# 2016 California Forest Pest Conditions

A publication of the
California Forest Pest Council

# In Memoriam

David H. Adams

1932 - 2017

*The 2016 California Forest Pest Conditions Report is dedicated to Dave Adams –*

*a friend and well-respected plant pathologist to many, both within and outside the forestry community*.

Dave grew up in Oakland, California. After graduating high school, he enlisted in the U.S. Air Force and served in the Korean War. Following his years of service, he married his wife Gerry, started a family, and earned his bachelor's degree in botany from Humboldt State University. He went on to earn his master's and doctoral degrees in plant pathology from Oregon State University, and dedicated his 1972 Ph.D. thesis on *Armillaria mellea* to Gerry and his three children: Herb, Jeff, and Lea. The family spent their summers near Bend, Oregon, while Dave conducted research at Pringle Falls Experimental Forest.

Following graduate school, Dave's first job was as a plant pathologist with the California Department of Food and Agriculture in Pest Detection, where he developed many lasting friendships and professional relationships. In 1980, he moved to the California Department of Forestry and Fire Protection to work on forest diseases, which opened a new chapter in his career. As the Department's first - and for many years, sole - forest pathologist, Dave worked throughout the state on a variety of native and invasive forest diseases. He was passionate about understanding trees and the environments they inhabited, whether in natural or urban settings. He was thoughtful and thorough in his work, endearing himself to the many clients he served. He retired from CAL FIRE in 2000.

After retirement, Dave continued to be an active member of "Tree Davis" in his home town of Davis. In an article he prepared for the group's newsletter, he extolled the city's trees as contributing to a "special feeling of community togetherness… in a way that no other features could do." Dave was a strong cyclist and an active member of the Davis Bike Club. For years, he led a group of CAL FIRE friends on an annual ride around Lake Tahoe, and at 67 he completed a 200-mile ride from Seattle to Portland with his daughter.

*Thank you, Dave, for your years of service working to protect the health of California's urban and wildland forests.*

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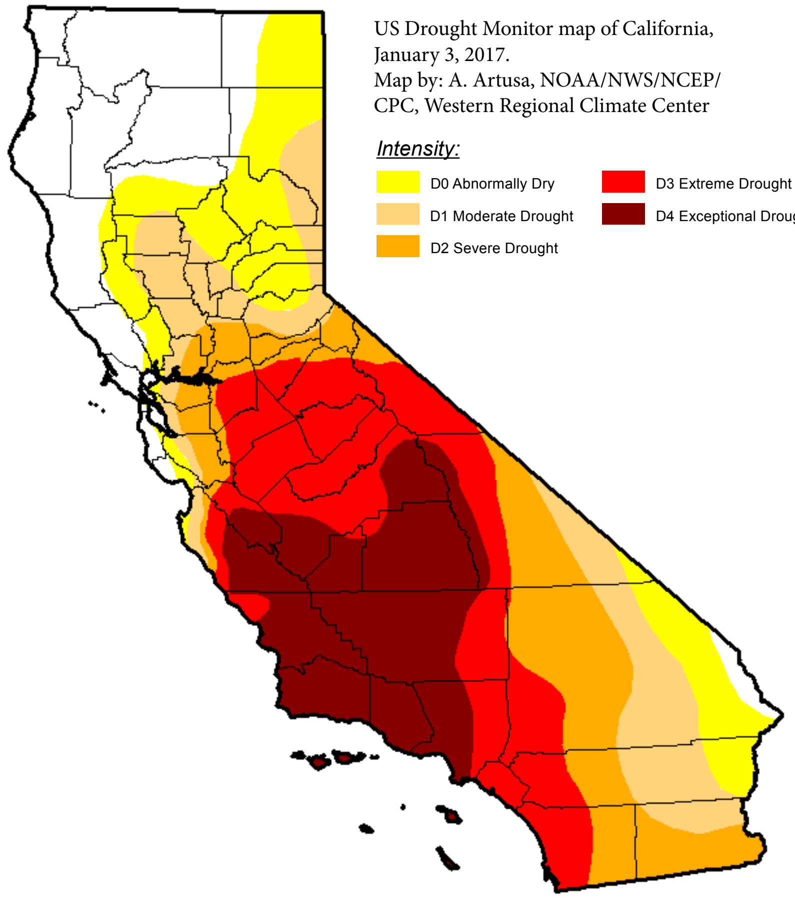
Overall, California's statewide precipitation was above average (105% of normal) in 2016 for the first time since 2011. Rainfall predominately occurred in December 2015, January 2016, and March 2016 (the water year runs from October 1 – September 30), while February 2016 was the 15th driest month on record. The April 1, 2016 statewide snowpack was 85% of average, up from 5% of average in 2015.

California experienced its third hottest year on record in 2016. February temperatures were 5.5 – 9.0°F above average and June temperatures were 3.6 - 6.9°F above average.

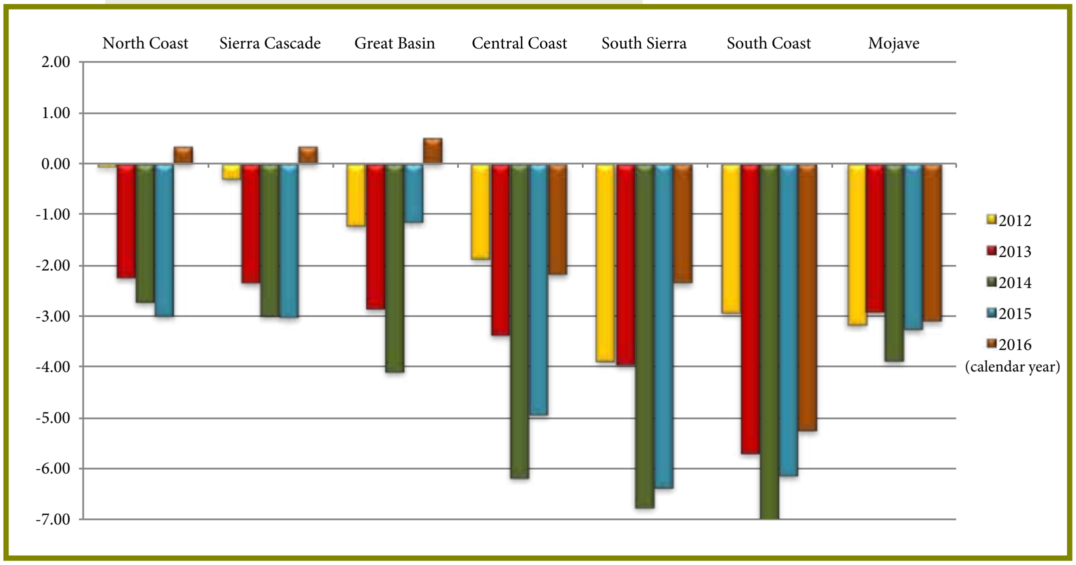
The prolonged drought, overstocked forests, and higher than average temperatures were the most significant factors affecting California forest health in 2016, with an estimated 62 million dead trees mapped across 4.3 million acres during the US Forest Service forest health aerial detection surveys. More than 50% of the dead trees mapped were on the Sequoia, Stanislaus, and Sierra National Forests. Statewide, 5,762 fires consumed 147,373 acres, killing millions of trees and leaving millions more weakened and susceptible to insects and diseases. Bark beetles continued to exploit the millions of drought-stricken trees, particularly in the central and southern Sierra Nevada range as well as areas of coastal and Southern California.



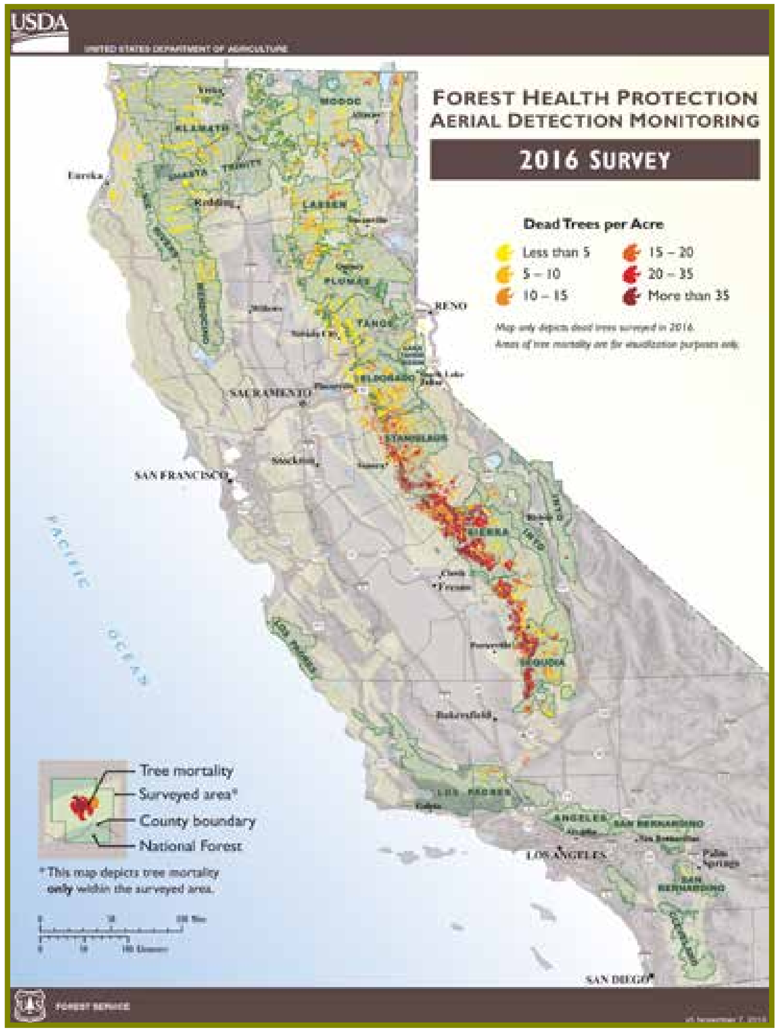

US Drought Monitor map of California, January 3, 2017.
Map by: A. Artusa, NOAA/NWS/NCEP/CPC, Western Regional Climate Center

**Palmer Drought Index**

The Palmer Drought Index is an indicator of drought and moisture excess, with negative values denoting degree of drought. In 2016, the yearly average Palmer Drought Index values ranged from 0.5 in the Great Basin (wettest zone) to -5.26 in the South Coast (driest zone).



Aerial surveys are conducted annually by the US Forest Service to assess and document the relative health of California's forests. Surveys are flown in light, fixed-wing aircraft and utilize a digital sketch-mapping system to document recent tree mortality and damage. Of the 47 million acres surveyed throughout California in 2016, an estimated 62 million trees were killed over approximately 4.3 million acres. This was an extensive increase from the 29 million trees detected over 2.8 million acres in 2015. Overall, an estimated 102 million trees have died since 2010, when California's extreme drought began. Mortality has been most intense in low-elevation pine and mixed conifer forests along the southern Sierra Nevada range. In 2016, extensive mortality was detected much further north and at higher elevations. Scattered mortality with locally concentrated groups was also common across forested landscapes. An aerial survey was conducted in May to acquire an early mortality assessment in low-level pine and oak woodlands. Regular summer flights began as usual in July and were mostly completed by the end of August, with the exception of the Sierra and Sequoia National Forests, which were not surveyed until late September due to the Cedar Fire. All National Forests and forested National Parks were surveyed, along with other federal, state, and private lands. Capturing drought-related mortality was the priority in 2016; consequently, other types of damage may not be as thoroughly documented as they might otherwise have been. (Acres reported below may be noted in more than one bullet as multiple issues often occur in the same location. Additionally, acres reported had some elevated level of mortality detected; not all host trees in given areas were killed.)




USDA FS California Aerial Detection Survey Tree Mortality, 2016.
Map by: B. Moran, USFS

Higher elevations in the Sierra Nevada range and further north of the Stanislaus NF are increasingly showing drought effects, Yosemite Valley. Photo by: J. Moore, USFS

## Bark Beetles and Wood Borers

- Over 4 million acres with elevated levels of tree mortality due to bark beetles or wood borers were mapped, up from 2.5 million acres in 2015 and 820,000 acres in 2014.
- Fir engraver beetle-related true fir mortality increased to 2.65 million acres, up from 1.21 million acres in 2015 and 460,000 acres in 2014.
- Western pine beetle-related predominately ponderosa pine mortality tripled to more than 2 million acres.
- Mountain pine beetle-related mortality increased dramatically from 600,000 acres to 10.9 million acres.
- Acres with Jeffrey pine mortality dramatically increased from 774,000 acres to almost 8.2 million acres.
- *Ips* beetle-related pinyon pine mortality decreased from 238,000 to 30,000 acres due to a lack of viable hosts in some areas with previous intense mortality.
- Drought-related gray pine mortality decreased from 40,000 to 6,700 acres.
- Coulter pine mortality caused by western pine beetle and *Ips* decreased substantially from 41,000 acres to 18,000, due primarily to lack of viable hosts in many of these isolated stands.

- Incense cedar, sugar pine, and other conifer species profoundly affected by the drought are likely underrepresented in survey results since they are typically minor components of mixed-conifer stands.
- Douglas-fir mortality of larger trees not attributed to bear feeding damage decreased more than 300%, from 101,000 acres in 2015 to 31,000 acres in 2016.
- Oak mortality attributed to goldspotted oak borer (GSOB) in San Diego County decreased from 16,000 to approximately 11,000 trees across 7,000 acres; however, some of these trees may have been killed directly by drought.
- Evergreen or live oak tree mortality attributed to drought decreased from almost 148,000 acres to 98,000 acres in 2016; however, it is often quite difficult to differentiate between recent and older mortality.
- The May 2016 survey detected over 52,000 acres with drought-related blue oak mortality. This early survey was not comprehensive and by summer it is too late to discern tree condition, thus this estimate is likely a considerable underrepresentation of blue oak mortality.

Intense recent and scattered older low elevation white fir and ponderosa and sugar pine mortality south of Shaver Lake, Sierra NF. The giant sequoia grove (lower left) appears healthy.
Photo by: J. Moore, USFS

Recent and older Coulter pine mortality along the Gabilon Mountain Range north of Pinnacles National Monument. The drought has removed most of the pine component in these isolated ridge tops. Photo by: J. Moore, USFS

## Defoliation

- Drought-induced blue and other deciduous oak defoliation and discoloration were ubiquitous in southern areas and are underrepresented in the survey results. Early deciduous oak leaf drop is common in drought years and can be cause for concern if conditions persist for several years.
- Aspen defoliation caused by either *Marssonina populi* leaf blight or defoliating insects such as satin moth was common in 2016, similar to observations in 2015.
- Other minor and localized defoliation attributed to insects was recorded, including a chronic infestation by lodgepole needle miner in the high country of Yosemite National Park.

## Diseases

- *Phytophthora ramorum*/sudden oak death (SOD)-related mortality in primarily tanoak decreased to approximately 10,500 acres. Several isolated areas of tanoak mortality were observed, but were attributed to drought since they were outside of known SOD-infested areas. Spread of this disease to new hosts and into new areas has been limited by the drought.
- Other observed diseases included Port-Orford-cedar root disease, western gall rust, pitch canker, Cytospora canker on true fir, and several foliar diseases.

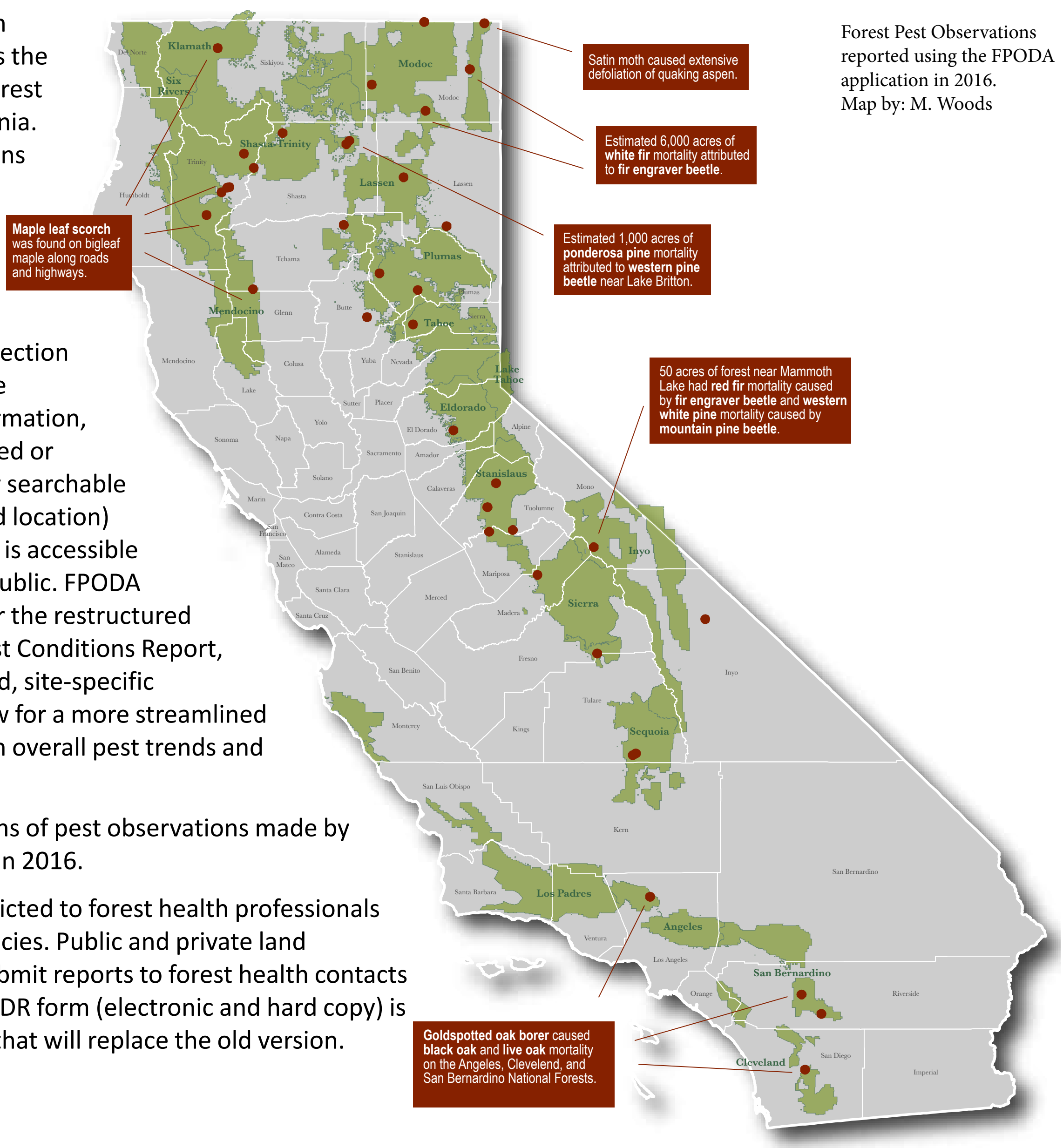
**Collaborative Project by:**

- **USFS Pacific Southwest Region, State & Private Forestry, Forest Health Protection**
- **USFS Forest Health Technology Enterprise Team**
- **CAL FIRE**
- **CA Forest Pest Council**

The Forest Pest Observation Database (FPODA) serves as the primary repository for all forest pest observations in California. Historically, pest observations were captured through a combination of the annual California Forest Pest Conditions Report and documented using Pest Detection Reports (PDRs). While these methods captured the information, they were not easily accessed or searchable. FPODA is a fully searchable (including by pest, host, and location) web-based application that is accessible to land managers and the public. FPODA serves as the foundation for the restructured annual California Forest Pest Conditions Report, containing all of the detailed, site-specific information which will allow for a more streamlined report that focuses more on overall pest trends and highlights.

This map shows the locations of pest observations made by forest health professionals in 2016.

Data entry is currently restricted to forest health professionals from state and federal agencies. Public and private land managers will be able to submit reports to forest health contacts for database entry. A new PDR form (electronic and hard copy) is currently being developed that will replace the old version.




Forest Pest Observations reported using the FPODA application in 2016.
Map by: M. Woods

## Native Insects

**Douglas-fir Beetle** (*Dendroctonus pseudotsugae*)
US Forest Service aerial surveys identified the highest levels ever observed of Douglas-fir beetle-caused Douglas-fir (*Pseudotsuga menziesii*) mortality in Humboldt, Mendocino, and Sonoma Counties. These detections have not been ground verified to confirm the mortality agent.

A group of 12 Douglas-fir trees (>20 in avg DBH) along Cottonwood Road (Tuolumne County) were found with fresh Douglas-fir beetle boring dust in June (2016). In California, Douglas-fir beetle is typically found in blowdown or broken stems due to windthrow or snowloading rather than in standing live trees. All infested trees were also heavily infected with *Phellinus pini*.

**Fir Engraver** (*Scolytus ventralis*)
Increasing levels of red (*Abies magnifica*) and white fir (*Abies concolor*) mortality attributed to drought and fir engraver beetle were observed in many areas throughout the state. Counties recording the highest numbers of dead true fir trees included Fresno, Madera, Mariposa, Modoc, and Tulare. National forests and parks with the highest levels of true fir mortality included the Modoc, Sequoia, and Sierra National Forests and Sequoia-Kings Canyon and Yosemite National Parks.

Fir engraver beetle activity in northwestern California true fir stands is often associated with stress conditions, such as overstocking, drought, and root disease infections. Plantations in the Lucky Springs watershed (Goosenest Ranger District, Klamath National Forest, Siskiyou County), where basal areas exceed 400 $ft^2$ per acre, had several pockets of fir engraver-killed white fir.

Extensive white fir mortality (thousands of trees over several thousand acres) was recorded again on the Lassen National Forest between Patterson and Ashurst Mountains and within the Franklin and Joseph Creek watersheds of the Warner Mountains, Modoc National Forest (Modoc County). New areas with white fir mortality also occurred on Manzanita Mountain, Modoc National Forest. All of these areas were historically pine-dominated forests with a frequent fire regime. Stands have not burned in well over 100 years and are densely stocked with white fir and very few pines.

White and red fir mortality greatly increased in the transition zones and higher elevations in the southern Sierra Nevada range on the Stanislaus, Sierra, and Sequoia National Forests, which were already experiencing high levels of pine mortality at lower elevations. True fir mortality was attributed to drought, fir engraver beetles, and other common associates. Fir mortality was most striking along Highway 203 toward the Mammoth Ski Area (Mono County), where the main byway that had been thinned several years ago was experiencing about two to four dead trees/acre in 2016. Ninety percent of the mortality was white fir, but western white (*Pinus monticola*) and lodgepole pine (*Pinus contorta*) were also intermixed and being killed by mountain pine beetles (*Dendroctonus ponderosae*). Increased mortality was also observed along Highway 108, south of Pinecrest Basin (Tuolumne County) on north-facing slopes that were previously thinned (to an average of 200 $ft^2$ per acre). Whole tree mortality or top-kill was observed in over 50% of the white fir.

Minimal white fir mortality occurred in Southern California in 2016. On the Los Padres National Forest, fir engraver activity was observed on white fir

Close-up of Douglas-fir beetle boring dust/frass next to *Phellinus pini* conk. Mi Wok RD, Stanislaus NF. Photo by: B. Bulaon, USFS

Fir engraver-killed white fir, Lucky Springs watershed, Goosenest RD, Klamath NF. Photo by: C. Snyder, USFS

Fir engraver beetle-killed white fir, Big Valley RD, Modoc NF. Photo by: W. Woodruff, USFS

Top kill of ponderosa pines (distant trees) caused by California five-spined ips next to western pine beetle-caused group kill of ponderosa pine, Yuba River RD, Tahoe NF. Photo by: D. Cluck, USFS

in approximately 40 acres of mixed-conifer stands, where low precipitation levels contributed to tree mortality. In general, white fir mortality levels in natural stands decreased in 2016 on the Mt. Pinos Ranger District (Los Padres National Forest - Ventura and Kern Counties).

***Ips* Species**

Small groups of 10-12 ponderosa (*Pinus ponderosa*) and Coulter pines (*Pinus coulteri*) on Rocky Butte Truck Trail in San Luis Obispo County were attacked by California five-spined ips (*Ips paraconfusus*; affecting 1-2 acres). Several *Ips* species were observed attacking scattered, drought-stressed pines or those growing on unsuitable sites in areas from Santa Clara County north through Humboldt County. In many sites with bishop (*Pinus muricata*), Monterey (*Pinus radiata*), or shore pines (*Pinus contorta*), the *Ips* species was associated with sapstreak of the tree xylem. Species recovered from these trees included *I. pini* (on shore pine), *I. plastographus* (on bishop pine), and *Pseudips mexicanus* (on bishop pine). Species attacking Monterey pine were undetermined. On shore pine, these engraver beetles were also accompanied by *Hylastes* sp. (bark beetle) and *Rhyncolus* sp. (weevil). *Ips* species were also observed killing tops of ponderosa pines in eastern Humboldt County (species undetermined) as well as mining in fire-killed ponderosa pine on Boggs Mountain Demonstration State Forest in Lake County.

Several pockets of California five-spined ips-killed ponderosa pines (ranging from 5-30 trees) were observed adjacent to western pine beetle (*Dendroctonus brevicomis*)-caused group kills near Camptonville, Nevada City, and Auburn on both the Tahoe National Forest and private lands (Placer County). In San Bernardino County, small pockets of 1-15 ponderosa, Coulter, and sugar (*Pinus lambertiana*) pines were attacked by California five-spined ips, then subsequently attacked by western (*Dendroctonus brevicomis*) or mountain (*Dendroctonus ponderosae*) pine beetle. *I. paraconfusus* was also commonly found on the Angeles and Los Padres National Forests and neighboring private lands.

Pinyon (*Pinus* sp.) pine mortality continued to be elevated in Inyo, Kern, Tulare, and Ventura Counties and on the Inyo, Los Padres, and Sequoia National Forests. Pinyon ips (*Ips confusus*) activity increased in southwest Inyo County. Along the lower slopes of the John Muir and Golden Trout Wildernesses, pinyon (*Pinus monophylla*) mortality increased and expanded. Larger diameter trees (>15 in diameter root crown) were targeted first, then surrounding smaller pines were infested as evidenced by scattered attacks on the boles. About 30% of lower boles also had woodborer activity; some trees appeared to have died in sections. Pinyon ips activity was also observed on the Santa Rosa Indian Reservation (Riverside County).

**Jeffrey Pine Beetle** (*Dendroctonus jeffreyi*)

US Forest Service aerial surveys detected high rates of Jeffrey pine (*Pinus jeffreyi*) mortality in the southern Sierra Nevada range as a result of Jeffrey pine beetle attacks and drought. The highest levels of mortality were recorded in Fresno, Kern, and Tulare Counties. The Sequoia, Sierra, and Stanislaus National Forests had the highest levels of mortality on national forest land. These detections have not yet been ground verified.

Scattered individual Jeffrey pines were attacked on the Beckwourth Ranger District, Plumas National Forest, near the town of Graeagle, and in the Lakes Basin Recreation Area (Plumas and Butte Counties). Attacked trees in the Lakes Basin area were generally the largest individuals that were competing with white fir. Jeffrey pine beetle activity was also observed killing trees (~12) on Manzanita Mountain, Modoc National Forest (Modoc County).

Jeffrey pine beetle galleries on dead Jeffrey pine tree, Big Valley RD, Modoc NF. Photo by: W. Woodruff, USFS

Jeffrey pine beetle was noted in Jeffrey pines that were intermixed with ponderosa pine (*Pinus ponderosa*) on the west side of the southern Sierra Nevada range. Ten (>18 in DBH) Jeffrey pines in the Frog Project area (Western Divide Ranger District, Sequoia National Forest) were attacked in a roadside plantation. The ponderosa pines did not have any bark beetle attacks. Jeffrey pine beetle activity was also noted on the High Sierra Ranger District (Sierra National Forest, Fresno County) in a 30-year-old Jeffrey and ponderosa pine plantation; all trees in that plantation were killed.

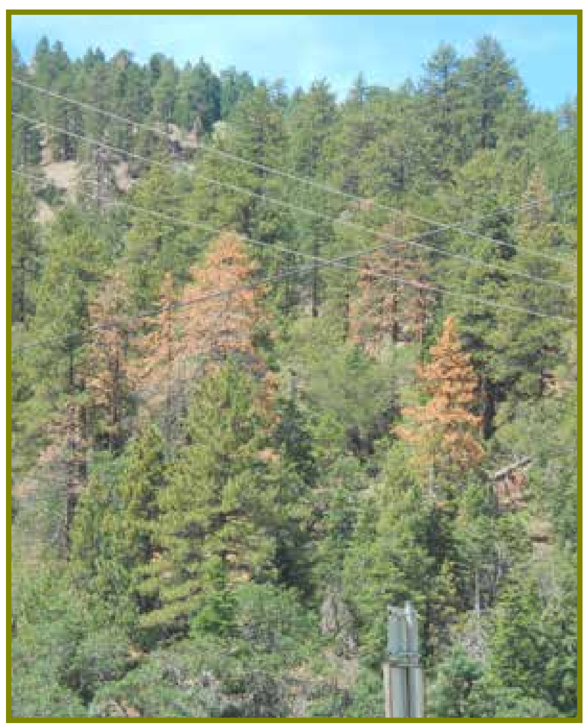
Mountain pine beetle-killed ponderosa pine, Lucky Springs watershed, Goosenest RD, Klamath NF. Photo by: C. Snyder, USFS

**Mountain Pine Beetle** (*Dendroctonus ponderosae*)
Mountain pine beetle was the primary cause of mortality of mature sugar pine (*Pinus lambertiana*) in northwestern California. Scattered single-tree mortality or small groups of two to three dead trees was very common in low-elevation (4,000-5,000 ft) mixed-conifer forests on the Mendocino National Forest along the M2 and M9 roads (Grindstone Ranger District), where at least two recorded rust-resistant sugar pines were killed in 2016 (Tehama and Glenn Counties). Mountain pine beetle was also found causing mortality in several small-diameter (<8 in DBH) ponderosa pines (*Pinus ponderosa*) in the Lucky Springs watershed on the Goosenest Ranger District, Klamath National Forest (Siskiyou County), in an overstocked plantation near areas noted for having western pine beetle (*Dendroctonus brevicomis*)-caused mortality in the same species.

Elevated mountain pine beetle-caused sugar pine mortality (average of one dead tree per 10 acres) was noted in areas surrounding the communities of Chester and Quincy as well as Plumas National Forest (Plumas County). Mortality was restricted to single large trees or small groups of smaller diameter trees. Further south in the Sierra Nevada range, unusually warm weather in February (~75°F daytime temperatures) initiated early mountain pine beetle emergence and gallery formation. Sugar pines on the Groveland Ranger District, Stanislaus National Forest (~ 3,500 ft elevation, Tuolumne County), had new attacks and pitch tubes in March.

Throughout the west slope of the southern Sierra Nevada range, mountain pine beetles continued to target large-diameter sugar pines (>15 in DBH) – often in the same locations where western pine beetle (*Dendroctonus brevicomis*) was attacking ponderosa pines. More sugar pine group kills were observed, some with as many as 20 dead trees (Sequoia National Forest, Kernville Ranger District, Kern County). Mountain pine beetles and western pine beetles were noted attacking <10 in DBH ponderosa pine trees in plantations; both beetle species could be found in some trees.

Sugar pine mortality was prominent in Yosemite National Park. Starting from the Big Oak Flat entrance station to Crane Flat Campground along Highway 120, high numbers of large-diameter sugar pines on south-facing slopes were killed. An anti-aggregation pheromone (SPLAT verb™) was applied early in the summer (2016) in Hogdon Campground and in two loops of Crane Flat Campground to protect as many sugar pines as possible from mountain pine beetle attacks. Over 200 trees were treated, ranging in size from 5-70 in DBH. Thirty-six treated trees died; the remaining appeared to not have any attacks. Some of the dead trees may have also had compromised root systems since many were bordering roads or parking areas.



Dead conifers, Running Springs, San Bernardino County. Photo by: H. Herrera, CAL FIRE

The most notable mountain pine beetle infestations in lodgepole pine (*Pinus contorta*) were in the Lakes Basin, Mammoth Lake Ranger District (Inyo National Forest, Mono County), and northbound on Highway 168 past Shaver Lake (High Sierra Ranger District, Sierra National Forest, Fresno County). Mortality was scattered and ranged from one to two trees per acre, despite basal areas >300 $ft^2$ per acre in some locations. In high-elevation five-needled pine forests, mountain pine beetle activity continued in the same places where activity has been ongoing for a few years. Lodgepole and limber (*Pinus flexilis*) pines near Cottonwood Campground (Inyo National Forest, Inyo County) were being attacked. No bristlecone (*Pinus aristata*) or foxtail (*Pinus balfouriana*) pines in plots monitored by the Rocky Mountain Research Station had recent attacks. Mountain pine beetle activity in lodgepole and whitebark (*Pinus albicaulis*) pines around June Mountain decreased significantly, most likely due to the previous mortality of most suitable hosts.

In San Bernardino County, pockets of 1-15 dead ponderosa and sugar pines were noted in the mountain communities of Wrightwood, Crestline, Running Springs, Lake Arrowhead, Big Bear, and Angelus Oaks.

**Red Turpentine Beetle** (*Dendroctonus valens*)
Red turpentine beetles attacked stressed, fire-weakened or fire-killed pines in numerous locations throughout the North Coast. On Boggs Mountain Demonstration State Forest (Lake County), the beetles were observed on ponderosa (*Pinus ponderosa*) and sugar (*Pinus lambertiana*) pines with green crowns that had some fire-killed cambium. Many of these trees succumbed to subsequent attacks by western pine beetle (*Dendroctonus brevicomis*). In many ponderosa and sugar pines, as well as topped Monterey pines (*Pinus radiata*) near Arcata (Humboldt County), beetles were attacking tree boles up to ~15 ft high. In Monterey and bishop pines (*Pinus muricata*) near Fortuna, Eureka, and Arcata (Humboldt County), red turpentine beetle attacks were associated with sapstaining by numerous species of Ophiostomatoid fungi.

Western pine beetle-killed Coulter and ponderosa pine, Rocky Butte Truck Trail, San Luis Obispo County.
Photo by: K. Corella, CAL FIRE

Western pine beetle-killed ponderosa pine, Mendocino NF.
Photo by: C. Snyder, USFS

**Western Pine Beetle** (*Dendroctonus brevicomis*)
Ponderosa pines (*Pinus ponderosa*) in many locations throughout the state were heavily impacted by western pine beetles. Five years of drought and overstocked forest conditions resulted in millions of suitable host trees for the beetles to attack and kill. As beetle populations continued to grow, even trees in thinned stands were often overcome. On National Forest Service land, the US Forest Service has been using a triage approach to respond to the tree mortality crisis, focusing first on public safety by removing dead and dying trees in high-hazard areas near communities, along roads, trails, and utility corridors, and in high-use recreation sites.

There is no indication that the warmer temperatures observed during this event have resulted in more generations of western pine beetle within a year than are typically observed. In addition, the extreme cold temperatures necessary to cause mortality of western pine beetle larvae have rarely been recorded (including for the duration of time needed) on the lower western slopes of the southern Sierra Nevada range, so it is not likely that unusual temperatures played a significant role in regulating western pine beetle populations and subsequent tree mortality levels in these areas.

Counties with the highest levels of ponderosa pine mortality (mostly attributed to western pine beetle) included Calaveras, El Dorado, Fresno, Kern, Madera, Mariposa, Tulare, and Tuolumne. The highest levels of ponderosa pine mortality on National Forests and National Parks were on the Sequoia, Sierra, and Stanislaus National Forests and Kings Canyon and Yosemite National Parks.

Western pine beetle activity increased on the Los Padres National Forest on Mount Figeroa and in Figeroa Campground (Ventura County) in natural stands of Coulter (*Pinus coulteri*) and ponderosa (*Pinus ponderosa*) pine. High levels of western pine beetle-caused Coulter pine mortality were also observed during FS aerial surveys in the Ohlone Regional Wilderness Area in southern Alameda County. This mortality appeared to affect all sizes of pines, with stand-level losses similar to those observed in the southern Sierra Nevada range. Small pockets of 10-12 ponderosa and Coulter pines across 1-2 acres on Rocky Butte Truck Trail (San Luis Obispo County) were also attacked.

Western pine beetle-killed ponderosa pine, Lake Britton PG&E Campground, Shasta County. Photo by: D. Cluck, USFS

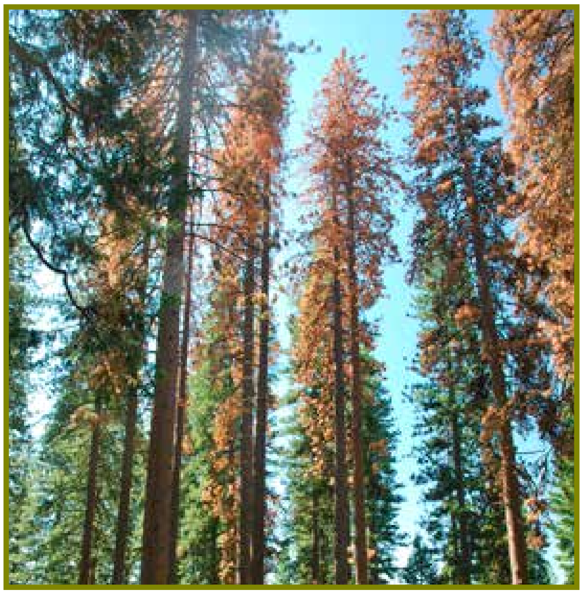
Western pine beetle-killed ponderosa pine, Yuba River RD, Tahoe NF and private land. Photo by: D. Cluck, USFS

Western pine beetle was observed in scattered ponderosa pine stands in Willits and Laytonville (Mendocino County) as well as the Dinsmore/Buck Mountain area (eastern Humboldt County). In each location, beetle attacks resulted in small groups of mortality (~10-15 trees). Similar-sized group kills were seen near Angwin and the Silverado Trail in Napa County. Around Boggs Mountain Demonstration State Forest (Lake County), the beetle was active at the periphery of the area burned in the Valley Fire, killing large groups of ponderosa pine in the community of Loch Lomond and along Siegler Canyon Road. Numerous group kills had been noted within the state forest before the fire in fall 2015. Western pine beetle-caused mortality was also highly visible along Highway 299 in Trinity and Shasta Counties, especially in the area bordering Buckhorn Summit along the county line. The M2 and M9 roads on the Mendocino National Forest (Tehama and Glenn Counties) continued to have pockets of expanding mortality. Vegetation types included natural ponderosa pine forests and plantations as well as mixed-conifer forests along mostly south- and west-facing slopes from 4,000-5,000 ft in elevation.

Western pine beetle-killed ponderosa pine, Eagle Lake RD, Lassen NF. Photo by: D. Cluck, USFS

Western pine beetle continued to be the primary cause of ponderosa pine mortality further north in the state, especially in overstocked plantations. The McCloud Flats area of the Shasta-Trinity National Forest (Siskiyou County) continued to have extensive western pine beetle-caused mortality due to overstocking and black stain root disease (caused by *Leptographium wageneri*).

Continued increases in western pine beetle-caused mortality were observed on the lower-elevation west side of the Lassen, Plumas, and Tahoe National Forests and adjacent private lands. The highest mortality areas were around Lake Britton and Soldier Mountain (Shasta County); along Ponderosa Way (Tehama County); and around the communities of Nevada City, Grass Valley (Nevada County), and Dutch Flat (Placer County). Groups of 10-100+ dead trees were observed in many of these locations.



Dead ponderosa pine stand in Trestle Project on Placerville RD, Eldorado NF, adjacent to Grizzly Flats, El Dorado County. Photo by: B. Bulaon, USFS

Ponderosa pine mortality attributed to drought, western pine beetles, and stocking levels continued to increase in many areas of the southern Sierra Nevada range. On the Eldorado National Forest, the number of group kills increased, as did the number of trees attacked per group. The Trestle Project, located east of Grizzly Flats, had many large groups (>50 trees over 5

Overview of North Fork, Tuolumne Creek, looking into Brown's Meadow, Stanislaus NF. Note ponderosa pine dying on south face (foreground), red trees to the left background are scattered, dying white fir.
Photo by: B. Bulaon, USFS

Dead conifers, Wrightwood, San Bernardino County.
Photo by: H. Herrera, CAL FIRE

acres) of western pine beetle-killed ponderosas and mountain pine beetle (*Dendroctonus ponderosae*)-killed sugar pines (*Pinus lambertiana*), many of which were adjacent to private lands (Amador County).

The Stanislaus National Forest and surrounding counties continued to experience increased drought-related tree mortality, with large-scale die off occurring on 40% of the southern portion of the forest. Young plantation trees (8-12 in DBH) in China Flat (Groveland Ranger District, Tuolumne County) were infested by western pine beetles, mountain pine beetles, and pine engravers (*Ips* sp.). Another recently thinned young plantation (Long Shanahan Fuel Reduction and Forest Health Project, Tuolumne County) had more than 50% mortality. Pine plantations and natural stands on the Mi-Wok and Summit Ranger Districts (Tuolumne County) had groups of >50 trees killed.

The Sierra and Sequoia National Forests had >50% mortality in predominantly pine sites. Surveys conducted in 255 plots that compared 2011 vs. 2016 conditions found survivorship for ponderosa and sugar pines on the Sierra National Forest was <25% for trees >10 in DBH (Piles, L.; Rojas, R.; and Lyons, O. 2016. Characterizing Tree Mortality in the Mixed Conifer Zone of the High Sierra Ranger District, Sierra National Forest. Poster presentation, 2016 California Forest Pest Council Annual Meeting.). For many areas below 4,000 ft in elevation, all ponderosa pines >5 in DBH have been killed. Some areas were already categorized as "deforested" in 2015. The Big Creek and Dinkey Creek watersheds (Fresno County) continued to have more mortality in thinned and untreated plantations and natural stands. The FS Big Creek Workstation felled nearly 100 ponderosa pines in the compound over the summer (2016); 10 trees being irrigated around the barracks remained alive.

In San Bernardino County, western pine beetle attacks resulted in small groups of 1-15 dead ponderosa and Coulter pines in the mountain communities of Wrightwood, Crestline, Running Springs, Lake Arrowhead, Big Bear, and Angelus Oaks. Western pine beetle activity also continued in two Coulter pine plantations and in natural stands located on Sawmill-Liebre Ridge of the Angeles National Forest (Los Angeles County), and mortality of ponderosa pine in natural stands primarily near the Sawmill Campground (Los Angeles County) continued. Tree mortality has been persistent in this area for the past 4 years, impacting hundreds of acres of forested land.

## Defoliators

**Douglas-fir Tussock Moth** (*Orgyia pseudotsugata*)
Douglas-fir tussock moth trap catches (males only) were extremely light in monitoring plots in the southern Sierra Nevada range in 2016. Trap catches remained very low (0-1 moth trap average) and there was no defoliation observed.

**Pandora Moth** (*Coloradia pandora*)
In July of 2015 and 2016, a UC Berkeley researcher noticed adult moths washed up along the shore of Mono Lake (Mono County). Over 700 moths were recovered in 2015 and 41 were recovered in 2016. Pandora moths require 2 years to complete their lifecycle, so alternate years could have lower counts. Monitoring will continue into 2017. Dramatic increases in pandora moth populations on the Inyo National Forest occur cyclically once every 20-30 years, with the most recent event noted in 2003, when about 40,000 acres were affected.

Satin moth-feeding injury to aspen foliage, Warner Mountain RD, Modoc NF. Photo by: M. Hommerding, USFS

Satin moth-feeding injury to aspen foliage observed during aerial survey, Warner Mountain RD, Modoc NF. Photo by: R. Schroeter, USFS

**Satin Moth** (*Leucoma salicis*)
Approximately 300 acres of satin moth-caused defoliation of quaking aspen (*Populus tremuloides*) was observed in the northern Warner Mountains near Dismal Swamp, Modoc National Forest (Modoc County).

## Scale Insects

**Black Pineleaf Scale** (*Nuculaspis californica*)
A black pineleaf scale outbreak occurred along a county dirt road near the community of Janesville, Lassen County, and affected about 100 acres of ponderosa pines. Trees were moderately to severely defoliated with some attacked by California flatheaded borers (*Melanophila californica*), pine engraver beetles (*Ips* sp.), and/or western pine beetles (*Dendroctonus brevicomis*).

**Oak Pit Scale** (*Asterolecanium* spp.)
Oak pit scales have affected hundreds of scrub oak in the Oak Hills area of San Bernardino County. These trees are dying due to the heavy infestations.

**Pinyon Needle Scale** (*Matsucoccus acalyptus*)
Pinyon needle scale was found in a new location on the east side of the Inyo Mountains, in Whippoorwill Flat (south pass of Saline Valley, Inyo County) at the 7,000 ft elevation. Conditions were very similar to where it has been found on the Inyo National Forest, including a fairly flat site and on mostly small (<5 in diameter at root crown) pinyons (*Pinus monophylla*) with wide spacing. Larger trees in these areas typically had very low scale infestation levels, while small trees had moderate to high infestation levels. Activity of pinyon needle scale continued in Southern California on the Santa Rosa Indian Reservation (Riverside County). Approximately 100 trees were severely defoliated and 50 trees were killed due to subsequent attack by *Ips* beetles.

## Other Insects

**Cedar Bark Beetle** (*Phloeosinus* spp.)
Incense cedar (*Calocedrus decurrens*) mortality increased dramatically in 2016, particularly in lower elevations in the southern Sierra Nevada range where pine mortality levels are also exceptionally high. The sudden mass dieoff is not surprising given drought conditions and the high level of mortality in other conifer species. Insects commonly associated with dying incense cedars (cedar bark beetles, woodborers) were found in varying degrees on trees, with smaller diameter trees having heavier infestations of cedar bark beetles than larger trees. Results of ground surveys on the Sierra National Forest (Piles, L.; Rojas, R.; and Lyons, O. 2016. Characterizing Tree Mortality in the Mixed Conifer

Mortality of 10-year-old redwood trees caused by redwood bark beetles and drought, north of Arcata, Humboldt County. Photo by: C. Lee, CAL FIRE

Zone of the High Sierra Ranger District, Sierra National Forest. Poster presentation, 2016 California Forest Pest Council Annual Meeting.) and in Sierra-Kings Canyon National Park (*pers com*. Adrian Das, USGS Ecologist, Sequoia-Kings Canyon National Park) indicated that, while many trees were rapidly dropping foliage, moderate to smaller diameter classes (<20 in DBH) were actually dead.

**Flatheaded Fir Borer** (*Phaenops drummondi*)
Mortality caused by flatheaded fir borer, generally in discrete patches of 1-10 trees scattered over hundreds of acres, was highly visible in the area between Buckhorn Summit and Whiskeytown Reservoir in western Shasta County.

**Other Woodborers**
Several species of unidentified flatheaded boring beetles were found in fire-killed ponderosa pines (*Pinus ponderosa*) on the southeastern edge of Boggs Mountain Demonstration State Forest; fire-killed pines in other areas of the forest were generally unaffected at the time of the survey. Unidentified roundheaded boring beetles caused dead tops and resinosis in 4-5 small, planted western red cedar (*Thuja plicata*) near the community of Mad River in western Trinity County.

**Redwood Bark Beetle** (*Phloeosinus sequoiae*)
Redwood bark beetles killed approximately 5 acres of 10-year-old coast redwood (*Sequoia sempervirens*) trees in a plantation on industrial timberland north of Arcata (Humboldt County). Adults were constructing galleries in October, suggesting that lack of moisture may have contributed to the trees being stressed, attracting the normally non-aggressive beetles.

## Non-Insect Pests

**Spruce Spider Mite** (*Oligonychus ununguis*)
Mature sitka spruce (*Picea sitchensis*) trees near Eureka (Humboldt County) that were previously observed to be infested with the green spruce aphid (*Elatobium abietinum*) were also infested with spruce spider mites in the spring (2016). These trees have been heavily defoliated over the years, with defoliation starting at the bottom of the crowns and proceeding upward. Defoliation is apparent on spruces in several roadside locations around Humboldt Bay, from Fortuna to McKinleyville as well as in scattered locations along Highway 101 to the north (Humboldt County).


Sitka spruce defoliated by spruce spider mites, Humboldt County. Photo by: C. Lee, CAL FIRE

## Invasive Insects

**European Gypsy Moth** (*Lymantria dispar*)
Nine European gypsy moth males were trapped in 2016 (Table 1), all were North American/European mitotype. The single find listed in Santa Barbara County was at a private campground on Paradise Road within the Los Padres National Forest near the Los Prietos Ranger Station. Forty-eight delimitation traps were set up around this find within a 4 $mi^2$ area, which extended onto National Forest land. Trapping continued through the first week of October without any additional finds and will continue for two more trapping seasons per California Department of Food and Agriculture protocol. Trapping protocols will also be implemented in the buffer areas where moths were trapped in 2016 (Table 1).

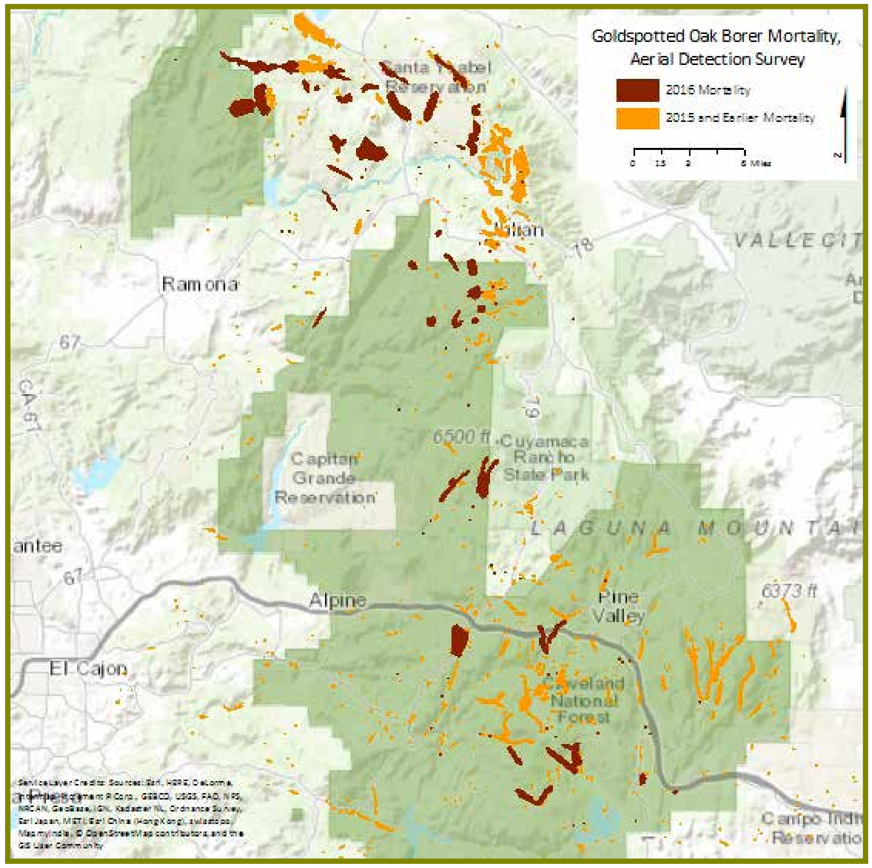
Twenty-eight European gypsy moth interceptions (at various life stages) were made at the border stations and one interception occurred during a follow-up inspection by San Francisco County officials.

| Location | # of Moths Trapped |
|---|---|
| Santa Barbara | 1 |
| Boonville | 2 |
| Compton | 3 |
| Castro Valley | 1 |
| San Rafael | 1 |
| Lomita | 1 |

Table 1. Cities (or approximate locations) and numbers of adult male gypsy moths trapped in California in 2016. Source: CA Department of Food and Agriculture

**Goldspotted Oak Borer** (*Agrilus auroguttatus*)
The goldspotted oak borer (GSOB) continued to cause oak mortality on public and private land in Los Angeles, Orange, Riverside, and San Diego Counties, killing an estimated 10,000 oak trees across 7,000 acres, as determined by FS aerial surveys. Follow-up ground surveys will be conducted to confirm the mortality agent.

In Los Angeles County, GSOB continued to attack coast live oaks (*Quercus agrifolia*) in the rural canyon community of Green Valley as well as on the neighboring Angeles National Forest. This infestation is the result of beetles emerging from infested firewood brought into the community and subsequently attacking surrounding trees and spreading out to more remote trees away from the community. The number of identified attacked trees is ~230, of which 100 are targeted for removal. Angeles National Forest staff predict losing 1,850-3,770 (at a density of 15-30 trees/acre) coast live oak trees on national forest land. In Orange County, GSOB stayed localized in Weir Canyon. Approximately 250 trees were removed or treated with pesticides. Detections of GSOB in California black oak (*Quercus kelloggii*) and coast live oak on San Bernardino National Forest land and private land in neighboring Idyllwild and Pine Cove continued to increase. A new GSOB infestation at the Pine Hills Fire Station on the Palomar Ranger District, Cleveland National Forest (San Diego County), was detected after coast live oak trees were removed by fire station staff. Oak mortality was moderate in this area. A past GSOB infestation located on the east grade of Mount Palomar (Cleveland National Forest, San Diego County) is now widespread and has reached the Mount Palomar State Park boundary. GSOB has also been detected in oaks on slopes west and south of Lake Henshaw (San Diego County). Efforts to remove infested trees, conduct public outreach campaigns, and hold community meetings are ongoing as the risk of long-distance spread of GSOB through firewood remains high. For more information about the goldspotted oak borer, please visit: [ucanr.edu/sites/gsobinfo/](ucanr.edu/sites/gsobinfo/)




Goldspotted oak borer attributed mortality, detected via aerial survey, USFS. Confirmation of mortality agent has not occurred. Map by: M. Woods, USFS

**Polyphagous and Kuroshio Shot Hole Borers** (*Euwallacea* spp.) **and Associated Fusarium Dieback** (*Fusarium* spp.)

In late 2016, a western sycamore (*Platanus racemose*) tree on private land in Montecito (Santa Barbara County) was confirmed to be infested with the Kuroshio shot hole borer (KSHB). Previously KSHB had only been observed in San Diego and Orange Counties. Further spread to neighboring riparian and natural woodland areas on the Los Padres National Forest is a concern. Female beetles can travel short distances via flight. Long-distance spread is likely through the movement of infested wood and greenwaste material. In San Diego, Orange, and Santa Barbara Counties, no tree mortality due to KSHB has been observed on National Forest land. Monitoring is ongoing on the Angeles and Los Padres National Forests.

In early 2016, KSHB was found for the first time in San Luis Obispo County. The lone beetle was recovered from a trap in a wood yard in the city of San Luis Obispo. No infestations have been found in the landscape to date and no further finds have been recovered from traps in the county.

The distribution of the polyphagous shot hole borer (PSHB) now spans five counties in Southern California: Riverside, San Bernardino, Orange, Los Angeles, and Ventura. A UCCE 2016 survey of Orange County Parks found rates of infestation are >50% in several hardwood species (e.g., California sycamore/*Plantanus racemosa*, willow/*Salix* sp., cottonwood/*Populus* sp., and London plane/a hybrid species in the *Plantanus* genus). In northern Los Angeles County, mortality due to PSHB has increased in parks and woodlands bordering National Forest land. In San Bernardino County, sycamores in the Carbon Canyon area are being killed by PSHB.

PSHB now has 48 known reproductive hosts; KSHB has 15. Both of these ambrosia beetles continue to spread. There is extreme concern by wildlife officials about riparian area destruction and the impacts of the associated tree mortality on endangered migratory songbirds and other wildlife species.

## Diseases

**Armillaria Root Rot** (*Armillaria* sp.)
*Armillaria* sp. were the only aggressive pests detected in a Douglas-fir (*Pseudotsuga menziesii*) disease center near Bridgeville, eastern Humboldt County (galleries of Douglas-fir pole beetle, *Pseudohylesinus nebulosus*, were also present, but not on all of the dead trees). All size classes of trees were killed within a 10-15 acre radius. The disease center was adjacent to a stand with many Oregon white oak (*Quercus garryana*) stumps, the oaks were removed about 20 years ago. *Armillaria* was also found associated with black stain root disease (*Leptographium wageneri*) and flatheaded fir borer (*Melanophila drummondi*) on large, declining Douglas-fir at a site near Buck Mountain, eastern Humboldt County.

**Black Stain Root Disease**
(*Leptographium wageneri*)
A black stain root disease pocket in a Douglas-fir (*Pseudotsuga menziesii*) stand was observed near the community of Blairsden, Plumas County. Approximately 20 larger diameter trees were either dead or showed signs of crown decline associated with infection.

Ponderosa pine (*Pinus ponderosa*) trees in Modoc County, 7 mi northwest of Crowder Flat at the Oregon border on the Modoc National Forest, continued to die from black stain root disease. Two dead pines approximately 200 ft east of Forest Road 48N08 were confirmed to have black staining in the xylem at their bases. Several much older nearby pine snags presumably also died from the disease. Black stain root disease on the Modoc National Forest north of Crowder Flat has been intermittently monitored by the US Forest Service for over 30 years.

Black stain root disease was identified in two individual large ponderosa pines in Cattle Camp Campground (Shasta-Trinity National Forest, Siskiyou County) and Hotelling Campground (Klamath National Forest, Siskiyou County). Both were marked for removal. The pathogen was not found in surrounding pines.

Evidence of black stain root disease was found in the roots of single leaf pinyon pine (*Pinus monophyla*) on Mazourka Canyon Road (Inyo Mountains on the boundary between the Inyo National Forest and Death Valley National Park). However, the sample taken did not yield a live culture for diagnostic purposes.

Opening in Douglas-fir stand caused by *Armillaria* spp. near Bridgeville, Humboldt County.
Photo by: C. Lee, CAL FIRE

Declining crown of blackstain root disease infected Douglas-fir, Plumas NF.
Photo by: D. Cluck, USFS

Ponderosa pine killed by black stain root disease near the Oregon border, Modoc NF.
Photo by: W. Woodruff, USFS

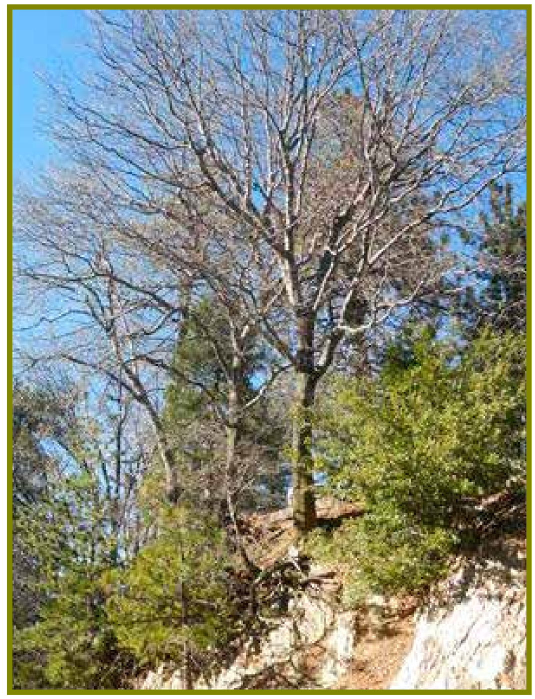
Black staining in xylem of an infected Douglas-fir, Plumas NF. Photo by: D. Cluck, USFS

Black stain root disease in dying ponderosa pine at Cattle Camp Campground, Shasta-Trinity NF.
Photo by: P. Angwin, USFS

**Branch Cankers** (various species)
Several fungi caused branch cankers in both conifers and hardwood species throughout the North Coast, from Sonoma County through Del Norte County. They typically affected one to five trees within a given area; several had not been previously detected on these trees in California. Fungi found include: *Sydowia polyspora* on shore pine (*Pinus contorta*), *Diplodia scrobiculata* on shore pine and coast redwood (*Sequoia sempervirens*), *Diplodia corticola* on tanoak (*Notholithocarpus densiflorus*), *Diplodia mutila* (=*Botryosphaeria stevensii*) on coast redwood, *Tubakia* sp. on coast live oak (*Quercus agrifolia*) and tanoak, *Neofusicoccum nonquaesitum* on California bay laurel (*Umbellularia californica*), *Neofusicoccum parvum* on Douglas-fir (*Pseudotsuga menziesii*), *Neofusicoccum luteum* and *Cytospora* sp. on coast redwood, *Diaporthe* spp. on manzanita (*Arctostaphylos* species) and bay, and *Fusarium* sp. on shore pine and Jeffrey pine (*Pinus jeffreyi*). Of these fungi, *Diplodia corticola* on tanoak and *Neofusicoccum nonquaesitum* on bay caused the most severe symptoms, quickly killing large numbers of branches and occasionally tree tops.


Bay branch dieback caused by *Neofusicoccum nonquaesitum* at Point Reyes National Seashore, Marin County. Photo by: C. Lee, CAL FIRE

**Bristlecone Fir Branch Canker** (*Diplodia mutila*)
Bristlecone fir branch canker was observed on bristlecone fir (*Abies bracteate*) in Contra Costa County. Branch and trunk cankers associated with copious resinosis and chlorotic foliage were noted on trees in two bristlecone fir groves planted in a botanical garden outside of their native range. This is the first report of *D. mutila* causing bristlecone fir branch canker in California.


California black oak with foamy bark canker. Photo by: H. Herrera, CAL FIRE

**Coffeeberry Stem Canker** (*Fusarium lateritium*)
Coffeeberry stem canker was found on coffeeberry (*Frangula* [*Rhamnus*] *californica*) in San Mateo County. Symptoms included stem cankers leading to branch flagging.

**Diplodia Blight of Pines** (*Sphaeropsis sapinea*)
Diplodia blight became a serious issue on ponderosa pines (*Pinus ponderosa*) throughout the central Sierra Nevada range. Reports of the disease causing tip dieback were received from Nevada to Calaveras Counties. Although tip dieback rarely killed trees outright, it may have placed additional stress on pines, increasing their susceptibility to western pine beetle (*Dendroctonus brevicomis*) attacks.

Diplodia blight was less common in southern Sierra Nevada counties, likely due to severe drought conditions throughout the region.

**Foamy Bark Canker** (*Geosmithia pallida*)
Foamy bark canker was found in San Bernardino County for the first time. The disease was found on an interior live oak (*Quercus wislizeni*) at Silverwood Lake State Recreation Area and on California black oak (*Quercus kellogii*) in the Crestline/Lake Arrowhead area.

Placer, El Dorado, and Calaveras Counties were also found to have foamy bark canker for the first time. In Placer County, the pathogen was recovered from an interior live oak in the city of Auburn. In El Dorado and Calaveras Counties, several interior live oaks along Highway 49 (El Dorado County) and oaks at a golf course (Calaveras County) were found to have sap seeping out of trunks and small entry holes (the size of a pencil head) in the summer (2016). Peeling back outer bark revealed multiple entry holes per tree, with necrosis surrounding the entry holes. Reddish sap was oozing from them, followed by prolific foamy liquids streaming 2 ft down the trunks. Infected trees were left on site and treated.


Interior live oak with foamy bark canker, Placer County. Photo by: J. Bena, LSA

*Heterobasidion occidentale* fruiting body from an infected white fir stump at Carter Meadows Group Horse Camp, Klamath NF. Photo by: P. Angwin, USFS

*Phellinus robustus* on the base of a coast live oak, Cleveland NF. Photo by: A. Weinhart, USFS

*Lentinus ponderosus* = *Neolentinus ponderosus,* found growing on the dead parts of a living bristleone pine. Photo by: M. MacKenzie, USFS

**Heterobasidion Root Disease** (*Heterobasidion occidentale*)
*Heterobasidion occidentale* was found in a white fir (*Abies concolor*) stump at Carter Meadows Group Horse Camp on the Scott River Ranger District of the Klamath National Forest (Siskiyou County). Nearby white firs had healthy-looking crowns. Fruiting bodies were last found in a white fir stump near the campground entrance in 1999.

In the Panther Creek thinning project on the Amador Ranger District (Eldorado National Forest) along Highway 88, a root-grafted 47-in white fir stump was split open, revealing fresh Heterobasidion root disease spore-producing conks. This was one of several pockets of expanding root disease in the stand. The area had historically been ponderosa pine (*Pinus ponderosa*). It later became dominated by large white fir that showed signs of both root disease and fir engraver beetles (*Scolytus ventralis*). Present regeneration indicates that the root disease may drive this stand to become dominated by incense cedar (*Calocedrus decurrens*) in the future.

**Marssonina Leaf Spot or Blight of Aspen** (*Marssonina populi*)
Many quaking aspen stands on the Modoc, Plumas, and Lassen National Forests were infested with Marssonina leaf spot due to wetter than normal conditions in late spring/early summer (2016). Although not as intensive and widespread as in 2015, this was the second consecutive year of moderate to severe infestation for many stands.

**Miscellaneous Heart and Butt Rots**
Conks associated with a heart rot were found at the base of a coast live oak tree (*Quercus agrifolia*) on the Cleveland National Forest (San Diego County). The fungus was identified as *Phellinus robustus* (current name *Fomitiporia robusta*). As the tree is in a campground and considered to be hazardous, there are plans for it to be removed. While monitoring the health of bristlecone pines (*Pinus longaeva*) and other high-elevation pines on the Inyo National Forest (Inyo County), *Lentinus ponderosus* (also known as *Neolentinus ponderosus*) was found fruiting close to the root collar of a bristlecone pine. Aside from this fungus, few decay fungi are ever observed on bristlecone pines.

The marshmallow fungus (*Tyromyces leucospongia*, also known as *Spongiosporus leucospongia*) was the most common fungus found on dead whitebark pines (*P. albicaulis*). While the whitebark forests at June Mountain (Mono County) have been heavily impacted by mountain pine beetle (*Dendroctonus ponderosae*), changes in the fungal decay ecosystem were not apparent at higher elevations.

**Ophiostomatoid Fungi Causing Sapstreak of Pines** (various species)
Several species of blue stain or sapstreak fungi (*Grossmannia aurea*, *Leptographium wingfieldii*, and an unknown blue stain) were recovered from declining and dying Monterey (*Pinus radiata*), bishop (*Pinus muricata*), and shore (*Pinus contorta*) pines in coastal Humboldt County. Many of the infested trees also had red turpentine beetle (*Dendroctonus valens*) attacks.

Dying bishop pine infected with a blue-staining vascular wilt fungus in Arcata, Humboldt County. Photo by: C. Lee, CAL FIRE

**Phytophthora Root Diseases** (*Phytophthora* spp.)
More than 50 *Phytophthora* taxa have been recovered from nursery stock transplanted into habitat restoration projects, primarily in riparian areas in Santa Clara, San Mateo, and Alameda Counties. Species identified have included multiple detections of *P. tentaculata*, the first isolation of *P. quercina* in the US, and the discovery of several previously undescribed taxa and hybrids. Most sampled areas were planted after 2012; however, some were planted in 2006 or earlier. *P. quercina* was recovered by baiting from the roots of several stunted valley oaks (*Quercus lobata*) in Santa Clara County that had been planted on the upper banks of a creek in 2002. Separate undescribed taxa of *Phytophthora* were detected on coast live oak (*Quercus agrifolia*), California mugwort (*Artemisia douglasiana*), and *Juncus* sp. planted in habitat restoration sites in Santa Clara and San Mateo Counties. Limited sampling of symptomatic plants at several dry restoration sites on the Angeles National Forest recovered *P. cactorum*, *P. niederhauserii*, and a hybrid or new species close to *P. cinnamomi* and *P. parvispora* that was detected in planted coast live oak. *P. cactorum* was also detected in planted Tucker's oak (*Q. john-tuckerii*), and *P. nicotianae* and an undetermined taxon close to *P. citrophthora* and *P. colocasiae* were found in several planted woody shrub species. These findings demonstrate that an alarming variety of *Phytophthora* species are being introduced into native habitats via nursery stock and that many of these species can persist at these sites for extended periods. Recovery of these *Phytophthora* species by baiting indicates that these pathogens are viable and present at levels that could lead to further spread.

Dying coast live oak nursery stock planted at a restoration site, Angeles NF. A new or hybrid species of *Phytophthora* close to *P. cinnamomi* and *P. parvispora* was baited from the roots of this plant. Photo by: T. Swiecki, Phytosphere Research

In one Santa Clara County site, a multi-species infestation (*P. cambivora*, *P. cactorum*, *P. kelmania*, and *P. syringae*) extending over at least 5 acres was associated with the planting of 30-50 or more nursery-grown *Ceanothus* plants as part of a restoration effort 22 years ago. Affected native species at the site included toyon (*Heteromeles arbutifolia*), coffeeberry (*Rhamnus californica*), and *Ceanothus* sp.

Decline of both young and mature valley oak, madrone (*Arbutus menziesii*), and toyon at a San Mateo County open space preserve was associated with *P. cambivora*. This pathogen has also been recovered in multiple disturbed oak woodland sites in San Mateo County, including one with recently killed young coast live oaks. No *P. ramorum* (sudden oak death) symptoms or inoculum sources were associated with the killed oaks. *P. cambivora* was also detected through baiting from winter runoff and seasonal creeks in Alameda and San Mateo Counties.

Uphill advance of mortality in a stand of Ione and whiteleaf manzanita with root rot caused by *P. cinnamomi* in Amador County. Circled white marker in foregroud was the edge of live canopy in 2004. Photo by: T. Swiecki, Phytosphere Research

Mortality due to *P. cinnamomi* continues to spread through stands of endangered Ione manzanita (*Arctostaphylos myrtifolia*) in Amador County. Whiteleaf manzanita (*A. viscida*) was also killed by *P. cinnamomi* in the infested areas. Interior live oak (*Quercus wislizeni*) and scrub oak (*Q. berberidifolia*) are also affected, though many interior live oak individuals appear to be relatively resistant.

Various species of *Phytophthora* (*P. crassamura*, *P. multivora*, and *P. cryptogea*) were causing root rot, stunting, and canopy dieback in coffeeberry (*Frangula* [*Rhamnus*] *californica*) in San Mateo, Santa Clara, and Marin Counties.

Blue blossom ceanothus (*Ceanothus thyrsiflorus*) suffered from branch flagging, stunted growth, and sparse foliage in San Francisco County as a result of ceanothus root rot and dieback caused by *P. multivora* and *P. cryptogea*.

Shore and bishop pines infected and killed by pitch canker, in southern coastal Mendocino County. Photo by: C. Lee, CAL FIRE

**Pitch Canker** (*Fusarium circinatum*)
Pitch canker was confirmed causing branch tip and top dieback in bishop pine (*Pinus muricata*) throughout Salt Point State Park in northern, coastal Sonoma County as well as in bishop and shore (*Pinus contorta*) pines in Mendocino County, 10 mi north of the Sonoma/Mendocino County line. Symptoms were found on trees of all sizes, killing some smaller ones outright, and were especially obvious in a dense, even-edged stand that regenerated after a recent coastal wildfire.

**Port Orford-Cedar Root Disease** (*Phytophthora lateralis*)
A new infestation of Port-Orford-cedar root disease (currently less than 1 acre) was identified where Red Mountain Creek crosses Forest Road 10N12, approximately 2 mi from the entrance to Fish Lake Campground (Six Rivers National Forest, Humboldt County).

Port-Orford-cedar root disease continued to infect and kill Port-Orford-cedar (*Chamaecyparis lawsoniana*) in various locations along the main channel of Willow Creek, east of Berry Summit (Humboldt County). The disease also remained active at two sites near the Little Bald Hills Trail, Redwood National Park (Humboldt County). One site encompassed approximately 7 acres and the other consisted of a small group of dead and dying trees.

**Pouch Fungus** (*Cryptoporus volvatus*)
There was a significant increase in the incidence of pouch fungus on western pine beetle (*Dendroctonus brevicomis*)-killed ponderosa pines in the central and southern Sierra Nevada range. The fungus is typically found following successful bark beetle attacks and subsequent tree death.

**Red Band Needle Blight** (*Mycosphaerella pini*)
Red band needle blight caused visible needle death on large Monterey (*Pinus radiata*) and Monterey X knobcone hybrid (*Pinus radiata* x *P. attenuata*) pines (as well as mortality of one small tree) in many locations throughout Mendocino and Humboldt Counties. Confirmed locations were identified near Fortuna and Eureka; symptomatic pines (death of second-year needles in the lower two-thirds of tree crowns) were apparent along roadsides near Willow Creek, Piercy, and Fernbridge.

Dead and dying Port-Orford-cedar at the crossing of Red Mountain Creek and Forest Road 10N12 near Fish Lake Campground, Six Rivers NF. Photo by: P. Angwin, USFS

Dead and dying Port-Orford-cedar near the Little Bald Hills trail at Redwood NP, Humboldt County. Photo by: P. Angwin, USFS

**Sudden Oak Death** (*Phytophthora ramorum*)
Per Sudden Oak Death (SOD) Blitz detections, California wildlands experienced a substantial increase in detectable *Phytophthora ramorum* (cause of sudden oak death/SOD and ramorum blight) levels compared to 2015 as a result of increased rainfall in coastal areas known to be susceptible to the pathogen in 2016. *P. ramorum* was detected for the first time in San Luis Obispo County during the 2016 SOD Blitz on 30 California bay laurel trees (*Umbellularia californica*; an early indicator species suggesting the pathogen is new to arrive there). Infested bay were found on the west side of Highway 101, 6 mi from the town of San Luis Obispo, north to Salmon Creek, Monterey County. Since the positive finds were the first south of Monterey County, regulatory samples and testing need to be completed before officially declaring it the 16th infested California county under *P. ramorum* quarantine.

Seven new *P. ramorum*-positive bay trees were identified in San Francisco's Golden Gate Park near the AIDS Memorial Grove (first found positive in 2004) and, for the first time, *P. ramorum* was found in the San Francisco Botanical Garden at Strybing Arboretum, which houses an international plant collection. Infected trees at the Arboretum included two possible new host species; further analysis is underway. Two separate outbreaks (5 trees total) were identified on Mount Diablo, Contra Costa County, as well as near Ukiah in southern coastal Mendocino County, and in the city of Piedmont (Alameda County). Several areas east of Highway 280 on the San Francisco Peninsula also had new, small outbreaks.

Pathogen activity increased in coastal Sonoma County along Fort Ross Road, from Cazadero to the coast, where sporadic tanoak (*Notholithocarpus densiflorus*) mortality was visible in August on both slopes bordering the road (i.e., the first and second ridges inland). East of Highway 1, approaching the coast through Fort Ross State Historic Park, *P. ramorum* symptoms were seen on a variety of tree species. Branch dieback and scattered foliar symptoms were apparent on tanoak as well as leader and tip dieback in small Douglas-fir (*Pseudotsuga menziesii*). Branch dieback and cankers were found on small Pacific madrones (*Arbutus menziesii*) along the roadside, and twig dieback could be seen throughout the crowns of numerous California black oaks (*Quercus kelloggii*).


Madrone branch dieback caused by *P. ramorum*, Cazadero Road, Sonoma County. Photo by: C. Lee, CAL FIRE

In Mendocino and Humboldt Counties, aerial surveys detected relatively little SOD-related mortality. In Jackson Demonstration State Forest, pathogen recovery was low in the fall and only within the known infested area. Infested tanoak and bay were detected in numerous areas in Redwood National Park (Humboldt County), downstream from current SOD management areas. Active tanoak and bay eradication treatments have been underway at two infested sites in Redwood Creek, Redwood National Park since discovery of the pathogen there in 2014. In 2016, surveys were conducted outside of the treatment areas to identify new areas of infestation at the Bridge Creek and 44-Bond Creek sites. While the locations of new infestations have been identified, GIS analysis is still underway to determine the total number of acres infested at each site.

According to 2016 SOD Blitz findings, the pathogen reemerged in areas across the state where SOD outbreaks had decreased in 2015, such as in Big Sur (Monterey County) and Marin County. In some areas that used to be marginally affected, there have been sharp increases in infection, such as in western San Mateo and western Santa Cruz Counties.

**Sycamore Canker and Dieback** (*Phytophthora crassamura*)
Sycamore canker and dieback was found on sycamores (*Platanus racemosa*) in Alameda County.

**Velvet Top Fungus Root Disease** (*Phaeolus schweinitzii*)
Velvet top fungus root disease was present in at least four large Douglas-fir (*Pseudotsuga menziesii*) trees at Butte Meadows Work Center on Lassen National Forest (Tehama County). The disease was confirmed by the presence of fungal fruiting bodies (conks) found at the bases of three of the trees. Several conks were also found growing from the roots of a fourth tree several feet from its base. All of the Douglas -fir trees had DBHs between 50-70 in and heights estimated to be greater than 120 ft.


*P. schweinitzii* conk on Douglas-fir at Butte Meadows Work Center. Photo by: W. Woodruff, USFS

**White Pine Blister Rust**
(*Cronartium ribicola*)
Although few reports of white pine blister rust were received in 2016, there was an increase in spore levels on the leaves of the alternate hosts (*Ribes* spp.) throughout the central Sierra Nevada range. Such an increase may act as a source of inoculum and may lead to an increase in the disease on white pine species in the coming years.


Willow dieback, dying branch symptoms (on the right) next to healthy branches (on the left). Photo by: A. Eskalen, UC Riverside


Cankered wood tissue showing the pycnidia (overwintering spore structures) on an infected willow branch.
Photo by: A. Eskalen, UC Riverside

**Willow Dieback**
Arroyo willows (*Salix lasiolepis*) were exhibiting extensive shoot and branch dieback in the summer (2016) in Elfin Forest as well as Questhaven Road and along Harmony Grove Road (Escondido creek watershed, San Diego County). Sampling and DNA testing identified the presence of *Botryopsphaeria dothidea*, *Neofusicocum parvum*, *Diplodia seriata*, and *Valsa malicola*. These fungi are known to cause wood cankers and dieback on a wide variety trees worldwide. They are also known to produce overwintering structures that release spores the following spring, re-infecting the host plant and possibly spreading to others. Pathogenicity tests for each fungus on arroyo willow are underway. Once the primary pathogen is identified, control measures will be investigated.

## Heart Rots and Decays

**California Tree Failure Report Program (CTFRP) Wood Decay Project**
Based on DNA testing, several fungal species (*Pleurotus, Hericium*, *Laetiporus*, and *Stereum*) were identified as the cause of wood decay on lodgepole pine (*Pinus contorta*). The fungi were identified by the CTFRP from decayed lodgepole pine (*Pinus contorta*) samples taken from the hollow butts of two fallen 24 in DBH lodgepole pine trees. The failed trees were on the Lassen National Forest approximately 15 ft east of Lassen County Road #A21, 6-10 mi north of Highway 36. The trees (one alive and one dead) blew over in the February 2015 wind event which toppled thousands of conifers on the Lassen National Forest (Lassen County).

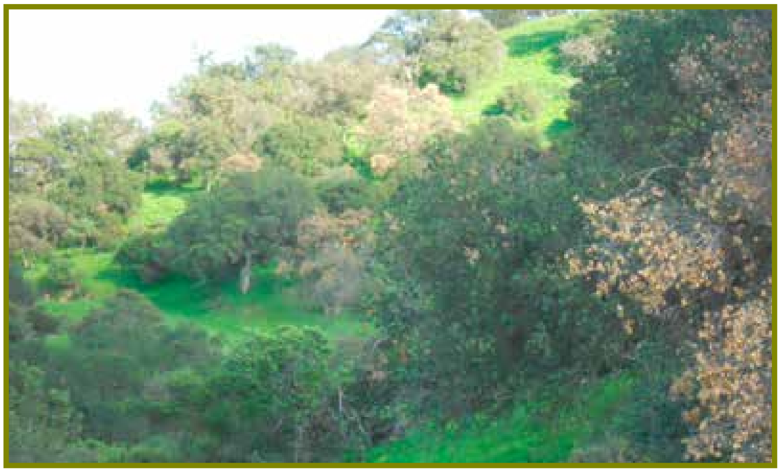
A deteriorated ponderosa pine (*Pinus ponderosa*) wood sample was removed from the base of a 36 in DBH roadside snag felled by Caltrans on the east side of Highway 44, 200 ft south of Lassen National Forest Road #33N32. Through fungal DNA analysis, *Armillaria* sp. and *Laetiporus* sp. were identified by the CTFRP as the cause of the wood decay.

## Abiotic Issues

**Drought**
Drought has resulted in approximately 20% mortality of the valley oaks (*Quercus lobata*) and blue oaks (*Quercus douglasii*) in the lower foothills of Mariposa and Madera Counties. In San Luis Obispo County on High Mountain Road, approximately 2,700 acres of the Los Padres National Forest has 20% coast live oak (*Quercus agrifolia*) drought-related dieback and mortality.

In the San Bernardino County mountain communities of Crestline, Running Springs, and Lake Arrowhead, incense cedars (*Calocedrus decurrens*) of all age classes were dying in the absence of insects and disease. Juniper trees (*Juniperus californica*) were dying from drought in Pinon Hills, Blady


Coast live oak dieback, Lopez Lake, High Mountain Road, San Luis Obispo County. Photo by: K. Corella, CAL FIRE



Coast live oak dieback, Lopez Lake, High Mountain Road, San Luis Obispo County. Photo by: K. Corella, CAL FIRE

Big leaf maple with maple leaf scorch along CA Hwy 70 and Feather River (July 15), possibly caused by *Xylella fastidiosa*. Photo by: W. Woodruff, USFS

Big leaf maple with male leaf scorch along Interstate 5 south of Dunsmuir (September 9), possibly caused by a lack of soil moisture. Photo by: W. Woodruff, USFS

Mesa, Phlena, and Wrightwood. Samples were submitted to UC Riverside; however, no insects or diseases were found to be significant damage agents. Coast live oaks were also dying due to severe drought.

Numerous reports of dead and dying incense cedars of all age classes were received from throughout the central and southern Sierra Nevada range. No insects or diseases were associated with the die off. Impacted trees tended to be found on drought-impacted sites where oak trees, shrubs, and other vegetation also appeared to be in poor condition. Drought is the suspected cause of incense cedar mortality. See the "Cedar Bark Beetle" section of this report for more information.

**Maple Leaf Scorch** *(*drought and suspected *Xylella fastidiosa)*
Maple leaf scorch (MLS) on big leaf maple (*Acer macrophyllum*) remained a problem in 2016. The onset of MLS symptoms occurred in June and July. The disease was thought to be caused in most areas by a lack of soil moisture in combination with moisture stress caused by xylem-feeding insects. It is possible that the xylem-limited bacterium *Xylella fastidiosa* is responsible for MLS in locations where maples showed heavy scorch early in the season. Lab screening for *X. fastidiosa* DNA from scorched big leaf maple leaves was not successful. It is believed that big leaf maples showing early chlorosis or necrosis on leaf tips or margins of normal-sized leaves throughout their crowns and lasting into the fall are trees affected by low soil moisture. In 2016, it is likely that low soil moisture combined with insects caused most MLS in California.

## New Statewide Analyses and Management Tools for Weed Management

Calflora – A new Calflora (calflora.org) tool allows users to set up personal email alerts when a plant species of interest is reported in an area of interest. The alerts can be for a personalized plant list or a pre-defined one (e.g., California's noxious weed list) as well as particular areas of interest or predefined areas (e.g., a national forest). Users can set up custom alerts and select alerts already configured with priority early detection/eradication species for their region. Calflora also continues to develop their WeedManager suite of applications, including new reports that track weed management and treatment methods. These tools can be accessed through the new "Invasives" link on the Calflora homepage.

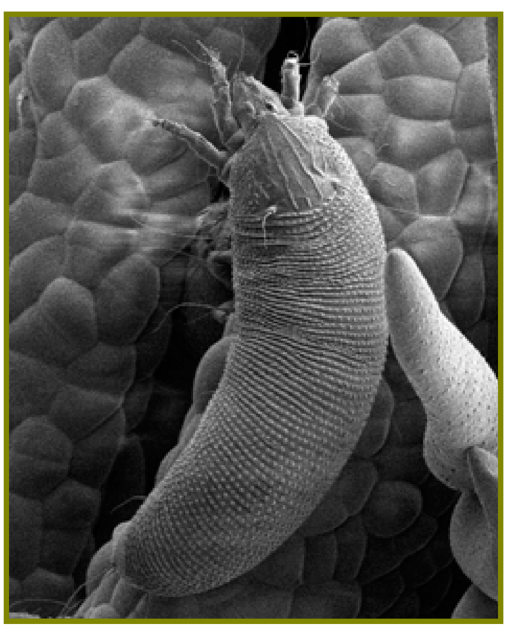
Plant Risk Evaluation (PRE) – In 2016, 200 species on the California Invasive Plant Council's (Cal-IPC's) Watchlist (cal-ipc.org/ip/management/alerts/index.php) were evaluated for potential invasiveness. In addition, Plant Assessment Forms (PAFs) are being completed for a few species that are already having an impact in the state. The final list of scores (from PRE evaluations and PAF assessments) should be available in early 2017 and will be posted for public comment. This process may result in new species being added to Cal-IPC's inventory of wildland invasive plants. Plant species that were evaluated through this process that might represent risks to forested lands include: Darwin's barberry (*Berberis darwinii*, a thorny evergreen shrub native to South America found along the Northern California coast); white broom (*Cytisus multiflorus*, a perennial shrub native to the Mediterranean, with records in California's San Francisco Bay Area, central Sierra foothills, and Humboldt County); giant ragweed (*Ambrosia trifida*, an annual herb native to North America, with records throughout California); and jointed goatgrass (*Aegilops cylindrica*, an annual grass native to Europe with numerous records throughout California). This work is supported by a grant to Cal-IPC from the US Forest Service.

## New Biocontrols for Invasive Plants

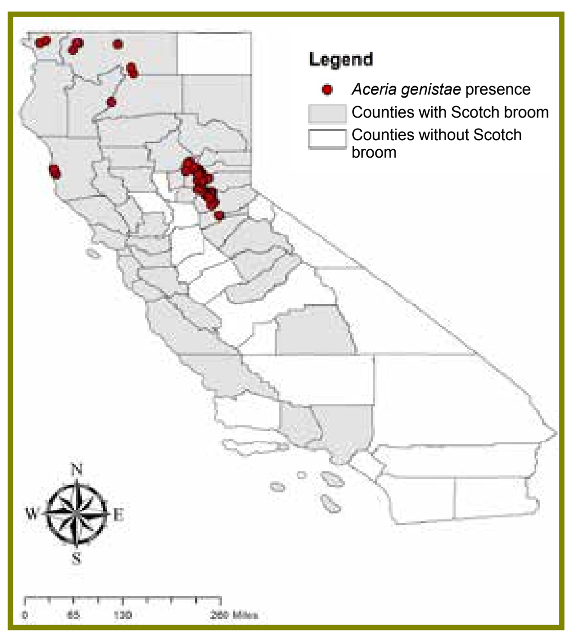
Cape Ivy (*Delairea odorata*) Biocontrol – In May 2016, the USDA Agricultural Research Service (ARS) Exotic and Invasive Weeds Research Unit received permission to release the cape ivy stem gall fly (*Parafreutreta regalis*). In August, this fly was released in several locations, from Monterey County to the East Bay Regional Parks to southern Sonoma County. Establishment has not yet been documented. It is hoped that the fly can survive winter conditions in California.

Cape Ivy, Los Padres NF, north of Big Sur.
Photo by: D. Bakke, USFS

Scotch Broom (*Cytisus scoparius*) Biocontrol – The Scotch broom gall mite (*Aceria genistae*) was originally identified by researchers in New Zealand and Australia and released there in the late 2000s. As the name implies, this gall mite causes the formation of numerous galls on attacked plants. Plants with high gall densities suffer from stem dieback. It was found in western Washington in 2005 and in California in 2014, near Georgetown (El Dorado County) and Happy Camp (Siskiyou County). Subsequent surveys have determined further expansion of its range, including along Interstate 80 in Placer County, although it is still somewhat limited. As the mite was never approved for introduction into the US, it cannot legally be moved or redistributed. There is a study proposed for 2017 to determine whether the mite represents a risk to native California flora. It is hoped the results of this study would eventually lead to allowable releases and redistribution within the state.



*Aceria genistae*, biocontrol for Scotch broom.
Photo by: P. Pratt, USDA ARS




*Aceria genistae* and Scotch broom locations in California.
Map by: C. Sodergren, USDA ARS

## New or Newly Naturalized Invasive Plant Species

*Genista linifolia*, flax broom. Photo by: D. Kelch, CDFA

**Flax or Mediterranean Broom** (*Genista linifolia*)
Known from older records in Santa Barbara and Los Angeles Counties and Catalina Island, this species has been spreading in these areas. This shrub species has hairy stems, lance-shaped leaflets with wooly undersides, and flowers bunched near ends of branches. It will likely pose more of a risk to forested lands where winters are mild, such as in Southern California. According to Calflora, there are also older records from San Diego and Humboldt Counties.

*Clematis vitalba*, old man's beard.
Photo by: Wikipedia Commons

**Old Man's Beard** (*Clematis vitalba*)
A kudzu-like perennial vine, this species has been found climbing coastal redwoods in Santa Cruz County and in Muir Woods (Marin County). It is considered noxious in Washington and New Zealand.

## Notable Expansions of Known Invasives

**Stinkwort or Dittrichia** (*Dittrichia Graveolens*)
This species is native to southern Europe and was first identified in California in Santa Clara County in 1984. With the potential to produce upwards of 15,000 seeds per plant, stinkwort has rapidly expanded to at least 36 counties in the state. It prefers hot and dry climates with well-drained, sandy or gravelly soils. Roadsides are a perfect habitat, with populations spreading from there. Stinkwort is a pyramid shaped shrub that flowers from September to December. Once flowers have developed, the plant can still produce seed after hand pulling. Stinkwort may cause allergic reactions when contacted by humans and also may be fatal to livestock if consumed.

Spotted knapweed along Truckee River. Photo by: P. Zortman, Placer County Agriculture Commisioner's Office

**Spotted Knapweed** (*Centaurea stoebe*) **and Musk Thistle** (*Carduus nutans*)
The Placer County Department of Agriculture documented a dramatic increase in the number of spotted knapweed infestations in Placer County in 2016 (191 sites in 2015; 364 in 2016), probably due to more intense surveys as well as some natural expansion. The surveys covered the Truckee River channel between the Squaw Creek confluence and the Placer/Nevada County line and found 35 sites on both private and public lands. There were also four musk thistle sites found along the river. The county is developing a strategy and will start to make contacts with private landowners to secure permissions to access properties and conduct treatments in 2017. There are other knapweed sites in Placer County along the Interstate 80 corridor (between Alta and Truckee), in the Lahontan development south of Truckee, and in Squaw Valley.

**Japanese Knotweed** (*Polygonum cuspidatum*)
The National Park Service (NPS) and partners conducted early detection surveys in Marin County. Japanese knotweed was known to occur in the area, but its extent was not known. Japanese knotweed is going to require rapid response across private, state, and NPS lands along Lagunitas Creek in order to control it. Three rounds of treatments were conducted this summer (2016) on NPS lands. Extensive outreach will be needed to complete this work.

**Management Action for Six Weed Species in Humboldt and Del Norte Counties**
Three knotweed species (Japanese knotweed, giant knotweed/*Fallopia sachalinensis*, and Himalayan knotweed/*Persicaria wallichi*) as well as giant reed (*Arundo donax*), rush skeletonweed (*Chondrilla juncea*), and shining geranium (*Geranium lucidum*) were identified in 2014 in Humboldt and Del Norte Counties. These species are known to have major negative effects on ecosystems. Each species was found in low enough numbers that they have the potential to be eradicated in a relatively short amount of time. Consequently, a regional early detection and rapid response project was implemented. The majority of the six species (particularly the knotweeds) are spreading south from Oregon and Washington where eradication is no longer an option due to extensive infestations. In 2015, the Redwood Community Action Agency received a $450,000 grant from the California Wildlife Conservation Board to eradicate these species from Humboldt and Del Norte Counties, halting their southward spread into California. In 2016, 80% of the knotweed populations and 95% of the populations of the other target species were treated.

By Robert S. Lane

## Lyme Disease in California Forests: Tick Carriers, Wildlife Hosts, and Personal Protective Measures

Lyme disease (LD), caused by several species of corkscrew-shaped bacteria known as spirochetes, is transmitted to humans by four species of ticks in temperate Northern Hemisphere regions. Two of those ticks reside in the US, the blacklegged or deer tick in the east and the western blacklegged tick (WBLT) in the west. All ticks are obligatory bloodsuckers that utilize protein in the blood meal for developmental and reproductive purposes.

Twenty species of LD spirochetes have been described globally, but the species that causes nearly all cases of LD in North America is *Borrelia burgdorferi* (Bb). LD is by far the most commonly reported arthropod-borne disease reported to the US Centers for Disease Control and Prevention, with an estimated 240,000 to 440,000 new cases a year. In California, roughly 100 or fewer confirmed cases are reported annually.

Lizards and Columbian black-tailed deer have been identified as major hosts for maintaining populations of juvenile and adult WBLTs in Northern California. The dusky-footed wood rat, western gray squirrel, and deer mouse serve as reservoir hosts of Bb, infecting juvenile WBLTs (larvae, nymphs) with Bb that feed on them. A few ground-foraging birds, such as the golden-crowned sparrow, may serve as secondary reservoir hosts for ticks.

In forested areas carpeted with leaf or fir-needle litter, the poppy seed-sized WBLT nymph is the primary carrier of Bb to people. Certain types of forests pose the greatest risk for human-nymph encounters. Research conducted in Mendocino County demonstrated that the density of Bb-infected nymphs was higher in hardwood-dominated versus conifer-dominated woodlands that included redwood or pine, while chaparral, grassland, and woodland grass represent low-risk habitats. Behaviors elevating the risk of exposure to nymphs include contact with leaf litter and wood, particularly woodcutting, sitting atop logs or against tree trunks, and gathering firewood.

Columbian black-tailed deer. Photo by: R. Lane, UC Berkeley, Emeritus

Personal protective measures are the first line of defense for reducing the likelihood of tick bites, including: wearing full-length pants tucked into socks and a long-sleeved shirt tucked into pants, applying tick repellents to clothing or skin prior to entering woodlands, avoiding or minimizing risky behaviors (e.g., sitting on logs), and inspecting clothing and skin several times a day to detect and remove ticks before they attach. Bathing within 2 hours after potential tick exposure can also reduce LD risk by removing unattached ticks. Additionally, placing field clothes in the dryer at high heat for up to an hour kills any ticks that may be on clothing.

An unfed western blacklegged tick nymph (~1/25 in long).
Photo by: R. Lane, UC Berkeley, emeritus

If an embedded tick is found, remove it immediately. Quick removal of an infected tick can prevent LD and other tick-borne illnesses. Grasp the tick's mouthparts close to the skin with either a pair of tweezers or fingers protected with a piece of tissue paper. Slowly and steadily extract the tick by pulling it straight backwards. Cleanse the wound with soap and water and, if available, apply a mild antiseptic such as rubbing alcohol or povidone-iodine. For more information about ticks, LD, and prevention, see Lane and Kjemtrup (2016, Lyme disease in California. Pest Notes Publ. 7485. Univ. Calif. Agr. Nat. Res.) online at ipm.ucanr.edu.

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# About the Pest Council

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

1. Coordinating the detection, reporting, and compilation of pest injury, primarily from forest insects, diseases, and animal damage.
2. Evaluating pest conditions, primarily those of forest insects, diseases, and animal damage.
3. Making recommendations on pest control to forest managers, protection agencies, and forest landowners.
4. Reviewing policy, legal, and research aspects of forest pest management and submitting recommendations to appropriate authorities.
5. Fostering educational work on forest pests and forest health.

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

This report was prepared by Forest Health Protection, US Forest Service, Pacific Southwest Region and the California Department of Forestry and Fire Protection with other member organizations of the Council.

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**Cover Photo**

Top kill of ponderosa pines (distant trees) caused by California five-spined ips next to western pine beetle-caused group kill of ponderosa pine, Yuba River RD, Tahoe NF. Photo by: D. Cluck, USFS

United States Department of Agriculture

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