United States
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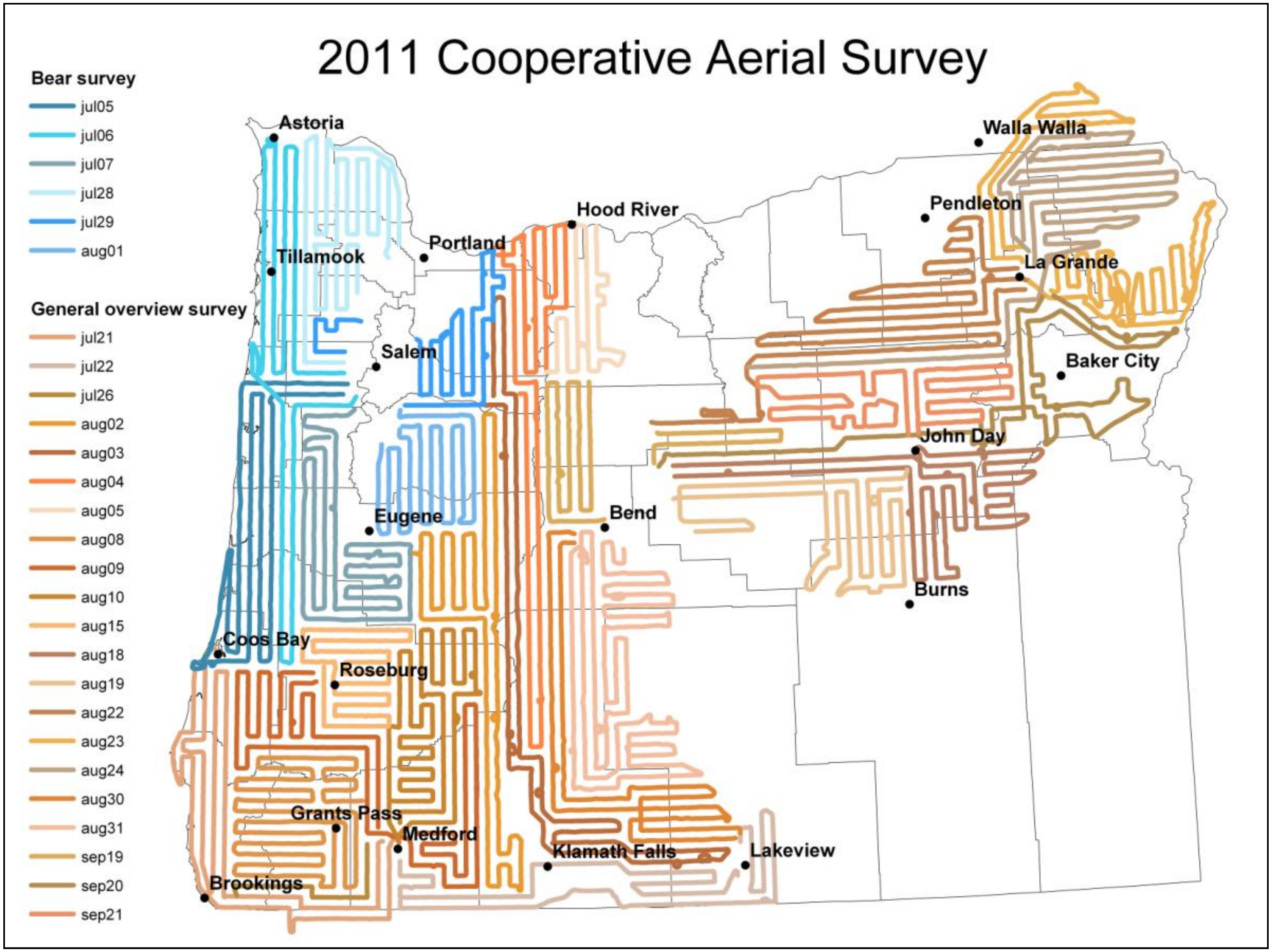
Forest Service
Pacific Northwest
Region

Oregon
Department of Forestry

# Forest Health Highlights in Oregon - 2011

## May 2012




*Coverage area and flight lines for the statewide aerial survey of Oregon forests, 2011.*
*Map by:  Robert Schroeter, USDA Forest Service*

# Forest Health Highlights In Oregon – 2011

Joint publication contributors:

Rob Flowers[1]
Alan Kanaskie[1]
Michael McWilliams[1]
Alison Nelson[2]
Robert Schroeter[2]

[1]Oregon Department of Forestry
[2]U.S. Department of Agriculture, Forest Service

***Front cover:*** *Pine butterfly larvae feeding on ponderosa pine in the Malheur National Forest. The largest known outbreak to have occurred in Oregon continued in 2011. (Photo by Bruce Hostetler, USDA Forest Service Ret.)*

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# Introduction

Insects, diseases, and other agents cause significant tree mortality, growth loss, and damage over large areas of forest lands in Oregon each year. These occurrences affect management strategies of landowners and may contribute to hazardous forest fire conditions. However, these disturbance agents are usually a natural and necessary part of forest ecosystems. They contribute to decomposition, nutrient cycling, and create openings which enhance vegetative diversity and wildlife habitat. A healthy forest is never free of insects, diseases, and other periodic disturbances.

The Oregon Department of Forestry works cooperatively with the USDA Forest Service and other public and private organizations to assess forest health throughout the state annually. This is done using an array of aerial and ground surveys that focus on detection and monitoring of a wide number of forest disturbance agents. In some cases, this also involves overseeing treatment or eradication efforts to mitigate their impacts. This report provides an overview and summary of the status of forest health in Oregon for 2011. For additional information, please refer to the websites provided at the conclusion of this report or contact the forest health professionals listed there.

# Forest Resources

The state of Oregon has approximately 28 million acres of forest lands, consisting of federal (60%), private (35%), state (3%) and tribal (2%) ownerships. Western Oregon is characterized by high rainfall and dense conifer forests along the Pacific coastline, Coast Range, and western slopes of the Cascades, 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 measures and monitors change to Oregon's forests through ground surveys within a statewide grid of permanent plots. A systematic subsample of plots is measured annually until all plots across the state have been sampled. Each plot is sampled once during every 10 year cycle (Figure 1). FIA data are valuable for assessing the occurrence of damaging agents that cannot be detected by aerial surveys.

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

PNW Forest Inventory and Analysis

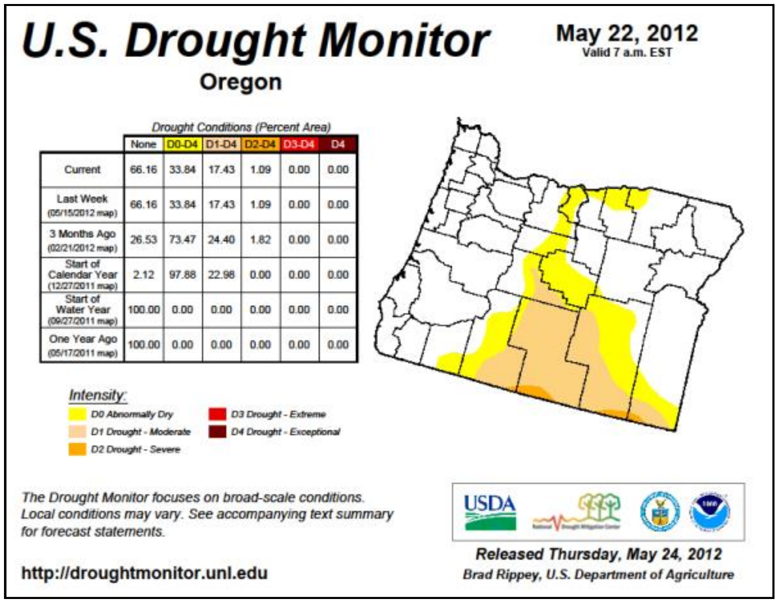
***Figure 1.*** *FIA monitors the extent and conditions of forest resources and analyses how these change over*

## Weather and Drought

In 2011, winter snowpack and spring precipitation were average to above-average for most of the forested areas in Oregon, while average spring and summer temperatures were generally below-normal. These colder and wetter spring conditions often negatively affect bark beetles, but can contribute to increases in the incidence and spread of some tree diseases.

Damage from winter storms was also below-average in 2011 and drought conditions were generally rare statewide. Trees that sustain damage from winter storm events or summer drought stress become more susceptible to injury by insects and diseases and may be less likely to recover. These effects are amplified in some areas of eastern Oregon, where trees are often growing on more drought-prone sites at high stand densities. Current data for Oregon shows drought conditions now occurring in some areas (Figure 2).

<u>Oregon Climate Service</u>: [http://www.ocs.orst.edu/](http://www.ocs.orst.edu/)




| | None | D0-D4 | D1-D4 | D2-D4 | D3-D4 | D4 |
|---|---|---|---|---|---|---|
| Current | 66.16 | 33.84 | 17.43 | 1.09 | 0.00 | 0.00 |
| Last Week (05/15/2012 map) | 66.16 | 33.84 | 17.43 | 1.09 | 0.00 | 0.00 |
| 3 Months Ago (02/21/2012 map) | 26.53 | 73.47 | 24.40 | 1.82 | 0.00 | 0.00 |
| Start of Calendar Year (12/27/2011 map) | 2.12 | 97.88 | 22.98 | 0.00 | 0.00 | 0.00 |
| Start of Water Year (09/27/2011 map) | 100.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| One Year Ago (05/17/2011 map) | 100.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |

***Figure 2.*** *U.S. drought monitor estimates for Oregon, May 2012.*

## Fire

The Oregon Department of Forestry provides fire protection on over 16 million acres of private and public forests and range lands. In 2011, there were 698 natural and human-caused fires recorded that burned over 2,600 acres; this was far less than the ten-year average of 1,074 fires and over 25,000 acres burned (Figure 3). The 2011 fire season in Oregon started out with cooler and wetter conditions than normal, delaying the onset of fire activity by several weeks.

Brian Pew, OR Dept. of Forestry

***Figure 3.*** *Wildfire burning in an area with bark beetle-killed trees (red crowns).*

Hotter and drier summer conditions returned by August, but storms producing "dry" lightning, the cause of many wildfires, were rare. However, on August 25th a series of intense thunderstorms generated over 8,500 lightning strikes that ignited numerous wildfires. Rapid response by firefighters and favorable weather conditions contained the majority of these fires to small areas. Special appropriation of aviation resources to strategic locations in Oregon were especially valuable in preventing many fires from growing into larger incidents this year.

# Aerial Surveys

Aerial surveys using both fixed and rotor-wing aircraft are conducted each year to assess forest health 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 (SOD). Surveyors use an array of imagery with a digital sketch-mapping system that is linked to a GPS. The system allows rapid detection and reporting of tree mortality and other damage.

Over 28 million acres were surveyed in the statewide aerial survey in Oregon in 2011. A separate survey of over 2 million acres in western Oregon to document damage from Swiss needle cast (SNC), a foliage disease of Douglas-fir, has been conducted since 1996. Maps, trend reports, and GIS data from these surveys are distributed to cooperators and other interested parties annually, and are available on Oregon Department of Forestry and USDA Forest Service, Forest Health Protection websites listed on the last page of this publication.

Special aerial surveys to detect tanoaks killed by the non-native pathogen, *Phytophthora ramorum*, the cause of sudden oak death (SOD), have been conducted in Curry County since 2001. Surveys precisely record the location of all dead and dying trees which are then visited by ground crews to assess the cause of tree mortality and sample for the SOD pathogen. In 2011, SOD aerial surveys were conducted in February, May, July, and October covering over 1 million acres in Oregon.

Rob Flowers, OR Dept. of Forestry

***Figure 4.*** *View from the Partenavia Observer aircraft used for aerial surveys in Oregon.*

# Insects

Forest insects are regulated by a number of factors that can lead to significant annual variation. In 2011, statewide aerial surveys estimated over 996,000 acres were affected by forest insects, with effects ranging from tree mortality to minor defoliation. Contrary to the trend observed for the last decade, insect defoliators accounted for a larger area of aerial detections this year (53%), followed by bark beetles (34%), and branch-feeding insects (13%). Dramatic increases in defoliator activity in eastern Oregon, coupled with significant declines in bark beetles in many areas, resulted in only a 2% rise in the overall area affected by forest insect relative to 2010.

Mountain pine beetle has been responsible for the majority of tree mortality detected by aerial surveys in Oregon during the last decade. In 2011, a significant decline in observed tree mortality occurred, with estimates falling to the lowest level since 2005. Other tree-killing bark beetles including the western pine beetle, Douglas-fir beetle, and fir engraver were observed to be at lower, endemic levels in most areas, while damage from the flatheaded fir borer rose in southwest Oregon. The amount of defoliation by conifer-feeding insects increased significantly in 2011, primarily due to increased activity by western spruce budworm, and an unprecedented outbreak of pine butterfly in eastern Oregon.

More localized defoliation by the larch casebearer and Douglas-fir tussock moth was also observed, and special trapping surveys were initiated for a non-native alder sawfly. For the first time since 1978, no moths were trapped in the on-going gypsy moth trapping program conducted by the Oregon Dept. of Agriculture. Damage from a non-native insect, the balsam woolly agelgid, continued, while increasing damage to Oregon white oaks was linked to oak pit scales.

## Mountain Pine Beetle (*Dendroctonus ponderosae*)

Tree mortality attributed to mountain pine beetle declined dramatically in many areas in 2011; however, localized damage to remaining, highly susceptible hosts including mature lodgepole and five-needle pines (western white, sugar, and whitebark) continued. The total area mapped with tree mortality decreased by 45% this year, and the estimated number of trees killed within those areas declined for a third consecutive year to the lowest level since 2001 (Figure 5).

Historically, outbreaks cannot be sustained once the majority of mature lodgepole stands are exhausted, and the declines since 2008 appear to be due to the depletion of these hosts in many areas. While overall detection of tree mortality is expected to decline in coming years, areas with large numbers of highly susceptible hosts remaining will likely continue to see substantial tree mortality. Recently, mature lodgepole pines occurring in riparian zones have been heavily impacted.

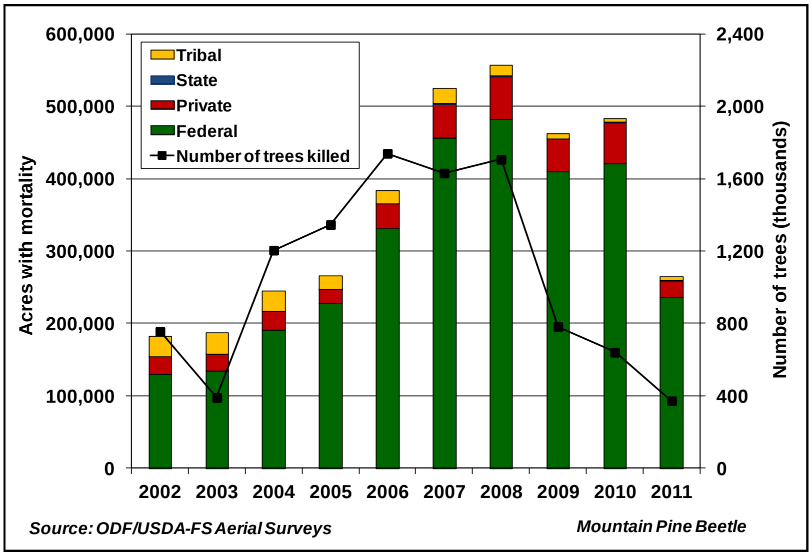



***Figure 5.*** *Ten-year trend for total acres affected and estimated number of trees killed by mountain pine beetle in Oregon.*

Iral Ragenovich, USDA Forest Service

***Figure 6.*** *Safety corridors and fuel breaks have been created where possible in areas with large-scale mortality.*

Tree mortality from mountain pine beetle was most apparent in 2011 in the Deschutes National Forest near Mt. Bachelor and Newberry Crater, and in the Fremont-Winema National Forests near Crater Lake, Yamsay Mountain, Yainix Butte, and the Warner Mountains. The current focus in areas with large-scale tree mortality has been to create strategic safety corridors and fuel breaks where possible (Figure 6). This involves removal of dead trees along roads and in recreation sites as well as reducing fuel loads, improving forest health, and increasing access and safety for firefighters.

## Western Pine Beetle (*Dendroctonus brevicomis*)

Western pine beetle most commonly attacks large-diameter, individual ponderosa pines stressed by root diseases, drought, defoliation, or wildfire damage. Group-killing of small-diameter pines also occurs, but is less common. Tree mortality attributed to western pine beetle declined in 2011 relative to 2010, and was estimated at over 25,000 acres (Figure 7).

The majority of damage observed this year occurred as scattered, individual large-diameter ponderosa pines, especially in areas of the Ochoco and Malheur National Forests that were damaged in 2007 by the 140,000 acre Egley Complex of wildfires. Group-killing of smaller pines was also observed, but ground surveys indicated these were more often attributable to mountain pine beetle, when they occurred near outbreak areas or were due to other bark beetles, most notably the California five-spined Ips (*Ips paraconfusus*).

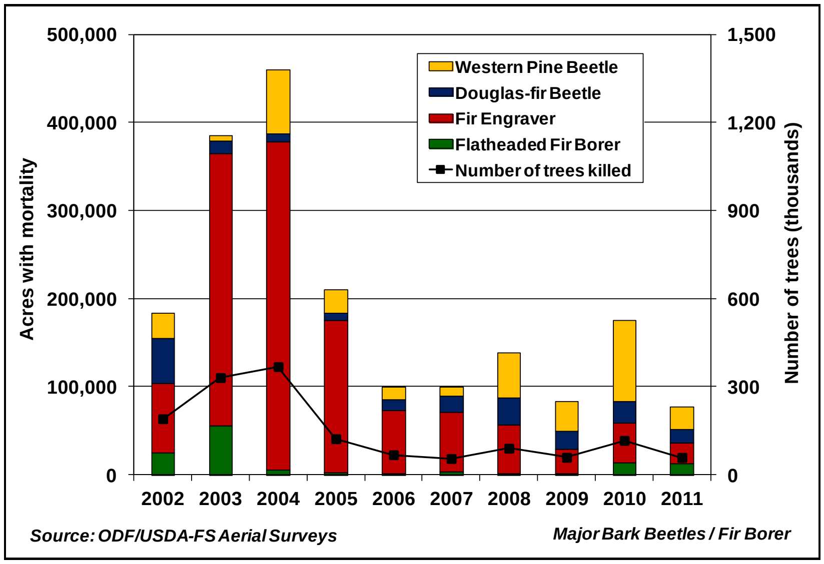



***Figure 7.*** *Ten-year trend for total acres affected and estimated number of trees killed by bark beetles and fir borer in Oregon.*

## Douglas-fir Beetle (*Dendroctonus pseudotsugae*)

Tree mortality attributed to Douglas-fir beetle declined by 40% from 2010 to over 14,000 acres this year (Figure 7). During endemic population levels, the majority of tree mortality occurs in association with root diseases, while periodic, localized outbreaks are most often linked to blow-down from winter storms, insect defoliation, wildfire damage, and moisture stress.

Craig Leech, OR State Parks


***Figure 8.*** *Winter storm damage in western Oregon is often linked to outbreaks of Douglas-fir beetle.*

Tree mortality in 2011 was most apparent in the Clatsop and Tillamook State Forests of northwest Oregon and in the Willamette National Forest from the North Santiam River south to the McKenzie River. However, detections may have been reduced in some areas due to below-average spring temperatures delaying foliar symptom development. Storm damage along the north coast, and in areas of the Willamette Valley and Columbia River Gorge during the winter of 2011-2012 (Figure 8), have created conditions that may lead to increased Douglas-fir beetle populations in coming years.

## Fir Engraver (*Scolytus ventralis*)

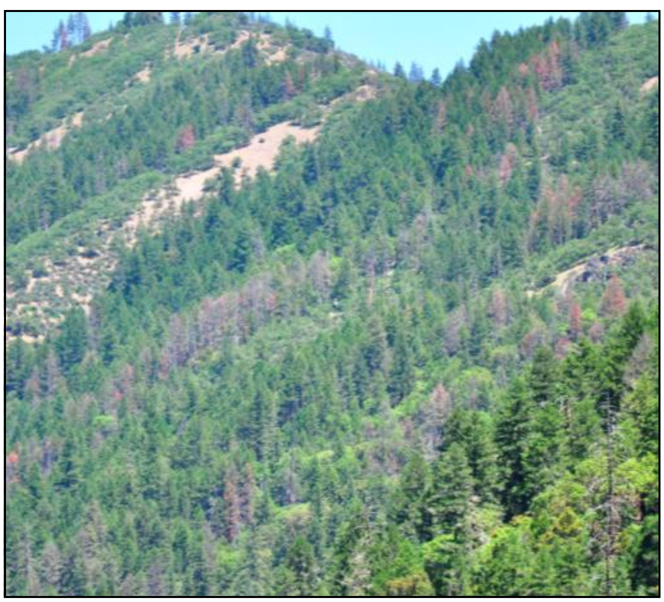
In 2011, tree mortality from fir engraver was estimated at over 23,000 acres (Figure 7). The estimated area affected by this beetle declined by 47% relative to 2010, and remained at a level generally considered to be endemic for Oregon. Historically, outbreaks of fir engraver have been most strongly associated with periods of prolonged drought or following large-scale disturbance events like insect defoliation or wildfires that have made hosts more susceptible.

The majority of detections in 2011 occurred in southwest Oregon in the Siskiyou Mountains and Rogue River National Forest, as well as in more drought-prone areas of the Blue Mountains. Fir engraver infestations can be identified by removing the bark and looking for horizontal galleries on the inner surface or those etched onto the outer surface of the wood (Figure 9). Low damage levels are expected to continue in most areas, with the possible exception of south-central Oregon, which has received below-average moisture recently and is forecast to experience drought conditions for the near future.

George Ferrell, USDA Forest Service

***Figure 9.*** *Fir engravers create horizontal galleries in the phloem tissue, often etching the surface of the wood.*

## Flatheaded fir Borer (*Phaenops drummondi*)



Ellen Goheen, USDA Forest Service

***Figure 10.*** *Douglas-fir mortality due to attacks by the flatheaded fir borer has increased in southwest Oregon.*

The flatheaded fir borer is a woodborer (Family Buprestidae) and not a bark beetle, but it can sometimes act aggressively and cause tree mortality. Historically, it has been credited with killing a large number of Douglas-fir in southwest Oregon, often those growing on lower-elevation, more drought-prone sites. And, while detection levels have been relatively low since 2003, damage has increased in 2010-2011, to over 11,000 acres. The most concentrated mortality was observed in the Siskiyou Mountains, Applegate watershed, and foothills east of Medford to the Rogue River National Forest (Figure 10). Previous ground surveys in these areas have indicated that while other agents play a role in tree mortality, flatheaded fir borer activity appears to be one of the primary factors.

# Western Spruce Budworm (*Choristoneura occidentalis*)

Defoliation due to the current outbreak of western spruce budworm has been observed during aerial surveys in central and northeast Oregon since 2001. The extent and damage within affected areas has continued to increase annually, with the exception of 2008, when activity appeared to be negatively impacted by below-average summer temperatures. Defoliation significantly increased in 2011, more than doubling to over 258,000 acres (Figure 11).

The current outbreak is affecting Douglas-fir and true firs, as well as Engelmann spruce where it occurs. It is concentrated in the Ochoco and Malheur National Forests near Snow Mountain, the Strawberry Mountains, and east of the Silvies Valley. It is co-occurring with a large outbreak of pine butterfly that is affecting ponderosa and lodgepole pines in many of the same areas. The current budworm outbreak is the most extensive since the last major outbreak ended in the early 1990's.

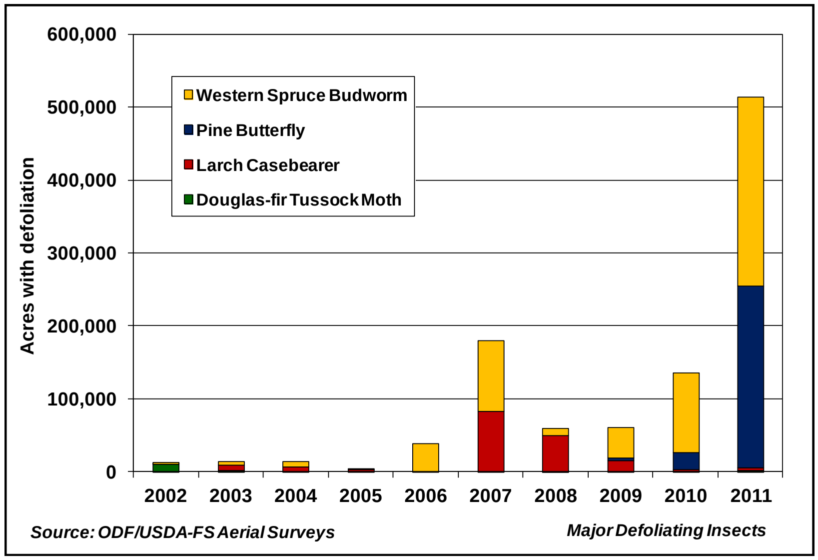



***Figure 11.*** *Ten-year trend of the total area affected by insect defoliators in Oregon, as detected by annual aerial surveys.*

Rob Flowers, OR Dept. of Forestry

***Figure 12.*** *Defoliation of Douglas-fir by western spruce budworm larvae in Northeast Oregon.*

Feeding by western spruce budworm may cause growth loss, top-kill, tree deformity, reduced seed production, or tree mortality. The intensity of the defoliation appeared to increase this year and some understory mortality and top-kill has been reported where defoliation has occurred for several years (Figure 12).

Host trees that survive budworm outbreaks in a weakened condition often become more susceptible to bark beetles. The increased abundance of preferred hosts in recent decades suggests that the current outbreak may continue to expand and intensify. Management strategies are best focused on maintaining appropriate tree densities and species compositions for the site.

## Pine Butterfly (*Neophasia menapia*)

Outbreaks of the pine butterfly have occurred historically in the Blue Mountains of Oregon from 1908-1911, 1940-1943, in 1982, and 2008-present. While previous outbreaks are often not well described, each appears to have been relatively short-lived and resulted in a limited amount of tree mortality. The current outbreak, first detected in 2008, expanded significantly in 2011, both in extent and severity of defoliation, and affected over 250,000 acres (Figure 11).

Defoliation intensity was described as moderate-to-severe on more than 90% of the affected area this year (Figure 13). Limited tree mortality has been observed to this point, but may occur due to increased susceptibility of trees to attacks by bark beetles. Many ownerships are affected including large areas of the Malheur National Forest east of the Silvies Valley between John Day and Burns as well as adjacent BLM and private lands. Outbreaks of pine sawflies (*Neodiprion* spp.) co-occurred in some areas, with defoliation likely underestimated at 11,000 ac.

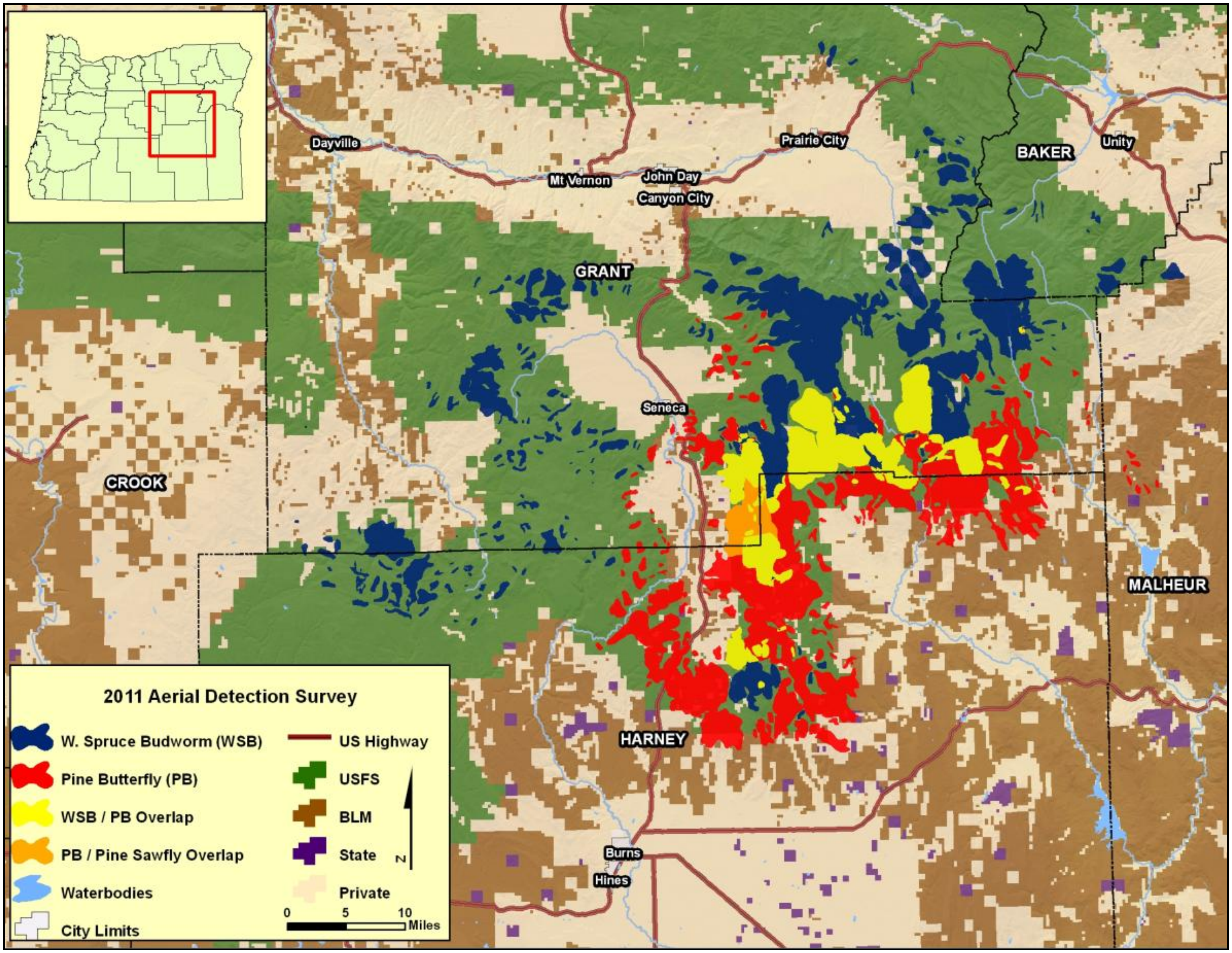
USDA Forest Service

***Figure 13.*** *Severe defoliation by pine butterfly larvae occurred over thousands of acres of ponderosa and lodgepole pines.*

USDA Forest Service

***Figure 14.*** *Pine butterfly adults were observed in extremely large numbers during August and September.*

Pine butterfly populations appear to be regulated to some degree by natural enemies, which were more abundant in 2011. A parasitic wasp (*Theronia atalantae*), described in earlier outbreaks, was very abundant this year as well as a larval predator (*Podisus* sp.). These agents, coupled with increasing larval starvation, suggest that the outbreak will soon collapse. Large numbers of eggs were laid on undefoliated hosts in adjacent areas, and some defoliation may continue to occur (Figure 14). A cooperative research project to assess growth loss and tree mortality is underway. Objectives are to better understand factors related to outbreaks and to aid in forest management decisions.




*Defoliation by western spruce budworm, pine butterfly, pine sawfly, and areas of overlap detected in 2011.*

## Douglas-fir Tussock Moth (*Orgyia pseudotsugata*)

Glenn Kohler, Washington DNR

***Figure 15.*** *Increasing Douglas-fir tussock moth defoliation has been detected in the Blue Mountains.*

Defoliation by the Douglas-fir tussock moth occurs periodically in the Blue Mountains of Oregon and can affect large areas. In 2011, over 1,200 acres of defoliation was detected, with an additional 7,800 acres observed north of the state border in Washington (Figure 15). Defoliation was deemed low intensity as only the tops of the primary hosts, Douglas-fir and true firs, were defoliated. Defoliation was most apparent in the Wenaha-Tucannon Wilderness in the Umatilla National Forest. Early-warning system trap captures had been elevated there since 2008, indicating populations were rising. Ground surveys indicated egg masses were abundant, and damage is expected to increase in the near future.

## Fall Webworm (*Hyphantria cunea*)

Fall webworm is one of the most commonly observed hardwood defoliators in Oregon, and causes localized defoliation on a number of hosts each year. Larval colonies feed within or in close proximity to large silk webs (Figure 16), and characteristically “skeletonize” the leaves. While their peak occurrence is often too late to be detected in annual aerial surveys, reports from Southwest Oregon have indicated outbreaks levels have been observed from 2009-2011.

Defoliation in the current outbreak has been most apparent on Pacific madrone, but a number of other forest and ornamental trees have also been affected. While the appearance of large numbers of webs has caused public concern, outbreaks are generally short-lived and tree mortality is very rare. Outbreaks of this size appear to be uncommon historically, and the long-term effects remain uncertain. Populations normally return to endemic levels after 2-3 years through natural means, and this outbreak is therefore not expected to persist.

Ellen Goheen, USDA Forest Service

***Figure 16.*** *Outbreaks of fall webworm continued in Southwest Oregon, affecting a number of hardwood hosts.*

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

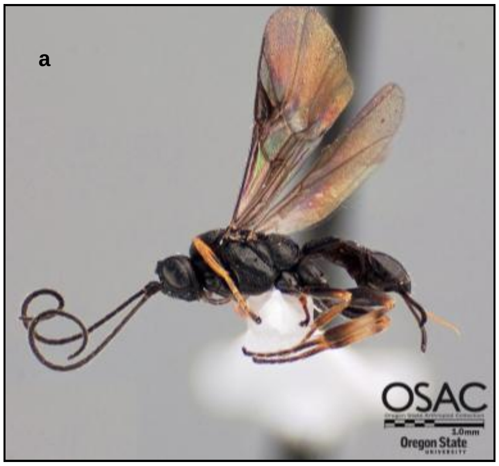
The larch casebearer (*Coleophora laricella*) is a non-native moth whose larvae can defoliate large areas of western larch. Defoliation from larch casebearer was estimated at over 3,000 acres in 2011 (Figure 11). This was similar to levels observed in 2010, but far below the over 82,000 acres detected in 2007. Defoliation this year occurred primarily on the Umatilla and Wallowa-Whitman National Forests and adjacent private lands. During the 1970's the USDA Forest Service initiated a biological control program for larch casebearer using 7 species of parasitoid wasps that were collected from its native range in Europe and Japan. These were released in northeast Oregon, appeared to affect larch casebearer populations, and the program was considered a major success. As no additional monitoring for the presence of these species had been completed since 1995, researchers at Oregon State University sampled western larch in 2010 and 2011 in the Blue Mountains to determine if these wasp species were still present within populations of the larch casebearer (Figure 17).

David Shaw, Oregon State University

***Figure 17.*** *Larch casebearer populations were sampled to look for previously released biological control agents.*

Sampling results indicated that at least two of the seven species originally released are still present, *Agathis pumila* and *Chrysocharis laricinellae* (Figure 18a,b). As this was not a comprehensive population study, it is difficult to determine if these parasitic wasps are controlling the larch casebearer to any degree. However, outbreaks of larch casebearer since that time have been short-lived in Northeast Oregon, suggesting that these and other natural enemies, along with environmental factors may be exerting some influence on larch casebearer.

OSU Arthropod Collection





OSU Arthropod Collection

***Figure 18:*** *Two parasitic wasps*, *Agathis pumila (a)* and *Chrysocharis laricinellae (b), previously released for biological control of larch casebearer are still present in Oregon.*

## Green Alder Sawfly (*Monsoma pulveratum*) *Non-native*

The green alder sawfly is native to Europe, North Africa, and the near East. It was first detected in the Pacific Northwest in 2010 near Vancouver, WA and was of concern due to its contribution to widespread defoliation of thin-leaf alder (*Alnus tenuifolia*) in Alaska. Cooperative trapping efforts were completed in 2010 and 2011 by state and federal agencies in four states. Surveys indicated that it appears to be widely distributed, with detections in 27 counties (Figure 19). Recent findings in insect museum collections suggest that it has occurred here since at least the mid-1990's. This sawfly does not appear to represent a threat to red alder (*Alnus rubra*) as where it has been detected, defoliation has been only relatively minor.

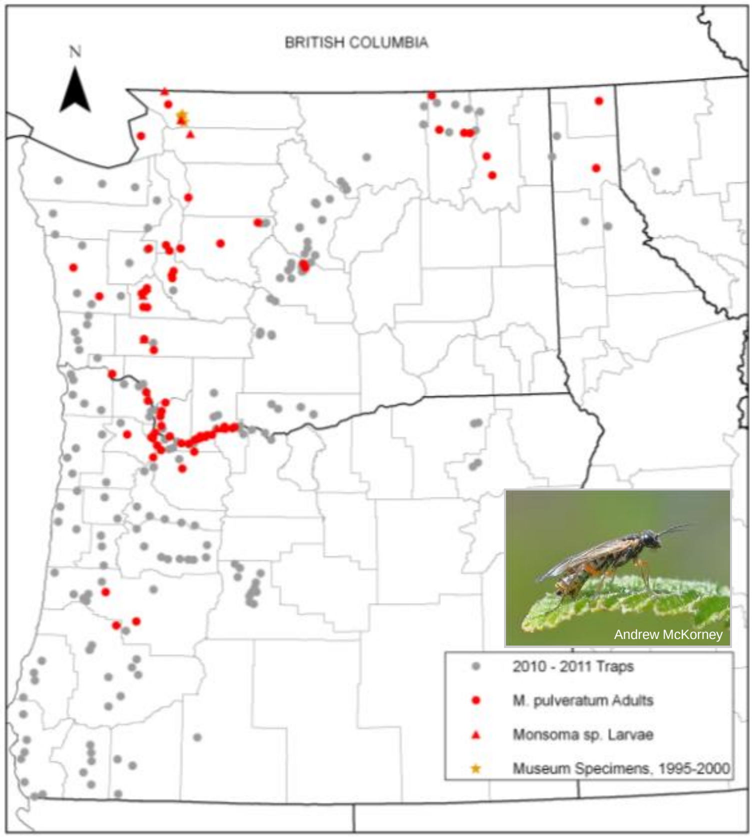



***Figure 19:*** *Green alder sawfly captures (red) and traps (grey) in OR, WA, ID, and MT. Map by: Chris Looney, WSDA.*

Kathy Sheehan, USDA-FS

***Figure 20:*** *Green alder sawfly larvae cause "shot-hole" feeding damage.*

Green alder sawfly feeding on red alder is very similar to damage caused by our native alder defoliators (Figure 20), which include the alder flea beetle and striped alder sawfly. Green alder sawfly differs from native sawflies in that they excavate chambers and pupate in dead or decaying wood. This behavior may have helped to facilitate their spread to new areas through firewood.

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

Nearly 13,000 traps were placed by the Oregon Department of Agriculture in 2011, and for the first time since 1978, no gypsy moths were collected. Only a single gypsy moth was captured in 2010, and no additional moths have been found at that site. This will be the third consecutive year with no eradication planned. No gypsy moths have been recovered at the two most recent eradication sites in Eugene (2009) and Shady Cove (2008). It is unknown what factors are responsible for the decline in recent captures, but diminished gypsy moth populations in some areas of the Eastern U.S. as well as economic factors that have reduced the number of shipments and people relocating to Oregon from infested areas, may have contributed.

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

The balsam woolly adelgid is a sap-feeding insect whose activity can cause severe defoliation and decline of true firs. Detection has increased in Eastern Oregon over the last decade, with aerial surveys reporting over 126,000 acres in 2011. While aerial detections were lower this year relative to the over 180,000 acres detected in 2010, this is more likely due to the difficulty in recognizing tree symptoms, coupled with the continued loss of hosts in chronically affected areas, than to reductions in adelgid populations. Decline has been most apparent in high-elevation subalpine and Pacific silver firs along the crest of the Cascades from Mount Hood south to the Rogue River National Forest and in Northeast Oregon in the Umatilla and-Wallowa-Whitman National Forests. Continued decline of these hosts is expected due to the minor impact of natural enemies and minimal host resistance (Figure 21).

Darci Carlson, USDA Forest Service

***Figure 21:*** *Chronic infestations of balsam woolly adelgid have contributed to subalpine fir declines.*

## Oak Pit Scales (*Asterolecanium* spp.)

Oak pit scales are sap-feeding insects that can cause severe foliage loss and branch dieback in Oregon white oak (*Quercus garryana*). In 2011, landowners along the Columbia River Gorge, in both Oregon and Washington, described a widespread decline evidenced by poor crown conditions. Aerial surveys supported these findings. Over 90 acres of scattered damage to oaks was detected in Oregon, primarily in Wasco County, as well as over 240 acres in Klickitat County, Washington. Ground surveys indicated that oak pit scales were abundant in most of these areas. Feeding by the scales causes direct cambial injury that can lead to branch dieback and delayed leaf expansion, resulting in clumped foliage (Figure 22). Oak pit scales are well known in California where valley oak (*Quercus lobata)* can be heavily impacted, but less is known about their effect on Oregon white oak as fewer reports of damage have occurred historically in the Pacific Northwest.

Univ. of California IPM

Amy Ramsey-Kroll, WA DNR

***Figure 22:*** *Oak pit scales are sap-feeding insects that attach to the bark; damage to white oaks was reported from many areas.*

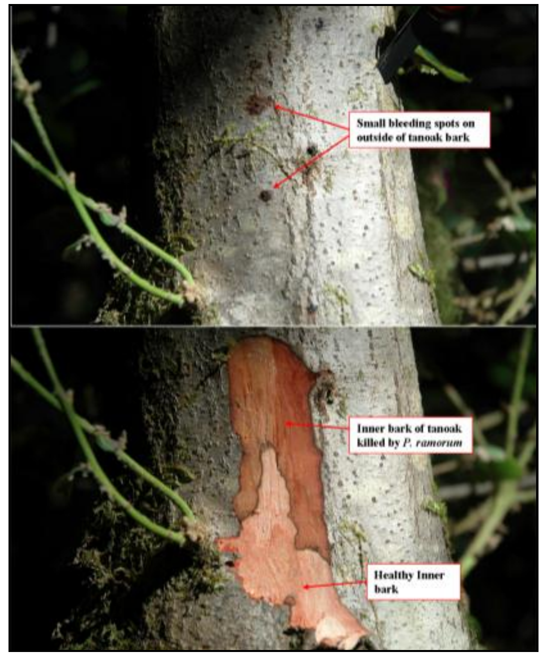
# Diseases

## 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). To date, eradication treatments have been completed on more than 3,500 acres at an estimated cost of over $7 million. Outside of Oregon, *P. ramorum* is known to occur in forests only in California (14 counties) and two European countries. The origin of the pathogen is unknown.

DOI Bureau of Land Management

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




Alan Kanaskie , OR Dept. of Forestry

***Figure 24.*** *Stem lesion on the inner bark of tanoak caused by* Phytophthora ramorum.

*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. *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 that are produced on infected leaves or twigs are released into the air and are either washed downward or transported in air currents. *P. ramorum* also has a tough resting spore stage, called a chlamydospore, which allows the pathogen to survive harsh conditions for months or years in soil or plant parts. The disease can be spread by humans transporting infected plants or infested soil.

Despite efforts to eradicate the pathogen from infested sites, the disease has continued to spread slowly. From 2007 to 2009 the number of new infested sites discovered each year appeared to stabilize at approximately 60 per year (Figure 25). In 2010 the number of new infested sites increased to 83, with many of these new sites located in areas where treatment delays had occurred in prior years. In 2011, there were 172 new sites detected (nearly triple the three-year average), with one site located at Cape Sebastian, 6.5 miles north of the quarantine boundary and 12 miles from the nearest known infested site (Figure 26, next page).

Disease spread between 2001 and 2011 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 4.7 miles, respectively. The initial quarantine area was 9 $mi^2$ in size. It has been expanded five times, with the most recent expansion to 202 $mi^2$ occurring in 2011. This was made official in early 2012.

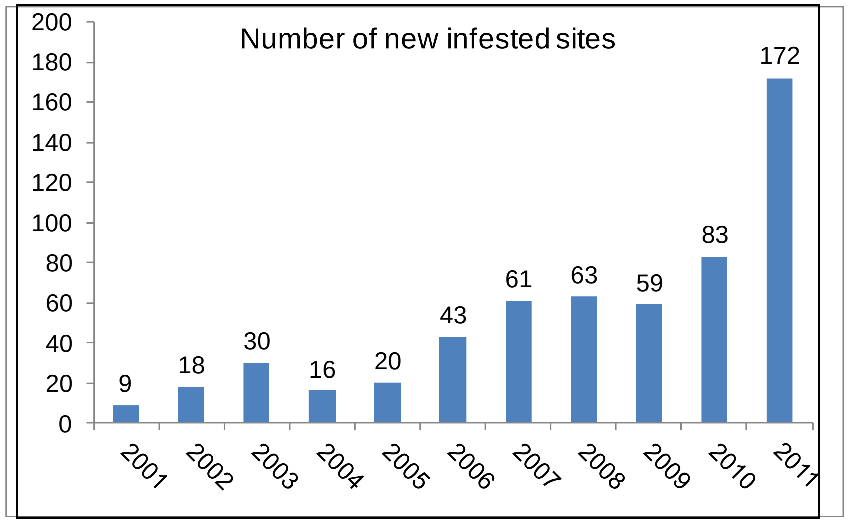



***Figure 25.*** *Number of new Sudden Oak Death infestations discovered each year in Curry County, Oregon.*

Several factors contribute to continued spread of the disease. Latency of the pathogen (*w*hen it is present but not detectable) allows for disease spread during the time between initial infection and the development of visible symptoms. Slow and uneven distribution of funding can delays treatments for months, during which time the disease can intensify and spread. Wet weather in the spring and early summer also favor disease spread.

The significant increase in disease occurrence in 2010 and 2011 clearly indicated that eradication treatment costs on private lands would exceed available or expected funds. The initial goal of complete eradication in Curry County forests is now considered unachievable. Our goal now is to slow-the-spread of the disease by: 1) early detection and rapid eradication of new infestations (prioritizing those that are most important in terms of potential disease spread); 2) reducing inoculum levels wherever practical through cost-share projects and best management practices, and; 3) improved education and outreach to prevent further disease spread by human activities. In early 2012, the Oregon State quarantine regulations were revised to reflect these new goals and funding levels.

Quarantine regulations and other information can be found at:
*http://www.oregon.gov/oda/cid/plant_health/sod_index.shtml*

A complete *P. ramorum* host list can be found at:
*http://www.aphis.usda.gov/ppq/ispm/pramorum/pdf_files/usdaprlist.pdf*

More information on Sudden Oak Death can be found at:
*http://www.nature.berkeley.edu/comtf/*

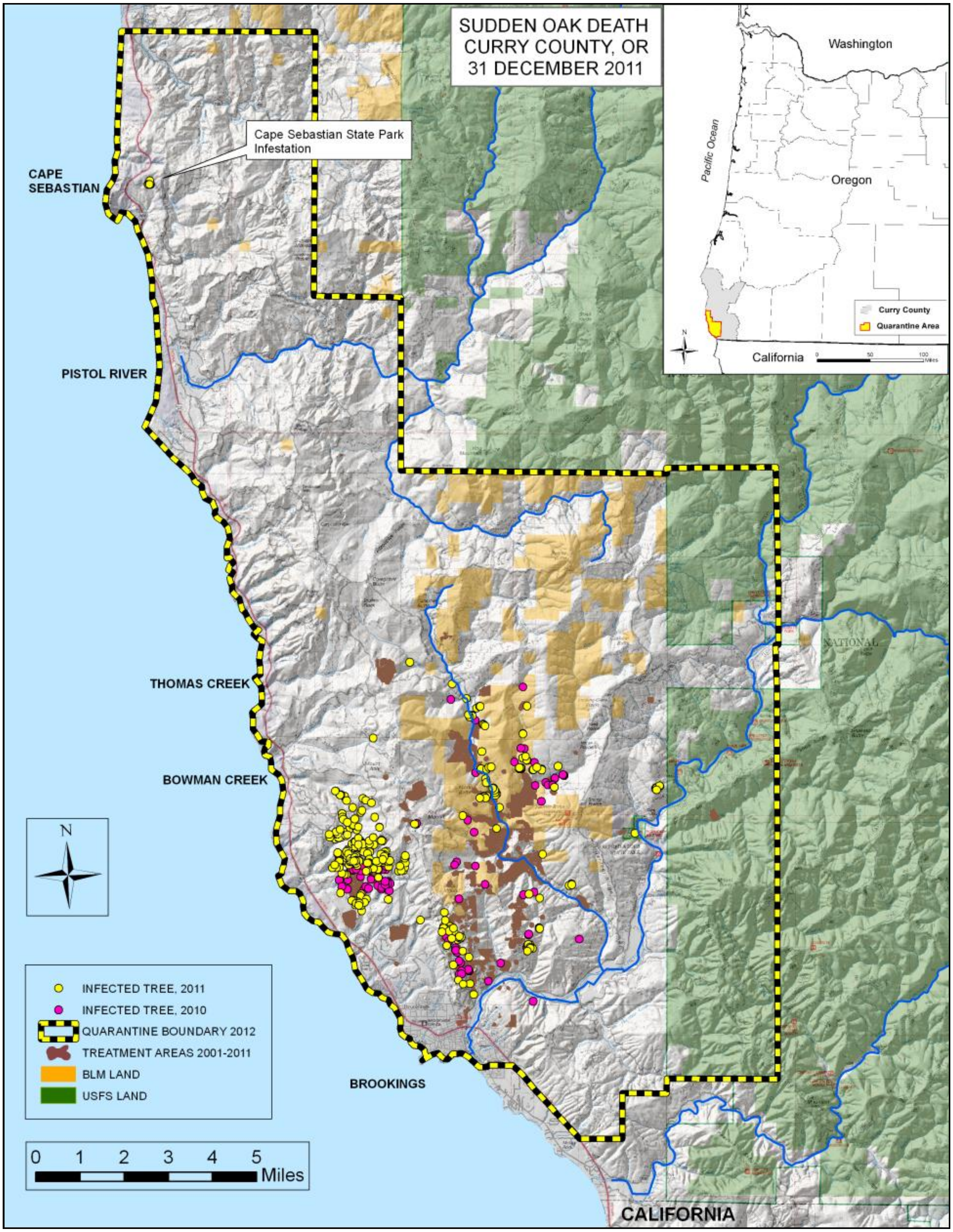



***Figure 26.*** *Location of areas infested with* Phytophthora ramorum *in southwest Oregon, December, 2011. The quarantine boundary shown was made official in early 2012. Map by: Alan Kanaskie.*

# Swiss Needle Cast (SNC)

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 tree, ultimately reducing tree growth and survival (Figures 27). 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 west slopes of the Oregon Coast Range.

Growth loss as a result of Swiss needle cast 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 (Figure 28). Growth loss due to Swiss needle cast in the Oregon Coast Range is estimated at more than 100 million board feet per year. In addition to growth impacts, Swiss needle cast alters wood properties and affects stand structure and development. This complicates stand management decisions, especially in pure Douglas-fir stands.

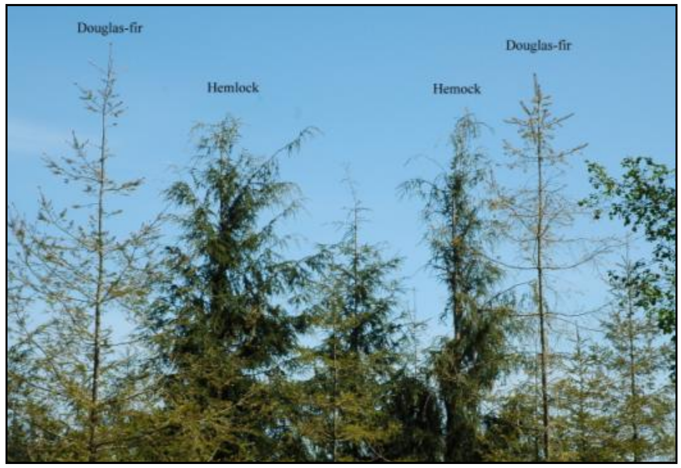



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***Figure 27.*** *In the Coast Range of western Oregon, Swiss needle cast causes foliage loss and sparse yellow crowns in Douglas-fir, which can reduce tree volume growth by more than 50 percent. Western hemlock is unaffected.*

Aerial surveys to detect and map the distribution of Swiss needle cast 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 west 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. The aerial observers map areas of Douglas-fir forest with obvious yellow to yellow-brown foliage, a symptom of moderate to severe Swiss needle cast damage (Figure 28).

The 2011 Oregon Coast Range survey was flown on May 18 and 24 and June 8, 9, and 17, and covered approximately 2.9 million acres of forest lands. The survey area extended from the Columbia River south to Brookings, and from the coastline eastward until obvious symptoms were no longer visible. We did not survey the Cascade Range in 2011, but Swiss needle cast does occur at damaging levels in some areas.

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***Figure 28.*** *Douglas-fir with obvious yellow to yellow-brown foliage indicates moderate-to-severe Swiss needle cast. Shown here also are western hemlock (dark green) and red alder (light green).*

The 2011 aerial survey showed an increase in the area of forest with symptoms of Swiss needle cast, compared to the previous three years, and reached an all-time high for the second year in a row. Over 444,000 acres of Douglas-fir forest with obvious symptoms of Swiss needle cast were mapped (Figure 29). As has been the case for the past several years, the easternmost area with obvious Swiss needle cast 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.


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*Figure 29.* *Areas of Douglas-fir forest with symptoms of Swiss needle cast detected in the 2011 aerial survey.*

The overall damage trend from 1996 through 2011 is shown below; results for 2008 were estimated by extrapolating from three sample survey blocks (Figure 30). Damage by Swiss needle cast continues at very high levels despite a shift by many landowners to forest management practices aimed at reducing damage from the disease. Caution is advised when interpreting aerial survey data. Swiss needle cast aerial surveys should be considered a conservative estimate because observers can map only those areas where

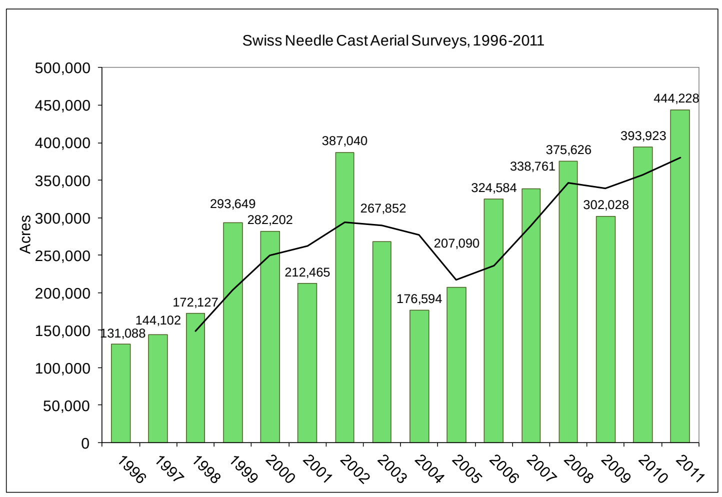


***Figure 30.*** *Trend in area of Douglas-fir forest in western Oregon with symptoms of Swiss needle cast, as detected by annual aerial surveys.*

disease symptoms have developed enough to be visible from the air. Permanent plot data and ground checks show that Swiss needle cast occurs throughout the survey area, but that discoloration often is not severe enough to enable aerial detection. Considerable variation from year to year can result from weather patterns which affect both symptom development and timing of the survey. Undoubtedly, the total area of forest affected by Swiss needle cast is far greater than indicated by the aerial surveys. Despite these shortcomings, the aerial survey provides a reasonable depiction of the extent of moderate and severe damage, coarsely documents damage trends over time, and establishes a zone in which forest management should take into account the effects of the disease.

## Swiss Needle Cast in the Cascades Range

In 2011, the Swiss Needle Cast Cooperative (SNCC) conducted the 10-year re-measurement of 59 Douglas-fir stands in the northern Oregon Cascade foothills and evaluated them for damage by Swiss needle cast. When the project was initiated in 2001, stand age ranged from 10 to 23 years. During this 10-year period, mid-crown foliage retention increased by an average of 1.2 annual needle complements, indicating that damage from SNC has decreased in this area. Results also showed that trees at higher elevations had more foliage and fewer fruiting bodies of the pathogen. These findings suggest that forest managers do not need to change their current management practices in the northern Oregon Cascades because of Swiss needle cast.

For SNC maps and GIS data, visit: *http://www.oregon.gov/odf/privateforests/fhMaps.shtml*

Oregon State University SNC Cooperative (SNCC): *http://sncc.forestry.oregonstate.edu/*

## Foliage Disease of Pacific Madrone

Persistent wet weather in spring and early summer allowed foliage diseases to flourish throughout the state in 2011. Most noticeable of these was a leaf blight of Pacific madrone, thought to be caused by *Phacidiopycnis washingtonensis*. In early 2011, the disease was so severe that entire hillsides of madrone appeared to have died as virtually all of the current-year foliage had turned brown (Figure 31). Trees of all ages and sizes, even young stump-sprouts in clear-cuts, were equally affected. The majority of these trees, however, were still alive and produced flowers (often very abundant ones) and leaves during the 2011 growing season. Symptoms of leaf blight on Pacific madrone include spots that coalesce and form dark blotches (Figure 32). The problem may become more severe after periods of sudden or extreme cold. Dead leaves remain attached to the tree until the new foliage is expanded. Damage was noticeable throughout the state, but was most severe inland, south of Eugene. Damage in the Willamette Valley was moderate in affected areas north of Eugene. Leaf blight was present but not severe in coastal Coos and Curry counties.


Alan Kanaskie, OR Dept. of Forestry

***Figure 31.*** *Leaf spot of Pacific madrone reached alarming levels throughout the state in 2011; many trees had no green foliage in late winter.*


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***Figure 32.*** *Despite appearing dead during winter, most Pacific madrone affected by leaf blight produced healthy foliage in the spring.*

For additional information on madrone leaf blight: *http://www.puyallup.wsu.edu/ppo/madrone/diseases/foliar_blight_2011.htm*

## 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 2011, bear damage was estimated at over 40,000 acres statewide (Figure 33). While this remained below the ten-year average, it was a significant increase relative to the low levels observed in 2010. Previous ground surveys indicate that, in addition to bears, tree injury at these sites is also commonly due to 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 preferred food sources as well as seasonal bear population levels and densities.

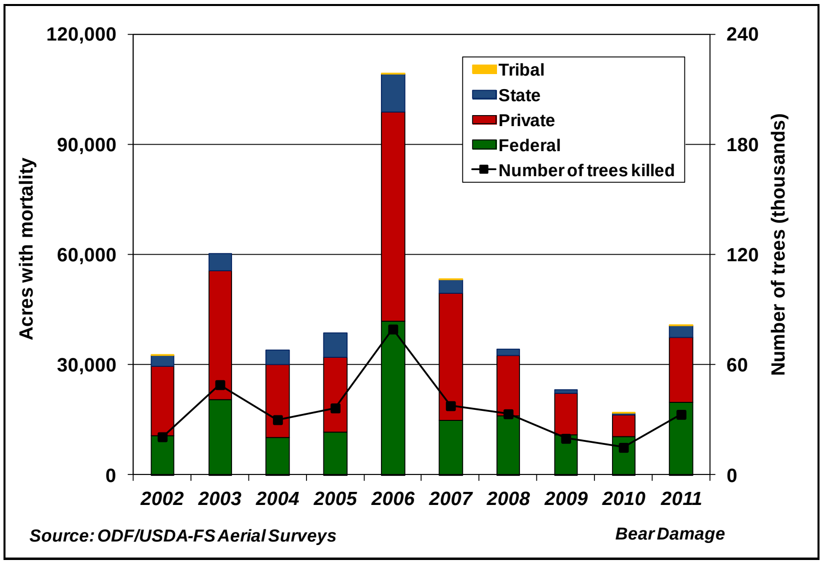


***Figure 33.*** *Ten-year trend of total acres affected by bears and the estimated number of trees killed annually.*

## Ozone Damage Monitoring

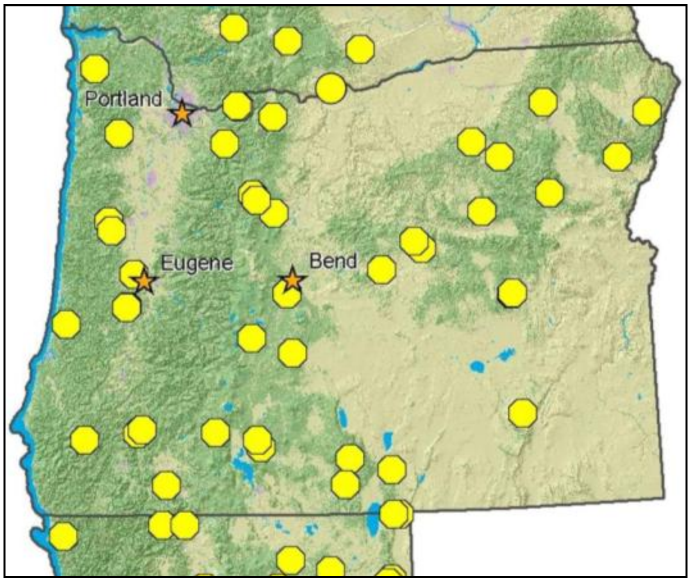


***Figure 34.*** *Ozone leaf injury was never detected in any of the 35 bio-monitoring plots in Oregon.*

High levels of ozone can cause a range of effects to vegetation including leaf injury, growth and yield reductions, and altered sensitivity to other stress agents. In trees, direct foliar injury can lead to increased susceptibility to damaging insects or diseases.

The Oregon Department of Forestry and the USDA Forest Service have cooperated in a national ozone biomonitoring program for the last ten years. This relied on annual ground surveys to assess indicator plant injury at 35 permanent plots distributed throughout the state (Figure 34). Ozone injury was never detected in any of the Oregon plots, and the project was discontinued in 2011

# Quaking Aspen Health Monitoring

In 2010 and 2011, the Oregon Department of Forestry, in cooperation with the Washington DNR and USDA Forest Service, evaluated the stand conditions and causal agents affecting quaking aspen (*Populus tremuloides)* in areas where damage had been observed during aerial surveys (Figure 35). In 2011, approximately 1,600 acres of damage to quaking aspen was observed in Oregon, similar to recent survey findings. Historically, this damage has been attributed primarily to defoliation by the non-native satin moth (*Leucoma salicis*), which does occur, but it was suspected that other agents were also involved. Ground surveys examined seventy-one locations dominated by aspen in Oregon and Washington.

fApproximately two-thirds were found to be in "stable" condition, while the remainder were deemed "successional" or "decadent" and at risk of continued decline. Conifer encroachment was a major contributing factor and was found at most sites. While aspen regeneration was present in over 90% of the sites, saplings occurred in less than 50%. The most frequent damage to trees resulted from ungulate (cattle, deer, and elk) chewing or rubbing, stem decays, woodboring beetles and fungal canker diseases; while regeneration was most affected by ungulate browsing, defoliating insects, and foliage diseases. Satin moth was detected at only a few sites, but did cause moderate defoliation where it occurred. The patterns observed here were not consistent with the rapid overstory mortality and lack of regeneration characteristic of "sudden aspen decline" (SAD) that has been reported elsewhere. There was instead evidence of slow, progressive decline resulting primarily from successional factors and ungulate activity. Conifer removal and fence exclosures may be needed to preserve aspen in some areas (Figure 36). Study findings have resulted in a new aerial survey code, "hardwood decline, aspen" (HDA), that will be used to describe this complex of agents affecting aspen in the Pacific Northwest.

Rob Flowers, OR Dept. of Forestry

***Figure 35.*** *Conifer encroachment and ungulate damage were the most common issues affecting aspen stands in Oregon.*

Michael Thompson, OR Dept. of Forestry

***Figure 36.*** *Conifer removal and fence exclosures may be needed to preserve declining aspen stands.*

## Aerial Survey Maps and GIS Data

Historic and current aerial survey quadrangle maps from 2003 to 2011 are available in PDF format at: *http://www.fs.usda.gov/goto/r6/fhp/ads/maps*

Arial survey spatial data from Oregon and Washington from 1980 to 2011 are available as GIS shapefiles at: *http://www.fs.usda.gov/goto/r6/fhp/ads/data*

Statewide (2003-2011) and Swiss needle cast (1996-2011) aerial survey data are also available for Oregon at: *http://www.oregon.gov/odf/privateforests/fhMaps.shtml*

## Additional Information on Forest Health

Historic annual forest health highlight reports for Oregon and Washington are available at: *http://www.fs.usda.gov/goto/r6/fhp/highlights*

Forest health notes on native and non-native forest insects and diseases are available at: *http://www.oregon.gov/odf/privateforests/fhPests.shtml* or *http://www.oregon.gov/odf/privateforests/fhInvasives.shtml*

Information on a broad range of forest health issues in the Pacific Northwest is available at: *http://www.fs.usda.gov/goto/r6/fhp*


*Access historic and current aerial survey maps, GIS data, and other information from the USDA Forest Service, Region 6, Forest Health Protection website.*

# Contacts

If you have questions about forest insect and disease activity in Oregon, please contact one of the following offices:

## State of Oregon


Forest Health Section
Oregon Department of Forestry, Bldg D
2600 State Street, Salem, OR 97310
http://oregon.gov/odf/privateforests/fh.shtml

Rob Flowers, 503-945-7396, rflowers@odf.state.or.us
Alan Kanaskie, 503-945-7397, akanaskie@odf.state.or.us
Michael McWilliams, 503-945-7395, mmcwilliams@odf.state.or.us


## USDA Forest Service


Forest Health Protection
Pacific Northwest Region, Natural Resources
P.O. Box 3623, Portland, OR 97208
http://www.fs.usda.gov/goto/r6/foresthealth

Doug Daoust, 503-808-2913, ddaoust@fs.fed.us
Alison Nelson, 503-808-2662, asnelson@fs.fed.us
Greg Filip, 503-808-2997, gmfilip@fs.fed.us
Iral Ragenovich, 503-808-2915, iragenovich@fs.fed.us
Kathy Sheehan, 503-808-2674, ksheehan@fs.fed.us

---

Blue Mountains Service Center
Forest Sciences Laboratory
1401 Gekeler Lane, La Grande, OR 97850

Craig Schmitt, 541-962-6544, clschmitt@fs.fed.us
Don Scott, 541-962-6545, dwscott@fs.fed.us
Lia Spiegel, 541-962-6575, lspiegel@fs.fed.us

---

Central Oregon Service Center
Deschutes National Forest
63095 Deschutes Market Rd, Bend, OR 97701

Andy Eglitis, 541-858-6127, aeglitis@fs.fed.us
Helen Maffei, 541-383-5591, hmaffei@fs.fed.us
Mike Simpson, 541-383-5575, mlsimpson@fs.fed.us

---

Southwest Oregon Service Center
J. Herbert Stone Nursery
2606 Old State Road, Central Point, OR 97502

Ellen Goheen, 541-858-6126, egoheen@fs.fed.us
Bill Schaupp, 541-858-6125, bschaupp@fs.fed.us
Robert Schroeter, 541-858-6123, rschroeter@fs.fed.us

---

Westside Oregon Service Center
Mount Hood National Forest
16400 Champion Way, Sandy, OR 97055

Kristen Chadwick, 503-668-1474, klchadwick@fs.fed.us
Holly Kearns, 503-668-1475, hkearns@fs.fed.us
Ben Smith, 503-668-1761; bsmith02@fs.fed.us
Keith Sprengel, 503-668-1476, ksprengel@fs.fed.us
Beth Willhite, 503-668-1477; bwillhite@fs.fed.us