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Forest Health Section

Forest Health Highlights in Oregon - 2013

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Front cover: *Severe defoliation of Oregon white oaks in the Willamette Valley caused by an outbreak of the Western oak looper (*Lambdina fiscellaria somniaria*). (Cover photo by David Shaw, Oregon State University; Inset photo by Elizabeth Willhite, USDA Forest Service)*

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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 functioning 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 vegetative 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 or other actions. The Oregon Department of Forestry (ODF) works cooperatively with the USDA Forest Service and other organizations to monitor forests in Oregon annually. 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 in 2013. 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

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, Coast Range, and western slopes of the Cascade Range, while large areas of eastern Oregon consist of lower density, semi-arid forests and high desert. Statewide forest cover is dominated by Douglas-fir, true firs, western hemlock, and ponderosa pine, while big leaf maple, red alder, Oregon white oak, and cottonwoods are among the most abundant hardwoods.

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 measures of forest condition and health and often detect damaging agents that cannot be observed using aerial surveys (Figure 1).

For more information, visit:
http://www.fs.fed.us/pnw/fia/

PNW Forest Inventory and Analysis

Figure 1. *FIA monitors permanent plots in Oregon to analyze long-term trends and change over time.*

Weather and Drought

Despite abnormally dry conditions throughout Oregon for much of the year, we had the wettest September on record. Storms that dropped several inches of rain along the Coast and in the Willamette Valley also brought lightning that contributed to a large numbers of wildfires. The fall rain and early winter snow was not enough to off-set dry conditions and below-average snowpack for most of the year. The U.S. drought monitor listed 100% of the state as being at least abnormally dry in 2013, with southern Oregon reaching historic levels (Figure 2). Trees growing in stands that are overly dense for the site or those that occur on drought-prone soils are more likely to suffer drought stress and become more suspectible to damage by insects and diseases. They are also less likely to recover when conditions improve.

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

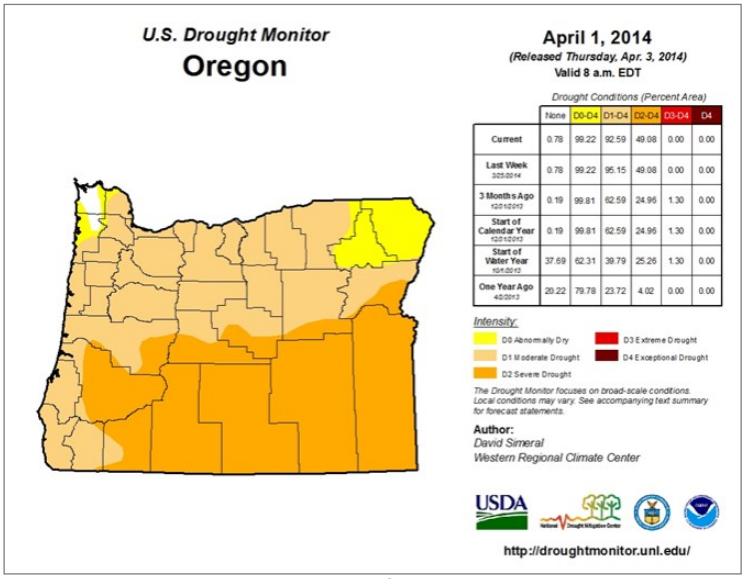

Figure 2. *U.S. drought monitor for Oregon, April 1, 2014.*

Fire

With a backdrop of drought, low snowpack, and high temperatures, an anticipated difficult fire season began early in 2013. Amid hot weather and record-low vegetation moisture, a dry-lightning storm in southwest Oregon on July 26 started over 80 fires. A few grew large, including the Douglas Complex, which became the top-priority fire in the U.S. for 11 days (Figure 3).

Wildfiretoday.com

Figure 3. *The Douglas Complex in southwest Oregon greatly impacted private forest lands.*

More lightning hit eastern Oregon in the days that followed with two fires growing large and threatening the communities of John Day and The Dalles. Of the 16 million acres protected by ODF, over 1,100 fires were reported this year that burned over 103,000 acres. This was the highest total on state-protected lands since 1951 at the end of the Tillamook Burn era. Although suppression costs and timber losses were substantial, cooperative efforts among federal, state, private, tribal, local, and other fire resources minimized the number of large fires that occurred this year, keeping over 94% of starts at 10 acres or less.

Aerial Surveys

Aerial surveys using both fixed-wing aircraft and helicopters are conducted each year to assess forest conditions in Oregon (Figure 4). These include a statewide survey of all designated forest lands and separate surveys for Swiss needle cast and sudden oak death. 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 suspected damaging agent(s) based on the surveyor's identification or knowledge of the tree species present. These methods provide for more comprehensive detection, faster data acquisition, and improved sharing of survey findings at a lower cost than using aerial photography or other remote-sensing techniques. Over 28 million acres were surveyed in the statewide aerial survey in 2013.

Special surveys were conducted over 2.8 million acres in western Oregon to detect damage from Swiss needle cast, a foliage disease of Douglas-fir, and 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 surveys have been conducted annually since 1996 and 2001, respectively. Aerial survey products including digital and paper maps, summary reports, and GIS data are provided to cooperators and other interested parties annually, and are available on the agency websites listed at the conclusion of this report.

Wyatt Williams, OR Dept. of Forestry

Figure 4. *Aerial surveyors use digital sketch-mapping systems to record forest damage.*

Insects

Outbreaks of forest insects occur periodically in Oregon and historically have resulted in significant tree mortality and other damage. In 2013, statewide aerial surveys detected over 460,000 acres of tree mortality and other damage by forest insects. Among these, bark beetles and woodboring insects were observed affecting the most acres (83%), followed by sap-feeding insects, (15%), and defoliating (2%) insects. The total area affected by bark beetles increased by 31% this year, to the highest level since 2010. The total area affected by the major defoliating insects and sap feeding insects, declined by 98% and 27%, respectively. Overall, relative to 2012, there was a 19% decline in the total area observed to have forest insect damage this year, while estimates of tree mortality within affected areas increased more than two-fold.

The majority of tree mortality detected in aerial surveys over the last decade has been due to outbreaks of the mountain pine beetle. While ongoing outbreaks are largely on the decline statewide, a few areas with significantly increased activity drove the upward trend seen this year. In 2013, 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* also increased in 2013, but each remained below their long-term averages and at endemic levels in most areas. Insect defoliation decreased significantly in 2013, due to reduced activity by pine butterfly and western spruce budworm. Localized defoliation by Western oak looper and larch casebearer was observed and chronic damage by balsam woolly adelgid continued in many areas of eastern Oregon.

Mountain Pine Beetle (*Dendroctonus ponderosae*)

In 2013, aerial surveys attributed over 334,000 acres of tree mortality to mountain pine beetle (MPB), an increase of 31% relative to 2012. The most concentrated tree mortality was observed in areas where mature lodgepole pines and other highly susceptible hosts occurred at high densities. Estimates of tree mortality more than doubled relative to 2012 (Figure 5).

The most severe damage seen from MPB in 2013 occurred in the Fremont-Winema National Forests near Crater Lake, Diamond Lake, and Yainix Butte. And, at the southern end of the Blue Mountains in the Wallowa-Whitman and Malheur National Forests. Lodgepole and ponderosa pine mortality was most prevalent, but five-needle pines (western white, sugar, and whitebark) in many areas continued to be greatly impacted (Figure 6).

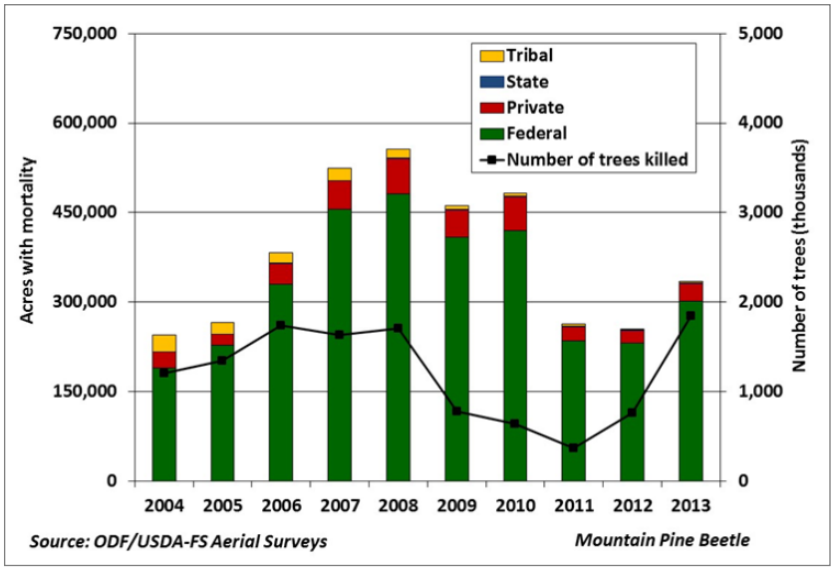

Figure 5. *Ten-year trend for total acres affected and estimated number of trees killed annually by mountain pine beetle in Oregon.*

Rob Flowers, OR Dept. of Forestry

Figure 6. *Ponderosa pine mortality increased in Klamath County in association with ongoing MPB outbreaks.*

Recent MPB outbreaks have resulted in large areas of dead and dying forests that have the potential to fuel major wildfires. 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 (*Dendroctonus brevicomis*)

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, and root diseases. In 2013, over 11,000 acres containing tree mortality consistent with WPB were observed, an increase of 40% from 2012 (Figure 7).

Aerial survey trends showed tree mortality attributed to WPB was below the long-term average, but activity remained widespread. Damage was most apparent on the Warm Springs Indian Reservation and within the Ochoco and Malheur National Forests in central Oregon. WPB is often found in association with MPB and *Ips* spp. and increased ponderosa pine mortality was also noted near outbreaks of these species and in areas damaged by fire.

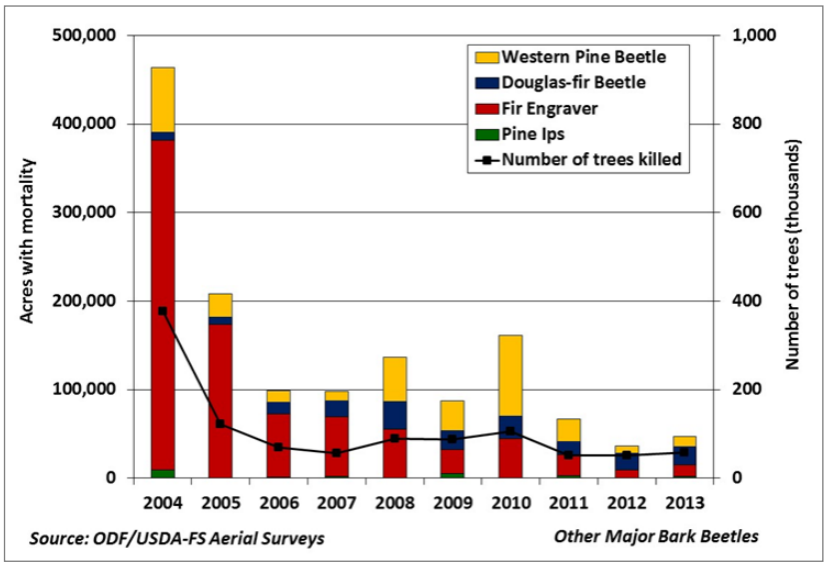

Figure 7. *Ten-year trend for total acres affected and estimated number of trees killed by the major bark beetles in Oregon.*

Douglas-fir Beetle (*Dendroctonus pseudotsugae*)

In 2013, over 20,000 acres were mapped with Douglas-fir beetle (DFB) damage statewide, an increase of 3% from 2012 (Figure 7). At endemic levels, DFB causes scattered tree mortality, often in association with root diseases or fire damage. Outbreaks in Oregon are often linked to large-scale blowdown events, which allow for population increases, or where trees are made more susceptible by wildfire damage or insect defoliation. Tree mortality this year was most apparent within the Willamette and Umpqua National Forests in southern Oregon and scattered across the Umatilla and Wallowa-Whitman National Forests in northeastern Oregon (Figure 8). Drought conditions and recent winter storm damage in many areas of Oregon have created conditions that favor the growth and success of DFB populations and have increased the likelihood of damage in the near future.

Rob Flowers, OR Dept. of Forestry

Figure 8. *DFB create extensive galleries in the inner bark that often leads to tree mortality.*

Fir Engraver (*Scolytus ventralis*)

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 2013, aerial surveys documented fir engraver damage on over 13,000 acres, an increase of 51% from 2012 (Figure 9). However, populations remained at endemic levels in most areas and damage fell well below the long-term average.

Scattered damage and individual tree mortality due to fir engraver was observed in most areas this year, while more concentrated damage was detected on the Rogue River National Forest in southern Oregon and the Umatilla and Wallowa-Whitman National Forests in northeastern Oregon. With moderate-to-severe drought conditions now occurring across the many areas of southwestern and eastern Oregon, fir engraver damage is expected to increase in the near term, especially where hosts are growing at high densities or on drought-prone sites.

Bill Ciesla, USDA Forest Service

Figure 9. *Fir engraver attacks can cause branch-kill, top-kill, and tree mortality in true firs.*

California Fivespined Ips (*Ips paraconfusus*)

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. Damage currently extends in Oregon East into Hood River and Wasco Counties and North into Washington. Attacks on ponderosa pine by CFI in these areas have been seen since 2010, and over 1,900 acres with mortality were mapped during aerial surveys in 2013 (Figure 10). Anecdotal evidence suggests recent trends are being driven by greater drought stress, in association with recent fire and storm damage, which has increased local CFI populations. Cooperative educational efforts to help landowners manage currently infested trees are ongoing, as well as research focused on documenting the current extent of CFI and examine its co-occurrence with WPB and pine engraver (*Ips pini*).

Rob Flowers, OR Dept. of Forestry

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

Flatheaded Fir Borer (*Phaenops drummondi*)

The flatheaded fir borer (FFB) has historically been associated with mortality of Douglas-fir in southwest Oregon. Stressed trees or those growing at more drought-prone sites appear to be most commonly affected (Figure 11). In 2013, aerial surveys detected over 2,000 acres in which tree mortality was occurring, a decline of 9% relative to 2012.

Bill Schaupp, USDA Forest Service Steve Valley, OR Dept. of Ag.

Figure 11. *FFB has been linked to mortality of Douglas-fir in southwest Oregon.*

Tree mortality this year was most evident in the Siskiyou Mountains, the Rogue River and Umpqua National Forests, and adjacent private lands. Ground surveys indicate that while other insects and diseases, as well as environmental factors are contributing to chronic Douglas-fir decline and mortality in some areas, infestation by FFB in these trees is significant. The USDA Forest Service recently completed geo-spatial analyses to examine cumulative mortality from FFB since 1971, and the risk of future mortality in Jackson and Josephine Counties. Factors including slope and elevation were examined to gain a better understanding of damage trends.

Western Spruce Budworm (*Choristoneura freemanii*)

Historically, the western spruce budworm (WSB) has been the most damaging defoliating insect in eastern Oregon, affecting Douglas-fir, true firs, Engelmann spruce, and western larch. Defoliation from current outbreaks has been observed since 2001. In 2013, aerial detections declined significantly, from 79,000 acres in 2012, to 300 acres this year, the lowest activity reported since 2005 (Figure 12). Detections this year occurred in the Malheur National Forest near the Strawberry Mountains in northeastern Oregon. Defoliation is likely more widespread than was aerially detected and the signature may have been obscured due to a late flush of new foliage in some areas. Ground surveys found WSB damage to be rare within the area where they have been co-occurring with a large outbreak of pine butterfly; whose populations collapsed this year.

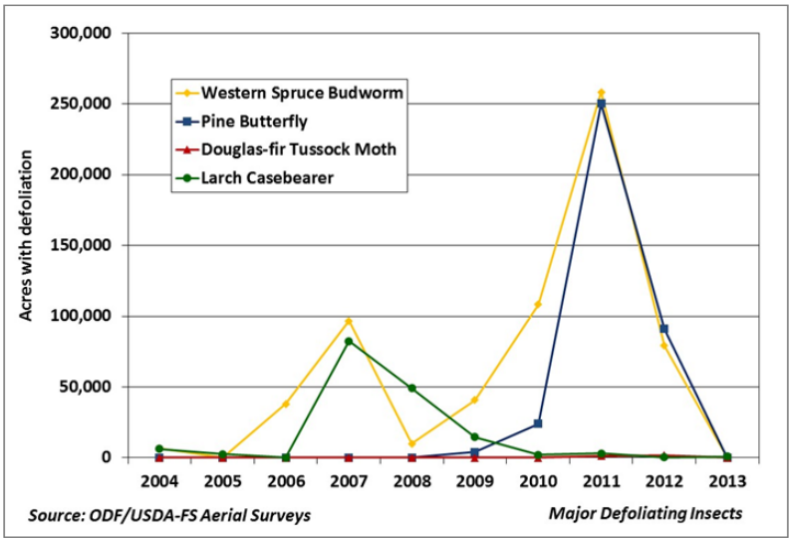

Figure 12. *Ten-year trend of the total area affected by insect defoliators in Oregon, as detected by annual aerial surveys.*

Pine Butterfly (*Neophasia menapia*)

The pine butterfly is a native insect that is commonly observed at endemic levels in Oregon. Pine butterfly outbreaks occur at widely-spaced, irregular intervals and usually last from 3-5 years. During outbreaks, large areas can be completely defoliated for several consecutive years, and tree mortality can result in association with attacks by bark beetles, drought, and other factors. Aerial surveys have detected defoliation from pine butterfly within the Malheur National Forest since 2009 (Figure 12). The peak of the outbreak was in 2011, affecting over 250,000 acres, and making it the largest ever recorded in Oregon. The outbreak began to decline in 2012, with the total defoliated area decreasing by 64%. The outbreak continued to collapse in 2013, and no observable defoliation was recorded this year (Figure 13).

Rob Flowers, OR Dept. of Forestry

Figure 13. *No visible pine butterfly defoliation was observed in 2013, indicating the outbreak has collapsed.*

Ari DeMarco, OR State University

Figure 14. *Natural enemies were abundant in 2012-2013 and contributed to the end of the outbreak.*

The collapse of the outbreak appeared to be due in part to an increased number of natural enemies and larval starvation due to host depletion, among other factors. The most commonly observed natural enemies were parasitic wasps (*Theronia atalantae*) and hemipteran predators (*Podisus* sp.) which attacked both larvae and pupae (Figure 14).

Rob Flowers, OR Dept. of Forestry

Figure 15. *Cooperative monitoring and research efforts on pine butterfly are continuing.*

A cooperative research effort, led by Oregon State University, installed 75 plot transects in 25 stands with severe defoliation during 2012-2013 (Figure 15). Over 500 trees have been tagged and will be re-assessed annually for up to 3 years. Initial findings indicate very low incidence of tree mortality. Mean defoliation was also not significantly different by stand density, structure, tree crown class, or position within the canopy.

Therefore, it seems unlikely that specific silvicultural guidance for pine butterfly is needed. Ongoing research includes evaluating radial growth loss, describing the natural enemy complex, and geo-spatial analyses of outbreak dynamics relative to environmental conditions (Figure 16).

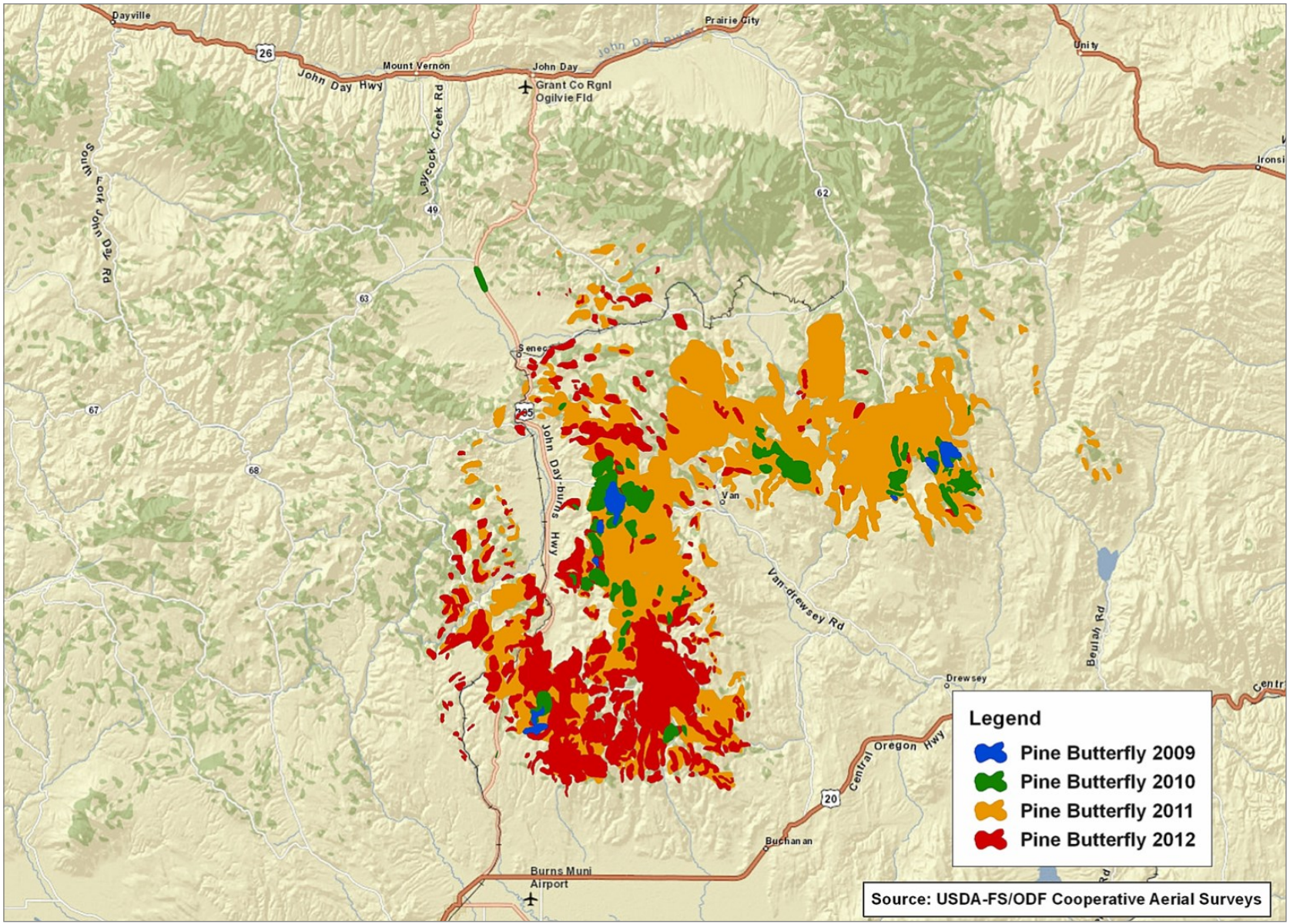

Figure 16. *Defoliation by pine butterfly as detected by aerial surveys, 2009-2012. No defoliation was visible in 2013. Map by: Rob Flowers, ODF.*

Western Oak Looper *(Lambdina fiscellaria somniaria)*

In 2013, severe defoliation by the Western oak looper occurred in highly localized areas of the Willamette Valley in western Oregon. Oregon white oaks were the primary host affected, but larvae were also observed feeding on Douglas-fir, grand fir, bigleaf maple, ash, and other hosts within and adjacent to outbreak areas (Figure 17). Ash appeared to be uncharacteristically preferred over white oak within the W.L. Finley Wildlife Refuge near Corvallis. Outbreaks tend to be episodic and are short-lived with peak defoliation lasting 2-3 years. This appears to be the first or second year of the outbreak in most areas, so defoliation is expected to continue in some areas in 2014.

Wyatt Williams, OR Dept. of Forestry

Figure 17. *Severe defoliation by the Western oak looper on white oak and intermixed Douglas-fir in the Willamette Valley.*

Larch Casebearer (*Coleophora laricella*) *Non-native*

The larch casebearer (LCB) is a long-established, non-native defoliator of western larch in Oregon. In 2013, the defoliation attributed to LCB was estimated at 700 acres, continuing a trend since 2011 of low levels of damage statewide (Figure 12). Defoliation was highly localized on the eastern portion of the Mount Hood National Forest and in northeastern Oregon in the Umatilla and Wallowa-Whitman National Forests. It is known that LCB usually co-occurs with two larch needle diseases, and ground surveys confirmed that that these foliar diseases were more abundant in most areas than LCB this year. Research by Oregon State University indicates that two parasitic wasps, released in the Blue Mountains for biological control of LCB decades ago, are still present in many areas and may be helping to regulate their populations.

Balsam Woolly Adelgid (*Adelges piceae*) *Non-Native*

The balsam woolly adelgid (BWA) is a long-established, non-native sap-feeding insect in Oregon. It feeds through the bark of true firs causing swelling and dieback on stems and branches. Damage continues to be widespread in Oregon with stands of subalpine and Pacific silver firs most impacted in recent years. Damage continues to be seen along the crest of the Cascade Range from Mount Hood south to the Rogue River National Forest and in the Umatilla and Wallowa-Whitman National Forests in northeastern Oregon. In 2013, over 69,000 acres were observed, a decrease from over 95,000 acres detected in 2012. However, this trend appears due more to the continued loss of preferred hosts rather than declines in BWA activity.

Diseases

Sudden Oak Death (SOD)

Sudden Oak Death, caused by the non-native pathogen *Phytophthora ramorum,* can kill highly susceptible tree species such as tanoak, coast live oak, and California black oak by causing lesions on the main stem (Figure 18). Tanoak is by far the most susceptible species in Oregon, and the disease threatens the future of this species. *P. ramorum* also causes leaf blight or shoot dieback on a number of other hosts including rhododendron, evergreen huckleberry, Douglas-fir, and Oregon myrtle (Figure 19).

Alan Kanaskie , OR Dept. of Forestry

Figure 18. *Stem lesion inside the bark of a large tanoak caused by* P. ramorum. *Dark-colored bleeding on the bark surface indicates an inner bark lesion.*

Alan Kanaskie, OR Dept. of Forestry

Figure 19. *Symptoms of* P. ramorum infection *on Douglas-fir (left) and Pacific rhododendron (right).*

Alan Kanaskie, OR Dept. of Forestry

Figure 20. *Cutting and burning host plants to eliminate* P. ramorum *from an infested site near Brookings, OR.*

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 was first discovered in Oregon forests in July 2001 near the coastal city of Brookings, 5 miles north of the California border. Since then an interagency team has been attempting eradication and slowing-the-spread of the pathogen through a program of early detection and destruction of infected and nearby host plants (Figure 20). Between 2001 and 2009 all infested sites received eradication treatments.

Figure 21. *Hillside in the "Generally Infested Area" where sudden oak death has killed most of the tanoaks. Grey and red trees are dead tanoaks; green trees are red alder and Douglas-fir.*

Sudden oak death continued to intensify and spread in Curry county forests during 2013, but it remained within the 264 mi^2 quarantine boundary (Figure 21). Intensification and expansion of the disease near the center of the quarantine area led to expansion of the Generally Infested Area (GIA) from 48 mi^2 to 56 mi^2 (Figure 22, next page). Large numbers of dead and dying trees inside the GIA increase the risk of wildfire and property damage from falling trees.

Tanoak and other host plants can be transported out of the quarantine area only if they are certified as being from a "disease-free area," which is defined as an area located more than one-quarter mile from the GIA or any other infested site, and which has been officially surveyed within the past 6-months and found free of *P. ramorum*.

Outside of Curry County, Oregon, *P. ramorum* is known to occur in forests only in California (14 counties) and several European countries. *P. ramorum* has the potential to spread throughout coastal Oregon, Washington, California, and British Columbia. If allowed to spread it will seriously damage the ecology of southwestern Oregon forests, and the resulting quarantine regulations would disrupt domestic and international trade of many forest and agricultural commodities.

For more information on SOD quarantine regulations in Oregon, visit:
http://www.oregon.gov/oda/cid/plant_health/sod_index.shtml

For more information on the National SOD program, visit:
http://www.aphis.usda.gov/plant_health/plant_pest_info/pram/

For more information on SOD research and monitoring, visit:
http://www.suddenoakdeath.org/

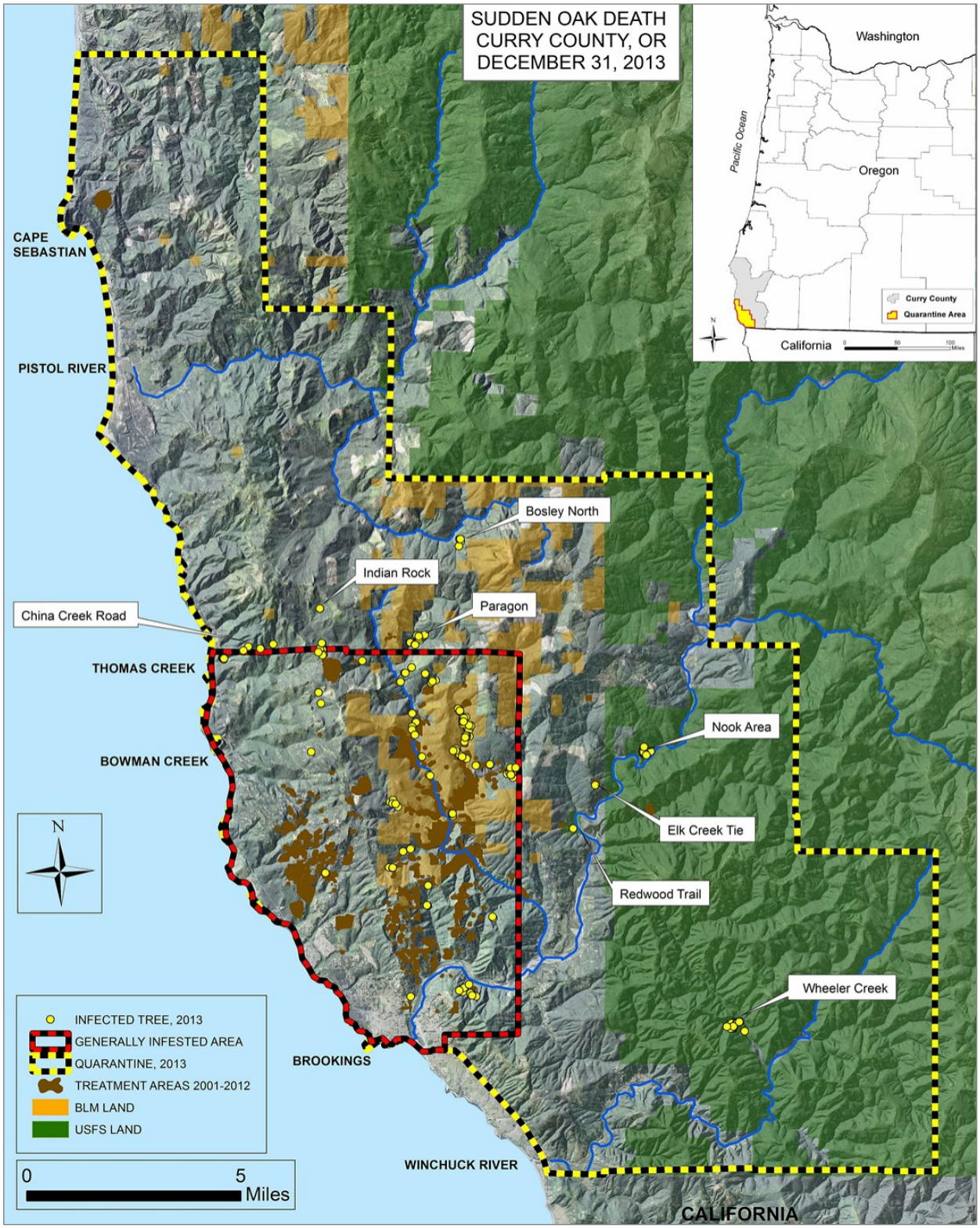

Figure 22. *Quarantine boundary and location of trees infected with* Phytophthora ramorum *in 2013. The infestation is more widespread inside the Generally Infested Area (GIA) than is shown on the map. New infestations outside the GIA or on federal land are receiving eradication treatments. Map by: Alan Kanakie, ODF.*

Swiss Needle Cast (SNC)

Swiss needle cast (SNC) is a disease of Douglas-fir foliage caused by the native fungus *Phaeocryptopus gaeumannii* (Figure 23). It causes needles to turn yellow and fall prematurely from trees, ultimately reducing tree growth and survival. 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 annual foliage compliment remaining on the tree) grow 50% less volume per year compared to healthy trees (Figure 24). Growth loss due to SNC in the Oregon Coast Range is estimated at more than 100 million board feet per year. In addition to growth impacts, SNC alters wood properties and affects stand development. This complicates stand management decisions, especially in pure Douglas-fir stands.

Alan Kanaskie , OR Dept. of Forestry

Figure 23. *Swiss needle cast causes foliage loss and sparse, yellow crowns in Douglas-fir (left). Other tree species at these sites, including western hemlock (right), are unaffected.*

Alan Kanaskie , OR Dept. of Forestry

Figure 24. *Foliage loss and damage from SNC can reduce tree volume growth by more than 50%. The Douglas-fir (left) is 5 years older than the western hemlock (right) and growing in the same plantation, but much smaller in diameter because of SNC.*

Aerial surveys to detect and map the distribution of SNC damage have been flown annually since 1996. In western Oregon, SNC presents a unique aerial survey signature that is highly visible for approximately 6 to 8 weeks each year prior to bud break, usually from late April to early June. Aerial observers map areas of Douglas-fir forest with obvious yellow to yellow-brown foliage, a symptom of moderate to severe SNC damage.

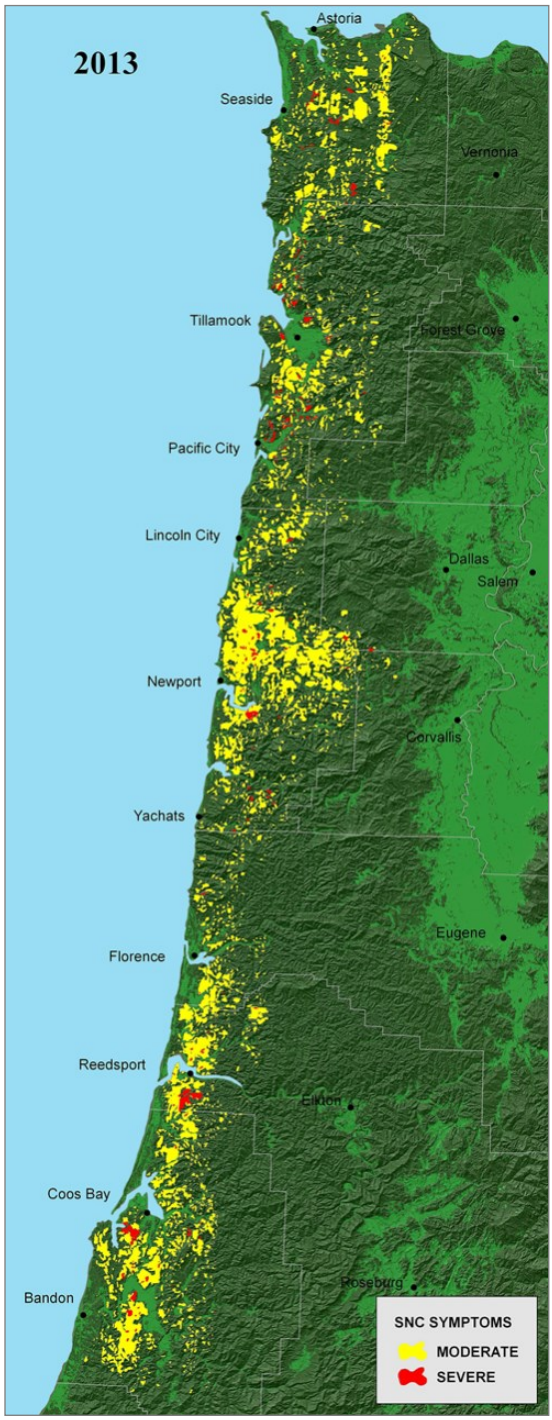

Figure 26. *Areas of Douglas-fir forest with symptoms of SNC detected in the 2013 aerial survey. Map by Alan Kanaskie, ODF.*

The 2013 SNC survey over the Oregon Coast Range was flown during the first week of May and covered approximately 2.8 million acres of forest. The survey mapped over 524,500 acres of Douglas-fir forest with symptoms of SNC, reaching an all-time high for the fourth year in a row (Figure 25).

Obvious SNC symptoms were visible up to 28 miles inland from the Coast in the Highway 20 corridor, but most occurred within 18 miles of the Coast (Figure 26). The Cascade Range was not surveyed, but ground surveys indicate that SNC does occur at damaging levels there in a few areas.

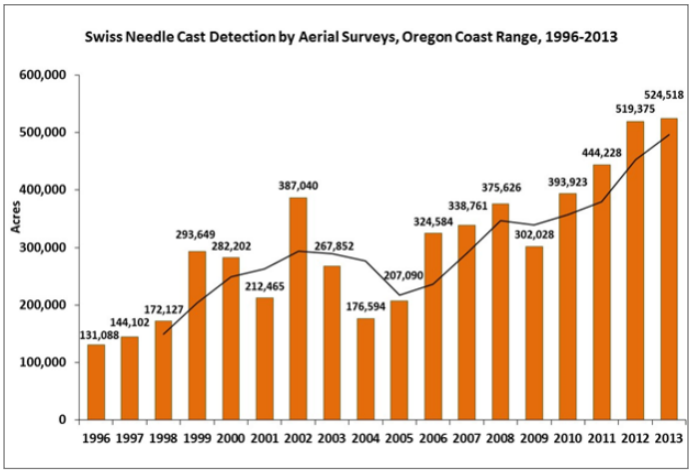

Figure 25. *Area of Douglas-fir forests in western Oregon with symptoms of SNC detected during aerial surveys in April and May, 1996-2012.*

The total area of forest affected by SNC is far greater than indicated by the aerial surveys. Swiss needle cast 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 by many landowners to forest management practices that reduce damage from SNC and increase the amount of non-host tree 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 (SNCC), visit:
http://sncc.forestry.oregonstate.edu/

Madrone Foliage Disease

Leaf blight of Pacific madrone (*Arbutus menziesii*), suspected to be caused by *Phacidiopycnis washingtonensis* and possibly other foliar pathogens, remained quite noticeable throughout the range of Pacific madrone in Oregon. However, damage was generally less severe than during the past two years (Figure 27). Despite the dramatic appearance of trees with heavy infection we have not observed any tree mortality from the disease, but the long term effects of chronic disease are unknown.

Alan Kanaskie, OR Dept. of Forestry

Figure 27. *Leaf blight of Pacific madrone remained highly visible in Oregon in 2013. Even when most foliage appears dead, new shoots continue to emerge the following spring.*

For additional information on madrone leaf blight, visit:
http://www.puyallup.wsu.edu/ppo/madrone/diseases/foliar_blight_2012.html

Larch Foliage Diseases

Alan Kanaskie, OR Dept. of Forestry

Figure 28. *Larch needle blight is a foliage disease that was highly visible in parts of eastern Oregon in 2013. Foliage disease is often more severe in the lower crown.*

In 2013, aerial surveys indicated an increase, at nearly three times the 10-year average, in larch needle foliar diseases. Larch needle cast (*Meria laricis*) and larch needle blight (*Hypodermella laricis*) occur in areas of eastern Oregon where western larch is abundant. Infection by both diseases results in foliage turning reddish-brown to straw-colored from May to July (Figure 28). Larch needle cast tends to appear earlier than larch needle blight, and damage from both diseases tends to be most severe in the lower crown. Although the damage can be highly visible during years when weather favors infection and intensification of the disease, they appear to have no significant impact on overall growth or survival of larch.

Dead Branches and Tops of Young Douglas-fir

In the early summer of 2013, branches and tops of many young Douglas-fir suddenly died in many areas of western Oregon (Figure 29). In some cases, affected trees displayed stem cankers (localized dead areas on the stem) and/or were attacked by a host of minor bark or twig beetles (*Pityopthorus pseudotsugae*). Damage was most severe on the fringe of forested areas, on shallow, rocky, or drought-prone soils, on former pasture lands, or south aspects. Although other conifers were affected, damage was most common on Douglas-fir less than 30 years old.

Alan Kanaskie, OR Dept. of Forestry

Figure 29. *Douglas-fir branch and top dieback caused by moisture stress in 2012 and secondary effects of insects and pathogens.*

The primary cause of the damage appeared to be water stress resulting from the prolonged summer and fall drought in 2012, but the symptoms did not appear until early 2013. As internal water stress increases, trees become more susceptible to opportunistic insects and diseases. Under severe drought conditions, water content may drop to levels where trees are irreversibly damaged and entire trees or only portions of them may die. The tops of trees and branch tips often die first because they are farthest from the roots. Many trees will survive this injury, but some mortality of younger trees was reported.

Bear Damage

Black bears damage conifers in western Oregon each spring by peeling the bark to feed on inner tissues. 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 2013, bear damage was estimated on over 38,000 acres (Figure 30).

While the affected area increased by 52% relative to 2012, 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 the complex of agents that occur at th. 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.

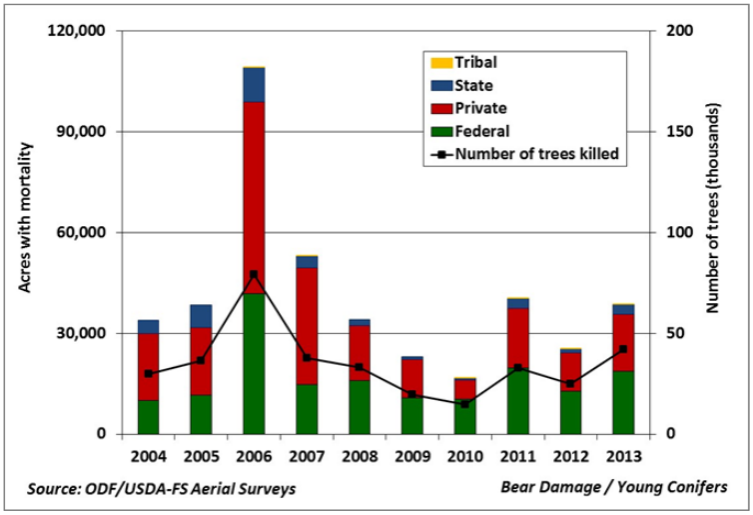

Figure 30. *Ten-year trend of total acres affected by bears and the estimated number of trees killed annually.*

Invasive Species Surveys and Monitoring

Emerald Ash Borer Surveys (*Agrilus plannipennis*)

In 2013, ODF cooperated with USDA APHIS-PPQ to conduct a statewide survey for the invasive Emerald Ash Borer (EAB). ODF personnel first validated a predictive model of ash occurrence, produced by the USDA Forest Service, by visiting 273 grids identified as having a high likelihood of ash (*Fraxinus* spp.). EAB traps were placed at 156 of the grids where hosts occurred and an additional 84 traps were placed in locations perceived to have a high likelihood of EAB introduction (campgrounds, urban areas) (Figure 31).

Wyatt Williams , OR Dept. of Forestry

Figure 31. *EAB trapping in Oregon used a purple prism, sticky traps baited with attractant tree volatiles.*

Wyatt Williams, OR Dept. of Forestry

Figure 32. *EAB traps are placed high in the canopy where there is an abundance of potential ash hosts.*

In total, 240 EAB traps were placed in 10 western Oregon counties from Washington County in the north to Jackson County in the south. Traps were deployed in May, checked and serviced in July, and collected in September (Figure 32). The mean duration of the traps on site was 117 days. No EAB adults were found in 2013 nor did ODF personnel observe symptoms of EAB attack in ash stands (D-shaped exit holes, loose bark, etc.).

In addition, Ari DeMarco, an entomology graduate student at Oregon State University, conducted a summer internship at ODF to investigate the diversity of native beetles captured on EAB traps between May and July. Over 500 beetles were sampled from 27 traps in four counties, and specimens were identified to family and in most cases species. The most abundant families included Elateridae, Throscidae, and Anobiidae, which represented 33%, 19%, and 7%, respectively, of total beetles captured. Many other minor and more rare beetle taxa were encountered, supporting the diverse nature of this insect order. Only two specimens of a native species in the family, Buprestidae, which contains EAB, were captured in the traps and were identified as *Chrysophana placida*. The reference collection from the study has been housed at ODF and includes 142 specimens representing 22 families and over 30 species. The Oregon Department of Agriculture provided assistance for all species identifications.

Gypsy Moth Surveys (*Lymantria dispar*)

The Oregon Department of Agriculture (ODA) conducts annual trapping surveys for gypsy moth (GM) and its Asian strain, the Asian gypsy moth (AGM) (Figure 33). ODA placed over 8,000 traps in Oregon in 2013; in addition, 100 traps were placed by ODF at EAB trapping sites. Traps are baited with a synthetic sex pheromone to attract males and are deployed in May and collected in September. Only two male GMs were captured statewide in 2013; both in a single trap at an ODF site northwest of Grants Pass in southwest Oregon. Delimitation trapping surveys are planned at this site next year. Only a single GM was found in 2012, near Eugene, and follow-up surveys have not detected any additional moths there.

USDA Forest Service, Bugwood.org

Figure 33. *Gypsy moth larvae can feed on over 300 species of trees, shrubs, and plants.*

Top Invasive Species Threats to Oregon's Forests

In 2013, ODF has led efforts to identify the worst invasive species threats to Oregon's forests as a way to focus the ever-decreasing resources available for these pests. A database of 2,237 species was developed from 24 international, national, and regional invasive species lists. The database was then pared down to 270 species that pertained to Oregon's forest ecosystems. The list currently includes 155 plant species (57%), 79 invertebrates (29%), 35 disease-causing microbes (13%), and one mammal. These have been grouped by relative importance into a "control" list, which includes 15 taxa that are present in Oregon and currently causing significant ecological or economic harm to forest ecosystems and a "prevent" list, which includes 13 taxa of organisms that are not currently widespread within the state but could cause significant harm to forests and our forest industries. A "watch" list has been reserved for the bulk of the species, either because they are already widely established, but don't appear to be damaging, or their negative effects are currently unknown. Finally, a "special" list was created for four species that could easily be transported on firefighting equipment, and deserve special consideration. Regional experts are reviewing these lists and further refinements will be made. These efforts will serve as a means of directing statewide efforts at prevention, early detection, and management of invasive forest species. The list is not meant to be exhaustive and will evolve as new invaders appear.

For more information on invasive forest pests, visit:
http://oregoninvasivespeciescouncil.org/
http://www.oregon.gov/ODA/plant/ippm/pages/index.aspx
http://www.oregon.gov/ODA/plant/weeds/Pages/index.aspx

Aerial Survey Maps and GIS Data

For historic and current aerial survey quadrangle maps from 2003 to 2013, visit: *http://www.fs.usda.gov/goto/r6/fhp/ads/maps*

For aerial survey GIS data from Oregon and Washington from 1980 to 2013, visit: *http://www.fs.usda.gov/goto/r6/fhp/ads/data*

For statewide (2003-2013) and Swiss needle cast (1996-2013) aerial survey data and summaries for Oregon, visit: *http://www.oregon.gov/odf/privateforests/pages/fhMaps.aspx*

Additional Information on Forest Health

For Forest Health Highlight reports for Oregon and Washington from 1998-2013, visit: *http://www.fs.usda.gov/goto/r6/fhp/highlights*

For forest health notes on native and non-native forest insects and diseases, visit: *http://www.oregon.gov/odf/privateforests/pages/fhPests.aspx* and *http://www.oregon.gov/odf/privateforests/pages/fhInvasives.aspx*

For information on a broad range of forest health issues in the Pacific Northwest, visit: *http://www.fs.usda.gov/goto/r6/fhp*

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