California Forest Pest Conditions - 2007

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California Forest Pest Conditions Report - 2007

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Cover: Declining old-growth foxtail pine (*Pinus balfouriana*) on Box Camp Mountain, Klamath National Forest, in 2005 due to the exotic white pine blister rust and recent mountain beetle attacks. Foxtail pine is endemic to California, where its disjunct distribution is limited to high-elevations in the mountains of northwestern California and southern Sierra Nevada. Photo: Deems Burton.

THE CALIFORNIA FOREST PEST COUNCIL

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

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

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

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

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

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

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

This report, ***Forest Pest Conditions in California 2007***, is compiled for public and private forest land managers and other interested parties to keep them informed of conditions on forested land in California, and as a historical record of forest insect and disease trends and occurrences. The report is based largely on information provided by three sources: (1) information generated by Forest Health Protection, Pacific Southwest Region, USDA Forest Service, while making formal detection surveys and biological evaluations, (2) reports and surveys of conditions on private lands provided by personnel of the California Department of Forestry and Fire Protection, and (3) the statewide Cooperative Forest Insect and Disease Survey, in which federal, state, and private foresters and land managers participate.

This report was prepared by Forest Health Protection, USDA Forest Service, Pacific Southwest Region in cooperation with other member organizations of the Council, published by the California Department of Forestry and Fire Protection and distributed by the two agencies. The report is available in color at the following website:

http://www.fs.fed.us/r5/spf/publications/pestconditions/

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FOREST PEST CONDITIONS IN CALIFORNIA 2007

ABSTRACT

This report describes the important forest insect and disease conditions in California in 2007. 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. Douglas-fir tussock moth pheromone detection cooperative survey
2. White pine blister rust screening program
3. Sudden oak death monitoring
4. Aerial detection surveys
5. 30-meter insect and disease risk model

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

This report contains information on the major biotic agents and abiotic agents that influenced tree health in California for 2007. Information was submitted by entomologists, pathologists, botanists and other forest health specialists.

Drought conditions returned to California following two consecutive years of above normal precipitation in 2005-2006. The statewide snowpack condition in April was just 39% of average (Table 1). Water conditions improved slightly as the year progressed, but dry conditions continued with annual precipitation for the state at 63% of normal in 2007. Moderate to extreme drought conditions existed for all hydrologic regions of California (Figure 1). Drought stress was reported on hardwoods and conifers in several areas around the state. Specifically, premature leaf senescence was noted in blue oak, incense cedar and California buckeye. Drought may have also contributed to the ongoing mortality of coast live oak and Engelmann oak in southern California.

Table 1. Snow course measurements for California in April. April 1 is the normal date of maximum accumulation for the season.

Region	% Average 4/1/2005*	% Average 4/1/2006	% Average 4/1/2007
North Coast	95%	139%	44%
Sacramento	110%	111%	37%
San Joaquin Valley	161%	133%	43%
Tulare Lake	170%	133%	33%
North Lahontan	142%	124%	39%
South Lahontan	167%	144%	26%
Statewide Average (weighted)	**137%**	**125%**	**39%**

Data courtesy of the California Cooperative Snow Survey, Department of Water Resources.

Despite the drought conditions, only 267,000 acres of tree injury from biotic factors were mapped by aerial survey in 2007, a decrease in the overall injury mapped in 2006 and well below the 14-year average (Figure 2). Injury includes tree mortality, defoliation, foliage discoloration, branch flagging and top kill. Drought-related tree stress and bark beetle activity has potential to increase, with crown fade due to late season bark beetle attacks not becoming apparent until 2008. Although overall aerially-detected injury decreased statewide, there were highly notable disturbances caused by forest insects and diseases throughout the state.

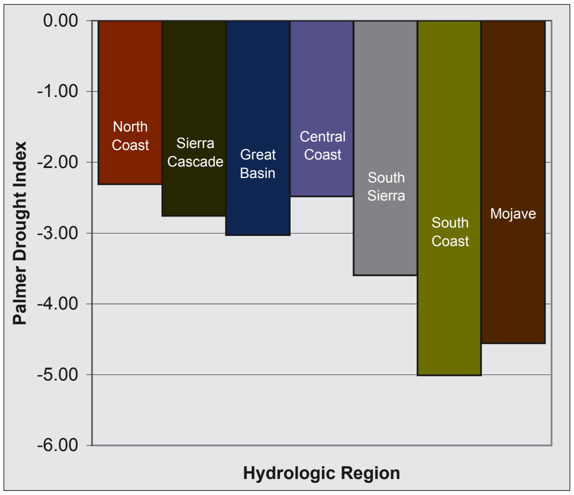


Figure 1. Average 2007 Palmer Drought Indices for the seven hydrologic regions in California.

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.

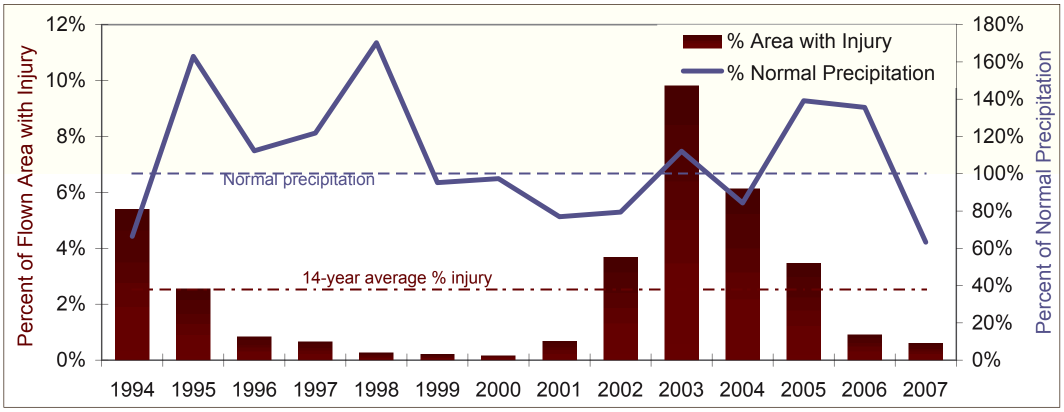


Figure 2. Aerial survey results: Percent of flown area with injury and percent of normal precipitation; 1994-2007 (excludes fire-caused mortality).

Notable Pest Activity

Figure 3. Jeffrey pine beetle larvae exposed following bark removal, Snowshoe Campground, Toiyabe National Forest.

Photo: S. Smith.

Mortality of Jeffrey pine caused by **Jeffrey pine beetle** continued to increase on the east side of the Sierra Nevada range this year from the Inyo National Forest north to the Lake Tahoe Basin Management Unit (Figure 3). Mortality was also detected at higher levels further north in the Sierra Nevada and southern Cascade ranges. Jeffrey pine mortality is expected to increase in these areas in 2008 as many green infested trees were observed late in the fall of 2007.

Figure 4. Continued mountain and western beetle-caused mortality of ponderosa, lodgepole, western white and whitebark pine on the Warner Mountain Ranger District

Photo: D. Cluck

Mountain and western pine beetle activity remained low in 2007, as evidenced by low levels of tree mortality, with the exception of a few areas on the Modoc, Lassen and Klamath National Forests. Specifically, continued mountain and western beetle-caused mortality was observed on ponderosa, lodgepole, western white and whitebark pine on the Warner Mountain Ranger District, Modoc National Forest (Figure 4). There was an increase in mountain pine beetle activity in lodgepole pine on the Lassen National Forest near Ashpan Flat and Big Lake, Hat Creek Ranger District, near Wilson Lake, Almanor Ranger District, and along the southern boundary of Lassen Volcanic National Park. Several thousand acres of lodgepole pine were killed by mountain pine beetle on the Goosenest Ranger District, Klamath National Forest in 2007.

Most of California experienced low to moderate levels of **fir engraver** activity in 2007. However, fir engraver-caused tree mortality in conjunction with overstocking, dwarf mistletoe, cytospora canker and annosus root disease continued at the same elevated levels seen in 2005-6 in a few areas of California. Elevated levels of white fir mortality continued on the Warner Mountain, Big Valley and Doublehead Ranger Districts, Modoc National Forest and throughout the entire red fir belt on the Tahoe National Forest. Red fir mortality was also noted at higher elevations throughout the Sierra Nevada range.

Figure 5. Douglas-fir tussock moth outbreak near Bear Mountain lookout, Shasta County.

Photo: D. Owen

Defoliation from **Douglas-fir tussock moth** decreased in the Sierra and Stanislaus National Forests and was not detected in Yosemite National Park in 2007. However the Douglas-fir tussock moth outbreak in Shasta County entered its third year with a significantly larger area of defoliation. Over 7,000 acres of defoliation were mapped in the vicinity of Bear Mountain, east of McCloud Flats (Figure 5), including both the Shasta-Trinity National Forest and private lands (USFS Aerial Survey Program). There was an increase from 2,455 acres of defoliation mapped in 2006.

Leaf injury caused by an **unknown oak leaf miner** was observed in black oak again in 2007 at a few locations on the Plumas and Tahoe National Forests. However, the defoliation was greatly reduced from the levels seen during the previous two years. Specimens were collected this past spring and are pending identification (Figure 6). No trees or individual branches have died as a result of defoliation by this insect for the past three years.

The **light brown apple moth,** an invasive species originally from Australia, was 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. Although mainly an agricultural pest, the light brown apple moth could affect several tree species including eucalyptus, fir, oak, pine, poplar, spruce and willow. Containment and eradication efforts are ongoing.

Figure 6. Unknown oak leaf miner larvae and damage on black oak.

Photo: D. Cluck

Port-Orford-cedar root disease continues to infest and kill Port-Orford-cedar throughout the host range in California. The disease was present along the main stem of the Sacramento River from Dunsmuir to Shotgun Creek (Siskiyou and Shasta Counties). A survey at Castle Crags State Park detected root disease and dying trees upstream from the suspension foot bridge on the Sacramento River (Figure 7). All Port-Orford-cedar in the diseased area will be cut as part of an ongoing effort to slow disease spread and mitigate its impacts within the Park. The Trinity River drainage (Trinity and Shasta Counties) remains to be the only uninfested major river drainage within the range of Port-Orford-cedar.

Figure 7. Port-Orford-cedar mortality due to Port-Orford-cedar root disease in Castle Crags State Park on the Sacramento River.

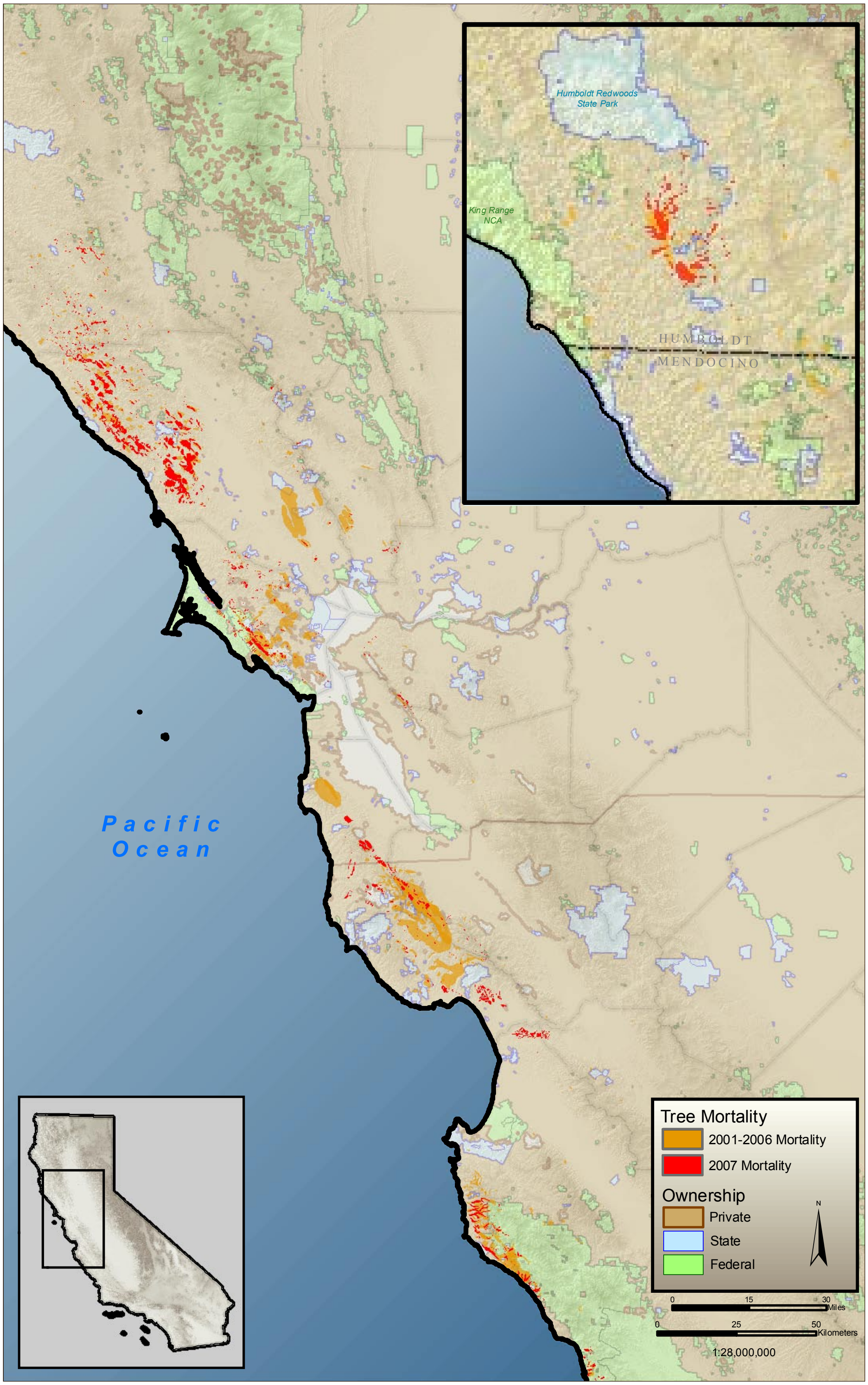
Photo: P. Angwin

Sudden oak death continued to be one of the most significant forest health issues in California. The distribution of sudden oak death did not change significantly (it was not detected in any additional counties), but the wet springs of 2005 and 2006 favored inoculum production and incited a severe second wave of mortality in 2007 in several

Figure 8. 2007 tanoak mortality in Big Sur.

Photo: Kerri Frangioso

Map 1. 2007 aerial detection survey results: hardwood mortality.



coastal California counties (Map 1). In 2006, observations indicated that more tanoak died than in any previous year. In 2007, mortality in coast live oak, which generally take longer to die than tanoaks, caused increased alarm. This disease was especially apparent in the densely populated urban-wildland interface areas in Sonoma (Figure 8), Marin, San Mateo, Santa Clara and Santa Cruz Counties where homeowners are dealing with fatally infected trees and the increasein the number of hazard trees.

Figure 9. Sugar pine branch mortality and top fade caused by the fungus *Cronartium ribicola*, white pine blister rust, near Monumental Ridge, American River Ranger District, Tahoe National Forest.

Photo: S. Smith, August. 2007.

Elevated levels of dieback and mortality from **white pine blister rust** occurred among pole-sized to mature western white pine on Latour State Forest, Shasta County. The rust was also detected on the east slope of Mt. Lassen, killing branches and tops of western white and whitebark pine trees. White pine blister rust was found causing branch and stem dieback in sugar pine on Monumental Ridge, American River Ranger District (Figure 9) and killing the tops of some western white pine seedlings along the trail from Squaw Valley Village to the tramway summit in Tahoe National Forest. The White Pine Blister Rust Resistance Program continued screening candidates suspected of carrying major gene resistance to blister rust; this work is summarized in this report.

Pitch canker increased within the coastal pitch canker zone of infestation in California in 2007; but did not spread outside of the previously infested areas. Notable areas of infestation included Benicia State Recreation Area (Solano County)(Figure 10), Point Lobos State Park (Monterey County), Point Reyes National Seashore (Marin County), Santa Maria (Santa Barbara County) and Arroyo Grande (San Luis Obispo County).

Figure 10. Branch kill on Monterey pines infected with pitch canker, Benicia State Recreation Area.

Photo: M. MacKenzie

Annosus root disease continued to cause scattered pockets of ponderosa pine mortality on McCloud Flats, Shasta-McCloud Management Unit, Shasta-Trinity National Forest.

Black stain root disease continued to kill young and old ponderosa and Jeffrey pine trees east of State Highway 139 between Willow Creek Campground and Heartrock on the Big Valley Ranger District, Modoc National Forest (Figure 11). Black stain root disease continued to cause tree mortality at the Mud Flow Research Natural Area, Shasta-McCloud Management Unit, Shasta-Trinity National Forest. Black stain root disease centers were also widespread and scattered in Douglas-fir plantations in the Wild Azbill Timber Sale Area, Round Valley Indian Reservation and in two Douglas-fir plantations near Black Mountain, north of Orleans, CA.

Figure 11. Black stain root disease center affecting ponderosa and Jeffrey pine trees east of State Highway 139 between Willow Creek Campground and Heartrock, Big Valley Ranger District, Modoc National Forest.

Photo: B. Woodruff

Insect Conditions

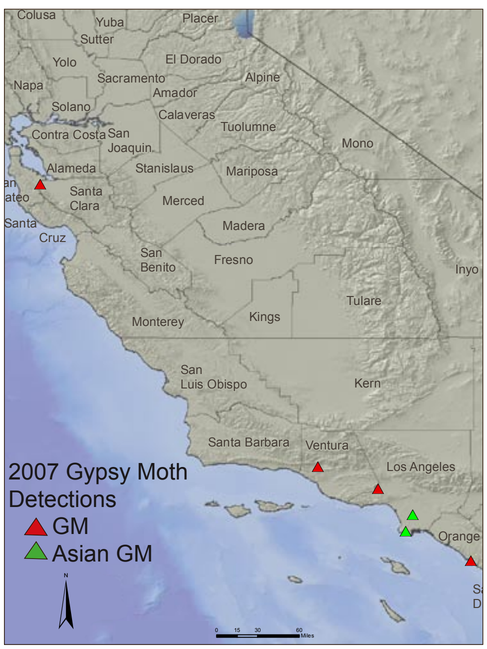
Introduced Insects

Asian Longhorned Beetle
Anoplophora glabripennis
California Department of Food and Agriculture, USDA Animal and Plant Health Inspection Service inspectors and Forest Service Smokejumpers continued ground survey procedures for Asian longhorned beetle (ALB) around the 2005 detection site in Sacramento County and the trace forward locations in Los Angeles and San Diego Counties. Over 24,400 trees were surveyed as of January 2007, none of which showed any signs of ALB.

In addition to ground and tree climbing surveys, potted sentinel trees (*Acer mono* (=*pictum*) or *A. truncatum*) were treated with a DEMAND insecticide and placed in the ¼ mile buffer zone of the 2005 detection. The sentinel trees were treated at a nursery then transported to the trapping site. Results from the sentinel tree program were also negative.

As a preventative measure, the Sacramento County Agricultural Commissioner's Office and Neighborly Pest Management (under contract) treated over 185 host trees with the prophylactic systemic insecticide Merit 75 WP and Imicide (imidacloprid).

Gypsy Moth
Lymantria dispar



Map 2. 2007 Detections of gypsy moths in California.

Data courtesy California Department of Food and Agriculture.

During the 2007 season, over 22,000 traps were deployed and monitored as part of California's program to detect and delimit gypsy moth (GM), Asian GM (AGM), or Siberian (SGM) infestations. Trap density in the 19 coastal California counties was three traps per square mile and two traps per square mile in the remaining 39 counties. Ports receiving shipments from foreign origins were trapped at twenty-five traps per square mile for AGM and SGM. Traps were deployed in urban areas and in rural residential areas of 300 or more homes per square mile. Nine moths were trapped at six sites in four counties in 2007, compared to seventeen moths at eleven sites in nine counties during 2006.

Five of the find sites were single-moth catches, and one find site had multiple moth catches. Seven of the moth catches were determined to be North American gypsy moth. Two of the moth catches were determined to be AGM; a single AGM was trapped in the City of Rolling Hills Estates, Los Angeles County, and a single AGM was trapped in the City of Los Angeles (Map 2). These were the fifth and sixth AGM's trapped in the state. Delimitation traps were placed for all of these finds. The Rolling Hills Estates AGM find was trapped in a delimitation response area from a previous AGM find at San Pedro in 2005.

Light Brown Apple Moth
Epiphyas postvittana
Two adult light brown apple moths (LBAM), an invasive species from Australia, were collected in California by a private collector in Berkeley in 2006. The California Department of Food and Agriculture (CDFA) was subsequently informed on February 6, 2007 that

the Berkeley specimens had been positively identified as LBAM by an Australian expert. Traps baited with synthetic female pheromones (male attractant) were placed and moths were first collected on February 27. To date, over 15,000 moths have been captured in the following 12 counties: Alameda, Contra Costa, Los Angeles, Marin, Monterey, Napa, San Francisco, San Luis Obispo, San Mateo, Santa Clara, Santa Cruz, and Solano (Map 3).

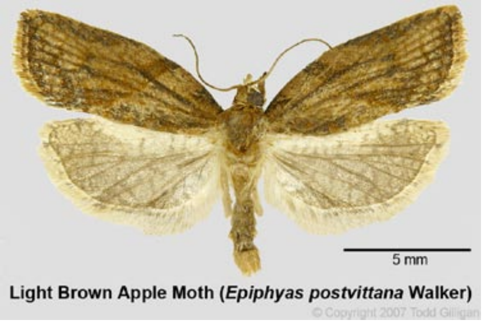


Figure 12. Adult light brown apple moth.

Photo: Todd Gilligan

Larvae feed on over 2,000 different hosts, from herbaceous ground cover to trees. Agricultural crops include almond, apple, apricot, avocado, cherry, citrus, fig, nectarine, peach, pear, persimmon, plum, walnut, blackberry, blueberry, boysenberry, currant, grape, kiwifruit, raspberry, alfalfa, bean, carrot, corn, pepper, potato, strawberry, and tomato. Ornamental and native hosts also include eucalyptus, fir, holly, oak, pine, poplar, spruce, willow, butterflybush, camellia, ceanothus, euonymus, jasmine, photinia, pittosporum, pyracantha, rhododendron, rose, aster, buttercup, chrysanthemum, clover, daisy, geranium, lupine, periwinkle, and plantain.

A Technical Working Group (TWG) composed of experts from Australia, New Zealand, and the United States was formed by the USDA to evaluate eradication and management options. The TWG concluded that CDFA and USDA should adopt a long-term goal of eradicating LBAM from the continental United States. They recommended that efforts be made to contain the infestation while area wide eradication technologies such as mating disruption and sterile insect techniques are researched and developed.

In order to contain the infestation, an existing mating disruption formulation called ISOMATE LBAM Plus® was used against isolated finds. This treatment consisted of deploying twist ties containing the female pheromone attached to a standard wire trap hanger and accompanied by a placement card. These were placed at a density of 250 ties per acre, and released pheromone at least 3 months. Mating disruption is a technique used to reduce successful mating by releasing high amounts of female pheromones that “confuse” males such that they are unable to find and mate with female moths.

Aerial mating disruption treatment with a new formulation, Checkmate OLR-F, was initiated in the Monterey and Santa Cruz areas. This formulation employed microcapsules to release the pheromone over a 30 day period. Checkmate OLR-F® was applied aerially Sept. 9-11 over 60 square miles of the Monterey/Seaside area. It contained omnivorous leafroller pheromone, which was shown to be 80-90% as effective as LBAM pheromone for mating disruption in New Zealand, although more pheromone had to be used. A new formulation with the full LBAM pheromone blend, Checkmate LBAM-F®, was used for all subsequent treatments. One more treatment was performed during October 24-26 in Monterey/Seaside area, and an initial treatment occurred during November 8-11 in the Santa Cruz and Salinas areas. Further treatments are on hold pending evaluation of these treatments and of alternative formulations.

Further information on LBAM activities in California can be found by clicking on Light Brown Apple Moth under Hot Topics on the CDFA website at http://www.cdfa.ca.gov.

Map 3. Detections of the light brown apple moth in the San Francisco Bay Area (updated 1/11/2008).

Light brown apple moth was also detected in Los Angeles (not shown), San Luis Obispo and Santa Cruz Counties.

Map courtesy of the California Department of Food and Agriculture.

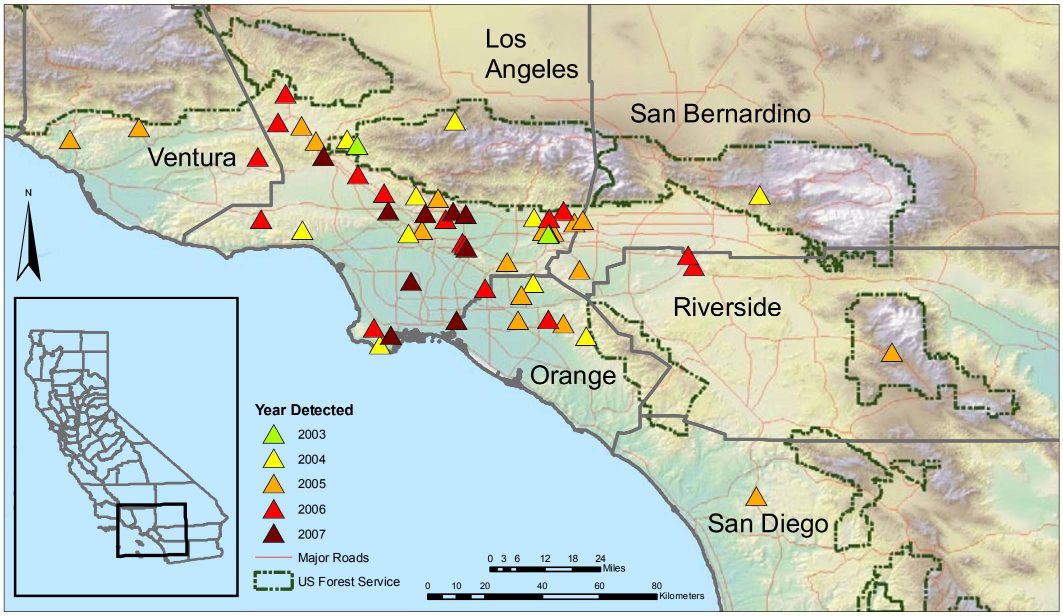
Mediterranean Pine Engraver Beetle
Orthotomicus erosus

The Mediterranean pine engraver was a new exotic bark beetle for North America when it was found in May 2004 in baited flight traps in Fresno, California by the California Department of Food and Agriculture. California remains the only place where Mediterranean pine engraver has been detected in North America. It has since been found abundantly throughout California's southern Central Valley (Fresno, Kern, Madera, Merced, and Tulare Counties) in flight traps or feeding in the phloem of cut logs of Aleppo, Canary Island, and Italian stone pines. A few beetles have also been captured in traps in Monterey and Sacramento, but to date breeding populations have not been found in these counties. Observations in California indicate that this species overwinters as larvae, pupae, and adults beneath the bark surface. In the Central Valley, the Mediterranean pine engraver initiates flight in late February, has perhaps 3-4 generations per year, and continues to fly until November-December.

In the laboratory under no-choice conditions, *O. erosus* was able to complete development in various native pines (*Pinus banksiana*, *P. contorta* murrayanae, *P. jeffreyi*, *P. lambertiana*, *P. monophylla*, *P. ponderosa*, *P. radiata*, *P. resinosa*, *P. sabininana*, *P. strobus*, *P. taeda*), exotic pines (*P. canariensis*, *P. halepensis*, *P. pinea*, *P. sylvestris*), and other conifers (*Larix laricina*, *Picea glauca*, *Picea mariana*, *Pseudotsuga menziesii*). Development did not occur in *Abies concolor*, *Calocedrus decurrens* or *Sequoia sempervirens* (J.C. Lee, PSW, unpublished data).

Redhaired Pine Bark Beetle
Hylurgus ligniperda

Established populations of the redhaired pine bark beetle were first found in North America in New York in 2000. In California, redhaired pine bark beetle was first detected by the California Department of Agriculture in July 2003 at two locations in Los Angeles County: Bear Divide Guard Station, Angeles National Forest and Frank G. Bonelli Regional County Park. Since then, hundreds of redhaired pine bark beetles have been collected in flight traps in Southern California each year from 2004 to 2007 (Map 4). So far, redhaired pine bark beetle has been found in six counties in Southern California (Los Angeles, Orange, Riverside, San Bernardino, San Diego and Ventura). The only new find in 2007 was that of a single beetle in a green waste pile near the El Dorado Regional Park in Long Beach. Flight bioassays in Los Angeles County suggested that redhaired pine bark beetle could have at least two generations a year, in the spring and summer.



Map 4. Detections of the red-haired pine bark beetle in southern California, 2003-2007.

Map created by Z. Heath based on data from R. L. Penrose (CDFA), J.C. Lee, D.G. Liu, and S.J. Seybold (all three, PSW).

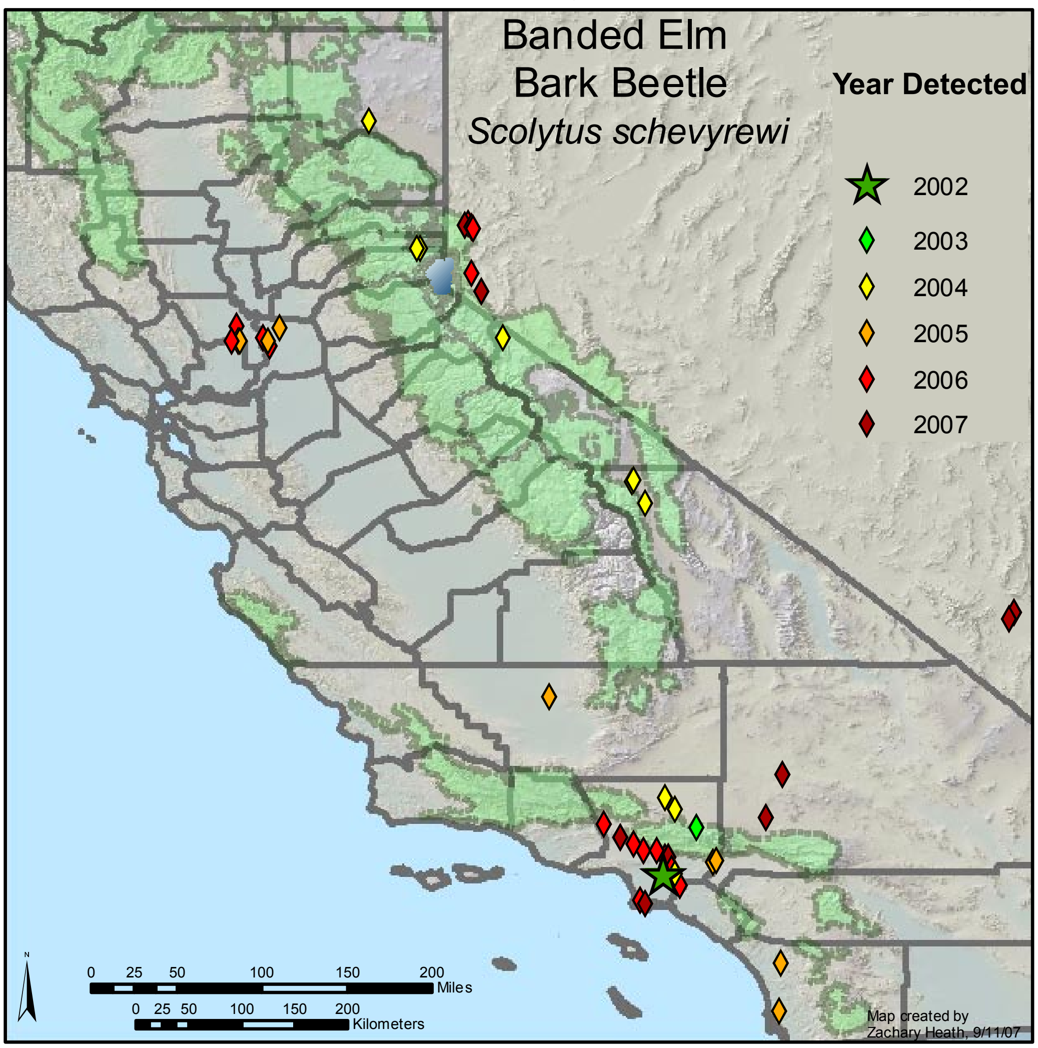
Adult redhaired pine bark beetles are attracted to freshly cut stumps, slash and logging debris for breeding. In unhealthy *Pinus* spp., the beetle usually breeds in thick bark near the base of the stem or in large exposed roots. Newly emerged adults may attack seedlings and stressed pole-sized trees. Adult beetles carry *Ophiostoma* and *Leptographium* spp. fungi, which have been implicated in staining and pine root decline diseases, respectively. A March 2005 survey in California revealed that redhaired pine bark beetle feeds and reproduces in the phloem of large dimensional cut logs of Aleppo and Canary Island pines.

Banded Elm Bark Beetle
Scolytus schevyrewi

Banded elm bark beetles were collected in funnel traps throughout California in 2007 (Map 5). This Siberian species has been slowly widening its range in the United States and was first detected in California in 2002. The relative abundance of *S. schevyrewi* and *S. multistriatus*, the long-established invasive European elm bark beetle, were monitored from April to September 2007 in Davis, Woodland, and Sacramento, California (Yolo and Sacramento Counties). *S. schevyrewi* comprised 13% of the elm bark beetles trapped. Near the border in Reno and Minden, Nevada, *S. schevyrewi* comprised of 68% of elm bark beetles trapped. From flight studies conducted in the field, *S. schevyrewi* showed a strong attraction to freshly cut Siberian elm. The beetle showed no preference between uninfested and infested elms suggesting that it mainly responds to host odors and may not produce an aggregation pheromone pheromone (J.C. Lee, PSW, unpublished data).

Map 5. Detections of the banded elm bark beetle in California, 2002-2007.

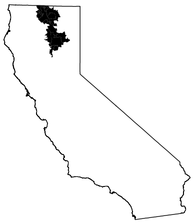
Map created by Z. Heath.



Bark Beetles

For the water year beginning October 1, 2006, precipitation for California averaged well below normal, following 2 consecutive years of above normal precipitation in 2005-2006. One of the most significant anomalies was an exceptionally dry and cold January 2007. For the most part, reports of bark beetle-caused mortality remained low. With the dry spring, however, tree stress and bark beetle-caused tree mortality is expected to increase with potential late season bark beetle attacks not resulting in crown fade until 2008.

Fir Engraver
Scolytus ventralis



M261D

M261G

M261E

Fir engraver activity was scattered and occurred at low levels as evidenced by low levels of tree mortality throughout northeastern California except in the following areas where significant numbers of attacked trees were observed: Thousand Lakes Wilderness area, Hat Creek Ranger District; areas northeast of Eagle Lake, Eagle Lake District, Lassen National Forest (M261D); the Warner Mountains, especially at the south end near Blue Lake, Warner Mountain District, Modoc National Forest (M261G); near Bucks Lake on the Feather River District, Plumas National Forest; and from the I-80 corridor to French Meadows Reservoir, Truckee and American River Districts, Tahoe National Forest. Tree mortality in most of the affected areas was closely associated with overstocking, dwarf mistletoe, cytospora canker and annosus root disease (M261E).

The fir engraver beetle also caused top kill of white fir on 100 acres in mixed conifer type at Haight Mountain, Goosenest Ranger District, Klamath National Forest (M621D).

Fir engraver activity in the southern Sierra Nevada range has remained at background levels for the past two years, occurring mainly in red fir. Reduced levels of mortality were due to above normal precipitation in 2005; however large areas of red fir mortality were detected in the higher elevations by General's Highway, near Big Meadow (Hume Lake Ranger District, Sequoia National Forest). Ground surveys determined that dwarf mistletoe, Cytospora canker, fir roundheaded borer, tree density and drought stress were contributing factors to red fir decline in these areas. There was also notable fir mortality east of Dorst Creek Campground, at the headwaters of Halstead Creek, Sequoia Kings Canyon National Park.

Jeffrey Pine Beetle
Dendroctonus jeffreyi

Jeffrey pine mortality caused by Jeffrey pine beetle continued to increase on the east side of the Sierra Nevada range this year and higher levels of tree mortality were also detected in the southern Cascade range. Specifically, the Heart Rock and Rush Creek areas of the Big Valley Ranger District, Modoc National Forest, had many small groups of fading Jeffrey pine this year (M261G). Most mortality continues to be in the larger diameter classes but group kills also included smaller diameter trees (Figure 13). Mortality was also observed on the Eagle Lake Ranger District, Lassen National Forest, near Round Valley Butte, Pole Springs, Grays Flat and along State Highway 36 near Fredonyer Pass (M261D). Scattered small groups and individual tree mortality caused by Jeffrey pine beetle was found throughout the Beckwourth Ranger District of the Plumas National Forest and the Sierraville and Truckee Ranger Districts, Tahoe National Forest (M261E).

Figure 13. Jeffrey pines killed by Jeffrey pine beetle, Eagle Lake Ranger District, Lassen National Forest.

Photo: R. Crowther

Scattered Jeffrey pine mortality was also noted in the Lake Tahoe Basin, particularly east of Sand Harbor along the east shore (Washoe County, NV) and from Tahoe City to DL Bliss

State Park on the west shore (M261E). Over 350 Jeffrey pine beetle-killed trees were detected on private land along Dollar Creek. High levels of tree mortality were observed south of Lake Tahoe along State Hwy 89 between Meyers and the junction of State Highway 89 and State Highway 88 (Figure 14). This area includes the Lake Tahoe Basin Management Unit, the Toiyabe National Forest and nearby private lands. Mortality of large diameter trees was readily apparent at Luther Pass which serves as the boundary between the two Forest Service units (Figure 15). Several Jeffrey pine group kills were also noted east of Armstrong Pass and south of Horse Meadow on the Toiyabe National Forest.

Figure 14. Jeffrey pines killed by Jeffrey pine beetle along Hwy 89 south of Meyers, CA. Photo shows trees that died in 2006 (group kill on right) and trees fading in 2007 (fading trees on left).

Photo: S. Smith, July 2007.

Figure 15. Jeffrey pines killed by Jeffrey pine beetle. Photo shows trees killed in 2006 (group kill on right) and trees killed in 2007 (fading trees on left).

Photo: S. Smith, July 2007.

Small groups of Jeffrey pine beetle-killed trees observed in 2006 have increased in size up to 60 trees in some areas on the Inyo National Forest. Large diameter Jeffrey pines were killed in many of the popular campgrounds. At Sherwin Creek Campground, beetle-killed trees were quickly turned into firewood. *Armillaria* root disease was detected in windblown trees in a Jeffrey pine beetle-infested pocket of old growth Jeffrey pine along Deadwood Road (Figure 16). Jeffrey pine beetles killed large diameter Jeffrey pines within the boundaries of the 2002 McNally Fire, Sequoia National Forest. Attacked trees had various levels of fire injury but most had substantial injury to the cambium near ground line. Single tree mortality and group kills were detected.

Figure 16. *Armillaria* root disease and Jeffrey pine beetle infested Jeffrey pines in the Inyo National Forest.

Photo: M. MacKenzie

M261E

Jeffrey pine beetle-caused tree mortality is expected to increase in these areas in 2008 as many green infested trees were observed late in the fall of 2007. FHP personnel documented both emergence of the overwintering generation and a second generation near Luther Pass this year (S. Smith, unpublished data, 2007). Subsequent life history studies are planned for 2008 to better document the Jeffrey pine beetle life cycle. A new project led by personnel from PSW and UC-Davis will investigate the linkage between drought and Jeffrey pine beetle activity on the Lassen, Tahoe, Inyo, Sequoia, and San Bernardino National Forests.

Mountain Pine Beetle
Dendroctonus ponderosae

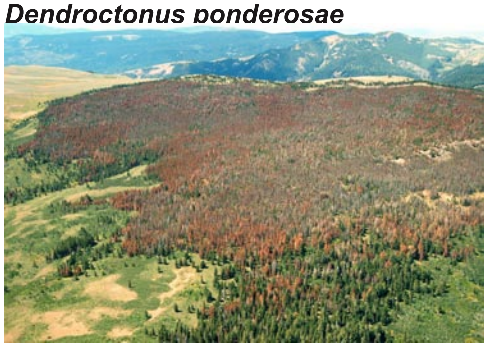


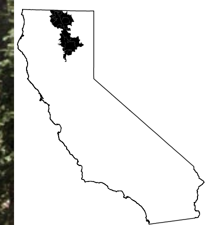
Figure 17. Mountain pine beetle infestation on Mt. Bidwell, Modoc National Forest.

Photo: Z. Heath

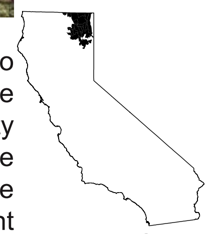
Mountain pine beetle activity continued to increase in lodgepole pine, western white pine and whitebark pine in 2007. The highest mortality levels were again observed on the Modoc National Forest where mountain pine beetle continued to cause extensive mortality of ponderosa pine, lodgepole pine, western white pine and whitebark pine. The Warner Mountain range has some of the highest mortality levels in California, especially on Mount Bidwell, where nearly all suitable hosts have been killed (Figure 17, 18). Other areas of mortality in the northern part of the Warner Mountain range include Mount Vida, Fandango Valley and Buck Mountain. Lodgepole and whitebark pine mortality also continued in the south end of the range near Pepperdine, Squaw Peak, and between Warren Peak and Eagle Peak. In addition, high levels of lodgepole pine mortality continued on the SE side of the Warner Mountains near Sworinger Reservoir and Red Rock Mountain, Warner Mountain District (M261G), and near Medicine Lake, Doublehead Ranger District, Modoc National Forest (M261D).

Figure 18. Western white pines killed by mountain pine beetle near Dismal Swamp, north of Mt. Bidwell, Warner Mountains Ranger District, Modoc National Forest.

Photo: S. Smith Sept. 2007.



M261D



M261G

A large increase in lodgepole pine mortality was detected near Ashpan Flat and Big Lake, Hat Creek Ranger District and near Wilson Lake, Almanor Ranger District, Lassen National Forest, and along the southern boundary of Lassen Volcanic National Park. Elevated levels of lodgepole pine mortality were also noted near McCoy Flat Reservoir, along the Susan River and at Norvell Flat, Eagle Lake Ranger District, Lassen National Forest. Scattered lodgepole and ponderosa pine mortality associated with mountain pine beetle attacks can be found throughout most of the eastside of the Lassen National Forest (M261D). Mountain pine beetle activity in ponderosa pine was also noted in this region on lands managed by the Bureau of Land Management northeast of Fredonyer Peak, Lassen County (M261G).

The Plumas National Forest had elevated levels of mountain pine beetle-caused lodgepole pine mortality near Lake Davis, Beckwourth Ranger District and scattered sugar pine mortality was observed throughout the western portion of the Forest (M261E).

The Tahoe National Forest continued to have elevated lodgepole pine mortality along Prosser Creek, by Boreal Ridge near Interstate 80, and southeast of Independence Lake, Truckee Ranger District. Lodgepole pine mortality in the Alder Creek area also increased during 2007, Truckee Ranger District. New areas of lodgepole pine mortality were recorded near Jackson Meadows Reservoir and Webber Lake, Sierraville Ranger District (M261E).

The Lake Tahoe Basin Management Unit had an increase of mountain pine beetle activity in 2007. Increased levels of lodgepole pine mortality were detected around the Heavenly Valley Ski Area and on the western side of the Sierra Nevada range along Ward Creek. Group kills were estimated to range between twenty to nearly 475 trees in some locations. There was scattered tree mortality (individual trees and small group kills) caused by mountain pine beetle around the rest of Lake Tahoe. Most of the affected trees were lodgepole pines; however some sugar pines were also attacked. Mountain pine beetle-caused mortality of sugar pine was elevated around Sugar Pine Point on the west shore of Lake Tahoe (M261E). High levels of lodepole pine mortality were observed near Dangberg Camp near the State Hwy 89 and State Hwy 88 junction, Toiyabe National Forest (M261E)(Figure 19). Elevated levels of lodgepole mortality were also observed along

Figure 19. Lodgepole pine trees killed by mountain pine beetle at Dangberg Camp near the State Hwy 89 and 88 junction, Toiyabe National Forest.

Photo: S. Smith, Sept. 2007.

the Carson River between Kit Carson Campground and the State Hwy 89 and State Hwy 88 junction. Mountain pine beetle was also active in the Sequoia National Forest, killing over 8,500 trees in Quaking meadow along the Western Divide Highway 107.

In northwestern California, mountain pine beetles attacked and killed lodgepole pine on several thousand acres in the Shovel Creek watershed, and on several hundred acres at Tamarack Flat, Goosenest District, Klamath National Forest (M621D). Mortality has been continuing for several years (Figure 20).

Figure 20. Lodgepole pole pine mortality caused by mountain pine beetle, Goosenest Ranger District, Klamath National Forest.

Photo: Z. Heath

Red Turpentine Beetle
Dendroctonus valens
This beetle is typically considered a secondary damage agent that responds to recent tree wounding due to fire or other physical damage. The red turpentine beetle was detected on fire scorched pines throughout the forests of California and was specifically noted attacking pines in the 3,000 acre area of the Angora Fire (2007) on the southwest side of Lake Tahoe.

Direct mortality (especially in large mature trees) from red turpentine beetle is uncommon but was detected in the Aspen Campground, Sequoia National Forest. A 30 inch plus diameter ponderosa pine was killed by red turpentine beetle, with attacks as high as 40 feet on the bole.

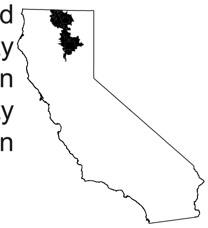
Western Pine Beetle
Dendroctonus brevicomis

M261G

Western pine beetle-caused ponderosa pine mortality occurred at about the same levels as last year for most of northeastern California. There was a slight increase in mortality in the Warner Mountains but other areas remained at or below levels observed in 2006. The lower western slopes of the Warner Mountains had a slight increase in mortality, especially in the Willow and Lassen Creeks in the north Warner Mountains and at Fitzhugh, Soup and Mill Creeks in the south Warner Mountains, Warner Mountain Ranger District, Modoc National Forest. The Wildhorse Reservoir and Weed Valley areas west of Goose Lake and the Happy Camp Mountain area of the Devils Garden Ranger District again had elevated levels of western pine beetle-caused ponderosa pine mortality. Many small pockets of dead ponderosa pine were also observed southwest of Adin near Boyd Hill, Big Valley Ranger District (M261G).

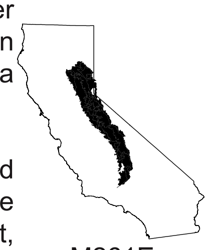
Ponderosa pine mortality continued on the Eagle Lake Ranger District (Lassen National

Forest) south of Campbell Mountain, near Ashurst Mountain, Hall's Flat, Grays Valley and in the Martin Creek area south of Pine Creek Valley. Areas where high levels of mortality were observed over the past couple of years such as Hog Flat Reservoir and the Susan River, Eagle Lake Ranger District, had less mortality in 2007. One larger area of mortality was observed just south of the Straylor Fire, Hat Creek Ranger District (M261D), Lassen National Forest.



M261D

The Plumas National Forest had a few areas of elevated ponderosa pine mortality near Pulga, Feather River Ranger District, and Frenchman Lake on the Beckwourth Ranger District. One larger group kill was observed on the Tahoe National Forest near Michigan Bluff, American River Ranger District (M261E). Low levels of scattered individual ponderosa pine mortality could be found throughout both of these Forests during 2007.



M261E

Western pine beetle activity remained low in northwestern California where beetle-caused ponderosa pine mortality was scattered over several hundred acres in the Hi Grouse area south and southeast of the 4 Corners Snowmobile Park, Goosenest Ranger District, Klamath National Forest (M261D).

In the southern Sierra Nevada range the number of small group kills of ponderosa pine increased in high use campgrounds, on private property and along roadsides. Roots on many of the trees were stressed by road and foot compaction. Two large western pine beetle infested ponderosa pines were felled by CALTRANS along the Western Divide Highway, at the entrance of the Trail of a 100 Giants campground, Sequoia National Forest. Tree mortality on the trail was limited to these two ponderosa pines.

Engraver Beetles

California Fivespined Ips
Ips paraconfusus
The California fivespined ips engraver beetle was responsible for top kill, and some whole tree mortality, of approximately 30 ponderosa pines in the 45+ year-old Volcano plantation near Foresthill, CA, American River Ranger District, Tahoe National Forest. These trees were previously underburned resulting in minor injuries to cambium and possibly to the roots. These injuries, combined with the shallow soil found at the micro-site, and the very dry conditions, have made these pines highly susceptible to successful attacks. California fivespined ips activity was also observed on very large (up to 40" DBH) ponderosa pines near Lake Spaulding, Placer County. These trees were growing on very rocky soils, upslope from the Bear River. Other locations with California fivespined ips activity were near Malakoff Diggins State Park, Nevada County (Figure 21), near the Knyack exit along Interstate 80, Placer County, and near Pulga on the Feather River District, Plumas National Forest (M261E).

Figure 21. Top kill caused by California fivespined ips near Malakoff Diggins State Park, Nevada County.

Photo: S. Smith

***Ips* spp.**
An outbreak of *Ips* was observed in recently thinned pine plantation near the Badger Hill Nursery, Eldorado National Forest. The beetles infested thinned trees that were cut in

long bolts (> 4 feet) and left in a partially shaded area. Two standing live trees were killed by new beetles that had emerged from the slash.

Figure 22. Ips infested slash piles at Camp Nelson, Sequoia National Forest.

Photo: B. Bulaon

Slash and a residual small pines in a plantation north of Camp Nelson, Sequoia National Forest, was infested early this summer primarily by *Ips*, but the trees also had some mountain pine beetle attacks. Slash (including bolts) was piled up which impeded phloem dessication (Figure 22). Ten residual trees were infested and killed by beetles that had emerged from the slash. Slash was treated about a month later.

Smaller Western Pine Engraver
Ips latidens
Two large ponderosa pines in Potter Valley, Mendocino County, had dying lower limbs. *Ips latidens* was found in one limb.

Figure 23. Pine engraver beetle-caused top-kill on large diameter ponderosa pine near the community of Genesee, Plumas County.

Photo: D. Cluck

M261E

Pine Engraver
Ips pini
Top-kill caused by the pine engraver beetle was detected on large diameter ponderosa pine near the community of Genesee, Plumas County. The activity appeared to be directly associated with the recent closure of an old irrigation ditch which had held water consistently for many years (M261E) (Figure 23).

Wood Boring Beetles

Flatheaded Fir Borer
Melanophila drummondi
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 (M261A). Landowners near Cedar Creek, Little Cow Creek, Gregory Creek, and the Pit River Arm of Shasta Lake expressed concern for the health of Douglas-fir. 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.

The flatheaded fir borer was the primary mortality agent of hundreds of Douglas-fir in Napa, Sonoma, and Mendocino Counties. Ninety-four dead and dying trees were examined at CDF's Mendocino Unit Headquarters (a.k.a. Howard Forest) in Mendocino County in May, 2007. Tree diameters ranged from 3.1 to 41.0 inches dbh. Of the 94 red crowned trees, 80 were killed by flatheaded fir borer (3.1 to 41.0 in. dbh), 2 were killed by Douglas-fir engraver beetle, *Scolytus unispinosus* (3.5 to 4.2 in. dbh), and 14 were top-killed, fading, or had galleries too high to sample (4.1 to 30.7 in. dbh). All trees were inspected at the root collar for signs of root diseases. None was found.

The trees died in the spring, indicating they were attacked during or before 2006, despite the above average rainfall in 2005 and 2006. A prolonged heat wave in July 2006 may have played a role in either beetle attacks or accelerated mortality.

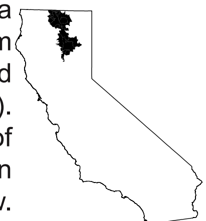
Defoliators

California Oakworm
Phryganidia californica
The California oakworm caused severe defoliation of various oak species in the mountain communities of the central coast. Many trees were completely defoliated.

Extensive moth flights and minor tanoak defoliation were also detected in Humboldt Redwoods State Park (a few miles north of Miranda in Humboldt County) and in Greenwood Ridge (inland from the town Elk in Mendocino County).

California Tortoise Shell
Nymphalis californica
A springtime infestation of the California Tortoise Shell led to approximately 1,000 acres of defoliated *Ceanothus* spp. in the Noyo and Ten Mile drainages of Mendocino County. Pupal populations were estimated at hundreds per bush. Roads and other surfaces were reportedly covered with 20-to-30 adult butterflies per square foot. By the end of summer, the *Ceanothus* spp. refoliated but did not look vigorous.

Douglas-Fir Tussock Moth
Orgyia pseudotsugata
The Douglas-fir tussock moth outbreak in Shasta County entered its third year with a significant increase in acres defoliated compared to 2006. USFS Aerial Survey Program personnel mapped 7,130 acres of defoliation in the vicinity of Bear Mountain, east of McCloud Flats, including both the Shasta-Trinity National Forest and private lands (M261D) (Map 6). In 2006, 2,455 acres of defoliation were mapped. The additional acres had light levels of defoliation. Along Bear Mountain Road, an area that had some of the heaviest defoliation in 2006, larval numbers were initially high but declined quickly and remained fairly low. Defoliation was principally on new foliage. Heavy feeding on older needles causes most of the injury. Most of this type of feeding occurred in 2006, considered the peak year of the outbreak. Populations of parasitic flies were quite high in all areas visited, but there was little evidence of virus. No egg masses were found during surveys conducted in October along Bear Mountain Road and near Red Tank Springs. Lack of egg masses led surveyors to conclude that the outbreak had declined. No defoliation is expected in 2008.

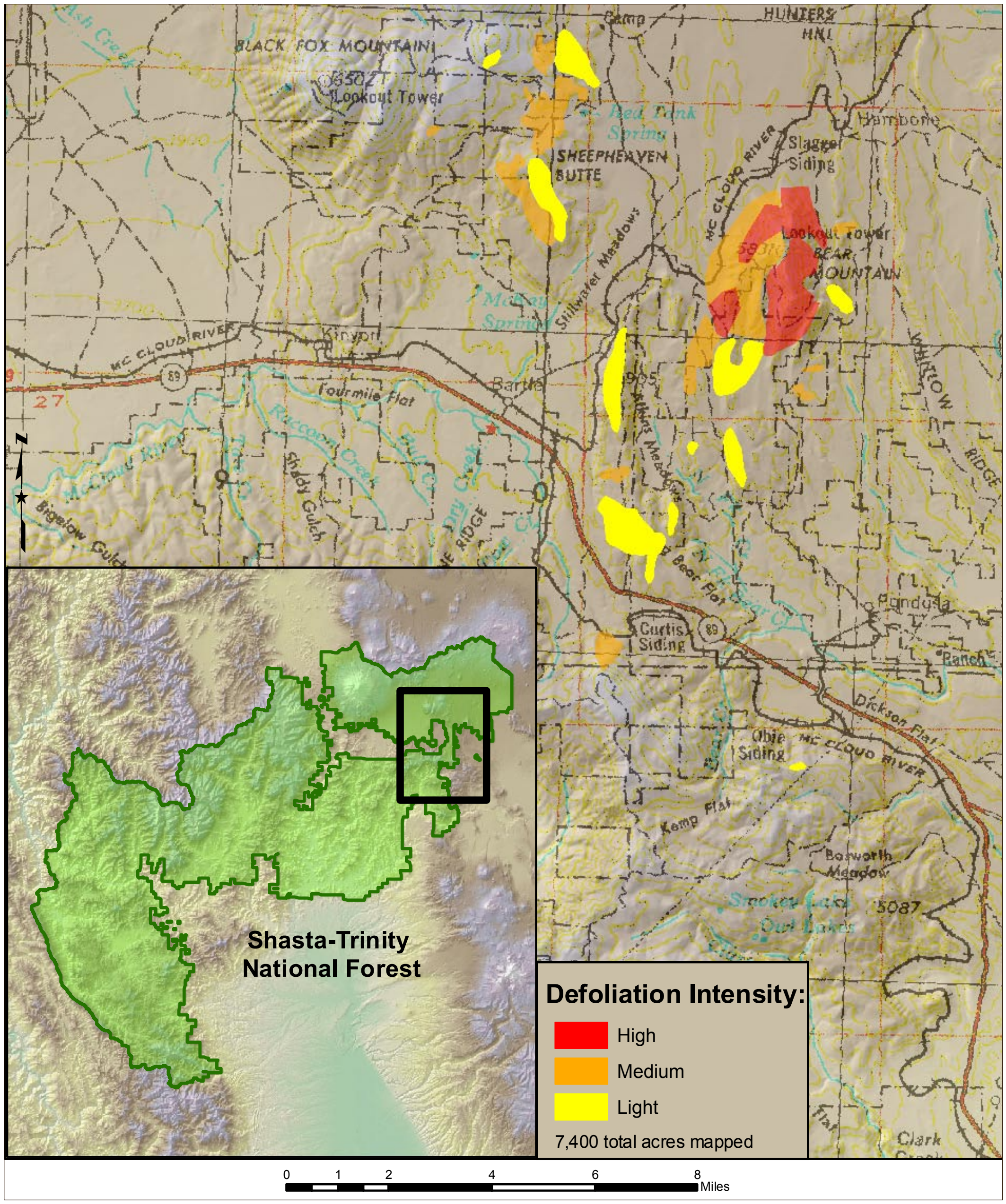


M261D

Aerial Survey Program personnel also mapped approximately 200 acres of defoliation on the northeast side of Ward Butte (Shasta County) in 2006, but no defoliation was detected in 2007 (M261D). Ground inspection confirmed Douglas-fir tussock moth as the cause and that no defoliation occurred this year.

In the southern sierras, no egg masses were found during ground surveys conducted in the fall of 2007 in previously infested areas of Yosemite National Park or on the Stanislaus and Sierra National Forest. Populations have been on the decline since 2006 and returned to endemic levels in 2007. No mortality was detected in Yosemite or on the Stanislaus National Forest, but additional top-kill in previously infested areas was noted in aerial surveys. Top-kill was detected in areas of the Sierra National Forest where repeated severe defoliation by the Douglas-fir tussock moth has occurred since 2002. Douglas-fir tussock moth defoliated 1,400 white fir in two areas: Browns Meadow, directly north of Whiskey Falls campground, and the eastern side of Summit Campground. Affected firs will gradually decline and eventually die if drought conditions persist. Defoliated trees are slow to recover from repeated years of defoliation, if other resources are limited.

During 2007, Federal and State personnel installed traps in 164 plots (5 traps/plot) with data collected for all plots (100% reporting). There were 163 plots (99%) with an average of <25 males per trap and 1 plot (1%) that averaged >25 moths per trap. This represents a continued decline in trap counts over the past two years (Table 2). The only plot that averaged >25 moths per trap in 2007 was located on the Almanor Ranger District, Lassen National Forest. There should be very few areas with defoliation in 2008 based on the results of the 2007 trap monitoring.



Map 6. Map of the defoliation caused by Douglas-fir tussock moth outbreak in Shasta County.

Map: Z. Heath

Table 2. Number of Douglas-fir tussock moth pheromone detection survey plots by trap catch for 1995-2007 for California.

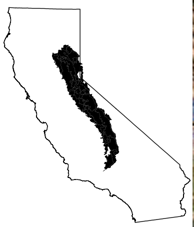
Year	Total # of Plots	NUMBER OF PLOTS WITH AN AVERAGE MOTH CATCH PER TRAP OF:													
		0<10	10<20	20<25	25<30	30<35	35<40	40<45	45<50	50<55	55<60	60<65	65<70	70<75	75+
1995	158	77	35	13	16	7	7	3	0	0	0	0	0	0	0
	100%	49%	22%	8%	10%	4.5%	4.5%	2%							
1996	149	33	26	16	8	7	12	9	5	8	6	8	5	1	5
	100%	22%	17%	11%	6%	4%	8%	6%	3%	6%	4%	6%	3%	1%	3%
1997	142	88	27	10	9	4	3	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%									

* Some plots were not collected due to weather.

Figure 24, 25. Jeffrey pine needles infested with Jeffrey pine needleminer, *Coleotechnites* sp. near *milleri*.

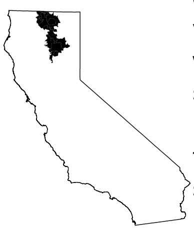
Photos: S. Smith.

Jeffrey Pine Needleminer
Coleotechnites* sp. *near milleri
A Jeffrey pine needleminer infestation was detected during 2007 on the south end of Lake Tahoe on private land between Oflying Drive and Pioneer Trail, Eldorado County. Approximately 5 acres were affected (M261E)(Figure 24, 25).

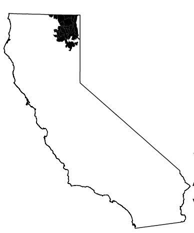


M261E

M261A



M261D



M261G

Lodgepole Pine Needleminer
Coleotechnites milleri
An outbreak of the lodgepole needleminer continued in Yosemite National Park in 2007. Fifteen thousand acres of defoliation caused by the lodgepole needleminer were detected in 2007 by Aerial Survey Program personnel. This was an increase from 14,000 acres of defoliation detected in 2006. Personnel conducting ground surveys found that most of the defoliation was at low to moderate levels. At one point this needleminer infestation, which began in 1993, covered more than 34,000 acres. Over the decade, population levels, as evidenced by the amount of defoliation, fluctuated greatly due to weather events, shortage of food supply, and levels of parasites. Total lodgepole pine mortality directly related to needleminer has not been estimated, however, defoliation had been so severe in locations with repeated infestations that mortality likely occured. Severity and extent defoliation caused by the needleminer is expected to increase and expand. High population levels were consistently found during the first years (odd numbered years) of the lifecycle in plots within Yosemite National Park, however the amount of defoliation varied between low and moderate. Insects were seen feeding on other pines such as western white or ponderosa in areas with repeatedly high levels of defoliation causing scarcity of lodgepole pine needles. Since 1999, new infestations of needleminer have been expanding east along the highway 120 corridor reaching Cathedral Peak and south towards the Merced River. Defoliation is predicted to be moderate to severe in 2008 and subsequent years if winter precipitation continues below normal.

Pandora Moth
Coloradia pandora
Pandora moth caused minor defoliation of Jeffrey pine in the Lake Tahoe basin.

Ponderosa Pine Tip Moth
Rhyacionia zozana
A complex of insects caused significant injury to ponderosa pine in plantations near Goose Valley, Shasta County (M261D) and north of Lookout, Modoc County (M261G). 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.

Sawflies
***Neodiprion* sp.**
Pine sawflies, *Neodiprion* sp., were detected feeding on young open-growing ponderosa pine in and around Yreka and along the Klamath River west of Interstate 5, Siskiyou County (M261A, D). Outbreaks are typically short-lived.

White Fir Sawfly
Neodiprion abietis
The white fir sawfly defoliated approximately one acre of white fir on the Lassen National Forest near Morgan Summit (M261D) and several acres on Bureau of Land Management land on the slopes of Fredonyer Peak (M261G). Light to moderate defoliation of older needles was observed with most injury affecting the understory trees. High levels of defoliation of the older needles was combined with the frost injury to shoots and buds, have put some trees at a high risk of mortality during this drier than normal period.

Unknown Oak Leaf Miner
Leaf injury caused by an unknown oak leaf miner was observed again in 2007 on black oak (*Quercus kelloggii*) at a few locations on the Plumas and Tahoe National Forests. The defoliation was greatly reduced from the levels observed during the previous two years. The largest affected area in 2007 was along Interstate 80 near Blue Canyon, Tahoe National Forest. Light defoliation was also observed in the Schneider Creek area and at the southwest end of Indian Valley, Mt. Hough District, Plumas National Forest. The insect causing the defoliation is presumed to be a micromoth (Order: Lepidoptera). Specimens were collected this past spring and are pending identification. New foliage was attacked, with eggs laid, immediately after bud break resulting in a shot hole pattern in fully elongated leaves. Larval mining initiated from these holes around mid-May caused a blotch mine pattern on the leaf surface by the first of June. The larvae subsequently dropped from the leaves and pupated in the soil. No trees or individual branches have died as a result of the 3 years of defoliation by this insect (M261E)(Figure 26).

Figure 26. Unknown oak leaf miner larvae and injury on black oak.

Photo: D. Cluck

Western Tent Caterpillar
Malacosoma californicum
The western tent caterpillar was detected on individual oaks in many locations around Tuolumne, Mariposa, and Yosemite counties.

Other Insects

Black Pineleaf Scale
Nuculaspis californica
The black pineleaf scale was detected on foliage of road side sugar pine in the Greenhorn Summit area of the Sequoia National Forest. The sugar pine had been defoliated by sugar pine needle cast (Figure 27). Injury caused by the black pineleaf scales was observed on current year needles (Figure 28). The combination of past drought stress and the needle cast fungus may have predisposed the trees to scale attack. The presence of road edge dust likely reduced the populations of scale's natural enemies.

Figure 27. Recovering sugar pine with new foliage after an infestation of the black pineleaf scale.

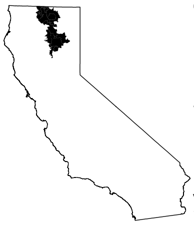
Photo: M. MacKenzie

Figure 28. Current year sugar pine needles with black pineleaf scale.

Photo: M. MacKenzie

Douglas-Fir Twig Weevil
Cylindrocopturus furnissi
The Douglas-fir twig weevil was detected at a Christmas plantation in the city of Los Gatos,

Santa Clara County. The owner noted many Douglas-fir with extensive twig mortality. Seventeen dead and dying branches were inspected and all were symptomatic of feeding and tunneling by the Douglas-fir twig weevil. The average infested branch diameter was 3/8 inches. For each infested twig there was one pupal chamber per 1.75 inches. Four weevils were found with evidence of insect parasitism, and 3 parasitic wasps were found in empty pupal chambers.



M261D

Gouty Pitch Midge
Cecidomyia piniinopsis
Branch tip flagging caused by the gouty pitch midge was common across Hatchet Mountain, Shasta County (M261D). Injury was prominent among ponderosa pines surrounding the vista point near Moose Camp. Scarring on previous year's growth indicates that the infestation has been present for many years, but this was the first year of noticeable tip dieback. This year's dieback may be related to increasing midge populations and/or drought stress.

Pine Needle Sheathminer
Zelleria haimbachi

Figure 29. Pine needle sheathminer in a plantation on the Groveland Ranger District, Stanislaus National Forest.

Photo: B. Bulaon

M261G

Aerial survey detected a 25 acre outbreak of pine needle sheathminer in a ponderosa pine plantation on the southeast side of Aubrey Ridge, near Burney, Shasta County (M261G). Significant defoliation occurred on current year terminals and side shoots, giving the trees a brown cast when viewed from a distance. Sheathminer feeding was also quite common on nearby ponderosa pine being attacked by the ponderosa pine tip moth south of Goose Valley.

Injury caused by the pine needle sheathminer was observed in a plantation on the Groveland Ranger District, Stanislaus National Forest; although in previous years injury was quite high, most of the infested trees recovered this summer and had full complements of needles (Figure 29).

M261A

Ponderosa Pine Twig Scale
Matsucoccus bisetosus
A *Matsucoccus* scale, most likely *M. bisetosus,* was found on 30-yr-old ponderosa pine in a plantation south of McCloud, Siskiyou County (M261A). Symptoms include needle chlorosis and shortening, and twig and branch dieback. Affected trees appear to be planted off site.

Poplar Bud Gall Mite
Aceria parapopuli
Light to moderate injury on aspen from this insect was detected in the Kernville Ranger District, Sequoia National Forest. No trees were killed, but damage was easily visible from the road.

Sugar pine cone beetle
Conophthorus lambertianae
Attacks by the sugar pine cone beetle caused the loss of numerous sugar pine cones on the American River Ranger District, Tahoe National Forest. In many cases, over 90% of the cone crop on individual trees dropped prematurely.

Coneworm
Dioryctria abietivorella

An Integrated Pest Management program at the Genetics Resource Center in Chico was established to control the coneworm *Dioryctria abietivorella,* on Douglas-fir. Asana XL was used on a 4 week cycle. This treatment also provided control of the seed bug *Leptoglossus occidentalis,* and the seed chalcid. There are three flights/year of *Dioryctria* in Chico, forcing a need to spray right up to harvest time in August. The spray program continued after the cone harvest using Asana XL at half the previous rate to control *Leptoglossus* in the pine orchards. Treatment continued until cooler weather returned and the seed bugs were less active. The program resulted in an enormous Douglas-fir cone crop in 2007 (Figure 30).

Figure 30. Robyn Sciblio, Site Manager, Genetics Resource Center, Chico, CA shows off the Douglas fir cone crop produced in 2007.

Photo: G. Norcross

Willow Clearwing Borer
Synanthedon sigmoidea

The willow clearwing borer caused severe dieback of black willow branches in the Davis area of Yolo County. Various aged trees were affected. Infested branches had deformities and swellings and often dieback to the point of infestation. Some of the smaller and younger trees were killed by the insects.

Western Pineshoot Borer
Eucosma sonomana

The western pineshoot borer continued to infest plantation ponderosa pine near Pondosa, Siskiyou and Shasta Counties, north of Lookout, Modoc County, and near Covington Mill, Trinity County (M261A, D, G). Damage, in the form of stunted terminals, was greatly reduced in stands receiving pheromone-based treatments.

Disease Conditions

Introduced Diseases

Pitch Canker
Fusarium circinatum

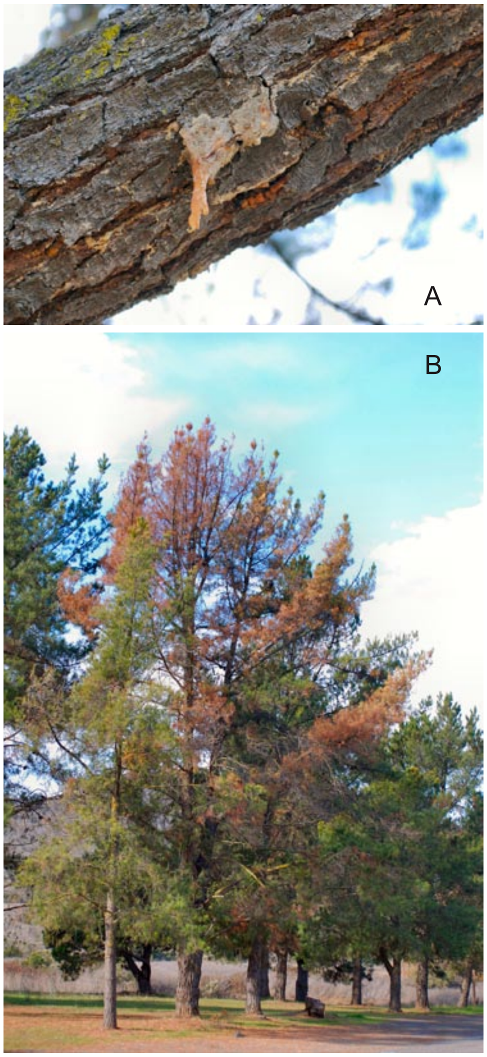


Figure 31. Symptoms of pitch canker on Monterey pine (A) pitch on the bole (B) flagging of the crown.

Photos: M. Mackenzie

Pitch canker disease was first identified in California on Monterey pine in the Santa Cruz area in 1986. It now exists in the coastal and adjacent areas of the state from San Diego to Mendocino Counties. The disease tends to be most serious on planted Monterey and Bishop pines, but is of a major concern in the limited natural range of Monterey pine in California. Pitch canker also affects Coulter, Gray, Knobcone, Shore, Torrey, Aleppo, Canary Island and Italian Stone Pines as well as Douglas-fir in California. Laboratory tests show that most native pines in the state could potentially be infected. The spread of the disease in California is thought to be primarily by insects, mostly bark, twig and cone beetles, that carry the fungus on their bodies and act as vectors. Humans may also spread the disease by moving infested material from one area to another.

Pitch canker disease increased in the Point Lobos State Park area south of Monterey. The disease was common in younger Monterey pine seedlings and saplings. Branch dieback and bole cankers were also observed on larger trees. Evidence of insect attacks on many trees suggests beetle introduction of pitch canker disease (Figure 31).

Spore traps for the pitch canker fungus were set up in San Diego County near the Legoland Park and Torrey Pine State Preserve throughout the year. Although planted Aleppo pine trees continue to die from the disease around Legoland, no spores were found in the traps. Extremely low rainfall throughout the year may have resulted in reduced spore production.

Figure 32. The removal of trees infected with or killed by the pitch canker fungus has resulted in more open sites at Benicia State Recreation Area.

Photo: M. MacKenzie

Branch flagging of ornamental Monterey pines appeared to increase in Santa Maria (Santa Barbara County) and Arroyo Grande (San Luis Obispo County). Incidence of the disease also increased in both Bishop and Monterey pines in the Point Reyes National Seashore. Symptoms seemed to be fewer in the Santa Rosa area of Sonoma County, and were absent from the only known infested area along the southwest coast of Mendocino County Pitch canker disease was also noted on Monterey pines in Benicia State Recreation Area (Solano County)(Figure 32).

Port-Orford-Cedar Root Disease
Phytophthora lateralis

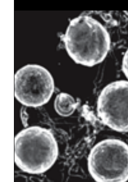
Port-Orford-cedar (POC) is found on approximately 35,000 acres in California; primarily on the Six Rivers National Forest and also on the Shasta-Trinity and Klamath National Forests. The species has a narrow geographic range, but wide ecological amplitude. POC is found at elevations from sea level to 6,400 feet and among a variety of species with differing ecological requirements from coast redwood to mountain hemlock.

Figure 33. Port-Orford-cedar mortality caused by Port-Orford-cedar root disease in Castle Crags State Park on the Sacramento River.

Photo: P. Angwin

Phytophthora lateralis, an exotic root pathogen, was introduced to the native range of POC in the early 1950s. It is almost always fatal to trees it infects. *P. lateralis* spores are spread via infested water or soil. A typical long distance spread scenario involves infested soil being transported into an un-infested area from mud on vehicles or pieces of equipment, or in infested water. The infested soil falls off of the vehicle or spores are delivered via water. The pathogen first infects POC near the site of introduction then is washed downhill in surface water and infects additional hosts. It is especially lethal along drainages and creeks where infested water is channeled and flows near concentrations of healthy POC. About 8% of the range of POC in California is infested with the disease.

M261A



Port-Orford-cedar root disease was present along the main stem of the Sacramento River from Dunsmuir to Shotgun Creek (Siskiyou and Shasta Counties, M261A). Monitoring of the Port-Orford-cedar eradication treatments at Scott Camp Creek in the upper part of the Sacramento River drainage (Siskiyou County, M261A) revealed no new infestations of the root disease in 2007. Root disease and dying trees were upstream of the suspension foot bridge on the Sacramento River (Figure 33). All Port Orford cedar in the diseased area will be cut as part of an ongoing effort to slow disease spread and mitigate its impacts within the Park.

The Trinity River drainage (Trinity and Shasta Counties, M261A) continues to be the only uninfested major river drainage within the range of Port-Orford-cedar.

Port-Orford-cedar root disease was identified in Port-Orford-cedar and Pacific yew along Clear Creek in the Siskiyou Wilderness Area (Happy Camp Ranger District, Klamath National Forest, M261A) in August, 2006. Scattered pockets of tree mortality were identified and confirmed to be caused by *P. lateralis,* starting approximately one mile south of Young's Valley (6.3 miles from the Young's Valley Trailhead) and continuing approximately nine miles further down Clear Creek (to approximately ½-mile above the junction of Clear Creek and the West Fork of Clear Creek). Additional pockets of dead and dying Port-Orford-cedar were observed from that point all the way to the Clear Creek Trailhead, but pathogen confirmations were not completed due to poor access.

In 2007, a Port-Orford-cedar eradication project was implemented on a ¼-acre at the most upstream infestation along the trail, about 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 section of the trail was relocated to avoid passing through a perennially muddy infested area. These improvements were made to limit disease spread by reducing the occurrence and potential transportation of inoculum along the trail.

Sudden Oak Death
Phytophthora ramorum

Phytophthora ramorum is an exotic pathogen that has been killing tanoaks and other oak species in coastal California for more than ten years. Wet springs in 2005 and 2006 favored inoculum production and incited a severe second wave of mortality in 2007 in several coastal California counties (Figure 34). In 2006, more tanoak (*Lithocarpus densiflorus*) died than in any previous year of the epidemic. In 2007, the level of mortality in coast live oak (*Quercus agrifolia*), which generally take longer to die than tanoaks, caused increased alarm. This disease is especially apparent in the densely populated urban-wildland interface areas in Sonoma, Marin, San Mateo, Santa Clara and Santa Cruz Counties. Homeowners in these counties are dealing with fatally infected trees and the increased hazards of dead trees.

The spread of the sudden oak death pathogen is greatly facilitated by wet, warm weather, and by the many foliar hosts in forests and nurseries which carry and distribute its spores. Though *P. ramorum* has not spread outside the 14 confirmed counties in California, spread in southwest Oregon and its continued presence in nurseries highlight the potential for further introductions and new outbreaks. Maps of *P. ramorum* confirmations and other pertinent information regarding this disease can be found online at the California Oak Mortality Task Force (COMTF) website, www.suddenoakdeath.org.

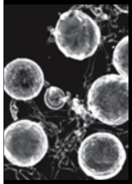
Figure 34. 2007 tanoak mortality in Big Sur.

Photo: Kerri Frangioso

***P. ramorum* in nurseries.** To date, nationwide, *P. ramorum* has been detected in nurseries in 7 states: California (7); Washington (7); Oregon (2); Florida (1); Georgia (3); Pennsylvania and Mississippi (1). Despite decreases in the number of infected nurseries (down from 96 in California in 2005 and 62 in 2006), these horticultural infestations continue to post a great risk. The pathogen was found in streams outside of infested nurseries in Washington and Mississippi; landscaped rhododendrons in residential Washington were found positive; a Humboldt nursery reported the first discovery of the European population (EU1) in California; and there were 4 new species added to the regulated host list (*Garrya* *elliptica, Mahonia aquifolium*, *Osmanthus delavayi*[1], and *Prunus laurocerasus*). These new additions were found in nurseries and all caused great concern.

Recognizing the continued threat from *P. ramorum*, and in the interest of providing a higher level of assurance to trading partners, the California Department of Food and Agriculture (CDFA) and County Agricultural Commissioners began conducting two inspections in all interstate shipping nurseries with high-risk plants, in addition to the compliance agreement inspection already in place.

New research findings. Several interesting new research findings were presented at the Third Sudden Oak Death Science Symposium in Santa Rosa in March 2007 (http://nature.berkeley.edu/comtf/sodsymposium/index.html) and the 4th Meeting of the IUFRO Phytophthoras in Forest and Natural Ecosystems (http://nature.berkeley.edu/IUFRO2007/phytophthora/) in Monterey in August. Below are a few highlights. For more information see the meeting links for abstracts.



Bay laurel plays a primary role in facilitating the sporulation (and hence the spread) of *P. ramorum.* Researchers working in coast live oak-dominated areas determined a minimum distance between bay foliage and oak trunks that should be maintained to minimize the risk of *P. ramorum* infections of the trunks. The researchers found that bay laurel within 2.5 m of a potentially susceptible coast live oak should be removed and all foliage cleared from within 5 m of the trunk to reduce infection potential. Additionally, even where bay laurel is not present, poison-oak should be removed from coast live oak crowns as it can potentially contribute infective inoculum to the oak tree (Swiecki and Bernhardt 2007).

Researchers from Sonoma State University and the University of North Carolina, Charlotte observed *P. ramorum* spores in the mud on hikers' shoes and bicycle tires in the Marin Municipal Water District. Hikers there were carrying spores on their shoes when they entered and existed the park. When the soil on the shoes was allowed to dry completely, the number of spores the scientists could recover fell sharply. However, when the shoes were left in a sealed, moist environment, the number of spores remained constant for several days (Cooper and Cushman 2006). Researchers from the United Kingdom (UK) reported similar findings (Weber and Rose 2007). This research, combined with earlier research done in 2002 in Santa Cruz County (Tjosvold and others 2002), confirmed that *P. ramorum* spores are transported on people.

P. ramorum has recently been observed to penetrate much farther into the sapwood of infected tanoak, beech, and other trees than previously suspected. Working independently, researchers in the UK and in Oregon found *P. ramorum* extending 25 mm (0.98 in) into the sapwood of beech trees (Brown and Brasier 2007) and 5 cm (1.97 in) into the sapwood of tanoak trees (Parke and others 2007). There is speculation that the pathogen may use the sapwood as a way to move through the tree bole. Hyphae of *P. ramorum* have been observed to inhibit water flow within tanoak sapwood vessels and tracheids. Additionally, the trees produce tyloses as a response to invasion that block the vessels and impede water flow.

Researchers in the UK inoculated a variety of logs with *P. ramorum* and *P. kernoviae* to determine if zoospores could penetrate the unwounded bark and cause phloem lesions. They observed such lesions in all species of logs studied, including *Fagus sylvatica, Castanea sativa, Quercus rubra,* and *Picea sitchensis. Quercus robur* developed no lesions, but researchers were able to recover *P. ramorum* from phloem tissue beneath the area of inoculation (Brasier and others 2007). Additionally, the ability of *P. ramorum* to infect a range of conifer logs (Brasier and others 2007, Moralejo and others 2007, Brasier and others 2005) is raising new concerns about conifer logs as a potential pathway for *P. ramorum* spread and the possible implications of this for the trade in conifer products.

[1] *Osmanthus delavayi* samples positive for *P. ramorum* were found in a US nursery and in an outdoor session in the UK.

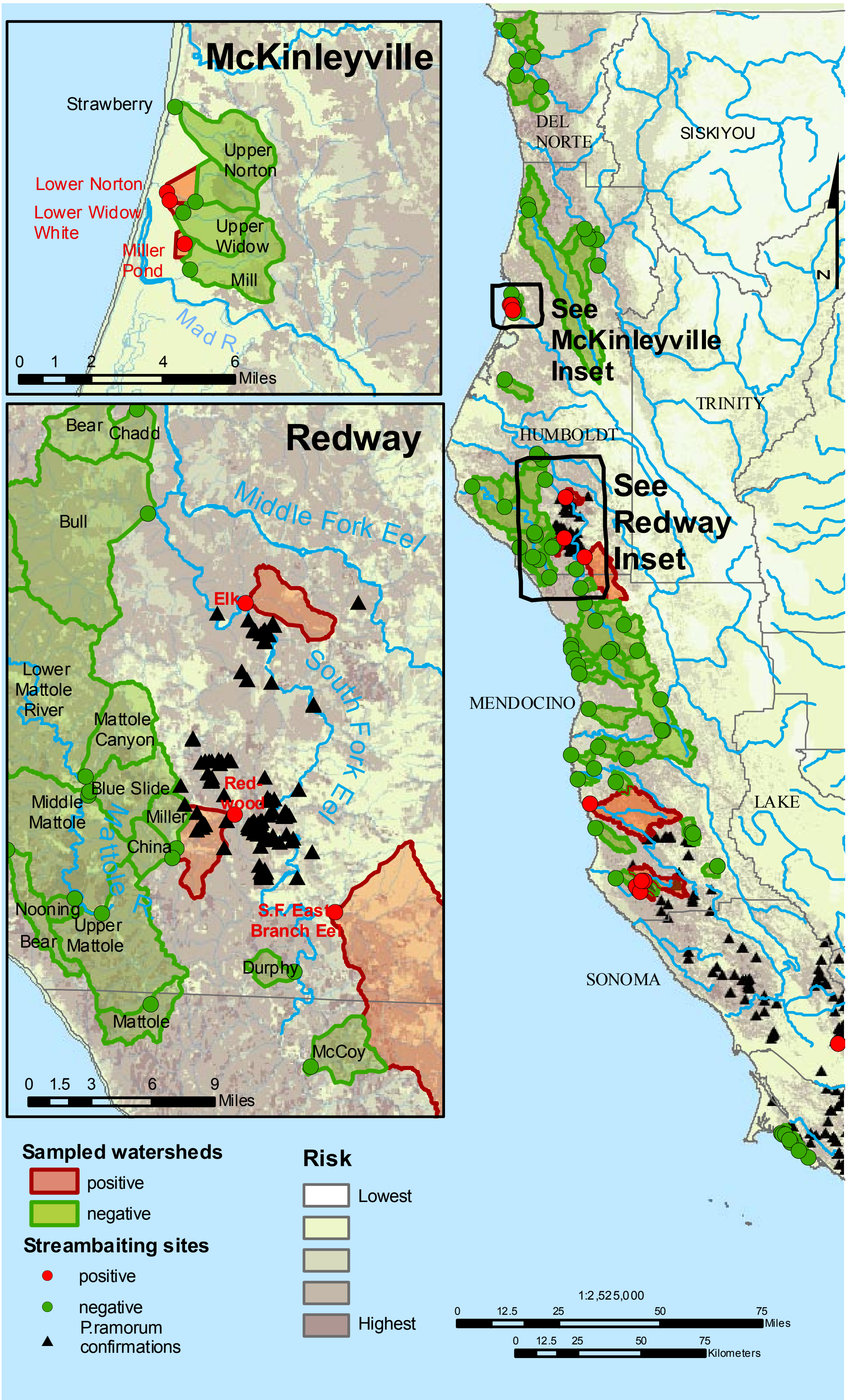
Surveying and monitoring. In 2007, 132 sites in perennial watercourses from the Oregon border to southern San Luis Obispo County, plus a cluster of sites in the Sierra Nevada from El Dorado to Butte Counties, were monitored for the presence of *P. ramorum.* Sixty-five of these sites had not been previously monitored. *P. ramorum* was detected at only fifteen sites (seven of them new in 2007), reflecting the paucity of recovery of *P. ramorum* from California terrestrial vegetation due to the dry 2006-2007 winter and spring. At all sites, the pathogen was recovered much less often and in lower quantities than in previous years. In 2006, the results from stream monitoring expanded the known northernmost (Map 7) and southernmost (Map 8) extents of the range of *P. ramorum* in Humboldt and Monterey Counties, as well as enabling the detection of inoculum in a small urban creek in Humboldt County 47 miles from the nearest forest infestation (see Humboldt County summary below). 2007 stream monitoring prompted no changes in these boundaries. All watercourses in the Sierra Nevada remained negative for *P. ramorum* inoculum.

In 2007, USDA Forest Service, Pacific Southwest Region, Forest Health Monitoring aerial survey personnel flew 1,000,000 acres in San Luis Obispo and Monterey Counties (1,060 linear miles) and mapped 2,589 acres of tanoak and coast live oak mortality. The survey also covered 626,000 acres in Del Norte County (628 linear miles) where 60 acres of mortality were mapped. Forest Service crews ground-checked most of the tanoak mortality points in Del Norte County and determined them to be caused by agents other than *P. ramorum.* As part of its general survey for plant injury caused by insects and diseases, some other coastal counties were also flown and checked for tanoak and oak mortality. Some of the results of these surveys are available on the Forest Health Monitoring website at: http://www.fs.fed.us/r5/spf/fhp/fhm/aerial/.

Big Sur disease spread. In 2007, the UC Davis Rizzo Laboratory continued the establishment of a long-term ecological monitoring plot network throughout the Big Sur region. Two hundred seventy-five plots were established, data analysis will begin this winter. The disease continued to spread in 2007 within the previously known extent of *P. ramorum* in Big Sur. In many places entire hillsides of trees died in 2007, where in 2006 there were only a few dead trees. The pathogen did not expand its range farther south than its previous known boundary (southern Monterey County) in 2007.

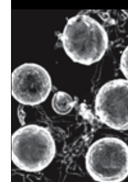
Allison Wickland and Kerri Frangioso have been working with both public and private landowners in the region establishing plots and providing information about treatment options to all interested parties. Additionally, in 2006 the UC Berkeley Garbelotto Laboratory set up management trials on private land in forests dominated by tanoak to test the efficacy of Agri-fos® in wildland settings. The Garbelotto Lab has also continued working with private landowners to treat individual trees surrounding structures. Both tanoak and oak trees were treated on private property. Doug Schmidt of the Garbelotto Lab plans on revisiting individual landowners this November to assess the health of previously treated trees and retreat trees that are still non-symptomatic.

There has been a coordinated effort between Big Sur residents, the Fire Safe Council, CAL FIRE, the Big Sur Volunteer Fire Brigade, the Mid-Coast Volunteer Fire Brigade, PG&E, and Monterey County officials to raise concern over the flammability of standing dead trees. Community-driven fundraising along with support from the California Fire Safe Council have helped Big Sur private landowners with clearance of SOD-killed trees. Residents along Partington Ridge in Big Sur have been awarded a matching grant to help comply with insurance companies' mandatory 150-foot clearance around structures and to protect the road corridor. The county has relaxed a regulation to allow private owners to remove dead trees without the usual permits, and PG&E has been working on one four-mile stretch of Palo Colorado Road to create a safer zone surrounding electrical lines. There have also been coordinated meetings with residents along Palo Colorado Road to see if they too, can obtain money to help remove dead trees in the canyon. Both densely populated



Map 7. Watershed monitoring for *Phytophthora ramorum* in northern California during 2007.

Map: Z. Heath



Map 8. Watershed monitoring for *Phytophthora ramorum* in southern California during 2007.

Map: Z. Heath

communities along Partington Ridge and Palo Colorado Road are predominately in redwood-tanoak habitat and trees in this area have been extremely hard hit by Sudden Oak Death.

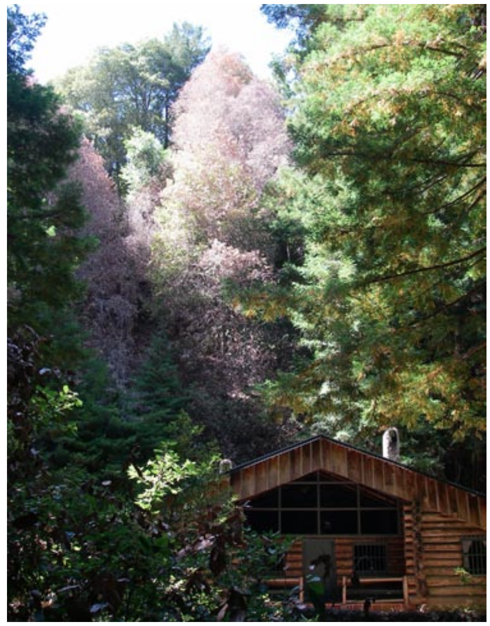
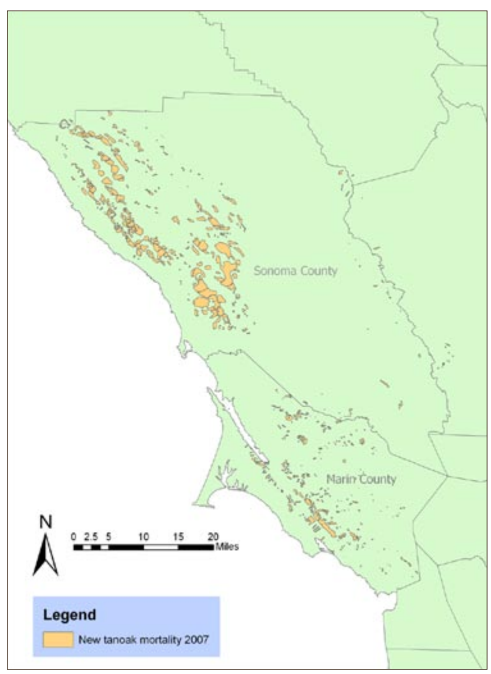


Figure 35. Tanoak mortality has flared up at the Mittledorf Preserve, Big Sur, (Monterey County). Ian Smith, University of Melbourne.

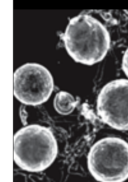
Marin County disease spread and impacts. Warm spring rains in 2005 and 2006 brought *P. ramorum* sporeloads to a new high in Marin County, causing scores of new oak and tanoak infections. According to Marin Municipal Water District personnel, tanoak mortality is now greater than during the initial outbreak between 1996-2001. In response to increased disease levels in the County, key Marin County agencies met in April 2007 to share observations and discuss future plans; Fire Safe Marin released the "Marin on Fire: Preparing for the Next Urban Wildfire" video (www.firesafemarin.org); the Public Works Department began removing hazardous trees in west Marin; and various departments began alerting the Marin County Board of Supervisors to the need for funding for additional hazard tree removals. Consequently, County Supervisor Judy Arnold is now reaching out to Sacramento lawmakers for assistance in dealing with the hazard tree removals in the County, and Agricultural Commissioner Stacy Carlsen is seeking support from fellow county Agricultural Commissioners impacted by *P. ramorum.*

Concerns among landowners and homeowners throughout the County are also increasing, with Mill Valley and Novato residents requesting information on the disease and how they can prevent it, and ranchers in Chileno Valley (NE Marin) asking for technical assistance as more of their oaks appear to be infected.

Sonoma County disease spread and impacts. Based on the last two years of Forest Service aerial surveys, and additional flights by CAL FIRE, Sonoma County personnel estimate that over 60,000 acres (6% of the county) were affected by Sudden Oak Death within the last two years. Most of the mortality observed in 2007 was thought to be a legacy of the warm, wet winter/spring period of 2005-2006. Most of the new mortality was seen in western Sonoma County throughout mountainous areas north of Occidental and west of the Hwy 101 corridor. Some of the most impacted communities include Occidental, Camp Meeker, Forestville, Guerneville, Monte Rio, Cazadero, and Annapolis. Most areas of mortality contain 20-30 or more dead trees per acre. *P. ramorum* infection was also recently confirmed in Doyle Park in Santa Rosa. This is the first detection of *P. ramorum* in Santa Rosa. Additionally, new areas of mortality were observed on hillsides close to the Sonoma-Mendocino County line north of Cloverdale (Map 9).



Map 9. Locations of oak and tanoak mortality (standing dead trees with dead crowns), in Sonoma and Marin Counties, in 2007. USDA-Forest Service.



Concern continues to mount over the impact of Sudden Oak Death on urban intermix forests heavily stocked with tanoak. Along the lower Russian River, many residents have converted former summer homes in steep, narrowly roaded canyons to year-round residency. Tanoak mortality is severe in many of these canyons and concerns mount over resident safety, hazards to electric lines, and potential for increased fire hazard. Within the past year, the concern from local residents prompted the Forest Service to fund two Sudden Oak Death Coordinator positions, one for University of California Cooperative Extension and one (half-time) for the Sonoma County Department of Emergency Services. These coordinators produced a draft Sudden Oak Death strategic plan that estimated immediate monetary needs for dealing with Sudden Oak Death impacts across Sonoma County public agencies at over $3 million, with continuing high costs anticipated for the immediate future. Thirteen outreach meetings have addressed the pathogen and its spread and treatment, as well as the fire risks associated with SOD-caused tree mortality and how homeowners might reduce risks to their homes. These workshops have directly educated over 650 concerned residents and will continue into the future.

Mendocino and Humboldt County disease spread. Very little *P. ramorum* inoculum was detected by spore trapping and soil sampling in known infested areas in 2007 in Humboldt County. Foliar symptoms (blackened petioles and shepherd's crooking of tanoak, large-scale branch-tip dieback in huckleberry, manzanita, and blueblossom) also declined after the dry winter of 2006-2007 compared to the level of symptoms apparent after the previous, very wet winter. Tanoak mortality continued in existing P. ramorum infested areas. This mortality is speculated to have mostly originated from infections initiated in 2005-2006.

Although dramatic expansions of the infested area were not evident from the ground, USDA Forest Service, Pacific Southwest Region, Forest Health Monitoring aerial survey personnel mapped several new large polygons of tree mortality along the Salmon Creek watershed north of the Redway area, roughly parallel to the South Fork of the Eel River. Additionally, a polygon of tanoak mortality was mapped at Eel Rock on the main stem Eel River to the east of the known infested area, which was subsequently confirmed to be caused by *P. ramorum.* Two polygons of mortality were also identified in the East Branch of the South Fork of the Eel river to the southeast of Garberville, a watershed in which *P. ramorum* inoculum had previously been detected but where no infected trees had so far been identified. This infestation is approximately three miles from previously known infested areas near the Garberville airport

In March, personnel from California State Parks and UCCE Humboldt-Del Norte supervised removal of all bay laurel trees along a 3.5-mile stretch between the Avenue of the Giants and the South Fork of the Eel River between Myers Flat and Burlington. This stretch represented the farthest known extent of the *P. ramorum* infestation to the north in the county and has not yet experienced any *P. ramorum*-caused tanoak mortality.

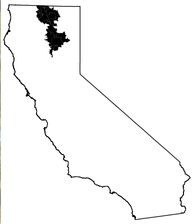
Additionally, UCCE personnel searched in the summers of 2006 and 2007 for the source of persistent *P. ramorum* inoculum in a small creek in McKinleyville (47 miles north of the infested area in southern Humboldt County), taking numerous samples of both host and non-host plants growing near the stream. Very few major *P. ramorum* hosts grow along the watercourse, which supports abundant alder, eucalyptus, willow, and Sitka spruce. None of the samples yielded *P. ramorum.* However, genotyping of 2006 and 2007 isolates of *P. ramorum* recovered in 2006 and 2007 from the stream revealed the presence of both the European A1 (EU1) and the American A2 (NA1) strains of the pathogen. These strains were previously recovered in an infested retail nursery in McKinleyville. No hydrological link is known between the nursery and the stream.

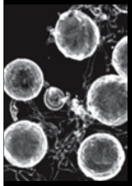
White Pine Blister Rust
Cronartium ribicola

White pine blister rust (WPBR) is the most destructive disease on five-needle pines (such as sugar pine, western white pine, and whitebark pine) in California. The pathogen is native to Asia, but was actually introduced on pine seedlings from Europe in the early 1900's.

Figure 36. Branch mortality and top fade on sugar pine caused by the fungus *Cronartium ribicola*, white pine blister rust, near Monumental Ridge, American River Ranger District, Tahoe National Forest.

Photo: S. Smith, August. 2007.





Elevated levels of dieback and mortality occurred among pole-sized to mature western white pine on Latour State Forest, Shasta County (M261D). One of the most severely impacted areas was on Buck Butte near Cirque Lake. A survey of the area revealed that the trees are suffering from old white pine blister rust infections. These infections occurred many years ago and as the infections advanced, branches, tops and sometimes the main stem were girdled. Few new infections were noted.

White pine blister rust was found infecting and causing branch and stem dieback in sugar pine on Monumental Ridge, American River District, Tahoe National Forest (M261E)(Figure 36). Elsewhere on the Tahoe National Forest, the rust was found killing the tops of some western white pine seedlings along the trail from Squaw Valley Village to the tramway summit (M261E). Mature western white pine appeared uninfected. White pine blister rust was also detected killing branches on the east slope of Mt. Lassen, killing branches and tops of western white and whitebark pine trees (M261D).

2007 WHITE PINE BLISTER RUST RESISTANCE SCREENING PROGRAM

The Region 5 Genetic Resources staff continued screening sugar pines (*Pinus lambertiana*) for natural genetic resistance to white pine blister rust (*Cronartium ribicola*). Screening for major gene resistance (MGR) occurs at the Placerville Nursery, Eldorado National Forest for slow rust resistance (SRR; also called 'partial resistance') screening occurs at the Happy Camp Outplant Site (HCOPS) on the Klamath National Forest. In 2007, at the Placerville nursery, 730 sugar pine families (seedling progeny) were screened for blister rust resistance from new field-candidate seed-parents suspected of carrying MGR; 61 of those families were shown to carry MGR (Figure 37). This brings the total number of proven resistant seed-parents to 1,686 in California from federal, state and private lands. In addition, 337 families had one or more MGR seedlings donated by an unknown MGR pollen-parent (MGR-PR). Most MGR and MGR-PR seedlings were transferred to HCOPS for SRR screening (which takes about 10 years). Some MGR-PR seedlings with northern California parents were also retained and planted in the local breeding arboretum near Placerville.

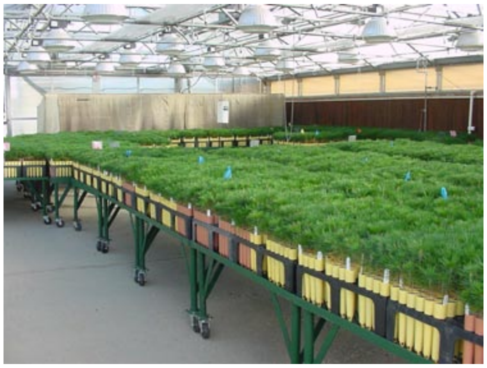


Figure 37. Placerville greenhouse – Sugar pine seedlings and burlap-covered chamber where seedlings are inoculated with white pine blister rust in the Fall of each year. Rust resistance data is collected the following Winter and Spring.

Photo: J. Dunlap

The Spring 2007 sowing included seed from 637 sugar pine families: they originated from the northern (17%) and southern California national forests (47%), private industry lands (23%), and the Lake Tahoe basin (11%). The Regional genetics staff continues to focus efforts on the northern forests (Klamath, Mendocino, Shasta-Trinity, Six Rivers, Modoc,

Figure 38. Happy Camp plantation – Plantation of MGR sugar pine progeny, planted from 1997 – 2000, at the Happy Camp Outplanting Site where they are screened and selected for slow rust resistance.

Photo: Deems Burton

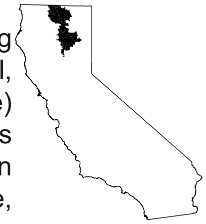
and Lassen National Forests) due to the difficulty in finding MGR trees in that part of the State. For those forests, while some seedlings go through the screening process at both Placerville and Happy Camp, additional siblings of the same families are transferred directly to Happy Camp, which should facilitate identifying SRR seedlings more quickly for that region. Sugar pine families from the southern California forests (Los Padres, Angeles, and San Bernardino National Forests) were sown for the second year of operational testing. The first screening, earlier this year, resulted in the identification of 23 MGR seed-parent trees from southern California; these will be retested to confirm initial findings of that screening.

The 2007 cone crop for sugar pine and other species was light; however, the genetics staff received cones from 192 MGR-candidate trees, from private forest lands (52%), the Lake Tahoe basin (23%, federal and non-federal lands), and the Lassen National Forest (20%). Cones were also collected from 97 known-MGR trees in the Sierra Nevada. Seed from these will be added to the Regional seed bank as part of an ongoing effort to have rust-resistant sugar pine well-represented in the bank.

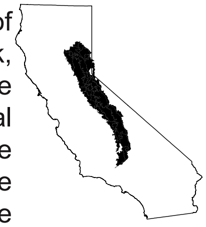
Activities on the Klamath National Forest included the planting of 1,952 MGR at the Happy Camp Outplant Site (HCOPS)(Figure 38) and 13,707 non-MGR sugar pine seedlings at the Classic field site, all shipped from Placerville for slow rust resistance testing. Additional activities included the selection of 18 sugar pines with slow rust resistance traits from 761 evaluated, and the collection and shipment of scion from these selects for clone bank and seed orchard establishment, and from 53 MGR-PR trees for North Zone MGR orchards. In cooperation with the Institute of Forest Genetics (IFG), Placerville, and the Region 6 Dorena Genetic Resource Center, Cottage Grove, Oregon, 600 *Ribes sanguinium* cuttings were sent to Dorena GRC and 1000 cuttings were sent to IFG for rooted plant propagation to supplement the host pathogen, *Cronartium ribicola,* in the sugar pine fields at the Happy Camp Outplant Site. As part of an ongoing effort to monitor the two virulent rust strains, vCr1 (sugar pine) and vCr2 (western white pine), in northern California, *Ribes sanguinium* leaves infected with *Cronartium ribicola* in the telial stage were collected from seven key locations and sent to IFG for evaluation. Researchers there continue to monitor the frequency of pathogenic virulence against major gene resistance in sugar pine at Happy Camp and at Mountain Home Demonstration State Forest, the only sites in California where virulence is known to occur in *Cronartium ribicola*.

Seed orchards are being developed by the USDA Forest Service and Sierra Pacific Industries to supply rust-resistant sugar pine seed for reforestation and fire restoration. Cuttings from parent trees possessing MGR or both MGR+SRR are being collected by these and additional cooperators throughout the State. Five seed orchards have been established and contain more than 700 unrelated parents from Sierra Nevada native forests. In Fall 2006, eight pounds of seed were collected in the first significant harvest of cones from orchard-grown MGR trees at the USDA Forest Service's Foresthill Genetic Resources Center on the Tahoe National Forest. Additional sites are used as "clone banks" to preserve rust-resistant sugar pine grafts from other parts of California, where seed needs are not as high or in anticipation of seed orchard development in the future. Last fall, 72 MGR parents were collected from wild stands and an additional 18 with both MGR+SRR which represented much of the State. More will be established each year to both conserve and use the genetic diversity of this species.

At the Institute of Forest Genetics, several avenues of research are being taken in studying the resistance of five-needled white pines to *Cronartium ribicola*. At the molecular level, the major gene for resistance in sugar pine (also called the '*Cr*1' gene for sugar pine) has been genetically mapped; however, the DNA sequence that corresponds to it remains unknown. Strategies are being advanced to determine the sequence, which would then allow for the investigation of biochemical processes involved in the resistance response, including pathogen-host interactions. Biochemical markers flanking the *Cr*1 gene are also being evaluated for use as diagnostic tools to identify resistant trees in wild populations of sugar pine. At the seedling level, a major thrust of research is into the mechanisms of resistance and modes of inheritance in southwestern white, limber, bristlecone, whitebark, and foxtail pine. Previously undetected mechanisms of resistance in southwestern white and bristlecone pine are being investigated in replications of earlier experiments. Several whitebark and foxtail pine families are now being cultivated in preparation for extensive inoculations to detect new resistance mechanisms. Because the latter two species thrive primarily in subalpine environments, these trials will require several years to complete since the expression of resistant phenotypes in high elevation species develops slowly and often cryptically. Evaluations of putatively-resistant eastern white pine families inoculated with El Dorado wild-type inoculum are close to completion; this is the first IFG examination of reported resistance in this species. The Institute of Forest Genetics is one of several organizations in the West in which rust resistance is being evaluated on the high elevation five-needled white pines.



M261D



M261E

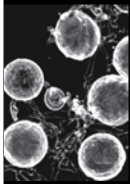


Figure 39. Red fir branch mortality caused by Cytospora abietis. Dwarf mistletoe, (*Arceuthobium abietinum*, *f. sp. magnificae*) was also present on these trees, near Monumental Ridge, American River Ranger District, Tahoe National Forest.

Photo: S. Smith

Canker Diseases

Cytospora Canker of True Fir
Cytospora abietis

Cytospora Canker in association with red fir dwarf mistletoe (*Arceuthobium abietinum f.sp. magnificae*) caused branch mortality on red fir branches near Robinson Flat Campground, Monumental Ridge and in other scattered areas of the American River District, Tahoe National Forest (M261E)(Figure 39). Branch flagging was especially intense this year due to the very dry conditions with some trees losing more than 50% of their crowns. Branch flagging was also detected on the Hat Creek Ranger District near the southwest corner of the Thousand Lakes Wilderness Area and the Heart Lake area of the Almanor Ranger District near Lassen Volcanic

Figure 40. Branch mortality on red fir caused by cytospora cankers and dwarf mistletoe, Lassen Volcanic National Park.

Photo: W. Woodruff

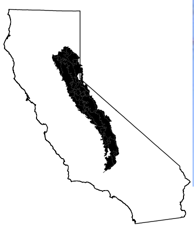
National Park (M261D). The disease was particularly evident in southwestern Lassen Volcanic National Park along CA Highway 89 where heavily infested red fir trees in the area have died recently as a result (Figure 40).

Cytospora canker was also severe along the Clear Creek Trail in the Siskiyou Wilderness near the Young's Valley trailhead (Happy Ranger Camp District, Klamath National Forest, M261A).

Cryptosphaeria dieback and canker diseases
***Cryptosphaeria* spp.**

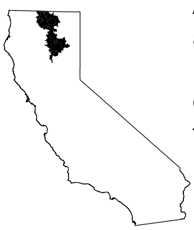
Figure 41. Severe symptoms of *Cryptosphaeria* dieback in a Fremont cottonwood tree.

In 2005 and 2006, Cryptosphaeria dieback, a new disease of Fremont cottonwood (*Populus fremontii*) and possibly Lombardi poplar (*P. nigra*) was detected throughout riparian areas in Napa, Sonoma, Solano, Merced, Sacramento, Yolo, Stanislaus and El Dorado Counties. Symptoms in trees were severe limb and twig dieback (Figure 41). Symptoms in the wood consisted of brown discoloration and decay in both sapwood and heartwood. Symptoms were often associated with the presence of fungal fruiting bodies originating from the surface of the dead bark. Preliminary work of identification for isolates obtained from cankers in Fremont cottonwood revealed a new *Cryptosphaeria* species to be associated with this disease. Ecological disturbances and water stresses in the native habitats of cottonwoods may have encouraged this new disease to develop.



M261E

Additional sampling in the higher elevations in the Sierra Nevada range on *P. tremuloides* and possibly *Populus balsamifera spp. trichocarpa*, resulted in the detection of the pathogen *C. lignyota*, the causal agent of Cryptosphaeria canker. Cryptosphaeria canker is a major disease of trembling aspen (*Populus tremuloides*) in the western United States. This is the first report of *C. lignyota* in California.



M261D

Diplodia Blight of Pines
Sphaeropsis sapinea (Diplodia pine)
Sphaeropsis sapinea continued to kill ponderosa pine branches along the North Yuba River in Sierra County (M261E). The disease was also observed in scattered ponderosa pine along CA Highway 89 in the Burney Falls area (M261D) and along CA Hwy 32 north of Chico (M261D). Isolated ponderosa and Jeffrey pine trees throughout their range in northeastern California appear to be occasionally affected by *S. sapinea*; genetics as well as microclimate may be involved.

M261A

Shoot dieback caused by *S. sapinea* was also observed again this year on ponderosa pines in the upper Sacramento River Canyon, Shasta and Siskiyou Counties (M261A). Diseased ponderosa pines were also noted in areas of the upper Trinity River drainage, Trinity County (M261A), in Whitmore (M261D), along State Route 299 between Whiskeytown Lake and Buckhorn Summit, Shasta County (M261A), in the community of Paradise, Butte County (M261D), and in and around the community of McCloud, Siskiyou County (M261A, D). Infection rates this year appear to be somewhat less than the previous 2 years, which had exceptionally wet spring weather. Most of these areas have experienced a chronic occurrence of Diplodia blight since the mid 1990s. Western gall rust is a common associate of Diplodia blight in the McCloud area.

Seiridium Canker
Seiridium cardinale
Seiridium canker was observed on scattered Port-Orford-cedar in the Port-Orford-cedar Provenance Test Site near the Stuart's Fork Arm of Trinity Lake (Shasta-Trinity National Forest, M261A). It was also found on Port-Orford-cedar at the Provenance Test Site at the Humboldt Nursery in McKinleyville (Humboldt County, 263Ae).


263a

Foliage Diseases


M261G

Madrone Leaf Blight
Mycosphaerella arbuticola
Madrones in many riparian areas in Napa, Sonoma, Mendocino and Del Norte Counties had severe leaf blight, resulting in the trees appearing to be dead or dying during the spring. Often only the very tops of the crowns seemed to have green foliage. *Mycosphaerella arbuticola* was recovered from most foliar samples. Trees in the Brooktrails area near Willits in Mendocino County were monitored over the summer and it was found that newer foliage emerged during the year during drier times, and appeared healthy throughout the summer.

Stigmina Leaf Spot Of Port-Orford-Cedar
Stigmina thujina
A foliar blight of Port-Orford-cedar (*Stigmina thujina*) was widespread in the Port-Orford-cedar Provenance Test Planting at the Humboldt Nursery near McKinleyville (Humboldt County, 263A).


Figure 42. *Virgella robusta* on white fir near Hamilton Mountain.

Photo: W. Woodruff

True Fir Needle Cast
Virgella robusta
True Fir Needle Cast was observed in white fir in several locations throughout northeastern California. A couple of notable areas include Manzanita Ridge, Big Valley Ranger District, Modoc National Forest (M261G), and Hamilton Mountain, Eagle Lake District, Lassen National Forest (M261D) (Figure 42).

Unidentified Needle Disease
An unidentified needle disease (possibly *Davisomycella montana*) was found killing 2- and 3-year-old lodgepole pine needles near Hog Flat Reservoir, Eagle Lake Ranger District, Lassen National Forest (M261D) (Figure 43).


Figure 43. unidentified needle disease on lodgepole pine needles near Hog Flat Reservoir, Eagle Lake District, Lassen National Forest.

Photo: D. Cluck

Root Diseases

Annosus Root Disease
Heterobasidion annosum
Annosus root disease in ponderosa pine north of State Hwy Highway 44 on the Eagle Lake Ranger District, Lassen National Forest (M261D) appeared to be inactive in many formerly active infection centers. The decrease in pine mortality caused by the disease may be the result of the Forest treating stumps with the borax for the last

three decades. The borax fungicide, now registered as SPORAX®, prevents *H. annosum* spores from infecting stumps and moving into connected root systems where it can persist for thirty years or more, killing pine regeneration and adjacent mature pine trees.

Annosus root disease continued to cause scattered pockets of mortality in ponderosa pine on McCloud Flats on the Shasta-McCloud Management Unit, Shasta-Trinity National Forest (M261D). Ponderosa pine mortality was particularly high on Forest Service land south of the Shasta Forest subdivision, approximately four miles northeast of McCloud.

Armillaria Root Disease
Amilllaria mellea

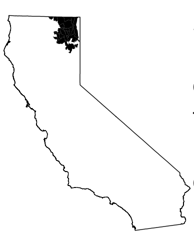
Figure 44. Declining giant sequoia (in plantation) due to Armillaria root disease. (Compare crown density with the tree background right).

Photo: M. MacKenzie

In 1996, John Pronos, Forest Health Protection (retired), reported mortality of giant sequoia (*Sequoiadendron giganteum*) in the Whitaker Plantation, Hume Lake Ranger District, Sequoia National Forest. The cause of mortality was attributed to *Armillaria melea*. The Whitaker Plantation covers about 12 acres and was logged of all non-sequoia species in 1983, broadcast burned in 1985 and the area adjacent to and under the reserved giant sequoia was under-planted with 1/0 giant sequoia in 1986. A site visit in the 2007 revealed that another two poles (at 17 ft with 6.4 & 6.3" DBH's) had also been attacked, and presumably killed by *Armillaria mellea*. An additional maturing tree, with a 56.0" DBH, was also now declining (Figure 44).

An examination of the two dead poles, found in 2007, revealed that both had well developed *Armillaria* mycelial fans beneath the bark in the root collar area. A bright green metallic wood boring beetle tentatively identified as *T. opulenta* was recovered from one of the dead poles and the other was supporting a thriving colony of termites (Termitidae). Additionally, very few rhizomorphs were found in the soil adjacent to the dead trees. In the case of these poles it would seem that there is a chance that the root rot pocket will run its course before a separate large tree is infected. The situation with the large declining tree may be problematic, as the stump might be able to sustain the fungus for decades.

Black Stain Root Disease
Leptographium wageneri



M261G

Black stain root disease continued to kill young and old ponderosa and Jeffrey pine trees east of State Hwy 139 between Willow Creek Campground and Heartrock (Figure 45) on the Big Valley Ranger District, Modoc National Forest (M261G). Mortality often occurs after infected trees are attacked by bark beetles. Four miles south, *L. wageneri* and bark beetles continue to cause pine mortality west of Hwy 139 (Figure 46).

Because of high levels of stocking, conspicuous concentrations of mortality around black stain root disease centers were evident at the Mud Flow Research Natural Area of the

Shasta-McCloud Management Unit, Shasta-Trinity National Forest (M261D).

Black stain root disease centers were widespread and scattered in the Douglas-fir plantations in the Wild Azbill Timber Sale Area of the Round Valley Indian Reservation, north of Covelo (Mendocino County, M261B). Black stain root disease was also found in two Douglas-fir plantation stands near Black Mountain, north of Orleans (Orleans Ranger District, Six Rivers National Forest, M261A).

Figure 45. Black stain root disease in old ponderosa and Jeffrey pine trees east of CA Highway 139 between Willow Creek Campground and Heartrock on the Big Valley District, Modoc National Forest (M261G).

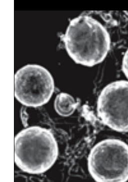
Photo: W. Woodruff

Figure 46. *L. wageneri* and bark beetles continue to cause pine mortality west of Hwy 139.

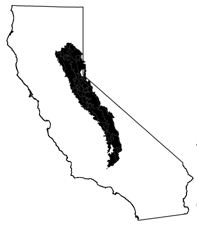
Photo: W. Woodruff

M261A

M261B



Rust Diseases



M261E

Incense-cedar Rust
Gymnosporangium libocedri
Incense-cedar rust was reported from Quincy, Plumas County (M261E).

Stalactiform Rust
***Cronartium coleosporioides* (= *C. stalactiformae*)**
Old and current injury to lodgepole pine caused by Stalactiform rust was present on 50-100 acres southeast of the 4 Corners Snowmobile Park Road (FS Road 44N77B, Goosenest Ranger District, Klamath National Forest, M261D).

M261D

Western gall rust
Endocronartium harknessii
Western gall rust was present on 20-year-old, planted Coulter pine in Oak Run, Shasta County (M261F).

Miscellaneous Diseases

M261F

Crown Gall disease
Agrobacterium tumefaciens
Young incense cedars at the Turtle Bay Museum in Redding, Shasta County had crown gall, caused by *Agrobacterium tumefaciens* (M261C).

Douglas Fir Needle Deformity
Cause Unknown
Douglas fir Christmas trees showed extensive deformity of needles in the San Luis Obispo area. Several true fir Christmas trees were also affected. Needles appeared to have been damaged within the bud prior to bud break. No insect or disease was observed however it is suspected that the injury may have occurred due to feeding by aphids or other insects prior to bud break.

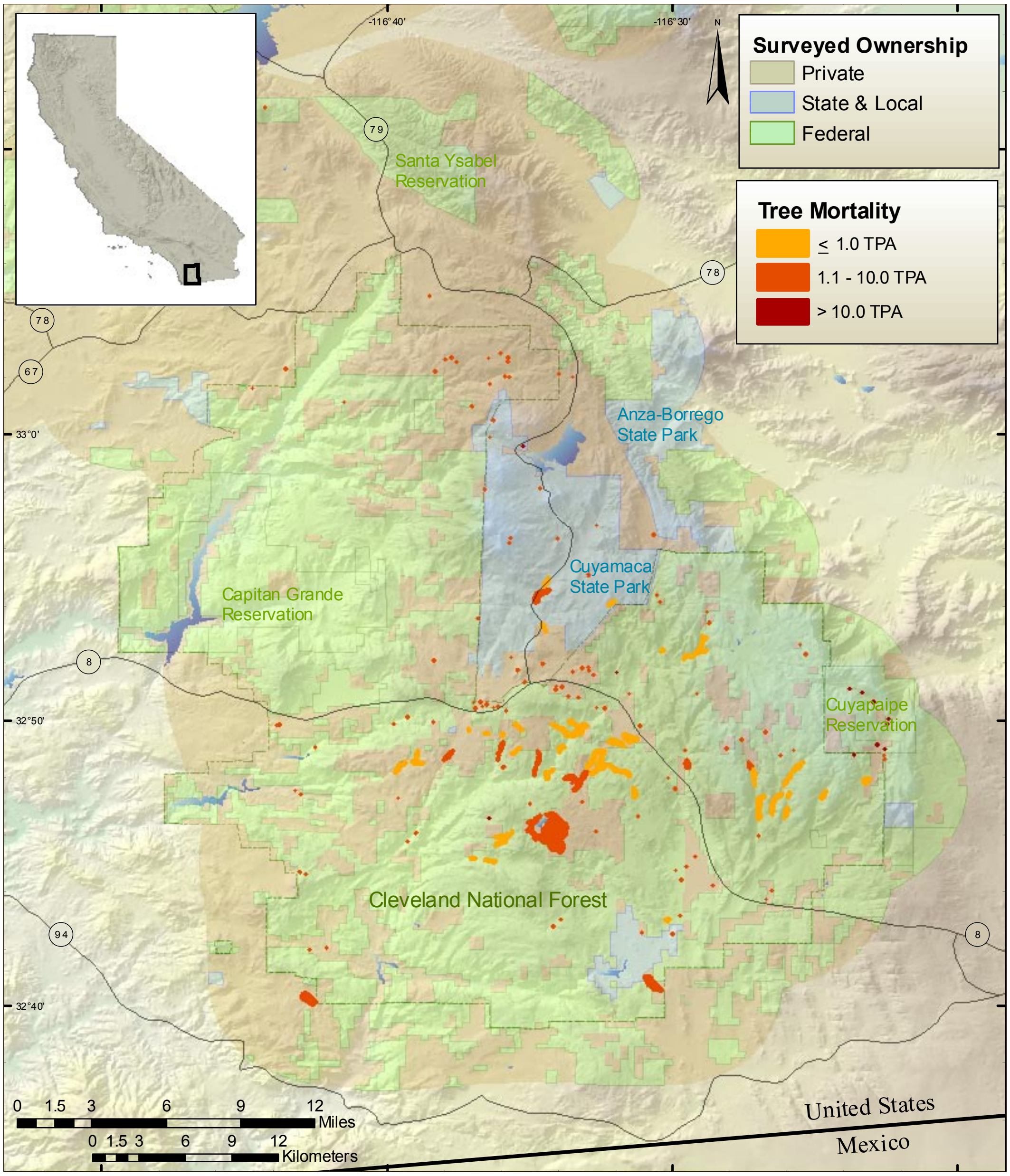
M261C

Liquidambar Leaf Scorch
Xylella fastidiosa
Liquidambar (sweet gum) street trees throughout the Los Angeles basin had leaf scorch and early leaf fall due to infection with the bacterial disease *Xylella fastidiosa*. Trees looked unhealthy and showing signs of stress from the infection. The overall impact of the disease is as yet unknown. Surveys will be conducted to determine the extent of the infection.

M262B

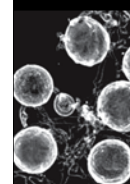
Oak Mortality – Southern California
Cause unknown
Extensive mortality in coast live and Engelmann oak continued in southern San Diego County in 2007. The mortality occurred around Descanso, Pine Valley, and in areas south of Interstate 8, including Horsethief Canyon, along Campo Road near Dutchman Canyon, and Lake Morena County Park (Map 10). The oak mortality is increasing and may be drought related. The cause for the widespread mortality is as yet undetermined, however investigations are continuing (M262B).

Phytophthora gonapodyides
A small stand of dead and dying tanoak in the Shafer Ranch area southwest of Willits in Mendocino County had symptoms similar to those caused by *P. ramorum*. However, the only pathogen recovered from bleeding stem cankers was *P. gonapodyides.*



Map 10. Hardwood mortality detected in 2007 in and around the Cleveland National Forest.

Map: Z. Heath



Red ring rot
Phellinus pini
Numerous ponderosa pines at Cal Fire's Paradise Fire Station, Butte County, were infected by *Phellinus pini* (M261D). Improper pruning may have contributed to the infections.

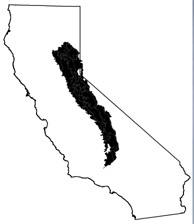
Slime Flux
Erwinia sp.
The bacterial disease caused oozing in various old live oaks in the interior developed canyons of Riverside County. The trees were also suffering from compaction and urban development. Although the trees were infected, they are likely to live for numerous years if treated properly.

Declines

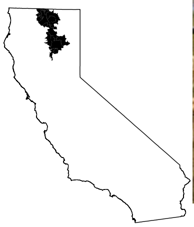
Gray Pine Decline

Figure 47. Gray pine showing signs of decline.

Photo: B. Bulaon



M261E



M261D

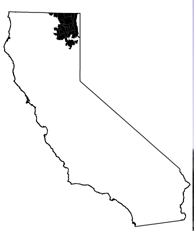
Mortality and signs of severe decline of gray pines was observed in many counties of the southern Sierra. Most trees were completely dead with signs of injury from roadside fires, old dwarf mistletoe infections, or limb breakage. Some of the dead trees did not have visible signs of injury and may have died due to drought stress (Figure 47).

Incense Cedar Decline

Incense cedar decline continued at low levels this year in many northeastern areas. The specific cause of the decline remains unknown but enduring drought effects are likely the cause. Symptoms include foliage dieback and whole tree mortality. Seedlings and saplings appeared to be the most affected but some large diameter tree mortality occurred (M261E, M261D, M261G).

Figure 48. Western white pine exhibiting decline on the northeast side of Haskell Peak, Plumas National Forest

Photo: W. Woodruff



M261G

Western White Pine Decline

The foliage in the upper crowns of old western white pine trees appeared thin and off-color on the western slope of Mt. Lassen in Lassen Volcanic National Park (M261D). The decline was likely related to an extended drought. White pine blister rust may also be contributing to this decline. The decline of western white pine has also been occurring over the last decade on the northeast side of Haskell Peak, Plumas National Forest (M261E)(Figure 48).

Chaparral Death and Decline

Mortality of coast live oaks occurred along with various chaparral species (black sage, yucca, and prickly pear cactus) in parts of Orange County. The dead and dying areas covered large sections of hill sides with all species in the area affected. The affected areas appeared to increase over time. Oaks and sage species died first followed by the yuccas and cactus. A generalist root disease is suspected and soil and root samples were collected for analysis to determine the cause.

Figure 49. Heavy infections of dwarf mistletoe on red fir at Summit Lake campground, Lassen Volcanic National Park.

Photo: W. Woodruff

Mistletoe

Red Fir Dwarf Mistletoe

Arceuthobium abietinum f.sp. magnificae

Heavy infections of red fir dwarf mistletoe were observed at Summit Lake campground, Lassen Volcanic National Park, causing stem and branch deformities in small diameter trees and branch, limb and bole swellings in larger diameter trees (Figure 49). No mortality was observed (M261D).

Western Dwarf Mistletoe
Arceuthobium campylopodum

Ponderosa pines were observed with western dwarf mistletoe near Saddleback Ridge, Yuba River Ranger District, Tahoe National Forest. These trees were in very poor health and some mortality had occurred (M261E). Many ponderosa pines on Dow Butte, Lassen National Forest, were also heavily infested with western dwarf mistletoe (Figure 50).

Figure 50. Ponderosa pines infected with western dwarf mistletoe near Dow Butte, Lassen National Forest.

Photo: W. Woodruff

Abiotic Conditions

Weather

Information from two sources was used to illustrate meteorological conditions in California over the past few years: the Palmer Drought Indices and data collected by the California Department of Water Resources. 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 (Figure 51). Moderate to severe drought conditions existed for most of California in 2007. The statewide average snowpack condition in April was 36% of normal. Overall precipitation for the state was at 63% of normal in 2007, following two consecutive years of mostly wet conditions.

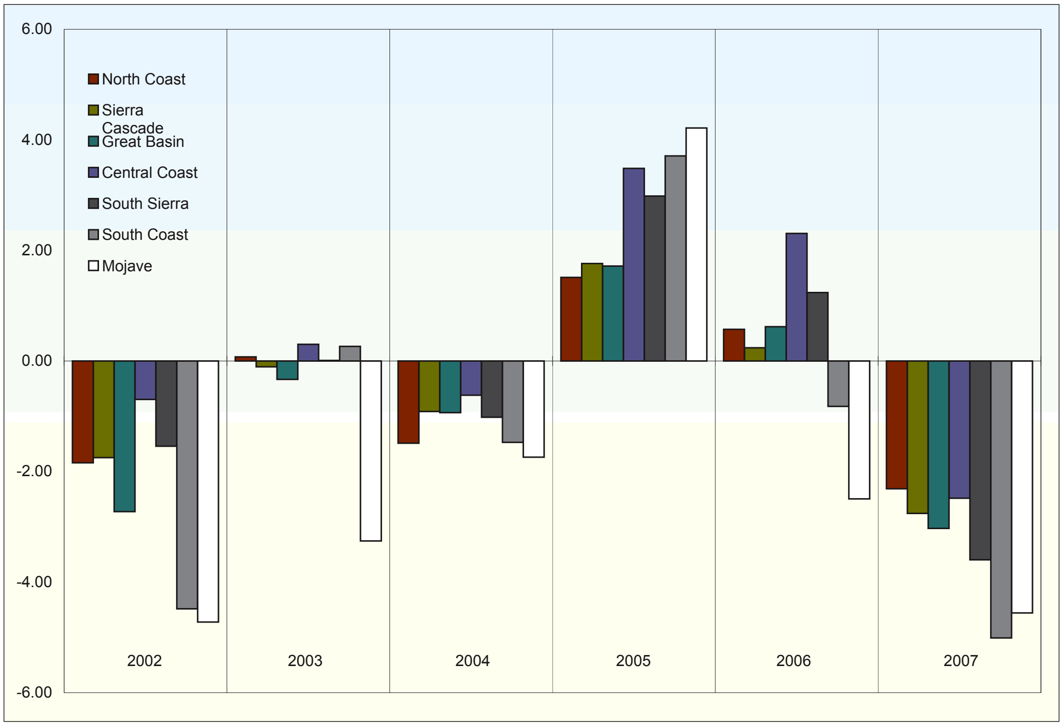
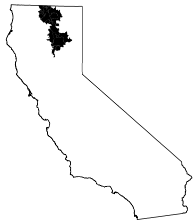


Figure 51. Palmer drought indices for the seven hydrologic zones in California, 2002-2007. The Palmer Drought Index is an indicator of drought or moisture excess and ranges from -6 to +6, with the negative values denoting degree of drought.

Drought Stress

M261C

Many conifers shed older needles and some hardwoods lost leaves prematurely as a result of drought stress. Notable examples include incense cedar and blue oak. Widespread mortality was noted across the highlands northeast of Mount Shasta, reaching its highest levels on the drier northern slopes facing Butte Valley. Black stain root disease and drought are contributing to elevated levels of ponderosa pine mortality on McCloud flats.



M261D

Drought stress also affected incense cedar along N. Old Stage Road, Siskiyou County (M261D). By July, these trees were exhibiting extensive yellowing of older needles and by the end of the summer; many of the yellow needles had dropped. Foothill pine in the northern Sacramento Valley (M261C) exhibited similar symptoms.

M261A

A dry spring and intense heat at the beginning of summer caused leaves on many blue oaks to change color and begin falling in early July in the northern Sacramento Valley (M261C). The effect did not persist, however, due to an unseasonable rain storm in mid July and fairly mild temperatures through the remainder of the season.

Dieback and thin crowns in red maple due to drought stress was observed at the CalTrans' Collier Rest Area, Siskiyou County (M261A). Other tree species suffered as well. Although the trees are in an irrigated lawn, they are now large enough that their water needs are probably not being met by the irrigation.

Coast redwood at the Turtle Bay Museum in Redding, Shasta County (M261C), experienced similar drought-related symptoms. The site has hardpan and the redwoods are showing signs of drought stress – principally top decline and dieback. Reduced stocking and increased irrigation may help, but soil conditions may ultimately be the limiting factor.

Drought stress was a common problem on low elevation sites in the upper Sacramento Valley where slope, aspect, and soil conditions play a major role in determining the composition of tree species. Douglas-fir, incense cedar, ponderosa pine, knobcone pine, grey pine, and various oak species typically grow in close proximity in these areas. Drought-stressed Douglas-fir were common, exhibiting dead tops and branch dieback, often from *Melanophila drummondi* attack. A number of reports were received from landowners in the general vicinity of Shasta Lake, Shasta County, of declining tree health, particularly for Douglas-fir (M261A).

Foothill oaks, blue oak (*Quercus douglasii*) in particular, were affected by drought in 2007. By late June the blue oaks had drought deciduous leaves. Blue oak, the most widely distributed Californian hardwood species, sheds older leaves to reduce the water demand during drought years. This was observed in the Sierra and Cascade foothills from Shasta County to south of Clovis, being more pronounced in the south. Buds on the oak trees were healthy in early July, but the shoots retained only the last 3-4 leaves on each twig end (Figure 52). Foresters reported that the Californian buckeye (*Aesculus californica*), had shed its leaves a month earlier than usual (Figure 53).

Figure 52. The view looking up and out through the edge of the tree crown, showing that the tree has retained only the last 3 to 4 leaves on each twig.

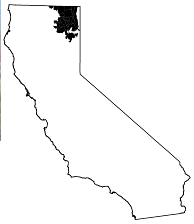
Photo: M. MacKenzie

Figure 53. California buckeye shed leaves early due to drought.

Photo: D. Cluck

Fire Injury

A large area of ponderosa and Jeffrey pine mortality was observed within the boundary of the 2004 Straylor Fire, Hat Creek Ranger District, Lassen National Forest. These trees suffered from various levels of fire injury to crowns, roots and boles. Most of these injured trees were attacked by woodboring and/or bark beetles (M261G).



M261G

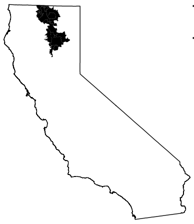
One site of particular interest was observed on the Yuba Ranger River District, Tahoe National Forest, where a white fir stand that was underburned 10+ years ago continues to have ongoing and elevated levels of tree mortality. These large diameter trees sustained major injuries to boles and roots, as evidenced by sloughing bark and decayed wood, but had limited crown injuries. Trees in this stand continue to succumb to attacks by woodboring and/or engraver beetles (M261E).

M261E

Frost Damage

New shoots on white fir suffered frost damage in many areas in the spring. Injury was noted in southeast Siskiyou County at various locations from McCloud to Pondosa, and on Hatchet Mountain and in and around Latour State Forest, Shasta County (all M261D).

White and red fir throughout many locations in northeastern CA suffered frost injuries to buds and newly elongating shoots during the first week of June. Many of the affected trees


M261D

failed to grow any new foliage in 2007. However, epicormic branching was observed in a few individuals by mid-summer (M261E, M261D, M261G).

Maple Leaf Scorch

Maple leaf scorch continued to affect maples throughout northeastern California (M261D/E). No biotic agent has been identified as the cause. The injury may be a physiological response to tree age and inter-tree competition. Indian Creek, Meadow Valley, Berry Creek, the Feather River Canyon in Plumas County and the North Yuba River in Sierra County had high levels of maple leaf scorch again this year (M261E). Leaf scorch was also detected on maple in the Deer Creek area along Highway 32 and along Janesville Grade in Lassen County (M261E). The cause of the scorch is still being investigated.


M261C

Miscellaneous Fasciations

Fasciations, thought to be caused by bacteria, rhabdoviruses, hormonal herbicides (such as 2,4D) and genetic mutations, were identified on ornamental evergreen eunymus (*Euonymus japonica*) and weeping birch plantings at a residence in Redding (Shasta County, M261C).

Salt Injury


Figure 54. Injury from de-icing salt on Jeffrey Pine.

Photo:
Kim Camilli
and Chandalin Bennett.


M261E


M261G

Application of sodium chloride to roads in the wintertime reduces the accumulation of snow and ice and is a common practice in the Lake Tahoe Basin. De-icing salts are regularly applied during and after storms to create safe driving conditions and passable roads. The two transportation departments responsible for maintaining the roads around Lake Tahoe (CalTrans and NDOT) have been recording their use of de-icing salts for almost two decades now and are aware that de-icing salts can have a negative impact on roadside vegetation, soil, and surface and ground water. Injury to roadside vegetation is of special concern because it is readily apparent on many of the trees around the lake. Researchers at the University of Nevada, Reno, in cooperation with NDOT and CalTrans, are currently working on a three-year project to assess the degree of injury caused by salt that is occurring on the conifers around the lake. Approximately 520 permanent research plots are being established around the lake, occurring on both the roadsides and in control areas away from the roads. Trees within these plots are being surveyed for incidence and severity of injury caused by salt, as well as insects and diseases. A typical symptom of the injury on pines is the browning of needles from the tip down to the base, with a clear demarcation between healthy and dead tissue (Figure 54). Tree species in the Lake Tahoe Basin most sensitive to salt include Jeffrey pine (*Pinus jeffreyi*), sugar pine (*P. lamertiana*), and ponderosa pine (*P. ponderosa*). Trees closest to the highway corridor had a higher incidence of injury than trees occurring even as little as 50 feet from the roadside. A higher incidence of injury also occurred on trees that were downslope from the highway rather than upslope. Numerous other factors play into the injury caused by salt seen on the conifers around Lake Tahoe including drought, temperature and precipitation differences, diseases and insects, and the varying amounts of salts applied to the roads from year to year. These and other external factors in conjunction with results from soil and foliage chemistry tests and annual survey data will be used to ultimately help determine factors most important in causing the injury on conifers in the Lake Tahoe Basin.

Salt was also noted causing foliage dieback of incense cedar along Highway 44 near the junction with Highway 36. All size classes of trees within 30 feet of the road were affected (M261D) (Figure 55).

Figure 55. Foliage dieback of incense cedar caused by salt, along Highway 44 near the junction with Highway 36.

Photo: D. Owen

Winter Damage

There was a noticeable dieback and decline of Manzanita and whitethorn in the Lake Tahoe basin. It is hypothesized that the shrubs were hurt by exceptionally cold weather that occurred in winter during a period of less than normal snow pack. Some shrub mortality was observed but most recovered during the growing season. This also occurred in snowbrush, *Ceanothus velutinus*, stands on the Beckwourth District, Plumas National Forest. Most of the affected shrubs had re-sprouted new foliage by mid summer.

Young Douglas-fir ($\leq$ 4 yrs old) were killed or damaged in a number of north State plantations over the winter. Mortality ranged from 30 - 90 % in plantations near Bigelow Meadow (M261D) and on Indian Spring Mountain (M261G), Siskiyou County, and near Dana (M261D), Shasta County. Precipitation in January was well below normal resulting in scant snow cover, while clear skies produced sunny days and colder than normal nights. The mechanism of damage is unclear, but affected seedlings were girdled by a distinct zone of dead tissue encircling the stem at or slightly above ground level. Tops thus desiccated and died, while roots were undamaged. No insect damage or disease was evident. Young ponderosa pine on Hatchet Mountain (M261D), Shasta County suffered similar damage in areas where snow cover was lacking.

Ozone

Forest Inventory and Analysis Ozone Biomonitoring

The USDA Forest Service's Forest Inventory and Analysis (FIA) uses biomonitoring to monitor the potential impact of tropospheric ozone (smog) on forests. Bioindicators are plants that exhibit a visible response to ozone pollution. Sixty-five plots were visited in 2007; ozone injury was present on 32 plots. Indicator species with validated injury were ponderosa pine, Jeffrey pine and blue elderberry.

Additional analysis of ozone injury detected by the FIA program is reported in the publication: Campbell, Sally J.; Wanek, Ron; Coulston, John W. 2007. Ozone injury in west coast forests: 6 years of monitoring. Gen. Tech. Rep. PNW-GTR-722. Portland, OR: U.S. Department of Agriculture, Forest Service, Pacific Northwest Research Station. 53 p.
http://www.fs.fed.us/pnw/pubs/pnw_gtr722.pdf

FIA ozone database for CA, OR, and WA, 2000-2006 (Access) is available upon request from Sally Campbell, PNW-FIA – scampbell01@fs.fed.us

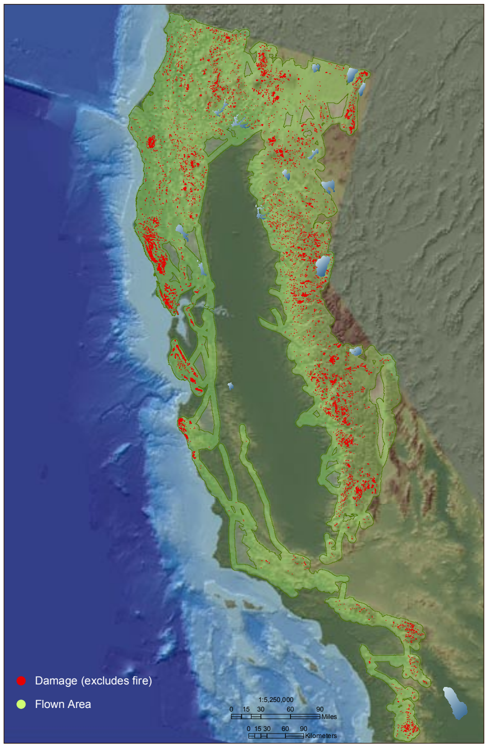
Animal Damage

Porcupines girdled the tops of ponderosa pines at a private campground on the eastside of Concow Reservoir, Butte County (M261F).

Top-killing of second growth redwood was reported from the Comptche area west of Ukiah, Mendocino County The suspected cause was stem girdling by rodents.

Aerial Detection Monitoring

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 damage to California's forested ecosystems.



Map 11. Flight coverage and injury detected during the 2007 aerial surveys.

Map: Z. Heath

Approximately 44 million acres were flown in California in 2007, including almost 20 million acres of Forest Service land and almost 19 million acres of private land (Map 11).

Approximately 791,000 acres with mortality or injury were observed and mapped in California, including 347,000 acres caused by biotic agents such as bark beetles and diseases.

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

Douglas-fir tussock moth (DFTM) was not observed from the areas where it was detected in 2006, with the exception of 7,000 acres in or near the Shasta-Trinity National Forest.

Live Oak and Tanoak mortality from sudden oak death continued to advance within currently infested counties.

Large areas of defoliation (approximately 8,500 acres) caused by California oak worm were observed along the California's central coast.

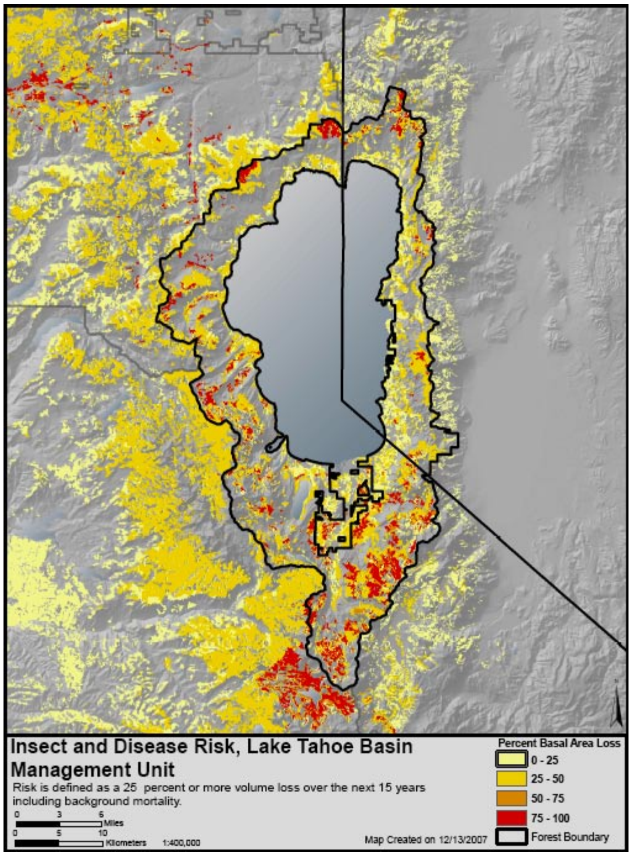
To download the final aerial detection survey report and learn more about aerial detection monitoring, view standards and metadata, or to download printable maps and data, go to: www.fs.fed.us/r5/spf/fhp.

Risk Modeling

Insect and Disease Risk Modeling was initiated in 1995 with the formation of an interdisciplinary team of specialists to model and predict potential risk of forest mortality due to insect and disease induced tree mortality. A multi-criterion framework has been established to facilitate a standardized modeling approach across all forest health regions to create a seamless final product. 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.

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 12. Insect and disease risk map of the Lake Tahoe Basin Management Unit.

Map: E. Haunreiter

While the methodology for the California risk map 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 12 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. The planned update schedule for the national map is every 5 years.

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
Bark Beetles and Wood Borers	
Ambrosia beetles	*Monarthrum* spp.
Asian Longhorned Beetle	*Anoplophora glabripennis*
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.
Other Insects	
Aspen gall wasp	unknown
Cooley spruce gall aphid	*Adelges cooleyi*
Douglas-fir twig weevil	*Cylindrocopturus furniss*
Jeffrey pine needleminer	*Coleotechnites* sp. near *milleri*
Needleminers	*Coleotechnites* spp.
Pine reproduction weevil	*Cylindrocopturus eatoni*
Ponderosa pine twig scale	*Matsucoccus bisetosus*
Red gum lerp psyllid	*Glycaspis brimblecombei*
Scales	*Physokermes* sp.
Sequoia pitch moth	*Vespamima sequoiae*
Spruce aphid	*Elatobium abietinum*
The obtuse sawyer	*Monochamus obtusus*
Tip moth	*Rhyacionia zosana*
Western pineshoot borer	*Eucosma sonomana*

Recent Introductions

Asian gypsy moth	*Lymantria dispar*
Asian longhorned beetle	*Anoplophora glabripennis*
Banded elm bark beetle	*Scolytus schevyrewi*
Mediterranean pine engraver	*Orthotomicus erosus*
Red-haired pine bark beetle	*Hylurgus ligniperda*

DISEASES AND THEIR CAUSAL PATHOGENS

Common Name of the Disease	Scientific Name of the Pathogen
Cankers	
Chinkapin canker	Unknown
Cytospora canker of true fir	*Cytospora abietis*
Diplodia blight of pines	*Sphaeropsis sapinea*
Douglas-fir canker	Unknown
Madrone canker	*Nattrassia mangiferae* and *Botryosphaeria dothidea*
Phomopsis canker	*Phomopsis lokoyae*
Pitch canker	*Fusarium circinatum*
Declines	
Incense-cedar decline	Unknown
Sudden oak death	*Phytophthora ramorum*
Dwarf Mistletoes	
Douglas-fir dwarf mistletoe	*Arceuthobium douglasii*
Gray pine dwarf mistletoe	*Arceuthobium occidentale*
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 disease	*Elytroderma deformans*
Sugar pine needle cast	*Lophodermella arcuata*
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*
Rusts	
Western gall rust	*Endocronartium harknessii*
White pine blister rust	*Cronartium ribicola*
True Mistletoes	
True mistletoe	*Phoradendron* spp.

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*
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.

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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:**

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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

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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