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Forest Health Highlights in Oregon—2014

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Pacific Northwest Region
Forest Health Protection

Forest Health Highlights In Oregon – 2014

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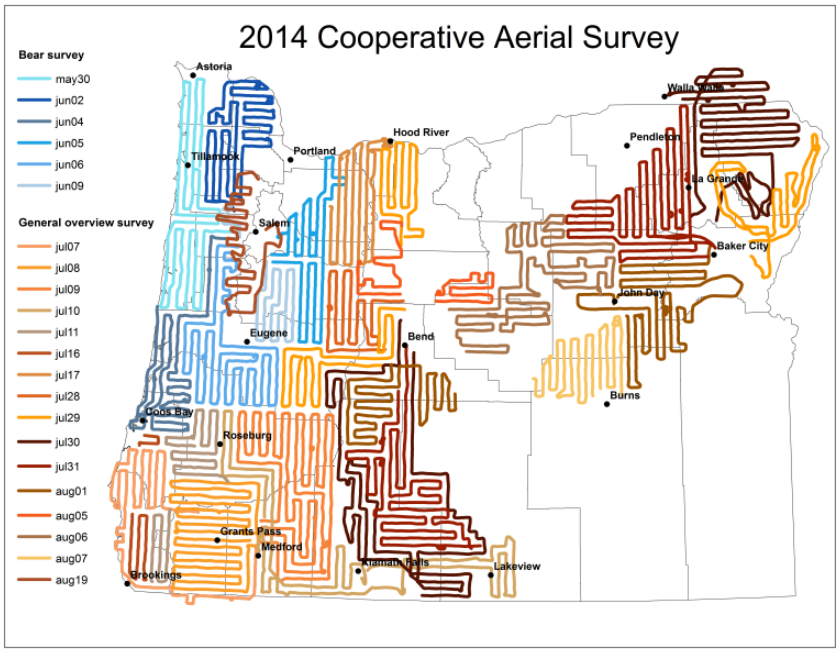

Front cover: *White pine blister rust canker on the bole of a young western white pine. The orange margin of the canker defines the leading edge of the infection. (Photo by Alan Kanaskie, ODF)*

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Introduction

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 free of insects, diseases, and other disturbances.

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 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 2014. Additional information on these and other agents can be found on the agency websites provided at the conclusion of this report or by contacting any of the forest health professionals listed there.

Forest Resources, Inventory, and Analysis

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.

The USDA Forest Service Forest Inventory and Analysis (FIA) program monitors change to Oregon's forests through ground surveys within a statewide grid of permanent plots. A systematic sub-sample of the plots 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).

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

PNW Forest Inventory and Analysis

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

Drought Conditions Intensify

Oregon normally experiences heavy snow at higher elevations as a result of winter storms. However that was not the case this year 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. It is likely that many areas will experience drought during 2015. Currently, the majority of the state is listed as being in abnormally dry to severe drought condition and forecasts indicate this pattern will likely continue (Figure 2). Trees growing in overly dense stands or on drought-prone soils are more likely to damaged directly from moisture stress or become susceptible to damage by insects and diseases.

For more information, visit:
http://www.ocs.orst.edu/
http://www.cpc.ncep.noaa.gov/

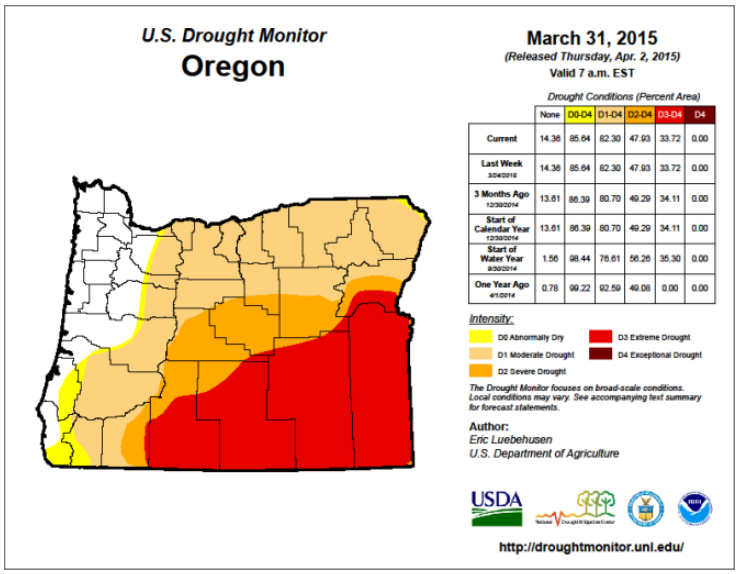


Figure 2. *U.S. drought monitor for Oregon, March 31, 2015.*

Cooperative Fire Protection Efforts

With a backdrop of drought, low snowpack, and high temperatures, the fire season began early in 2014. Similar to 2013, hot and dry conditions with abundant lightning produced large numbers of fires across eastern Oregon (Figure 3). Of the 16 million acres protected by ODF, there were 1,121 fires reported that burned over 283,000 acres in 2014. Although suppression costs were substantial, cooperative efforts minimized the number of large fires with 92% of fire starts held to 10 acres or less. Each year ODF teams up with the Oregon Department of Corrections (DOC) to select and train inmates to dispatch to wildfires. DOC fire crews were deployed in January and continued through October. During that time, DOC deployed 242 staff members and 2,701 inmates to aid in battling 66 fires. These crews were invaluable this year in helping to protect Oregon's natural resources and communities at risk from fire.

OR Dept. of Forestry

Figure 3. *Oregon Department of Corrections crews assisted on 66 fires this year.*

Statewide and Special Aerial Detection Surveys

Aerial surveys using both fixed-wing aircraft and helicopters are conducted each year to assess forest health conditions in Oregon (Figure 4). Surveyors use a digital sketch-mapping computer system, linked to a GPS, and record all visibly affected areas in the form of polygon figures. All figures are coded with the damaging agent(s) based on the surveyor's identification or knowledge of the tree species present. These methods provide for faster data acquisition and improved sharing of survey findings at a lower cost than using other remote-sensing techniques. Over 28 million acres were completed in the annual statewide aerial survey this year. Special surveys were also conducted on over 3.8 million acres in western Oregon to detect damage from Swiss needle cast, a native foliage disease of Douglas-fir, and on over 1 million acres in Curry County to detect tanoaks killed by the non-native pathogen, *Phytophthora ramorum* - the cause of sudden oak death. These special surveys have been conducted annually since 1996 and 2001, respectively. An new aerial survey of over 300,000 acres mapped gorse (*Ulex europaeus*), an invasive, non-native weed found in southwest Oregon. Information from these surveys, including digital and paper maps, summary reports, and GIS data, were 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 4. *The statewide aerial survey of forest health in Oregon covers over 28 million acres. Other special surveys occur annually.*

Forest Insect Damage and Trends

Outbreaks of forest insects occur periodically in Oregon and historically have resulted in significant tree mortality and other damage. In 2014, statewide aerial surveys detected over 581,000 acres of tree mortality and other damage by forest insects. Among these, bark beetles and woodboring insects affected the largest amount of acreage (83%), followed by sap-feeding insects, (13%), and defoliating (4%) insects. The total area affected by bark beetles increased by 25% this year, while the total area affected by the major defoliating insects and sap-feeding insects increased by 220% and 12%, respectively. Overall, relative to 2013, there was a 26% increase in the total area observed to have forest insect damage this year. Tree mortality increased by 38% to reach its highest point in the past two decades.

The majority of tree mortality detected in aerial surveys over the last decade has been due to outbreaks of the mountain pine beetle. Although ongoing outbreaks are largely on the decline statewide, a few areas with increased activity drove the upward trend seen this year. In 2014, estimates of tree mortality within those areas increased to their highest level in the last decade. Activity by other major bark beetles including the western pine beetle, Douglas-fir beetle, fir

engraver, and pine I*ps* spp. also increased in 2014. Statewide defoliation by insects increased in 2014 as well, due primarily to highly localized outbreaks of western spruce budworm, oak looper, and tent caterpillar. Chronic damage by balsam woolly adelgid continued in areas of eastern Oregon.

Mountain Pine Beetle Increases in Eastern Oregon

In 2014, aerial surveys attributed over 382,000 acres of tree mortality to mountain pine beetle (MPB) (Figure 5). MPB increased by 14% and entered the second consecutive year of increases in both areas affected and estimated number of trees killed. This appears to be primarily due to high intensity, localized damage in areas with highly susceptible lodgepole and five-needle pines (whitebark, western white, and sugar pines). Concentrated lodgepole pine mortality was most apparent in Klamath and Lake Counties on the Fremont-Winema National Forests and in Baker and Grant Counties at the southern end of the Blue Mountains in the Malheur and Wallowa-Whitman National Forests (Figure 6). Increased mortality of ponderosa pines by MPB, near outbreak areas, was also observed.

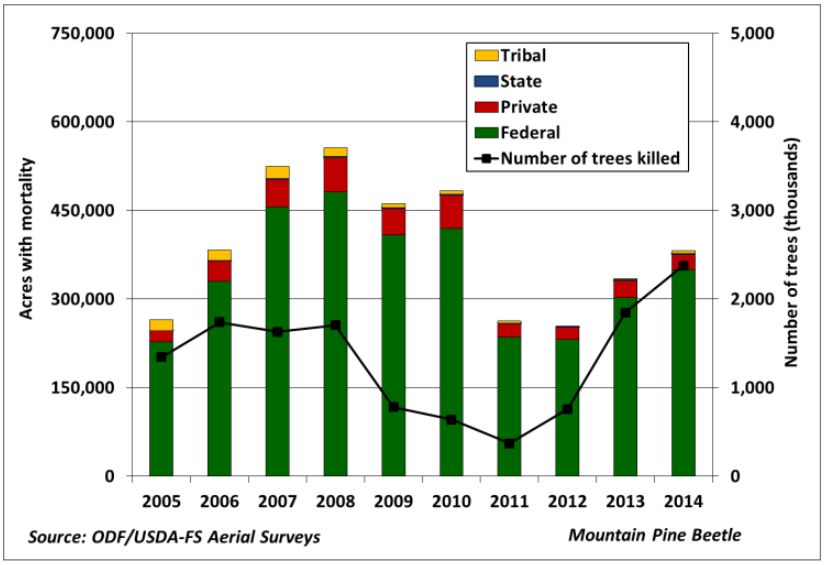


Figure 5. *Ten-year trend for total acres affected and estimated number of trees killed annually by mountain pine beetle in Oregon.*

Robbie Flowers, USDA Forest Service

Figure 6. *A large area of pine mortality on National Forest lands at the southern end of the Blue Mountains.*

Cooperative efforts are continuing in heavily impacted areas 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. Pine species in Oregon do not require fire for regeneration so most areas are being allowed to recover naturally.

Western Pine Beetle Intensifies with Drought

Western pine beetle (WPB) is one of the most common causes of tree mortality in large-diameter ponderosa pine in Oregon. Trees are more susceptible to WPB during droughts, and when damaged by fires, defoliation, or root diseases. In 2014, over 21,000 acres containing tree mortality consistent with WPB were observed, an increase of 91% from 2013 (Figure 7).

Tree mortality from WPB remained just below the 10-year average, but activity was widespread. Tree mortality was most apparent this year in the Warm Springs Indian Reservation in central Oregon, across the Ochoco and Malheur National Forests in north-east Oregon, and in more drought-prone areas of southwest Oregon. Trends for WPB are strongly tied to drought conditions so damage is expected to increase in 2015.

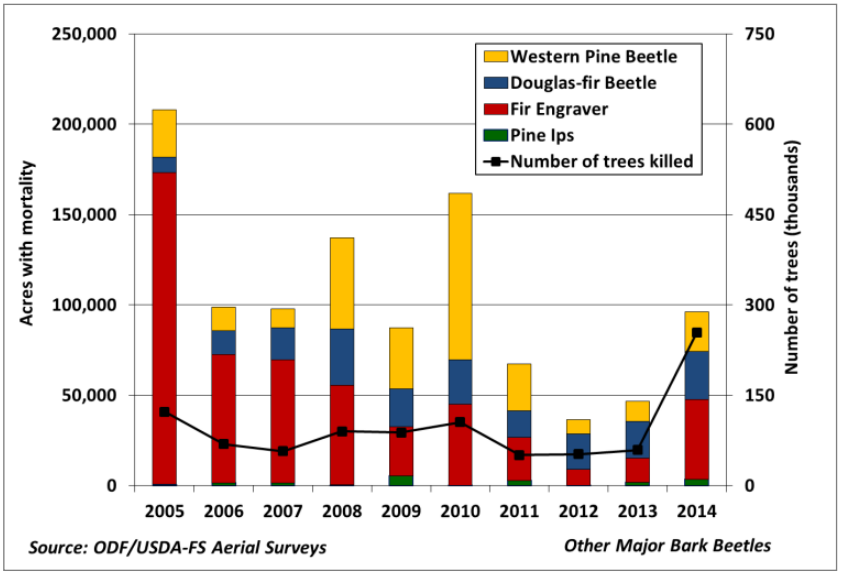


Figure 7. *Ten-year trend for total acres affected and estimated number of trees killed by the major bark beetles in Oregon.*

Douglas-fir Beetle Outbreaks Linked to Winter Storms

In 2014, over 26,000 acres of Douglas-fir beetle (DFB) damage were mapped statewide, which was 32% higher than in 2013 and an increase from the 10-year average (Figure 7). Tree mortality due to DFB is often associated with root diseases, fires, and insect defoliation.

Robbie Flowers, USDA Forest Service

Figure 8. *Current outbreaks of DFB in the Columbia River Gorge are connected to storm damage in 2012.*

Outbreaks in western Oregon are often linked to storm damage and blowdown events. Tree mortality this year was most apparent along the Columbia River Gorge in Hood River and Wasco Counties (Figure 8) and scattered in the Blue Mountains. Outbreaks along the Columbia River Gorge appear to be have been connected to winter storms from 2012. Drought conditions in eastern Oregon have created conditions that favor the success of DFB populations and have increased the likelihood of damage in the coming year.

Fir Engraver in Northeast Oregon

Fir engravers can infest all species of true fir (*Abies* spp.) in Oregon, but most commonly affect grand, white, and noble firs in forest settings. In 2014, aerial surveys documented fir engraver damage on over 44,000 acres, representing a three-fold increase from 2013, but remaining below the 10-year average (Figure 7). Increased 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 of central and southwest Oregon (Figure 9). Similar to WPB, outbreaks of fir engraver are closely tied to tree moisture stress related to drought conditions. With moderate-to-severe droughts now occurring across much of the forested areas of southwest and eastern Oregon, fir engraver damage is expected to increase in the near future, especially where hosts are growing at higher densities or on more drought-prone sites.

Oregon State University

Figure 9. *Fir engraver outbreaks are strongly tied to moisture stress brought on by drought conditions.*

California Fivespined Ips in the Columbia River Gorge

Damage from the California fivespined *Ips* (CFI) has historically been reported in areas of western Oregon where pine species are present, but only recently has it been documented contributing to tree mortality along the Columbia River Gorge. Outbreak levels have been observed along both the Oregon and Washington sides of the Columbia River Gorge since 2010. Over 3,400 acres of mortality were mapped during aerial surveys in Hood River and Wasco Counties in 2014, representing a 79% increase from 2013. This trend appears to be driven by greater stress associated with recent fire and storm damage as well as drought. Cooperative trapping efforts by state and federal agencies from 2010-2014 have demonstrated that CFI occurs much further North and East than historical range maps indicate. Examinations of trees infested with CFI in these areas have also shown the presence of attacks by WPB.

Glenn Kohler, WA DNR

Figure 10. *Increased top-kill and mortality of ponderosa pine occurred along the Columbia River Gorge.*

Western Spruce Budworm Declines

Historically, western spruce budworm (WSB) has been the most damaging defoliating insect in eastern Oregon. Its primary hosts are Douglas-fir, true firs, Engelmann spruce, and western larch. Defoliation from current outbreaks has been observed since 2001. However, over the last few years, aerial detections have declined substantially; from 79,000 acres in 2012 to 300 and 1,300 acres in 2013 and 2014, respectively. Detections this year occurred in the Malheur National Forest near the Strawberry Mountain Wilderness in northeast Oregon. Defoliation appears to be more widespread than was aerially detected and the signature may have been obscured due to a late flush of foliage in some areas. Ground surveys found that budworm larvae continue to be rare in areas where they overlap with recent pine butterfly outbreak.

Western Oak Looper Outbreak Continues

Severe defoliation by the Western oak looper continued to occur in areas of the mid-Willamette Valley of western Oregon this year (Figure 11). In 2014, over 7,300 acres of defoliation was observed, a significant increase from the over 2,400 acres recorded in 2013. Oregon white oak is the primary host but larvae were also observed feeding heavily on Douglas-fir, grand fir, bigleaf maple, Oregon ash, and other hosts within and immediately adjacent to outbreak areas. In 2014 mortality was observed in some Douglas-fir that were severely defoliated in 2013 (Figure 12). Outbreaks tend to be episodic and are short-lived with peak defoliation lasting 2-3 years. This appears to be the second or third year of the outbreak in most areas, therefore declines are expected in 2015.

Robbie Flowers, USDA Forest Service

Figure 11. *Severe defoliation by the Western oak looper in the Willamette Valley of western Oregon.*

David Shaw, Oregon State Univ.

Figure 12. *Some Douglas-fir mortality occurred this year due to the effects of heavy defoliation in 2013.*

Western Tent Caterpillar in Northwest Oregon

Western tent caterpillar is a native moth whose larvae can feed on a wide variety of hardwood tree and shrub species. The caterpillars often occur grouped together, located within or near silk "tents" they construct within the tree (Figure 13). Outbreaks by this insect in Oregon are common with the latest occurring in northwest Oregon from 2001-2002. In 2014, over 11,000 acres of defoliation by western tent caterpillar was observed in the Coast Range, making this the largest documented outbreak in Oregon in the last two decades (Figure 14). The areas mapped during aerial surveys were primarily located in the northern portion of Columbia County adjacent to the Columbia River, but damage was also observed nearby in southwest Washington.

Robbie Flowers, USDA Forest Service

Figure 13. *Western tent caterpillar larvae feed on red alder and a variety of other hosts.*

Robbie Flowers, USDA Forest Service

Figure 14. *An outbreak of western tent caterpillars caused heavy defoliation in localized areas of northwest Oregon.*

The primary species affected was red alder, but many other hardwoods were also defoliated. Damage within affected areas was highly variable, ranging from light to severe defoliation. Historically, outbreaks have been short-lived, persisting for 1-2 years, with only minor growth loss reported. Parasitic wasps and viruses have been identified as among the most significant natural control agents that can quickly reduce populations from outbreak to endemic levels.

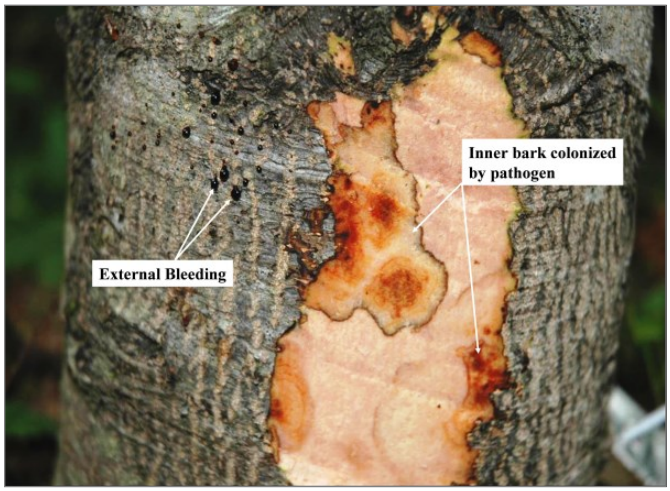
Balsam Woolly Adelgid Impacts Continue (*Non-Native*)

The balsam woolly adelgid is a long-established, non-native sap-feeding insect of true firs in Oregon. It feeds by piercing through bark causing swelling and dieback on stems and branches. Damage from the balsam woolly adelgid continues to be widespread is currently affecting subalpine and Pacific silver firs at high elevations across central and eastern Oregon. In 2014, approximately 77,000 acres were mapped during aerial surveys. This was similar to the area detected in 2013 and below the 10-year average of over 109,000 acres. A trend toward decreased detections in many areas appears to be due more to the continued decline and mortality of highly preferred hosts rather than changes in adelgid activity levels and populations.

Forest Disease Damage and Trends

Sudden Oak Death Intensifies in Curry County

Sudden Oak Death, 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 15). Tanoaks are the most susceptible, but it also causes leaf blight or shoot dieback on a number of other hosts including rhododendron, evergreen huckleberry, Douglas-fir, and Oregon myrtle (Figure 16). In Oregon forests these hosts are only infected when growing very near infected tanoaks.



Alan Kanaskie , OR Dept. of Forestry

Figure 15. *Stem lesion on tanoak caused by* P. ramorum.

Alan Kanaskie, OR Dept. of Forestry

Figure 16. *Dieback of grand fir caused by* P. ramorum *infection. In Oregon forests, most plant species only become infected when growing near infected tanoaks.*

Alan Kanaskie, OR Dept. of Forestry

Figure 17. *Cutting and piling tanoak on a SOD site in preparation for burning 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.

Sudden oak death probably arrived in Oregon near the town of Brookings in 1997 or 1998, but it was not discovered until 2001. Since then an interagency team has been eradicating and slowing spread of the pathogen through a program of early detection and destruction of nearby infected host plants (Figure 17). Between 2001 and 2009 all infested sites received eradication treatments. In 2010, disease levels began to exceed 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 to ensure sufficient funds to treat higher -priority infestations near the quarantine boundary. In 2012, a Generally Infested Area (GIA) was declared in which eradication treatments are no longer required on private land. All sites on federal land continue to be treated, regardless of location. Despite control efforts, sudden oak death continued to intensify and spread in Curry county forests during 2014 (Figure 18).

Alan Kanaskie , OR Dept. of Forestry

Figure 18. *Dead and dying tanoak in an active sudden oak death infestation near Brookings, OR. Dead trees increase risk of wildfire and are hazards when near dwellings and roadways.*

Thirteen new infestations were found outside of the GIA; one was 0.3 mi outside the Quarantine boundary, and two others were within one mile of the Quarantine boundary (Figure 19, next page). As a result, the 264 mi^2 quarantine area will be expanded in 2015. The GIA was expanded from 56 mi^2 to 58 mi^2 in response to new large infestations along its northern edge.

Tree mortality increased rapidly in the GIA during 2014. Large numbers of dead and dying trees have increased the risk of wildfire and property damage from falling trees, and dead trees along road ways present significant hazards. Because of limited funds for eradication treatments, the size of treatment areas on private land was reduced in order to allow some level of treatment on all sites outside the GIA.

P. ramorum is known to occur in forests only in Oregon, California (15 counties) and a few European countries. It poses a tremendous threat to tanoak ecosystems in Oregon and California, and to forest ecosystems 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 trade of many forest and agricultural commodities.

For Sudden Oak Death quarantine regulations, visit:
http://www.suddenoakdeath.org/diagnosis-and-management/regulations/

For other information on Sudden Oak Death, visit:
http://www.suddenoakdeath.org/

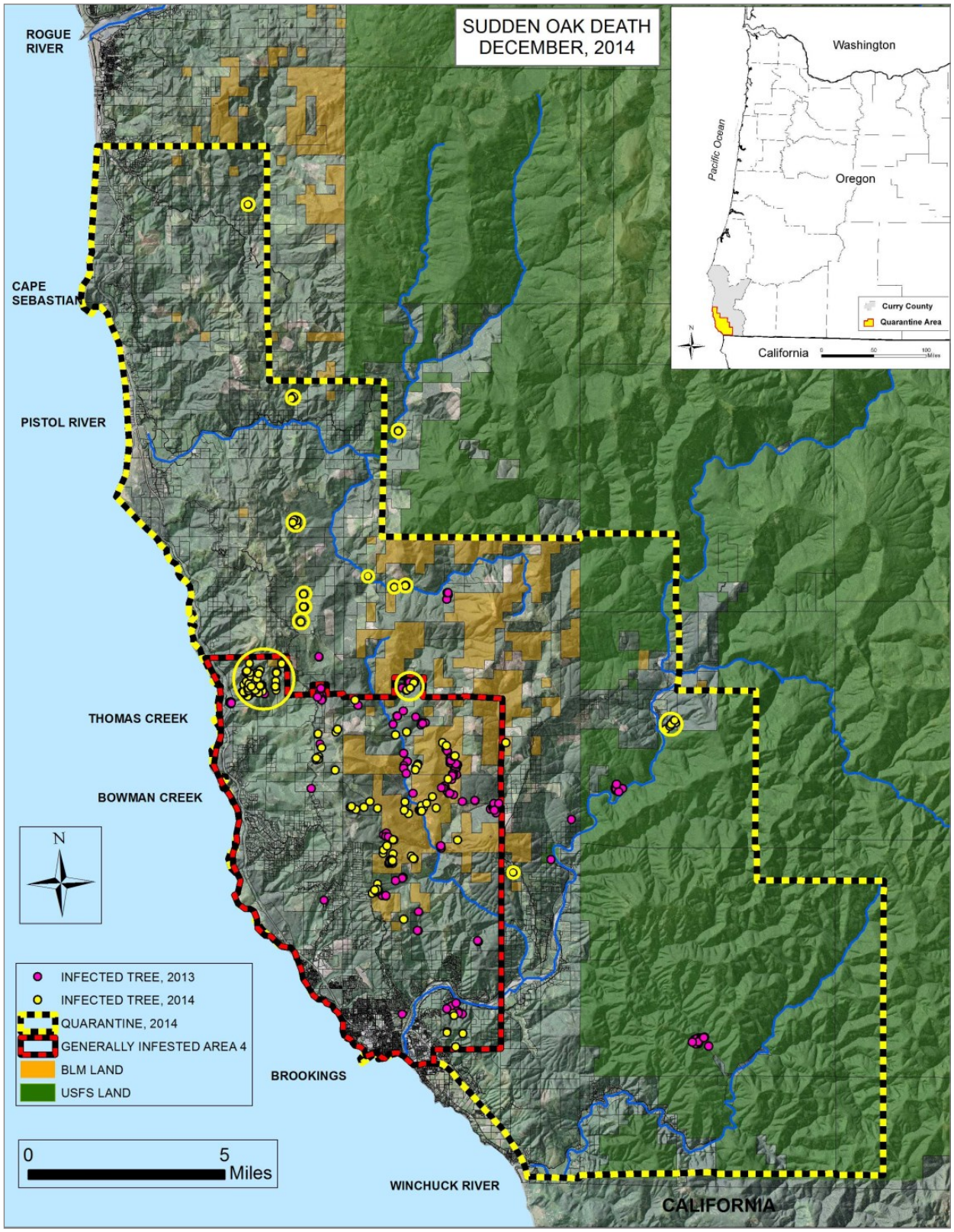


Figure 19. *Quarantine boundary and location of trees infected with* Phytophthora ramorum *found in 2014. Yellow circles indicate high-priority sites. The infestation is more widespread inside the Generally Infested Area (GIA) than shown on the map, due to decreased survey effort. Map by A. Kanaskie, ODF.*

Swiss Needle Cast Increases for Fifth Consecutive Year

Swiss needle cast (SNC) is a disease of Douglas-fir foliage caused by the native fungus *Phaeocryptopus gaeumannii*. It causes needles to turn yellow and fall prematurely from trees, ultimately reducing tree growth and survival (Figure 20). Tree mortality is rare, occurring only after many years of defoliation. Since the late 1980's, the disease has become particularly damaging to Douglas-fir forests on the western slopes of the Oregon Coast Range. Growth loss as a result of SNC correlates with the amount of defoliation caused by the disease. Trees with severe defoliation (only one years growth remaining) grow 50% less volume per year compared to healthy trees. 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, with an impact on the Oregon economy of over $128 million per year (jobs, labor income, and tax revenue). Swiss needle cast also alters wood properties which can lower value of certain lumber products, and its effect on stand development complicates management decisions. Aerial surveys to detect and map the distribution of SNC damage have been done annually since 1996. Aerial observers map areas of Douglas-fir forest with obvious yellow to yellow-brown foliage, a symptom of moderate to severe SNC damage.

Alan Kanaskie , OR Dept. of Forestry

Figure 20. *Swiss needle cast causes foliage loss and sparse, yellow crowns in Douglas-fir (left), reducing volume growth. Other tree species such as western hemlock (right), are unaffected.*

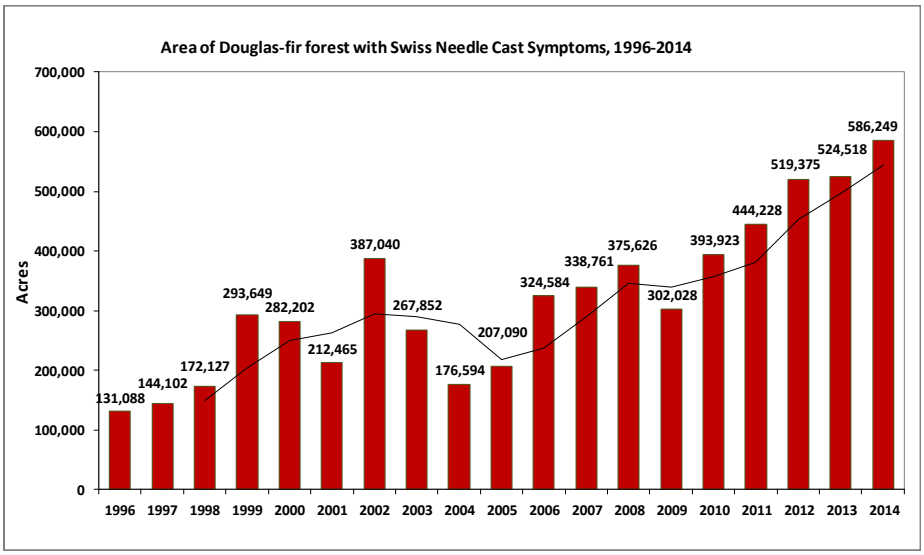


Figure 21. *Area of Douglas-fir forests in western Oregon with symptoms of SNC detected during aerial surveys in April and May, 1996-2014.*

The 2014 survey covered a total of 3.8 million acres in the Coast Range, and recorded an all-time high of 586,249 acres of Douglas-fir forest with symptoms of Swiss needle cast (Figure 21). The easternmost area with symptoms was approximately 28 miles inland from the coast in the Highway 20 corridor, but most

occurred within 18 miles of the coast (Figure 22). This year's increase in SNC is likely due in part to prolonged wet weather in spring 2013; these conditions were conducive to infection, symptom development and detection in 2014 (Figure 23). Usually this aerial survey ends in northern Curry County because few symptoms have been observed south of this location. In 2014, the survey extended south through Curry County to the California border and 96 polygons representing 7,362 acres were mapped. Ground checks of a random sample of 14 polygons confirmed that SNC was present in all of them. However, in 15% of the polygons, factors other than SNC were the cause of observed symptoms.

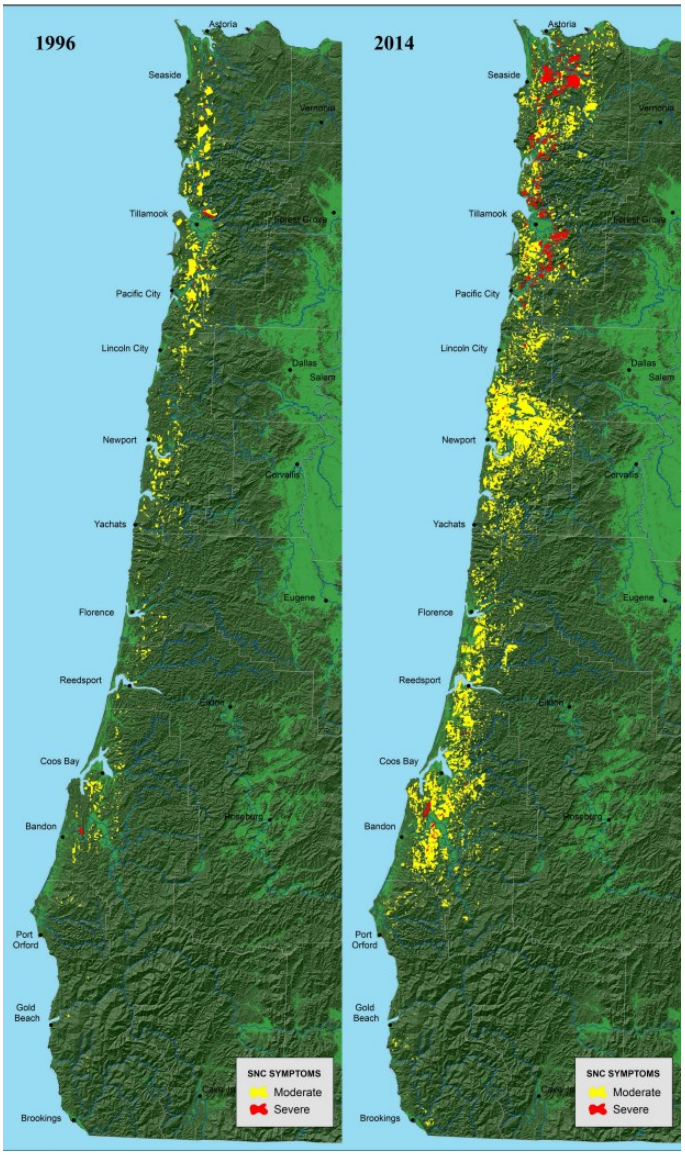


Figure 22. *Areas of Douglas-fir forest with symptoms of SNC detected in the 1996 (left) and 2014 (right) aerial surveys. Only severe and moderate damage are detected in aerial surveys. Map by Alan Kanaskie, ODF.*

Robbie Flowers, USDA Forest Service

Figure 23. *Aerial surveyors map SNC based on the yellow to yellow-brown color of infected Douglas-fir in April and May. Dark green conifers in the image are hemlock and spruce; light green trees are red alder.*

The total area of forest affected by SNC is far greater than indicated by aerial surveys. The disease occurs throughout the state's Douglas-fir forests, but discoloration often is not severe enough to enable aerial detection. Damage by SNC continues at very high levels despite a shift in forest management by many landowners to increase the amount of non-host species such as hemlock, western red cedar, and red alder.

For Swiss Needle Cast Maps and GIS data, visit:
http://www.oregon.gov/odf/privateforests/pages/fhMaps.aspx

For information on the Swiss Needle Cast Cooperative, visit: *http://sncc.forestry.oregonstate.edu/*

White Pine Blister Rust in Western Oregon (*Non-native*)

White pine blister rust, caused by the non-native fungus *Cronartium ribicola*, has been present in Oregon since the 1920's and continues to damage western white pine, sugar pine and whitebark pine throughout the state (Figure 24). The unique high-elevation whitebark pine forests near timberline are particularly threatened by a combination of blister rust and bark beetles. For many decades resource managers were reluctant to plant or manage five-needle pines because of blister rust. Fortunately, The USDA Forest Service rust resistance program at the Dorena Genetic Resource Center is producing seed for growing rust-resistant seedlings. The availability of seed from the resistance program has renewed interest in planting sugar pine and western white pine and will help restore these species in Oregon forests. Western white pine is tolerant to laminated root rot and is often planted in root disease patches instead of the highly susceptible Douglas-fir. White pine plantings in western Oregon, where rust hazard is high, must be pruned one or more times during the first 5 to 15 years to prevent rust infections on branches from reaching the main stem and becoming lethal.

Alan Kanaskie, OR Dept. of Forestry

Figure 24. *Richard Sniezko (USDA-FS Dorena Genetic Resource Center) examines a western white pine plantation in the Oregon Coast range. Young pines must be pruned to prevent white pine blister rust cankers on the main stem.*

Shore Pine Needle Cast Linked to Weather

Alan Kanaskie, OR Dept. of Forestry

Figure 25. *Red band needle blight of shore pine, caused by* Mycosphaerella pini, *was highly visible at many locations in the coastal forests during 2014.*

Shore pine at numerous locations along the central and southern Oregon Coast in 2014 displayed strong symptoms of red-band needle blight (*Mycosphaerella pini,* synonym *Dothistroma pini*) (Figure 25). The aerial survey mapped more than 4,000 acres of damage in coastal forests. Examination of foliage confirmed the disease as red-band needle blight. Rainy periods during the spring and summer of 2013 very likely led to high level of infection seen in 2014.

Madrone Foliage Disease Persists

Leaf blight of Pacific madrone (*Arbutus menziesii*), suspected to be caused by *Phacidiopycnis washingtonensis* and other foliar pathogens, remained quite noticeable throughout the range of Pacific madrone in Oregon in 2014, although, the distribution was patchier than in previous years. In late winter, all leaves on affected trees can appear completely brown, but they typically produce new shoots in spring. Significant branch dieback was observed on trees that have had successive years of damage in the southern Willamette Valley and central Coast Range, but tree mortality was not observed (Figure 26). Long-term effects of repeated severe damage from these foliage diseases are unknown.

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Figure 26. *Leaf blight of Pacific madrone caused by several foliage pathogens was highly visible in parts of western Oregon in 2014. Although most foliage appears dead, the majority of buds are alive and new shoots will emerge in spring.*

Black Stain Root Disease Increases

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Figure 27. *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.*

Several important root diseases affect Oregon forests, but because they do not lend themselves to detection by aerial survey, annual damage trends are lacking. Statewide, laminated root rot (caused by *Phellinus sulphurascens*, synonym *Phellinus weirii*) causes the most damage, especially in the highly productive forests of the Coast and Cascade Ranges. Black stain root disease (caused by *Leptographium wagneri*) causes damage in ponderosa pine forests of eastern Oregon as well as in Douglas-fir forests of western Oregon. Recent reports from landowners suggest that the disease may be on the increase in Douglas-fir plantations in some areas of southwest Oregon. (Figure 27).

Port-Orford Cedar Root Disease (*Non-Native*)

Port-Orford cedar root disease, caused by the non-native pathogen *Phytophthora lateralis*, was first identified in the Port-Orford cedar forests of southwestern Oregon in 1952. Since then this soil- and water-borne pathogen has been spread to many areas throughout the range of Port-Orford cedar in southwest Oregon and northern California (Figure 28). In recent years, the statewide aerial survey has mapped approximately 4,000 acres of Port-Orford cedar mortality per year. Disease management emphasizes excluding the pathogen from areas where it does not yet occur and minimizing spread in already infested areas. This is accomplished through road closures, limiting wet-weather access into stands with Port-Orford-cedar, washing equipment, roadside sanitation, and treating water used for firefighting and road maintenance. Seed from disease-resistant Port-Orford cedar is now being produced through a cooperative program between the USDA-Forest Service, USDI Bureau of Land Management, and Oregon State University. Planting resistant seedlings greatly improves opportunities for restoring this important tree species.

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Figure 28. *Port-Orford cedar root disease is widespread in southwestern Oregon. The soil- and water-borne disease is common along roadsides and streams.*

Cytospora Canker in True Firs

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Figure 29. *Red branch tips, also known as branch "flagging", often is caused by* Cytospora *canker infections on true firs in central and southern Oregon.*

The 2014 aerial survey mapped nearly 20,000 acres of damage to true firs in central and southern Oregon caused by the canker-causing fungus *Cytospora abietis*. *Cytopsora* canker is visible to aerial observers because of branch "flagging" (or dead branches with reddish brown foliage) that persist throughout the year (Figure 29). *Cytospora abietis* is considered a weak pathogen, with infections developing when trees are stressed due to drought or other injury. The disease usually is closely associated with dwarf mistletoe infection because the pathogen invades cracks in the bark that develop on swellings caused by dwarf mistletoes.

Ice Damages Plantations in Benton County

Alan Kanaskie, OR Dept. of Forestry

Figure 30. *Ice accumulation (inset) on branches from a storm in November 2014 caused severe top-breakage in conifer stands in the Coast Range west of Corvallis.*

A freezing rain event in November of 2014 coated branches and tree tops with inches of ice that caused substantial top breakage and other damage in the Coast Range west of Corvallis (Figure 30). The affected area was centered near Blodgett, with a northern extent near King's Valley and a southern extent near the Benton and Lane County line. An aerial survey that covered over 250,000 acres estimated more than 6,600 acres of damage, with ground-based observations suggesting a much larger area. Douglas-fir and red alder were the most severely damaged species. Some whole tree failure was observed, but the majority of damage was top-breakage. In many stands more than 90 percent of the trees had breakage, causing considerable present and future volume loss due to stem deformation and decay from the top-rot fungus *Fomitopsis cajanderi*.

Bear Damage in Conifer Plantations

Black bears damage conifers in western Oregon each spring by peeling the bark to feed on the inner bark. Tree mortality in conifer plantations is most common, but partial peeling of older trees may reduce growth and provide entry points for decay organisms that reduce wood value. In 2014, bear damage was estimated on over 39,000 acres (Figure 31). This year the affected area increased by 2% relative to 2013, and tree mortality remained below the 10-year average. Ground surveys indicate that damage at these sites is also commonly caused by root diseases and moisture stress. Therefore, "bear" damage, as described here, represents a complex of these agents. Factors that may influence peeling damage include the timing and availability of more highly preferred food sources as well as seasonal and local bear population levels and densities.

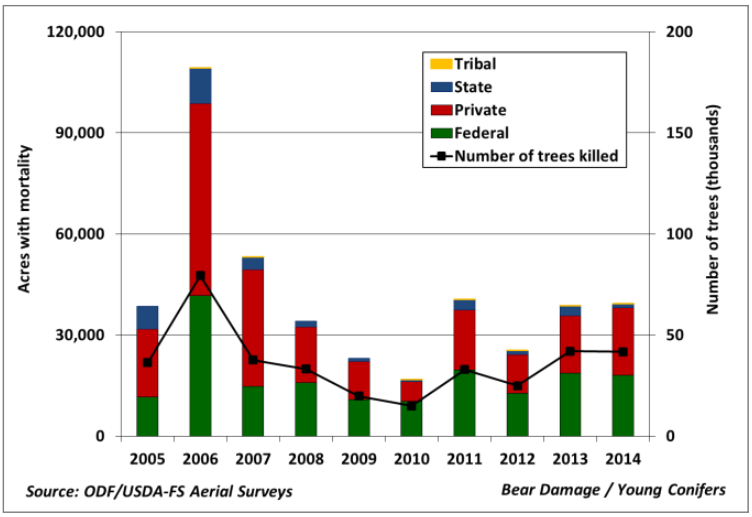

Figure 31. *Ten-year trend of total acres affected by bears and the estimated number of trees killed annually.*

Invasive Species Surveys and Monitoring

Emerald Ash Borer Surveys Continue (*Non-Native*)

In 2014, under a cooperative agreement with USDA APHIS-PPQ, ODF Forest Health conducted its second annual statewide survey for the invasive emerald ash borer (EAB) (*Agrilus planipennis*). The 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 2002 and has now spread to 25 states and has killed over 100 million ash trees despite monumental eradication, quarantine, and outreach efforts. Although this insect disperses naturally by flying (up to 12 miles per year), the primary long-distance dispersal mechanism is human-mediated by the movement of infested firewood. 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 depreciation, and timber revenue losses. The closest known EAB infestation to Oregon is Boulder, CO, where officials detected two small populations in September of 2013. ODF staff placed 198 EAB purple panel traps in conjunction with 55 traps placed in the Portland metro area by APHIS-PPQ for a total of 253 EAB traps across 15 counties statewide (Figure 32). The purple traps were baited with two plant volatile lures (Z-3-hexenol and manuka oil). Trap locations were chosen using a risk model (USDA Forest Health Technology Enterprise Team (FHTET) supplemented by trapper discretion. Among ODF's traps, 111 were chosen based on the FHTET high-risk sites and 87 were chosen as discretionary sites. Traps were placed in May, and checked for EAB at week 8 (July) and Week 16 (September). Lures were replaced at week 8. To date, there have been no EAB detected on any of the Oregon traps.

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USDA Forest Service, Bugwood.org (A)

Figure 32. *Detecting EAB (A) uses a purple prism sticky trap baited with attractant tree volatiles (B).*

Gypsy Moth Surveys Expanded (*Non-Native*)

The Oregon Department of Agriculture (ODA) conducts annual trapping surveys for European gypsy moth (GM) and Asian gypsy moth (AGM). ODF assisted ODA in 2014 by deploying 200 of the 4,089 GM traps placed across the state. Traps are baited with a synthetic sex pheromone to attract males (Figure 33) and are placed from May to September. Of the 200 traps set by ODF staff, 70 were placed by ODF State Forests Division on state lands in the Astoria, Forest Grove and Tillamook Units of Tillamook State Forest, in Santiam State Forest, and on the Southwest Oregon, Western Oregon, and Western Lane Districts. In 2013, cooperative trapping efforts yielded two male GMs in a single trap located 4.5 miles northwest of Grants Pass, the only positive detection in the state that year. In 2014, ODA conducted an intense delimitation survey at this site and captured four additional GMs in three traps 1.5 miles southwest of the 2013 detection. Six GMs captured over the course of two years indicates a low to non-viable population; however, ODA plans to conduct additional delimitation surveys in the vicinity of Grants Pass in 2015 to ensure a reproducing GM population is not developing. ODF anticipates cooperating with ODA in placing GM traps on forest lands again in 2015.

USDA Forest Service, Bugwood.org

Figure 33. *Gypsy moth traps captures adult males using a pheromone lure.*

Scotch Broom Biocontrol Agents Evaluated (*Non-Native*)

In 2014, ODF, in association with ODA, Washington State University Extension, California Department of Food and Agriculture, and the British Columbia Ministry of Forestry, participated in a cooperative regional study focused on assessing the status of biological control agents of Scotch broom. The seed predators evaluated include two beetles, *Exapion fuscirostre* and *Bruchidius villosus*. ODF and ODA staff collected several hundred ripened seed pods from more than 32 sites across the state. The seed pods were dissected and the mean seed destruction across all Oregon sites was 58% with some sites reaching 80-90%. The Oregon data will be incorporated into a larger dataset to assess the effectiveness of the biological control agents at limiting the numbers of seeds produced per plant. Population models predict that if 70% or more of the seed is removed, Scotch broom populations will stop increasing. The seed predators only consume developing seeds inside the current year's pods, so any viable seed remaining in the soil can still emerge decades later. However, the seed predators can limit new seed from being produced, thus helping to stop the spread of this highly invasive forest weed.

For more information on Scotch broom and other invasive forest weeds, visit:
http://www.oregon.gov/ODA/plant/weeds/Pages/index.aspx

Special Aerial Survey for Invasive Gorse (*Non-Native*)

In March 2014, ODF Forest Health staff conducted a special aerial survey for the invasive forest weed gorse. Five survey area plots in Coos and Curry counties, totaling over 300,000 acres (the epicenter of gorse in the state), were identified by the interagency cooperative Gorse Action Group as priority areas to be surveyed. Mid-March was selected to conduct the survey because this was the peak of the gorse bloom, and occurred prior to the flowering of Scotch broom, a close relative with similar yellow flowers. The yellow flowers were used for aerial detection and affected areas were mapped in the form of polygon figures using digital sketch-mapping (Figure 34). Each polygon was classified into one of two categories based on the population density of gorse: ≥50% canopy cover (High-density) or <50% canopy cover (Low-density). In total, 6,230 acres of gorse were mapped within 181 polygons, and over 4,000 acres were classified as High-density. Follow-up ground surveys revealed that at least 85% of the polygons were comprised of gorse. It is important to track the occurrence of gorse on the landscape because a recent economic analysis by ODA reports that this forest weed currently occupies only 1% of its potential range in Oregon yet wields an estimated economic impact of over $200 million annually to the state.

A brief report of the gorse aerial survey findings, GIS data, and geo-referenced aerial photos are available here: *www.oregon.gov/odf/privateforests/pages/*

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Figure 34. *High-densities of gorse were detected during aerial surveys within the town of Bandon where it was first introduced.*

Additional Information on Forest Health

For annual aerial detection survey data viewers, maps, and GIS shapefiles visit:
http://www.fs.usda.gov/goto/r6/fhp/ads
http://www.oregon.gov/odf/privateforests/pages/fhMaps.aspx

For previous *Forest Health Highlights* reports for Oregon and Washington, visit:
http://www.fs.usda.gov/goto/r6/fhp/highlights

For information on a wide range of forest insects and diseases, visit:
http://www.oregon.gov/odf/privateforests/pages/fh.aspx
http://www.fs.usda.gov/main/r6/forest-grasslandhealth/insects-diseases

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