indian Reservations, the Piute Mountains and Breckenridge areas of the Sequoia National Forest, as well as scattered areas on the Angeles National Forest.

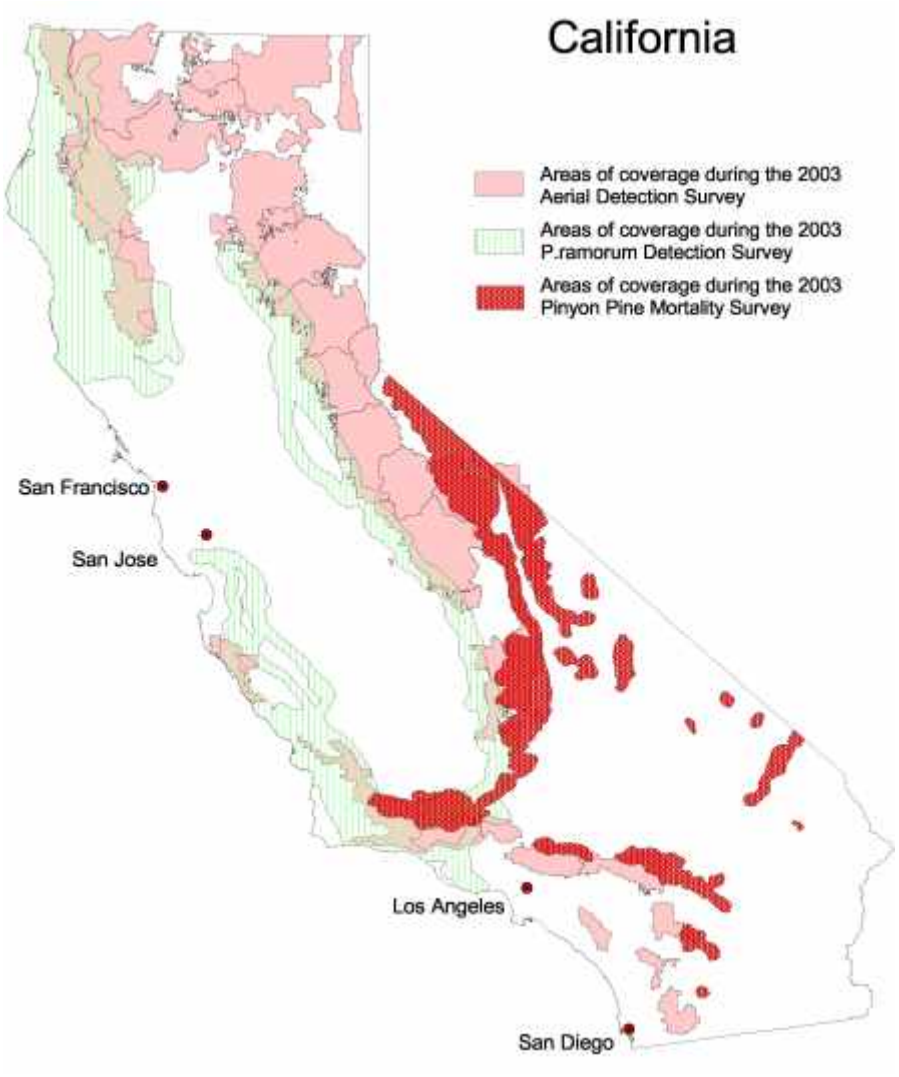


Figure 13. Aerial coverage for the annual aerial survey, Sudden Oak Death detection and pinyon pine mortality.

Predicted risk along with observed tree mortality is displayed in Figure 14. Areas predicted to be at risk, based on rule-based models, are experiencing increased levels of mortality (see calrisk02_1 at www.fs.fed.us/r5/rsl/clearinghouse/gis-download.shtml). Due to the rapid onset of tree mortality and interest from various agency and public entities, the San Bernardino N.F. was surveyed three times during 2003. Approximately 68% of the land base within the administrative boundary is currently affected, increasing from the 44% observed last April.

Figure 15 displays historic damage for all units surveyed. Of the acreage mapped in 2002, approximately 85% is attributed to insect and disease damage agents. The remainder of the acreage is attributed to abiotic agents such as fire, though not all fires are represented. Approximately 94% of the 2002 acreage represents various levels of tree mortality, the balance includes defoliation and top kill damage types. Generally, half of the total acreage affected is within the mixed conifer forest type, one quarter in pine types and the remainder distributed throughout various fir and hardwood types. Similar results are expected for the 2003 surveys to be compiled and analyzed by the end of the calendar year (see tree mortality at http://www.fs.fed.us/r5/rsl/clearinghouse/data.shtml).

Surveys for pinyon pine mortality covering approximately 8,500,000 acres were also conducted in California, with coverage expanding slightly into Nevada. This was part of a larger survey of pinyon mortality in the southwestern United States. Both old and recent mortality was observed in nearly all areas surveyed. Generally, the highest levels of pinyon pine mortality (averaging approximately 25%) were observed along the Hwy 395 corridor from Carson City to Bridgeport.

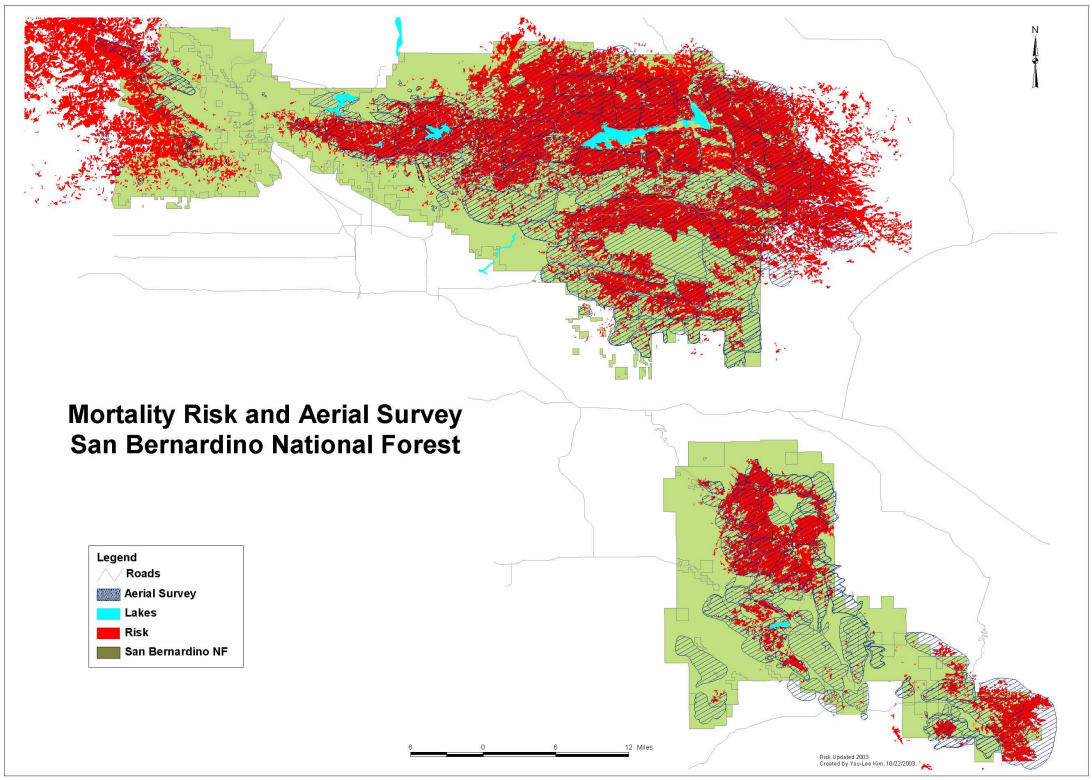


Figure 14. Mortality risk and aerial survey, San Bernardino National Forest.

Aerial surveys and field visits for Sudden oak Death have been completed. Approximately 10,000 miles were flown over 19 million acres of host habitat to map hardwood mortality potentially related to the pathogen and 425 mortality polygons were mapped, totaling approximately 8,200 acres. These acres are not necessarily acres of mortality because some polygons represent only one or two trees. Over 100 sites were prioritized largely on the basis of distances from currently confirmed infestations. No new counties were added to the regulated list as a result of the survey, however, one new positive near Plaskett in Monterey County extended the range approximately 15 miles to the south (see http://kellylab.berkeley.edu/SODmonitoring/OakMapper.htm).

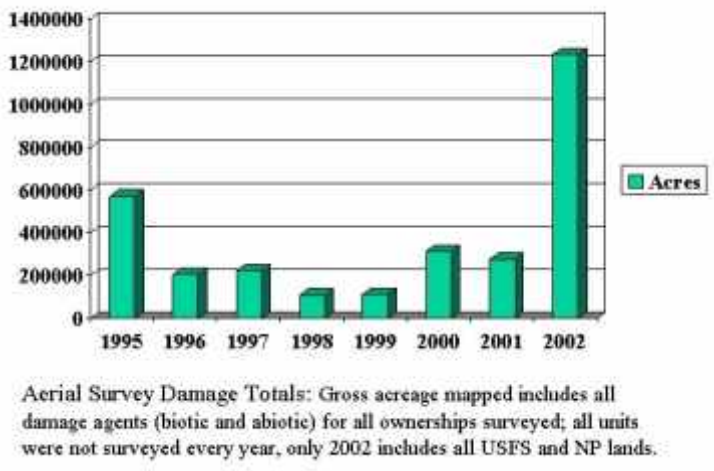


Figure 15. Gross acreage aerially surveyed in California, 1995 to 2002.

DEMONSTRATION THINNING PLOTS IN THE EASTSIDE PINE TYPE ON THE LASSEN NATIONAL FOREST.

In 1978-1979 the Forest Service established plots in the eastside pine type to show the effects of thinning on pest-caused losses in areas of high tree mortality. The stands chosen were mostly pole-size ponderosa pine mixed with some white fir and incense-cedar, growing on medium to low sites, and ranging in age from 70 to 90 years. Within the demonstration plots, four levels of stocking density — 40, 55, 70 and 100 percent of normal basal area — were established to demonstrate the biological and economic alternatives available for management planning. (Normal basal area is the basal area that a stand should have reached when fully stocked with trees, which in the demonstration areas ranges from 185 to 215 sq ft/ac depending on site quality.) Twenty-four years after thinning, the treatments had reduced mortality from 95 to 100 percent of the level in unthinned stands (Table 3).

TABLE 3. Commercial Tree Mortality by Stocking Level, 24 years after thinning [a]

Year	Residual Stocking After Thinning[b] 40%	55%	70%	100%
		Trees per Acre		
1980	0.0	0.2	0.2	2.4
1981	0.0	0.0	0.7	2.4
1982	0.0	0.5	0.3	3.6
1983	0.0	0.1	0.8	4.1
1984	0.0	0.0	0.0	1.0
1985	0.0	0.2	0.0	0.6
1986	0.0	0.0	0.0	1.3
1987	0.0	0.0	0.0	1.4
1988	0.0	0.0	0.0	0.0
1989	0.0	0.4	0.0	2.6
1990	0.0	0.0	0.0	2.6
1991	0.0	0.0	0.0	1.8
1992	0.0	0.2	0.0	3.0
1993	0.0	0.2	0.3	5.2
1994	0.0	0.0	0.0	4.8
1995	0.0	0.0	0.3	0.4
1996	0.0	0.2	0.0	1.3
1997	0.0	0.2	0.0	1.3
1998	0.0	0.0	0.0	0.0
1999	0.0	0.0	0.0	0.9
2000	0.0	0.2	0.3	0.0
2001	0.0	0.2	0.3	0.9
2002	0.0	0.1	0.0	0.9
2003	0.3	0.0	0.3	1.7
Mean	0.0	0.1	0.15	1.84
Range	0-0.3	0-0.5	0-0.8	0-5.2
Percent Mortality Reduction Compared with normal Basal Area	100	95.0	92.0	—

[a.] Commercial trees are 8 inches dbh and larger, with straight boles, yielding at least one 10-foot log with a 6-inch top. Trees were killed by the mountain pine beetle. [b.] Percent of normal basal area.

LIST OF COMMON AND SCIENTIFIC NAMES

INSECTS

Common Name	Scientific Name
Bark Beetles and Wood Borers	
A spruce engraver	*Ips tridens*
Cedar bark beetle	*Phloeosinus* sp.
Cedar roundheaded wood borer	*Semanotus* sp.
Douglas-fir engraver	*Scolytus unispinosus*
Fir engraver	*Scolytus ventralis*
Flatheaded fir borer	*Melanophila drummondi*
Jeffrey pine beetle	*Dendroctonus jeffreyi*
Monterey pine ips	*Ips mexicanus*
Mountain pine beetle	*Dendroctonus ponderosae*
Pine engraver	*Ips pini*
Pine engravers	*Ips* spp.
Piñon ips	*Ips confusus*
Red turpentine beetle	*Dendroctonus valens*
Western oak bark beetle	*Pseudopityophthorus pubipennis*
Western pine beetle	*Dendroctonus brevicomis*
Defoliators	
California budworm	*Choristoneura carnana californica*
California oakworm	*Phryganidia californica*
Douglas-fir tussock moth	*Orgyia pseudotsugata*
Elm leaf beetle	*Pyrrhalta luteola*
Fall webworm	*Hyphantria cunea*
Fruittree leafroller	*Archips argyrospilus*
Gypsy moth	*Lymantria dispar*
Lodgepole pine needleminer	*Coleotechnites milleri*
Pandora moth	*Coloradia pandora*
Pine sawfly	*Neodiprion fulviceps*
Pine sawflys	*Neodiprion* sp.
White fir sawfly	*Neodiprion abietis*
Tree Regeneration Insects	
Douglas-fir twig weevil	*Cylindrocopturus furnissi*
Gouty pitch midge	*Cecidomyia piniinopis*
Pine needle scale	*Chionaspis pinifoliae*
Pitch nodule moth	*Petrova* sp. nr. *monophylliana*
Western pineshoot borer	*Eucosma sonomana*
Other	
Africanized honey bee	*Apis mellifera scutellata*
Alder flea beetle	*Altica ambiens*
Cooley spruce gall aphid	*Adelges cooleyi*
Hackberry wooly adelgid	*Shivaphis celti*
Honey locust pod gall midge	*Dasineura gleditchae*
Leaf beetles	*Chrysomela* sp.
Maple leafhopper scorch	A leafhopper
Needleminers	*Coleotechnites* spp.
Piñon needle scale	*Matsucoccus acalyptus*
Redgum lerp psyllid	*Glycaspis brimblecombei*

Spider mite	*Oligonychus subnudus*
Spruce aphid	*Elatobium abietinum*
Woolly oak aphid	*Stegophylla quercicola*

DISEASES AND THEIR CAUSAL PATHOGENS

Common Name of the Disease	**Scientific Name of the Pathogen**
Cankers	
Black knot of cherry	*Apiosporina morbosa*
Botryosphaeria canker	*Botryosphaeria dothidea*
Cytospora canker of true fir	*Cytospora abietis*
Cytospora canker of poplars and willows	Cytospora chrysosperma
Dermea canker	*Dermea pseudotsugae*
Diplodia blight of pines	*Sphaeropsis sapinea* (*Diplodia pinea*)
Phomopsis canker of Douglas-fir	*Phomopsis lokoyae*
Pitch canker	*Fusarium circinatum*
Seiridium canker	*Seiridium cardinale*
Declines	
Aspen decline	unknown
A new phytophthora	*Phytophthora pseudosyringae*
Incense-cedar decline	unknown
Madrone decline	unknown
Pine decline	unknown
Sudden oak death	*Phytophthora ramorum*
Phytophthora stem canker	*Phytophthora nemarosa*
Dwarf Mistletoe	
Gray pine dwarf mistletoe	*Arceuthobium occidentale*
Limber pine dwarf mistletoe	*Arceuthobium cyanocarpum*
Mountain hemlock dwarf mistletoe	*Arceuthobium tsugense subsp. mertensianae*
Western dwarf mistletoe	*Arceuthobium campylopodum*
Foliage Diseases	
Powdery mildews	*Microsphaera alni, Sphaerotheca lanestris*
Root Diseases	
Annosus root disease	*Heterobasidion annosum*
Armillaria root disease	*Armillaria mellea, Armillaria* sp.
Black stain root disease	*Leptographium wageneri*
Port-Orford-cedar root disease	*Phytophthora lateralis*
Rusts	
Incense-cedar rust	*Gymnosporangium libocedri*
Western gall rust	*Endocronartium harknessii*
White pine blister rust	*Cronartium ribicola*
Willow-conifer rust	*Melampsora epitea*
Miscellaneous	
Big leaf maple anthracnose	*Discula* sp.
Needle cast on Monterey pine	*Lophodermium* sp.
Oak anthracnose	*Apiognomonia quercina*
Oak leaf blister	*Taphrina caerulescens*
Sycamore anthracnose	*Apiognomonia veneta*

TREES

Common Name	Scientific Name

Conifers

Pines

Bishop pine	*Pinus muricata*
Foxtail pine	*Pinus balfouriana*
Jeffrey pine	*Pinus jeffreyi*
Knobcone pine	*Pinus attenuata*
Lodgepole pine	*Pinus contorta* var. *murrayana*
Monterey pine	*Pinus radiata*
Ponderosa pine	*Pinus ponderosa*
Pinyon	*Pinus californiarum*
Singleleaf pinyon	*Pinus monophylla*
Sugar pine	*Pinus lambertiana*
Western white pine	*Pinus monticola*
Whitebark pine	*Pinus albicaulis*

True firs

Grand fir	*Abies grandis*
Red fir	*Abies magnifica*
White fir	*Abies concolor*

Others

Brewer spruce	*Picea breweriana*
Douglas-fir	*Pseudotsuga menziesii*
Engelmann spruce	*Picea engelmannii*
Incense-cedar	*Libocedrus decurrens*
Mountain hemlock	*Tsuga mertensiana*
Port-Orford-cedar	*Chamaecyparis lawsoniana*
Redwood	*Sequoia sempervirens*
Sitka spruce	*Picea sitchensis*
Western juniper	*Juniperus occidentalis*

Hardwoods

Oaks

Oaks	*Quercus* spp.
Blue oak	*Quercus douglasii*
California black oak	*Quercus kelloggii*
Canyon live oak	*Quercus chyrsolepis*
Coast live oak	*Quercus agrifolia*
Interior live oak	*Quercus wislizenii*
Oregon white oak	*Quercus garryana*
Shreve oak	*Quercus parvula* var. *shreveii*

Other

Alder	*Alnus* spp.
Aspen	*Populus tremuloides*
Big-leaf maple	*Acer macrophyllum*
California laurel	*Umbellularia californica*

California sycamore	*Platanus racemosa*
Camphor	*Cinnamomum camphora*
Chinkapin	*Castanopsis chrysophylla*
Coast redwood	*Sequoia sempervirens*
European alder	*Alnus glutinosa*
European beech	*Fagus sylvatica*
Hackberry	*Celtis occidentalis*
Honey locust	*Gleditsia triacanthos*
Pacific madrone	*Arbutus menziesii*
Poplars	*Populus* spp.
Raywood ash	*Fraxinus oxycarpa* ‘Raywood’
Redgum	*Eucalyptus camaldulensis*
Tanoak	*Lithocarpus densiflorus*
Western choke-cherry	*Prunus virginiana* var. *demissa*
Willow	*Salix* spp.

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Owen, D.R. 2003. The western pine beetle. California Department of Forestry & Fire Protection, Tree Note No. 13. 4 p.

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Figure 16. Ecoregions of California.