2015

California Forest Health Highlights

A publication of the
California Forest Pest Council

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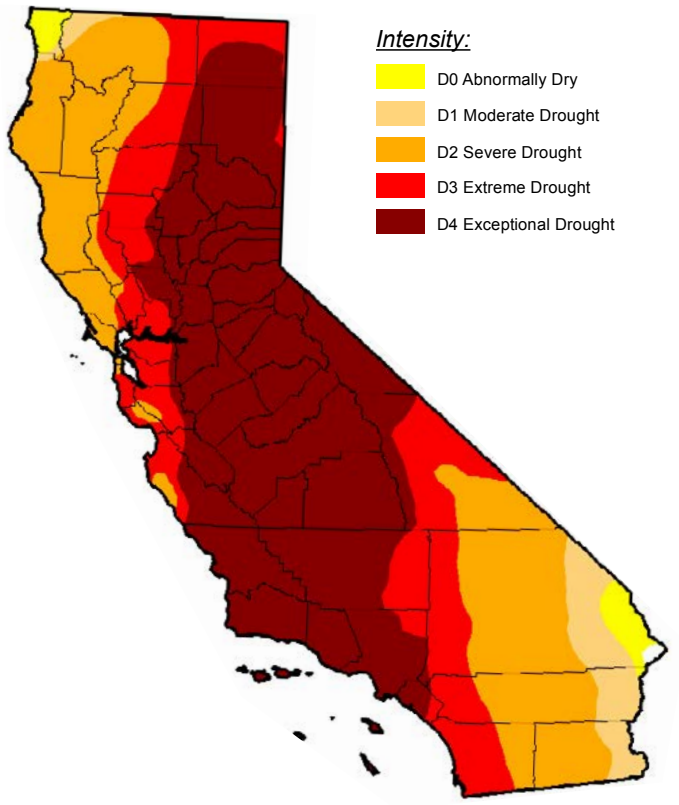
California experienced a fourth consecutive year of below-average precipitation in 2015. Most rainfall occurred from October 2014 to February 2015 (water years are from October 1 – September 30), with only 6.1 in. of the total 36.8 in. of precipitation falling in northern California the last 8 months of the year. The statewide snowpack was also well below normal, at 5 percent of average.

Mean monthly temperatures reached record or near record highs in January, February, March, and June, making 2015 the hottest year on record for the state. In northern California (in the central and eastern portion), June temperatures were 5 to 7 degrees warmer than historical averages, with areas such as Redding experiencing 17 days over 100 °F. High temperatures continued through July and into late summer.

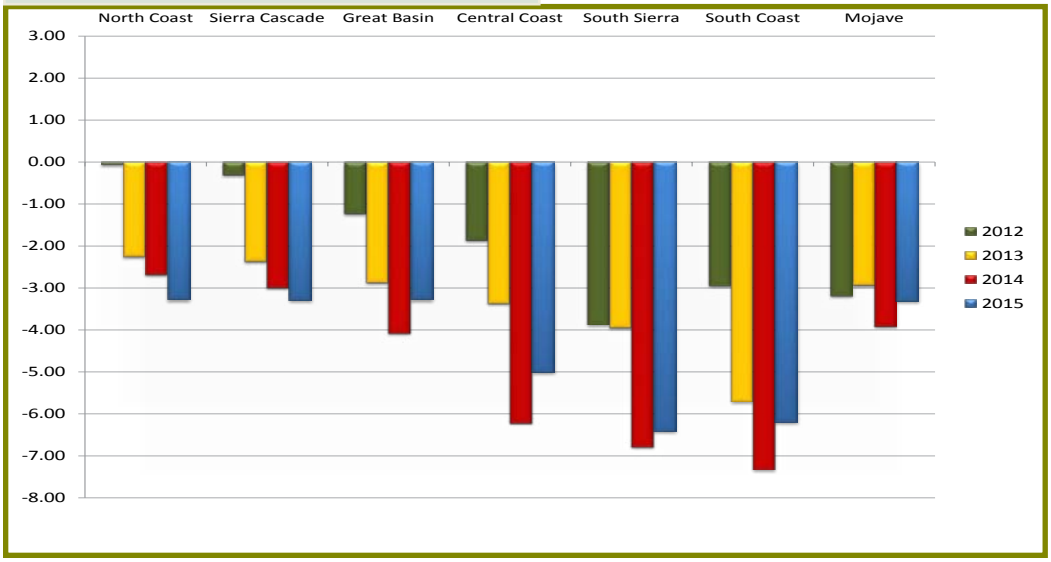
The prolonged drought, over-stocked forests, and higher than average temperatures were the most significant factors affecting California forest health in 2015, with nearly 28 million dead trees mapped during US Forest Service forest health aerial surveys. Statewide, 8,380 fires (state and federal responsibility areas) consumed 846,872 acres in some of the largest and most destructive fires in state history, killing millions of trees outright, while leaving millions more weakened and susceptible to insect and disease attacks. Drought-stricken and fire-damaged trees fueled bark beetle outbreaks of epidemic proportions throughout the central and southern Sierra Nevada range as well as areas of coastal and southern California, and oak and incense cedar died outright from drought.



US Drought Monitor map of California, April 28, 2015.
Map by: A. Artusa, NOAA/NWS/NCEP/CPC, Western Regional Climate Center

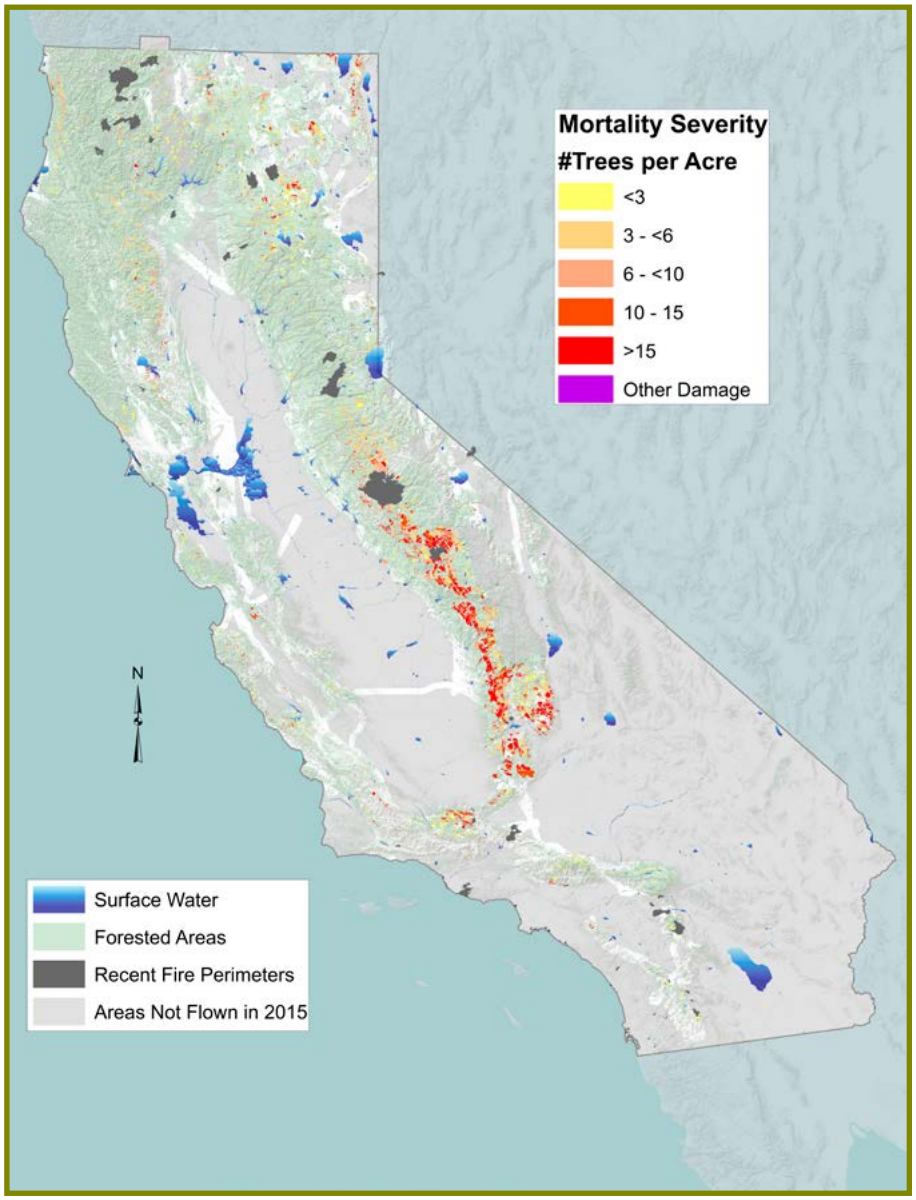
Palmer Drought Index

The Palmer Drought Index is an indicator of drought and moisture excess, with negative values denoting degree of drought. In 2015, the yearly average Palmer Drought Index values were negative across California, ranging from -3.28 on the North Coast, Sierra Cascade, and Great Basin (wettest zones) to -6.41 in the South Sierra (driest zone).



By Jeffrey Moore

Aerial surveys are conducted annually by the US Forest Service to map recently killed and declining trees throughout California's forests. Surveyors typically fly in light, fixed-wing aircraft and use a digital sketch-mapping system to document tree mortality and damage. Of the 45 million acres surveyed across California in 2015, an estimated 27.7 million trees were killed over approximately 2,812,000 acres, up from 3.3 million trees over 909,000 acres in 2014. In addition to special surveys conducted in April in the driest areas of the state, summer surveys began earlier than usual to better ascertain the health of oak woodlands given the exceptional drought conditions. Surveys also ended later than usual due to wildfire challenges. All National Forests and forested National Parks were surveyed, along with other federal, state, and private lands. (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.)



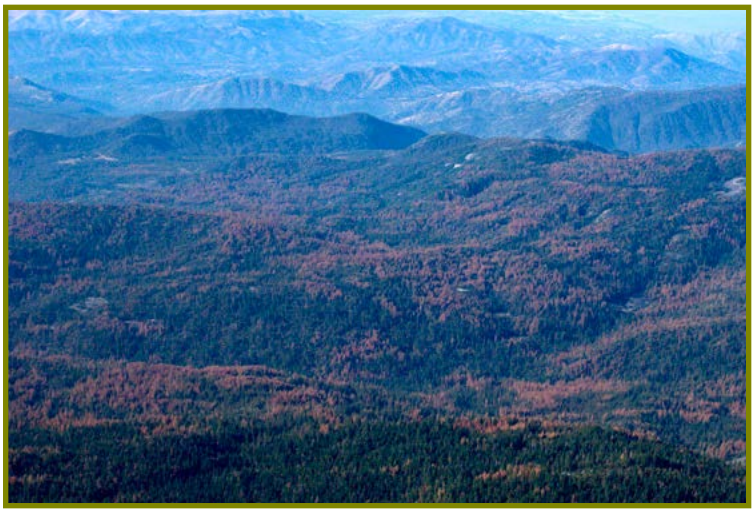
USFS California Aerial Survey Tree Mortality, 2015. Map by: J. Moore, USFS

Bark Beetles and Wood Borers

- Over 2.5 million acres of tree mortality were mapped due to bark beetles or wood borers, up from 820,000 acres in 2014.
- Fir engraver beetle-related true fir mortality increased to 1.21 million acres, up from 460,000 acres in 2014.
- Western pine beetle-related pine mortality more than doubled from 2014 levels to 635,000 acres.
- Mountain pine beetle-related pine mortality tripled from 2014 levels to more than 600,000 acres.
- Acres with Jeffrey pine mortality attributed to Jeffrey pine beetles, engraver beetles, and/or California flatheaded borers increased more than 600 percent to more than 774,000 acres.
- Approximately 238,000 acres with pinyon *Ips*-related pinyon pine mortality were mapped, up from 58,000 acres in 2014.
- Over 40,000 acres with drought-related gray pine mortality were mapped, nearly double the previous 2 years.
- Coulter pine mortality caused by western pine beetle and *Ips* increased to more than 41,000 acres, up from 13,000 acres in 2014 and very little mortality for several years prior.
- Douglas-fir beetle-related Douglas-fir mortality continued to be modest at 14,500 acres; however, Douglas-fir mortality attributed to the flatheaded fir borer increased to approximately 87,000 acres, up from 16,000 acres in 2014.
- Oak mortality attributed to the goldspotted oak borer (GSOB) in San Diego County increased slightly, to approximately 16,000 trees across 3,800 acres. However, some of these trees may have been killed directly by drought.
- Evergreen or live oak trees were likely killed by drought with almost 148,000 acres mapped.

Defoliation

- Early summer aerial surveys detected leaf drop in blue oak occurring much earlier than usual, with almost 400,000 acres of oak defoliation and discoloration recorded primarily at the southern extent of the blue oak range. Deciduous oak early leaf drop is common in drought years and can be cause for concern if conditions persist for several years.
- The Douglas-fir tussock moth defoliation event on the Plumas and Lassen National Forests in 2013-2014 has ended. No new defoliation was observed. Mortality and topkill from this event was minimal.



Mixed conifer (mostly ponderosa pine) mortality on low-elevation pine, northwestern Sequoia NF, October 2015. Photo by: J. Moore, USFS

Diseases

- *Phytophthora ramorum*/sudden oak death-related mortality increased to more than 60,000 acres, up from 28,700 acres in 2014 (similar to 2013 levels - 47,500 acres). Spread of this disease 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.

Live oak and gray pine mortality along with early leaf drop defoliation and discoloration of blue and other deciduous oaks near Yuba River State Park, July 2015. Photo by: J. Moore, USFS

- *Marssonina populi* leaf blight on aspen was common in northern CA, with foliage appearing thin and yellow mid-year. However, south of Lake Tahoe, aspen defoliation was attributed to satin moth as foliage was thin, but not yellow.
- Other minor and localized defoliating insect events were recorded, including Jeffrey pine needle miner south of Lake Tahoe and lodgepole pine needle miner in Yosemite National Park high country.

Widespread singleleaf pinyon pine mortality, Scodie Mountains, southern Sierra Nevada range, August 2015. Photo by: J. Moore, USFS

By Beverly Bulaon

Native Insects

Douglas-fir Beetle (*Dendroctonus pseudotsugae*)

A few small pockets of Douglas-fir beetle-caused mortality occurred on the drier west slope of the Almanor Ranger District, Lassen National Forest. Small patches (there to 10 trees) of mortality in Douglas-fir attributed to Douglas-fir beetle were also noted along the edges of moderately burned areas of the 2014 Happy Camp Complex, Klamath National Forest (Siskiyou County).

Fir Engraver (*Scolytus ventralis*)

Fir engraver beetle-related mortality is often associated with extended drought conditions. In 2015, true fir in northwestern California started to show branch flagging and mortality in lower elevation forests, sites typically more suited to ponderosa pine. Significant mortality was noted in fir stands west of Goose Lake, Modoc County, and was particularly heavy in the Corral Creek drainage. This area was also impacted during the drought in the late 1980s to early 1990s. Extremely high levels of white fir mortality were observed on the Eagle Lake Ranger District (Lassen National Forest) between Patterson and Ashurst Mountains as well as within the Franklin, Joseph, and Thoms Creek watersheds (Warner Mountains, Modoc National Forest). White fir left as residual trees from 20-year-old thinning projects on Harvey Mountain (Lassen National Forest) also suffered high levels of mortality. Root disease, low precipitation, and dwarf mistletoe contributed to the mortality.

Fir engraver beetle gallery on white fir, Fresno Co., July 2015.
Photo by: K. Corella, Cal Fire

Fir engraver beetle-caused white fir mortality, Franklin Creek, Modoc NF, July 2015. Photo by: D. Cluck, USFS

Fir engraver-associated white fir mortality was more noticeable in the higher elevations of the southern Sierra Nevada range (greater than 5,000 ft.). Tree mortality in forested areas around Pinecrest Lake (Summit Ranger District, Stanislaus National Forest) was scattered and primarily found in moderate size classes (15 - 25 in. dbh). Mature white firs with severe true leafy mistletoe infection were prominently dying in the Greenhorn Mountains along 23S16 Road and Western Divide Highway (Western Divide Ranger District, Sequoia National Forest). A white fir progeny site in the Pilliken Plantation area (Pacific Ranger District, Eldorado National Forest, El Dorado County) had a few small groupings (two – four) of fir engraver-killed trees, but root disease and dense stocking most likely contributed to their decline.

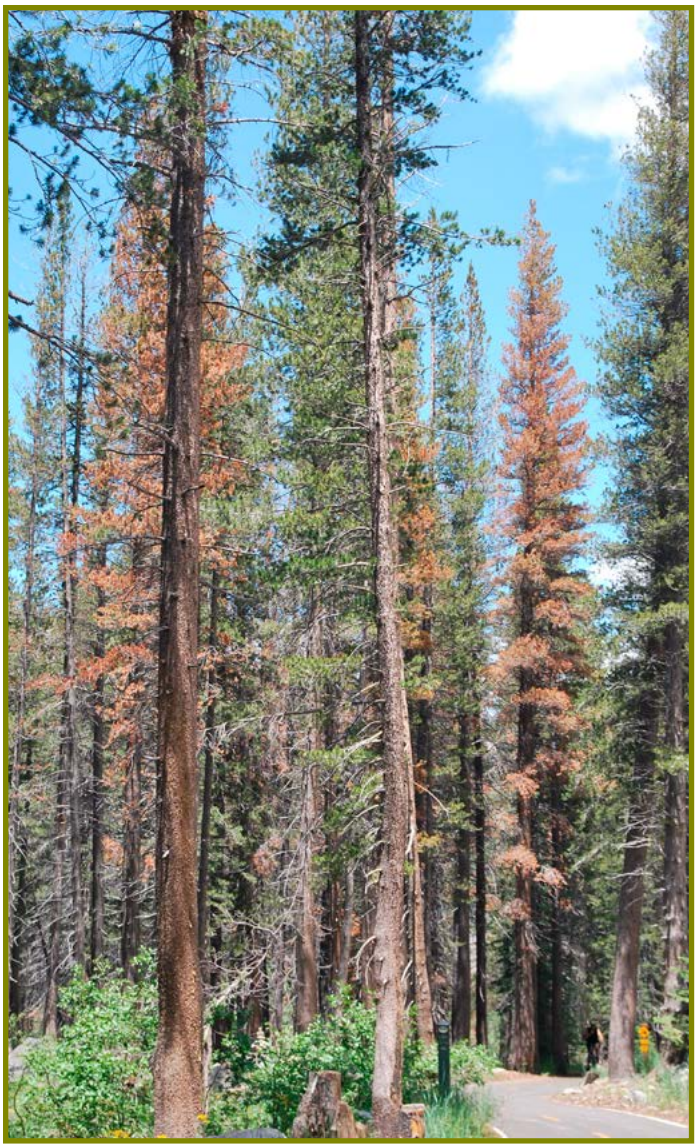
White fir mortality in southern California was significantly lower than previous drought-related tree mortality recorded from 2002 - 2004. However, there was some patchy die off (less than ten trees per acre) in natural stands on the Mt. Pinos Ranger District, Los Padres National Forest.

Jeffrey Pine Beetle (*Dendroctonus jeffreyi*)

Scattered individual trees were attacked by Jeffrey pine beetle on the Hat Creek Ranger District (Lassen National Forest) near Ashpan Snowmobile Park as well as on the southern end of the Big Valley Ranger District (Modoc National Forest).

Mountain Pine Beetle (*Dendroctonus ponderosae*)

Mountain Pine Beetle (MPB) activity doubled from 2014, particularly in sugar pines on the western slope of the Sierra Nevada range. Large groups of mature sugar pines (five - 20 trees) were attacked, even in previously thinned or burned areas of Sequoia-Kings Canyon and Yosemite National Parks, and on the Sierra and Sequoia National Forests. Mortality was visible along the first eight miles of Highway 120 in Yosemite from the Big Oak Flat entrance station (Mariposa County). Trees in thinned stands around 24S15 Road also were attacked (Kernville Ranger District, Sequoia National Forest). Red turpentine beetle was often found in



Mountain pine beetle infestation of lodgepole pine, Twin Lakes, Inyo NF, July 2015. Photo by: B. Bulaon, USFS

association with MPB-infested trees. In the upper elevations, MPB activity in lodgepole pine stands did not increase, yet beetle activity was found in foxtail, limber, western white, and whitebark pines on the lower east slope of the Sierra Nevada range around Onion Valley, Whitney Peak, and Cottonwood Lakes (Inyo National Forest). Mature whitebark pines were already decimated in several locations on the Inyo National Forest due to ongoing MPB infestations since 2007, and mortality in other five-needled pines has been increasing annually since the inception of the drought. A small number of mature sugar pines were killed by MPB on Boggs Mountain Demonstration State Forest, Lake County. MPB also contributed to ponderosa pine mortality near the City of Portola, Plumas County (see western pine beetle section).

Whitebark pine on the Warner Mountains and lodgepole pine on Medicine Lake Highlands (Modoc National Forest) had decreased MPB activity in 2015. MPB continued to cause scattered mortality on approximately 100 acres of whitebark pine on Ball Mountain, Klamath National Forest (Siskiyou County). There were three locations with two - 10 trees dying as well as scattered individual trees above the 7,400 ft. elevation. Scattered mortality in western white pine, whitebark pine, and foxtail pine on Eddy Peak (Klamath Mountains, Siskiyou County) was attributed to MPB.

A small pocket of lodgepole pine mortality (six trees, 14 in. dbh) was attributed to MPB approximately three miles from Pumice Stone Mountain, Klamath National Forest (Siskiyou County), about 10 miles east of Tenant. This area is known for very dry, volcanic soils.

Western Pine Beetle (*Dendroctonus brevicomis*)

Western pine beetle (WPB)-associated mortality in 2015 was at epidemic levels on Sierra and Sequoia National Forests, Yosemite National Park, Sequoia-Kings Canyon National Park, and surrounding forested communities, with large stands of dead ponderosa pine coalescing into landscape-scale mortality. Bass Lake (Bass Lake Ranger District, Madera County), a popular recreation destination, experienced complete loss of overstory pines in several campgrounds and around lake housing communities. In Mariposa (Mariposa County) and surrounding communities, 54 percent of pines were dead, with final numbers for 2015 expected to near 72 percent mortality (Mariposa County Report, August 2015). Several counties that incorporate the Sierra and Sequoia National Forests declared a state of emergency due to the overwhelming number of dead trees near private property, public utilities, and infrastructure. Communities in Tuolumne (Groveland, Twain Harte, and Greeley Hills), Calaveras (Arnold, Hathaway Pines, and Avery), and Amador (Amador, Pioneer, and Pine Grove) Counties continue to remove hazardous trees.

A comparison of High Sierra Ranger District, Sierra National Forest WPB plot inventories taken in 2011 and 2015 revealed that 49 percent of ponderosa pine forest stands have greater than 50 percent mortality, and mixed conifer pine forests have 17 percent mortality. Findings estimated that about 8 million trees (greater than 15 in dbh) were killed forest wide, including 51 percent of ponderosa pine, 27 percent of white fir, and 17 percent of sugar pine. Mortality levels on the Sierra National Forest are unprecedented (Rojas, Collaborative Forest Landscape Restoration Forest Report, October 2015).

All classes of pines and stand conditions experienced mortality, regardless of size or structure. Around Pilot Peak (Bass Lake Ranger District, Mariposa County), plantation trees were heavily

Western pine beetle-infested ponderosa pine and mountain pine beetle-infested sugar pine, 2012 Chips Fire, Plumas NF, October 2015. Photo by: D. Cluck, USFS

Western pine beetle infestation of ponderosa pine, Lassen NF, July 2015. Photo by: D. Cluck, USFS

infested. Stands with basal areas that were 150 ft² per acre or more had nearly 100 percent pine mortality, and neighboring stands that may have otherwise been resilient during average precipitation years were attacked. Elevations of 5,000 ft. and below, where foothill vegetation transitions into mixed conifer forests, had the greatest mortality levels from Tuolumne County south to Kern County.

Western pine beetle activity increased in two separate Coulter pine plantations and scattered natural stands located on the Sawmill-Liebre Ridge of the Angeles National Forest (Los Angeles County). Ponderosa pines were killed in natural stands primarily near Sawmill Campground. Tree mortality has been persistent in this area for the past 3 years, impacting hundreds of acres of forested land. Ponderosa pine mortality also increased west of Crestline along Highway 138 on the San Bernardino National Forest. Several pockets of tree mortality impacted less than 30 acres adjacent to the highway.

Mortality of ponderosa pine caused by WPB continued across northern California, with some locations experiencing significant increases. In Shasta County, mortality on Bullskin Ridge that first appeared in 2013 (initiated by tree breakage the previous winter) continued through 2015. As has occurred during previous droughts, mortality was relatively common in the Shingletown area, portions of eastern Shasta County, and McCloud Flats in Siskiyou County. The McCloud Flats area is known for blackstain root disease as well as *Heterobasidion* root disease in ponderosa pine. The combined stresses have increased susceptibility to WPB, which have killed large patches of ponderosa pine (five trees to several acres) along Tatham and Beetle Ridges, Mendocino National Forest (Tehama County), west of the community of Paskenta.

Large increases in WPB activity were observed at lower elevations in ponderosa pine on the west slopes of the Lassen, Plumas, and Tahoe National Forests as well as on the Doublehead and Devil's Garden Ranger Districts, Modoc National Forest. WPB-related mortality was high in previously burned areas, such as the Chips and Barry Point Fires (2012, Plumas and Modoc National Forest, respectively). On a parcel owned by the city of Portola (Plumas County), ponderosa pines were killed by western and mountain pine beetles, with secondary infestations from *Ips* and red turpentine beetles. Smaller incense cedars were also dying. The site is overstocked and has a severe pine dwarf mistletoe infestation.

A March aerial survey of the Boggs Mountain Demonstration State Forest (Lake County) area revealed extensive WPB-related ponderosa pine mortality within lower elevation mixed pine and oak forests surrounding Boggs Mountain and Seigler Mountain (to the northwest). These trees were killed at the end of 2014. Significant changes within the Demonstration State Forest began with the 2015 spring WPB flight. A July aerial survey identified 37 groups of 10 or more ponderosa pines killed by this cohort of beetles. Even greater numbers of recently attacked pines, still with green crowns were identified by ground surveys. Most trees within the forest were subsequently killed in September by the Valley Fire.

Mountain pine beetle-associated whitebark pine mortality, Warner Mountains, Modoc NF, July 2015. Photo by: J. Moore, USFS

Defoliators

Douglas-fir Tussock Moth (*Orgyia pseudotsugata*; DFTM)

Populations of Douglas-fir tussock moth, which caused defoliation over nearly 29,000 acres statewide in 2014, appeared to have collapsed based on late 2014 egg mass sampling. The 2013/14 Douglas-fir tussock moth outbreak on the Lassen and Plumas National Forests officially collapsed. No defoliation was detected in 2015. Most white fir that had previously had light to moderate defoliation made a full recovery.

Oak Defoliator (*Epinotia emarginana*)

Several oak species were defoliated this spring over more than 20 square miles near Old Shasta, west of Redding (Shasta County). The most severe defoliation occurred on blue oaks, some of which lost all of their leaves. Black and interior live oaks were also defoliated. *Epinotia emarginana*, a small, olive-colored tortricid moth larva was identified as the cause. This was the second year of defoliation in the area, with 2014 defoliation having been relatively light. In 2014, affected areas were inspected after defoliation, and no evidence of the defoliator was found. Observations this year showed that larvae entered the leaf litter beneath defoliated trees to pupate at the beginning of April. Therefore, it was possible to collect and ship pupae to the California Department of Food and Agriculture diagnostics lab for identification. Similar defoliation was noted on blue oaks along Highway 20, west of Williams (Colusa County); however, *E. emarginana* was not confirmed as the cause.

Epinotia emarginana feeding on blue oak, Shasta Co., March 2015. Photo by: D. Owen, Cal Fire

Other Species

California Flatheaded Borer (*Phaenops californica*)

Ips pini-infested ponderosa and Jeffrey pine, Susanville Ranch Park, Lassen Co., January 2015. Photo by: D. Cluck, USFS

California flatheaded borer (CFB) displaced Jeffrey pine beetle (JPB) in the lower Sierra Nevada range, particularly on the Piute and Greenhorn Mountains of Sequoia National Forest (Kern County), where CFB was found attacking Jeffrey pine. Almost no JPBs were observed in combination with CFB. Instead, CFB appeared to be assisted by lion beetles (*Ulochaetes leoninus* LeConte) infesting the lower two ft. of trees. This phenomenon was also noted in several Nevada locations in 2013 on Jeffrey pine outside of Washoe Lake (Washoe County), where stumps were riddled with lion beetle holes even after trees were cut and the boles removed.

Jeffrey pine beetle activity was offset by overwhelming numbers of CFB and pine engravers (*Ips* spp.) making initial attacks before JPB emergence. On Piute and Greenhorn Mountains (Sequoia National Forest, Kern County), large groups of Jeffrey pines had evidence of borer activity, with minimal to no JPB present. At higher elevations on the forest, JPB was accompanied by CFB at a ratio of 1:1 along Sherman Pass (Sequoia National Forest, Kern County). These attacks occurred on Jeffrey pines on fairly dry, open sites intermixed with ponderosa pines being killed by WPB.

Flatheaded Fir Borer (*Phaenops drummondi*)

The flatheaded fir borer caused widely scattered Douglas-fir mortality in the Hyampom Valley, Trinity County. A ground inspection of fading trees in the spring revealed an even greater number of infested trees than anticipated, as some of the infested trees still had green crowns. Much of the mortality was on drier, south-facing slopes with hardwoods and other conifers present. Large numbers

Flatheaded fir borer in Douglas-fir, Lake Britton, Lassen NF, June 2015. Photo by: D. Cluck, USFS

of Douglas-fir were also killed by flatheaded fir borers near Lake Britton, Lassen National Forest.

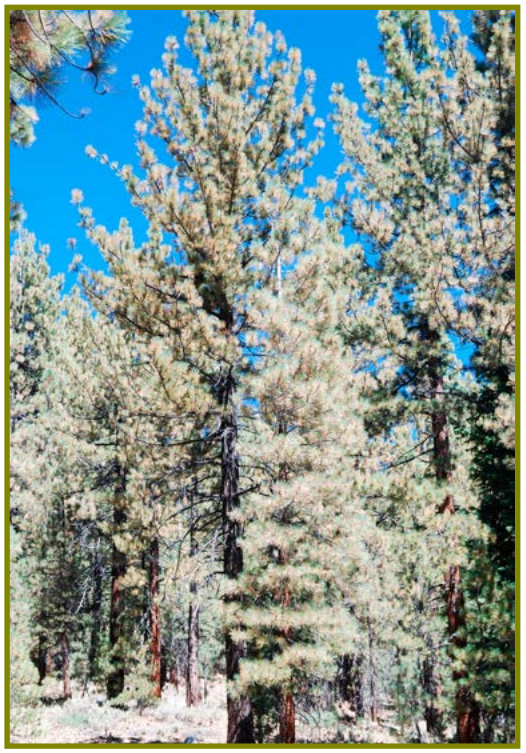
***Ips* sp.**

Over 100 dead trees (mostly ponderosa pine and canyon live oak) were removed from a 25-acre stand along the Crystal Creek Water Ditch Trail at Whiskeytown National Recreation Area (Shasta County) as a result of an *Ips paraconfusus* infestation. Most of the mortality occurred in the first 200 ft. of a steep trail along two switchbacks. This is a popular hiking and biking trail, including a clean-out house at the second switchback. The clean-out house is a water-powered rotary rake that removes pinecones, leaves, and other debris from flowing water before it tunnels under Hwy 299, east to the historic Camden House (1/2 mile away). Mortality began when issues at the diversion dam (across Crystal Creek) required the ditch water to be turned off in 2013. The water issue has yet to be fully resolved, causing the ditch to remain dry for the past two years.

In January, an inspection of ponderosa pine at Siskiyou Lake Campground (Siskiyou County) identified approximately 40 trees either recently dead or with top kill. Mortality started in the summer of 2014 in tree tops and progressed to small groups of trees being killed by the end of the season. *Ips paraconfusus* was recovered from the boles of smaller trees, while WPB and red turpentine beetle were recovered from larger trees. *I. paraconfusus* and red turpentine beetle were commonly found on trees killed by the WPB. *I. paraconfusus* was also responsible for top kill in mature ponderosa pines and mortality of smaller diameter trees.

California five-spined *Ips* killed high numbers of Jeffrey pine on the Mt. Pinos Ranger District, Los Padres National Forest, and Sawmill-Liebre Ridge, Angeles National Forest. Small, isolated pockets of mortality of low-elevation, small-diameter trees were scattered on Laguna Mountain of the Descanso Ranger District, Cleveland National Forest, and thousands of acres of pinyon *Ips*-related single-leaf pinyon pine mortality occurred on the Mt. Pinos Ranger District, Los Padres National Forest. Tree mortality has been persistent in these stands for several years as a result of the drought. Jeffrey pines on the east slope of the Inyo National Forest (Mono County) were killed by pine engravers rather than Jeffrey pine beetle (JPB). Several group kills averaging about 20 acres each were found in the Antelope Valley area (Mammoth Ranger District), with 10 in. and smaller diameter trees completely riddled with pine engravers and larger trees killed by a combination of engraver beetles and JPB. Various life stages of pine engravers found under the bark indicated that larger Jeffrey pine trees were attacked by multiple generations during the summer.

Pinyon *Ips*-associated mortality expanded in the lower eastern Sierra Nevada range south of Bishop. Bureau of Land Management wilderness areas (Chimney and Owens Peaks) east of Sequoia National Forest have experienced widespread mortality since 2013. Mortality swaths 100 acres in size were observed in Mazourka Canyon (Inyo Mountains) and in lower stands around Alabama Hills (Lone Pine Ranger District, Inyo National Forest). The die-off was concentrated in drier, south-facing slopes and mature dense stands. Nearly 90 percent of mature trees were attacked, with smaller diameter trees within the same stands also dying. Scattered outbreaks of pinyon needle scale (*Matsucoccus acalyptus* Herbert) were severely affecting pinyon pine regeneration (trees under five ft.), causing some mortality in locations where pinyon *Ips* were not active



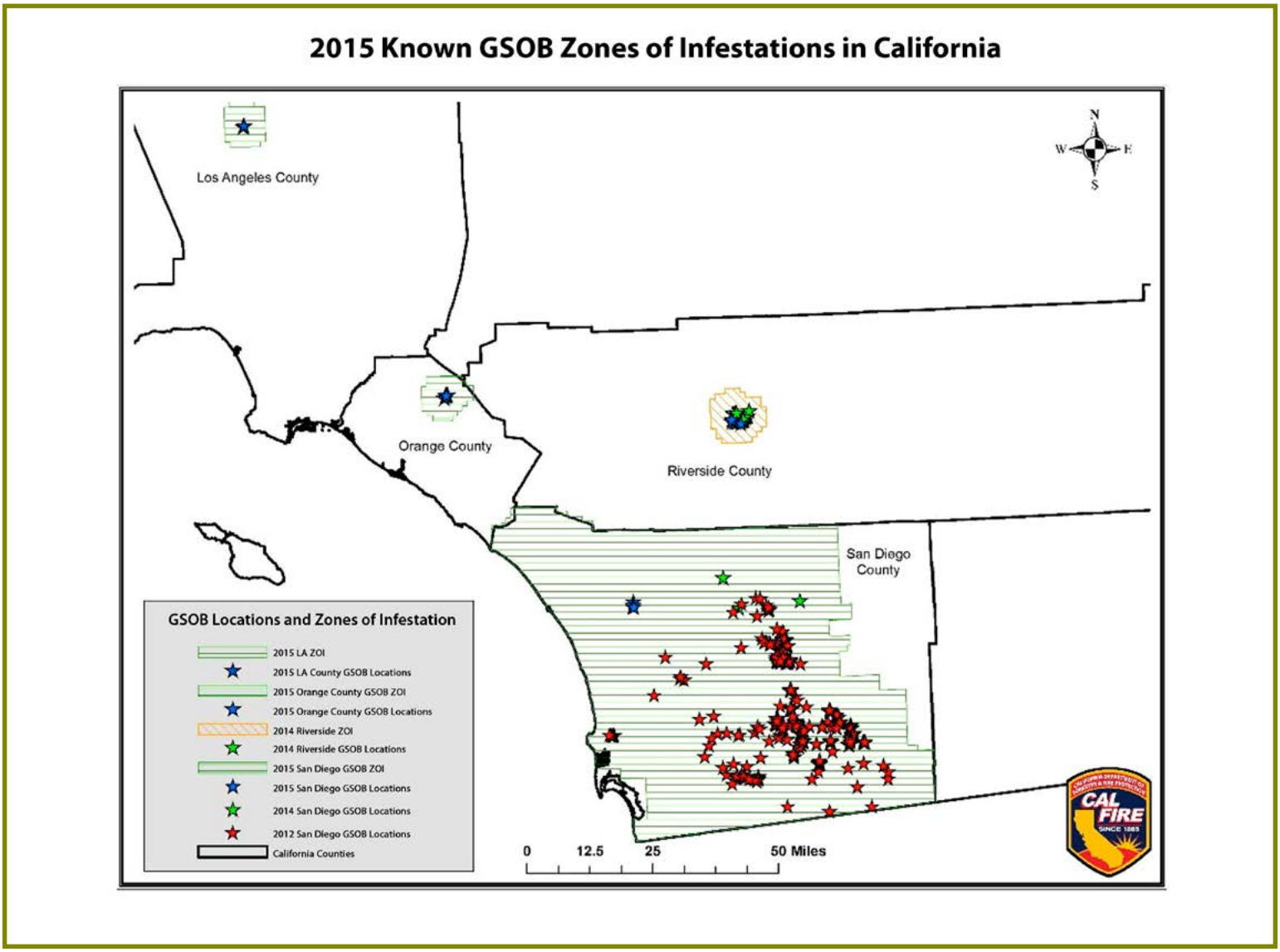
Jeffrey pine needleminer in Jeffrey pine, Hope Campground, August 2015.
Photo by: B. Bulaon, USFS

Jeffrey Pine Needleminer (*Coleotechnites* spp.)

A new infestation of Jeffrey pine needleminer (JPNM) was detected in South Lake Tahoe. This was the third outbreak location identified in the Basin since 2012. Conditions within and around the Basin seemed conducive to population increase. Stand conditions where infestations have been found include multiple overstory Jeffrey pines, moderate stocking, and a nearly pure pine component. This new site can be seen along Highway 88 above Crystal Springs Campground (Humboldt-Toyaibe National Forest, Placer County). Needle sampling found a general infestation rate of 50 percent at the site; however, trees were infested to varying degrees. The initial 2013 outbreak located in the Al Tahoe neighborhood, South Lake Tahoe, appeared to have diminished to background levels, but was still detected upon needle inspection of previously infested trees (14 percent of needles were infected). Samples taken in the Pioneer neighborhood in South Lake Tahoe (second site) were found to have a 47 percent infection rate. There the infestation has intensified north around the housing community, but diminished within Forest Service thinned stands south of Pioneer Trail road.

The JPNM infestation along Highway 395 (Inyo National Forest, Mono County) persisted for a second year, with infestation levels similar to the Pioneer neighborhood (South Lake Tahoe). Some trees had lost a significant amount of foliage, but no mortality was detected. The majority of the infestated areas had stand conditions similar to those found in Lake Tahoe. Stand density did not appear to be a factor in JPNM site selection, as stands ranged from widely spaced to very dense with multiple-age classes. Natural predators from Al Tahoe, Pioneer, and Highway 395 needle samples have been reared, but not yet identified.

Invasive Insects



Map of known CA counties with GSOB infestations. Map by: J. Gonzales, UC Cooperative Extension

European Gypsy Moth *(Lymantria dispar)*

There were five European gypsy moths detections in traps in California this year; one male in Hayward (Alameda County); one male in Danville (Contra Costa County); one male in Chula Vista and two males in National City (San Diego County).

GSOB Larvae, Los Angeles Co., August 2015.
Photo by: K. Corella, Cal Fire

Goldspotted Oak Borer (*Agrilus auroguttatus*)

The goldspotted oak borer (GSOB) continued to kill thousands of coast live oaks and California black oaks in 2015. A new infestation was discovered in San Diego County north of Escondido. A majority of the county's oak woodlands are now considered to be infested. In the mountain community of Idyllwild (Riverside County), the number of impacted trees increased to more than 100, and infested oaks were found for the first time on adjoining San Bernardino National Forest land. The Orange County Weir Canyon infestation remained localized, but increased to approximately 180 trees. In August, GSOB was detected for the first time in Los Angeles County, approximately 130 miles north of the original San Diego County infestation. This well-established, isolated infestation is in the rural canyon community of Green Valley on private land within the Angeles National Forest and less than 30 miles from the Los Padres National Forest. The beetle is now in four southern California counties with infested trees confirmed on two national forests (Cleveland, San Bernardino), and two other national forests are at immediate risk (Angeles, Los Padres). Long-distance GSOB spread is believed to be the result of infested firewood movement. Efforts to slow GSOB spread via infested firewood movement as well as to minimize impacts in infested areas are ongoing.

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

Since 2010, the polyphagous shot hole borer (PSHB) was thought to be the only exotic shot hole borer impacting southern California. However, in 2015, genetic analysis of the beetle population found that the San Diego population was actually a unique, yet closely related *Euwallacea* species. Consequently, there are now two exotic *Euwallacea* species confirmed in southern California: the PSHB (Vietnam origin) and the Kuroshio shot hole borer (KSHB; Taiwan origin). Each species has its own unique symbiotic fungal pathogens that it farms for food in reproductive hosts (support beetle rearing). These fungi grow in tree tissue, clogging the vascular system, and thereby minimizing the tree's ability to transport food and water, ultimately leading to tree stress and sometimes death. PSHB currently has 38 known reproductive host species and KSHB has 14; more may be added as research continues. Reproductive hosts are often riddled with holes from beetle activity, compromising tree structural integrity and health. Hosts include native tree species, common ornamental plants, and agriculturally important species, such as avocado.

Kuroshio shot hole borer holes in CA sycamore (bark removed) females present and fungal discoloring of the wood, Tijuana River infestation, San Diego Co., December 2015.
Photo by: K. Turner, USFS

Polyphagous shot hole borer infestations have become fairly extensive in Los Angeles and Orange Counties with much smaller distributions in San Bernardino and Riverside Counties. In late 2015, PSHB adults were found for the first time in Ventura County traps near Santa Paula and Ojai. KSHB distribution has been almost exclusively in San Diego County, though some adults were recovered for the first time in 2015 from a trap in eastern Orange County, near a wood yard and in close proximity to a known PSHB infestation. In October 2015, KSHB was found infesting vegetation in the Tijuana River Valley Regional Park. Infested trees have become hazard trees in some areas of the park; eight to 12" DBH trees are failing due to infestation. Over 144,000 plants are estimated to be infested/dead. In San Diego County alone over 58,000 acres of riparian woodlands are at risk. PSHB and KSHB are readily spread to new areas through the movement of infested wood. Drought does not appear to be a contributing factor to beetle success as these borers thrive in riparian and well-watered trees.

By Tom Smith

Abiotic Diseases and Complexes

Heat, Drought, and Sun Damage

In 2015, many blue oaks at the northern end of the Sacramento Valley began shedding leaves in early July as a result of the drought. Despite this early initiation of leaf fall, oaks in the area still maintained a relatively full complement of foliage throughout the summer and into the fall. Blue oaks produced a good acorn crop in the northern Sacramento Valley, although many trees growing on harsher, drier sites produced none or few.

Early leaf drop affecting blue oaks near South Yuba River State Park, Nevada Co., July 2015. Photo by: J. Moore, USFS

In the central and southern Sierra Nevada range below the 5,000 foot elevation, almost all tree species displayed severe distress symptoms. Blue, interior, and canyon live oaks were dropping all leaves down to buds or had branch die back. Manzanita and whitethorn (*Ceaonothus* sp.) bushes exhibited dieback and had symptoms similar to burn scars. Large natural stands of knobcone pine on the Stanislaus (Blacks Mountain, Groveland Ranger District) and Sierra National Forests (Bass Lake Ranger District) were killed by pine engravers (*Ips* spp.); however, no insects were noted among many of the dead trees. Numerous acres of knobcone pine mortality have been detected via aerial surveys for the past two years.

Exceptional drought conditions along Paradise Road of the Santa Barbara Ranger District, Los Padres National Forest, caused coast live oak mortality, with ground surveys only identifying secondary insects and no pathogens. Other drought-related hardwood mortality was limited within southern California, where ground surveys confirmed that oaks and alders succumbed more frequently than other species.

Incense cedar, Pine Lake, Sequoia National Forest, July 2015. Photo by: B. Bulaon, USFS

Widespread incense cedar mortality in the southern Sierra Nevada range exemplified the severity of the drought. Incense cedars of all size classes shed older needles throughout their crowns, with many trees dying without any evidence of insect or disease activity. Cedars in Sequoia National Forest were fading in large groups along hillsides, campgrounds, and roadsides. At the entrance of Road 23S05 from the town of Pine Flat (Western Divide Ranger District, Sequoia National Forest), cedars of all sizes were dying. Insect damage or root disease was not detected regularly enough in dead trees to determine if they were the primary cause of decline; however, secondary agents were commonly found finishing off dying and severely stressed trees. Pinehurst (Hume Lake Ranger District, Fresno County) continued to have cedar mortality in addition to large-scale ponderosa pine mortality. South-facing dry slopes along Highway 180 and Kings River had scattered cedars dying alongside dead ponderosa pines and stunted or dead canyon live oaks.

Twig and branch dieback in the lower crowns of white fir was common in some areas of McCloud Flats, Siskiyou County. Inspection of branches showed no distinct regions of dieback as would be expected if caused by beetles or fungal infection. Necrotic patches within the inner bark and cambial region were diffuse and ill-defined, suggesting an abiotic cause such as drought stress. While the damage was pervasive in some stands, it did not appear severe enough to threaten tree health.

Mature ponderosa pines within the boundaries of the 2014 Beaver Fire (Siskiyou County) exhibited foliage heat damage that was not directly related to the fire, including brown and stunted green needles intermixed on new shoots in the upper crowns. The terminal shoots typically had the most severe symptoms, often appearing devoid of needles. Close inspection of the shoots revealed foliage tips that appeared scorched. Stunted needles were the result of burned tips abscising. Shoots and buds were green and healthy. It is suspected that the needle scorching occurred prior to the needles fully maturing, perhaps during the unusual and rapid onset of high temperatures in June.

Ponderosa pine with needles presumably damaged by record high temperatures in early summer, Siskiyou County, September 2015. Photo by: D. Owen, Cal Fire

At a Christmas tree farm in Happy Valley, Shasta County, a variety of trees experienced some level of sun damage, resulting in needle and twig dieback on the southwest side of tree crowns. The damaged trees were seven years old and included Douglas-fir, Turkish fir, blue spruce, and Scots pine. This was the first time such damage had occurred. Probable contributing factors were drought, reduced irrigation due to water cutbacks by the local water district, and hotter than normal summer temperatures.

Oak trees throughout southern California have been experiencing leaf drop, extreme crown thinning, and dieback due to the ongoing drought. Oaks on the north slopes, in valleys, and in lowlands appeared to be affected more severely than those on southern slopes or harsher locations. Trees in San Luis Obispo and Santa Barbara Counties experienced California oakworm and oak twig girdler infestations. These insects typically do not seriously affect trees; however, in combination with the extreme drought, oak tree health was being affected.

Fire Damage

Many trees that survived recent fires (since 2013) were attacked by bark beetles in 2015. In the Aspen (2013) and French Fires (2014) on the Sierra National Forest, it was estimated that 30 percent of the trees that survived were killed by bark beetles in 2015 (Ramiro Rojas, 2015). Much of the mortality did not appear until late summer, post-bud break. Entire stands of ponderosa pine, sugar pine, and white fir appeared to fade rapidly following insect attack. White firs were heavily attacked by secondary woodborers and ambrosia beetles, with trees emitting little to no pitch. Ponderosa pines with low crown or bole scorch (trees that would have survived during average precipitation years) were overwhelmed by western pine beetles and red turpentine beetles. Sugar and ponderosa pines of all sizes in moderately burned areas of the Rim Fire (Groveland Ranger District, Stanislaus National Forest, 2013) succumbed to insect infestation, and large numbers of ponderosa pine killed in the Frog Fire (2015) were infested with woodboring beetles on the Modoc National Forest. Woodborers were also found in many trees in older fires, such as the 2012 Reading Fire on the Lassen National Forest. Wildfires combined with drought predisposed trees to subsequent insect attacks.

California five-spined *Ips* killed small-diameter Jeffrey pine following two prescribed fires on the Descanso Ranger District, Cleveland National Forest. Mortality was limited to trees with high levels of crown scorch (>95 percent). Western pine beetle continued to kill Coulter pine injured by the Mountain Fire on the San Jacinto Ranger District, San Bernardino National Forest. Tree mortality levels were likely higher than expected in the burned areas due to the ongoing drought.

Hail Damage

Hail damage to white fir was reported in the vicinity of Lower Forni, east of Wrights Lake Road in El Dorado County.

Blowdown

A major blowdown event occurred on the Lassen National Forest in Lassen and Shasta Counties on February 6th, taking down trees across 16,311 acres. High southerly winds affected low-lying areas with sustained speeds of 50 to 65 mph for over 12 hours. Most of the blowdown occurred on the eastside of the forest in ponderosa, Jeffrey, and lodgepole pine stands, where primarily larger diameter trees (>18 in. dbh) were uprooted or snapped off. Many trees that managed to stay upright were “root sprung” (roots were pulled away from the soil and rock in which they were embedded) or suffered other structural damage that has left them leaning or bent over. Most of the affected area sustained losses of about one large tree per acre, but some stands lost up to 20 per acre. High concentrations of blowdown were found along edges of openings such as meadows and sagebrush flats and within recently thinned areas where residual trees lacked wind firmness. No injuries or fatalities were reported, but wind-thrown trees did hit several structures, power and phone lines, and closed portions of CA State Highways 44 and 89 between Susanville, Old Station, and Hat Creek.

Jeffrey pine blowdown, Lassen National Forest., February 2015. Photo by: D. Cluck, USFS

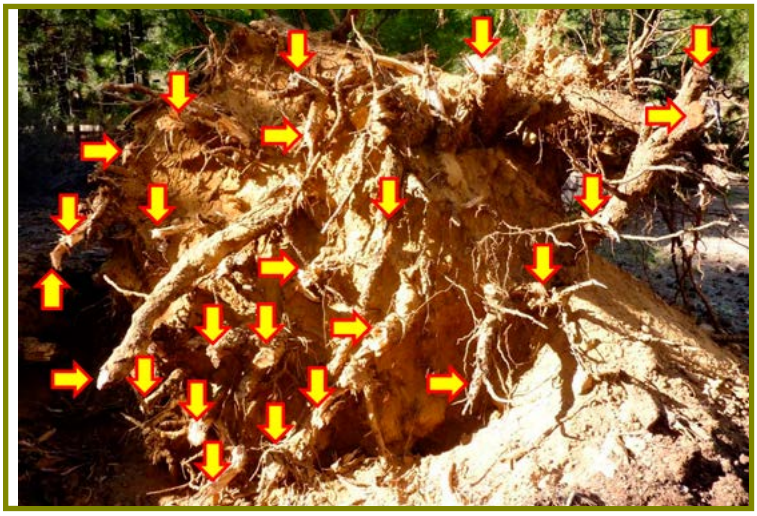
While smaller blowdown events have occurred in this region, an event covering this much area had not been recorded. Lassen National Forest personnel are working to remove downed and standing hazard trees from recreation and administrative sites as well as along highways and county roads. Once finished, work will focus on making major forest roads accessible and preparing the most impacted areas for timber sales to remove downed material.

Native Diseases

Black Stain Root Disease (*Leptographium [Ophiostoma] wageneri*)

Black stain root disease was observed in many locations throughout the north coast on both dead and declining Douglas-fir of all class sizes. Infested locations included South Fork Road, south of Highway 299 (Trinity County); several sites along Highway 299 between Willow Creek and Berry Summit (Humboldt County); Buck Mountain along Highway 36 (eastern Humboldt County); South Fork Mountain (eastern Trinity County); Humboldt Redwoods State Park near Miranda (southern Humboldt County); Baechtel Road east of Willits (Mendocino County); Boggs Mountain Demonstration State Forest (Lake County); and Armstrong Redwoods State Park (Sonoma County).

Heterobasidion Root Disease (*Heterobasidion irregulare* and *H. occidentale*)



Roots of uprooted ponderosa pine showing decay (yellow arrows), Hat Creek Campground, Lassen National Forest, March 2015. Photo by: B. Woodruff, USFS

On February 6th, a severe windstorm uprooted thousands of conifers between Lassen Volcanic National Park and Eagle Lake on the Lassen National Forest. US Forest Service aerial survey personnel mapped 16,311 acres of blowdown and estimated that 71,000 trees were blown down or broken by the storm (see section on Blowdown). Roots of some of the blowdown trees were found to have decay caused by *Heterobasidion irregulare* (ponderosa and Jeffrey pine) and *H. occidentale* (white fir) in Ashpan Snowmobile Park. Ponderosa pine also had *H. irregulare* near the western extent of the blowdown in Hat Creek Campground and south of Eagle Lake near the eastern extent of the blowdown. White fir root decay varied in severity throughout the blowdown area depending on the location. Root decay was never observed in uprooted lodgepole pine.

Marssonina Leaf Spot or Blight of Aspen (*Marssonina* sp.)

Nearly all quaking aspen stands on the Plumas and Lassen National Forests were infected with Marssonina leaf spot to varying degrees due to wetter than normal conditions in late spring/early summer. Stands that were severely infected early in the year were able to partially re-foliate by mid-summer. Other heavily infected stands lost most of their leaves by the end of August without any re-foliation. This disease was also reported on aspen in the Warner Mountains, Modoc National Forest, and on the Lake Tahoe Basin Management Unit, Lake Tahoe.

Marssonina leaf blight, Lassen National Forest, September 2015. Photo by: D. Cluck, USFS

Miscellaneous Leaf Diseases

Dieback of bigleaf maple was evident along Highway 299 east of Berry Summit (Humboldt County) and Highway 20 west of Willits (Mendocino County). *Neonectria* sp. was consistently isolated from black-stained sapwood in diseased maples. Additionally, *Tubakia* sp. and another unidentified fungus were consistently isolated from tanoaks with twig dieback at several locations along Highway 299. It is suspected that many of these dieback fungi are opportunistic endophytes capitalizing on drought-stressed trees.

Mycosphaerella foliar pathogens were evident throughout the north coast following late winter rains. Madrone leaf blight caused by *M. arbuticola* was visible along roadsides, and red band needle blight caused by *M. pini* affected non-native, planted pines. Both of these pathogens made tree crowns very unsightly, killing up to two-thirds of the pine foliage and the entire complement of madrone foliage; however, by late summer most trees had recovered and were entirely green. Other foliar pathogens of note included *Cylindrosporium kelloggii* on black oak in inland areas throughout the region and an unidentified *Cylindrocladium* species

California bay laurel affected by unidentified *Cylindrocladium* sp. Armstrong Redwoods State Park, Sonoma County, May 2015. Photo by: C. Lee, Cal Fire

on California bay laurel causing thinning crowns and, in some cases, killing entire branches.

Exotic Diseases

Foamy Bark Canker of Oaks (*Geosmithia pallida*)

Foamy bark canker was found in San Bernardino County on a California black oak in Crestline. This is the first time black oak has been formally confirmed to be a host of the fungus via laboratory confirmation and the first time the fungus has been found in San Bernardino County.

Foamy bark canker was confirmed on various native oak species (California black oak, valley oak, and canyon live oak) in an urban setting near Folsom Lake in the Sacramento Valley. A dead oak had been cut for firewood and attracted native oak bark beetles that then spread to live trees and introduced the fungus. All of the trees were under drought stress.

Fusarium Dieback (*Fusarium* sp.) Associated with Polyphagous and Kuroshio Shot Hole Borers (*Euwallacea* sp.) **See page 11.**

Maple Leaf Scorch (suspected *Xylella fastidiosa*)

Maple leaf scorch on big leaf maple remained a problem in 2015, with the onset of symptoms occurring at least a month later than in 2014. The disease is thought to be caused by the xylem-limited bacterium *Xylella fastidiosa* and unidentified xylem-feeding insects. Lab screening for *X. fastidiosa* DNA from scorched big leaf maple leaves had little success in 2015. It is unknown how much of the leaf scorch is caused by *X. fastidiosa*, how much is caused by insects, and how much is caused by a combination of the two. Drought likely contributed to the scorch observed.

Needle Necrosis on True Fir (*Sydowia polyspora*)

The fungus *Sydowia polyspora* was identified as the cause of white fir needle necrosis at a Christmas tree farm in Camino, El Dorado County. Current-year needles had brown tips or browning that started near the middle of needles, but did not extend completely to the tips. Some needles with advanced symptoms also had dark (nearly black) staining within dead tissue in the middle of the needle. Older needles were not damaged. Affected trees comprised roughly 10 percent of the plantation and usually were grouped together. This fungus also causes twig dieback in white fir and a number of other conifer species.

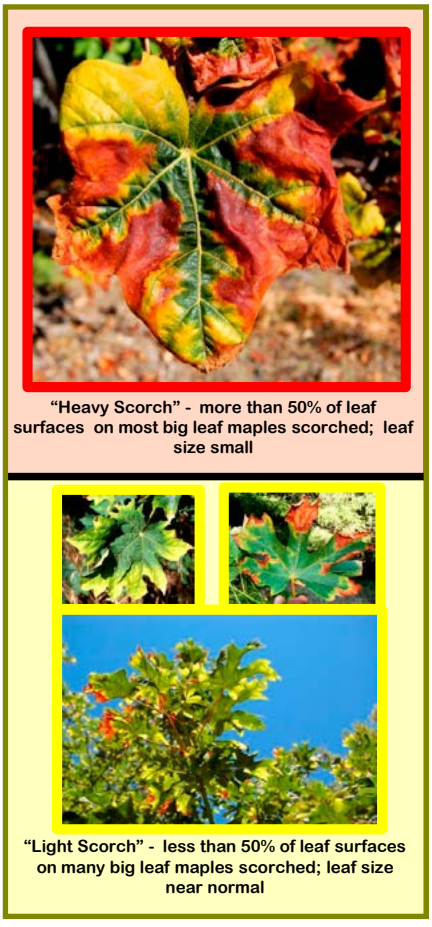
***Phytophthora* Species in Native Plant Nurseries**

Between 2014 and 2015, nearly 1,200 samples taken from native plant nurseries and restoration sites in 16 counties were submitted to the California Department of Food and Agriculture (CDFA) Plant Pest Diagnostics Lab for *Phytophthora* sp. testing. In addition to *P. tentaculata* (see *P. tentaculata* entry below), more than a dozen additional *Phytophthora* species were found infecting native plant species, including those in the *Artemesia*, *Ceanothus*, and *Arctostaphylos* genera. *P. cactorum* was the most common species, accounting for 30 percent of the *Phytophthora* detections. Other species detected included *P. cryptogea*, *P. nicotianae*, *P. hedraiandra*, *P. megasperma*, *P. multivora*, *P. cinnamomi*, and *P. cambivora*. Many of these *Phytophthora* species/native plant associations have not been previously documented. Pathogenicity experiments will need to be completed before proof of pathogenicity for each *Phytophthora* sp. and host is confirmed.

Phytophthora tentaculata

Phytophthora tentaculata was discovered for the first time in the US in a California native plant nursery in 2012. It has since been detected in eight additional California native plant nurseries in seven counties and in outplanted nursery stock at six restoration sites (in three counties). Of the eight counties with pathogen detections, three were newly detected in 2015.

Worldwide, *P. tentaculata* has been reported on woody and semi-woody perennial hosts in



2015 maple leaf scorch.
Photos by: B. Woodruff, USFS

Root and stem rot caused by *Phytophthora nicotianae* on container grown California bee plants, October 2015.
Photo by: Suzanne Rooney-Latham, CDFA

Root, stem and foliar infection caused by *Phytophthora hedraiandra* on a container grown manzanita plant, January 2015.
Photo by: Suzanne Rooney-Latham, CDFA

Root and crown rot caused by *Phytophthora tentaculata* on a container grown sticky monkey flower plant, December 2015.
Photo by: Suzanne Rooney-Latham, CDFA

the Asteraceae, Ranunculaceae, Lamiaceae, Rhamnaceae, Phrymaceae, Rosaceae, and Verbenaceae plant families. It has not been detected on any tree species. In California, it has been detected on nursery-grown native plant species, including California mugwort, tarragon, California sagebrush, buckbrush, sticky monkey flower, coffeeberry, toyon, coyote mint, and sage. It is currently listed as a USDA Animal and Plant Health Inspection Service Actionable/Reportable pest.

Pitch Canker (*Fusarium circinatum*)

In many locations where pitch canker was prominent, the disease has become much less conspicuous. This includes the Monterey Peninsula, where the number of new infections on Monterey pine has been monitored in six plots (50 trees each) since September 2011. The 2015 survey identified 14 new infections. No trees had more than a few infections and none were severely injured.The low number of new infections continued a downward trend that has been apparent since 2012. In part, the diminished impact of pitch canker can be attributed to systemic-induced-resistance, which renders trees less susceptible to pitch canker following their initial exposure to the pathogen. This seems to be a general pattern where pitch canker has affected Monterey pines. The initial impact is severe and some trees are killed by the disease, but over time the impact moderates and many diseased trees recover completely. However, this pattern has not yet been observed at Pt. Reyes National Seashore, where Bishop pines continued to sustain high infection rates. Injury caused by pitch canker was especially evident in areas that were burned in the Mount Vision Fire (1995). Pitch canker also continued to be a problem in some Christmas tree farms. There is no evidence of the disease becoming established on the coast north of Sonoma County, nor in the Sierra Nevada range.

Port-Orford-Cedar Root Disease (*Phytophthora lateralis*)

Port Orford-cedar root disease continued to infect and kill Port Orford-cedar in various locations along the main channel of Willow Creek, east of Berry Summit in Humboldt County.

Seiridium Canker (*Seiridium unicorne*)

Seiridium canker was significant on Monterey and Leyland Cypress in windbreak plantings throughout Santa Barbara, San Luis Obispo, and Kern Counties. Girdling cankers led to tip and progressive branch dieback, with individual and multiple branches fading from green to yellow to reddish-brown. The pathogen spread to nearby trees due to their close proximity.

Sudden Oak Death (*Phytophthora ramorum*)

Although *Phytophthora ramorum*/sudden oak death continued to cause mortality in tanoak and susceptible oak species within California's 15 infested coastal counties, the ongoing drought moderated its impacts, with 60,000 acres of mortality detected in 2015. Where environmental conditions were conducive to pathogen establishment and intensification, high levels of infection continued to manifest, such as the coastal mountains of Santa Cruz and Sonoma Counties. Where the pathogen is established in the drier east, relatively little new mortality was detected.

Bishop pines affected by pitch canker, Pt. Reyes National Seashore, January 2016. Photo by: T. Gordon, UC Cooperative Extension

New infested watersheds in California were limited to the north coast, including five locations in Humboldt County and two in Mendocino County, all of which were relatively close to watercourses previously known to be infested. The most significant of these finds was in Redwood Creek (Humboldt County), about nine miles upstream of the nearest known infestation in the watershed. Early aerial detection efforts covering the upper Redwood Creek watershed did not identify tanoak mortality associated with *P. ramorum*.

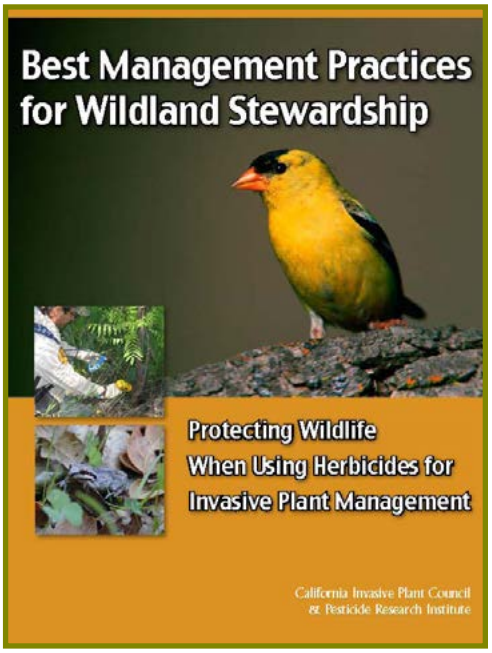
In the more consistent environmental conditions of coastal Oregon, *P. ramorum* was observed infesting part of the Winchuk River watershed only 1.5 miles north of the Del Norte County (CA) border. Further north in Curry County (OR), the EU1 pathogen lineage was recovered for the first time in the US from wildland vegetation. This isolate came from a single tanoak and was genetically similar to EU1 isolates from a nearby nursery (now closed) where infected ornamentals were previously found. The discovery of this lineage in the wild raises concerns about genetic recombination between it and the prevalent NA1 lineage in forests, with the resulting possibility of future novel *P. ramorum* characteristics and behaviors.

Phytophthora ramorum was found infecting five new host plants in California forests in 2015: chinquapin, chaparral-pea, Bolinas manzanita, Eastwood's manzanita, and the native California blackberry. Symptoms varied from leaf spots to branch dieback; no mortality was observed. In Washington, red huckleberry, which is also present in northwestern California, was also confirmed as a new host.

By David Bakke

New Best Management Practices Available Soon

The California Invasive Plant Council will soon be publishing the third in a series of Best Management Practices guides, titled “Best Management Practices for Wildland Stewardship: Protecting Wildlife When Using Herbicides for Invasive Plant Management.” It will include techniques used by experienced land managers as well as accessible toxicology information for herbicides commonly used in natural areas. This document is the result of a multi-year collaborative effort by many individuals and organizations in California.



Best Management Practices for Wildland Stewardship: Protecting Wildlife When Using Herbicides for Invasive Plant Management, courtesy of California Invasive Plant Council.

New or Newly Naturalized Invasive Plant Species in California

Volutaria tubuliflora **(Mediterranean desert knapweed, Egyptian knapweed) -** Initially found in San Diego County in 2011 near Borrego Springs, a new population was discovered in 2015 in Upper Newport Bay, Orange County. Native to southern Europe and northern Africa, eastward to the Arabian Peninsula, it likely arrived in California via Chile from Morocco (based on the white-flowered form found in Morocco, Chile, and California). This annual plant germinates with fall/winter rains, can quickly grow 3 - 6 ft. high, and is a prolific seeder.

Berteroa incana **(hoary cress or hoary alyssum)** – Native to Eurasia, this plant is widespread in North America, but rare in California. While known to be present in Lassen County for several years, a new site was found in 2015 near Alpine Meadows Ski Resort, Placer County. A member of the mustard family, this annual to short-lived-perennial forb is mostly found in disturbed sites. It can tolerate winter cold and summer dry periods common in California. As a high percentage of feed, this species can be toxic to horses.

Senecio quadridentatus **(cotton fireweed)** – Native to New Zealand and Australia, this plant is known to be present in San Diego and Santa Barbara Counties. It is a fire-adapted perennial herb found in regions with coastal scrub and chaparral.

Senecio quadridentatus. Photo by: Pieter Pelser, 2010, PhytoImages

Close-up of *Volutaria tubuliflora* flower. Photo by: Tom Chester, http://tchester.org/bd/species/asteraceae/volutaria_canariensis.html

Close-up of *Berteroa incana* flowers. Photo by: H. Zell, 2009, Wikimedia Commons

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.

The report can be found online at http://www.fs.usda.gov/Internet/FSE_DOCUMENTS/fseprd503531.pdf.

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Cover Photo

View from the west shore of Bass Lake, Bass Lake RD, Sierra NF, looking at the east shore, November 19, 2015. Photo by L. Swan, USFS

United States Department of Agriculture

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California Forest Pest Council