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Forest Health Highlights in Oregon—2015

Oregon Department of Forestry
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for the greatest good

Oregon Department of Forestry
Forest Health

Pacific Northwest Region
Forest Health Protection

Forest Health Highlights
In Oregon – 2015

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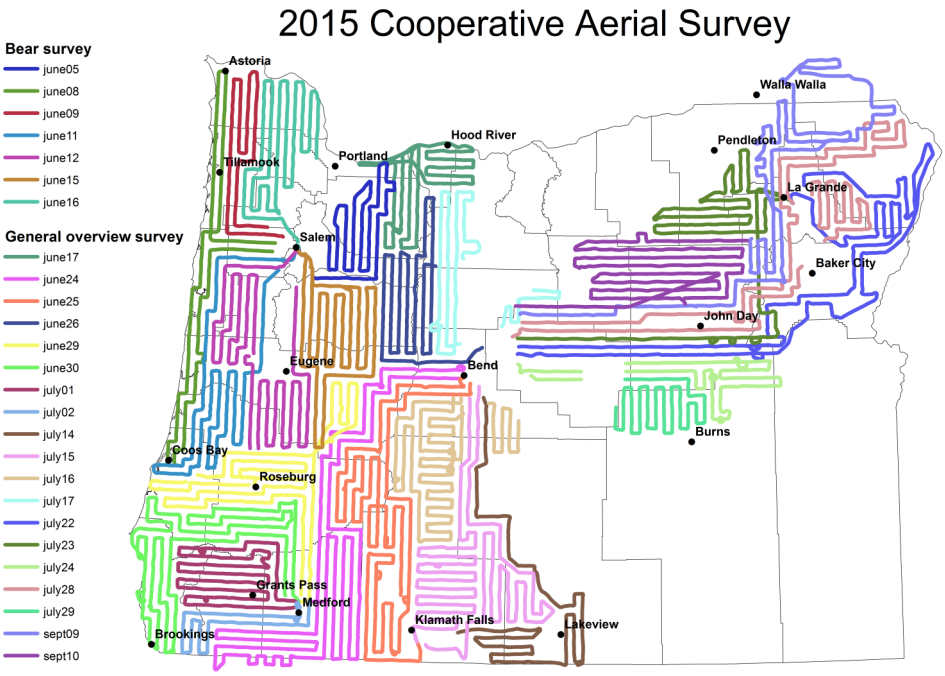

Front cover: *Western tent caterpillar gathered near their webbed tent (Photo by Rob Flowers, USDA Forest Service). An outbreak of this pest occurred in 2015, primarily on alder in Tillamook.*

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Summary

Insects, diseases, and other disturbance agents cause significant tree mortality, growth loss, and damage in Oregon forests each year. Large outbreaks can affect the function and resilience of forest ecosystems and may contribute to hazardous forest fire conditions. However, these agents also play a critical role in maintaining healthy, functioning forests by contributing to decomposition, nutrient cycling, and creating openings that enhance forest diversity and wildlife habitat. **A healthy forest is never totally free of damaging insects, diseases, and other disturbances.**

Oregon's forests cover approximately 30 million acres of the state and consist of federal (60%), private (35%), state (3%), tribal (1%), and other public (1%) ownerships. Western Oregon is characterized by high rainfall and dense conifer forests along the Pacific coastline, the Coast Range, and western slopes of the Cascade Range. Eastern Oregon largely consists of lower density, semi-arid forests and high desert. Statewide forest cover is dominated by conifers such as Douglas-fir, true firs, western hemlock, and ponderosa pine. The most abundant hardwoods are big leaf maple, red alder, Oregon white oak, and cottonwoods.

In 2015, **1.68 million trees were recently killed by insect, disease or bear damage across an area of over 698,000 acres,** as was identified by aerial survey. Acres of mortality have increased for a second consecutive year:

2014: **661,000 acres** 2013: **530,000** 2012: **615,000** 2011: **1.09 million**

2015 was the warmest year on record, which along with limited snow pack, intensified drought conditions. This drought resulted in direct tree mortality and conditions favorable to wildfire. **Over 2,500 fires occurred in Oregon in 2015, damaging more than 685,000 acres. Over half of these fires were human-caused.**

Bark beetles such as Douglas-fir beetle, mountain pine beetle, western pine beetle, *Ips* and fir engraver contributed the majority of insect-related tree mortality. Other than an isolated outbreak of western tent caterpillar, native defoliators remained at endemic levels. Sap-sucking insects such as balsam woolly adelgid and black pineleaf scale continued to be a chronic problem in areas where they have become established. For invasive insects being monitored for entry into Oregon, emerald ash borer has not yet been detected although gypsy moth was detected and a multi-agency action plan is underway to address Asian gypsy moth finds in the Portland metro area.

Sudden oak death and Swiss needle cast continue to spread in their respective areas. Douglas-fir was plagued by two "new" foliar diseases—web blight and Phytophthora needle cast. Pacific madrone recovered from leaf blight throughout its range.

Bear damage increased but damage distribution appears to be more diffuse across the landscape, relative to previous years.

Surveys

Determining the extent and severity of forest damage from insects and diseases through surveys is an important step in prioritizing and planning management and other actions. The Oregon Department of Forestry (ODF) works cooperatively with the USDA Forest Service (USFS) and other organizations to annually monitor forests in Oregon. Aerial and ground surveys are used to detect and evaluate forest conditions throughout the state. This report provides an overview and summary for many of the major agents observed during 2015. Additional information on these and other agents can be found on the ODF and USFS websites or from the forest health professionals listed at the end of this report.

Forest Resources, Inventory and Analysis

The USDA Forest Service Forest Inventory and Analysis (FIA) program monitors change to Oregon's forests through ground surveys within a national grid of permanent plots. A systematic sub-sample of the plots in Oregon are measured annually until each has been inventoried. Each plot is measured once during the 10 year sampling cycle. FIA plot data are comprehensive and include quantitative measurements of forest condition and health, and often identification of damaging agents that cannot be observed using aerial surveys (Figure 1).

PNW Forest Inventory and Analysis

Figure 1. *USDA-FIA monitors permanent plots in Oregon to analyze trends over time.*

For more information, visit:
http://www.fs.fed.us/pnw/rma/fia-topics/index.php

Statewide and Special Aerial Detection Surveys

Aerial surveys of forest health conditions have been conducted in Oregon annually since 1947. Statewide and special aerial detection surveys for Swiss needle cast and sudden oak death covered over 41 million acres in 2015 using both fixed-wing aircraft and helicopters.

Surveyors use a digital sketch-mapping computer system to record all visibly affected areas in the form of polygon or point data (Figure 2). All figures are coded with the damaging agent(s) based on surveyor knowledge and training in identifying characteristic signatures. These methods provide for faster data acquisition and improved sharing of survey findings at a lower cost than using other remote-sensing techniques.

GIS data, reports, digital and paper maps from surveys are provided to cooperators and other interested parties and are available on the agency websites listed at the end of this report.

Robbie Flowers, USDA Forest Service

Figure 2. *The statewide aerial survey of forest health in Oregon covers over 35 million acres. Other special surveys occur annually.*

Climate and Weather

Drought Conditions Intensify

Oregon normally experiences heavy snow at higher elevations as a result of winter storms. However that was not the case in 2015, as above-average temperatures led to precipitation in the form of rain rather than snow in many high-elevation areas. As a result, snowpack throughout the Cascade Range was well below normal. Snowpack serves as a natural reservoir to support forests and other ecosystems in the summer when water needs are greatest (Figure 3). It is likely that many areas will continue to exhibit the effects of the 2015 drought in spring and summer of 2016.

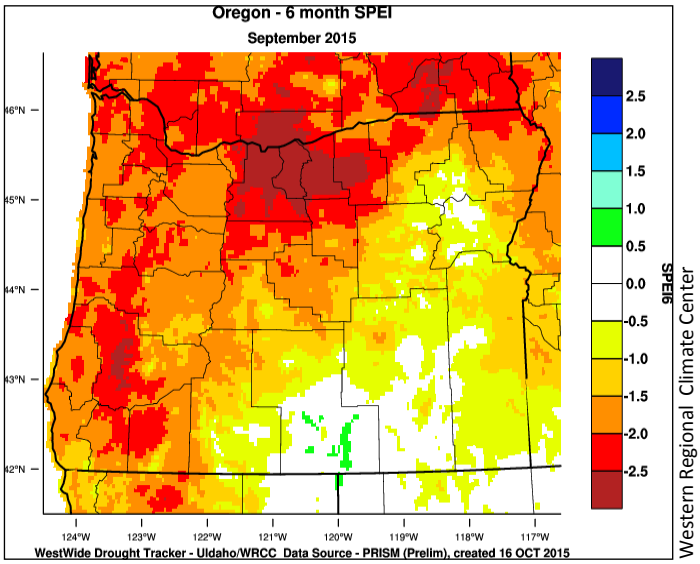


Figure 3. *April-September drought severity index for Oregon.*

Additionally, foliage discoloration (Figure 4) from insect infestations is typically exhibited the season following attack but due to intense drought conditions, this signature may appear within the same season—particularly in Douglas-fir. Heavy rains and mountain snowpack starting in early 2016 may mitigate the stress of recent drought conditions although the current drought cycle is projected to persist in some areas around the state. **Trees growing in overly dense stands or on drought-prone soils are more at risk for moisture stress and increased susceptibility to insects and diseases.**

Winter storms were milder in 2015 than in 2014. An isolated wind event occurred in Lake County resulting in 650 acres of blowdown. The blowdown was primarily mature ponderosa pine; slash from this event may attract pine slash-infesting beetles such as Ips in the spring.

Parch blight, was again apparent in Douglas-fir, western hemlock and western redcedar in areas along the Columbia River Gorge and south to Clackamas River and Mt. Hood districts. Parch blight is caused by dry winter winds, usually from the east, that cause water loss in foliage that exceeds water uptake by roots and results in needle or shoot desiccation.

Bigleaf maple experienced high seed crops in 2015, due to favorable pollination conditions. Drought also likely added to the stress of seed production.


Robbie Flowers, USDA Forest Service

Figure 4. *Drought damage was seen throughout the Willamette valley in Douglas-fir.*

Fire

With a backdrop of drought, low snowpack, and high temperatures, the fire season began early in 2015. Similar to 2014, hot and dry conditions with abundant lightning produced large numbers of fires across southern and eastern Oregon. Across all ownerships in Oregon there were 2,588 fires reported that burned over 685,809 acres in 2015 (Figure 5). There were fewer fires and acres burned in 2015 relative to 2014, but the number of **human-caused fires increased**.

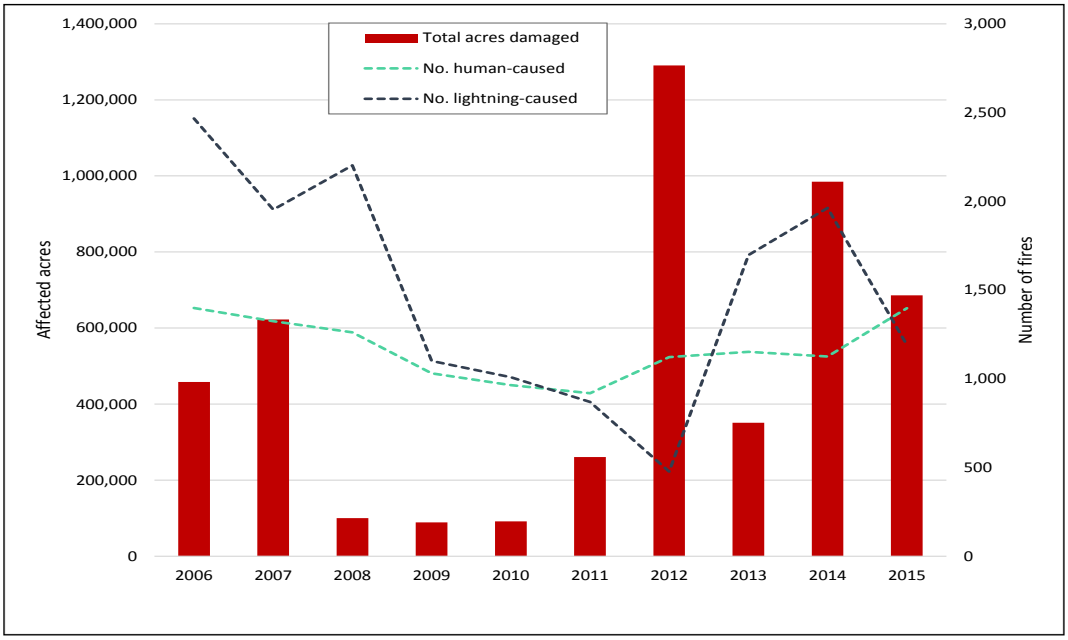


Figure 5. *10-year trend for total acres damaged by wildfire (left axis) and number of human- and lightning-caused fires (right axis).*

Jason Pettigrew, ODF

Figure 6. *Firefighters at the Stouts Creek fire in SW Oregon, which was sparked by a lawn mower and burned over 26,000 acres.*

Although suppression costs were substantial, cooperative efforts among ODF, USFS and Oregon Department of Corrections (DOC) fire crews as well as many other cooperators and contractors minimized the number of large fires (Figure 6).

These cooperative efforts minimized the number of large fires with 92% of fire starts held to 10 acres or less.

Insects

Outbreaks of forest insects occur periodically in Oregon and historically have resulted in significant tree damage or mortality. In 2015, statewide aerial surveys detected 600,000 acres of tree mortality and other damage by forest insects (Figure 7; Figure 8 on next page).

Bark beetles, followed distantly by sap-sucking insects, caused the majority of aerially-detected tree mortality in Oregon forests in 2015. Although total insect-caused mortality in 2015 was below the 10-year average, trends indicate increasing insect damage—particularly from bark beetles.

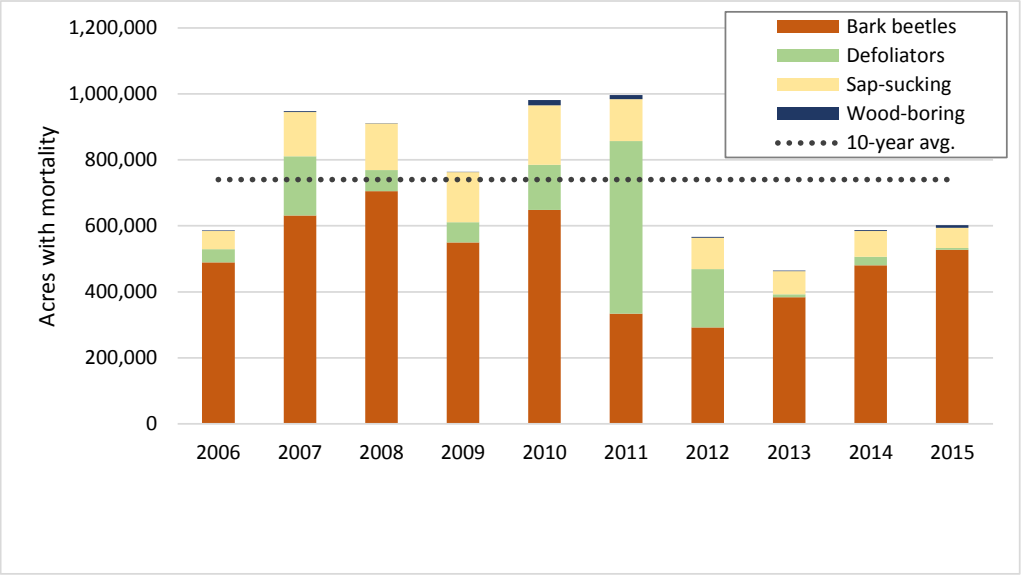


Figure 7. *Ten-year trend for insect damage in Oregon forests.*

The most damaging **bark beetles** as of late include Douglas-fir, mountain pine, western pine, *Ips* and fir engraver beetles. Of these, we saw an increase in tree mortality from western pine, *Ips* and fir engraver beetles in 2015, relative to 2014.

Trends for sap-sucking insects and defoliators reveal slight decreases in tree mortality from these agents in recent years. Infestations of **sap-sucking insects** such as the exotic balsam woolly adelgid and black pineleaf scale continue to be chronic in some areas.

Defoliator outbreaks are often cyclical and isolated. In 2015, western tent caterpillar repeated an appearance in what's likely the end of an outbreak.

Within the **wood-boring beetles** group, the primary mortality-causing species is the flatheaded fir borer. Mortality in Douglas-fir more than doubled from flatheaded fir borer in 2015.

Insect Damage Map

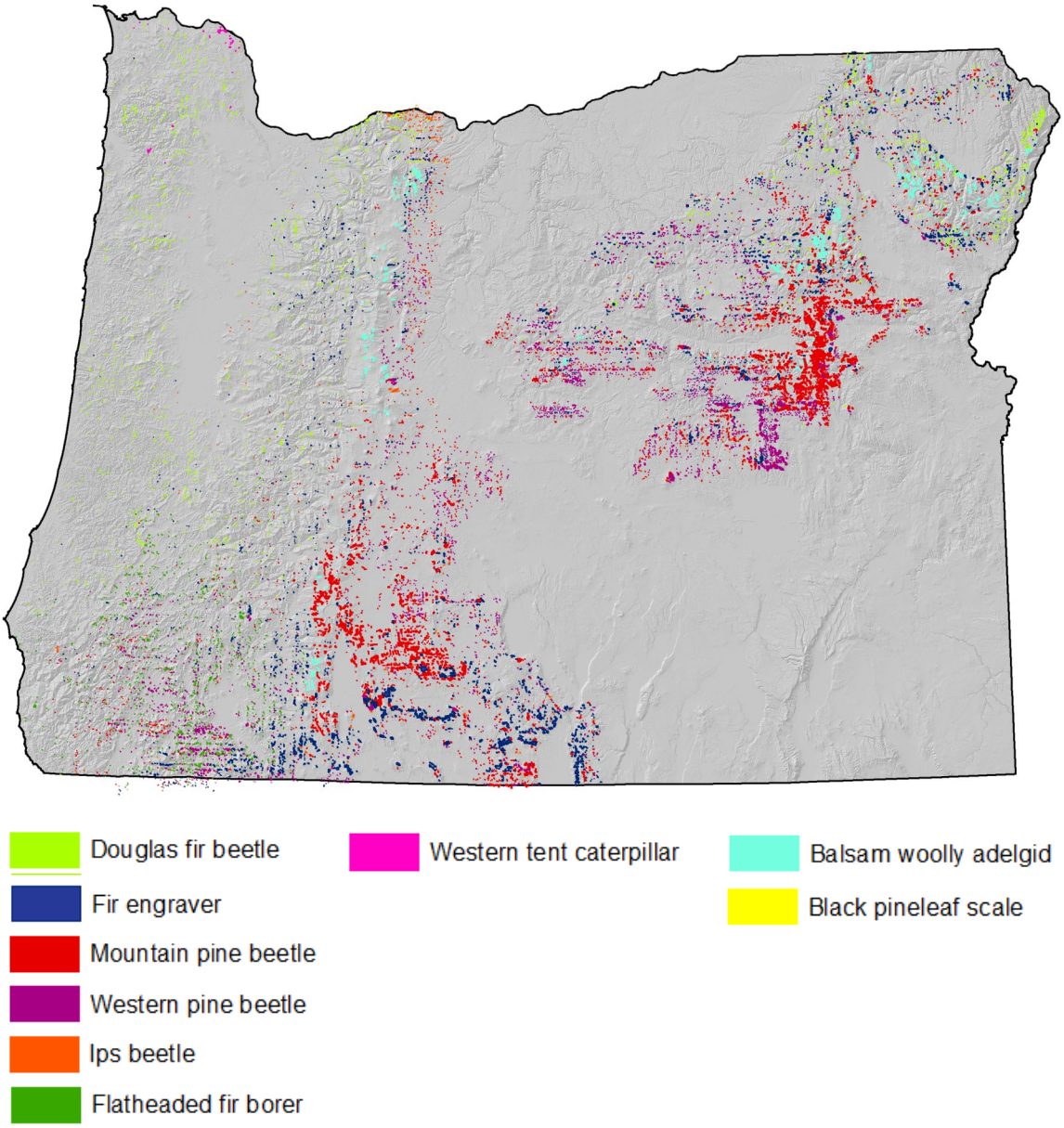


Figure 8. *Map of insect damage from major bark beetle, wood-boring beetle, defoliator and sap-sucking insect agents from the 2015 statewide aerial survey. Map by Christine Buhl, ODF.*

Bark Beetles

Bark beetles are tiny beetles that typically create extensive galleries under bark, which girdle vascular tissues. They may also vector various types of stain-causing fungi and other pathogens, depending on the species. The more significant bark beetles in Oregon forests include Douglas-fir, mountain pine, western pine and Ips beetles. Secondary bark beetle pests that may become more problematic in heavily stressed areas include Douglas-fir pole beetle, Douglas-fir engraver beetle, fir engraver and red turpentine beetle, among others. The presence of these secondary agents may also be indicators of infestations by primary agents.

Douglas-fir beetle (DFB; *Dendroctonus pseudotsugae*) is a primary mortality agent in Douglas-fir and is associated with blowdown events (Figure 9), root disease, fires or defoliation. Outbreaks following stress events can last up to four years.

In 2015, 13,000 acres of DFB damage were mapped statewide, which was half of the acreage from 2014, and well under the 10-year average. Tree mortality this year was most apparent along the Columbia River Gorge in Multnomah and Hood River Counties and along the Wallowa Mountains. Outbreaks along the Columbia River Gorge are likely a continuation of an outbreak that began after winter storms in 2012. Continued drought conditions in eastern Oregon have created conditions that favor the success of DFB populations and increase the likelihood of subsequent damage.

Alan Kanaskie, ODF

Figure 9. *Blowdown in Douglas-fir stand.*

Fir engravers (*Scolytus ventralis*) can infest all species of true fir (*Abies* spp.) in Oregon, but most commonly affect grand, white, and noble firs in forest settings (Figure 10). These secondary agents cause strip attacks that kill portions of the tree but don't usually cause whole-tree mortality. This pest is strongly associated with drought stress and has been on the rise in correlation with intensifying drought conditions.

In 2015, aerial surveys documented fir engraver damage on over 140,000 acres, representing a 3-fold increase from damage in 2014 and 6-fold increase from 2013.

Tree mortality due to fir engraver was primarily observed across the Umatilla and Wallowa-Whitman National Forests in northeast Oregon, and in more drought-prone areas along the Cascades and in southwest Oregon. Increased mortality is expected from this pest particularly on droughted sites with dense stands of true fir.

Christine Buhl, ODF

Figure 10. *Fir engraver galleries.*

Mountain pine beetle (MPB; *Dendroctonus ponderosae*) is most often associated with overly dense or mature lodgepole pine but will also infest large-diameter ponderosa as well as the five-needle pines (sugar, western white and whitebark). In 2015, aerial surveys attributed over 290,000 acres of tree mortality to MPB (Figure 11). MPB-caused mortality across all pine species was a quarter less than that from 2014, most likely due to the loss of preferred hosts from previous attacks rather than from improving conditions.

Lodgepole and ponderosa pine are the primary hosts for MPB and mortality decreased in both tree species this year. However mortality in the critically threatened whitebark pine actually increased by 33% relative to last year. MPB damage in lodgepole was most apparent in the Fremont-Winema National Forest and Blue Mountains region of the Malheur and Wallowa-Whitman National Forests. Damage in ponderosa pine was observed in areas scattered around lodgepole infestations and in the southwest corner of Lake County.

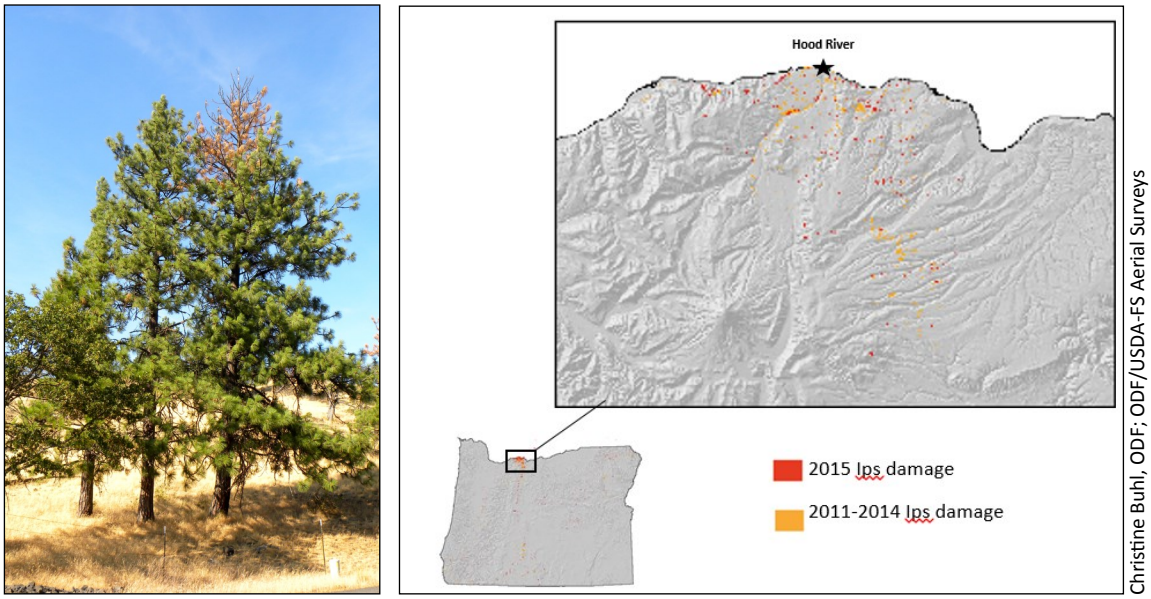
Robbie Flowers, USDA Forest Service; Christine Buhl, ODF

Figure 11. *A large area of pine mortality on National Forest lands at the southern end of the Blue Mountains (left); MPB galleries.*

Western pine beetle (WPB; *Dendroctonus brevicomis*) is one of the most common causes of tree mortality in large-diameter ponderosa pine in Oregon. Ponderosa stressed by drought, fire, defoliation or root disease are most at risk for WPB infestations. In 2015, 80,000 acres of forest land exhibited aerial signatures consistent with WPB damage, a 72% increase from 2014 and double the 10-year average. WPB damage was scattered throughout the range of ponderosa pine and most concentrated in the Malheur National Forest. Because WPB susceptibility is strongly associated with drought, more damage is expected as a result of intensified drought conditions in 2015.

Cooperative efforts are continuing in areas heavily affected by MPB and WPB to create strategic safety corridors and fuel breaks. This includes the removal of dead and dying trees along roads and in recreation sites as well as reducing fuel loads and increasing access and safety for firefighters.

Two major *Ips* beetle species in Oregon are the **pine engraver** (*Ips pini*) and the **California fivespined Ips** (CFI; *I. paraconfusus*). Both prefer to attack green slash and the tops (Figure 12) of mostly ponderosa, but also lodgepole pine. Outbreaks can last 1-3 years depending on the species, although areas along the Columbia River Gorge have been experiencing a continuous CFI outbreak since 2010.



Christine Buhl, ODF; ODF/USDA-FS Aerial Surveys

Figure 12. *Topkill is a common indicator of* Ips *beetles; (left); pine mortality attributed to* Ips *outbreaks in the Columbia Gorge infestation (right).*

Over 4,600 acres of *Ips*-caused mortality were mapped during 2015 aerial surveys, representing a 25% increase from 2014. This trend appears to be driven by greater stress associated with recent fire and storm damage as well as drought. In the Gorge area alone 370 acres were damaged, which doubled from last year (Figure 11). Examinations of trees infested with CFI in the Gorge have also shown signs of WPB infestation.

Wood-boring Insects

Wood-boring insects include roundheaded/longhorned borers, flatheaded borers, ambrosia beetles, horntail and wood wasps. These insects, with exceptions, typically bore more deeply into wood than bark beetles. While many of these insects are not primary contributors of tree mortality and are actually beneficial for wood decomposition and nutrient cycling, one species is a primary pest of Douglas-fir.

Steve Valley, ODA

Figure 13. *FFB morphotypes.*

The flatheaded fir borer (FFB; *Phaenops drummondi*) is a major pest of Douglas-fir growing below 3,500 feet on dry, poor quality sites (Figure 13). Damage from this pest tends to occur in the Klamath-Siskiyou and South Cascade ecoregions and has been low, historically. Mortality from FFB more than doubled from 2014 to 9,000 acres in 2015 likely due to additive stress from, poor quality habitat, drought and recent fire damage.

Defoliators

Historically, principal forest defoliators in Oregon include western spruce budworm, Douglas-fir tussock moth, pine butterfly and various sawfly species. Defoliators of conifers reduce growth and increase susceptibility to other pests such as bark beetles. Less-damaging defoliator species include hardwood pests such as western oak looper and western tent caterpillar. Defoliators of hardwoods typically do not cause mortality unless trees are severely stressed by other factors. Two forest defoliators that made noticeable appearances this year are western tent caterpillar and Douglas-fir tussock moth.

Christine Buhl, ODF

Figure 14. *Western tent caterpillar*

Western tent caterpillar (WTC; *Malacosoma californicum, Figure 14*) is a pest of hardwoods with a preference for alder and oak; they construct 'silk' tents in trees. The largest documented outbreak of WTC over the last two decades in Oregon occurred in 2014 in Columbia County. A smaller continuation of this outbreak occurred in 2015 in Tillamook. WTC outbreaks typically last 1-2 years and defoliated trees produce new foliage the year after defoliation, provided that they are healthy prior to attack.

Douglas-fir tussock moth (DFTM; *Orgyia pseudotsugata*) early detection traps are set by cooperators around various parts of the state to detect building populations and predict impending outbreaks. In 2015, elevated levels of DFTM were found in traps near the Fremont-Winema National Forest (Figure 15). This region will be closely monitored for DFTM activity in 2016. Outbreaks from this pest last 1-2 years; the last outbreak in Oregon occurred in 2011.

Christine Buhl, ODF

Figure 15. *DFTM detection trap.*

Pandora moth (*Coloradia pandora*) (Figure 16) is a defoliator seen infrequently, but in 2015 elevated numbers of adults were detected near light sources in central Oregon near Bend and Chemult. This insect has a 2-year life cycle and prefers to feed on mature ponderosa, Jeffrey, lodgepole and sugar pine growing in loose volcanic or limestone-based soils. Mature larvae and pupae are traditional foods collected by several native American tribes such as the Paiute, Klamath and Modoc. The last outbreak of this insect was from 2004-2008 in central Oregon.

William Ciesla, For. Health Mgt. Int.

Figure 16. *Pandora moth, one of the largest American pests.*

Sap-Sucking insects

Sap-sucking forest pests of most concern are scales, aphids and adelgids (similar to aphids). Feeding may cause chlorosis, needle loss, sooty mold growth on their liquid wastes (i.e., "honeydew"), tip dieback and reduced tree growth from chronic infestations. These pests are mostly stationary and may become established in an area. Sap-sucking insect populations typically are held in check by natural parasites and predators. Agricultural insecticide applications can inadvertently depress predator/prey populations and exacerbate sap-sucker outbreaks.

The balsam woolly adelgid (BWA; *Adelges piceae*) is non-native but has been established on the West Coast since 1929. BWA attacks various true firs in Oregon. It feeds by piercing through bark causing swelling (Figure 17) and dieback on stems and branches. Damage from the balsam woolly adelgid continues to be widespread and is currently affecting subalpine and Pacific silver firs at high elevations across central and eastern Oregon. In 2015, approximately 61,000 acres of BWA damage was mapped during aerial surveys. This was similar to the area detected in 2014. Although BWA damage in recent years is below the 10-year average of 109,000 acres, infestations are chronic, thus declining damage detected in surveys may be due to mortality of preferred hosts.

Christine Buhl, ODF

Figure 17. *Balsam woolly adelgid-caused branch swellings.*

Christine Buhl, ODF

Figure 18. *Black pineleaf scale on ponderosa.*

Black pineleaf scale (BPLS; *Aspidiotus californicus*) primarily infests ponderosa pine but may also attack lodgepole pine, Douglas-fir and white fir (Figure 18). BPLS infestations are not widespread but can become concentrated and chronic in isolated areas often due to pesticide sprays that kill their natural enemies. Pockets of outbreaks have been identified, via ground surveys, in Hood River and in central and northeastern Oregon.

Diseases

Sudden Oak Death

Sudden Oak Death (SOD), caused by the non-native pathogen *Phytophthora ramorum,* kills highly susceptible tree species such as tanoak, coast live oak, and California black oak by causing lesions on the main stem (Figure 19). It also causes leaf blight or shoot dieback on a number of other hosts including rhododendron, evergreen huckleberry, Douglas-fir, and Oregon myrtle (Figure 20). In Oregon forests these hosts are only infected when growing very near infected tanoaks.

Alan Kanaskie , OR Dept. of Forestry

Figure 19. P. Ramorum *stem lesion on tanoak.*

Alan Kanaskie, ODF

Figure 20. *Leaf and shoot blight of Pacific Rhododendron caused by* P. ramorum. *In Oregon forests, most plant species only become infected when growing near infected tanoaks.*

Alan Kanaskie, ODF

Figure 21. *Cutting and burning of tanoak to eliminate* P. ramorum.

P. ramorum spreads during rainy periods when spores produced on infected leaves or twigs are released into the air and are either washed downward or transported in air currents. The pathogen can survive for months or years in soil or plant parts. The disease also can be spread by humans transporting infected plants or infested soil.

SOD was first discovered in coastal southwest Oregon forests in July 2001. An interagency team attempted to eradicate the pathogen though a program of early detection surveys followed by mandatory destruction of infected and nearby host plants (Figure 21). Even though eradication treatments eliminated disease from many infested sites, the disease continued to spread slowly in a predominantly northward direction and up major river drainages, following the pattern of winds that prevail during storms and wet weather. Continued spread of sudden oak death is attributed to the slow development of symptoms in infected trees which hinders early detection, as well as delays in completing eradication treatments due to limited budgets.

From 2001-2009, all infested sites received mandatory eradication treatments. In 2010, disease levels exceeded the capacity to apply eradication treatments to all infested sites on private land, so sites near the center of the quarantine were left untreated in order treat higher-priority infestations near the quarantine boundary. In 2012, the quarantine regulations were changed and a Generally Infested Area (GIA) was declared in which eradication treatments were no longer required on private land (Figure 22). All sites on federal land continued to be treated, regardless of location.

In early 2015, the quarantine area was expanded from 264 mi^2 to 515 mi^2 because of the distribution of newly infested sites discovered in 2014. Also in 2015, 18 new infestations were detected at or beyond the boundary of the Generally Infested Area but well within the quarantine boundary. One large site was located on the Winchuck River, 1.5 miles north of the California border (Figure 22, next page). The GIA remained at 58 mi^2 in 2015; sites furthest from the GIA were treated to a 300 foot buffer, those closest had a 25-50 foot buffer.

Danny Norlander , ODF

Figure 22. *Dead and dying tanoak inside the Generally Infested Area increase risks of wildfire and damage to property from falling trees. Grey trees in the photo are dead tanoaks.*

In early 2015, another clonal lineage of *P. ramorum* (EU1) was detected on a single tanoak tree near the Pistol River. This is the first report of the EU1 lineage in US forests. Genetic analysis suggests a nearby private nursery (now closed) as the probable source. This finding is of particular concern because in Europe the EU1 lineage kills or damages several conifer tree species. Furthermore, establishment of the EU1 lineage would create the potential for sexual reproduction and increased variability in the North American *P. ramorum* population. The EU1 infestation was cut and burned (13 acres) and has not been detected in post-treatment soil and vegetation sampling.

SOD is a tremendous threat to tanoak ecosystems in Oregon and California, and to forests elsewhere in the U.S. and abroad. If allowed to spread it will seriously damage the ecology of southwest Oregon forests, and the resulting quarantine regulations will disrupt domestic and international trade of many forest and agricultural commodities.

For more information on SOD visit:
http://www.oregon.gov/oda/cid/plant_health/sod_index.shtml
http://www.aphis.usda.gov/plant_health/plant_pest_info/pram/
http://www.suddenoakdeath.org

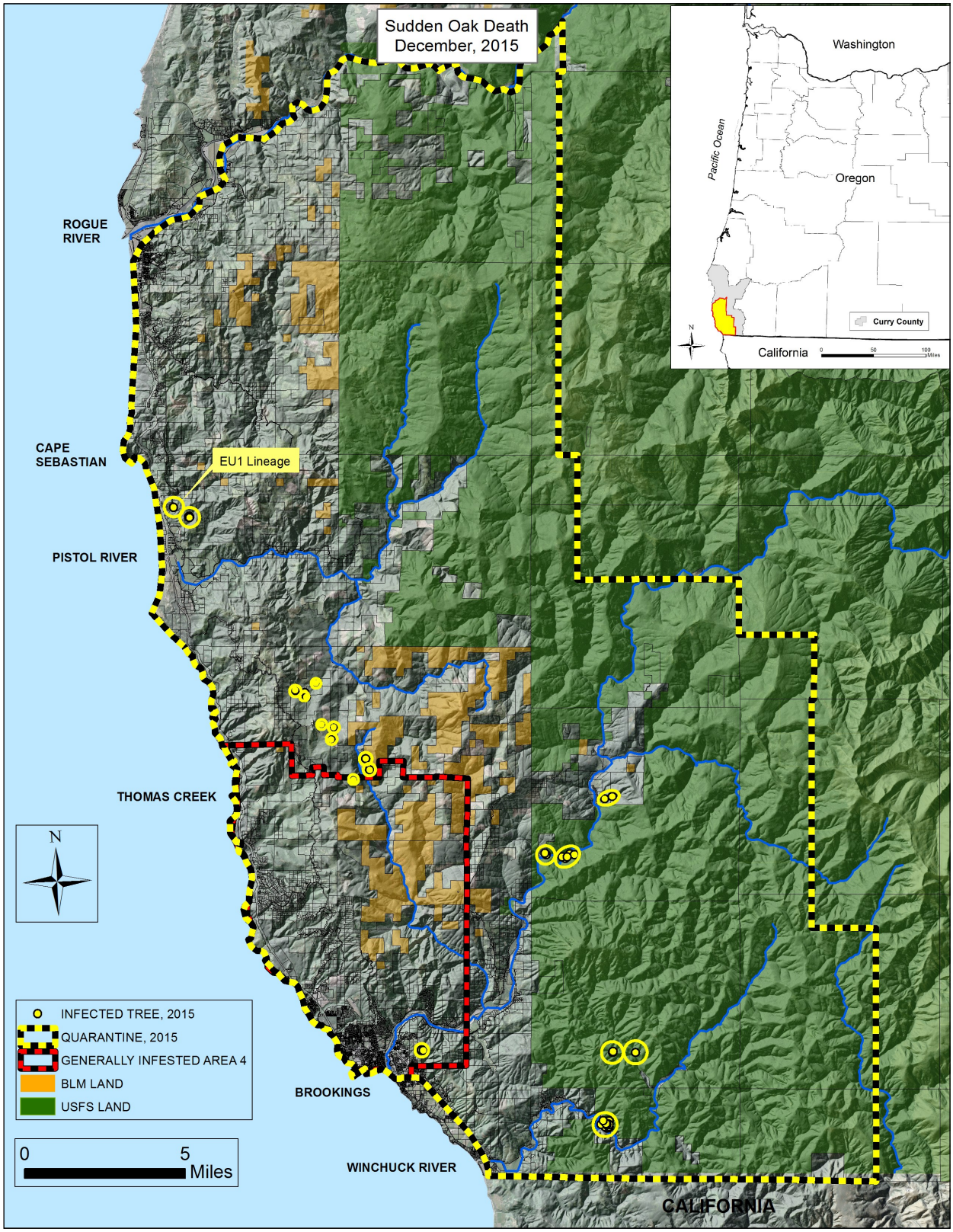


Figure 23. *Quarantine boundary and location of trees infected with* P. ramorum *that were found in 2015. The infestation is more widespread inside the Generally Infested Area (GIA) than shown on the map, due to decreased survey effort there. Map by Alan Kanaskie, ODF.*

Swiss Needle Cast

Swiss needle cast (SNC) is caused by the native fungus *Phaeocryptopus gaeumannii* and affects only Douglas-fir. Symptoms are yellowing and premature needle loss (Figure 24).

Alan Kanaskie, ODF

Figure 24. *SNC causes foliage loss and sparse, yellow crowns in Douglas-fir, which greatly reduces volume growth.*

Foliage loss does not directly kill trees, but reduces tree volume growth by more than 50% and decreases long-term survival. Growth loss due to SNC in 10-70 year-old Douglas-fir in the Oregon Coast Range is estimated at more than 190 million board feet per year. SNC also alters wood properties which can lower value of certain lumber products, hinder the development of stand structure and wildlife habitat, limit stand management options, and increase the risk of catastrophic fire. The disease is present wherever Douglas-fir grows but has become particularly damaging to Douglas-fir forests on the western slopes of the Oregon Coast Range.

Aerial surveys are conducted in April and May each year to detect and map the distribution of SNC damage (Figure 25). The 2015 survey covered 3.7 million acres in the Coast Range, and recorded an all-time high of 589,851 acres of Douglas-fir forest presenting SNC symptoms.

Danny Norlander, ODF

Figure 25. *SNC appears as yellow/brown needles in April and May. Dark green conifers in the photo are hemlock and spruce; light green trees are red alder.*

Most damage occurred within 18 miles of the coast, although damage extended 28 miles inland along the Highway 20 corridor (Figure 26, next page).

In 2015, as in 2014, the survey was extended south through Curry County to the California border even though few symptoms typically are observed south of Port-Orford. In Curry County only 4,319 acres with symptoms were detected, most of them in the Port Orford area.

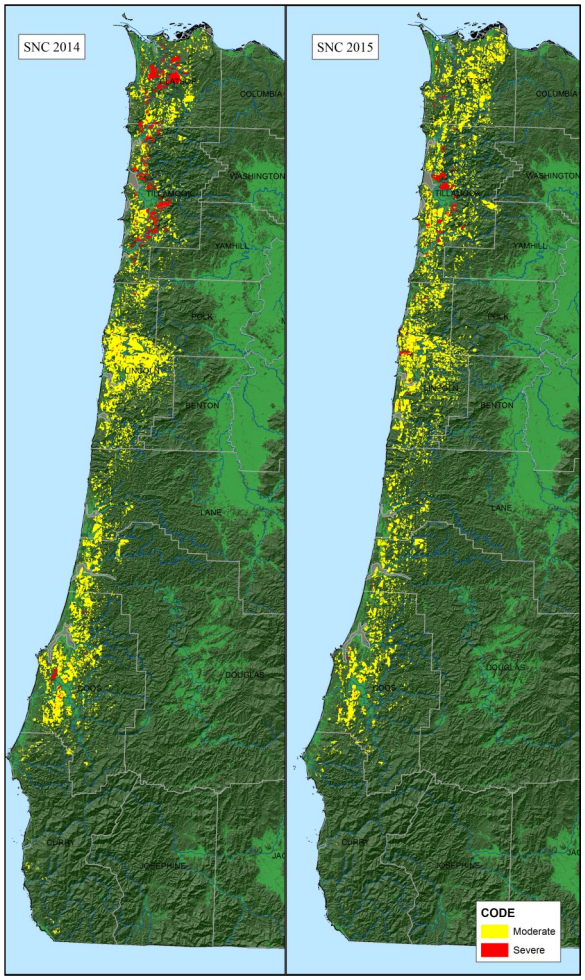


Figure 26. *Areas of Douglas-fir forest with symptoms of SNC detected in the 2014 (left) and 2015 (right) aerial surveys. Maps by Alan Kanaskie, ODF.*

In the 2015 partial survey of the Cascades Range (Lane, Linn, Marion, and Clackamas Counties), 3,186 acres of moderate SNC symptoms were detected. Limited ground-truthing confirmed several stands with damage in Linn County, but in other cases symptoms likely were caused by other agents.

The SNC aerial survey provides a conservative estimate of damage because observers can map only those areas where disease symptoms have developed enough to be visible from the air. SNC occurs throughout western Oregon but often is not severe enough to enable aerial detection. The aerial survey depicts the extent of moderate to severe damage, documents trends over time, and establishes a zone in which forest managers should account for the effects of the disease.

Figure 27 shows the trend in damage from 1996 through 2015. The unusually mild late winter and spring weather may have contributed to this year's increase in the area with symptoms detected by the survey.

For SNC maps, GIS data and information, visit: *http://www.oregon.gov/ODF/ForestBenefits/Pages/ForestHealth.aspx*

http://sncc.forestry.oregonstate.edu/

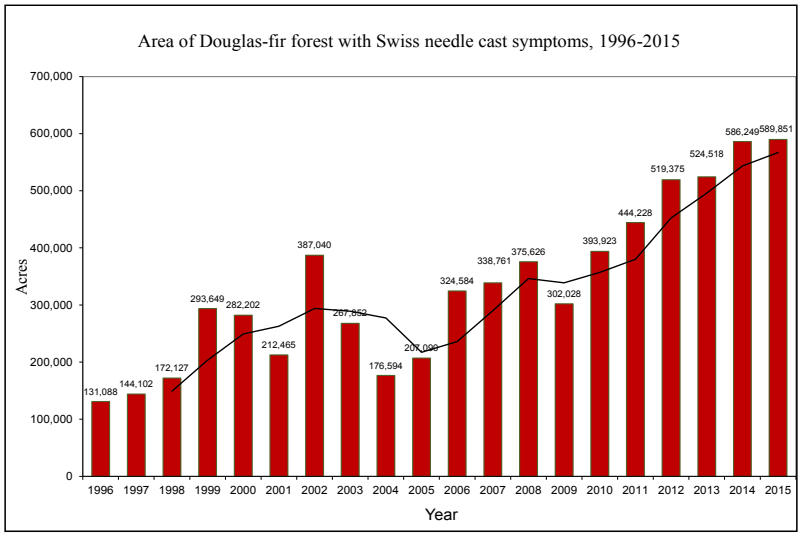


Figure 27. *Trend in SNC damage. Chart by Alan Kanaskie, ODF.*

Two “New” Foliar Diseases in Douglas-fir

In late winter and early spring of 2015, severe discoloration and abnormal needle loss in the lower crowns of Douglas-fir was noticed along the central Coast Range and in the Cascades. Oregon State University and several agencies collaborated to collect foliage throughout western Oregon to determine distribution of the disease and determine the causal agents: web blight and Phytophthora needle cast.

Alan Kanaskie, ODF

Figure 28. *Web blight (left and right) is characterized by dead needles bound together and to the twig by fine fungal filaments.*

Web blight, caused by a *Rhizoctonia*-like fungus, has been known for over a decade as a disease of Christmas trees (Douglas-fir and true firs) and occasionally dense natural stands with very restricted air flow. Infected needles turn brown and hang from branches long after they have died, bound there by very fine fungal webbing (Figure 28).

Symptoms first become visible in late winter, are most prevalent in the lower crown, and give the appearance of moving upward in the tree crown as the season progresses to spring. Symptoms were widespread and obvious on native Douglas-fir in many areas of western Oregon, especially the central Coast Range.

In the Cascade Range, similar symptoms were found on mature western hemlock. In some cases, damage was severe, with defoliation of most of the tree crown. Web blight was found from Coos County to the northern end of the state (Figure 29).

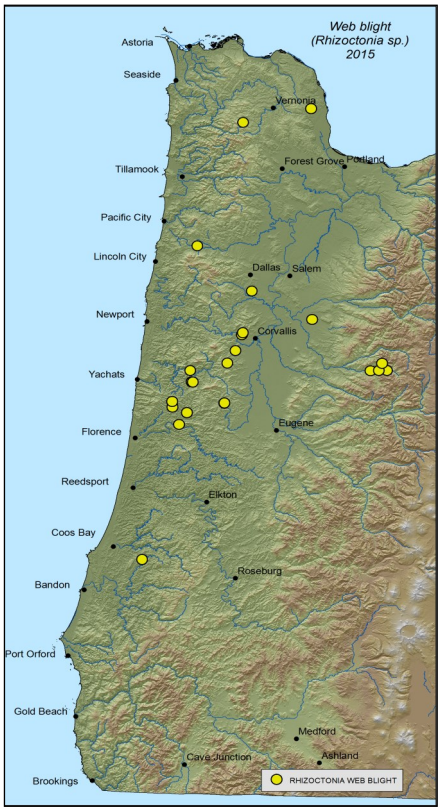


Figure 29. *Web blight locations. Map by Alan Kanaskie, ODF.*

Alan Kanaskie , ODF

Figure 30. *Needles infected with* P. pluvialis *become discolored and fall prematurely (left), often while still green (right).*

Phytophthora needle cast of Douglas-fir, caused by *Phytophthora pluvialis,* was first recognized in New Zealand in 2012. In 2014, Oregon State University confirmed the pathogenicity of *P. pluvialis* on Douglas-fir in Oregon.

The symptoms and signs of Phytophthora needle cast differ from web blight in that needles infected with *P. pluvialis* are shed quickly, often while still green or slightly yellow (Figure 30). The field symptom of bare lower branches often is coupled with abundant green or yellow needles covering the ground beneath the tree (Figure 30).

Foliage collections made throughout the state confirmed *P. pluvialis* to be widespread in western Oregon (Figure 31), and in many cases co-occurred with the web blight pathogen. At this time *P. pluvialis* is considered native to Oregon, but much remains to be learned.

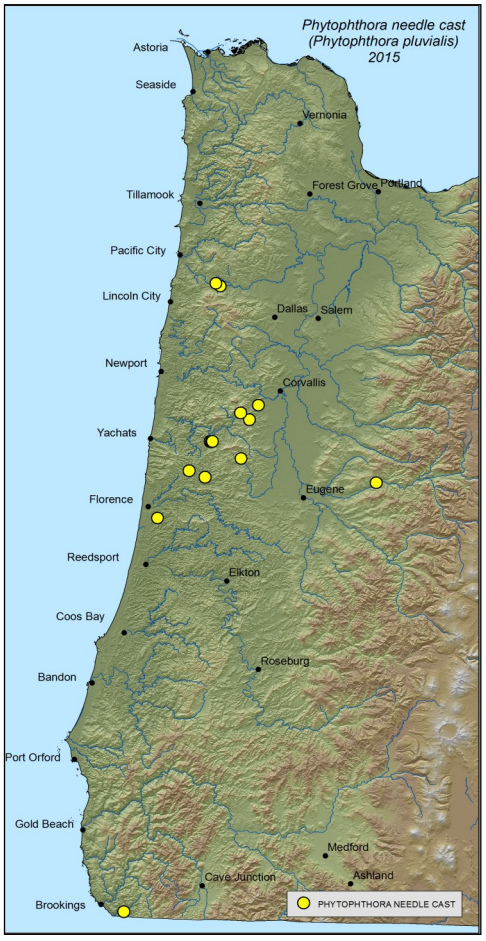


Figure 31. Phytophthora *needle cast locations. Map by Alan Kanaskie, ODF.*

Diplodia Tip Blight

Diplodia tip blight, caused by the fungus *Diplodia sapinea (*syn*. Sphaeropsis sapinea),* was observed on ponderosa pine in many areas of northeast Oregon in 2015. This agent is a weak parasite that typically affects trees stressed by drought or other agents and when conditions are ideal for infection and disease development. Cool moist conditions favor infection.

The primary symptom is "flagging" of branch tips which occurs when the pathogen kills entire current-year shoots leaving obvious clusters of brown foliage at branch ends (Figure 32). In contrast to the needle casts, needles affected by this disease remain on the tree through the winter. Tree mortality is uncommon, but growth loss, branch dieback, and top-kill can occur. Management actions usually are not recommended.

Alan Kanaskie, ODF

Figure 32. *Branch tip flagging caused by Diplodia tip blight on Ponderosa pine in NE Oregon.*

Leaf Blight of Pacific Madrone

Alan Kanaskie, ODF

Figure 33. *Leaf blight of Pacific madrone subsided in 2015, with most madrones displaying normal foliage for the first time in several years.*

Leaf blight of Pacific madrone (*Arbutus menziesii*), caused by *Phacidiopycnis washingtonensis* and other foliar pathogens, has been strikingly obvious throughout the range of madrone in Oregon since 2011. In winter, infected leaves turn brown and can give the impression that the entire tree is dead.

In 2015, madrone showed remarkable improvement, with most trees in western Oregon showing healthy foliage (Figure 33). This rather sudden turn-around is likely due to the abnormally dry and warm winter conditions in late 2014 and 2015.

Incense Cedar Canker

Incense cedar canker continued to be highly noticeable on incense cedar throughout the Willamette Valley. Branch "flagging" (red-brown dead foliage on branches) typically begins in the lower crown and progresses upward over a period of years, often resulting in trees with very sparse ragged crowns (Figure 34).

Tree death has not been observed. The disease is much more common in planted trees than in trees growing in natural forests (Figure 35). Several pathogens have been recovered from samples by the OSU Plant Clinic and others, including *Diplodia sp*. and *Seiridium sp*., but recent work by the USDA-ARS Horticultural Crops Research Laboratory in Corvallis implicates *Phaeobotryon cupressi* as the most common pathogen associated with the cankers. The disease is poorly understood at this time.

Alan Kanaskie, ODF

Figure 34. *Incense cedar canker causes branch flagging and dieback.*

Alan Kanaskie, ODF

Figure 35. *Branch flagging in planted incense cedar.*

Black Stain Root Disease

Black stain root disease is caused by a tree-killing vascular wilt-type fungus (*Leptographium wageneri)*, transmitted by root feeding bark beetles and weevils (Figure 36). The fungus can also spread tree-to-tree by root contact. It occurs throughout Oregon and causes damage in the Douglas-fir forests of western Oregon and in ponderosa pine forests of eastern Oregon.

The most severe damage occurs in young Douglas-fir plantations in the Coast Range. Disease incidence has been positively correlated with management activities that damage or stress trees, such as pre-commercial thinning, soil disturbance, and roadside brushing. These activities attract and favor population increase of the insect vectors.

Observations during 2014 and 2015 suggest that the disease may be increasing in several parts of the Coast Range. Damage is most common in 10-30 year-old plantations (Figure 37), but recently significant mortality has been observed in much younger plantations – just 2 or 3 years after planting. Disease management is based largely on evaluating local disease risk and avoiding activities that favor spread by insect vectors.

Rune Axelsson

Figure 36. *Root-feeding bark beetle and weevil vectors of black stain root disease.*

Alan Kanaskie, ODF

Figure 37. *Dead and dying Douglas-fir with black stain root disease in the northern Coast Range (left); Black stain root disease on young Douglas-fir in southwest Oregon. Black streaks indicate where the pathogen has colonized the tree's water conducting sapwood (right).*

Drought Damage in Conifers

Drought conditions plagued Oregon forests for the third consecutive year, with 2015 being one of the most severe growing season droughts on record (See Figure 3). Under severe drought conditions, portions of the canopy or whole tree may die. Roots and the lower main trunk are the last to die, and often remain living even though above ground parts are dead. As internal water stress increases, trees become increasingly susceptible to certain insects and diseases, particularly canker diseases (Figure 38), twig beetles, and engraver beetles.

Alan Kanaskie, ODF

Figure 38. *Stem canker on drought-stressed Douglas-fir.*

Symptoms of tree damage from drought usually become apparent in spring and early summer of the year following the drought. In early summer of 2015, conifer trees throughout western Oregon displayed symptoms of the 2014 drought: dead lateral branches, tops or whole dead trees, as well as damage by secondary insects and pathogens (Figure 39). Damage was most visible in the Willamette Valley, the Coast and Cascade Range foothills, and the interior valleys of southern Oregon, especially on the fringe of forested areas, on former pasture land, and on compacted, rocky, or shallow soils. The prolonged and severe drought of 2015 caused additional tree damage that showed up in autumn and affected mature trees and those growing in the interior of stands. Douglas-fir and western redcedar suffered the most damage, especially in trees less than 30 years old (Figure 39). Additional drought-related damage is expected early 2016.

Alan Kanaskie, ODF

Figure 39. *Dead branches and tops in Douglas-fir from drought (left); Willamette Valley Ponderosa pine survived drought conditions much better than either Douglas-fir or western red cedar (right).*

Animal Damage

Bear and other vertebrate damage to young conifers has been aerially surveyed each year since 1988. Black bears can cause substantial damage to young conifer stands as they feed on the nutrient-rich cambium when other food is less abundant. The bear aerial survey is conducted from the northern Oregon border south to Coos Bay and east to Roseburg and detects fading trees, i.e., where needles have changed from green to red (Figure 40).

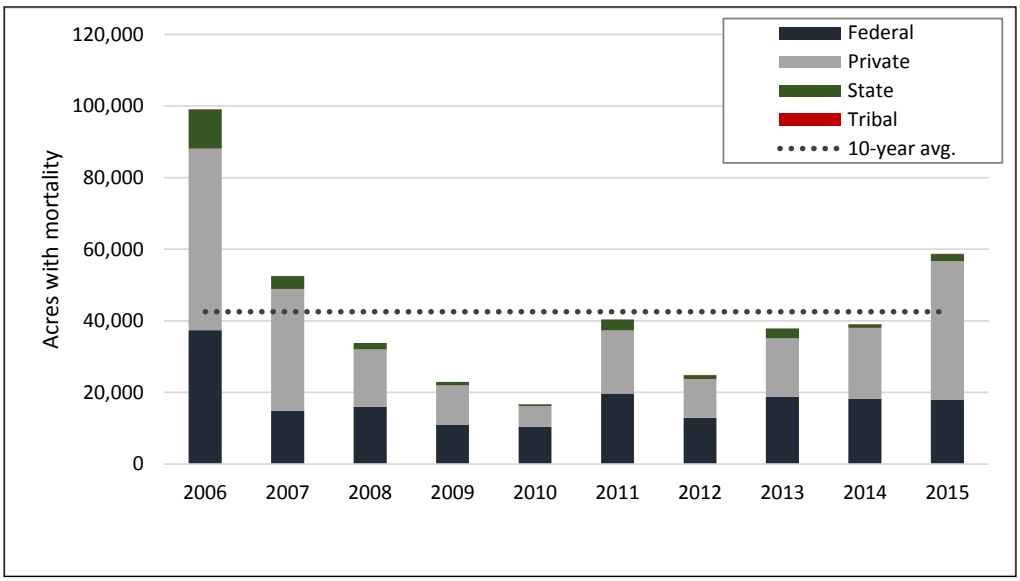
In the region mapped during the bear survey (completed in June), damage increased 31% from the previous year. However, the number of damage areas decreased by approximately 15%, indicating more diffuse damage over the landscape.

2015 estimates of young conifer mortality reached their highest point in 10 years at 85,000 trees statewide and 60,000 in the area covered by this special survey alone. Acres of damage doubled from 2014 and 2013, and were well above the 10-year average (Figure 41).

ODF file photo

Figure 40. *Scattered bear damage.*

Damage levels in most northwest Oregon counties remained constant, although damage increased by over 11,000 acres in Columbia and 7,000 acres in Lane.



ODF/USDA-FS Aerial Surveys

Figure 41. *Ten-year trend of acreage affected by bears.*

Invasive Species

Emerald ash borer (EAB), a non-native wood-boring beetle, was surveyed for the third consecutive year to detect introductions into the state. This insect was introduced accidentally in the mid-1990s to Detroit, MI, most likely on infested wood pallets utilized for global commerce. The insect was first detected in the U.S. in 2002 and has now spread to 25 states and has killed over 100 million ash trees despite monumental eradication, control and outreach efforts. Although the insect disperses naturally by flying up to 20 km (12 miles) per year, the primary long-distance dispersal mechanism is human-mediated through the movement of infested firewood and nursery stock. EAB has become the costliest invasive forest insect in the history of the U.S. with over $3.5 billion in control costs, property value depreciations, and timber revenue losses. The closest known EAB infestation is Boulder, CO, where officials detected two small populations in September of 2013.

Eric Day, Virginia Poly. Inst. & State Univ.

USDA-APHIS

Figure 42. *EAB (top); baited, green funnel trap (bottom).*

New for 2015 EAB survey season was the deployment of green, multi-funnel traps targeting EAB (Figure 42) along with the standard purple panel traps traditionally used for this insect. Both were baited with two plant volatile lures: Z-3-hexenol and manuka oil. Lures were replaced at the midway point of the survey season (week 8). A total of 294 EAB traps (58 green, 236 purple) were placed in 15 counties statewide.

Trap locations were chosen using a risk model (USDA-Forest Health Technology Enterprise Team; FHTET) or trapper discretion. Traps were in place May - June, starting in the southern portion of the state, and removed August - October.

There were no EAB detected on any Oregon traps in 2015.

The annual **Gypsy moth** survey consisted of over 15,000 pheromone traps deployed across the state (Figure 43). Seven **European gypsy moths** (EGM; *Lymantria dispar dispar,* Figure 44) were captured in four traps approximately 6 miles NW of Grants Pass for the third consecutive year of positive trap catches in this vicinity, indicating an incipient breeding population. ODA intends to continue a targeted delimitation survey in this area in 2016 to determine the geographical center and extent of this population before potential eradication activities.

USDA Forest Service

Figure 43. *Gypsy moth pheromone-baited detection trap.*

Christine Buhl, ODF

Figure 44. *Male (brown) and female (white) European gypsy moth adults and eggs.*

The 2015 gypsy moth survey also reported five additional European gypsy moths at five sites in northern Oregon (Forest Grove, Hillsboro, Forest Park, West Linn and St. Johns) as well as **Asian gypsy moth** (AGM; *Lymantria dispar asiatica*) at two sites (Forest Park and St. Johns).

The positive detection of AGM triggered a multi-agency response from federal and state partners. AGM is considered high-risk because unlike EGM it is not established in the U.S., has much greater dispersal ability, and can successfully develop on conifer species such as Douglas-fir.

To prevent establishment of this pest, 8,641 acres surrounding the positive AGM and EGM sites in the Portland area will be treated with Btk, a targeted and organic naturally occurring soil bacterium. Additionally, 3,785 pheromone traps will be placed within a 73,749 acre delimitation survey area to determine treatment efficacy. ODA is the lead agency for this effort and will be assisted by ODF, USDA-USFS, APHIS-PPQ and other agencies.

rjcox

Figure 45. *Gypsy moth defoliation of Virginia's Shenandoah Valley.*

Invasive forest plants (Figures 46 and 47) continue to be a top priority for ODF Forest Health staff. ODF Invasive Species staff provided training and landowner technical assistance on common Oregon forest weeds, such as Himalayan blackberry (*Rubus armeniacus*), Scotch broom (*Cytisus scoparius*), gorse (*Ulex europaeus*) English ivy (*Hedera helix*), False brome (*Brachypodium sylvaticum*), knotweed (*Fallopia* spp.), and various thistles and knapweeds. ODF State Forests Division consulted with ODF Forest Health staff on 2015 revisions to the Division's Recreation rule (OAR 629-025-0000 through 629-025-0080) as it pertains to invasive species management. The ODF Forest Health staff recommended adopting new rules to prevent the movement and establishment of noxious weeds by requiring the use of certified Weed Free Forage (WFF) when on recreating lands administered by ODF. A similar WFF rule was adopted in 2004 by U.S. Forest Service Pacific Northwest Region. Moreover, the state of Oregon maintains a WFF certification program through the ODA. The revised ODF Recreation Rule is currently being considered by the Board of Forestry.

Wyatt Williams, ODF

Figure 46. Hay bales can harbor seeds of noxious weeds (left); English holly is hard to kill, thrives in shady understory, is dispersed by birds, and is grown commercially in western Oregon (right).

Wyatt Williams, ODF

Figure 47. Bamboo is beginning to escape from landscaping particularly in western Oregon (left); English ivy was once widely used in the horticultural trade and is still a problem in many natural areas where it has escaped and established (right).

Oregon Forest Pest Detector Program

For the second year, ODF Forest Health team members served on the interagency Oregon Forest Pest Detector (OFPD) program. The USDA-funded OFPD, coordinated and led by Oregon State University Extension Forestry, aims to train arborists, landscapers, park workers and other professionals on the early signs and symptoms of priority invasive forest pests. Using a combination of online presentations (Figure 48), face-to-face seminars and field training courses, over 200 professionals were trained as "First Detectors" of emerald ash borer and Asian long-horned beetles. The OFPD worked with the Oregon Invasive Species Council to refine a mobile-friendly online reporting system so that First Detectors could take a picture and log a report while in the field. The overall goal is to detect key forest invaders early in their invasion establishment when eradication is still feasible.

For more info, visit the OFPD website: http://pestdetector.forestry.oregonstate.edu/

Wyatt Williams , OR Dept. of Forestry

Figure 48. ODF Invasive Species Specialist, Wyatt Williams, provides training on emerald ash borer to students in the Oregon Forest Pest Detector program.

Additional Information on Forest Health

Annual aerial detection survey data viewers, maps, and GIS shapefiles:

http://www.oregon.gov/odf/privateforests/pages/fhMaps.aspx

http://www.fs.usda.gov/goto/r6/fhp/ads

Previous *Forest Health Highlights* reports for Oregon and Washington:

http://www.fs.usda.gov/goto/r6/fhp/highlights

Information on a wide range of forest insects and diseases:

http://www.oregon.gov/ODF/ForestBenefits/Pages/ForestHealth.aspx

http://www.fs.usda.gov/main/r6/forest-grasslandhealth/insects-diseases

Oregon Department of Forestry: Forest Health Notes

Forest Service: Forest Insect & Disease Leaflets (FIDLs)

See also:

"Field Guide to the Common Diseases and Insect Pests of Oregon and Washington Conifers" and "Western Forest Insects " publications produced by the USDA Forest Service Pacific Northwest Region

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