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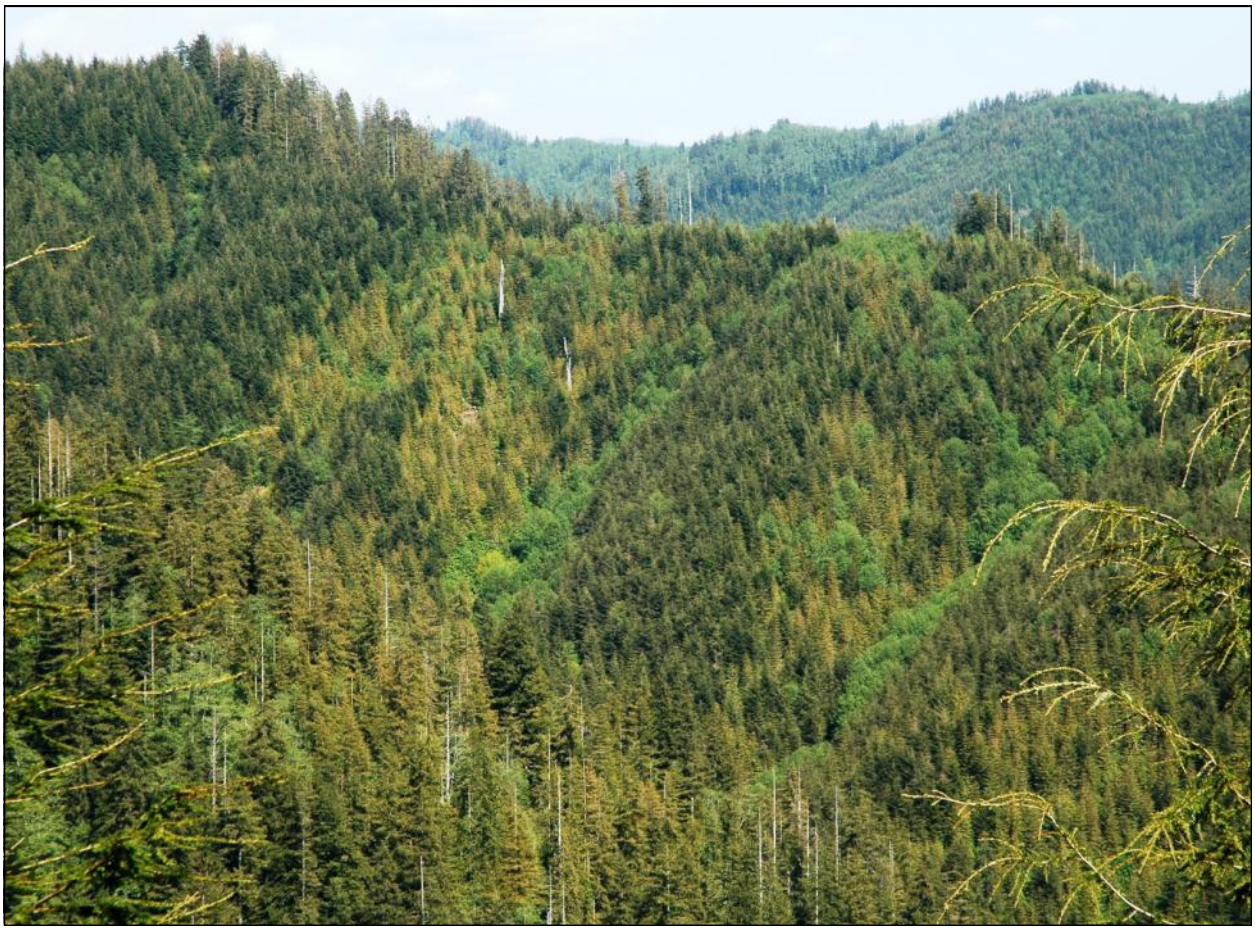
Forest Service
Pacific Northwest Region
Forest Health Protection

Oregon Department of Forestry
Forest Health Section

Forest Health Highlights in Oregon - 2012



May 2013

Forest Health Highlights In Oregon – 2012

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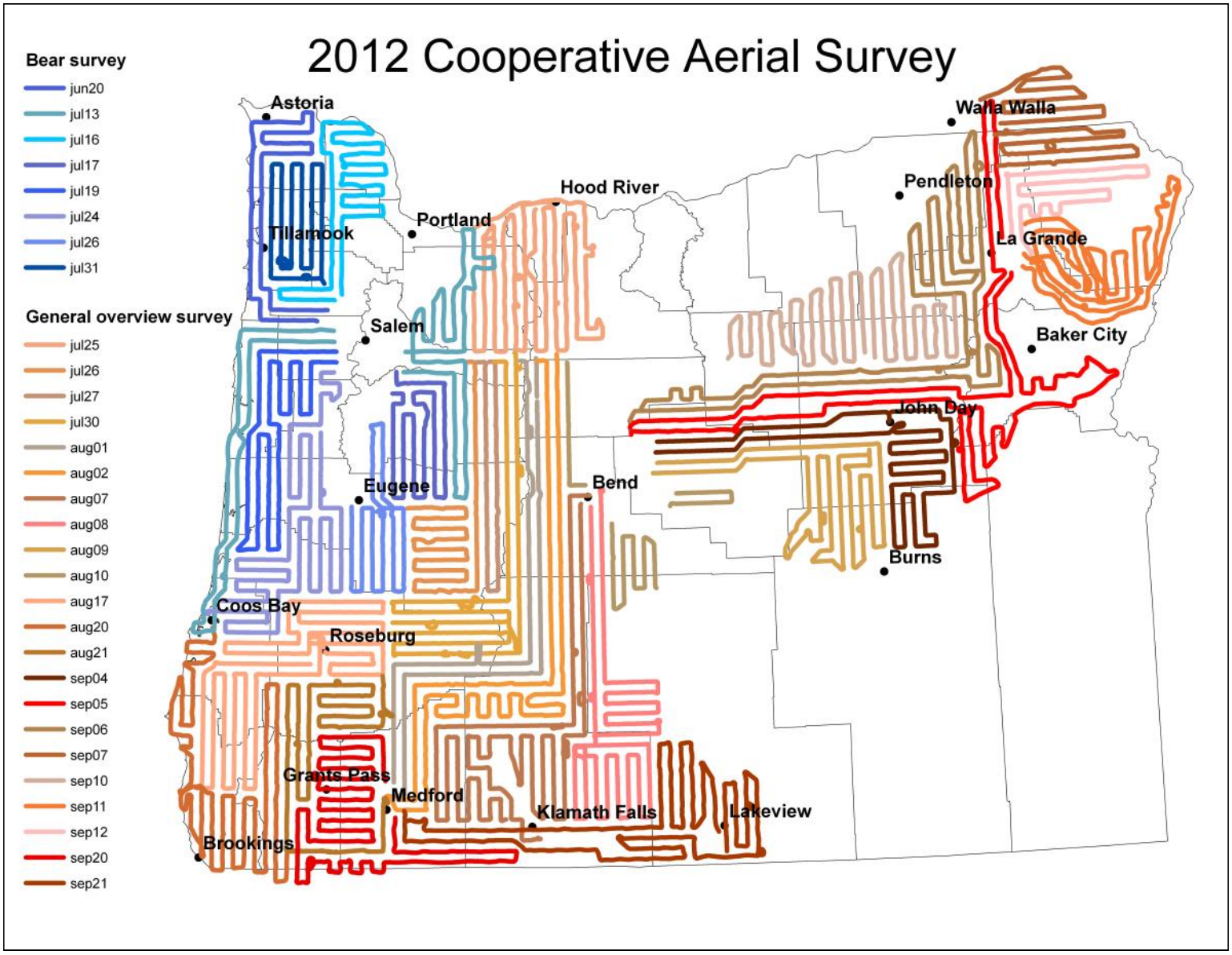
Front cover: *Douglas-fir on the west slopes of the Coast Range with obvious yellow to yellow-brown foliage indicates moderate-to-severe infection by Swiss needle cast. Shown also are western hemlock (dark green) and red alder (light green). (Photo by Alan Kanaskie, Oregon Dept. of Forestry)*



Coverage area and flight lines for the statewide aerial survey of Oregon forests, 2012. Map by: Robert Schroeter, USDA-FS.

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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.

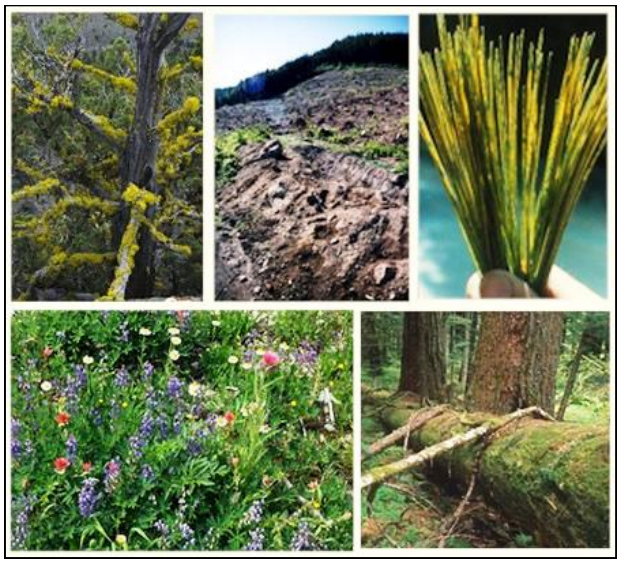
Determining the extent and severity of forest damage from insects and diseases through surveys is an important step in prioritizing and planning management or other actions. The Oregon Department of Forestry works cooperatively with the USDA Forest Service and other organizations to monitor forests in 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 2012. 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

In early 2012, winter snowpack and spring precipitation were above-average over much of Oregon's forests. However, a period of over 80 days during the summer and fall in which no precipitation was recorded led to abnormally dry to moderate drought conditions occurring over many areas of the state. Current predictions are for increased drying and drought over much of the western US, with expanded areas of southwest and eastern Oregon affected in 2013 (Figure 2). Trees growing in stands at too high a density for the site or on drought-prone soils are more likely to have drought stress and become more susceptible to insects and diseases. They are also less likely to recover when conditions improve.

For more information, visit:
Oregon Climate Service
http://www.ocs.orst.edu/
NOAA Climate Prediction Center
http://www.cpc.ncep.noaa.gov/

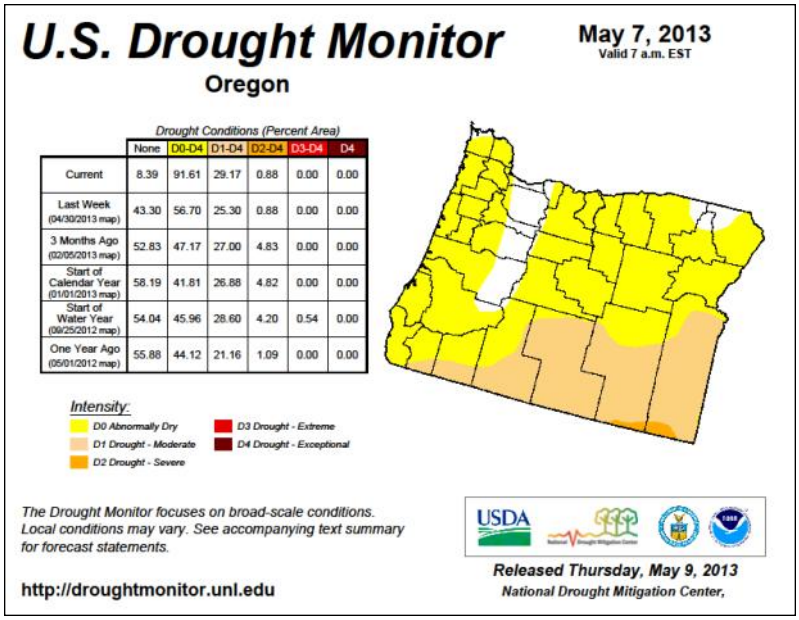


Figure 2. *U.S. drought monitor estimates for Oregon, May 2013.*

Fire

The beginning of the 2012 fire season was postponed several weeks due to prolonged wet and cold spring weather. By mid-summer, the situation had changed dramatically due to an extended periodwith no significant rainfall. The largest fires in 2012 occurred on range lands in southeast Oregon. At over 557,000 acres, the Long Draw fire raced across the high desert to become the largest blaze in Oregon in more than a century. Other large range fires, including the Holloway and Miller Homestead, as well as the Barry Point, Cache Creek, and Pole Creek fires contributed to a total of 1.26 million acres burned in 2012. On the 16 million acres protected by the Oregon Dept. of Forestry, it was an average fire season with over 700 fires reported covering over 17,000 acres. Tribal, federal, state, and local fire resources teamed with private landowners to help minimize the spread of large fires on private forest lands.

PNW Incident Mgt Team 2

Figure 3. *The Barry Point fire near Lakeview impacted both public and private forest lands.*

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 2012. 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 1.1 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.

Rob Flowers, OR Dept. of Forestry

Figure 4. *Aerial surveys require cooperation among many state and federal agencies.*

Insects

Outbreaks of forest insects have occurred periodically in Oregon and historically have resulted in significant tree mortality or other damage. In 2012, the statewide aerial surveys detected over 565,000 acres of tree mortality and other damage related to forest insects. Among these, bark beetles or other woodboring insects affected the largest number of acres (52%), followed by defoliating (31%) and sap-feeding insects (17%). Despite a continued downward trend in the total area affected by bark beetles annually, estimates of tree mortality within those areas nearly doubled in 2012. The total area affected by defoliating insects also declined in 2012, but severe defoliation continued in some areas. There was a 43% decline in the overall area affected by forest insects relative to 2011, while estimates of tree mortality increased by 88%.

The majority of tree mortality detected during aerial surveys in Oregon over the last decade has been due to outbreaks of the mountain pine beetle. Despite declines in the total area affected (acres) for a third consecutive year, estimates of tree mortality within those areas increased to their highest level since 2009. Activity by the western pine beetle, Douglas-fir beetle, and fir

engraver remained at endemic levels in 2012, while tree mortality due to pine *Ips* bark beetles increased. Insect defoliation decreased in 2012, due to reduced activity by pine butterfly and western spruce budworm. Localized defoliation by Douglas-fir tussock moth, conifer sawflies, and larch casebearer was also observed. Only one gypsy moth was trapped statewide in 2012, while damage from a long-established non-native insect, the balsam woolly adelgid, continued.

Mountain Pine Beetle (*Dendroctonus ponderosae*)

In 2012, aerial surveys detected more than 254,000 acres within which mountain pine beetle (MPB) mortality was occurring, a decline of 3% relative to 2011. Concentrated areas of tree mortality continued in areas where mature lodgepole pines and other highly susceptible hosts occurred at high densities. Estimates of the number of trees killed nearly doubled (Figure 5).

The most severe areas of tree mortality in 2012 were on Fremont-Winema National Forest in Klamath County near Crater Lake, Diamond Lake, Yamsay Mountain, and on the southern portion of the Wallowa-Whitman National Forest in Baker County. Mortality of lodgepole and ponderosa pines were most common, but five-needle pines (western white, sugar, and whitebark) in many areas continued to be greatly impacted by MPB (Figure 6).

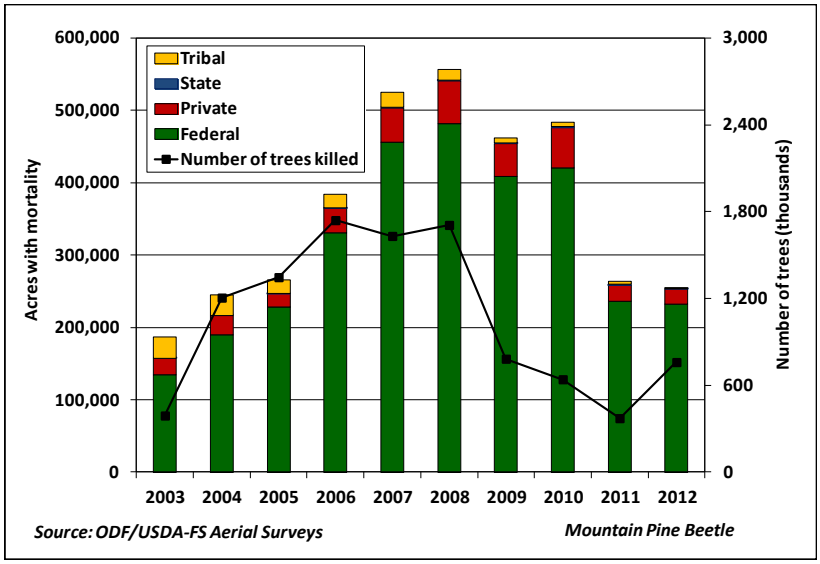


Figure 5. *Ten-year trend for total acres affected and estimated number of trees killed by mountain pine beetle in Oregon.*

Rob Flowers, OR Dept. of Forestry

Figure 6. *Concentrated mortality of mature lodgepole pines due to MPB continued to occur in Klamath County.*

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*)

Tree mortality due to western pine beetle (WPB) in Oregon usually occurs in scattered, large-diameter ponderosa pines. Trees are more susceptible to WPB during droughts, or when damaged by fires, defoliation, or root diseases. In 2012, over 8,100 acres of ponderosa pine mortality consistent with WPB damage was observed, a decline of 68% relative to 2011 (Figure 7).

While tree mortality due to WPB was low statewide, activity remained widespread. It was most apparent over the Ochoco National Forest, on the Prairie City Ranger District of the Malheur National Forest and in the vicinity of Calimus Butte on the Fremont-Winema National Forests. WPB is often found in association with MPB and *Ips* spp. and increased levels of mortality are expected near areas affected by recent wildfires and severe insect defoliation.

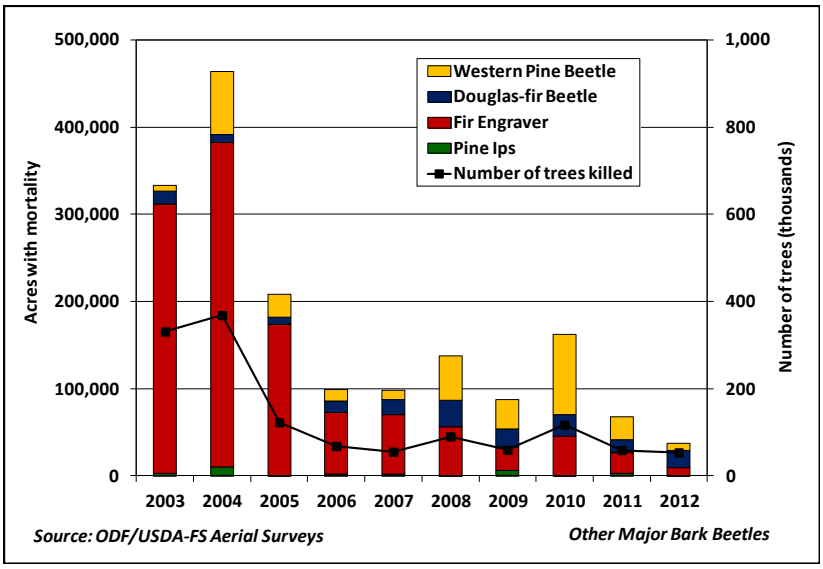


Figure 7. *Ten-year trend for total acres affected and estimated number of trees killed by the major bark beetles in Oregon.*

Douglas-fir Beetle (*Dendroctonus pseudotsugae*)

In 2012, over 19,000 acres of Douglas-fir beetle (DFB) caused tree mortality was observed statewide, an increase of 32% from 2011 (Figure 7). At endemic levels, DFB causes scattered tree mortality, often in association with root diseases. Outbreaks are common and are usually linked to blow-down of large trees where population builds-up can occur, or where trees are made more susceptible by wildfire damage or insect defoliation. Tree mortality in 2012 was most apparent on the west slopes of the Cascades along the Middle Fork of the Willamette River in the Willamette National Forest and in the Rogue -Umpqua Divide Wilderness on the Umpqua National Forest where recent fires have occurred (Figure 8). Wind storms along the Columbia River Gorge have also created conditions favoring higher populations of DFB, which may lead to increased tree mortality in coming years.

Mike McWilliams, OR Dept. of Forestry

Figure 8. *Tree mortality associated with wildfire and subsequent attacks by DFB on the Willamette NF.*

Fir Engraver (*Scolytus ventralis*)

Fir engraver can infest all species of true firs (*Abies* spp.) in Oregon, but it is most commonly observed killing grand, white, and noble firs. In 2012, tree mortality attributed to fir engraver was estimated on over 8,800 acres, a decline of 63% from 2011 (Figure 9). Levels of activity observed this year were well below the long-term average and the lowest in the last decade.

Scattered mortality of individual trees was most commonly observed, consistent with endemic population levels. Areas of more concentrated damage occurred on the Rogue River National Forest in southwest Oregon and on more drought-prone sites in the Blue Mountains of northeast Oregon. Increased levels of fir engraver damage are expected in coming years due to the abnormally dry to moderate drought conditions that are occurring and that are anticipated to continue across much of southwest and eastern Oregon.

Scott Tunnock, USDA Forest Service

Figure 9. *Fir engraver beetle attacks can cause a variety of damage including branch-kill, top-kill, and tree mortality.*

California Fivespined Ips (*Ips paraconfusus*)

Jim LaBonte, OR Dept. of Ag. Rob Flowers, OR Dept. of Forestry

Figure 10. Ips *spp. have periodic outbreaks that cause top-kill in large trees and group-killing of smaller trees.*

California fivespined *Ips* (CFI), *Ips paraconfusus*, has historically caused pine mortality in California and southwest Oregon. Trapping surveys from 2008-2010 indicated that it was also well-distributed in the Willamette Valley, where top-kill of remnant, mature Willamette Valley ponderosa pines and group-killing in recently established plantations had increased (Figure 10). Additional trapping surveys from 2011-2012 indicated that the range of CFI extends East along the Columbia River Gorge, to Hood River County, and North into Pierce County, WA. It remains unclear if this is due to range expansion or a previously unknown historical range.

While annual tree mortality from *Ips* spp. is usually less extensive than observed for other bark beetles in Oregon, localized outbreaks can cause significant tree mortality. Outbreaks are often linked to tree stress resulting from drought conditions or following injury and breakage from fires or winter storms. In 2012, increasing levels of damage from CFI were observed along the Columbia River Gorge National Scenic Area in Washington and Oregon (Figure 11).

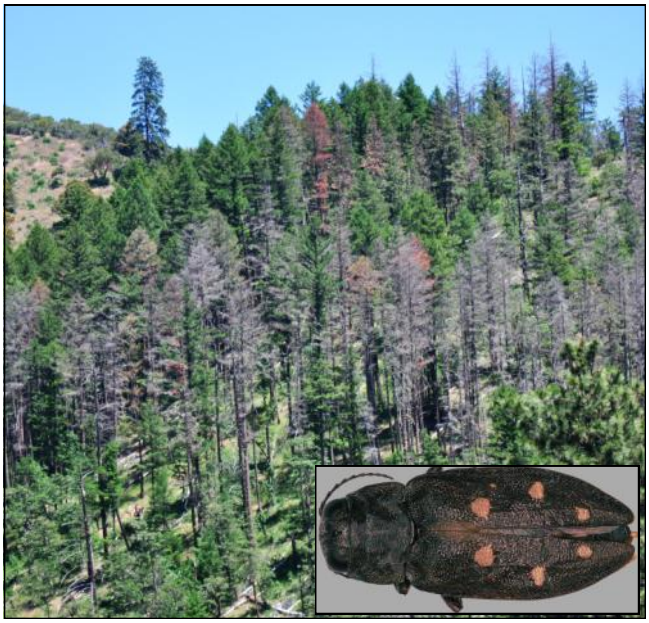
Ips outbreaks are generally short-lived and are not expected to continue. Cooperative educational efforts are ongoing and are focused on helping landowners manage currently infested trees and slash, reducing the future availability of preferred host materials that can lead to population build-ups. Trapping efforts are continuing and will provide for a better understanding of *Ips* spp. distributions and interactions in the Pacific Northwest.

Beth Willhite, USDA Forest Service

Figure 11. *Recent outbreaks of* Ips *spp. along the Columbia River Gorge appear to be related to fire and storm damage.*

Flatheaded fir Borer (*Phaenops drummondi*)

The flatheaded fir borer is a woodboring insect that historically has been associated with mortality of larger-diameter Douglas-fir in southwest Oregon. Stressed trees appear to be most commonly affected, especially those growing at lower-elevation or more drought-prone sites.



Steve Valley, OR Dept. of Ag. Ellen Goheen, USDA Forest Service

Figure 12. *Flatheaded fir borer has been linked to mortality of Douglas-fir in southwest Oregon.*

In 2012, aerial surveys detected approximately 2,200 acres where tree mortality was occurring, a decline of 81% relative to the recent high of over 12,000 acres in 2011. Current tree mortality was most evident in the Siskiyou Mountains, the Applegate watershed West of Medford, and on the Rogue River National Forest. Ground surveys in these areas indicate that while other woodboring insects and diseases contribute to tree decline and mortality in these areas, the activity of this woodborer appears to be one of the primary causes (Figure 12). Evaluations to examine stand/site factors related to woodborer damage and interactions with other agents are ongoing.

Western Spruce Budworm (*Choristoneura occidentalis*)

The western spruce budworm (WSB) is one of the most damaging defoliating insects in central and northeast Oregon, affecting Douglas-fir, true firs, Engelmann spruce, and western larch. Defoliation due to recent outbreaks has been observed since 2001. In 2012, defoliation was detected on over 97,000 acres, a decline of 63% relative to the previous year (Figure 13).

The most concentrated defoliation in recent years has been in the Ochoco and Malheur National Forests near Snow Mountain, the Strawberry Mountains, and east of the Silvies Valley. In many of these areas, WSB has co-occurred with a large outbreak of pine butterfly that is affecting ponderosa and lodgepole pines. The current WSB outbreak is the most extensive since the last major outbreak ended in the early 1990's.

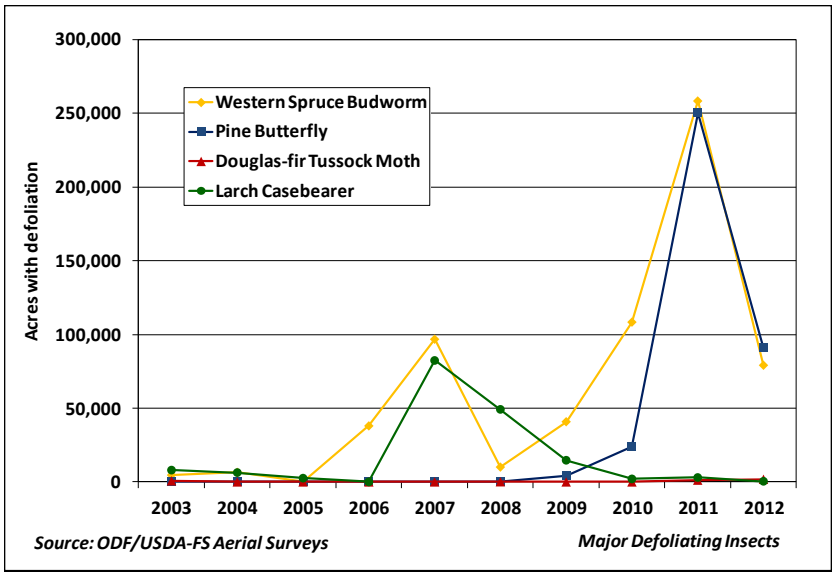


Figure 13. *Ten-year trend of the total area affected by insect defoliators in Oregon, as detected by annual aerial surveys.*

Rob Flowers, OR Dept. of Forestry

B.C. Ministry of Forests

Figure 14. *Chronic defoliation of Douglas-fir and true firs by WSB has occurred in some areas since 2001.*

Feeding by WSB larvae may cause growth loss, tree deformity, top-kill, or even tree mortality (Figure 14). The extent of the defoliation appeared to increase dramatically in 2011, and reports of understory tree mortality and top-kill of overstory trees have been more common near chronic infestations.

The appearance of WSB defoliation varies widely in accordance with annual weather patterns, making consistent detection by aerial survey challenging. However, the persistence of WSB and the abundance of preferred hosts suggests that the current outbreak will continue. Forest management focused on reducing the densities of highly preferred hosts, especially on drier sites, can be effective but has been limited.

Pine Butterfly (*Neophasia menapia*)

Pine butterfly has historically been a serious defoliator of ponderosa and lodgepole pine in central and eastern Oregon. Previous outbreaks in the Blue Mountains have not been well-described, but appear to have been short-lived and resulted in limited tree mortality. Aerial surveys have detected defoliation from pine butterfly since 2008, reaching a high of over 250,000 acres in 2011, the largest outbreak ever recorded in Oregon (Figure 13). In 2012, over 91,000 acres of defoliation was detected, a decline of 64%. However, defoliation intensity remained at moderate-to-severe over 90% of the affected area, similar to the previous year. Currently affected areas include the Malheur National Forest east of the Silvies Valley between John Day and Burns as well as BLM and private ownerships (Figure 15).

Rob Flowers, OR Dept. of Forestry

Figure 15. *Severe defoliation by pine butterfly larvae continued on the southern portion of the Malheur National Forest.*

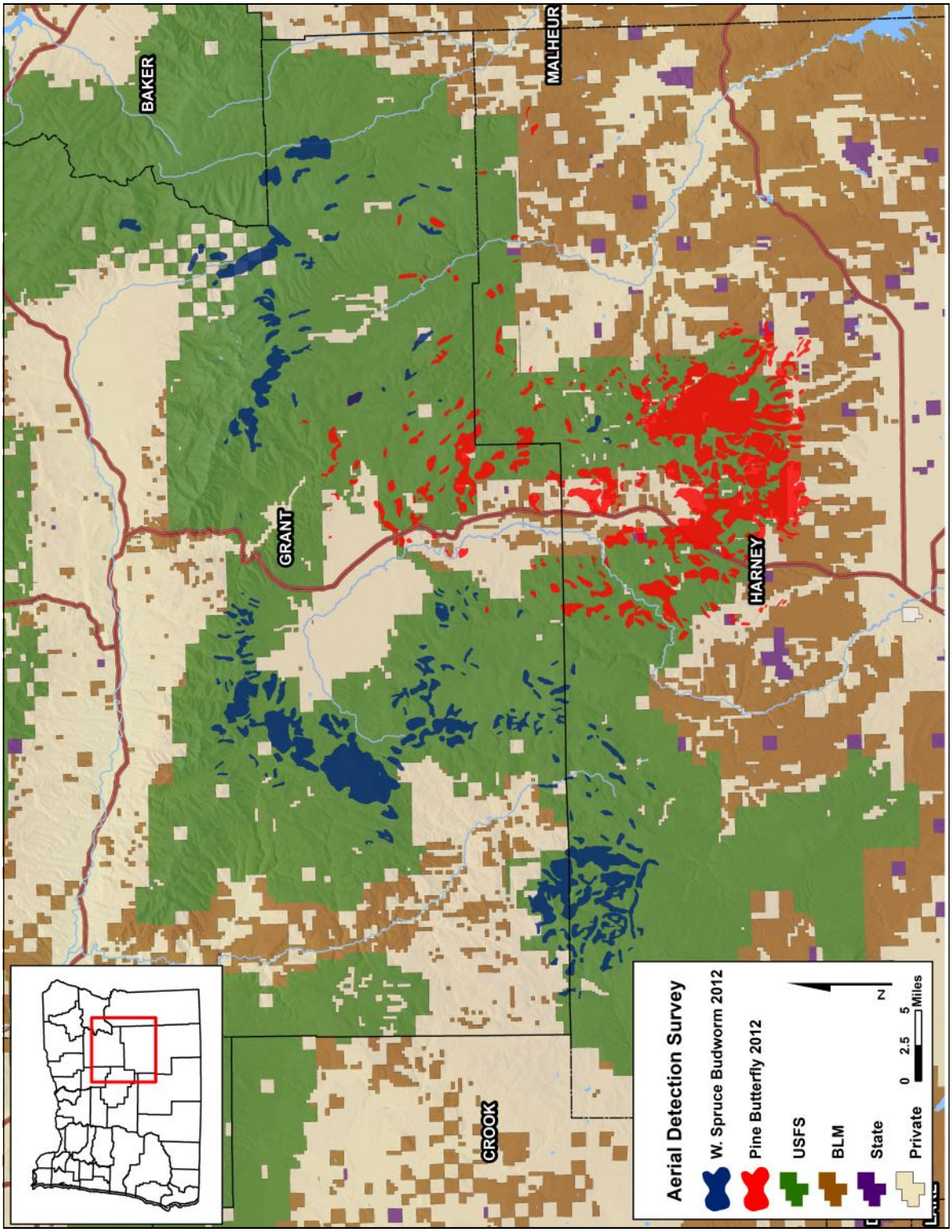
Figure 16. *Natural enemies were abundant in 2012 and appear to have contributed to declines.*

Rob Flowers, OR Dept. of Forestry

Figure 17. *Research and monitoring efforts in areas affected by pine butterfly are continuing.*

Pine butterfly populations appear to be regulated to some degree by natural enemies, which were very abundant in 2012. Among the most common was a parasitic wasp (*Theronia atalantae*) and a hemipteran predator (*Podisus* sp.) that fed on pine butterfly larvae and pupae (Figure 16). These agents along with the overall decline in adult butterflies and affected area observed this year suggests that the outbreak is collapsing.

Cooperative monitoring and research efforts on pine butterfly are ongoing (Figure 17). Objectives include examining the relationship between stand structure and defoliation severity as well as evaluating the cumulative effects of defoliation on tree growth and survival. Results will be used to develop guidelines to assist forest managers during future outbreaks in the PNW and elsewhere.



Defoliation by western spruce budworm and pine butterfly as detected by aerial surveys, 2012. Map by: Rob Flowers, ODF.

Douglas-fir Tussock Moth (*Orgyia pseudotsugata*)

Glenn Kohler, Washington DNR

Figure 18. *Defoliation by DFTM has increased in the Umatilla NF.*

The Douglas-fir tussock moth (DFTM) is a defoliator of Douglas-fir, true firs, and Engelmann spruce that periodically reaches outbreak levels in the Blue Mountains. In 2012, over 1,700 acres of defoliation was detected during aerial surveys, with an additional 8,600 acres observed nearby in Washington. Defoliation was generally light with the top-third of the crown most heavily defoliated (Figure 18). The majority of affected areas were in or near the Wenaha-Tucannon Wilderness of the Umatilla National Forest, similar to 2011. Ground surveys indicate that low numbers of DFTM egg masses are present in these areas, suggesting that populations are collapsing and that defoliation should decline in the near future.

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

The larch casebearer (LCB) is a long-established, non-native defoliator of western larch. In 2012, the defoliation attributed to LCB during aerial surveys was estimated at 400 acres, continuing a downward trend since the recent high of over 82,000 acres in 2007 (Figure 13).

Defoliation this year occurred mostly in young larch stands in the Umatilla and Wallowa-Whitman National Forests (Figure 19). Recent research by Oregon State University indicates that two parasitic wasps, introduced from Europe into the Blue Mountains in the 1970's for biological control of LCB, are still present in many of the populations in Oregon. Since that time, outbreaks of LCB appear to have been short-lived, suggesting that these natural enemies may be helping to regulate populations.

Rob Flowers, OR Dept. of Forestry

Figure 19. *Limited defoliation by the larch casebearer was observed in 2011 and 2012.*

Gypsy Moth (*Lymantria dispar*) *Non-Native*

The Oregon Department of Agriculture (ODA) conducts extensive trapping surveys for gypsy moth (GM) and its Asian strain, the Asian gypsy moth (AGM) annually. ODA placed over 2,400 GM and over 6,000 AGM traps in Oregon in 2012. Only one GM was detected this year, near Eugene, and delimitation trapping is planned at that site. There were no moths detected in 2011, and no additional moths were trapped at the location where a GM was found in 2010. AGM populations in Asia and the Russian Far East have increased of late and continue to pose a serious threat. In 2012, U.S. Customs and Border Protection reported more interceptions of AGM egg masses on ships originating from Asia than in any of the previous five years.

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

The balsam woolly adelgid (BWA) is a sap-feeding insect that was introduced to North America from Europe around 1900. It feeds through the bark on stems and branches of true firs, causing branch gouting, dieback, and mortality (Figure 20). Aerial survey detections of BWA rely on declining crown symptoms of hosts coupled with substantial lichen growth in the crown. In 2012, aerial surveys detected over 95,000 acres affected by BWA, down from over 126,000 acres in 2011. Stand decline and tree mortality over the last decade has been most apparent along the crest of the Cascade Range from Mount Hood south to the Rogue River National Forest and in northeast Oregon in the Umatilla and Wallowa-Whitman National Forests. The primary hosts affected are subalpine and Pacific silver firs. During feeding, BWA injects a salivary substance into the tree that causes branch calluses and abnormal wood formation (Figure 21). Continued stand declines in infested areas are expected due to a lack of specific natural enemies for BWA and the minimal degree of host resistance.

Jerald Dewey, USDA Forest Service

Figure 20: *Chronic infestations of balsam woolly adelgid have contributed to subalpine fir declines.*

Kelly Oten, NC State Univ.

Figure 21: *BWA is a very small, sap-feeding insect that attaches to stems and branches of its hosts.*

Permanent plots have been established by the USDA Forest Service in 26 subalpine fir stands in central and eastern Oregon and Washington. Stand and site conditions were measured and a BWA infestation rating was developed to gauge BWA severity. Plots will be re-measured at 5-year intervals to monitor long-term trends. Preliminary results for Oregon indicate that the majority of stands were moderately-to-severely infested by BWA with some having over 50% mortality (Figure 22). In mixed stands, Engelmann spruce and lodgepole pine may come to dominate these sites. Management options for BWA continue to be explored.

Mike McWilliams, OR Dept. of Forestry

Figure 22: *Permanent plots have been established for long-term monitoring of BWA in OR and WA.*

Diseases

Sudden Oak Death (SOD)

Sudden Oak Death, caused by the non-native pathogen *Phytophthora ramorum,* is lethal to tanoak (*Notholithocarpus densiflorus*) and threatens this species throughout its range in Oregon. The disease was first discovered in coastal southwest Oregon forests in July 2001. Since then an interagency team has been attempting to eradicate the pathogen through a program of early detection and destruction of infected and nearby host plants (Figure 23). Outside of Oregon, *P. ramorum* is known to occur in forests only in California (14 counties) and several European countries. The origin of the pathogen is unknown.

Alan Kanaskie, OR Dept. of Forestry

Figure 23. *Cutting and burning host plants to eliminate* P. ramorum *from an infested site in OR.*

Alan Kanaskie, OR Dept. of Forestry

Figure 25. *Symptoms of infection by* P. ramorum *on Pacific rhododendron (left) and grand fir (right).*

Alan Kanaskie , OR Dept. of Forestry

Figure 24. *Stem lesion on the inner bark of tanoak caused by* P. ramorum. *Dark-colored droplets on bark indicate an inner bark lesion.*

P. 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 24). Tanoak is by far the most susceptible species in Oregon, and the disease seriously threatens the future of this species. *P. ramorum* also causes leaf blight or shoot dieback on a number of other hosts that include rhododendron, evergreen huckleberry, Douglas-fir, and Oregon myrtle (Figure 25). *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 southwest Oregon forests, and the resulting quarantine regulations would disrupt domestic and international trade of many forest and agricultural commodities. It poses a substantial threat to many forest ecosystems in North America and elsewhere around the world.

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 can be spread by humans transporting infected plants or infested soil. Disease spread between 2001 and 2012 has been predominantly northward, following the prevailing wind direction during storms and wet weather. From the initial infestations the disease has spread southward 1.2 miles, and northward and eastward 17.3 and 8.0 miles, respectively.

Sudden oak death continued to intensify and spread in Curry county forests during 2012 (Figure 26), especially on the northern disease front and near areas where eradication treatments were suspended several times since 2009 because of lack of funding. Large numbers of dead and dying trees became evident in the Duley creek – Cape Ferrelo area along the western edge of the infested area (Figure 27) and this increases the risk of wildfire and property damage from falling trees.

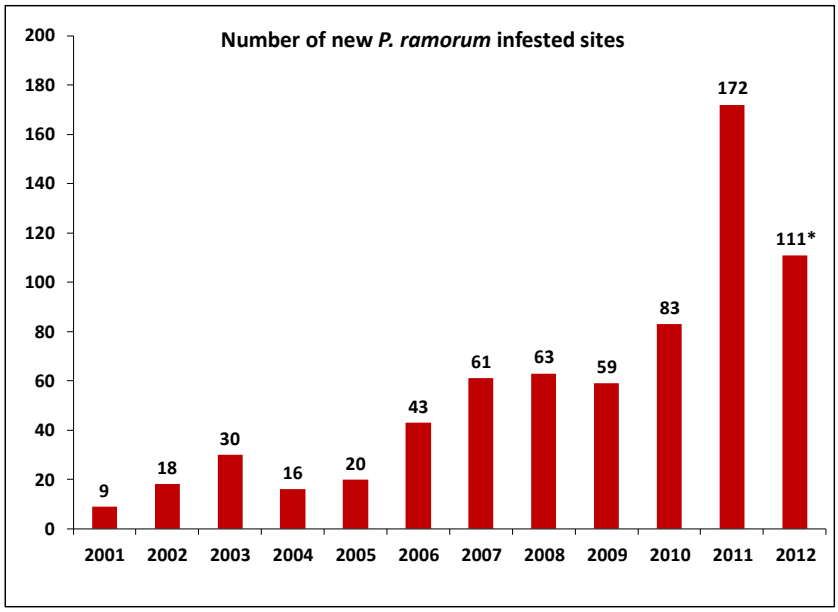


Figure 26. *Number of new sites infested with* P. ramorum *discovered annually from 2001-2012 in Curry County, Oregon. *Data for 2012 underestimates the amount of disease due to decreased surveys within the "Generally Infested Area."*

Several new infestations were also found at considerable distances from other known infestations and in unexpected places such as Wheeler Creek and the East Fork of the Winchuck River (Figure 28, next page). New infestations were discovered as a result of aerial, ground, and stream-bait surveys. Increased emphasis on ground surveys in areas where dead trees were not yet evident resulted in several early detections.

Alan Kanaskie , OR Dept. of Forestry

Figure 27. *Within the "Generally Infested Area" sudden oak death is intensifying and tanoak mortality is increasing rapidly.*

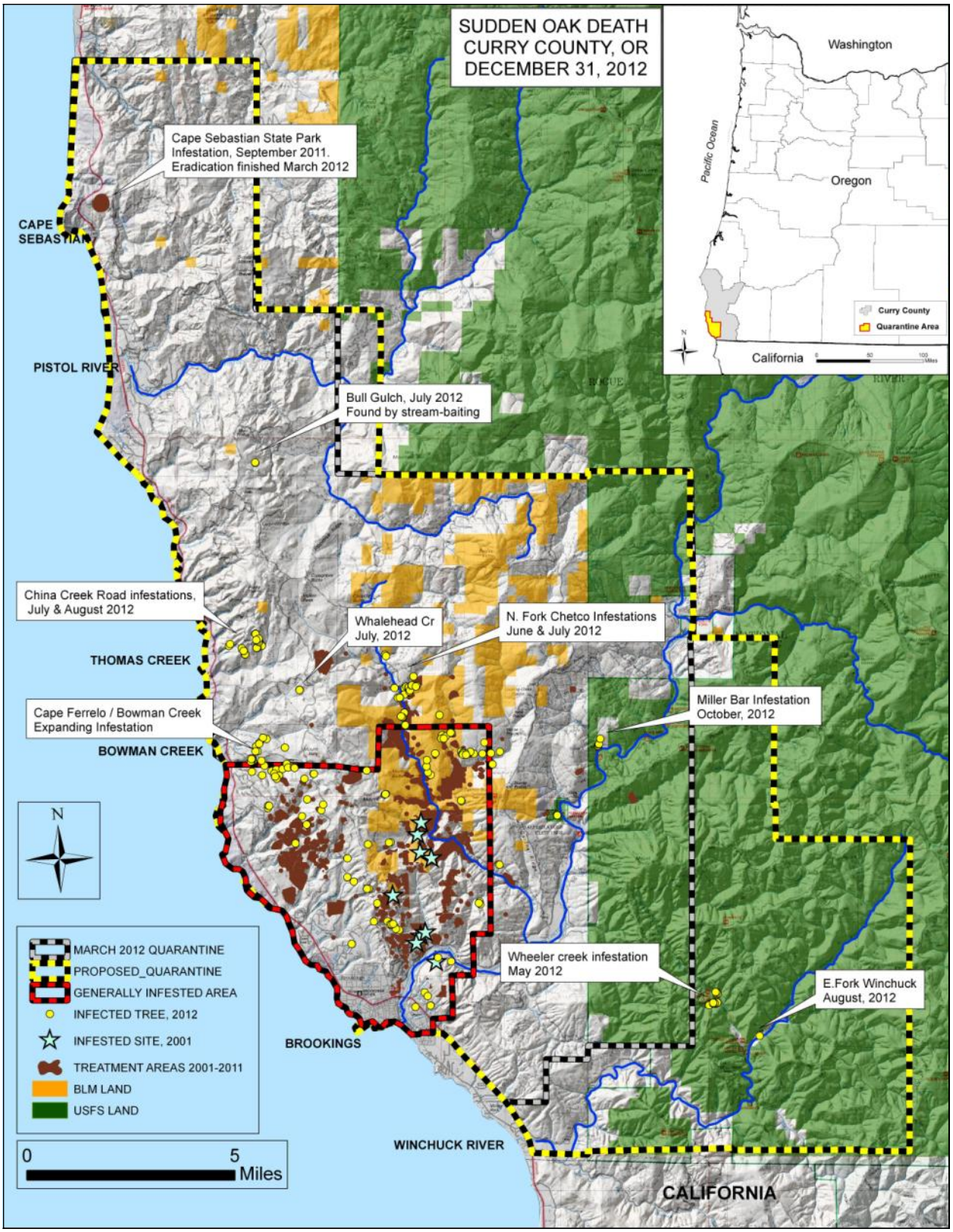


Figure 28. *Quarantine boundary and location of areas infested with* Phytophthora ramorum *in south-west Oregon, December, 2012. Eradication is no longer required within the "Generally Infested Area." Map by: Alan Kanaskie, ODF.*

Expansion and intensification of the disease led to an increase in the quarantine area to 202 mi^2 in March 2012, and then to 264 mi^2 in December 2012 (the latter went into effect in March 2013). In addition to a larger quarantine area, the quarantine rules were revised as follows: 1) establishes a "Generally Infested Area" (GIA) within the quarantine boundary where *P. ramorum* has persisted or intensified and treatment is no longer required by the State; 2) defines high-priority sites where eradication treatments are required, and; 3) allows increased utilization of tanoak within the quarantine area.

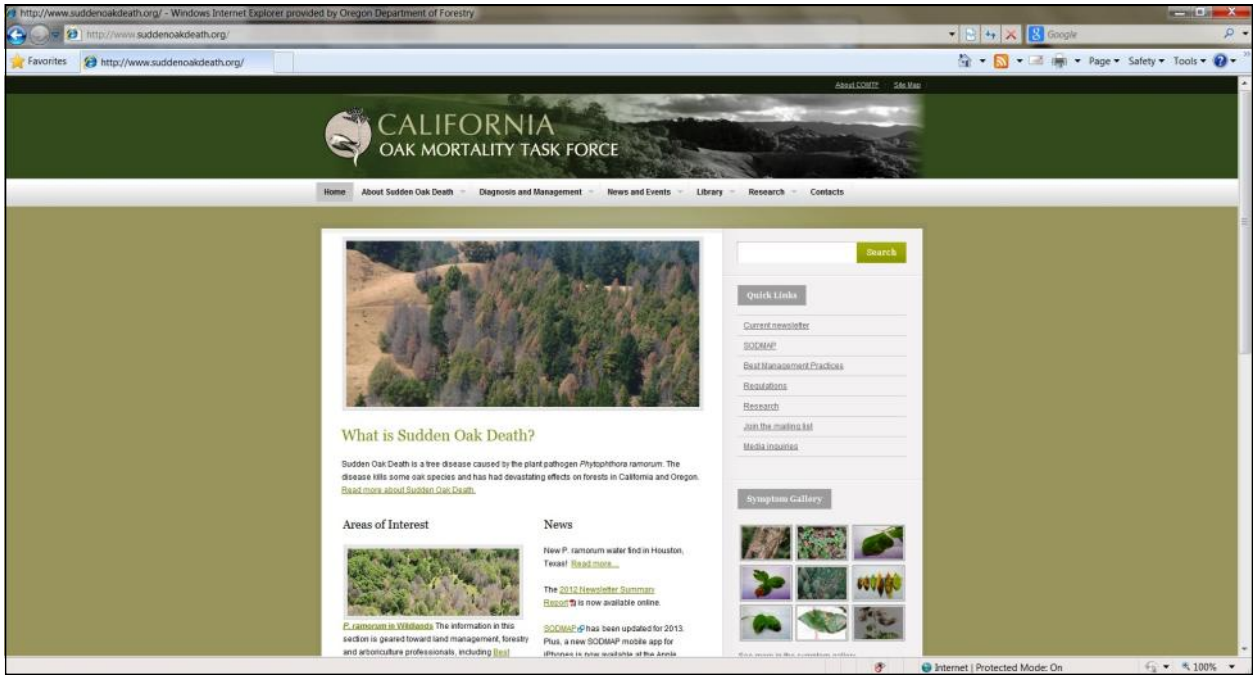
Tanoak and other host plants can be transported out of the quarantine area only if they are from a "disease-free area," which is defined as an area located more than one-quarter mile from the generally infested area or any other infested site, and which has been officially surveyed within the past 6-months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

The program goal is to slow further disease spread by: 1) early detection and rapid eradication of new infestations that are the most important in terms of disease spread; 2) reducing inoculum levels where practical through cost-share projects and best management practices, and; 3) improving education and outreach to prevent spread by humans.

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



Swiss Needle Cast (SNC)

Swiss needle cast (SNC) is a disease of Douglas-fir foliage caused by the native fungus *Phaeocryptopus gaeumannii* (Figure 29). It causes needles to turn yellow and fall prematurely from trees, ultimately reducing tree growth and survival (Figures 30). 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 foliage retention. High foliage retention (3 or 4 annual complements) means less damage and better tree growth; low foliage retention (1 or 2 annual complements) means severe damage and reduced tree growth. 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.

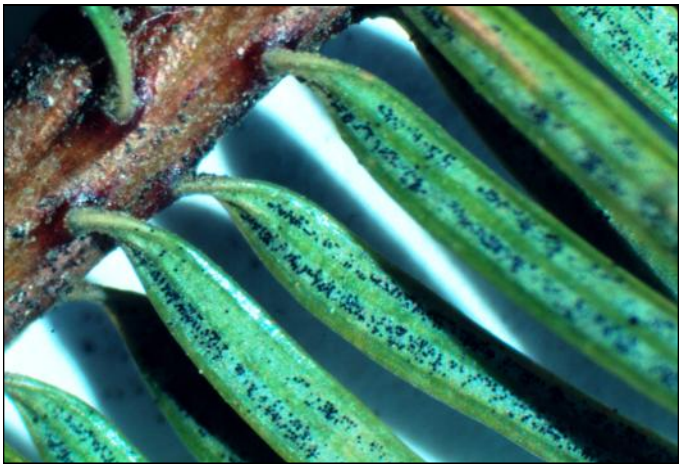


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Figure 29. *Fruiting bodies of the SNC fungus block stomates on the underside of Douglas-fir needles. The pathogen disrupts photosynthesis and reduces tree growth.*

Aerial surveys to detect and map the distribution of SNC damage have been flown annually since 1996. Although the disease occurs throughout the range of Douglas-fir, it is most severe in the forests on the western slopes of the Coast Range, and in this area it presents a unique aerial survey signature that is highly visible for approximately 6 to 8 weeks prior to bud break and shoot elongation, 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. The 2012 Oregon Coast Range survey was flown on May 8-11 and 14, and covered over 2.8 million acres of forests. The survey area extended from the Columbia River southward to the northern border of Curry County, and from the coastline eastward until obvious symptoms were no longer visible. The Cascade Range was not surveyed, but SNC does occur at damaging levels in a few areas. Weather conditions were excellent for symptom development and aerial observation.

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Figure 30. *SNC causes foliage loss and sparse, yellow crowns in Douglas-fir and can reduce tree volume growth by more than 50%. Other tree species are unaffected.*

Figure 32. *Areas of Douglas-fir forest with symptoms of SNC detected in the 2012 aerial survey. Map by A. Kanaskie*

The survey mapped over 519,000 acres of Douglas-fir forest with obvious symptoms of SNC, reaching an all-time high for the third year in a row (Figure 31). As has been the case for the past several years, the eastern-most area with obvious SNC symptoms was approximately 28 miles inland from the coast in the Highway 20 corridor, but most of the area with symptoms occurred within 18 miles of the coast (Figure 32).

SNC Damage 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.

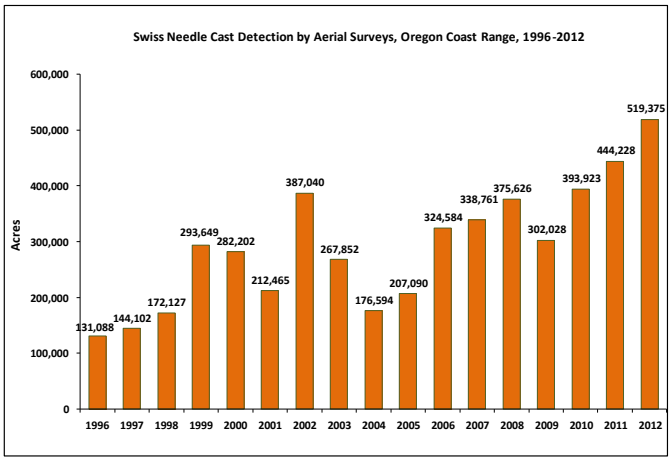

Figure 31. *Area of Douglas-fir forests in western Oregon with symptoms of SNC detected during aerial surveys in April and May, 1996-2012.*

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. Considerable variation can also result from weather patterns which affect both symptom development and the timing of aerial surveys.

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*), apparently caused by *Phacidiopycnis washingtonensis,* once again was highly noticeable throughout the range of madrone in Oregon. Distribution of damage was more uneven than in previous years and most severe in inland areas. Leaves of infected trees develop brown spots which coalesce until the entire leaf turns brown. Dead leaves remain attached to the tree until the new foliage expands. By late winter trees may appear completely dead because green leaves are absent. However, buds and shoots remain alive and will flush in the next growing season (Figure 33). The long term effects of repeated severe disease are unknown.

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Figure 33. *Leaf spot of Pacific madrone caused by* P. washingtonensis *continued at high levels in Oregon in 2012. Despite appearing totally dead during winter, most trees still had live shoots and buds.*

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

Conifer Foliage Rusts

Jim Hall, OR Dept. of Forestry

Persistent wet weather in spring and early summer allowed certain conifer rust diseases to flourish in western Oregon in 2012. Spruce needle rust (*Chrysomyxa ledicola)* was observed on Sitka spruce at numerous locations along the central Coast (Figure 34). Damage was mainly on the 2012 foliage, with little or no damage on older foliage, reflecting the importance of weather conditions during the early summer infection period. Despite the dramatic appearance, there should be no long-term impact on affected trees.

Figure 34. *Spruce needle rust (*Chrysomyxa ledicola*) was highly visible on Sitka spruce along the central coast (note the tan fruiting bodies on the needles).*

In inland areas, the true fir needle rusts, *Pucciniastrum goeppertianum* and *Uredinopsis pteridis,* as well as incense cedar rust, *Gymnosporangium libocedri*, were unusually abundant (Figures 35 and 36). The occurrence of these diseases typically fluctuates annually depending on the abundance of alternate hosts and the extent of wet weather during spring and early summer. In most cases, outbreaks of these diseases cause no lasting damage to forest trees.

Figure 35. *Fir-bracken rust (*Uredinopsis pteridis*) was abundant on grand fir in the Coast Range and Willamette Valley due to persistent wet weather.*

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Figure 36. *Bright red fruiting bodies of incense cedar rust (*Gymnosporangium libocedri*) were evident in early summer.*

Needle Cast of Lodgepole Pine

Episodes of spring and summer wet weather in central Oregon during 2011 contributed to an increase in lodgepole pine needle cast that became visible in 2012. The disease is caused by the fungus *Lophodermella concolor*. Young developing needles are infected in spring and summer during periods of wet weather, turn reddish-brown the following spring, and later are shed, giving the defoliated branches a "lion's tail" appearance. This disease can cause severe defoliation when it occurs. Trees are seldom killed but growth reduction and mortality may result after repeated epidemics, particularly in young stands (Figure 37).

Rob Flowers, OR Dept. of Forestry

Figure 37. *Lodgepole pine needle cast (*Lophodermella concolor*) in central Oregon. Damage is most severe following periods of wet weather and in young plantations.*

Sphaeropsis (Diplodia) Tip Blight of Ponderosa Pine

Rob Flowers, OR Dept. of Forestry

Figure 38. *Branch tip flagging caused by* Sphaeropsis (Diplodia) *tip blight on ponderosa pine in northeast Oregon.*

Tip and branch dieback on ponderosa pine was observed in many areas of northeast Oregon in 2012. Scattered damage occurred over a wide area, but was most evident along the edges of the Grande Ronde and Wallowa Valleys, along sections of the Wallowa and Imnaha Rivers and near the town of Troy in Wallowa County (Figure 38). Damage was also observed in some areas of western Oregon.

The causal fungus, *Sphaeropsis sapinea (syn. Diplodia pinea)*, is a weak parasite that typically affects trees stressed by drought or other agents and when cool and moist conditions, ideal for infection and disease development, occur. The primary symptom is "flagging" of branch tips which occurs when the pathogen kills the entire current-year shoots, leaving clusters of reddish-brown foliage.

Other indicators include resin drops at the base of needles and tiny fruiting bodies on infected needles and cones (Figures 39 and 40). In contrast to the needle casts, needles affected by this disease remain on the tree throughout the winter. Tree mortality is uncommon, but growth loss, branch dieback, and top-kill can occur. Management in forest settings is not recommended.

For additional information, visit:
http://extension.oregonstate.edu/mwm/flagging-our-pines-who-what-where-and-why

Figure 39. *Infection by* Sphaeropsis (Diplodia) *tip blight causes dead shoots and resinous droplets to form at the base of infected needles.*

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Figure 40. *Fruiting bodies of* Sphaeropsis (Diplodia) tip blight *appear as small black pimples on ponderosa pine cone scales.*

Armillaria Root Disease on Oak and Douglas-fir

Oregon white oak commonly harbors the root pathogen *Armillaria mellea*. Infected trees often decline, die, or fall over, particularly in irrigated landscapes where excess summer moisture favors disease development. When oak stands are harvested and converted to conifer plantations, the disease can be particularly damaging to the newly planted conifers. After the oaks are cut the fungus grows rapidly using the stump and root system as an energy source (Figure 41). Nearby trees often succumb quickly to this aggressive native pathogen.

Alan Kanaskie, OR Dept. of Forestry

Figure 41. *Mushrooms of* Armillaria *sp. on stump and Douglas-fir sapling following harvest of an Oregon white oak – Douglas-fir stand.*

Bear Damage

Black bears damage a large number of conifers in Oregon each spring by peeling the bark to feed on inner tissues. Tree mortality of young trees in conifer plantations is most commonly observed, but partial peeling of older trees also occurs and may reduce growth and provide entry points for decay organisms that can reduce wood value. In 2012, bear damage was estimated at over 25,000 acres statewide (Figure 42). Levels of tree mortality remained below the 10-year average, and the affected area declined by 37% relative to observations in 2011.

Previous ground surveys indicate that tree injury at these sites is also commonly caused by root diseases and moisture stress. As ground surveys are not done annually, "bear" damage, as described here, represents the complex of agents that occur at these sites. Factors that may influence peeling damage include the timing and availability of more highly preferred food sources as well as seasonal bear population levels and densities.

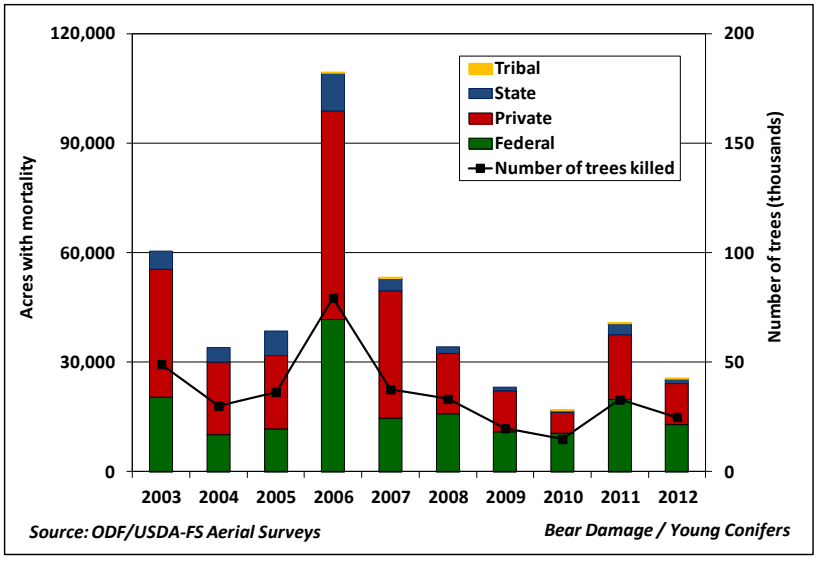
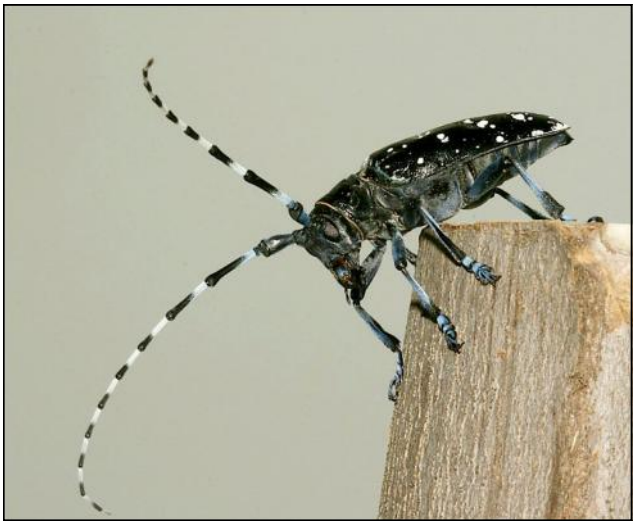


Figure 42. *Ten-year trend of total acres affected by bears and the estimated number of trees killed annually.*

Invasive Species of Oregon Forests

In 2012, the Oregon Department of Forestry expanded its role in combating invasive forest pests by establishing a new position, an "invasive species specialist," which was filled in September by Wyatt Williams. Wyatt holds a Ph.D. from Colorado State University where he studied biological control of non-native weeds using insects and gained experience with several other high priority invasive species. The focus of the position will be to manage and coordinate projects focused on the detection, monitoring, and management of priority invasive species that threaten forests in Oregon.

Recently, two specialized lists of invasive species have been developed to help focus and direct agency resources toward cooperative efforts. The first list, "the most unwanted invasive species in Oregon's forests" includes a variety of non-native insects, diseases, and weeds that have not yet established in Oregon (*e.g.* Asian longhorned beetle, ash dieback disease, and kudzu). For many of these agents, highly coordinated early detection programs, in cooperation with other agencies and organizations, are needed to continue to prevent their introduction and establishment (Figure 43).



USDA Forest Service, Bugwood.org

Figure 43. *Asian longhorned beetle is among the most "unwanted invasive species" in Oregon.*

Rob Flowers, OR Dept. of Forestry

Figure 44. *Scotch broom is among "the most damaging invasive species" to forestry in Oregon.*

A second list, "the most damaging invasive species in Oregon's forests" focuses on those non-native species that are currently the most costly to forestry (*e.g.* Scotch broom) or other aggressive species within the State's boundaries that are likely to have severe economic and ecological impacts if allowed to continue to spread unchecked (*e.g.* Gorse, Japanese knotweed, false broom) (Figure 44).

USDA Forest Service, Bugwood.org

Figure 45. *Cooperative trapping surveys for the non-native emerald ash borer are ongoing in Oregon.*

In late 2012, a cooperative agreement was made between the Oregon Dept. of Forestry and USDA APHIS to conduct a statewide trapping survey for the non-native, emerald ash borer during the summer of 2013 (Figure 45). This insect has caused serious damage in many areas of the midwestern US and it continues to spread.

Aerial Survey Maps and GIS Data

For historic and current aerial survey quadrangle maps from 2003 to 2012, visit: *http://www.fs.usda.gov/goto/r6/fhp/ads/maps*

For aerial survey GIS data from Oregon and Washington from 1980 to 2012, visit: *http://www.fs.usda.gov/goto/r6/fhp/ads/data*

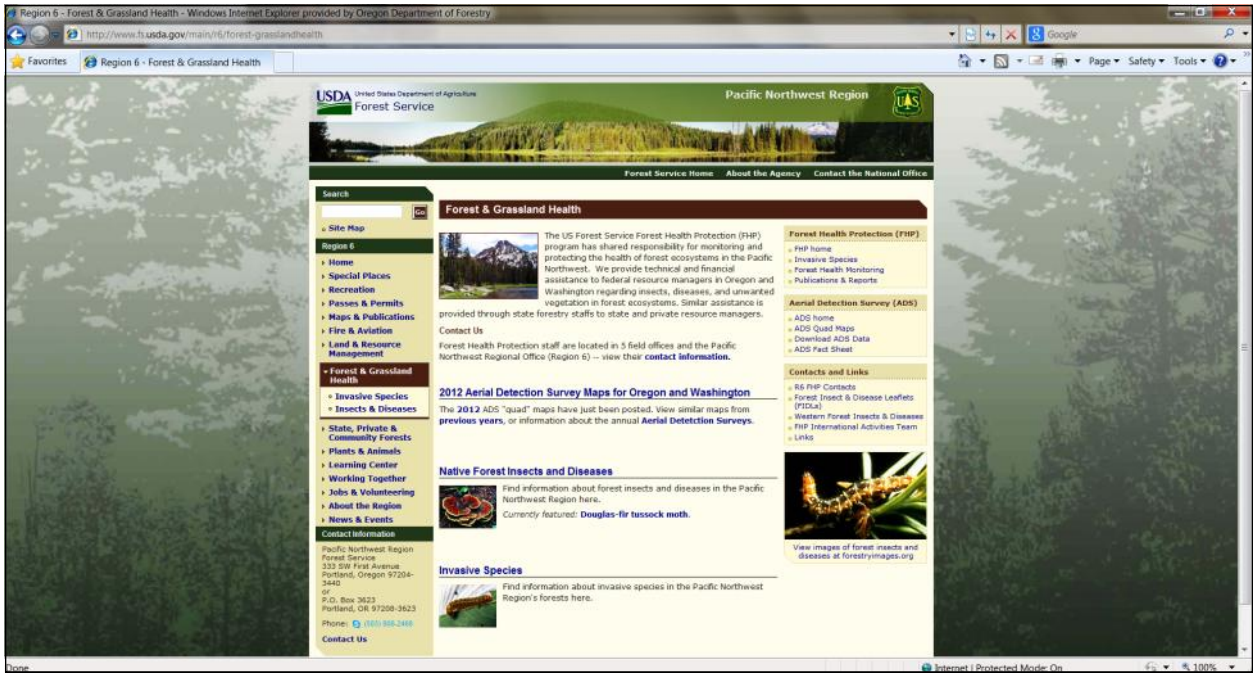
For statewide (2003-2012) and Swiss needle cast (1996-2012) aerial survey data and summaries for Oregon, visit: *http://www.oregon.gov/odf/privateforests/pages/fhMaps.aspx*

Additional Information on Forest Health

For Forest Health Highlight reports for Oregon and Washington from 1998-2012, 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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http://www.oregon.gov/odf/privateforests/pages/fh.aspx

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