California Forest Pest Conditions - 2008

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California Forest Pest Conditions Report - 2008

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Cover: Photograph was taken from a photographic observation point on Hwy 88 known as Devils Garden, elevation ~7, 900 ft. View is looking North towards Bald Mountain and Pyramid Peak. Photo: Martin MacKenzie.

THE CALIFORNIA FOREST PEST COUNCIL

The California Forest Pest Council, a 501(c)(3) 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 injury 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 injury, 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 and Fire Protection 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 2008***, 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, US 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/pestconditions/

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FOREST PEST CONDITIONS IN CALIFORNIA 2008

ABSTRACT

This report describes the important forest insect and disease conditions in California in 2008. Included is information on introduced insects and diseases, bark beetles, defoliators, dwarf mistletoes, declines and root diseases, foliage, rust and canker diseases, abiotic injury and animal damage. Sections on surveys and evaluations include summaries of the following:

1. White pine blister rust screening program
2. Sudden oak death monitoring
3. Port Orford Cedar Root Disease
4. Aerial detection surveys
5. Insect and disease risk modeling and mapping

Key words: California, forest health, forest diseases, forest insects, forest surveys, tree mortality

This report provides information on major biotic agents and abiotic events that influenced tree health in California during 2008. Information was submitted by entomologists, pathologists, botanists and other forest health specialists.

CALIFORNIA FOREST PEST CONDITIONS 2008

Conditions in Brief

The second year of drought conditions in the region had an impact on the health of a variety of forest tree species. Statewide average seasonal precipitation through April was just 85% of normal, and as the year progressed water conditions declined drastically in many areas. As of October 2008, all forests in central, northeastern, and southern California were experiencing severe to extreme drought. Increased levels of mortality, dieback, or loss of vigor were observed on numerous species.

Despite the drought conditions, only 217,000 acres of tree injury from biotic factors were mapped by aerial survey in 2008, a decrease from the number of acres mapped in 2007, and well below the 15-year average. Injury detected by aerial survey included tree mortality, defoliation, foliage discoloration, branch flagging, and top kill. The highest number of acres of mapped mortality was attributed to the mountain pine beetle.

The influence of the drought on Sudden Oak Death reduced the spread of the disease in 2008 compared to previous years. However, trees with existing cankers in their boles detected early in the year were more prone to dying.

Similarly many of the conifer trees that appeared to be dying from drought in 2008 were found to have their root systems colonized by root-rotting pathogens such as Heterobasidion annosum and blackstain.

Drought related tree stress, death from trees with root rots and canker diseases, and bark and engraver beetle activity is expected to rise sharply in 2009 if drought conditions persist.

Notable Pest Activity

Insects

Jeffrey pine beetle, mountain pine beetle and western pine beetle attacked and killed their hosts in many areas of the southern Cascades, Sierra Nevada and Southern California mountains, although in most locations mortality was limited to either individual trees or small groups of trees. Tree mortality caused by these beetles is expected to greatly increase next year if drought conditions persist. Stands in many areas are highly susceptible to increases in bark beetle-caused tree mortality primarily due to dense stocking and species composition.

Jeffrey pine beetle remained active in the Lake Tahoe Basin and on the Lassen, Toiyabe, Inyo, Angeles, and San Bernardino National Forests with most mortality occurring in large diameter and pole size trees. Mountain pine beetle continued to be active in lodgepole pine in the northeastern part of the state as well as on the Klamath National Forest and in single-leaf pinyon pine on the San Bernardino National Forest. During 2008 western pine beetle was most active in ponderosa pine plantations on the Eldorado and Stanislaus National Forests where 50-100 tree group kills were noted. Mortality of mature sugar pine on the Sequoia, Stanislaus, and Sierra National Forests increased in popular campgrounds, along roadways, and in summer housing tracts. The largest known sugar pine on the Stanislaus National Forest was killed in 2008. Limited Coulter pine mortality also occurred on the San Bernardino National Forest.

Early season wildfires (June and July) throughout northern California created extensive landscapes of dead and fire-injured trees which were readily colonized by wood borers and red turpentine beetle. Fire-injured trees may also become habitat for other bark beetles in 2009.

Most forests in northeastern California and in the southern Sierra Nevada range experienced higher levels of fir engraver beetle-caused tree mortality in both red and white fir compared to 2007, with the exception of southern California where mortality was not commonly observed. Fir engraver beetle attacks were commonly found in overstocked stands with dwarf mistletoe, cytospora canker and/or annosus root disease.

Feeding injury by an unknown oak leaf miner increased dramatically in black oak (Quercus kelloggii) in 2008 near Blue Canyon, Tahoe National Forest, Placer County. However, no trees or individual branches died as a result of the 3 years of defoliation by this insect. Another notable insect, larve of the California tortoise shell butterfly, defoliated several thousand acres of *Ceanothus* sp. throughout northeastern California. Snow brush (*Ceanothus velutinus*) was defoliated in Lassen County on 600 acres and also on multiple areas in Shasta and Siskiyou Counties. Successful development of larvae in these areas resulted in a spectacular adult flight in late July and widespread reports of mass butterfly migrations from motorists on state highways.

Invasive Insects

For the past six years, elevated oak mortality has occurred consistently on federal, state, tribal, and private lands in southern California (M262B), principally among coast live and California black oaks. Extensive oak mortality was centered around the communities of Descanso and Pine Valley, and stretched as far north as Julian. During 2008, approximately 1,400 dead oaks were detected via aerial survey on the Cleveland National Forest. In June, 2008, the goldspotted oak borer was determined to be the primary cause of the oak mortality. The estimated range of this oak borer, as of October, 2008, was 30 square miles. Investigation of its life history, distribution, and impacts to forest health caused by this new, non-native pest will continue in 2009.


M262B

The walnut twig beetle, native to North America, causes decline and death of black walnut. Tree mortality, resulting from an attack by the walnut twig beetle and subsequent canker development around the beetle galleries, is caused by a fungus, *Geosmithia* sp. Isolated captures of the walnut twig beetle in California were first recorded in 1959 in Los Angeles County in association with black walnut and California walnut. In 2002, it was recovered in Los Angeles County, Riverside County and the Central Valley counties of Butte, Yolo, Fresno and Tulare. In 2008 it was found in Davis, Ojai and Lake Piru (just south of Angeles and Los Padres National Forest) and east of Escondido. The beetle was also detected in Early Detection/Rapid Response traps in Anderson and in Susanville in 2008.

Native to southern and central Europe, the redhaired pine bark beetle was first detected in the Los Angeles Basin in 2003 and has been detected several times in successive years, including the summer of 2008. During 2008 this bark beetle was collected in traps in native and non-native pine plantations in southern California.

In 2008, seven European gypsy moth adults were trapped in the area of Ojai, Ventura Co. As of the date of publication, CDFA had not released data for other GM catches for 2008.

The light brown apple moth, an invasive defoliator originally from Australia, was first detected in Berkeley in 2006. Since then the California Department of Food and Agriculture has trapped over 15,000 moths, mostly in the San Francisco Bay Area and along the central coast. The first plant injury due to the light brown apple moth, was reported in 2008. Populations of the insect continued to increase due to legal injunctions that have halted control efforts.

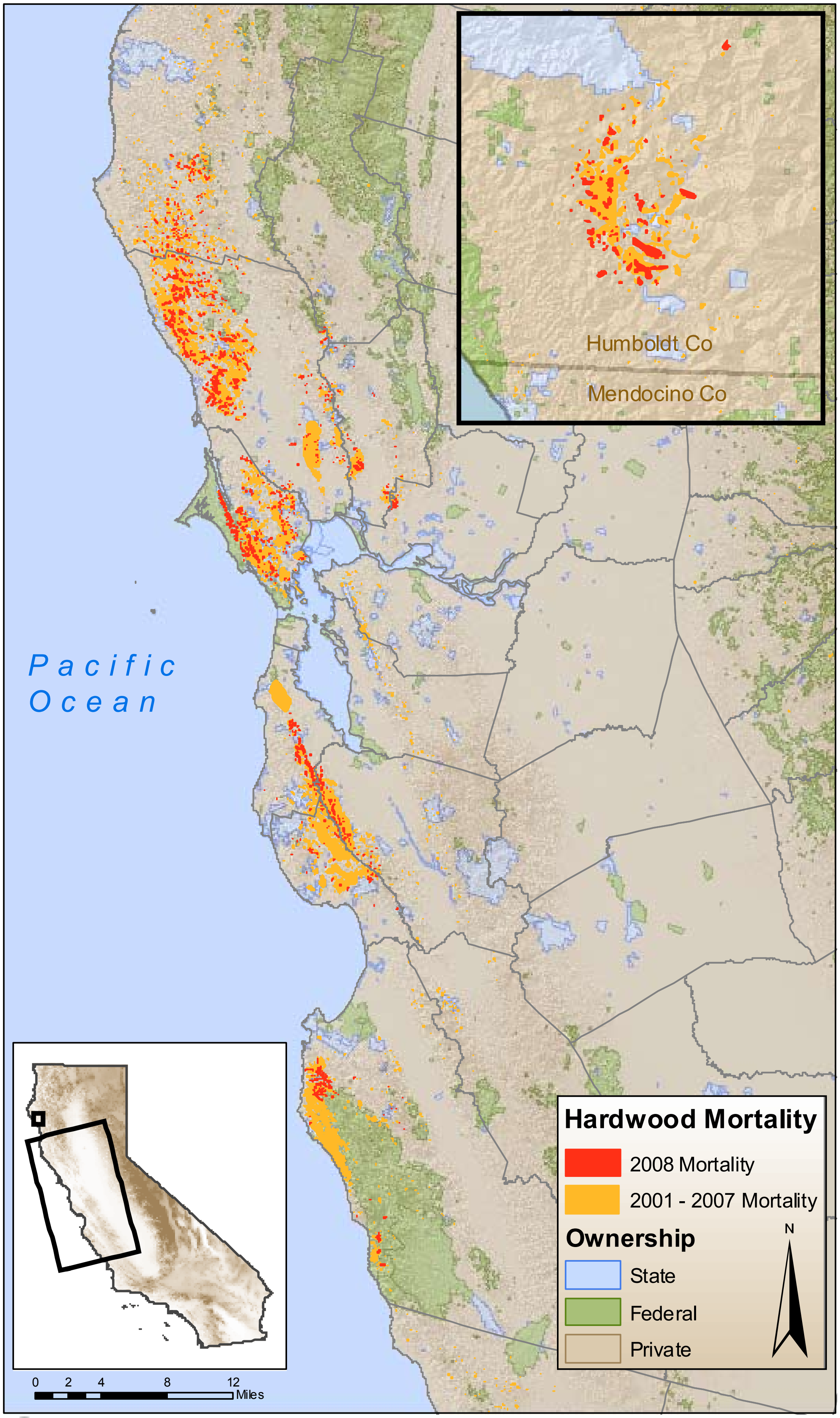
Diseases

In general, 2008 was unfavorable for the spread of forest diseases in California. In only a few cases, tree death was attributed solely to drought. This was most apparent where trees were growing on convex topographies, in areas at the drier fringe of their natural range, or where tree densities were excessively high. Trees that were already affected by biotic diseases declined at a faster than usual rate, but many disease-causing organisms had difficulty sporulating, dispersing, and infecting new hosts.

Drought increased the likelihood of mortality of tanoak and live oak trees that had bole cankers caused by *Phytophthora ramorum*, the causal agent of Sudden Oak Death. But like most diseases, spread and intensity of the disease was reduced. Aerial surveys mapped much less acreage and estimated fewer number of trees killed than in previous years (Map 1). In addition, fir trees infected by *Cytospora* sp. canker exhibited high levels of branch mortality and needle retention was poor on trees infested with mistletoe resulting in thinner crowns. The drought also resulted in high levels of mortality of trees infected with annosus or black stain root disease.

Pitch canker, caused by *Fusarium circinatum*, appeared to be slowed by drought. This fungus needs moisture (usually in the form of rain) to produce spores and infect new hosts. It also needs succulent (growing swiftly) host tissue. With a dry spring and summer, leader growth on host pines was very limited and consequently there was insufficient host tissue to attack.

The extensive fires in 2008, especially the Basin Fire in Big Sur, burned large areas affected by Sudden Oak Death.



Map 1: 2008 Aerial Detection Survey results: hardwood mortality.

Map: Z. Heath

Insect Conditions

Introduced Insects

Goldspotted Oak Borer

Agrilus coxalis

M262B

For six years, oak mortality has occurred consistently on federal, state, tribal, and private lands in southern California (M262B), most commonly in coast live oak and California black oak. Extensive oak mortality centered around the communities of Descanso and Pine Valley, and stretched as far north as Julian. Since 2002, approximately 17,000 dead oak trees have been estimated via aerial survey. In June, 2008 the goldspotted oak borer was determined to be the primary cause of the oak mortality. The borer is a larva of a beetle in the family Buprestidae (flatheaded borers). It was initially collected in Cuyamaca State Park in 2004 and is native to southern Mexico, Guatemala, and southeastern Arizona. The presence of the goldspotted oak borer in southern California is either due to a range expansion from Mexico or Arizona, or through an introduction in or on oak firewood which has been transported from Mexico into California for the past 20 years.

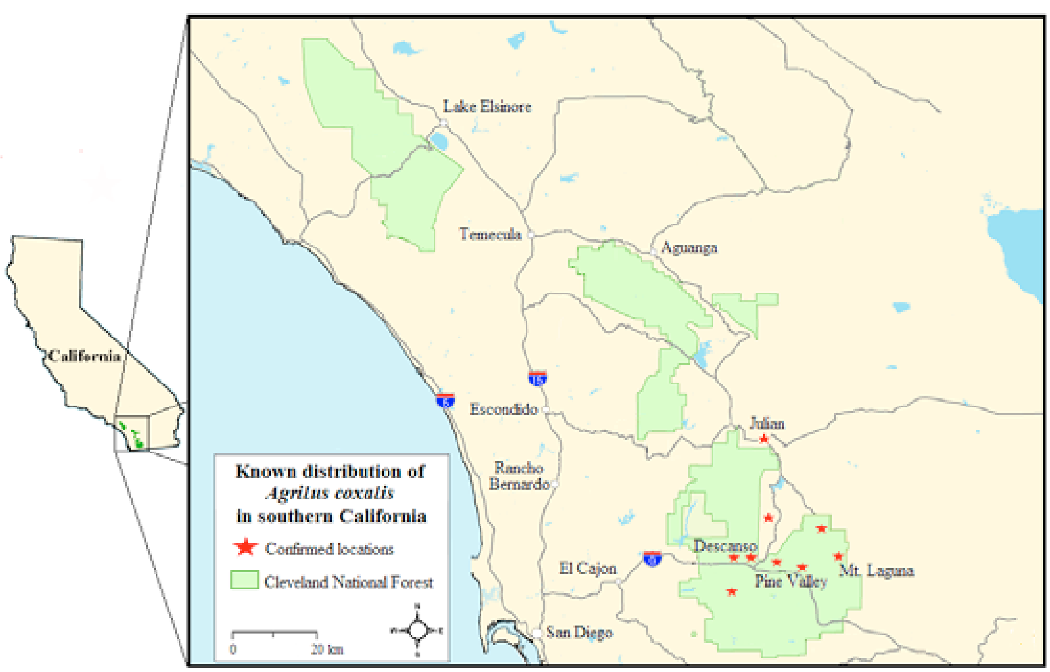
The goldspotted oak borer is similar to other wood-boring species of *Agrilus* found throughout the U.S. Early symptoms of infestation are dark-colored stained areas on the bark surface, D-shaped adult exit holes, and thinning crowns on infested hosts. This oak borer attacks oaks aggressively along the main stem and largest branches. Larvae feed primarily at the interface of the wood and phloem resulting in patches of dead cambium. Tree mortality occurs after several years of continuous infestation.

Approximately 1,400 dead California black oaks and coast live oaks were detected via aerial survey in 2008; primarily surrounding the Descanso Ranger District, Cleveland National Forest. The estimated range of the oak borer as of October 2008 was 30 square miles.

Etiology of the goldspotted oak borer and its potential threat to oak species in California is unknown. A cooperative program between Forest Health Protection, Pacific Southwest Research Station, CalFire, and other cooperators was initiated in 2008 to investigate

Map 2: Distribution of *Agrilus coxalis* in Southern California.

Map: T. Coleman



the oak borer's life history, distribution, and impacts to forest health. In addition, an oak management task force was formed to collaborate in the investigation and management actions to mitigate the effects of the infestation. A Pest Alert can be found at: http://www.fs.fed.us/r5/spf/fhp/socal/Pest%20Alert%20Agrilus%20coxalis%20(10-4-08).pdf.

261A

Light Brown Apple Moth
Epiphyas postvittana
The population of the light brown apple moth continued to grow throughout the coastal area of central California primarily from Monterey to Sonoma Counties with outlying populations in Napa and Santa Barbara Counties (261A and 263A). Eradication efforts, using aerial spraying of pheromones for mating disruption, were halted due to public concerns and court orders. Ground treatments using twist ties impregnated with pheromones continued. Mating disruption will be reinstituted in 2009 using a sterile moth release.

263A

The first detection of feeding injury was noted in 2008 in the areas with the highest populations of the moths, Soquel in Santa Cruz County and Golden Gate Park in San Francisco. Minor defoliation and leaf injury was noted on an Australian Tea Tree in Golden Gate Park and on various hosts in the Soquel area. Plant injury caused by larval feeding is expected to increase if the population of the insect continues to grow.

The insect has a large host range that includes most timber and tree species in California, although limited information is available about its ability to cause injury and/or mortality of hosts which include oaks, willows, eucalyptus, Douglas fir, true firs, pines, maples, and coast redwood among others. It is also a defoliator of understory shrubs and herbs as well as numerous agricultural crops.

European Gypsy Moth
***Lymantria dispar* Linnaeus**
In 2008, European gypsy moth adults were trapped in the area of Ojai, Ventura County for the second straight year (M262B). In 2007, four moths were trapped in a ½ mile square location. During 2008 seven moths were caught in the same area (Table 1).

M262B

The California Department of Food and Agriculture conducted surveys for egg masses on private land in Ojai to determine the extent of the infested area. Suspect egg masses were found on oak trees on two separate properties. One of the properties had an airstream trailer parked under the infested oak tree. The trailer was from Grand Marais, Michigan. Another egg mass was found under a fence rail on private property. Partial samples of egg masses were collected and shipped to the Plant Pest Diagnostics Lab. Eradication efforts are being coordinated primarily by CDFA and APHIS. All other single- moth catches in the state will be trapped at a higher density in 2009.

Mediterranean Pine Engraver
Orthotomicus erosus
The Mediterranean pine engraver is an invasive bark beetle that was first detected in Fresno, California in 2004. Established populations in the U.S. have only been observed in the southern Central Valley of California. Under laboratory conditions, this engraver beetle can develop in various native and exotic pines, as well as on other conifers such as Douglas fir, tamarack, and spruce. In June and August 2008, dispersal and survival studies were conducted with *O. erosus* on the dry Tulare lakebed near Kettleman City (Kings County) on the western side of the Central Valley. No beetles were present at this site prior to the experiment as determined by pheromone trapping. In one trial, marked beetles flew nearly 10 kilometers in 24 hours in the open, treeless landscape, whereas in a second study, 20% of all beetles released were captured in a single pheromone-baited trap within 80 meters of the release site.

Table 1: Gypsy Moth captures in 2008

Wild Male Gypsy Moths (Lymantria dispar Linnaeus) Captured in California, 2008

Date	PDR	County	City	Number	Mitotype
17-Jun	1322495	Ventura	Ojai	1	European type - North American FS-1, BamH I-, Nla III- BamH I-, Nla III
3-Jul	1322496	Ventura	Ojai	1	European type - North American FS-1, BamH I-, Nla III-
5-Jul	1322497	Ventura	Ojai	1	European type - North American FS-1, BamH I-, Nla III-
7-Jul	1322498	Ventura	Ojai	1	European type - North American FS-1, BamH I-, Nla III-
14-Jul	1428009	Orange	Irvine	1	European type - North American FS-1, BamH I-, Nla III-
15-Jul	1322499	Ventura	Ojai	1	European type - North American FS-1, BamH I-, Nla III-
18-Jul	1425402	Ventura	Ojai	1	European type - North American FS-1, BamH I-, Nla III-
22-Jul	1322500	Ventura	Ojai	1	European type - North American FS-1, BamH I-, Nla III-
22-Jul	1452351	Los Angeles	Carson	1	European type - North American FS-1, BamH I-, Nla III-
13-Aug	1379902	Placer	Dutch Flat	1	European type - North American FS-1, BamH I-, Nla III-
21-Aug	1483615	Alameda	Oakland	1	European type - North American FS-1, BamH I-, Nla III-
9-Oct	1422481	Ventura	Ojai	egg masses	Not analyzed
9-Oct	1422482	Ventura	Ojai	egg masses	European type - both homozygous & heterozygous FS-1 BamH I-, Nla III- heterozygous FS-1 BamH I-, Nla III

Note: North American FS-1 is normally homozygous, but a small percentage of the North American population are heterozygous (5 - 8%).

On the eastern side of the Central Valley (Sequoia Airfield, Visalia, Tulare Co.), a small number of pheromone-baited traps attracted hundreds of beetles when placed in a treeless alfalfa field. The abundance of *Orthotomicus erosus* in these agricultural fields suggests that where established, these insects can survive even under harsh conditions (e.g., scarcity of host trees, and hot and windy weather). This cooperative research (PSW, UC-Davis, R4 and R5 FHP) on dispersal of *O. erosus* is supported by the Special Technology Development Program and the Western Wildland Environmental Threat Assessment Center.

Redhaired Pine Bark Beetle
Hylurgus ligniperda

M262B

Native to central and southern Europe, the Mediterranean region, and central and southern Asia, the redhaired pine bark beetle, *Hylurgus ligniperda*, was first detected in the Los Angeles Basin in 2003 (M262B), and has been repeatedly collected in urban parks and green waste facilities in this area. The presence of this beetle in the Angeles and San Bernardino National Forests (2003 and subsequent years) led to an expanded, targeted survey of National Forest lands by entomologists with PSW, UC-Davis, and R5 with support from the Forest Health Monitoring Program. Approximately 150 flight and pitfall traps were installed and monitored on the Angeles, Cleveland, and San Bernardino National Forests.

Redhaired pine bark beetle was collected on the Angeles NF in ethanol and α-pinene-baited traps in native and non-native pine plantations along Highways 2 and 39 (based on preliminary sorting of the 2008 trap catches). On the San Bernardino NF, it was detected in a native knobcone pine stand along Highway 330. This site is a transitional point between the urban forest in the Los Angeles Basin and the mixed conifer forest in the San Bernardino Mountains. *H. ligniperda* was not caught in traps on the Cleveland National Forest and it has not been associated with pine mortality on any National Forest lands. The survey will continue on federal lands in southern California in 2009.

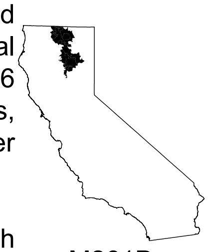
Asian Citrus Pysllid
Diaphorina citri
During September 2008, in the South Bay Terrace area of San Diego, over 250 Asian citrus psyllids were detected as well as a single psyllid in the community of Dulzura. The Asian citrus psyllid can carry the disease huanglongbing (HLB) also known as citrus greening disease. All citrus and closely related plant species are susceptible host plants for both the Asian citrus psyllid and HLB. There is no cure for HLB once a tree becomes infected. Asian citrus psyllid, but not HLB has been detected in Texas, Georgia, Mississippi, South Carolina, and Alabama. A quarantine was established in part of southern San Diego County to regulate the movement of citrus and closely-related plants.

Bronze Birch Borer
Agrilus anxius
The bronze birch borer caused dieback of street trees in Marin and Sonoma Counties. Larvae feed on the cambium and phloem of the trees, which disrupts the flow of water and nutrients, causing root and branch death. Most of the injury can be related to other stresses as well, especially drought conditions.

Bark Beetles

Jeffrey Pine Beetle
Dendroctonus jeffreyi
Jeffrey pine beetle activity continued on the east side of the Sierra Nevada and Cascade ranges this year. Scattered small groups and individual tree mortality were noted along Highway 89 north and south (Pole Springs) of Truckee, Tahoe National Forest (Nevada and Placer Counties) (M261E). Mortality continued on the Eagle Lake District, Lassen National Forest (Lassen County), near Campbell Mountain, Martin Springs, and along Highway 36 near Fredonyer Pass (M261D). Tree mortality continued in all susceptible size classes, however, in many of these locations the number of new trees attacked in 2008 was fewer than in either of the previous two years.

M261E



M261D

Group kills and mortality of individual large diameter (>40” dbh) trees was observed south of Lake Tahoe along State Hwy 89 between Meyers and the junction of Hwy 89 and State Hwy 88 into Hope Valley. This area included lands under Federal ownership on the Lake Tahoe Basin Management Unit, the Toiyabe National Forest, and also private lands. One group kill near Luther Pass (Lake Tahoe Basin Management Unit, El Dorado County) included 49 trees (stands composed of >80% Jeffrey pine) that averaged 21 inches DBH (range 6-39 in. DBH). This group kill expanded five times the level detected in 2007 (10 trees). Mortality also occurred in numerous other small, scattered groups of Jeffrey pine in stands on southern aspects along Highway 88 between Highway 50 and Luther Pass. Jeffrey pine mortality has been increasing in this area since 2006 and is concurrent with below average precipitation for multiple years.

Figure 1: Old and new Jeffrey Pine Beetle mortality, Martin Springs, ELRD, LNF, 2008

Photo: D. Cluck

Sparse attacks were observed on Jeffrey pine trees in Sequoia National Park, near the Lodgepole campground and at various sites along Generals Highway throughout higher

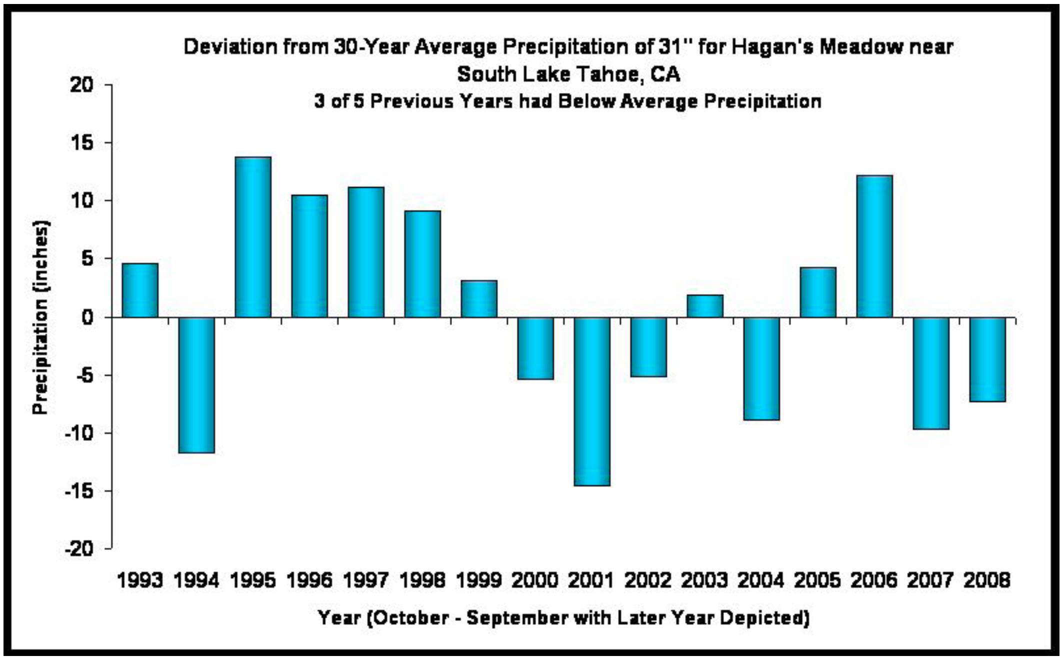


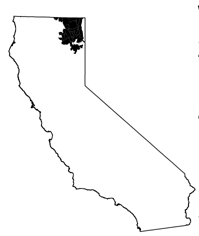
Table 2. Table depicts deviation from 30 year average precipitation data from Hagan's Meadow SNOTEL weather station located approximately 3 miles north of Jeffery pine beetle-caused grouped mortality patches along Highway 89 near Luther Pass. Data were obtained from the Natural Resources Conservation Service at: http://www.nv.nrcs.usda.gov/snow/precipitation.html

elevations of the park (Tulare County). On the Sequoia National Forest (Tulare County) Jeffrey pine beetle activity was noted in fire-injured Jeffrey pines along the western side of Kennedy Meadows Road near Kennedy Campground.

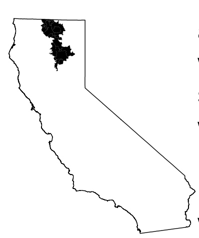
Jeffrey pine beetle activity on the Inyo National Forest continued in 2008 as additional trees were attacked in areas infested for the past three years. Over sixty trees have died over the past three years along Deadman Road and in Sherwin Creek campground (Mono County). The number of infested trees declined in 2008 to 3-4 trees per site, compared to 15-20 trees/site in 2007. Smaller diameter trees were attacked this year – possibly due to fewer large Jeffrey pines available. Jeffrey pine mortality was also visible through much of the Jeffrey pine stands on the Inyo National Forest, both as group kills and individual trees.

M262B

Jeffrey pine mortality caused by Jeffrey pine beetle increased (186 trees over 279 acres) from 2007 levels around Fawnskin and in Holcomb Valley (San Bernardino National Forest) (M262B). Additional mortality was detected across the Mountain Top Ranger District encompassing a total of 266 acres. Over 400 trees were killed in the San Gorgonio Wilderness, near Sugarloaf Mountain and Heart Bar campground. Activity continued from 2007 west of Wrightwood on the Angeles National Forest and along the Angeles Crest Highway. Dying or recently killed Jeffrey pines were detected by aerial survey on 220 acres in the vicinity of Three Points trailhead (M262B).



M261G



M261D

Mountain Pine Beetle
Dendroctonus ponderosae
In northeastern California fewer trees were killed in 2008 by mountain pine beetle in areas where high levels of pine mortality have been observed in previous years. The reduced amount of mortality observed this year is likely due to the depletion of suitable host material within affected stands. Mountain pine beetle activity continued to increase in stands where suitable host material existed. Notable areas included Dismal Swamp (lodgepole and western white pine), South Warner Mountain Wilderness (whitebark pine) Warner Mountain Ranger District (M261G) and Medicine Lake, Doublehead Ranger District, Modoc National Forest (Modoc County) (M261D). Attacks on drought-stressed lodgepole and western white pine at Dismal Swamp resulted only in piles of frass around the base of trees. Few pitch tubes were visible.

Figure 2: Lodgepole and western white pines infested with mountain pine beetle, Mt. Bidwell, Modoc National Forest, Sept. 2008.

Photo: Z. Heath

Figure 3: Mountain pine beetle pitch tubes, boring dust and frass around base of lodgepole pine, Mt. Bidwell, Modoc National Forest, Sept. 2008

Photo: S. Smith

Continuing elevated levels of mountain pine beetle activity were also noted near Susan River and Norvell Flat, Eagle Lake Ranger District, Lassen National Forest (Lassen County) (M261D) and on the Plumas National Forest adjacent to Lake Davis, Beckwourth Ranger District (Plumas County) (M261E). All of these affected lodgepole pine stands had high stand density and a high percentage of trees >10” DBH and >100 years old. The Tahoe National Forest (Nevada County), continued to have elevated lodgepole pine mortality along Alder Creek. (M261E)

M261D

On research plots near the headwaters of Shovel Creek and the Little Shasta River, Goosenest RD, Klamath National Forest (Siskiyou County), mountain pine beetle caused extensive mortality of lodgepole pine. In most plots, current infestation levels matched or exceed those detected in 2007. A similar situation existed on private land on Whaleback Mountain (Siskiyou County). In both areas, cumulative mortality over the past several years in the most heavily impacted plots exceeded 70%.

M261E

Mountain pine beetles killed ponderosa pine in a commercial harvest unit in the Alder Springs SPLAT (Strategically Placed Landscape Area Treatment) on the Mendocino National Forest (Glenn County) (M261B). Scattered outbreaks continued to occur in the Hi-Grouse area, Goosenest District, Klamath National Forest (Siskiyou County) (M261D).

M261B

Mountain pine beetles killed pockets of ponderosa pine in the Lake Tahoe Basin (El Dorado County), and in the community of Coloma (El Dorado County). At High Meadows in the Lake Tahoe Basin Management Unit (El Dorado County), widespread lodgepole pine mortality occurred over 400 acres. Mountain pine beetles were responsible for mortality in some lodgepole pine stands that exceeded 95%. Mountain pine beetles were also found attacking Western white and whitebark pine above High Meadow at the upper elevations of the drainage.

Along the southwest end of Highway 88 and in the Ward Creek drainage on the northeast side of the Lake Tahoe Basin (both El Dorado County), mountain pine beetle has been active in selecting mid-to-larger-sized host trees and killing groups of 5-10 trees annually. Infested stands have similar conditions: densely stocked, composed of larger mature trees, and nearly pure host type. Eagle Meadows Campground, Stanislaus National Forest, has

Figure 4: Mountain Pine Beetle mortality at Alder Springs, Mendocino NF

Photo: C. Snyder

Figure 5: Large diameter western white pines killed by mountain pine beetle, Mt. Bidwell, Modoc National Forest, July 2008.
Photo: S. Smith

M262B

Figure 6: Mountain pine beetle larvae and adult beetle galleries in lodgepole pine, Mt. Bidwell, Modoc National Forest, Sept. 2008.

Photo: S. Smith

had chronic levels of mortality for several years; 25 trees were killed in 2008. On the east side of Huntington Lake at Rancheria Campground (High Sierra Ranger District, Sierra National Forest, Fresno County), where lodgepole pine are in close proximity to the lake's edge and water is not a limiting resource, density was the suspected stress factor facilitating successful attacks. The campground was estimated to have basal areas as high as 400 ft2/ acre.

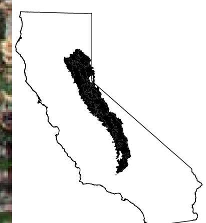
Small groups of sugar pine of variable age classes, as well as individual trees, in the southern Sierra Nevada range have experienced increased mountain pine beetle attacks this year. The largest sugar pine in the Pinecrest housing tract (Stanislaus National Forest, Tuolumne County) was killed by mountain pine beetle, along with two 15 inch sugar pine neighbors. No pitch tubes from attacks were found on the smaller neighbors, indicating severe moisture stress. The Sequoia National Forest is losing statuesque sugar pines in one of their most highly visited campgrounds, Redwood Campground (outside the Trail of 100 Giants, Kern County). Three large sugar pines (all over 30 inches in diameter) were killed in the campground – right over two picnic tables. As in most campgrounds, the death of these large trees significantly reduces the overstory canopy cover, natural regeneration, and aesthetic beauty that draws visitors to particular locations. In the Sierra National Forest near Sonny Meadows (Mariposa county), small groups of young sugar pines were succumbing to attack because of severe overcrowding.

Mountain pine beetle-caused mortality was relatively low in 2008 in southern California (M262B). A few lodgepole pines (over about 20 acres) were killed near Grinnell Mountain along with some sugar pine (<10 acres) on San Jacinto Peak, San Bernardino National Forest.

Single-leaf pinyon pine mortality due to the mountain pine beetle continued on the San Bernardino National Forest. Although a sub-optimal host for this bark beetle species, mortality in single-leaf pinyon has been evident in the area for several years on ~ 5 acres. In 2008, mortality was limited to two trees near the Cougar Crest trailhead (M262B). Additional trees were observed with unsuccessful attacks.

Figure 7: Lodgepole pines killed by mountain pine beetle, Mt. Bidwell, Modoc National Forest, Sept. 2008

Photo: S. Smith



M261E

Western Pine Beetle
Dendroctonus brevicomis

Throughout the northeastern part of the state, western pine beetle killed fewer ponderosa pine during 2008 compared to 2007. Some mortality in large diameter ponderosa pine, possibly affected by annosus root disease, occurred near Eagle Lake, Lassen National Forest (Lassen County). Elevated ponderosa pine mortality was noted near Lake Davis on the Beckwourth Ranger District, Plumas National Forest (Plumas County), in extremely overstocked stands. (M261E).

M261B

Western pine beetle mortality was found in scattered pockets across northwestern California. Group kills (~ 10 trees) were found in the Pacific project on the Grindstone Ranger District, Mendocino National Forest (Glenn County) (M261B). Scattered pockets of mortality also occurred across several hundred acres in the Hi-Grouse area, Goosenest Ranger District, Klamath National Forest (Siskiyou County) (M261D). In addition, hundreds of ponderosa pine were killed in the Slate Creek drainage (Shasta County). Ultramafic soils, which can be nutrient-poor, are common in the area and appear to be a contributing factor along with drought. Stem breakage from this past winter was present in some of the mortality areas, but a direct connection to the western pine beetle was not apparent. While western pine beetle was the cause of mortality of trees without stem breakage, pine engravers and wood borers were the principal colonizers of broken trees.

Figure 8: Ponderosa pine mortality at Lake Davis, CA, Plumas NF, Plumas County.

Photo: D. Cluck

M261D

Figure 9: Western Pine Beetle mortality, Masterson II Project, Klamath NF

Photo: C. Snyder

Western pine beetle-caused mortality was variable in ponderosa pine throughout the Eldorado, Stanislaus and Sierra National Forests in the central Sierra Nevada range relative to 2007 levels. Multiple years of below average precipitation, combined with over-stocked stand conditions or other disturbance agents, were contributing factors. Along Silver Fork Road, Eldorado National Forest (El Dorado County), some group kills encompassed as many as 100 trees. Tree diameters in plantations ranged from 8 to 25 inches (SDI >240), with the largest trees having been attacked in previous years. Two larger trees (27-39" dbh) in a natural stand of ponderosa pine along Silver Fork Road immediately adjacent to a younger plantation, were attacked and killed in 2008. Mortality also occurred in various plantations and wild stands around China Creek Campground, Eldorado National Forest (El Dorado County). At Forest Creek (Calaveras RD, Stanislaus National Forest, Calaveras County), there were twelve pockets of mortality across 250 acres of plantation ponderosa pine – some group kills were as large as 50 to 100 trees.

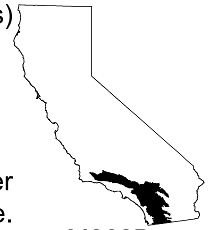
On the Sequoia National Forest, western pine beetle attacked a few large diameter (>30" dbh) ponderosa pine in the White River Campground and Recreation tract (Western Divide Ranger District, Kern County) and along Logger Point Road 14S46 (Hume Lake Ranger District, Fresno County). Basal areas were as high as 600 square feet/acre in some of these areas and the incense cedars also exhibited stress symptoms due to competition and lack of moisture.

Western pine beetles opportunistically killed ponderosa pines weakened by dry conditions and previous-year prescribed burns. Group kills (50-100 trees) were observed between Camp and Green Creeks, Eldorado National Forest (Amador County) and on Peterson Road in the Kings River drainage, Sierra National Forest (Fresno County). Western pine beetle contributed to extensive mortality (multiple groups of 50+ trees) in an area burned during the 2004 Power Fire near Green Creek on the Eldorado National Forest (Amador County); many (50-75%) of these trees also were attacked by the red turpentine beetle. Additional areas with fairly large pockets of western pine beetle-caused tree mortality include four separate locations in and around the Sierra National Forest: above China Creek drainage just off Falcon View Road (Madera County), within Penny Pines plantation (west of Sonny Meadows) and Miami Mountain both on the Bass Lake Ranger District (Madera County), and in Blue Canyon on the High Sierra Ranger District (Fresno County). Mortality also occurred on the Eldorado National Forest in various plantations and wild stands around China Creek Road (El Dorado County).

Western pine beetle killed 15 ponderosa pine in the Crystal Lake Campground, Angeles National Forest (M262B) during 2008, and activity is expected to continue in 2009. In 2004, healthy trees in the campground were preventively sprayed to protect high-value ponderosa pine from bark beetle attack. The spray was effective, but treatment efficacy has ended and beetles are attacking trees with poor health. Several of the pines in the campground are infected with dwarf mistletoe further reducing tree health.

Coulter pines (on ~80 acres) on a marginal but densely stocked site on Thomas Mountain, San Bernardino National Forest, were killed by western pine beetles. Mortality will likely

continue in these stands in 2009. Additional Coulter pine mortality (136 trees on 239 acres) was detected via aerial survey north of Julian on Santa Ysabel Grant land (M262B).



M262B

Red Turpentine Beetle
Dendroctonus valens
Red turpentine beetle activity was detected at Merrill Campground, Eagle Lake Ranger District, Lassen National Forest (Lassen County), in ponderosa and Jeffrey pine. Approximately 100 trees in the campground were injured during campsite reconstruction (trenching for utility lines and grading and paving of roads) over the previous two years. Injured trees had numerous red turpentine beetle pitch tubes and a few were attacked and killed by primary bark beetles. Some of the larger diameter trees were sprayed with carbaryl this spring, prior to beetle flight, to prevent additional attacks.

M261D

Red turpentine beetle were found scattered in mature fire-killed ponderosa pine in the Hotlum Fire of 2006 on the northwest side of Mt. Shasta, Siskiyou County (M261D). Other activity associated with fire injuries were attacks on some of the surviving pines in the Angora Fire, Lake Tahoe Basin Management Unit, Jeffrey pine in the 2007 Butler fire north of Fawnskin, San Bernardino National Forest, and Coulter pine, Palomar Ranger District, Cleveland National Forest, injured by the 2007 Poomacha fire.

Red turpentine beetle attacks on pines were observed in the following locations on the Stanislaus National Forest in conjunction with more aggressive western pine beetle group kills of ponderosa pine, and Jeffrey pine beetle attacks of single legacy Jeffrey pines. Housing tracts in Pinecrest Lake (Summit Ranger District, Tuolumne county), and Sand Flat campground along Clark Fork road (Summit Ranger District, Tuolumne County), where trees typically endure visitor-induced stress, had several new attacks. Red turpentine beetle activities observed in these locations were either strip attacks or complete attacks of the entire lower 8 feet of the tree bole. All red turpentine beetle attacks of this severity have been recorded and will be monitored by district personnel or Forest Health Protection.

High numbers of attacks were observed on large individual pines as strip attacks or encircling the entire lower 8 feet of tree boles in housing tracts at Pinecrest Lake and in some popular campgrounds like Sand Flat along Clark Fork Road (Summit Ranger District, Stanislaus National Forest, Tuolumne County) where trees typically endure visitor-induced stress. The red turpentine beetle-attacked trees were near trees that had been successfully attacked by western or Jeffrey pine beetles.

Red turpentine beetle was also frequently found attacking pines attacked by California flathead borer, Jeffrey pine beetle, and western pine beetle throughout southern California (M262B).

Engraver Beetles

Fir Engraver
Scolytus ventralis
Most of northeastern California experienced slightly elevated levels of fir engraver beetle activity that were above background levels in 2008. Most of the affected areas were closely associated with overstocking, dwarf mistletoe, cytospora canker and annosus root disease infections. A few scattered individual trees were noted on the Eagle Lake District, Lassen National Forest, Lassen County, along Highway 36 near Fredonyer Pass and Hamilton Mountain. (M261D)

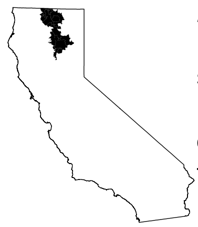
In the southern range of the Sierra Nevada Mountains fir engraver caused white and red fir mortality, primarily of trees infected with *Heterobasidion annosum*. Mortality occurred individually or in small groups of large and small diameter white fir in Fence Creek and

Clark Fork Campgrounds, and in red fir around Dodge Ridge Ski Area, Stanislaus National Forest (Tuolumne County) and Eleven Pines, Eldorado National Forest (El Dorado County). Additional mortality occurred in white fir in the Lake Tahoe Basin (Placer County) and along Highway 88 near the summit of Luther Pass, Lake Tahoe Basin Management Unit (El Dorado County).

M262B

Fir engraver-caused tree mortality was not commonly observed in southern California even though precipitation levels were below the yearly average. White fir infected with true mistletoe succumbed to fir engraver attacks at Crystal Lake Campground, Angeles National Forest. White fir top kill, and/or mortality (35 trees), was mapped via aerial survey along Grinnell Mountain, San Bernardino National Forest (M262B).

Pine Engraver
Ips pini
Ips pini activity was low throughout the state in 2008. Pine engraver beetles attacked a small group of larger diameter (16 – 20“ DBH) Jeffrey pine near Fredonyer Pass, Eagle Lake District, Lassen National Forest (Lassen County) (M261D) resulting in top kill. No obvious causes were noted that may have predisposed these relatively healthy looking trees to successful attacks.



M261D

California Five-spined Ips
Ips paraconfusus
Ips paraconfusus attacks resulted in topkill of 6 trees in the Mountain Thin Project near the town of Mt. Shasta, Siskiyou County (M261D).

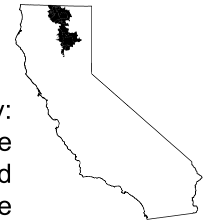
Top-kill was noted in a recently masticated pine plantation (Sonny Meadows, Bass Lake RD, Sierra NF) where western pine beetle had attacked 15 trees and *I. paraconfusus* had attacked three trees where masticated slash was piled close by. Attacks were also found on green trees that had snapped from snow loading or windstorms in the Forest Creek plantation (Calaveras RD, Summit RD, Calaveras County). Trees were also infested with western pine beetle.

Ips attacks caused knobcone pine mortality in several extremely dense plantations along Highway 330 on the San Bernardino National Forest (M262B). Several wind thrown trees located in the area produced large numbers of engraver beetles that subsequently injured and killed adjacent standing pines.

Pinyon Ips
Ips confusus
The pinyon ips killed single-leaf pinyon pine north of Wrightwood on the Angeles National Forest. Mortality has occurred over the past several years, killing 25 trees across 10 acres. In addition, pinyon ips-caused mortality (67 single-leaf pinyon trees on 43 acres) was aerially detected near Onyx Peak, San Bernardino National Forest (M262B).

Ips
Ips spp.
Ips engraver bark beetle caused-mortality was prevalent in Jeffrey pine (25 trees on 30 acres) in the Wooded Hills area on the Cleveland National Forest. Ips engraver beetles also caused top kill and tree mortality in Coulter pine on Thomas Mountain, San Bernardino National Forest (M262B).

Wood Boring Beetles



M261D

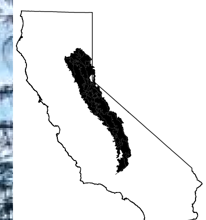
Overview

Roundheaded wood borer (Family: Cerambycidae) and flatheaded wood borer (Family: Buprestidae) activity was high in pockets of fire-injured trees resulting from the wildfires in late June and early July in northeastern California. Large amounts of boring dust accompanied by larval chewing sounds and woodpecker feeding were noted by forest managers in the Peterson Fire, Hat Creek Ranger District, and the Corral Fire, Eagle Lake Ranger District, Lassen National Forest (Lassen County) (M261D). It was also found after the Cold Fire, Beckwourth Ranger District, Plumas National Forest (Plumas County), and the Fall Fire, Yuba River Ranger District, Tahoe National Forest (Nevada County) (M261E).

Flatheaded Fir Borer
Melanophila drummondi

Figure 10: Douglas-fir mortality associated the flatheaded fir borer, Lassen National Forest.

Photo: W. Woodruff

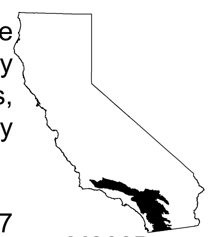


M261E

The flatheaded fir borer attacked drought-stressed Douglas fir on the northeast flank of Brown's Butte, Hat Creek Ranger District, Lassen National Forest (Shasta County) (M261D). Trees were larger diameter Douglas fir in a dense mixed conifer stand on approximately 40 acres. These trees appeared to have relatively healthy crowns and no signs of disease were detected.

The flatheaded fir borer continues to be a factor in the dieback and decline of Douglas fir on low elevation, drier sites in the general vicinity of Shasta Lake (Shasta County) including private lands near Cedar Creek, Little Cow Creek, Gregory Creek, and the Pit River Arm of Shasta Lake. Trees exhibit various degrees of resin streaming and branch and top dieback, symptoms that are typical of chronic stress and attack by the flatheaded fir borer and other borers.

California Flatheaded Borer
Melanophila californica

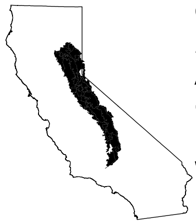


M262B

Increased levels of mortality from the California flatheaded borer were detected on the Los Padres National Forest (M262B). High levels of mortality seen in 2007 in Jeffrey pine around Mt. Pinos continued in 2008 (447 trees on 100 acres). High stand densities, below average precipitation in 2008, and dwarf mistletoe weakened pines which eventually succumbed to wood borers.

California flatheaded borer-caused mortality (95 trees on 77 acres) continued from 2007 in Jeffrey pine north of Big Bear Lake in Holcomb Valley, San Bernardino National Forest. Additional mortality of >200 Jeffrey pine trees caused by the California flathead borer was detected along Thomas Mountain. On the Cleveland National Forest, pockets of Jeffrey pine mortality from the California flatheaded borer were scattered across Mt. Laguna (all M262B).

Defoliators



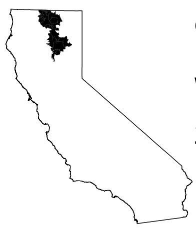
M261E

Oak Leaf Miner
Eriocraniella aurosparsella

Activity of this leaf mining moth, previously referred to as an “unknown species” in prior California Pest Conditions Reports (2005 -2007), increased dramatically in black oak (Quercus kelloggii) in 2008 near Blue Canyon, Tahoe National Forest, Placer County. While the intensity of defoliation increased, the area affected has remained the same. No trees or individual branches have died as a result of the 4 years of partial defoliation caused by this insect. (M261E)

Douglas-Fir Tussock Moth
Orgyia pseudotsugata

The outbreak in the vicinity of Bear Mountain, east of McCloud Flats, Shasta County, collapsed by the end of 2007 and no defoliation occurred in 2008. The outbreak, which ran from 2005-2007, resulted in one area (30 acres) of elevated tree mortality on the ridge extending to the SW from Bear Mountain. During 2008, traps were installed in 155 plots (5 traps/plot) with data collected for all plots (100% reporting). There were 155 plots (100%) with an average of <25 males per trap (all plots averaged <10 males per trap). This represents lowest average trap count for the last 13 years (Table 2). No DFTM caused defoliation was detected in California in 2008.



M261D

White Fir Sawfly
Neodiprion abietis

The white fir sawfly partially defoliated approximately 1000 acres of white fir on the Eagle Lake Ranger District, Lassen National Forest (Lassen County), near Antelope and Fox Mountains (M261D). Defoliation of the older needles ranged from light to moderate, mostly affecting understory trees and lower crowns of mid and overstory trees.

Figure 11: Jeffrey pine needles infested with Jeffrey pine needleminer. Lake Tahoe Basin, July 2008.

Photo: S. Smith

Jeffrey Pine Needleminer
Coleotechnites sp. near milleri

A Jeffrey pine needleminer infestation was detected again in 2008 on the south end of Lake Tahoe on private land between Oflying Drive and Pioneer Trail, El Dorado County. Approximately 5 acres were affected.

California Tortoise Shell
Nymphalis californica

The California tortoise shell defoliated several thousand acres of *Ceanothus* sp. throughout northeastern California in 2008. In Lassen County, approximately 600 acres of snow brush (*Ceanothus velutinus*) on Antelope Mountain, Eagle Lake Ranger District, Lassen National Forest (M261D) was almost completely defoliated. However, nearly all shrubs had put on new foliage by the end of summer. Successful development of larvae in these areas resulted in a massive adult flight by late July and reports of mass butterfly migrations from motorists on state highways were widespread.

Snow brush was defoliated on the Mt. Shasta and McCloud Ranger Districts, Shasta-Trinity National Forest (Shasta County) and the Goosenest District, Klamath National Forest, especially along the Everitt Memorial Highway and in rural subdivisions about 5 miles northeast of McCloud (Siskiyou County). Defoliation was also reported on private timberlands near Picadilly Ridge and Horse Peak, northeast of Mount Shasta.

Table 3: Number of Douglas-fir tussock moth pheromone detection survey plots by trap catch for 1996-2008 for California

Year	Total # 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+
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	0	0	1	0	0	0	0	0
	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%	1%	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%		<1%	<1%						
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%		
2004	174	68	43	6	16	11	6	5	3	0	2	1	1	0	0
	* 93%	39%	25%	3%	9%	6%	3%	3%	2%		1%	<1%	<1%		
2005	195	139	15	11	7	4	3	2	3	1	0	0	0	1	1
	*95%	71%	8%	5%	4%	2%	2%	1%	2%	<1%				<1%	<1%
2006	164	98	26	8	8	5	3	4	3	4	2	0	1	1	1
	100%	60%	16%	5%	5%	3%	2%	2%	2%	2%	2%		<1%	<1%	<1%
2007	164	157	6	0	0	1	0	0	0	0	0	0	0	0	0
	100%	96%	4%			<1%									
2008	155	155	0	0	0	0	0	0	0	0	0	0	0	0	0
	100%	100%													

* Some plots were not collected due to weather.

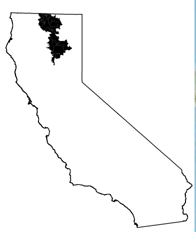
Other Insects

Walnut Twig Beetle
Pityophthorus juglandis
The walnut twig beetle is native to North America and causes unusual decline of black walnut, *Juglans nigra*. Initial symptoms are yellowing of the upper crown, which progresses to include death of larger branches. During the final stages high amounts of foliage may wilt rapidly and trees are often killed within 3 years. Tree mortality is the result of the attack by the walnut twig beetle and subsequent canker development around the beetle galleries caused by its fungal associate (*Geosmithia* sp.). *Geosmithia* sp. cankers are initially small, diffuse and dark brown to black. They expand rapidly and develop more extensively lengthwise along the stem and eventually the cankers coalesce.

Isolated captures of the walnut twig beetle in California were first recorded in 1959 in Los Angeles County in association with black walnut, *J. nigra* and California walnut, *J. californica*. In 2002, it was recovered in Los Angeles County, Riverside County and the Central Valley counties of Butte, Yolo, Fresno and Tulare. In 2008 it was found in Davis, Ojai and Lake Piru (just south of Angeles and Los Padres National Forest) and east of Escondido. *P. juglandis* was also detected in Early Detection/Rapid Response (USDA Forest Service, Forest Health Protection) traps in Anderson (1 beetle in Sept. 2008) and in Susanville (1 beetle in July 2008).

Figure 12: western pine shoot borer, short needles on terminal and dead lateral shoots, Antelope Mtn, Lassen NF, Lassen County

Photo: D. Cluck



M261D

Western Pineshoot Borer
Eucosma sonomana
The western pine shoot borer was detected in 8 to 12 foot tall ponderosa and Jeffrey pine in a plantation near Summit Camp, Eagle Lake Ranger District, Lassen National Forest (Lassen County) (M261D). Affected trees were the dominant individuals in the plantation and attacks were noted on approximately 50% of the trees. No terminal mortality was associated with these attacks, only a marked reduction in growth.

The western pineshoot borer continued to infest plantation ponderosa pine from McCloud to Dana (Siskiyou and Shasta Counties), and north of Lookout (Modoc County). The number of stunted terminals was greatly reduced in stands where pheromone-based treatments occurred. The shoot borer also impacted pines in the Highway 70 corridor southeast of Quincy. Approximately 150 acres of pine planted in the mid-to-late 1990’s had low to moderate infestation rates.

Ponderosa Pine Tip Moth
Rhyacionia zozana
A complex of insects caused significant injury to ponderosa pine in plantations near Goose Valley (Shasta County) and north of Lookout (Modoc County). The principal pest was the ponderosa pine tip moth. Larvae mine the cambial region of shoots leaving a thin layer of bark to the outside and a cylinder of wood to the inside. Pine needle sheath miner and western pine shoot borer were also present.

Pine Needle Sheathminer
Zelleria haimbachi
A 25-acre outbreak of pine needle sheath miner in a plantation of ponderosa pine on the southeast side of Aubrey Ridge, near Burney (Shasta County) declined to endemic levels.

Endemic populations can cause low-level defoliation in some plantations, but significant defoliation rarely extends beyond 1-2 years.

Gouty Pitch Midge
Cecidomyia piniinopis
Mortality of branch tips caused by the gouty pitch midge was common again this year across Hatchet Mountain (Shasta County). Injury was prominent among ponderosa pine surrounding the vista point near Moose Camp. Scarring on previous year's growth indicates that the infestation has been present for many years. This was the second year of noticeable tip dieback.

Sequoia Pitch Moth
Synanthedon sequoiae
At the Oakdale Golf Course and Country Club (Stanislaus County), pitch masses resulting from pitch moth were observed on ornamental Aleppo and Italian stone pine. All pines on the golf course had low to moderate infestations with numerous masses on the entire bole and out onto branches. The infestation resulted in noticeable symptoms such as thinning crowns, branch dieback, and death of a few trees. Pitch moth attacks were also common on knobcone pine along Highway 330 on the San Bernardino National Forest (M262B). These trees were also attacked by *Ips* sp.

Pine Reproduction Weevil
Cylindrocopturus eatoni
Cylindrocopturus eatoni caused mortality in ponderosa pine seedlings averaging 2 ft (range 1-3 ft) in height in an area planted at 10 x 10 ft spacing where natural regeneration had established after the Mineral Fire (2003) in San Antonio Creek drainage, Stanislaus National Forest (Calaveras County). Mortality occurred in clumped groups in 5% of the seedlings. Seedlings >3 ft tall were not affected.

Unknown Twig Miner
(Unknown species)
Branch mortality and flagging caused by pith mining of an unknown twig pruning beetle (potentially *Myeloborus boycei* – samples were sent to the California Department of Food and Agriculture Diagnostic Lab for identification) occurred between Silver Lake and Bear River Reservoir along a 5 mile stretch of Highway 88 (Amador County) on lodgepole pine. Beetles invaded twigs 6 in. from axillary bud producing a small mass of pitch then proceeded to excavate galleries in the pith that progressively increased in diameter as they extended towards the bud. Some trees were also infected with lodgepole pine dwarf mistletoe, *Arceuthobium americanum*.

Black Pineleaf Scale
Nuculaspis californica
High densities of black pineleaf scale were detected on the San Bernardino National Forest (M262B). Scale populations caused premature needle loss and needle discoloration of sugar pine and Jeffrey pine south of Lake Arrowhead. Injury and populations of the black pineleaf scale declined from 2007 levels. Twenty trees across 5 acres were found with dense scale populations. The pine needle scale, *Chionaspis pinifoliae*, was also found infesting white fir in the area, but at lower densities.


M262B

Disease Conditions

Introduced Diseases

Sudden Oak Death

Phytophthora ramorum

Over the past decade, *Phytophthora ramorum*, the causal agent of sudden oak death, has killed over three million tanoak trees (*Lithocarpus densiflorus*) in the central and northern coastal areas of California and the extreme southwestern corner of Oregon. California live oak and two other native oak species (Shreve Oak and California Black Oak) are also vulnerable to this disease, but far fewer of these trees have died.

The spread of the pathogen is greatly facilitated by wet, warm weather. *P. ramorum* is a fungus-like organism whose spores can be spread in rainwater. It can grow on the leaves and twigs of over 100 species that won't necessarily die from this pathogen, but serve as sources of inoculum. The most frequently killed species is tanoak followed by California live oak. For these susceptible species, mortality takes place because the spores can penetrate the bark of the trees and cause cankers in the main bole. Currently, the disease is established in 14 counties throughout Coastal California and one county in SW Oregon, Curry County (Map 5).

Figure 13: Canker in tanoak caused by Phytophthora ramorum.

Photo: J. Mai

Figure 14: Tanoak killed by Phytophthora ramorum.

Photo: J. Mai

261A

In 2008, parts of coastal California experienced the driest spring conditions on record. This unusually dry spring helped reduce pathogen spread. However, the extended dry and hot conditions through the spring, summer, and fall of 2008, led to substantial mortality of trees already infected with the cankers caused by this pathogen. This increase in mortality was observed in Marin, Sonoma, San Mateo, Santa Clara, and Monterey Counties (261A, 263A, and M262A).

263A

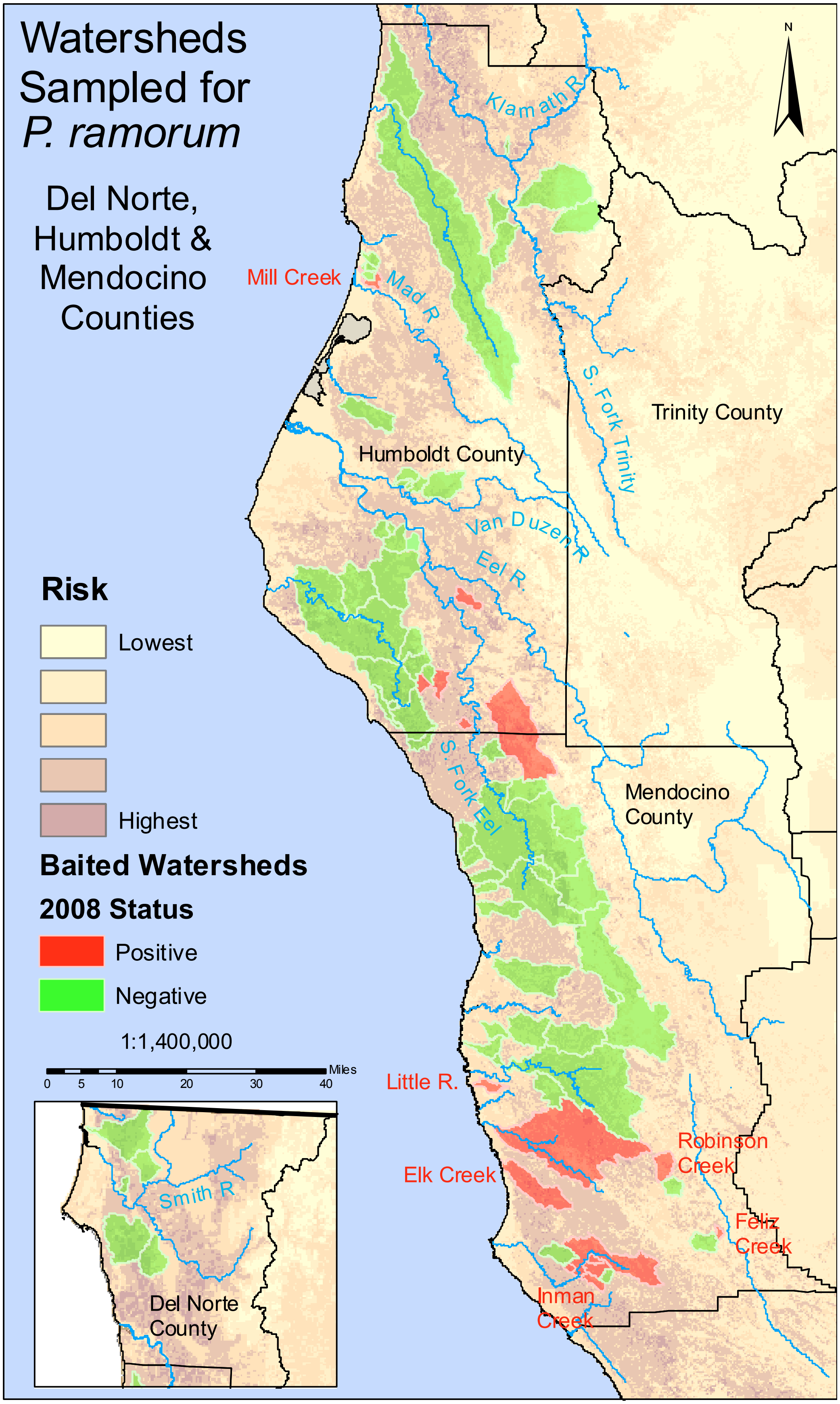
<u>Detection Monitoring of Sudden Oak Death</u>

Stream monitoring has been determined to be the most efficient way to detect the presence of *Phytophthora ramorum* in a watershed.

Monitoring was focused on high risk watersheds without known *Phytophthora ramorum* presence, including 156 stream monitoring sites in northern and southern California (Maps 3 and 4, Table 3). A number of new monitoring sites were added in 2008, collecting and analyzing over 1600 samples.

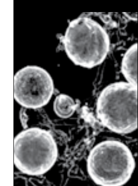
M262A

New positives were found in the following areas:

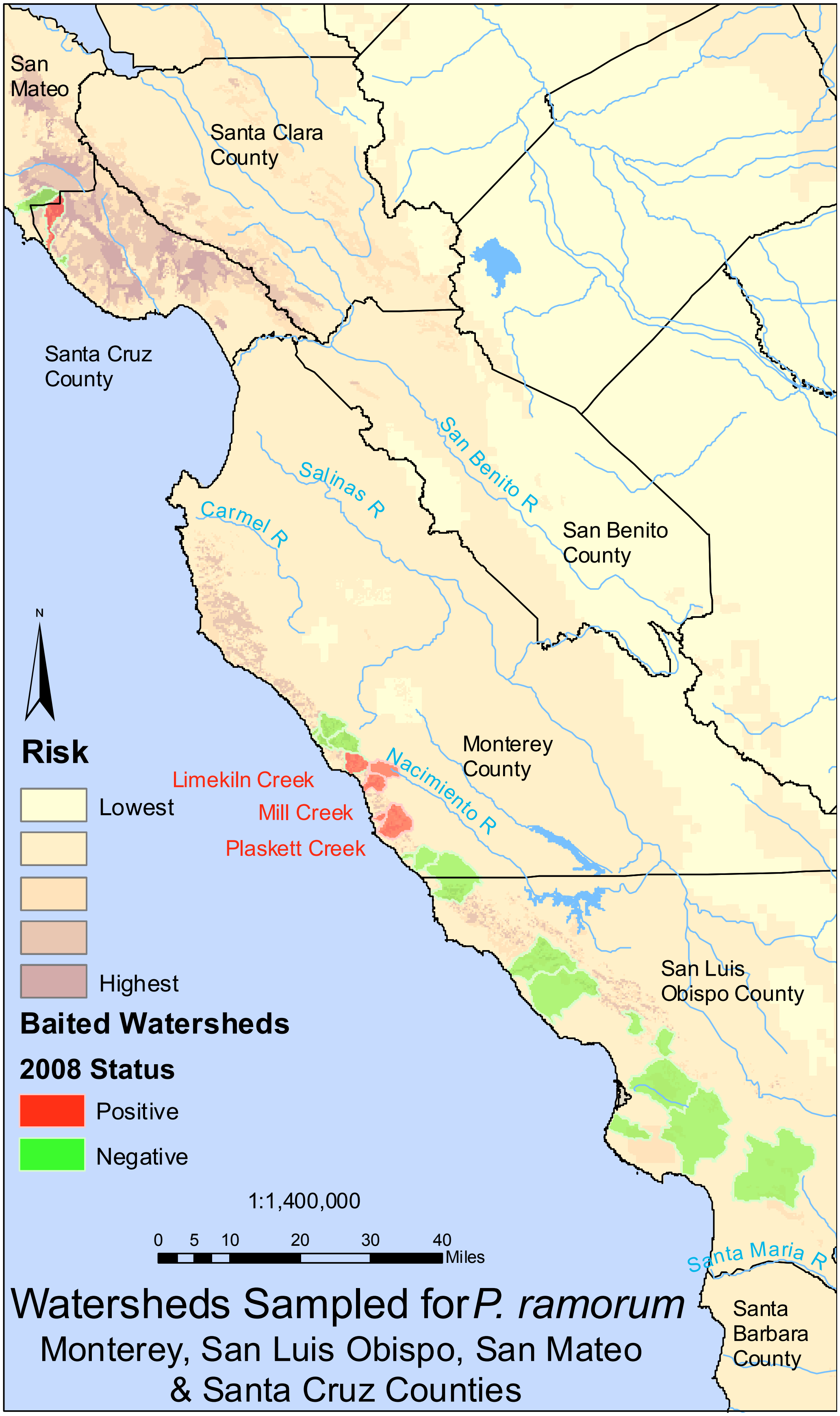


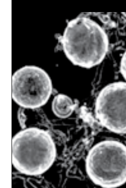
Map 3: Watershed monitoring for *Phytophthora ramorum* in northern California during 2008.

Map: Z. Heath



Map 4: Watershed monitoring for *Phytophthora ramorum* in southern California during 2008.





- Mill Creek at Highway 101, south of previously positive Miller Farm nursery, McKinleyville (Humboldt County). This is the first infestation of a waterway south of this nursery.

- Feliz Creek, northwest of Hopland, Robinson Creek, west of Ukiah, Inman Creek on the Garcia preserve, and the Little River at Van Damme State Park. Collectively all of these finds indicate a filling in of this disease around the already positive Navarro River basin in Mendocino County.

County	Number of Sites
Del Norte	6
Humboldt	50
Mendocino	35
Sonoma	1
Santa Cruz	3
Monterey	11
San Luis Obispo	9
Butte, Yuba, Nevada	31
El Dorado, Placer	10
Total	**156**

Table 4: Stream monitoring sites by county during the 2008 field season

- Elk Creek, near the town of Elk on the Mendocino County coast.

The only new positive on the central coast was Mill Creek in Monterey County, filling in between previously confirmed positives in Limekiln Creek and Plaskett Creek watersheds (Map 4).

Distribution of Sudden Oak Death as of June 5, 2008

Map produced on 6/5/08 by UCB GIIF: http://kellylab.berkeley.edu/SODmonitoring/
For more information about Sudden Oak Death, please visit the California Oak Mortality Task Force website at http://www.suddenoakdeath.org/

Map 5: Distribution of Sudden Oak Death in California.
(Courtesy of Kelly Lab)

In the northern Sierra and Cascades (Butte, Yuba, Nevada, Placer and El Dorado Counties) a total of 31 watercourse sites were baited for SOD. This included tributaries to the following major drainages: Feather, Yuba, Bear, American, and Cosumnes Rivers. No positives were found.

From December 2007 through September 2008, more than 1100 bait samples and 374 plant samples were collected and processed from Del Norte, Humboldt, Mendocino, Sonoma, Monterey, Santa Clara, San Mateo, and Marin counties (Table 4). These samples were part of several on-going monitoring projects from various groups including the UC Cooperative Extension in Humboldt County (plant samples, rainwater monitoring in treatment areas), the Big Sur Adaptive Management project, Cal Fire, Redwood National Park, PNW-FIA, Mattole Restoration Council, and USFS FHP. At the request of officials from USDA Forest Service, National Parks, Sonoma County, and Mid-Peninsula Open Space, a number of site visits were made to investigate more specific reports. Regular updates of new confirmed isolations are made to the UC Berkeley OakMapper site: http://www.oakmapper.org/.

Table 5: Summary of plant samples processed for the presence of *Phytophthora* species from January through September, 2008

Source	Number of Samples
Humboldt Cooperative Extension	206
Redwood National Park	102
PNW - Forest Inventory Analysis	16
USFS Aerial Surveys	5
Cal Poly, San Luis Obispo	21
CDFA (Cal Fire)	7
Miscellaneous	17
Total	**374**

As a service to other diagnosticians and researchers, a collection of *P. ramorum* (500 isolates) and other *Phtyophthora* (70 isolates) is maintained. Maintenance of voucher cultures is critical for identification of *Phytophthora* species and genotypes. Media is provided to collaborators to conduct their own isolations and identifications are made when *Phytophthora* species are recovered. This service is provided to researchers around the world.

<u>Plot Surveys</u>

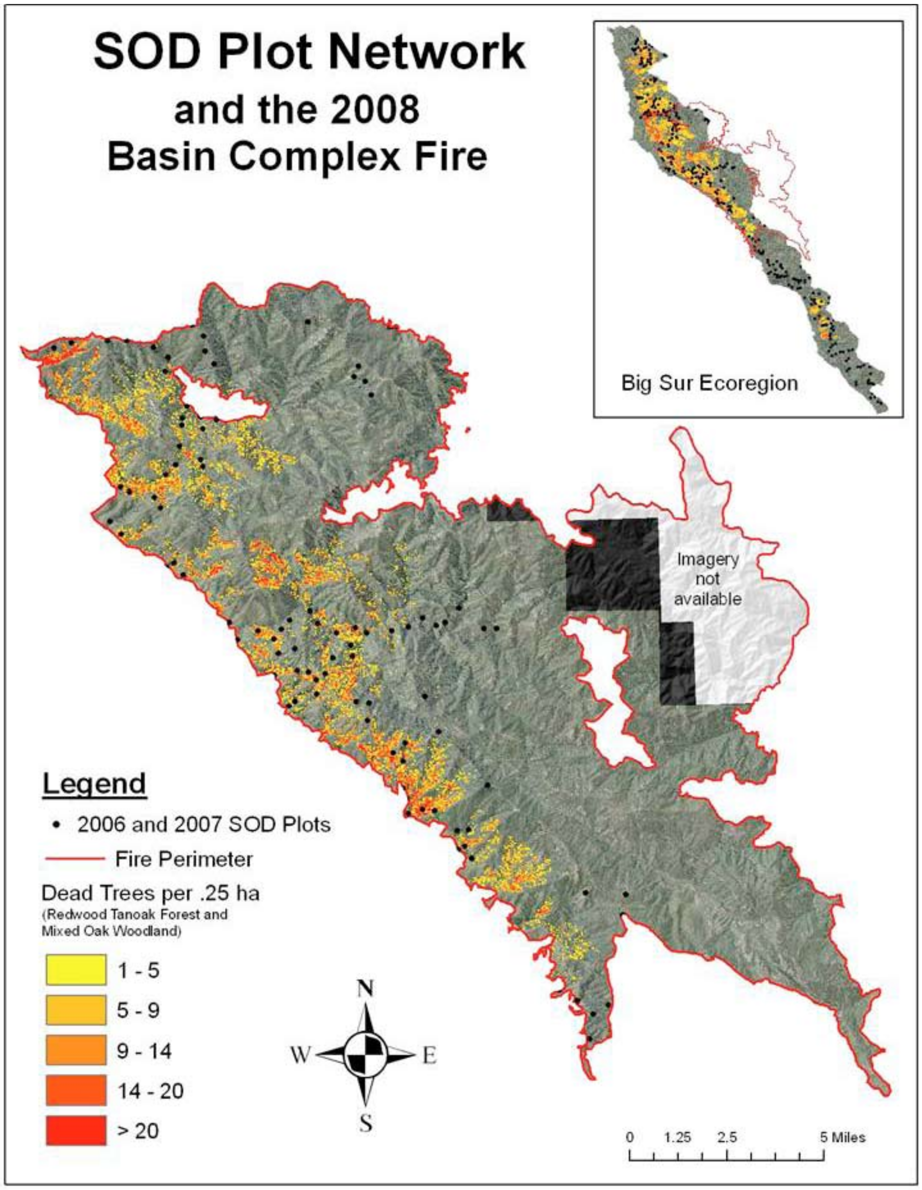
A long-term ecological plot network was established in Big Sur in 2007 to conduct various treatments including public and private landowner participation. This year no new plots were added. However, during June-July 2008, the Basin Complex fire greatly impacted the Big Sur region. The perimeter of the fire encompassed approximately 90 of the 280 long-term field plots in the Big Sur region (Map 6). The plots within the fire perimeter were in both mixed-evergreen and redwood forest types that span a range of SOD mortality levels. Throughout the network, plots more heavily invaded by *P. ramorum* had a greater number of standing dead host trees and downed logs than plots with little or no infection. Starting in September 2008, a post-fire assessment was conducted to determine the degree to which variation in SOD mortality levels might have influenced fire severity.

Map 6 illustrates the estimated density of sudden oak death tree mortality (Meentemeyer at al., in press) and spatial distribution of monitoring plots (Rizzo at al., unpubl.) in Big Sur redwood-tanoak and mixed oak woodlands in relation to the Basin Complex fire perimeter. The inset shows the entire Big Sur plot network with the fire perimeter in red.

Current information and publications on SOD can be found on the California Oak Mortality Task Force website at: www.suddenoakdeath.org (the COMTF website).

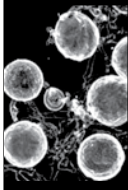
<u>Aerial Survey Monitoring of Sudden Oak Death</u>

The USFS conducted a special SOD survey (jointly with Oregon Department of Forestry)



Map 6: SOD plot network in the Big Sur Ecoregion and the area burned in the Basin Complex Fire.

Map: D. Rizzo



in DelNorte County to identify dead tanoak to target ground surveys for SOD. Twelve locations were mapped, and follow-up ground surveys discovered no *P. ramorum*. The same survey was conducted in conjunction with San Luis Obispo County. No positives were found in San Luis Obispo, as well.

Other Accounts of SOD Influencing Fire Incidence or Behavior

Sudden Oak Death was related to the ignition of a fire along Saint Helena Road in Napa County in May. This fire started when a green stem of a coast live oak, infected with *P. ramorum*, fell on a power line. It caused local power outages and disrupted commuter traffic.

PG&E actively worked to clear potential hazard trees near lines in other locations. For instance, along Palo Colorado Road in Big Sur (Monterey County), they removed approximately 560 trees along a 4-mile stretch in the past 3 years. Another large project of this type was conducted along many power lines in the Point Reyes area.

Oak Mortality Management Challenges and Options

Oak Mortality is a problem because it is unsightly, trees can be expensive to take out, there can be a temporary increase in wildfire, wildlife habitats are impacted, and Indian Tribes which use the acorns in their cultural gatherings miss the acorns. However, when susceptible trees are killed, they are often quickly replaced by other tree species like bay laurel (myrtle) and Douglas-fir. Some of the possible environmental problems (soil erosion, increased water turbidity, warming stream temperatures, and reduced CO_2 fixation) are largely eschewed.

There are many management activities taking place to curtail the impact of this disease. These include:

- An extensive detection survey (watershed and aerial)
- Monitoring and management of nurseries in counties already known to be affected (refer to the nursery section of this report)
- Spraying as-yet-uninfected potential host trees with a chemical (Agrifos @) to induce resistance of these trees
- Removal of bay trees near vulnerable oak trees to lower the spore load
- Development of host-free strips of forest land to prevent the movement of inoculum into areas that are not yet impacted by the disease
- Intensive eradication of infected and potentially infected trees in areas where the disease has just recently shown up

Outlook

Conditions in some parts of Coastal California and SW Oregon have proven to be very conducive to the development of SOD and *Phytophthora ramorum* has proven it can be a devastating pathogen, especially during years with long, wet springs. Over the next decade, the disease may continue to kill many hundreds of thousands more tanoak and live oak in areas where the disease has already become distributed.

Cost-effective diagnostic procedures are now in place for detecting the disease. In each region where the pathogen has shown up, or could show up, there are regionally specific means for limiting its impact. A good extension program, already functioning for the most highly impacted regions of the state, can continue to increase awareness of these options for both owners and stewards of forested lands.

The spread of the pathogen through nursery stock is also being much more tightly controlled (see section on Nursery Diseases in this report).

New Research Findings

1. In 2008, research by Jennifer Parke, Oregon State University and Elizabeth Fichtner, UC Davis, examined the possible role of slugs in *P. ramorum* disease transmission (8). They concluded that whereas this could be possible, the role would be small compared to the spread of aerial propagules dispersed by wind and rain.
2. Research by Steve Jeffers and colleagues at Clemson University included experiments to look at the potential for using commercial algaecides to manage *P. ramorum* and other *Phytophthora spp*. in waterways (5). In laboratory settings, researchers examined two algaecides, Captan and K-Tea, both treatments appeared to have good potential to eliminate *P. ramorum* from infested waterways. Future work will focus on the pathogen's response in naturally-infested water. Note: Dave Bakke, Regional Pesticide Specialist for the Forest Service, points out that K-Tea is, indeed, registered in California for this purpose, but that Captan, so far, is not (nor is it commonly used as an algaecide).
3. Amy Rossman and Mary Palm-Hernandez published an article in Plant Disease (2008; Vol 92, No 10 pp1376-1386) which showed that the Oomycetes, which include the Phytophthoras are not fungi (which belong to the Animal Kingdom), but rather stramenopiles which are very closely related to the yellow-brown algae and are

members of the Kingdom Chromista.

4. Jennifer Davidson and others, UC Davis, published results showing that inoculum quantities produced in coastal redwood forests during the rainy seasons of 03-04 and 04-05 were significantly greater on California bay laurel leaves when compared to tanoak twigs (2). The researchers concluded that the majority of *P. ramorum* inoculum produced in California redwood forests was from bay laurel leaves. They also observed that years with extended rains pose an elevated risk for tanoak because inoculum levels are higher and infectious periods continue into late spring.
5. This year a literature review on Climate and Forest Diseases of Western North America was completed which included *P. ramorum* among other western pathogens. The authors concluded that climate change resulting in wetter springs would favor the development of the pathogen in areas where it already occurs. They also stated that the wetter spring scenario would provide favorable conditions for establishment of the pathogen in new locations.

For further information on SOD, also consult the following resources:

(1) www.suddenoakdeath.org (the COMTF website)

(2) www.aphis.usda.gov/plant_health/plant_pest_info/pram/index.shtml (the APHIS website) for additional information on this disease

(3) www.wrcc.dri.edu/monitor/cal-mon/index.html (California Climate Tracker)

(4) Davidson, J.M.; Patterson, H.A.; and Rizzo, D.M. 2008. Sources of inoculum for *Phytophthora ramorum* in a redwood forest. Phytopathology 98:860-866.

(5) Frankel, S.J. 2007. Climate change's influence on sudden oak death, PACLIM 2007. May 13-15. 2007, Monterey, CA. www.fs.fed.us/psw/cirmount/meetings/paclim/pdf/frankel_talk_PACLIM2007.pdf

Port-Orford-Cedar Root Disease
Phytophthora lateralis

M261A

Port-Orford-cedar (POC) root disease was present in approximately a dozen discrete locations along the main stem of the Sacramento River from Dunsmuir to Shotgun Creek (Siskiyou and Shasta Counties, M261A). Port-Orford-cedar root disease was discovered along the Sacramento River in the main camping area of Riverside Campground at Castle Crags State Park in 2001 (Siskiyou County, M261A). In an effort to limit pathogen spread, all POC were removed from the campground in the summer of 2003. In 2007, newly infected POC were found upstream from the campground, but no upstream spread was observed in 2008.

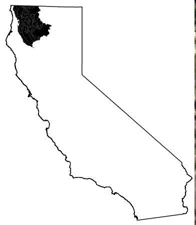
Figure 15: Symptoms of Port-Orford-cedar root disease in the upper Sacramento River drainage

Photo: P. Angwin

Port-Orford-cedar root disease is established in three locations in the upper Sacramento River drainage at Scott Camp Creek (Siskiyou County) (M261A). Removal treatments were implemented over a three year period (2003-2005) to eradicate the pathogen from a 3-acre area around the infected trees. Based on the results from the 2008 monitoring the disease had been successfully contained within the eradication treatment area. The pathogen was still present at low levels within the treatment

Figure 16: Trailworks to prevent the spread of Phytophthora lateralis.

Photo: P. Angwin



area at Scott Camp Creek based on baiting with POC seedlings during the summer of 2008. *Phytophthora lateralis* was detected, using PCR genetic analysis techniques, in one of the twenty-four bait seedlings that were deployed in the creek.

In 2008, additional POC downstream died in the same area where dead and dying trees were found in 2007 along Slide Creek immediately above and below the crossing with the Bluff Creek Road, Road 13N01, Orleans Ranger District, Six Rivers National Forest (Humboldt County) (M261A). Samples were taken from several symptomatic trees in 2008 and subsequent PCR genetic analysis confirmed the presence of *P. lateralis*. The Trinity River drainage (Trinity and Shasta Counties) (M261A) continues to be the only major uninfested river drainage within the range of Port-Orford-cedar.

In 2007, a ¼-acre *P. lateralis* eradication project was implemented at the most upstream infestation along the trail, 6.3 miles south of the Young's Valley trailhead. Trail improvements were also made in four areas to improve drainage and avoid the pickup and deposition of pathogen-infested mud by hikers and pack animals. In addition, a 1,000-foot long trail relocation was started so hikers would avoid passing through a perennially muddy infested area. In 2008, the trail relocation was completed and trail improvements, to reduce inoculum spread, were also completed in 7 more locations.

Thousand Cankers Disease of Black Walnut
Geosmithia sp. and Fusarium solani
(vector, Walnut twig beetle – *Pityophthorus juglandis*)

Figure 17: The walnut twig beetle, *Pityophthorus juglandis*, is the main vector of *Geosmithia* sp.

Photo: S. Seybold

Figure 18: Closeup of the thousand cankers disease caused by *Geosmithia* sp.

Photo: S. Seybold

Over the past decade, widespread tree mortality has been observed in the western U.S. in adventive plantings of black walnut, *Juglans nigra*, as well as in various native stands of western black walnuts (e.g., *Juglans californica, J. hindsii*, and *J. major*). This mortality has been attributed to attacks from the walnut twig beetle, *Pityophthorus juglandis* Blackman, and subsequent canker formation caused by an unnamed *Geosmithia* sp. fungus.

In the summer of 2008, infected walnut branch material was collected in Davis (Yolo County), Winters (Yolo County), Stockton (San Joaquin County), Grimes Canyon (Ventura County), and the Angeles Crest Highway (San Bernardino County). *Pityophthorus juglandis* was reared from these branches and sub-samples of stained bark, phloem, and xylem were prepared. *Geosmithia* sp. was present on all of the collected material.

Based on preliminary observations of nine species of native and Asian walnuts planted at the USDA National Clonal Germplasm Repository in Winters, California (maintained through UC-Davis), *J. californica* suffered the most impact from the pest complex. Commercially

Figure 19: Black walnut suffering from the thousand cankers disease.

Photo: S. Seybold

valuable *J. regia* showed symptoms less frequently.

A second fungus, *Fusarium solani*, is associated with canker formation on the trunk and scaffold branches. This fungus occurs in black walnut trees in advance stages of decline. These diffuse cankers are much larger then those caused by *Geosmithia* sp., often exceed two meters in length, and may encompass more then half the circumference of the trunk.

Alder Canker
Phytophthora siskiyouensis

In 2007, *Phytophthora siskiyouensis* was found causing cankers on a limited number of Italian alder trees in Foster City. This was the first report of this pathogen in California. The pathogen was detected in Southern California in 2008, in a managed landscape setting

Figure 20: Cambial tissue of alder killed by Phytophthora siskiyouensis.

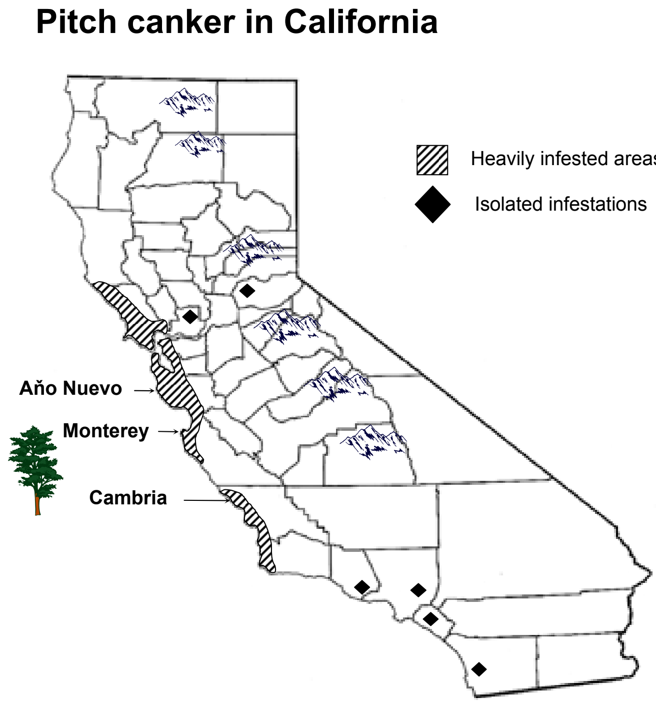
Photo: S. Frankel

Figure 21: Trees killed by alder canker disease in Foster City.

Photo: S. Frankel

Map 7: Distribution and intensity of pitch canker in California.

Map: T. Gordon



in Orange County. Affected alders had noticeable dieback and bleeding areas on the trunk. The pathogen was isolated at one of four sites where alders were symptomatic.

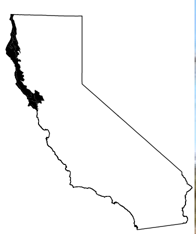
261A

Pitch Canker
Fusarium circinatum
Pitch canker, caused by *Fusarium circinatum*, has been reported to occur in 20 California counties (Map 7). Nineteen of these counties are coastal and extend from San Diego County to Mendocino County (261A and 263A). El Dorado County is the only non-coastal county.

In 2008, drought conditions limited the spread of pitch canker. In Marin County, pitch canker has become well established at multiple locations within the Pt. Reyes National Seashore and has spread and intensified, especially in the past two years. Bishop pine stands that developed after the Mt. Vision fire in 1995 are the most severely affected. In some areas, mortality appeared to be extensive.

Figure 22: Symptoms of pitch canker caused by Fusarium circinatum

Photo: T. Gordon



263A

Pitch canker was still evident in many parts of the San Francisco Bay area including the Redwood Regional Park near Oakland and the State Park in Benecia. Approximately 650 acres were affected in Monterey pine in the East Ridge Trail Area in the Redwood Regional Park. It was also found as far inland as Moraga, but the intensity of the disease did not appear to have increased significantly in this area.

Affected Monterey pine were also reported at Ano Nuevo, Cambria, and at many other low elevations in Monterey County along Highway 1. This year the southernmost report of this disease came from Plaskett Creek.

From a statewide perspective, pitch canker

Figure 23: Happy Camp test site for evaluating major gene resistance (MGR) in sugar pine to the white pine blister rust.

Photo: D. Burton

remains a problem in coastal forests with Monterey pine the most severely affected and also significant injury to bishop and knobcone pine.

White Pine Blister Rust
Cronartium ribicola
White pine blister rust (WPBR) is the most damaging disease of five needle pines in California and is distributed in most of the areas where five needle pines exist in Northern California and in the Sierra Nevada Range. A breeding program has been in place in California to develop resistant sugar pine since 1958.

The rust was found in some dominant overstory sugar pines on the Stanislaus National Forest (Pinecrest Lake Recreation Area, Gold Camp) during 2008 following a thinning project to release these same trees.

2008 White Pine Blister Rust Resistance Screening Program
The Region 5 Genetic Resources staff has a continuing program of screening sugar pine (*Pinus lambertiana*) for natural genetic resistance to WPBR (*Cronartium ribicola*). Screening occurs for major gene resistance (MGR) at the Placerville Nursery on the Eldorado National Forest and for slow rust resistance (SRR; also called 'partial resistance') at the Happy Camp Outplant Site (HCOPS) on the Klamath National Forest. In 2008, 1209 sugar pine families were screened for MGR and 143 sugar pine families were screened for SSR.

Figure 24: Dean Davis retired in 2008 after a very full career of breeding for white pine blister rust resistance at Happy Camp.

Photo: D. Burton

On the Klamath NF, activities related to slow rust evaluations continued with the planting of 1,708 MGR sugar pine seedlings from 274 families at the Happy Camp Outplant Site (HCOPS) and 5553 non-MGR seedlings from 222 families at the Classic field site. Low rust resistance evaluations resulted in the selection of 56 sugar pines with SRR traits.

This year's cone crop on sugar pine was light in most areas. However, cones were received from 503 MGR-candidate trees on both National Forest and non-federal forest lands, from the Modoc National Forest to the Lake Tahoe Basin Management Unit. In addition, cones were collected from some western white pine candidate trees. Eighty-six known-MGR trees in

Diseases

Figure 25: Guava rust, *Puccinia psidii*, on myrtle.

Photo: P. Nolan

the southern California National Forests and the Sierra Nevada had higher cone yields.

Six sugar pine seed orchards have been established by the US-Forest Service and Sierra Pacific Industries. These, collectively contain more than 700 unrelated parents from Sierra Nevada native forests. During fiscal year 2008, 50 MGR parents were collected from wild stands and an additional 28 parents were collected with both MGR+SRR. More will be established each year to both conserve and use the genetic diversity of this species and to give good coverage for the entire state. Approximately 98,000 seedlings were sown for planting in California forests.

Eucalyptus / Guava / Myrtle Rust
Puccinia psidii
Puccinia psidii is a rust that affects many members of the myrtle family (Myrtaceae), including guava (*Psidium*), New Zealand Christmas tree and 'ohi'a (*Meterosideros*), allspice (*Pimenta*), brush cherries, rose apple and wax apple (*Syzygium*), and eucalyptus (*Eucalyptus*). In California, eucalyptus species are widely planted as drought-tolerant trees and have become naturalized in some areas. Other hosts in the myrtle family are important in the nursery trade as ornamentals.

An intensive survey of California nurseries in 2008 yielded only a single (3/19/2008) detection of the rust on a wax apple plant (*Syzygium samaragense*) (San Diego County) received as part of a shipment from Hawaii. Prior to this, the most recent detection had been on 7/23/2007 on a New Zealand Christmas tree.

Leaf Scorch

Sweetgum Leaf Scorch
Xylella fastidiosa
Bacterial leaf scorch is caused by the bacterium *Xylella fastidiosa*. The bacterium is spread from plant to plant by the glassy-winged sharpshooter (*Homalodisca vitripennis*) and other sharpshooter insects (Homoptera; Cicadellidae). Insect feeding introduces bacteria into the xylem, where the pathogen reproduces and spreads.

Many of California's most important commercial and ornamental trees, shrubs, and vines are susceptible to the scorch pathogen, but not all hosts are susceptible to the same bacterial strains. In 2008, the disease was common in Sweetgum that were planted as street trees in the vicinity of Riverside and San Bernadino.

Several researchers from UC Riverside are working on this disease including Frank Wong, Don Cooksey, Richard Stouthammer, and Len Nunney.

M261E

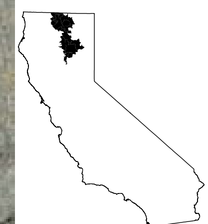
Maple Leaf Scorch
Xylella fastidiosa
In Plumas, Butte, and Sierra Counties maple leaf scorch was present in the same locations in 2008 as reported in previous years (state highways and county roads along Indian Creek, Meadow Valley, Berry Creek, and the Feather River Canyon in Plumas County, Deer Creek in Butte County and the North Yuba River in Sierra County) (M261E). Big leaf

maple in many of these areas were in an advanced state of decline, and only very young regeneration showed signs of good health and vigor during the mid part of the growing season. Nearly every tree throughout the range of big leaf maple in northeastern California exhibited symptomatic foliage. Samples of leaf scorch were sent to Rutgers University to determine if a bacterial infection was the cause of these recurring symptoms. Test results were positive for the bacteria *Xylella fastidiosa*. It was not known whether all individual big leaf maples exhibiting these symptoms throughout the Sierra Nevada were infected with these bacteria or if there were other underlying causes of leaf scorch symptoms. Investigations will continue in 2009.

Canker Diseases

Figure 26: Spore tendrils and pycnidia of *Cytospora abietis* on affected branch.

Photo: P. Angwin



M261D

M261B

Cytospora Canker of True Fir
Cytospora abietis

Over 20,000 California red fir, on more than 2,000 acres on the southwest slope of Magee Peak in Shasta County (M261D), were heavily infested with dwarf mistletoe and cytospora cankers. An aerial survey over portions of eastern Shasta and Siskiyou Counties revealed that this condition was common throughout mature red fir stands in the area.

Cytospora canker was also detected in approximately 5-10 white fir at the Box Camp Trailhead, Salmon River Ranger District, Klamath National Forest (Siskiyou County) (M261A), and on branches of three red fir on the Grindstone Ranger District, Mendocino National Forest (Glenn County) (M261B) also infected with red fir dwarf mistletoe (*Arceuthobium abietinum f. sp. magnificae*).

Further south, branch dieback caused by *C. abietis* continued to increase along the South Fork of the Rubicon River near the Poison Hole Trail on the Pacific Ranger District, Eldorado National Forest.

Cytospora Canker
Cytospora chrysosperma

In Camp 9, on the edge of Lake Isabella, Sequoia National Forest, Kern County, approximately 60% of a black cottonwood plantation died due to *C. chrysosperma*, after an irrigation system failed.

M261A

Chinquapin Canker
Phytophthora cambivora

Chinquapin canker is believed to be an introduced disease. A single dead chinquapin with a basal canker was found off of French Hill Road (County Road 411) near the town of Gasquet (Humboldt County) (M261A). Symptoms matched those of chinquapin canker.

Sooty Bark Canker
Encoelia pruinosa (= Cenangium singulare)

Over the last 10-20 years, aspen stands in the Black Butte Late Successional Reserve (LSR), Goosenest Ranger District, Klamath National Forest (Siskiyou County) (M261D) have been declining. The decline is due to conifer encroachment and infection by sooty bark canker fungus (*Encoelia pruinosa (= Cenangium singulare*). In addition, cattle, deer and elk browse are limiting aspen regeneration in this area.

Diplodia Blight of Pines
Sphaeropsis sapinea (Diplodia pinea)
Shoot dieback caused by *Sphaeropsis sapinea* was observed in 2008 on ponderosa pine in the upper Sacramento River Canyon, Shasta and Siskiyou counties. Infection rates appeared to have decreased for a second year in conjunction with two consecutive dry springs. Infected trees were widely scattered.

Madrone Canker
Botryosphaeria dothidea
A stand of older madrone trees in the mountains of western Napa County were found to be infected with madrone canker. Another stand in Nevada County was also infected. Nearly all of the trees were mature, overstory trees, however, some understory trees were also infected. Large cankered areas were visible on the main trunks and many trees died from the disease. Other diseases may have been active on the sites including Phytophthora root and butt diseases.

Figure 27: *Stigmina thujina* caused leaf spot on Port-Orford-cedar.

Photo: J. Stone

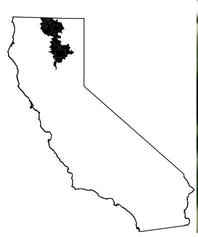
263A

Foliage Diseases

Stigmina Leaf Spot Of Port-Orford-Cedar
Stigmina thujina
Foliage blight caused by *Stigmina thujina* continued to be widespread in the Port-Orford-cedar provenance trial at the Humboldt Nursery in McKinleyville (Humboldt County) (263A). The disease first appeared shortly after the trees were planted in 1996 and became more noticeable during the last five years. A survey conducted in spring and early summer 2008 found that 84 percent of the trees were affected. Symptoms ranged from minor amounts of chlorotic and dead scales, to defoliation of a large proportion of the crown in severely affected trees. Factors contributing to disease development include off-site stock, proximity to the coast (high relative humidity and mild temperatures), and high stand density. In addition to the foliage blight caused by *S. thujina*, the trees were affected by wind and poor soil conditions.

Figure 28: Typical symptoms and sign of aspen ink spot disease.

Photo: P. Angwin



M261D

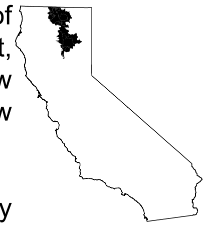
Elytraderma Needle Cast
Elytraderma deformans
Elytraderma needle cast was found in the Idyllwild area of Riverside County on Jeffrey pine trees. The trees showed typical fading symptoms of the needles and were beginning to form witches' brooms. None of the trees appeared to be severely impacted by the disease.

Ink Spot of Aspen
Ciborinia whetzelii
Low levels of ink spot leaf disease (*Ciborinia whetzelii*) were noted in an aspen stand in the Black Butte Late Successional Reserve (LSR), Goosenest Ranger District, Klamath National Forest (Siskiyou County) (M261D).

Root Diseases

Annosus Root Disease
Heterobasidion annosum

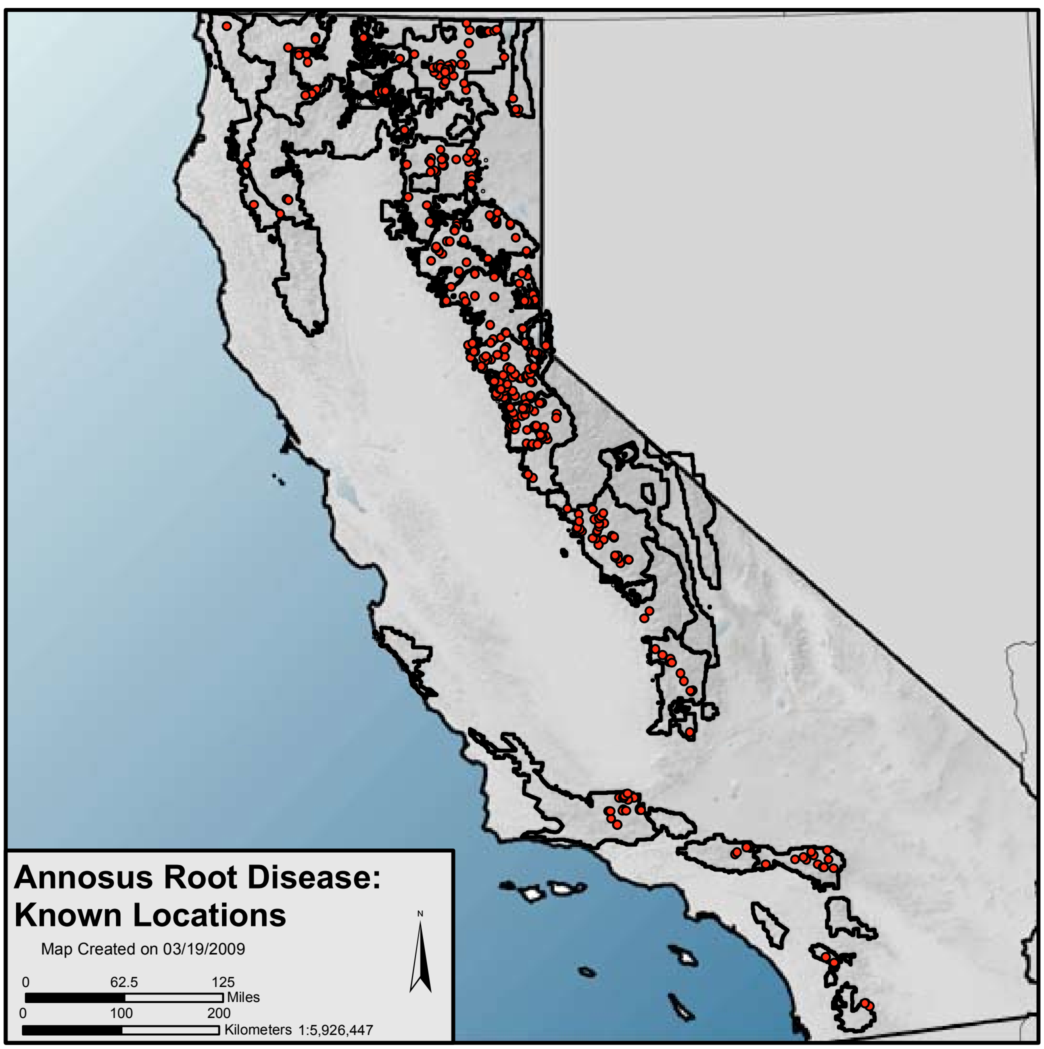
In Northern California, annosus root disease continued to cause scattered pockets of mortality in ponderosa pine on McCloud Flats, Shasta-McCloud Management Unit, Shasta-Trinity National Forest (Siskiyou County) (M261D) (Map 8). In July, 2008 a few active annosus root disease centers were identified in the comparison stand for the "Show Plantation Commercial Thinning Study" near Edson Creek.



M261D

Annosus root disease caused scattered pockets of mortality in white fir in the Big Pony Adaptive Management Area (AMA) and in the proposed Hi-Grouse Silvicultural Treatment Area, Goosenest Ranger District, Klamath National Forest (Siskiyou County) (M261D). Conks were found in white fir stumps in the area and hundreds of white fir trees were infected. Proposed treatment units that were dominated by white fir had root disease centers scattered throughout.

An annosus root rot center was noted on the Eldorado National Forest near Georgetown. Annosus conks were easily found in some fir stumps from past thinnings. In Gold Camp in the Pinecrest Recreation Area (Sequoia National Forest), a large pocket of old white fir stumps was observed with annosus conks. Annosus root disease was reported to be



Map 8: The distribution of *Heterobasidion annosum* in coniferous forests of California.

Map: M. Woods

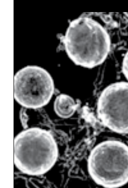


Figure 29: Stump adequately treated with borax to prevent colonization by *Heterobasidion annosum*.

Photo: D. Bakke

Figure 30: Fir tree with roots rotted by *Heterobasidion annosum*. Such trees are predisposed to wiindthrow.

Photo: M. MacKenzie

very prevalent in this recreation area. This area will receive a great deal of attention in the upcoming years to both reduce the number of hazard trees in the area and to reduce further spread of the pathogen.

In Southern California, a large active infection center or a cluster of coalesced infection centers of trees were observed on the Descanso Ranger District, Cleveland National Forest, near the Redtail Roost Volunteer Activity Center and Laguna Fire Station on Laguna Mountain. Jeffrey pine were dying from a combination of several agents, including annosus root disease, dwarf mistletoe, California flatheaded borers, and Ips engraver beetles. Many broken stumps and roots had stringy white rot typical of advanced annosus root decay. Blowovers at the stump were more common than blowdowns with stem breakage (15 trees vs. 9 trees).

Armillaria Root Disease
Armillaria mellea

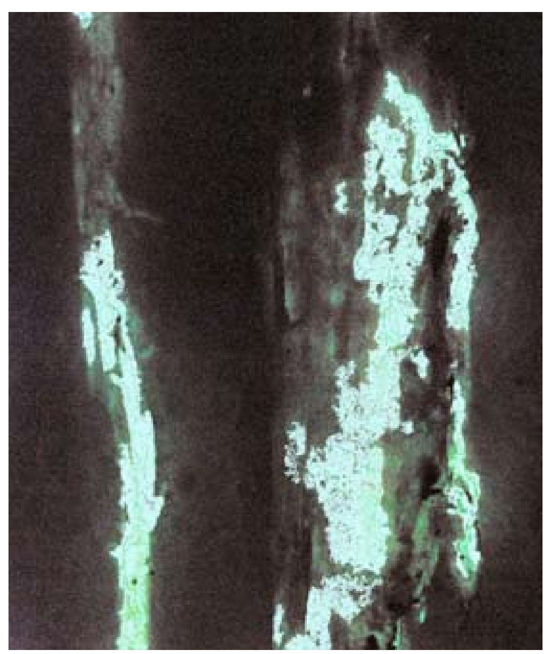
In the Lake Tahoe Basin Management Unit (Ward Creek Drainage) a very large white fir blew over. It was a legacy tree from the Comstock Era of logging. Its crown was small but the needles were green when the tree fell. Evidence of pathogenic Armillaria attack was found in the bole. The root collar was encrusted with resin soaked soil, through which rhizomorphs could be seen growing. Removing the bark beneath this resin revealed small mycelial fans.

Figure 31: Wood rotted by *Armillaria sp*.

Photo: M. MacKenzie

Figure 32: Same piece of wood under a blacklight. The hyphae of *Armillaria* floresce.

Photo: M. MacKenzie



In the Sequoia National Forest (Black Mountain Grove, Hot Springs/Tule River District), three large giant sequoias fell over the winter of 2007/2008. Armillaria was the best candidate for having caused most of this decay.

A single tree and large patches of blue oak were killed by Armillaria at Clear Lake State Park (Lake Co.).

Black Stain Root Disease
Leptographium wageneri
Black stain root disease (BSRD) is chronic in some areas of Humboldt County. However, two new infection areas were found in 2008. One was on infected Douglas fir regeneration and small trees on Buck Mountain east of Bridgeville near the Trinity Co. line. The other was in Lake Co., where scores of Douglas fir seedlings and small saplings were dead and dying in an area east of Bartlett Springs, Lake County.


M261D

BSRD- caused mortality centers were widespread, scattered, and actively spreading in Unit 30 of the proposed Algoma LSR thinning project area (Siskiyou County) (M261D). This mortality was first noticed in the spring of 2007. Western pine beetle has contributed to the death of pines in and adjacent to the root disease infection centers. Similar BSRD/western pine beetle-caused tree mortality last occurred in stands near Algoma from 2003-2005, following widespread drought.


M261G

Because of high levels of stocking, conspicuous concentrations of mortality around BSRD centers continued to be evident at the Mud Flow Research Natural Area, Shasta-McCloud Management Unit, Shasta-Trinity National Forest (Siskiyou County) (M261D).


Figure 33: Typical black staining in the cambium of BSRD impacted pinyon pine.

Photo: P. Zambino

On the Modoc National Forest, BSRD continued killing pole- and sawtimber-sized ponderosa pine trees on the Devils Garden Ranger District. Four mortality centers were identified one quarter mile east of Crawder Flat Ranger Station (M261G). On the Lassen National Forest, two new BSRD locations were identified; a single ponderosa pine tree was detected on the Eagle Lake Ranger District (Lassen County) just west of Swains Hole Road and 0.4 mile north of State Highway 44 (M261D) and on the Hat Creek Ranger District (Shasta County), one mile east of Vista Point rest stop on CA Hwy 44, 5 miles SW of Old Station, M261D) three 1/10 acre mortality centers were detected within approximately 1000 feet of each other. Black staining was found in the wood at the base of one of the trees.


M261E

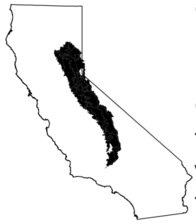
BSRD and flathead borers were also found in a large Douglas fir tree, just south of State Highway 70, about 200 feet west of the intersection with State Highway 89, (Plumas County) (M261E). This 100-foot tall tree was located within a group of other dead and fading Douglas fir trees.


Figure 34: Black stain root disease, caused by Leptographium wageneri, impacting pinyon pine near Big Bear Lake.

Photo: P. Zambino

There were several reports of BSRD in scattered dying Douglas fir trees (~6” DBH) along an 8 mile stretch of Hwy 120 near Groveland (Toulumne

County) (M261E). They were small trees, all about 6 in DBH and scattered along the road.



M261E

On the San Bernadino National Forest, single-leaf pinyon (*Pinus monophylla*) continued to be affected in areas where BSRD has occurred historically. Typical stain symptoms were found in the lower bole and roots of fading and recently dead trees of all ages at the edges of infection centers north and west of Big Bear Discovery Center near Big Bear Lake (M262B). Large numbers of infection centers had been previously reported in this area in a survey conducted in 1991. Regeneration was slow and sparse at the center of the expanding infection centers, in part due to persistent woody debris from downed trees killed by the disease.

M262B

Phytophthora Root Disease
Phytophthora cinnamomi
Phytophthora cinnamomi root disease was found affecting white fir in the Tahoe Basin (Nevada County) in an area that had the water table altered by the building of a catch basin for a ski resort. Water from the entire built up area of the resort funneled into this catch basin. The small diameter and fine feeder roots of the affected firs were rotting. All diameter size classes of trees within the area were affected. The trees were also suffering from bark beetle attack as they lost vigor due to the root disease. Water from the catch basin and a stream downhill were also found to be infected with the pathogen.

Oak trees growing in yard situations in the Folsom area of Sacramento County and in various locations in Marin County suffered from *P. cinnamomi* root disease. Trees of various native oak species were watered along with the lawns. Overwatering and the saturated soil encouraged the disease to spread. Recommendations were made to separate lawn and tree areas, stop watering the trees, and to surround the trees with mulch and drought-hardy vegetation to stop the problems with Phytophthora root disease.

Rust Diseases

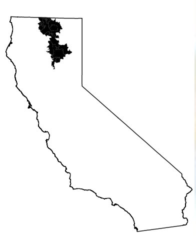
M261A

Incense-cedar Rust
Gymnosporangium libocedri
Incense-cedar rust was unusually widespread and heavy in incense-cedar at Castle Crags State Park (Siskiyou County) (M261A) during spring and early summer. This disease is common during wet springs. By summer, orange-brown telial masses had dried to a crust on affected foliage and there was no permanent injury.

The disease was also reported in Quincy, Plumas County.

Figure 35: Orange pustules of *Cronartium coleosporioides*.

Photo: J. Egan



M261D

Stalactiform Rust
Cronartium coleosporioides
(= *C. stalactiformae*)
Stalactiform rust was scattered and common in lodgepole pine, as well as in Unit 18 of the proposed Hi-Grouse Silvicultural Treatment Area, Goosenest Ranger District, Klamath National Forest (Siskiyou County) (M261D).

Cankers caused by *Cronartium coleosporioides* girdled leaders and branches of lodgepole pine and contributed to mortality of 100-150 year old trees growing from 9,000 to 9,300 feet elevation in Paradise Valley, Carson-Iceberg Wilderness, Stanislaus National Forest (M261E). The pines averaged 30” DBH (range 5-40” DBH), of which 70% had symptoms of infection. Thirty percent of the infected pines had cankers on the lower bole, 20% had cankers on the upper bole and also topkill, and 20% had branch infections. Cankers on the lower bole often had excessive resinosis and were longer than they were wide. These cankers ranged from 3” wide x 9” long to 3’ wide x 15’ long. Cankers on the upper bole occasionally had excessive resinosis and had caused top kill on the upper 20’ (range 10-50 ft.). In 2007/2008 mortality occurred in 1 tree/acre. Plants of *Castilleja* sp., the primary alternate host of this rust, were common in these stands. Infection of the pines likely occurred for 20-30 years. Infected trees were only found in wilderness areas, however multiple lodgepole pine located ≈ 3 miles from high-value recreation areas along Clark Fork Road had canker symptoms.

Figure 36: Very large stalactiform rust canker caused by *Cronartium coleosporioides*.

Photo: J. Egan

Western gall rust
Endocronartium harknessii
Ponderosa and knobcone pine seedlings and saplings in stands regenerating in the Forks Fire area (east of Bartlett Springs, Lake County) had western gall rust bole and branch infections. The galls were still sporulating in late September.

Nursery Disease

Cylindrocarpon destructans
Forty-six of 1,400 sugar pine grafts died in the Placerville Nursery. They had symptoms suggestive of Fusarium root rot. Isolations were made in the Sonora Forest Health Protection lab and isolates of potential pathogenic fungi were sent to the Rocky Mountain Research Station, Moscow, Idaho for molecular identification. Molecular identification indicated the presence of *Cylindrocarpon destructans* and *Fusarium solani*. This may be the first record of *Cylindrocarpon destructans* on *Pinus lambertiana* in California. The root stock for these grafts came from the Dorena nursery in Oregon.

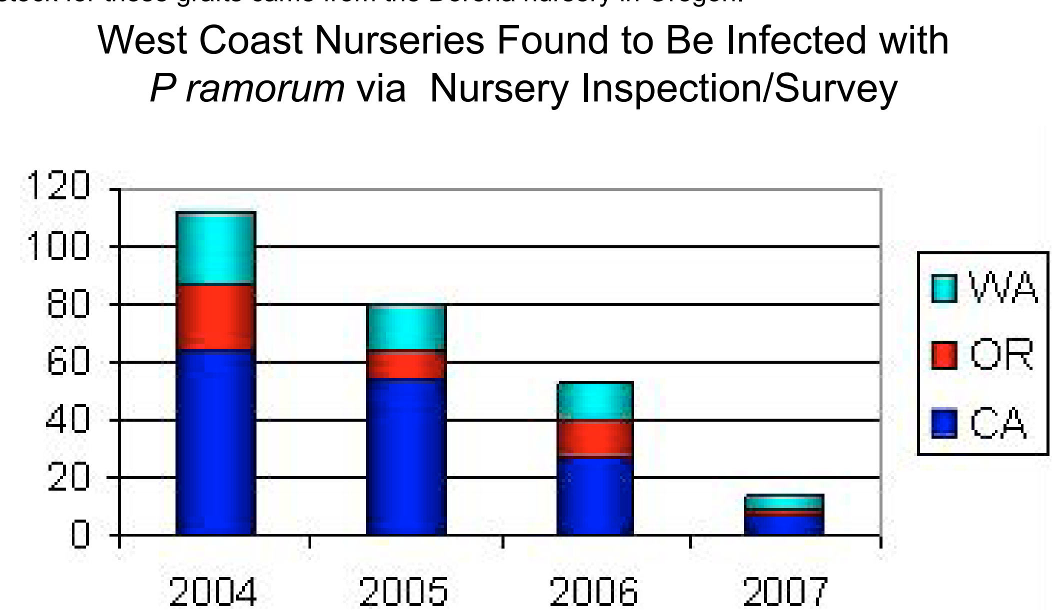


Table 6: Graph showing the decline in nursery cases of *Phytophthora ramorum* over time as a result of very stringent inspection and management.

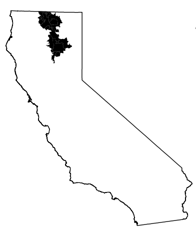
Graph: K. Suslow

Phytophthora ramorum

Through September 2008, thirteen California nurseries had positive detections for *P. ramorum*, including four producers, two wholesalers/producers, one production/retail, and six retailers. Approximately half of the nurseries were within the 14 quarantined counties, while the other half were in non-infested counties in Southern California. Six of the 13 nurseries had previously been positive for *P. ramorum*. One nursery had shipped plant products interstate. Also, a San Mateo County retail nursery was discovered to have all three *P. ramorum* lineages (NA1, EU1, and NA2). This was of concern since this situation could potentially allow for sexual reproduction of the pathogen and independent assortment leading, potentially, to even more aggressive and omnivorous Phytophthoras.

Despite the positive finds for *P. ramorum* in 2008, the overall impact of the *P. ramorum* detection and management practices in nurseries dramatically reduced the incidence of *P. ramorum* in California nurseries.

Butt Rots



M261D

Phellinus tremulae

Low levels (five trees in two aspen stands) of aspen trunk rot were noted in the Black Butte Late Successional Reserve (LSR), Goosenest Ranger District, Klamath National Forest (Siskiyou County) (M261D).

Declines

M262B

Oak Decline

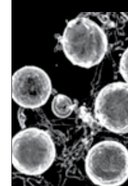
Plant injury from a combination of golden oak scale insects (*Asterolecanium puteanum*) and unidentified canker pathogens was observed on several species of oaks (California black oak, *Quercus kelloggii*, canyon live oak, *Quercus chrysolepis*, and “scrub oak”, *Quercus dumosa,* in the broad sense) at several sites on the Angeles National Forest including the Charlton Flat Campground and oaks along Road 7N23 along the north slope of Liebre Mountain (M262B). The golden oak scale is an insect that causes local necrosis and a recessed pit in the bark of its host. The association of canker fungi with the injury caused by the pit scale resulted in mortality of small trees. In larger trees, death of small to major branches caused very noticeable crown thinning. Ongoing drought was likely a factor, as previous studies have suggested that impacts caused by cankers and mortality attributable to pit scale insects increases during drought.

Chaparral Death and Decline

Chaparral decline was observed in chaparral species at many locations on the Angeles and San Bernardino National Forests in southern California. Manzanita species across the region generally appeared to have intensification in stem mortality from long-standing stem cankers.

Decline appeared particularly significant over several hundred acres along Spunky Edison Road in Spunky Canyon (Angeles National Forest) (M262B) several miles north of the Bouquet Reservoir. Nearly all greenleaf manzanita (*Arctostaphylos patula*) had numerous stems that had died from cankers, other stems with cankers in earlier stages, cankers on small twigs that had borne blooms, and mortality of intermediate branches. Some clumps had died outright. Virtually all individuals in this area were large for chaparral species, and plants of young cohorts were rare, indicating a lack of recent fire. Scrub oaks were affected by branch cankers. Some of the oak branch cankers may have been related to injury caused by a variety of twig insects.

Apparent decline of chaparral was observed along Highway 243 in the Morongo Indian Reservation just north of the San Jacinto Ranger District, San Bernardino National Forest in



September, nearly two years after the area was burned in the Esperanza Fire. It appeared that scrub oak stems that survived the fire were now dying from very long, linear, fast-growing stem cankers. Many stems had green and recently dead foliage on adjacent branches. Examination of cross sections of the bases of severely declining stems typically showed less than 5% live xylem. However, multiple shoots had sprouted after the fire from the same oak patches that were in apparent decline, and these new shoots appeared healthy. Foliage of some other shrubby chaparral species in the area had died back, but stems were still green, possibly indicating that water stress had played a role in the observed symptoms.

Mistletoe

M261B

Red Fir Dwarf Mistletoe

Arceuthobium abietinum f.sp. magnificae

Red fir dwarf mistletoe was identified in the branches of three red fir trees at Unit 25 of the proposed Smokey Project Area in the Buttermilk LSR, Grindstone Ranger District, Mendocino National Forest (Glenn County) (M261B). Cytospora canker (*Cytospora abeitis*) was found associated with the dwarf mistletoe branch infections. Overall injury was minimal.

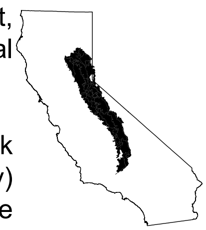
M261A

Western Dwarf Mistletoe

Arceuthobium campylopodum

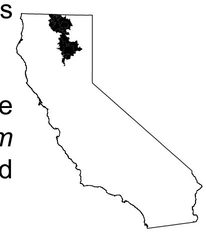
Western dwarf mistletoe was detected in two small centers (<6 trees) of ponderosa pine in Stand 789 on the Pacific Timber Sale, Blue Slides LSR, Grindstone Ranger District, Mendocino National Forest (Colusa County) (M261B). Dwarf mistletoe ratings in individual pines ranged from 2 to 4.

A light infestation of western dwarf mistletoe was identified in Stand 531-2, Tompkins Creek Plantation Area, Scott River Ranger District, Klamath National Forest (Siskiyou County) (M261A). The stand is in the Forks of Salmon WUI and Seiad Late Successional Reserve (LSR). The disease was scattered in about 10 small centers (<6 trees) of ponderosa pines. The infestation was light, with dwarf mistletoe ratings in most individual affected pines ranging from 1 to 3.



M261E

Near Lake Davis, Beckwourth Ranger District, Plumas National Forest (Plumas County) five acres of ponderosa pine were heavily infected with western dwarf mistletoe (*Arceuthobium campylopodum*). These trees were in very poor health and several were being attacked and killed by bark and wood boring beetles (M261E).



M261D

Lodgepole Pine Dwarf Mistletoe

Arceuthobium americanum

Lodgepole pine dwarf mistletoe was common and widespread in the Hi-Grouse Proposed Silvicultural Treatment Area, Goosenest Ranger District, Klamath National Forest (Siskiyou County) (M261D). Dwarf mistletoe infection centers were scattered throughout treatment units with a significant lodgepole pine component. Individual tree DMRs from 3 to 6 were common in Units 12 and 13.

Figure 37: Dwarf mistletoe plants, *Arceuthobium occidentale*, infecting grey pine. The miniature grape-like structures are the seed.

Photo: M. MacKenzie

Gray Pine Dwarf Mistletoe

Arceuthobium occidentale

Dwarf mistletoe *Arceuthobium occidentale* of gray pine was found in the vicinity of Sonora.

Affected trees had numerous dead branches, were fading, and were unhealthy. The parasitic seed plants were barely noticeable on the affected branches and trees. Many trees did not show visible plants yet but had the branch swelling indicative of dwarf mistletoe infection.

Oak Mistletoe

Phoradendron serotinum ssp. tomentosum (Phoradendron villosum)

Oak mistletoe is a true (leafy) mistletoe and is easily recognizable in oak forests in southern California. Severe infestations of this parasitic plant pose a substantial threat to the health of their hosts primarily because mistletoe's have a high rate of transpiration which increases water stress of its hosts. Large dense clusters of mistletoe can also shade the lower branches of hosts and increase the potential for branch breakage.

California black oaks that were in decline or that had died from very heavy mistletoe infestation were observed at the Sawmill Campground, Angeles National Forest. Trees with less mistletoe had relatively few symptoms of stress. Loss of these highly prized trees could have a substantial impact on site quality and recreational enjoyment by decreasing the shade and aesthetics of the area.

A mistletoe removal project on the San Bernardino National Forest dramatically improved tree health, site aesthetics, and visitor safety in recreational areas.

Abiotic Conditions

Drought Stress
The health of a forest is highly dependant on the amount of precipitation being received not only during the current year but during previous years as well since all of this water collectively contributes to the amount of available water to trees growing at that site.

The most accurate way to determine the insufficiency of water available to trees at a given site is to measure the drought stress (measured in negative bars) that is being experienced by the needles of those trees growing at a time when transpiration rates should be peaking (e.g. from noon to 3:00 PM on a late summer day).

Precipitation varied substantially at six different National Forests in California both during the current year and the eight previous years:

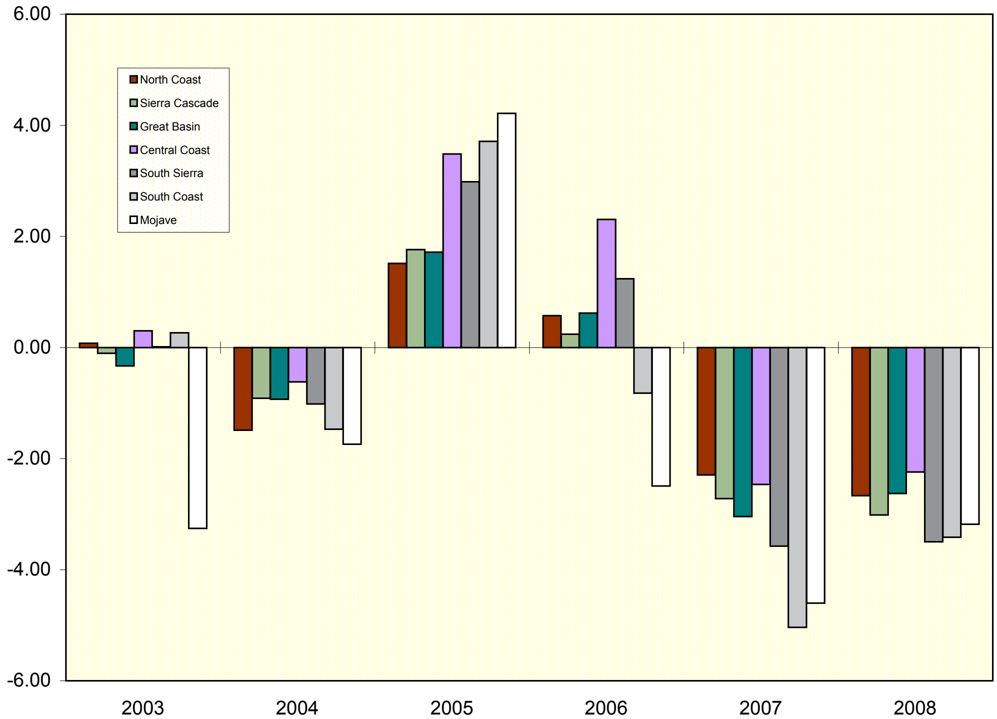


Table 7. Palmer drought indices for the seven hydrologic zones in California, 2003-2008. The Palmer Drought Index is an indicator of drought or moisture excess and ranges from -6 to +6, with the negative values denoting degree of drought.

San Bernardino National Forest, Holcomb Valley, San Bernardino County (34º20'N, 111º55'W, 1800 m, M262B). Precipitation was 95% of the California 130 year mean annual precipitation record; this follows 2007 with 31% of average. In the last eight years, four years were below 60% of average precipitation. This is a site 'to watch' for bark beetle activity due to the severity of the 2007 drought and because of the frequency of severe drought. Drought stress in Jeffrey pine was significant in mid May. In some very stressed trees, the cambial tissue was papery (instead of turgid) in August. There was a significant increase in needle and branch elongation growth over the 2007 drought year. Needle elongation increased to 65% of the maximum (within branch) needle length observed in 2008 vs. 28% of maximum in 2007.

Sequoia National Forest, Troy Meadow (east side of Sierra Nevada); Tulare County (36º05'N, 117º52'37" W, 2350 m). Precipitation was 79% of the 20 yr mean annual precipitation record; this follows 2007 with 66% of average. In the last eight years, two years had below 60% of average precipitation. There was little drought stress in Jeffrey pine in mid June (-5 to -8 bars). Mortality due to drought stress and bark beetles over the last two years combined was 2% (of 50 trees).

Inyo National Forest, Smokey the Bear Flats, Inyo County (37º45'N, 119º07' W, 2300 m). Precipitation was 60% of an intermittent, 80 year precipitation record (of which 60 yr were recoverable). In the last 8 years, 3 yrs had below 60% of average precipitation. There was little drought stress in Jeffrey pine in mid June (-5 to -10 bars). There has been no mortality (in 50 trees) during the past two years.

Tahoe National Forest, Verde Peak Rd, Nevada County (39º20:N, 120º05"W, 1780 m). Precipitation was 50% of an intermittent, 80 year precipitation record (of which 60 years were recoverable). In the last 8 years, 3 years were below 60% of average precipitation. This is a site 'to watch' for bark beetle activity due to the frequency of severe drought. There was little drought stress in Jeffrey pine in mid June. There has been no mortality (in 50 trees) during the past two years.

Lassen National Forest, Lassen County (40º25'N, 120º50' W, 1600 m). Precipitation was 50% of an 80 year precipitation record. In the last 8 years, 4 years were below 60% of average precipitation. This is a site 'to watch' for developing insect outbreaks due to the severity of the 2008 drought, and frequency of severe drought. There was little drought stress in Jeffrey pine in early June. In late August, some trees were moderately drought stressed. Trees experiencing a prescribed burn in fall of 2006 exhibited slightly more drought stress. Mortality from drought stress and bark beetle over the past two years was 9% (in 55 trees).

Sequoia National Forest, Stony Creek area (west side), Tulare County (36º40N, 118º45' 50"W, 2000 m). Precipitation was 92% of the.80 year mean annual precipitation record; this follows 2007 with 57% of average. In the last 8 years, 1 year was below 60% of average precipitation. This is a site 'to watch' for developing bark beetle activity due to the severity of the 2007 drought. Mid-June noon leaf water potentials suggested little drought stress in Jeffrey pine. In late August trees were moderately drought stressed. There was no mortality due to drought or bark beetle in control trees (this was part of a larger manipulative study) over the last 10 years.

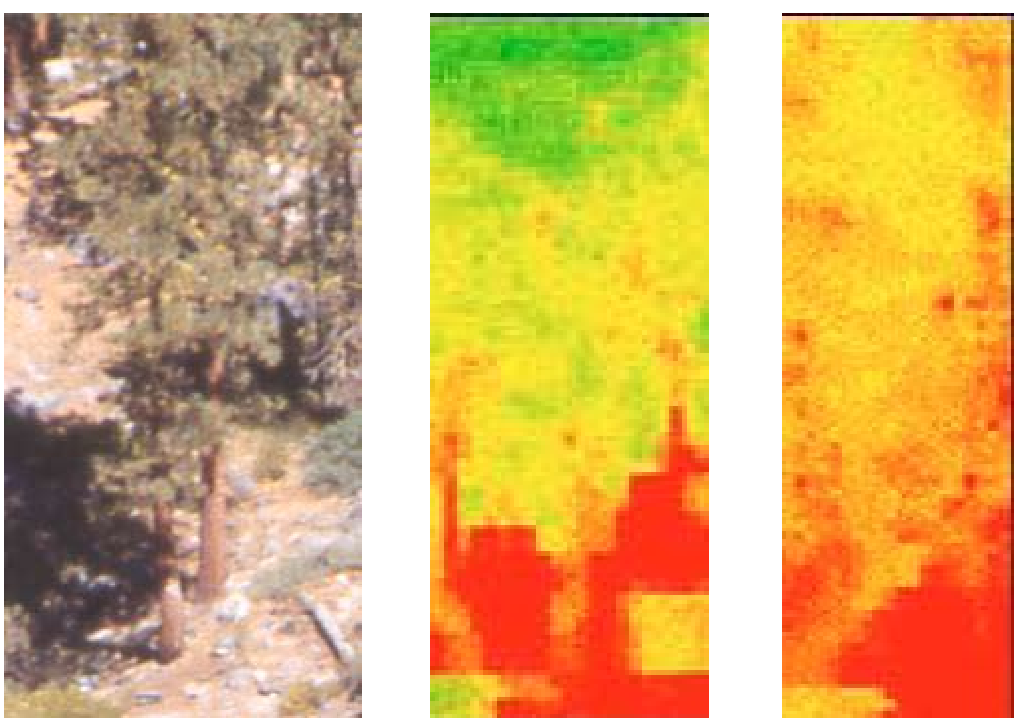


Figure 38a: Jeffery pine photographed from 2500m and enlarged.

Figure 38b: Same pine photographed at 10:30 AM using thermal imagery.

Figure 38c: Same pine photographed at 1:00 PM using thermal imagery. At this point most of the stomata have shut down.

Figures: N. Grulke and P. Riggan

A pilot project to develop a tool using thermal information from remotely sensed data to assess forest health was initiated in 2008. The series of photos (41a, b, and c) shows the stress in Jeffrey pine trees (41a) due to lack of moisture. When there is a lack of moisture, a tree does not transpire and temperatures rise. Temperature increase can be picked up by this thermal imagery. The Jeffrey pine in Figures 41b and 41c shows yellows to reds increasing which relates to greater moisture stress. The moisture stress can be an indication of drought stress.

Other Area Reports

A dry spring and the onset of summer heat caused leaves on many blue oaks to change color and begin falling in July in the northern Sacramento Valley. August weather was hotter than normal, advancing the trend through the remainder of the summer.

For the water year beginning October 1, 2007, precipitation for the Cascade / Northern Sierra area averaged well below normal, resulting in 2 consecutive dry years. While precipitation was slightly above average October 2007 – January 2008, precipitation remained well below normal through the remainder of the winter and spring, with only trace amounts of precipitation from March through June.

Inland, but still near the coast of northern California there was an excessive heat wave in July 2006 and a very early heat wave in May 2008. Many tree species have shown stress from the heat and/or drought. Flatheaded fir borer attacks in Douglas fir have been especially common.

Many coastal species growing on southerly and westerly aspects had needle or leaf injury. The most common symptom was drooped tips as a heat wave hit northern California in May at the same time when plant tissues were succulent.

Planted incense cedar wind breaks in the community of Mosquito Ridge (El Dorado County) were dying from drought with no insect or disease agents detected. The trees had previously had access to water from a pond, but this pond had dried up. Although 2007 and 2008 may have been too dry for optimal health and growth of many forest species in California, they were good years for cone production in red and white firs. While the white fir cone crop was variable across the region the red fir cone crop was very large from Lake Tahoe to the Sequoia National Forest.

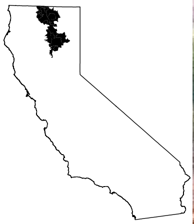
Two years of drought conditions are causing a number of species of trees to suffer dieback and mortality in southern California. In Orange County various chaparral species and shrub oaks succumbed to drought. The soil contained almost no moisture. No insect or disease agents were found. Various oak species were dying in the Lake Elsinore area (Riverside County). Trees were found in an area along a stream that has been completely dry for two years. Death of these oaks was attributed to the drop in the water table. Also in southern California white fir Christmas trees were dying near Yucaipa (San Bernardino County). The trees had previously been watered and the water source had dried up. No insect or disease agents were found at the site.

Seedling Mortality from Drought Stress

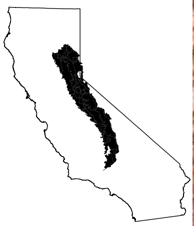
In Southern California seedlings are typically planted in March and April, soon after snow melt allows access. This helps to enable plants to establish before they encounter the stresses of dry, warm summer conditions. Yet, precipitation deficits reflected in the soil moisture at planting and amounts of precipitation after planting can vary greatly from year to year, affecting seedling survival. Likelihood of seedlings surviving after planting on the San Bernardino National Forest appears to have improved in the past year. In 2007, soils seemed to be drier than usual during planting, and observation was that survival at most sites ranged from 65-80 percent. One location north of Lake Arrowhead which had been

Figure 39: Crown injured true fir, Moonlight Fire, Plumas National Forest.

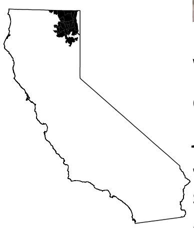
Photo: D. Cluck



M261D



M261E



M261G

replanted because of a failure the year before had a survival of only around 10%. Results from preliminary surveys of 2008 plantings on the San Jacinto Ranger District indicated survival of around 95%, with very few dead seedlings. Seedlings in both years were of Jeffrey, ponderosa, sugar, and Coulter pine.

Fire Injury

Conifers of all species found in northeastern California suffered various levels of fire injury in 2008 (M261D, E and G). Of interest for several fires was the relationship of crown scorch to actual crown kill in long needled pines and how long it took after the fire before this relationship could be determined. For example, many ponderosa and Jeffrey pine that sustained high levels of crown scorch in early season fires had good survival of twigs and buds. This was contrary to some of the literature that suggests that crown scorch and crown kill are nearly equal for long needled pines subjected to early season fires.

Where bud and twig survival was detected during post-fire field observations, the surviving crown, as determined by the presence of newly elongated foliage, was apparent within just a few weeks and very obvious by the end of August. Many of the fires that started in June coincided with the beginning of needle elongation and the surviving portions of the scorched crown continued to grow after the fire. The result was green tufts of needles with scorched tips. The length of the scorched portion of the needle tips depended on the extent of needle elongation just prior to sustaining fire injury. This information was important in determining the type of fire-salvage marking guideline land managers should implement when evaluating ponderosa and Jeffrey pine that sustained early season fire injuries.

The dry lightning strikes in mid-June caused thousands of fires in the north coastal and inland counties. The fires killed or scorched thousands of trees, affecting over 800,000 acres. The fires were early enough in the fire season to allow 2008 insect attacks. Spring and early summer of 2009 will likely reveal the extent of insect activity in and adjacent to the fires.

Frost Injury

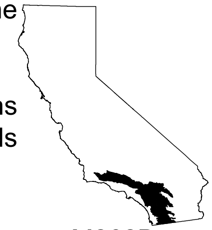
M261F

An unusually late frost hit the Sacramento Valley on April 20 damaging a variety of plants. Among native trees, interior live and blue oaks showed the most injury. Younger, succulent shoots and foliage was killed, while older, hardened tissue was undamaged. Dieback occurred as scattered patches within tree crowns and varied widely across the landscape. Areas of blue oak, black oak and other hardwood species in the foothills of Yuba and Nevada counties suffered frost injuries to new foliage during late April of 2008 as well. This event caused a general browning of newly elongating leaves that made many trees appear as if they had died. However, most of these trees and shrubs fully recovered by growing new foliage by early summer. (M261F)

Frost caused the loss of the entire Douglas fir cone crop at a seed orchard near Malakoff State Park, Nevada Co.

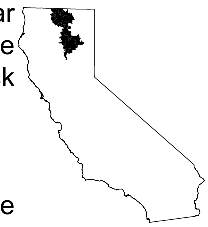
Blue gum eucalyptus on the Nipomo Mesa area (San Luis Obispo County) suffered dieback and defoliation from a severe spring freeze (temperatures reached below 20 degrees F for a couple of nights following the onset of the growing season). Hundreds of large eucalypts from a plantation established in the 1920's, and trees along nearby roadways, were completely defoliated and feared dead. Small branches were killed back. As the summer progressed, around 90% of the trees produced a new crop of leaves. Most of the trees killed by the freeze were young, small understory trees.

Late snowfall and cold temperatures in early June along the San Bernardino Mountains caused frost injury on California black oak. Browning of foliage tips and shriveled leaf ends were discovered north of Fawnskin and near Lake Arrowhead (M262B).



M262B

Salt Injury
Incense cedar foliage dieback was observed again in 2008 along State Highway 44 near the junction with State Highway 36. All size classes of trees within 30 feet of the road were affected. Several individuals lost significant portions of their crowns and were at a high risk of mortality (M261D).



M261D

Soil Compaction
Planted giant sequoia trees in Idyllwild (Riverside County) died in various locations. The trees were suffering from severe soil compaction or paving around the trees which killed the shallow roots and caused tree dieback and an overall unhealthy appearance. The continuing drought in southern California likely added to the tree stress.

Herbicide Injury
Acacias, understory shrubs and planted ground covers along State Highway 4 in Antioch (Contra Costa County) were killed or suffered severe chemical burn and die-back from herbicide spraying. All plant species growing in the area were affected. The acacias suffered dieback and burn symptoms but were not killed.

Ozone
Ozone injury is most likely to develop on current year's foliage as it is developing. The amount of ozone in the air and the weather are two factors that influence the degree of ozone injury that will be sustained. Ozone influences the trees ability to photosynthesize and can lead to premature crown thinning.

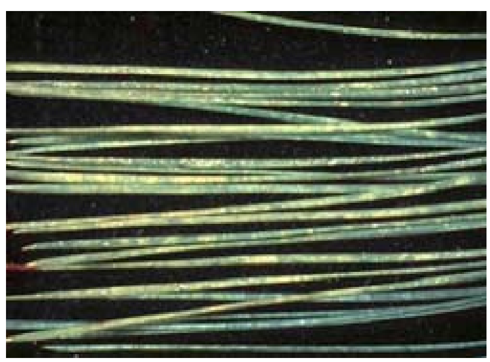


Figure 40: Ozone injury on the needles of ponderosa pine.

Photo: N. Grulke

The following is a brief summary of ozone needle injury in six National Forests:

San Bernardino National Forest, Holcomb Valley, San Bernardino County (34º20'N, 111º55'W 1800 m). Although there were some trees with foliar ozone injury even in current year needles at this site, overall, foliar ozone injury was low in 2008. Needle injury caused by ozone was frequently encountered along Highway 138 on the San Bernardino National Forest. In Bayliss Park, multiple pine species were found with yellow flecking on the needles. Years of stress due to ozone caused crown thinning in the pine species.

Sequoia National Forest, Troy Meadow (east side of Sierra Nevada); Tulare County (36º05'N, 117º52'37" W, 2350 m). No ozone injury was observed on current year foliage in 2008. Foliar ozone injury was low in older needle age classes, and was generally <6% chlorotic mottle on four-year-old needles.

Inyo National Forest, Smokey Bear Flats, Inyo County (37º45'N, 119º07' W, 2300 m). No ozone injury was observed on current year foliage in 2008. Foliar ozone injury was low in older needle age classes, and was generally <8% chlorotic mottle on 4 year old needles.

Tahoe National Forest, Verde Peak Rd, Nevada County (39º20:N, 120º05"W, 1780 m). No ozone injury was observed on current year foliage in 2008. Foliar ozone injury was low in older needle age classes, and was generally <8% chlorotic mottle on 4 year old needles.

Lassen National Forest, Lassen County (40º25'N, 120º50' W, 1600 m). No ozone injury was observed on current year foliage in 2008. Foliar ozone injury was low in older needle age classes, and was generally <10% chlorotic mottle on 4 year old needles. Several trees in a dense stand had 15% chlorotic mottle on 4 year old needles. These 'sensitive' trees were also infected with ants, pine needle scale, mistletoe, and Elytroderma spp.

Sequoia National Forest, Stony Creek area (west side), Tulare County (36º40N, 118º45' 50"W, 2000 m). Most trees had no ozone injury in current year foliage. Foliar ozone injury was moderate in older needle age classes, and was generally <15% chlorotic mottle in 4 year old needles. At least one third of the population had significant injury in 4 year old needles, from 25 to 95% chlorotic mottle.

Climate and Disease Interactions

2008 was exceptionally dry. This had a variety of influences on forest diseases depending, in large measure, on the disease in question. Many trees died from drought alone.

The influence of the drought on Sudden Oak Death was mixed. Because rain and humid conditions are required for the pathogen, *Phytopthora ramorum*, to colonize leaf tissue, produce spores and spread, the spread of this disease was minimal in 2008. However, trees which had already had cankers on their boles were very prone to dying as these cankers made it even more difficult for the crowns of affected trees to receive enough water.

Similarly many of the conifer trees that appeared to be dying from drought in 2008 were found to have their root systems colonized by root-rotting pathogens such as Heterobasidion annosum and blackstain.

In Northwestern California a surprisingly high number of Douglas fir were observed to be dying from bear injury. It is suspected that the drought, coupled with the injury to the vascular tissue on the bole, had combined to allow only sub-sufficient amounts of water to reach the crowns of the impacted trees.

Trees that suffered from a high level of mistletoe infestation were also prone to dying out as mistletoe is known to increase levels of moisture loss, substantially.

Likewise semi-soft bark tissue on drought-stressed trees was vulnerable to sunscald which in turn made parts of trees exposed to the afternoon sun especially vulnerable to the development of some canker diseases.

On the other hand, with the amount of drought in the state, there was also a remarkably lower incidence of many biotic foliar pathogens on both hardwoods and conifers.

Animal Damage

Porcupine feeding resulted in the girdling of boles and branches on several Jeffrey and ponderosa pine next to Eagle Lake, Lassen National Forest (Lassen County) (M261D). This was the first report of porcupine feeding in many years for this area. Examination of the affected stands revealed much older feeding injuries on several trees in close proximity to the current damage, suggesting that some characteristic of the site and/or trees was preferred by porcupines or porcupines are displaying some feeding site loyalty.

Figure 41: Bear damage to Douglas fir.

Photo: J. Marshall

Figure 42: Bear damage to Douglas fir.

Photo: J. Marshall

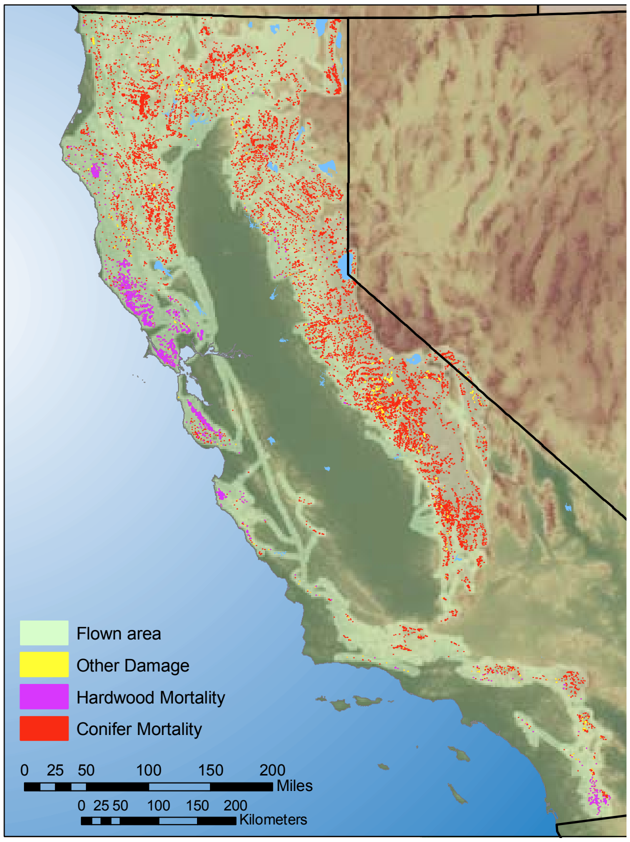
Continued bear damage to young growth redwood and, to a lesser degree, Douglas fir was reported for the area between Mad River and Redwood Creek, and east of Redwood Creek to Burnt Ranch in Humboldt County. In most cases it is suspected that the drought, coupled with the damage to the vascular tissue on the bole, had combined to allow only sub-sufficient amounts of water to reach the crowns of the impacted trees.

Pocket gophers were a common problem in plantations in the Quincy area of Plumas County at elevations above 4000 feet.

Livestock (cows), and to a lesser extent, deer and elk, browsing heavily on aspen sprouts and seedlings caused aspen regeneration failure in at least three aspen stands in the Black Butte Late Successional Reserve (LSR), Goosenest Ranger District, Klamath National Forest (Siskiyou County) (M261D).

Figure 43: Douglas fir sapling with typical pocket gopher damage.

Photo: J. Marshall



Map 9. Flight coverage and injury detected during the 2008 aerial surveys.

Map: Z. Heath

2008 Aerial Surveys

The US Forest Service Forest Health Protection program conducts aerial detection surveys nationally. Surveys have been conducted in the Pacific Southwest Region annually since 1994. Data is collected using a digital aerial sketch mapping system following national protocols in order to provide standardized information on biotic and abiotic injury to California's forested ecosystems (Map 9).

Approximately 41 million acres were flown in California in 2008, including almost 20 million acres of National Forest Service land and over 16 million acres of private land.

Approximately 217,000 acres with mortality or injury caused by biotic agents such as bark beetles and diseases were observed and mapped in California. This is down over 100,000 acres from last year. The reduction can be attributed partly to large areas of forested land that burned over in 2007 and 2008 that typically contain tree mortality, especially the large acreages of oak mortality in the Big Sur area that burned in the Basin Fire in 2008.

High levels of conifer mortality caused by the mountain pine beetle were observed in the northwest portion of the state (Klamath, Modoc, and Shasta-Trinity National Forests) affecting lodgepole, ponderosa, and white bark pine, similar to last year.

Live oak and tanoak mortality from sudden oak death appeared to have decreased from previous years. Oak mortality in San Diego County, now attributed to goldspotted oak borer, remained constant.

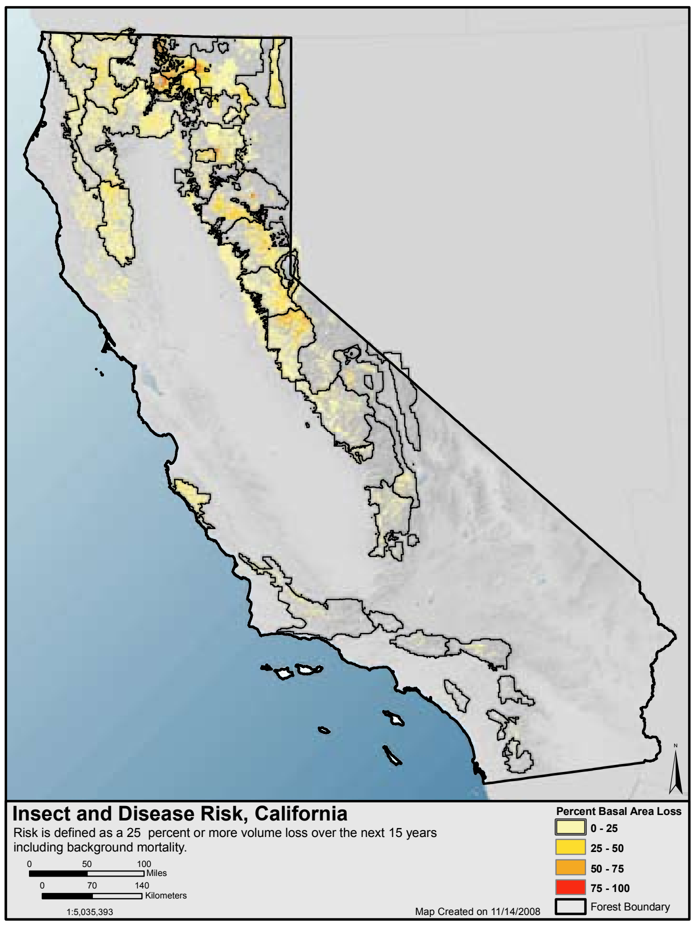
Several defoliators mapped in previous years such as Douglas fir tussock moth and California oak worm were not observed. Large areas of black oak defoliation were mapped in the Tahoe & Sierra National Forests that were attributed to an unknown leafminer.

To download the final aerial detection survey report and learn more about aerial detection monitoring, view standards and metadata, or to download printable maps and data, go to: www.fs.fed.us/r5/spf/fhp.

Insect and Disease Risk Modeling

Insect and Disease Risk Modeling was initiated in 1995. A national multi-criterion framework has been established to facilitate a standardized modeling approach across all forest health regions to create a seamless set of risk models for forest insects and diseases. Model criteria and parameters vary across the landscape for each host type. Scientific literature, professional knowledge, and statistical data form the basis for the development of the host-specific models. Input criteria for the models include: stand density index (SDI), basal area (BA), quadratic mean diameter (QMD), precipitation, relative humidity, elevation, percent canopy cover, and temperature regime, among others.

For the National Risk Map, risk is defined as a 25 percent or more volume loss over the next 15 years including background mortality. National and Regional risk map products have evolved out of the initial efforts of the Risk Map team. For the National Risk Map, standardized national data sets have been modeled from Forest Inventory and Analysis (FIA) plots for BA, QMD, SDI, and canopy cover at a spatial resolution of one kilometer. Download the National Insect and Disease Risk Map data at: www.fs.fed.us/foresthealth/technology/nidrm.shtml.



Map 10. Insect and disease risk map of California

Map: M. Woods

While the methodology for the California risk map (Map 10) is the same as for the national product, the regional product relies on higher resolution datasets for all input data. The Regional Risk Map uses Existing Vegetation Data (EVEG, USDA Forest Service, Region 5, Remote Sensing Laboratory) and CA-GAP data sets as the vegetation base layers for host type at a spatial resolution of 30 meters. Other input layers including SDI and QMD are also generated at a spatial resolution of 30 meters (see Map 10 for an example). The risk models, both regionally and nationally, are constantly evolving as new data becomes available and new scientific literature relating to forest health is published. The regional map will be updated as regional vegetation data layers are updated. A planned update for the national map is 2010. This new update will utilize higher resolution datasets standardizing them to 30m nationwide.

Risk maps are available on the USDA Forest Service, Forest Health Monitoring website at: http://www.fs.fed.us/r5/spf/fhp/fhm/risk/.

LIST OF COMMON AND SCIENTIFIC NAMES

INSECTS

Common Name	Scientific Name
Recent Introductions	
Asian citrus psyllid	*Diaphorina citri*
Asian longhorned beetle	*Anoplophora glabripennis*
Banded elm bark beetle	*Scolytus schevyrewi*
European gypsy moth	*Lymantria dispar Linnaeus*
Goldspotted oak borer	*Agrilus coxalis*
Light brown apple moth	*Epiphyas postvittana*
Mediterranean pine engraver	*Orthotomicus erosus*
Red-haired pine bark beetle	*Hylurgus ligniperda*
Walnut twig beetle	*Pityophthorus juglandis*
Bark Beetles and Wood Borers	
Ambrosia beetles	*Monarthrum spp.*
Bronze birch borer	*Agrilus anxius*
California fivespined ips	*Ips paraconfusus*
California flatheaded borer	*Melanophila californica*
Cedar bark beetle	*Phloeosinus sp*.
Douglas-fir beetle	*Dendroctonus pseudotsugae*
Fir engraver	*Scolytus ventralis*
Fir roundheaded borer	*Tetropium abietis*
Flatheaded fir borer	*Melanophila drummondi*
Jeffrey pine beetle	*Dendroctonus jeffreyi*
Monterey pine ips	*Ips mexicanus*
Mountain pine beetle	*Dendroctonus ponderosae*
Oak bark beetles	*Pseudopityophthorus spp.*
Pine engraver	*Ips pini*
Pine engravers	*Ips spp.*
Pinyon ips	*Ips confusus*
Red turpentine beetle	*Dendroctonus valens*
Western oak bark beetle	*Pseudopityophthorus pubipennis*
Western pine beetle	*Dendroctonus brevicomis*
Wood borers	*Semanotus sp.*
Yellow Phoracantha	*Phoracantha recurva*
Defoliators	
California oakworm	*Phryganidia californica*
Douglas-fir tussock moth	*Orgyia pseudotsugata*
Fall webworm	*Hyphantria cunea*
Fruittree leafroller	*Archyps argyrosphila*
Gypsy moth	*Lymantria dispar*
Lodgepole pine needleminer	*Coleotechnites milleri*
Pandora moth	*Coloradia pandora*
Pine catkin sawflies	*Xyela* spp.
White fir sawfly	*Neodiprion abietis*
Other Insects	
Aspen gall wasp	unknown
Black Pineleaf Scale	*Nuculaspis californica*
Cooley spruce gall aphid	*Adelges cooleyi*
Douglas-fir twig weevil	*Cylindrocopturus furniss*

Gouty pitch midge	*Cecidomyia piniinopis*
Jeffrey pine needleminer	*Coleotechnites sp. near milleri*
Needleminers	*Coleotechnites spp*.
Pine needle sheathminer	*Zelleria haimbachi*
Pine reproduction weevil	*Cylindrocopturus eatoni*
Ponderosa pine tip moth	*Rhyacionia zozana*
Ponderosa pine twig scale	*Matsucoccus bisetosus*
Red gum lerp psyllid	*Glycaspis brimblecombei*
Scales	*Physokermes sp.*
Sequoia pitch moth	*Synanthedon sequoiae*
Spruce aphid	*Elatobium abietinum*
The obtuse sawyer	*Monochamus obtusus*
Western pineshoot borer	*Eucosma sonomana*

DISEASES AND THEIR CAUSAL PATHOGENS

Common Name	Scientific Name
Cankers	
Alder canker	*Phytophthora siskiyouensis*
Chinquapin canker	*Phytophthora cambivora*
Chinkapin canker	Unknown
Cytospora canker of true fir	*Cytospora abietis*
Diplodia blight of pines	*Sphaeropsis sapinea (Diplodia pinea)*
Douglas-fir canker	Unknown
Madrone canker	*Nattrassia mangiferae* and *Botryosphaeria dothidea*
Phomopsis canker	*Phomopsis lokoyae*
Pitch canker	*Fusarium circinatum*
Sooty Bark Canker	*Encoelia pruinosa (=Cenangium singulare)*
Thousand Cankers Disease of Black Walnut	*Geosmithia sp. and Fusarium solani*
Declines	
Oak Decline	Unknown
Chaparral Death and Decline	Unknown
Incense-cedar decline	Unknown
Sudden oak death	*Phytophthora ramorum*
Mistletoes	
Douglas-fir dwarf mistletoe	*Arceuthobium douglasii*
Gray pine dwarf mistletoe	*Arceuthobium occidentale*
Lodgepole Pine Dwarf Mistletoe	*Arceuthobium americanum*
Mountain hemlock dwarf mistletoe	*Arceuthobium tsugense* subsp. *mertensianae*
Pinyon pine dwarf mistletoe	*Arceuthobium divaricatum*
Red fir dwarf mistletoe	*Arceuthobium abietinum* f. sp. *magnificae*
Sugar pine dwarf mistletoe	*Arceuthobium californicum*
Western dwarf mistletoe	*Arceuthobium campylopodum*
White fir dwarf mistletoe	*Arceuthobium abietinum* f. sp. *concoloris*
Foliage Diseases	
Elytroderma Needle Cast	*Elytroderma deformans*

Ink Spot of Aspen	*Ciborinia whetzelii*
Stigmina Leaf Spot Of Port-Orford-Cedar	*Stigmina thujina*
Sugar pine needle cast	*Lophodermella arcuata*

Nursery Diseases

No Common Name	*Cylindrocarpon destructans*
No Common Name	*Phytophthora ramorum*

Leaf Scorch

Sweetgum Leaf Scorch	*Xylella fastidiosa*
Maple Leaf Scorch	*Xylella fastidiosa*

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*
Phytophthora root rot	*Phytophthora cinnamomi*
Schweinitzii root disease	*Phaeolus schweinitzii*

Rots

Butt Rot	*Phellinus tremulae*

Rusts

Eucalyptus/guava/myrtle rust	*Puccinia psidii*
Incense-cedar Rust	*Gymnosporangium libocedri*
Stalactiform Rust	*Cronartium coleosporioides (= C. stalactiformae)*
Western gall rust	*Endocronartium harknessii*
White pine blister rust	*Cronartium ribicola*

True Mistletoes

True mistletoe	*Phoradendron* spp.
Oak Mistletoe	*Phoradendron serotinum ssp. tomentosum (Phoradendron villosum)*

TREES

Common Name	Scientific Name
Conifers	
Pines	
Aleppo pine	*Pinus halepensis*
Bishop pine	*Pinus muricata*
Coulter pine	*Pinus coulteri*
Foxtail pine	*Pinus balfouriana*
Gray pine	*Pinus sabiniana*
Italian stone pine	*Pinus pinea*
Jeffrey pine	*Pinus jeffreyi*
Knobcone pine	*Pinus attenuata*
Lodgepole pine	*Pinus contorta* var. *murrayana*
Monterey pine	*Pinus radiata*
Ponderosa pine	*Pinus ponderosa*
Singleleaf pinyon	*Pinus monophylla*
Sugar pine	*Pinus lambertiana*

Torrey pine	*Pinus torreyana*
Western white pine	*Pinus monticola*
Whitebark pine	*Pinus albicaulis*
True firs	
Red fir	*Abies magnifica*
White fir	*Abies concolor*
Others	
Brewer spruce	*Picea breweriana*
Douglas-fir	*Pseudotsuga menziesii*
Engelmann spruce	*Picea engelmannii*
Giant sequoia	*Sequoia giganteum*
Incense-cedar	*Calocedrus decurrens*
Mountain hemlock	*Tsuga mertensiana*
Port-Orford-cedar	*Chamaecyparis lawsoniana*
Coast redwood	*Sequoia sempervirens*
Sitka spruce	*Picea sitchensis*
Hardwoods	
Oaks	
Oaks	*Quercus* spp.
California black oak	*Quercus kelloggii*
Coast live oak	*Quercus agrifolia*
Shreve Oak	*Quercus parvula* var. *shrevei*
Other	
Aspen	*Populus tremuloides*
Big-leaf maple	*Acer macrophyllum*
California bay laurel	*Umbellularia californica*
California sycamore	*Platanus racemosa*
Camphor	*Cinnamomum camphora*
Chinkapin	*Castanopsis chrysophylla*
Eucalyptus	*Eucalyptus* spp.
Mountain mahogany	*Cercocarpus* sp.
Pacific madrone	*Arbutus menziesii*
Poison oak	*Toxicodendron diversilobum*
Poplar	*Populus* spp.
Tanoak	*Lithocarpus densiflorus*
Willow	*Salix* spp.

Ecological Units of California

Throughout this publication are a number of maps that indicate sections of California; these sections are also referenced within the text. The maps indicate the regions of California impacted by individual pests. The pest may only be found in a few spots, or throughout the region. These ecological sections were defined in Ecoregions and Subregions of the United States (Bailey, et al. 1994). Bailey's map depicts ecosystems of regional and subregional extents, using a hierarchical order to define smaller ecosystems within larger ecosystems.

The ecological sections referenced in this publication are as follows:

261A – Central California Coast Section

263A – Northern California Coast Section

M261A – Klamath Mountain Section

M261B – Northern California Coast Ranges Section

M261C – Northern California Interior Coast Ranges Section

M261D – Southern Cascades Section

M261E – Sierra Nevada Section

M261F – Sierra Nevada Foothills Section

M261G – Modoc Plateau Section

M262A – Central California Coast Ranges Section

M262B – Southern California Mountains and Valleys Section

2008 Forest Health Publications

Angwin, Peter A. 2007. Forest Health Protection input for vegetation section of the Whiskeytown-Shasta-Trinity National Recreation Area Guide. USDA Forest Service, Pacific Southwest Region, Forest Health Protection Report No. N08-02. 13 p.

Angwin, Peter A. 2008. Biological evaluation of proposed Godfrey Ranch, Tompkins and Masterson thinning projects- Salmon/Scott River Ranger District. USDA Forest Service, Pacific Southwest Region, Forest Health Protection Report No. N08-06. 6 p.

Angwin, Peter A. 2008. Evaluation of Humbug mastication thinning project. USDA Forest Service, Pacific Southwest Region, Forest Health Protection Report No. N08-07. 3 p.

Angwin, Peter A. 2008. Refuge LSR Western Bark Beetle Initiative project proposals and priority order of NCA Service Area WBBI proposals for 2009. USDA Forest Service, Pacific Southwest Region, Forest Health Protection Report No. N08-08. 5 p.

Bulaon, B. and M.MacKenzie 2008. Evaluation of Current Tree Decline and Mortality: Sherwin Creek and Glass Creek Campgrounds, and Deadman Road. USDA Forest Service, Forest Health Protection, FHP Report SS08-1.

Bulaon, B. and M.MacKenzie 2008. Pitch Canker at Benicia State Recreation Area. USDA Forest Service, Forest Health Protection, FHP Report SS08-2.

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FOREST PEST DETECTION REPORT

I. FIELD INFORMATION (See instructions on reverse)

1. County:	2. Forest (FS only):	3. District (FS only):
4. Legal Description: T. R. Section (s) 5. Date:	6. Location: UTM:	7. Landownership: National Forest ☐ Other Federal ☐ State ☐ Private ☐
8. Suspected Cause of Injury: 1. Insect ☐ 5. Chemical ☐ 2. Disease ☐ 6. Mechanical ☐ 3. Animal ☐ 7. Weed ☐ 4. Weather ☐ 8. Unknown ☐	9. Size of Trees Affected: 1. Seedling ☐ 4. Sawtimber ☐ 2. Sapling ☐ 5. Overmature ☐ 3. Pole ☐	10. Part(s) of Tree Affected: 1. Root ☐ 5. Twig ☐ 2. Branch ☐ 6. Foliage ☐ 3. Leader ☐ 7. Bud ☐ 4. Bole ☐ 8. Cone ☐
11. Species Affected:	12. Number Affected:	13. Acres Affected:

14. Injury Distribution: 1. Scattered ◯ 2. Grouped ◯	15. Status of Injury: 1. Decreasing ◯ 2. Static ◯ 3. Increasing ◯	16. Elevation:
17. Plantation? 1. Yes ◯ 2. No ◯	18. Stand Composition (species):	19. Stand Age and Site Class: Age: Class:

20. Stand Density:	21. Site Quality:

22. Pest Names (if known) and Remarks (symptoms and contributing factors):

23. Sample Forwarded: 1. Yes ◯ 2. No ◯	24. Action Requested: 1. Information only ☐ 2. Lab Identification ☐ 3. Field Evaluation ☐	25. Reporter's Name:	26. Reporter's Agency:

27. Reporter's Address, email and Phone Number:

email: ______________________ phone: ______________

Address 1: ______________________

Address 2: ______________________

City: ______________ State: ______________ Zip: ________

II. Reply (Pest Management Use)

28. Response:

29. Report Number:	30. Date:	31. Examiner's Signature:

R5-3400-1 (Rev. 3/02)

Completing the Detection Report Form

Heading (Blocks 1-7): Enter all information requested. In Block 6, **LOCATION**, provide sufficient information for the injury center to be relocated. If possible, attach a location map to this form.
Injury Description (Blocks 8-15): Check as many boxes as are applicable, and fill in the requested information as completely as possible.
Stand Description (Blocks 16-21): This information will aid the examiner in determining how the stand conditions contributed to the pest situation. In Block 18 indicate the major tree species in the overstory and understory. In Block 19, indicate the stand age in years and/or the size class (seedling-sapling; pole; young sawtimber; mature sawtimber; overmature or decadent).
Pest Names (Block 22): Write a detailed description of the pest or pests, the injury symptoms, and any contributing factors.
Action Requested (Block 24): Mark "Field Evaluation" only if you consider the injury serious enough to warrant a professional site evaluation. Mark "Information Only" if you a reporting a condition that does not require further attention. All reports will be acknowledged and questions answered on the lower part of this form.
Reply (Section II): Make no entries in this block; for examining personnel only. A copy of this report will be returned to you with the information requested.
Handling Samples: Please submit injury samples with each detection report. If possible, send several specimens illustrating the stages of injury and decline. Keep samples cool and ship them immediately after collection. Send them in a sturdy container, and enclose a completed copy of the detection report.

Your participation in the Cooperative Forest Pest Detection Survey is greatly appreciated. Additional copies of this form are available from the Forest Service - Forest Health Protection, and from the California Department of Forestry and Fire Protection.

The Cooperative Forest Pest Detection Survey is sponsored by the California Forest Pest Council. The Council encourages federal, state, and private land managers and individuals to contribute to the Survey by submitting pest injury reports and samples in the following manner:

Federal Personnel: Send all detection reports through appropriate channels. Mail injury samples with a copy of this report to one of the following offices:

USDA Forest Service State and Private Forestry Forest Health Protection 1323 Club Drive Vallejo, CA 94592	Forest Health Protection Shasta-Trinity National Forest 3644 Avtech Parkway Redding, CA 96002	Forest Health Protection Stanislaus National Forest 19777 Greenley Road Sonora, CA 95370
Forest Health Protection Lassen National Forest 2550 Riverside Drive Susanville, CA 96130	Forest Health Protection San Bernardino National Forest 602 Tippecanoe Avenue San Bernardino, CA 92408-2677	

State Personnel: Send all detection reports through channels. Mail injury samples with a copy of this report to one of the following appropriate offices:

Forest Pest Management CA Dept. of Forestry & Fire Protection P.O. Box 944246 Sacramento, CA 94244-2460	Forest Pest Management CA Dept. of Forestry & Fire Protection 6105 Airport Road Redding, CA 96002
Forest Pest Management CA Dept. of Forestry & Fire Protection 17501 N. Highway 101 Willits, CA 95490	Forest Pest Management CA Dept. of Forestry & Fire Protection SLU Meridian Station 4050 Branch Road Paso Robles, CA 93446

Private Land Managers and Individuals: Send all detection reports and samples to the closest California Department of Forestry and Fire Protection office listed above.

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