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Forest Service
Pacific Northwest Region

Oregon
Department of Forestry

Forest Health Highlights
In Oregon – 2007

April 2008

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Front cover: Tanoak tree killed by Sudden Oak Death in southwest Oregon.

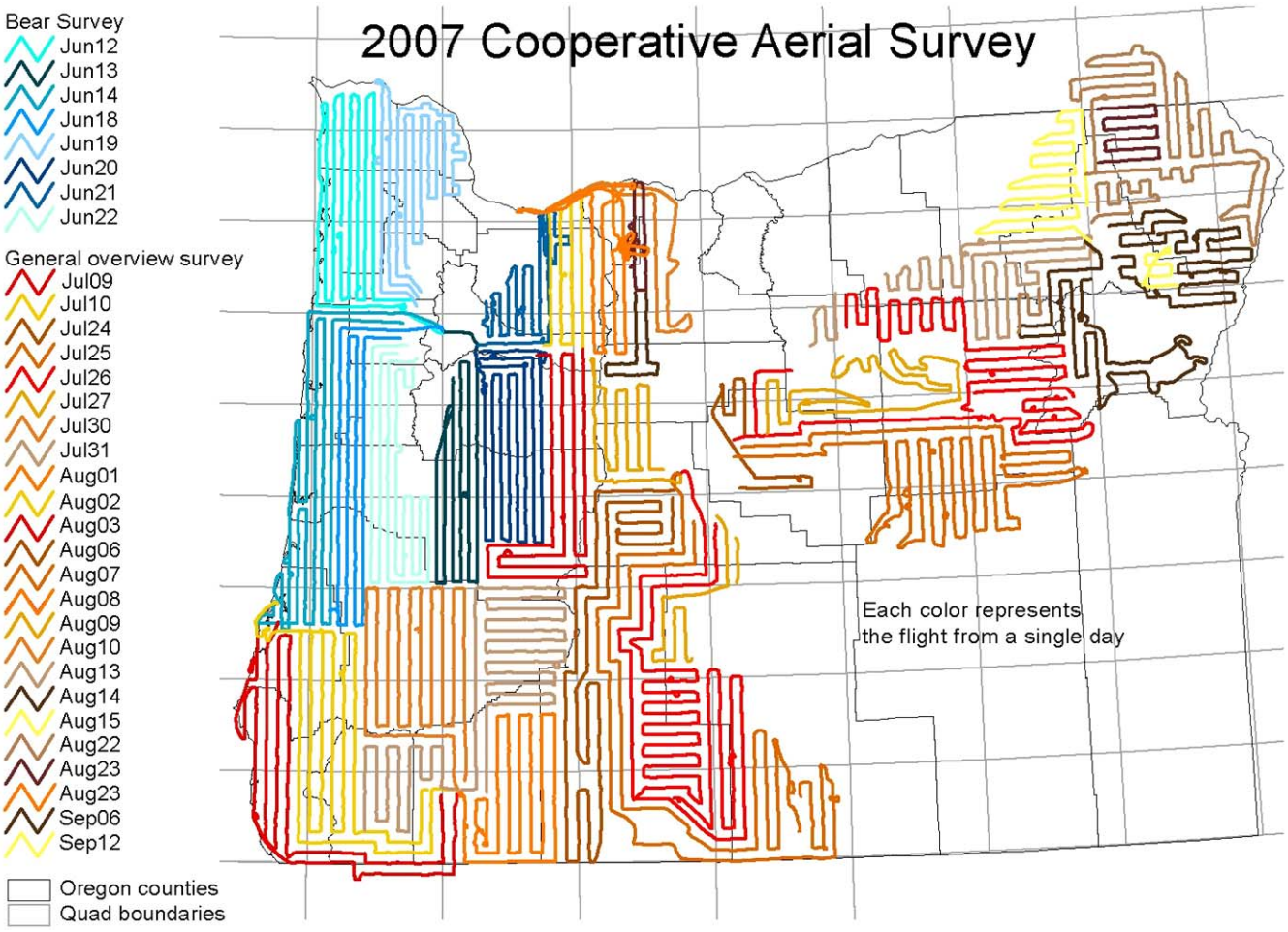


Figure 1 – Coverage area and flight lines for the 2007 statewide aerial survey of Oregon forest lands. Photo by USDA Forest Service.

Introduction

Insects and disease pathogens cause significant tree mortality, growth loss, and damage to large volumes of potential wood products each year. This can reduce management options for landowners, and contribute to hazardous forest fire conditions. However, these disturbance agents are a natural and necessary part of forest ecosystems. They contribute to decomposition and nutrient cycling, create openings which enhance vegetative diversity and create additional wildlife habitat. A healthy forest is never free of insects, disease, disturbances, and tree defects.

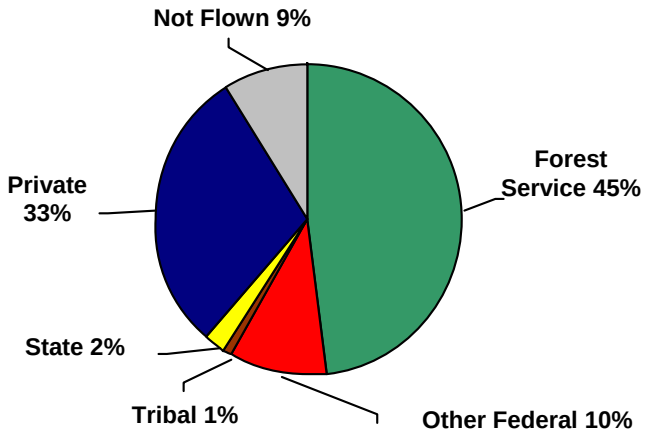
The Oregon Department of Forestry works cooperatively with the U.S. Forest Service in aerial surveys, insect and disease detection, mapping, monitoring, and eradication. This report provides information about major insect and disease activity in Oregon in 2007. For additional information, or for specific questions, please contact the specialists listed on the back page of this report.

Aerial Survey

Aerial surveys are conducted each year to assess forest health in Oregon. They include a statewide survey of forest lands and separate surveys for Swiss needle cast and sudden oak death (SOD). The surveys use an advanced digital sketch-mapping system that increases spatial accuracy and allows for the rapid summarization and reporting of tree mortality and damage.

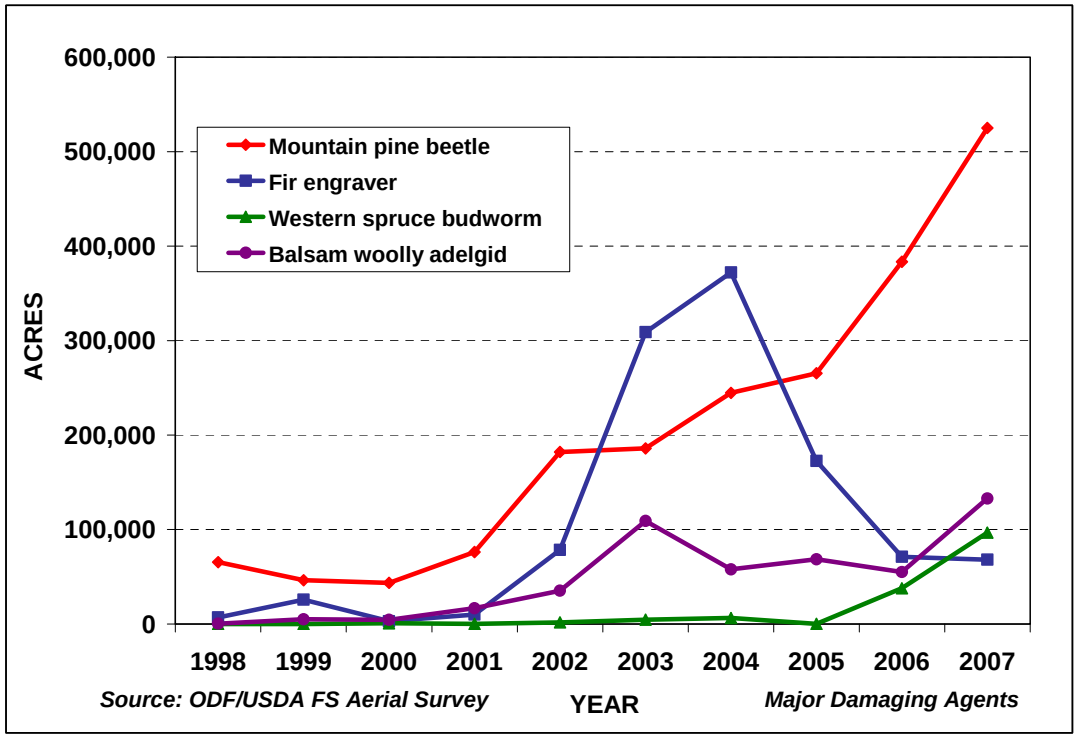
The annual statewide aerial survey covers approximately 28 million acres in Oregon (Figure 1 on previous page). Ownership over the survey area includes federal (64 percent), private (33 percent), state (2 percent) and tribal (1 percent) lands. A separate survey of 2 million acres in Western Oregon was initiated in 2006 to document damage from Swiss needle cast (SNC), a foliage disease of Douglas-fir. Maps and data summaries of surveys are distributed to cooperators, landowners and other interested parties annually. Digital maps and GIS files are also made available to the public at Oregon Department of Forestry & USDA Forest Service websites.
http://www.oregon.gov/odf/private_forests/fh.shtml
http://www.fs.fed.us/r6/nr/fid/data.shtml

Special aerial surveys to detect tanoaks killed by sudden oak death (SOD) have been conducted in Curry County since 2001. Fixed-wing and helicopter flights are used to precisely record GPS coordinates of all dead and dying tanoak trees. All trees identified in the survey are then visited by ground crews, checked for the cause of mortality, and sampled for the SOD pathogen, *Phytophthora ramorum*. In 2007, SOD aerial surveys were conducted in February, June & October.



Forest Insect Outbreaks

Forest insect outbreaks are regulated by a number of factors including moisture levels, stand conditions, tree-damaging events, and inherent population cycles. In the 2007 statewide survey of forest lands, over 900,000 acres of tree damage was observed. Of the total area affected by insects, bark beetles accounted for the majority of damage (67 percent) followed by defoliators (19 percent) and sap-feeding insects (14 percent). Favorable survey conditions along with increasing infestations of particular agents increased detection by over 350,000 acres this year. Trends for four of the major



damaging agents are shown in Figure 2. Overall, mountain pine beetle accounted for the majority of tree mortality, with smaller areas affected by fir engraver and Douglas fir beetle. The majority of defoliation and other damage this year was due to the activity of Western spruce budworm, larch casebearer and balsam woolly adelgid. Trapping of non-native forest pests is ongoing.

Figure 2 – Ten year damage trend for 4 of the major insect agents affecting Oregon in 2007.

Insects

Mountain Pine Beetle *(Dendroctonus ponderosae)*

Mountain pine beetle has long been the most destructive bark beetle in Oregon. From 1975-1989, the average damage from infestations was over 1 million acres. Outbreaks are generally driven an abundant, older lodgepole pine in overstocked stands. The area affected by mountain pine beetle in Oregon increased by over 140,000 acres in 2007. While lodgepole and Ponderosa pine are the major species affected, increasing amounts of 5-needled pines (sugar, whitebark and Western white) are also being killed (Figure 3). The current outbreak, which began in 2001, is concentrated Eastern slopes of the Cascades from Crater Lake to Mt. Hood and over large areas of the Fremont and Winema National Forests in Klamath and Lake Counties

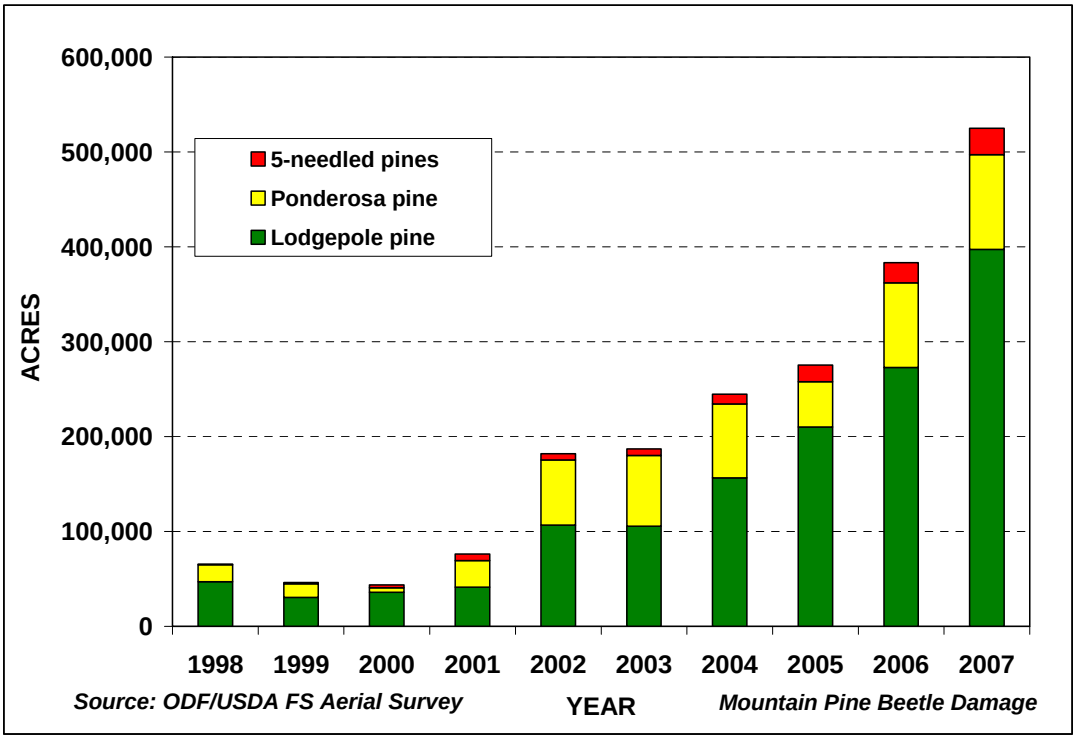


Figure 3 – Ten-year damage trend for mountain pine beetle by host tree species.

(Figure 4). Outbreaks can persist for up to a decade or more and often result in the majority of trees less than 6″ in diameter being killed. Thinning overstocked stands to increase tree vigor can provide some resistance and may reduce damage at low to moderate beetle population levels.

Figure 4 – Stands of whitebark pine are being increasingly affected by high populations of mountain pine beetle. (Oregon Dept of Forestry and USDA FS photo)

Fir Engraver Beetle (*Scolytus ventralis*)

Outbreaks of fir engraver have historically caused high levels of true fir mortality in Oregon, and are often triggered by consecutive years of below-average moisture. The outbreak that began in 2002 appears to be further declining, with damage detected on approximately 68,000 acres in 2007. Damage was most apparent in areas of Central and Northeast Oregon, especially where true fir was growing at drier sites or along valley edges. Adult beetles need only a strip of cambium to reproduce, so attacks often result in a variety of damage including dead branches, top-kill or total tree mortality (Figure 5). Abundant slash from forest operations or wind breakage from storm events can lead to localized outbreaks, but widespread damage will likely continue to decline in areas where normal moisture levels are maintained.

Figure 5 – Fir engraver beetles produce 4-12" galleries running across the wood grain. Attacks can lead to a variety of damage including dead branches, top-kill or tree mortality. (Oregon Dept of Forestry photo)

Douglas-fir Beetle (*Dendroctonus pseudotsugae*)

Damage attributed to Douglas fir beetle showed a moderate increase to over 18,000 acres in 2007, due in large part to winter storm damage in 2006. Outbreaks can occur following high wind events that lead to blow-down or breakage of larger diameter trees. High levels of down materials allow populations to rapidly build to damaging levels over the next 1-2 years, and attacks on adjacent standing trees often occur (Figure 6). Two severe storm systems hit the Northwest coast in December 2007 and are estimated to have caused over 16,000 acres of wind-damaged timber. Despite current salvage efforts, it is likely that large amounts of material will remain and may lead to an increase in beetle outbreaks. Anti-aggregant pheromone capsules (MCH) to prevent damage from Douglas-fir beetle are available to protect high-value areas.

Figure 6 – Blowdown from winter storms can lead to damage from Douglas fir beetle. Early signs of attack include abundant orange-brown boring dust in bark crevices. (USDA FS photo)

Western Spruce Budworm (*Choristoneura occidentalis*)

It has been over 25 years since the last Western spruce budworm outbreak in Oregon, but damage has been increasing in Eastern Oregon since 2001. Many areas have become more vulnerable to damage in recent decades as the percentage of preferred hosts like Douglas-fir and true fir species have increased. Budworm defoliation rose by over 58,000 acres in 2007, with the majority of the affected area expanding from existing infestations in the Ochoco and Malheur National Forests (Figure 7). Defoliation intensity was generally considered low to moderate in most areas and often restricted to the upper crown (Figure 8). Vigorous trees can survive several years of defoliation, but become increasingly susceptible to root diseases and bark beetles. As budworm damage is correlated with high stand densities and low diversity, thinning treatments to improve stand vigor as well as favoring larch and pine at those sites may help to reduce losses.

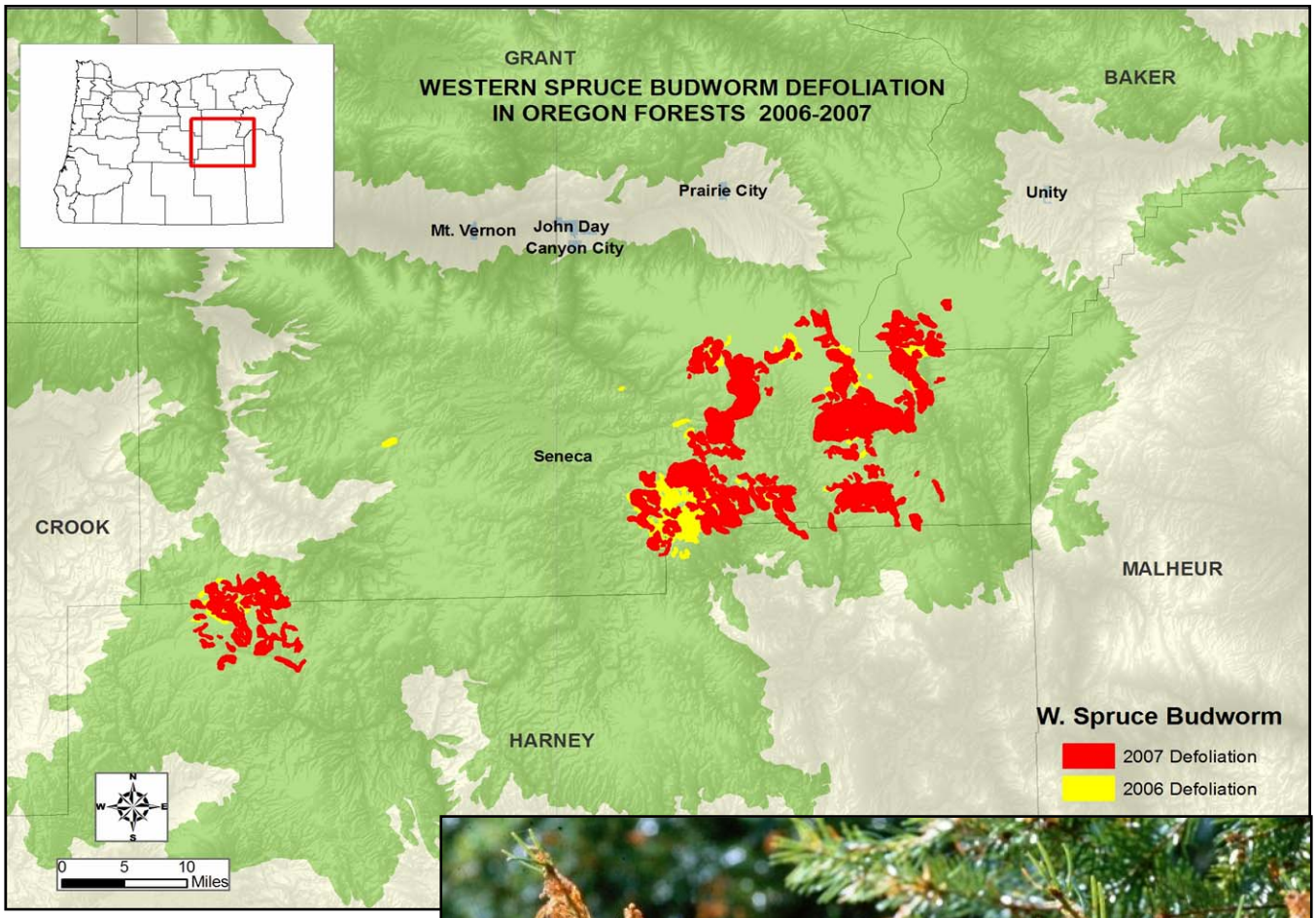


Figure 7-8 – Western spruce budworm defoliation in Eastern Oregon in 2006-2007. Expansion occurred adjacent to previously infested areas and was considered low to moderate.

Larch Casebearer *(Coleophora laricella)*

Damage from the non-native larch casebearer moth has been observed in Oregon since 1999, but aerial detection has often been obscured due to survey timing and conditions. In 2007, low intensity defoliation was detected on over 82,000 acres in Central and Northeast Oregon (Figure 9). Damage was widespread on the Wallowa-Whitman and Umatilla National Forests along with many surrounding private ownerships. Ground surveys indicated that while casebearer was abundant, foliar diseases were also common and likely contributed to the observed damage. Larch is relatively resistant to defoliation, often producing a second flush of needles by summer, but successive years of damage can severely reduce terminal and radial growth (Figure 10a & b). It is thought that over time the combination of previously released biological control agents, native natural enemies, and environmental factors may reduce populations below damaging levels in Oregon as has occurred in some Eastern states.

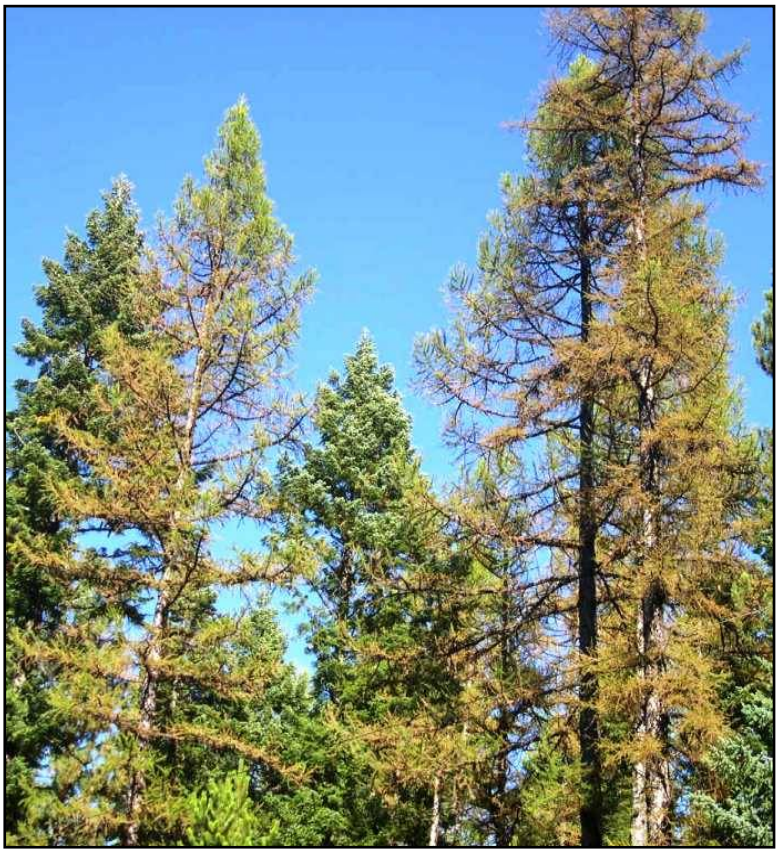


Figure 9,10a, 10b – Changes in crown color (yellow-red) of Western larch in early summer are often due to damage by larch casebearer. Larvae are found within cigar-shaped cases and their feeding causes foliage to turn yellow and curl at the ends. (ODF and USDA FS photo)

Balsam Woolly Adelgid (*Adelges piceae*)

Balsam woolly adelgid is a non-native sap-feeding insect which over recent decades has greatly affected several true fir species in Oregon. Wide-spread decline and mortality of grand and Pacific silver fir occurred in Western Oregon during the 1950s and 1960s, while more recently stands of subalpine fir have been increasingly affected in Eastern Oregon. Damage was detected on over 132,000 acres in 2007, occurring scattered along the Cascades from the Rogue River to

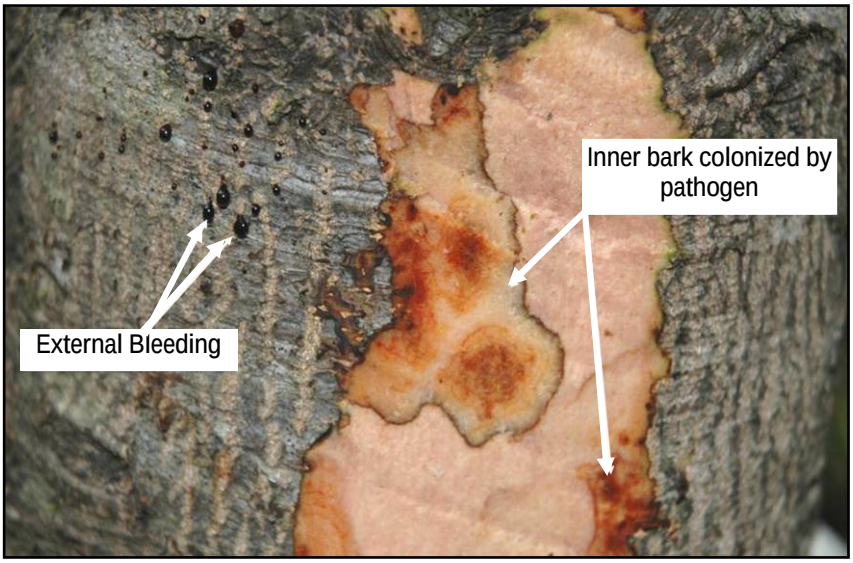
Figure 11 – Balsam woolly adelgid infestations in subalpine fir leads to progressive crown decline and often mortality. Signs of branch infestation include gouting (swelling), while woolly tufts on the bark indicate stem infestations. (Oregon Dept of Forestry photo)

Mt. Hood and in the Wallowa-Whitman, Umatilla, and Malheur National Forests. Branch infestations lead to gouting (swelling) on terminal and lateral nodes and buds, reducing the production of new foliage and cones, while stem infestations disrupt phloem transport leading to further crown decline or mortality (Figure 11). Environmental patterns appear to the primary factor in regulating adelgid abundance, with prolonged cold periods decreasing survival and warmer conditions allowing for rapid population growth. Expansion of infestations appears to be occurring unchecked in most areas and may significantly affect the survival and regeneration of true fir in many areas of Oregon. Systemic insecticides have proven effective in controlling populations and can be used to preserve high-value trees.

Diseases

Sudden Oak Death *(Phytophthora ramorum)*

Sudden Oak Death (SOD), caused by the non-native pathogen *Phytophthora ramorum*, is a relatively new disease in Oregon. It was first discovered in July 2001 at five sites on the southwest coast near the town of Brookings. Aerial photos of the area indicate that the pathogen was present at one of the sites since 1997 or 1998. Outside of Oregon, *P. ramorum* is known to occur in forests only in California (14 counties) and in two European countries. The origin of the pathogen is unknown.



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 12). Tanoak is by far the most susceptible species in Oregon, and unchecked spread of the disease seriously threatens the future of this species. *P. ramorum* also causes leaf blight or shoot dieback on a number of other hosts including rhododendron, evergreen huckleberry, Douglas-fir, and Oregon myrtle.

Figure 12 – Stem lesion, inner bark of tanoak (Lithocarpus densiflorus) caused by Phytophthora ramorum. Oregon Department of Forestry photo.

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 (Figure 13). *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 infected plant parts.

Figure 13 – Infected leaves and twigs of tanoak (Lithocarpus densiflorus) caused by Phytophthora ramorum. Oregon Department of Forestry photo.

Since fall of 2001, state and federal agencies have been attempting to eradicate *P. ramorum* from infested sites in Oregon by cutting and burning all infected host plants and adjacent apparently uninfected plants (Figure 14). Each eradication site is monitored twice yearly for presence of *P. ramorum* by sampling vegetation and soils. During the first few years of the eradication effort, the pathogen survived the initial treatment on most sites and was present in stump sprouts of host vegetation for one or more years after treatment. In 2003 we began chemical sprout treatment (non-federal lands only) and herbicide injection of tanoaks prior to cutting. Since then, recovery of *P. ramorum* within treated sites has decreased dramatically. *P. ramorum* has been recovered from soils at several eradication sites, but with very low frequency.

Figure 14 – Sudden Oak Death eradication site after treatment, southwest Oregon. Oregon Department of Forestry photo

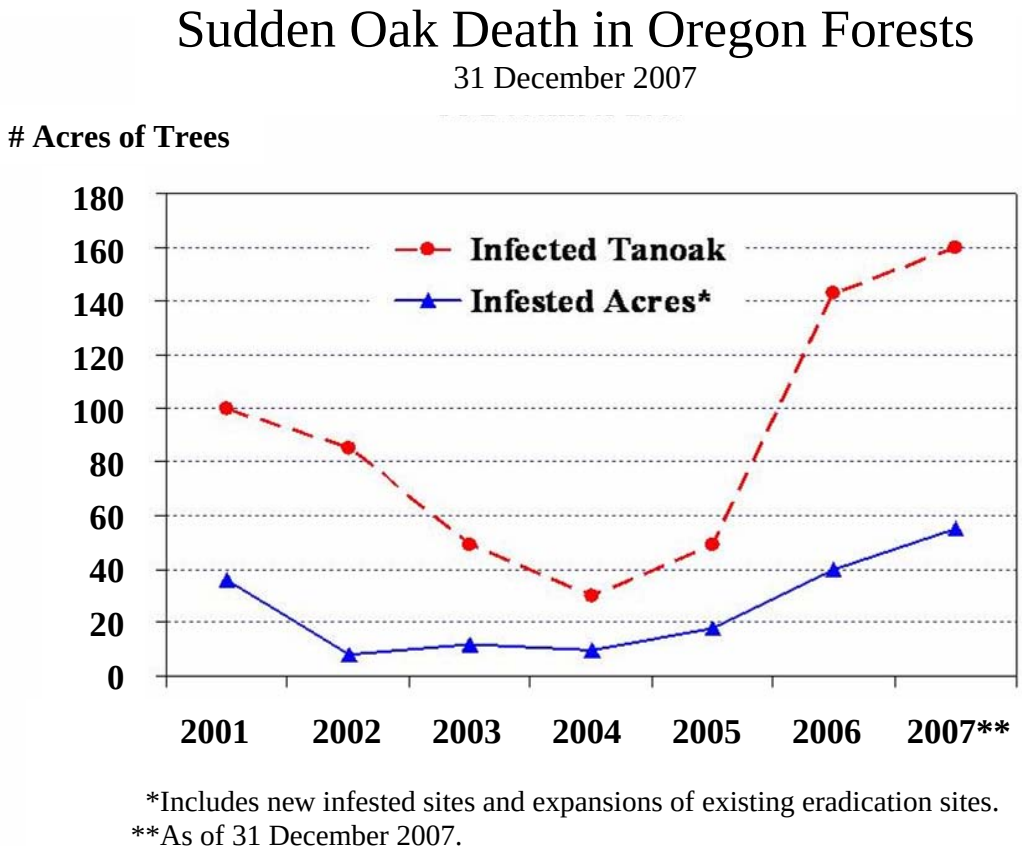


Figure 15 – Sudden Oak Death trends in southern Curry County, Oregon. Oregon Department of Forestry photo

During the first 4 years of the eradication effort, the number of new infested sites and infected trees decreased each year. That trend ended in 2005. In 2006 and 2007, the extent of the disease increased considerably (Figure 15). In 2007, 6 new sites were found outside of the quarantine area, and several of these sites were 2 or more miles from the nearest other infested site (Figure 16 on page 8). Most of the other new sites were small (less than 1 acre) and scattered near the center of the quarantine zone. We attribute this disease expansion to consecutive years of unusually wet spring and early summer weather which appears to favor long distance spread of *P. ramorum*.

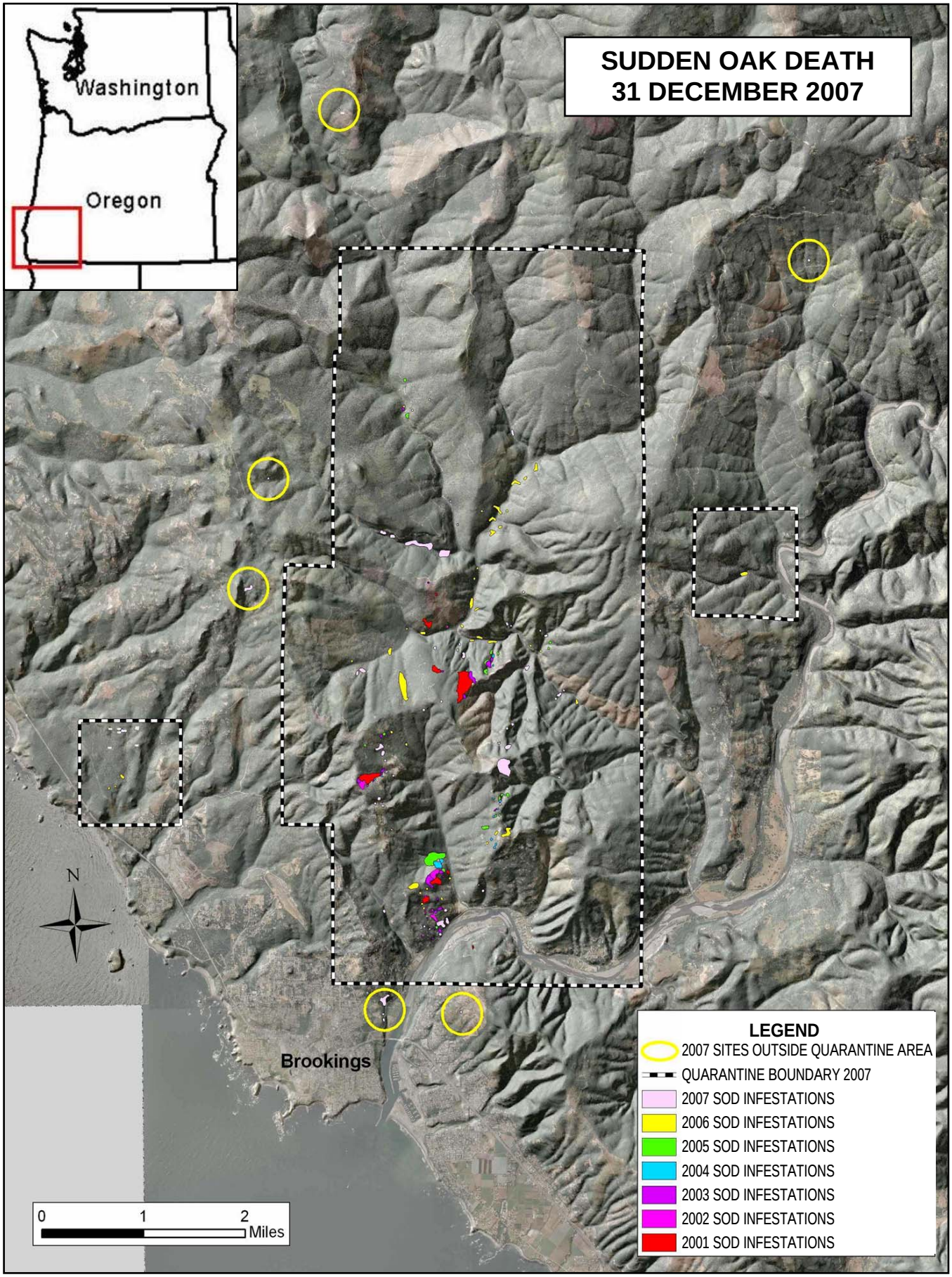


Figure 16 – Location of areas infested with Phytophthora ramorum in southwest Oregon, December 2007. Yellow circles highlight the six sites that occurred outside of the quarantine area in 2007.

Despite the new occurrences of *P. ramorum* in 2007, distribution of the pathogen in Oregon forests remains limited to a very small area near Brookings, suggesting that the eradication effort has at least slowed spread of the pathogen. Four aerial surveys, numerous ground-based surveys, and year-round stream sampling have failed to detect the pathogen in forests beyond this general area of infestation. The forested area in Oregon under quarantine by the Oregon Department of Agriculture and USDA-APHIS was 26 mi^2 in 2007, and will increase to 162 mi^2 in early 2008. Efforts to eradicate the pathogen from Oregon forests likely will continue for several years. A complete *P. ramorum* host list can be found at: http://www.aphis.usda.gov/ppq/ispm/pramorum/pdf_files/usdaprlist.pdf
For more information on Sudden Oak Death, go to: http://nature.berkeley.edu/comtf/

Swiss Needle Cast *(Phaeocryptopus gaeumannii)*

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 17). Tree mortality is rare, occurring only after many years of defoliation.

Figure 17 – Sparse yellow crowns of Douglas-fir damaged by Swiss needle cast, western Oregon. Oregon Department of Forestry photo.

Growth loss as a result of Swiss needle cast correlates with foliage retention – the less foliage retained on the tree, the greater the growth loss (Figure 18). 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 loss and some mortality, Swiss needle cast reduces stand management options, hinders the development of stand structures and wildlife habitat, and may increase the risk of catastrophic fire.

Since the late 1980's, the disease has become particularly damaging to Douglas-fir forests on the west slopes of the Oregon Coast range. Aerial surveys for SNC damage have been conducted each year since 1996 during April and May. 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.

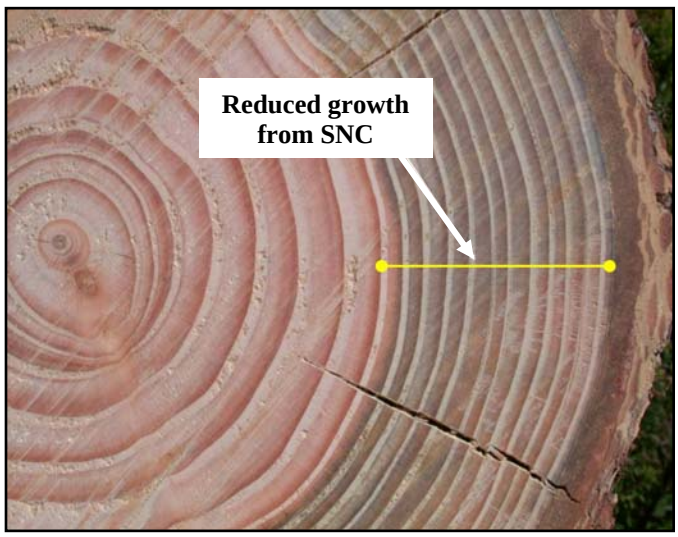


Figure 18 – Reduction in recent radial growth increment of Douglas-fir caused by Swiss needle cast, Tillamook, OR. Oregon Department of Forestry photo.

The 2007 survey covered approximately 3 million acres of forest and showed a continued increase in the area with symptoms of Swiss needle cast compared to the previous 3 years (Figure 19). The easternmost area with obvious SNC symptoms was approximately 28 miles inland from the coast in the Highway 20 corridor, but the majority of area with symptoms occurred within 18 miles of the coast. Observers mapped 338,761 acres of Douglas-fir forest with obvious symptoms of Swiss needle cast; 220,866 acres north of the Lincoln-Lane county line and 117,896 acres south of the Lincoln-Lane County line (Figure 20).

The Swiss needle cast aerial survey provides a conservative estimate of damage because observers can map only those areas where disease symptoms have developed enough to be visible from the air. We know (from permanent plot data and ground checks) that Swiss needle cast occurs throughout western Oregon, but often is not severe enough to enable aerial detection. The aerial survey reasonably depicts the extent of moderate to severe damage, coarsely documents trends in damage over time, and establishes a zone in which forest management should take into account the effects of the disease.

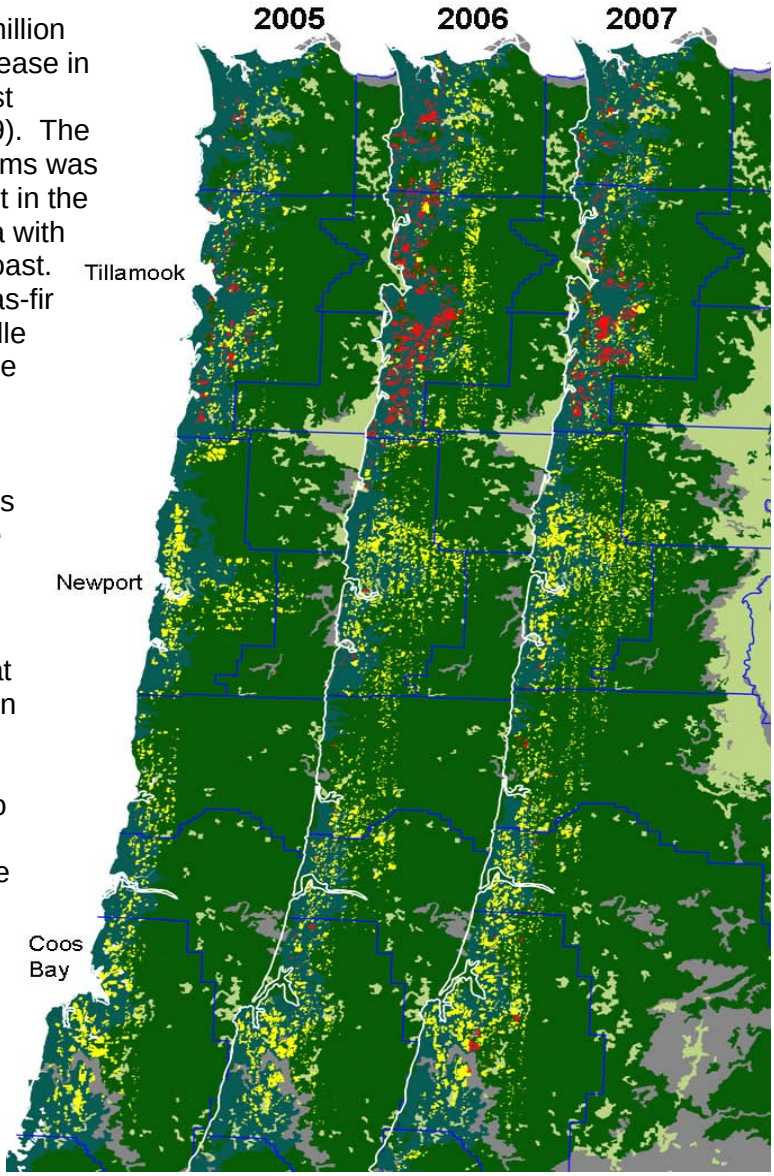


Figure 19 – Areas of Douglas-fir forest with symptoms of Swiss Needle Cast detected in the 2005-2007 aerial surveys. Yellow = moderate damage, red = severe damage.

Area of Douglas-fir Forest with Swiss Needle Cast Symptoms Detected by Aerial Surveys; Coast Range, Oregon, 1996-2007

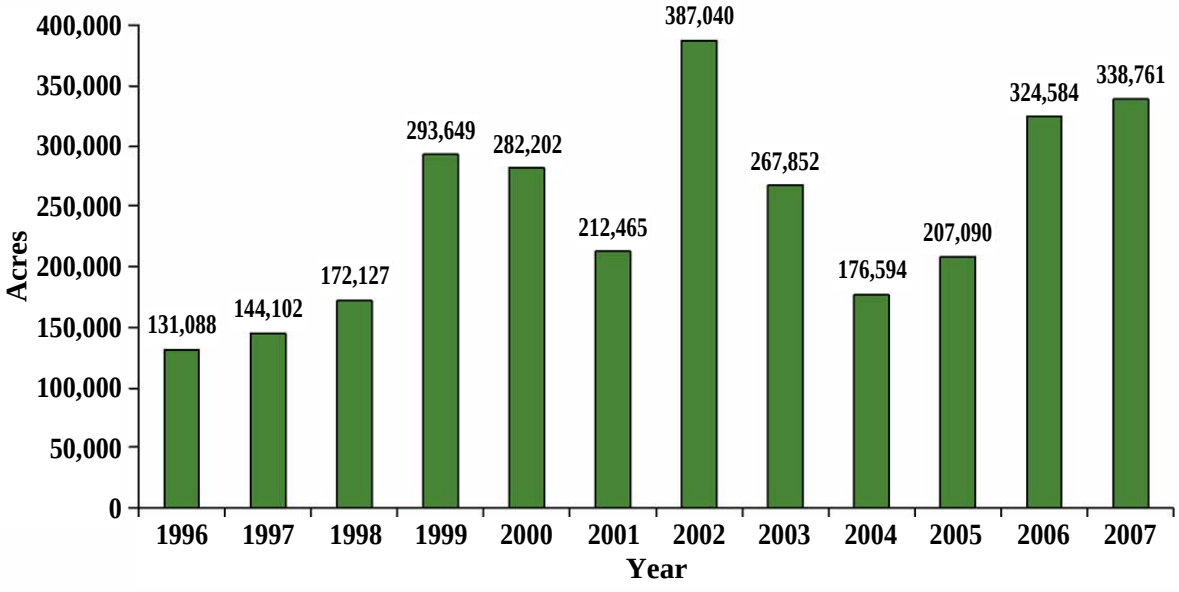


Figure 20 – Trend in the number of acres of Swiss needle cast mapped in aerial surveys between 1996 and 2007 in the Coast Range of Oregon.

Drought Interactions

The sudden appearance in spring or early summer of dead lateral branches, dead tops, or entire dead conifer trees can be alarming. The pattern of damage can be disorderly – branches on only one side of the tree may die, or scattered branches in the middle of the tree may die, or just the top few feet may turn red (Figure 21). Close inspection may reveal indicators of insects or pathogens (Figure 22). Damaged trees are most common on the fringe of forested areas, in young stands with much competing vegetation, on compacted or disturbed soils, and on droughty or shallow soil types. Douglas-fir is the most severely damaged species in western Oregon.

Figure 21 – Branch and top death of Douglas-fir resulting from moisture stress during the previous growing season, Willamette Valley, Oregon. OR Dept. of Forestry photo.

Figure 22 – Stem canker caused by a fungus on young Douglas-fir predisposed by moisture stress, Willamette Valley, Oregon. Oregon Department of Forestry photo.

The primary cause of damage is water stress within the tree resulting from drought conditions that occurred in the previous year or that accumulated over several years. As moisture stress increases, trees become increasingly susceptible to certain insects and diseases, particularly canker diseases, and twig beetles. Under severe drought conditions water content in the tree may drop so low that the entire tree or portions of it may die. Roots and the lower main trunk are the last to die, and often remain living even though above ground parts are dead. Damage such as this was particularly noticeable on Douglas-fir in the Willamette Valley and Coast Range foothills during the summer of 2007, reflecting the very dry conditions that prevailed in late 2006.

December Storm

A large powerful storm struck the Pacific Northwest on December 2 and 3, 2007. Gale force winds and intense rainfall caused extensive damage to forest stands, and damaged trees in nearly every public park and municipality along the coast. Damage was most severe along northern Oregon coast (Figure 23).

Clatsop and Tillamook Counties sustained considerable wind damage (blow-down and breakage) on more than 16,000 acres of forest, with Clatsop County

Figure 23 – Wind breakage and blown down from December 2007 storm. Oregon Department of Forestry photo.

bearing the brunt of the damage (Figure 24). Combined, the two counties have an estimated gross volume of wind damage of more than 390 million board feet across all ownerships (by comparison, wind damage resulting from the 1962 Columbus Day storm is estimated as 11 to 15 billion board feet in Northern California, Oregon, and Washington combined).

The large amount of down wood remaining after the storm increases the risk of an outbreak of the Douglas-fir bark beetle. This risk can be mitigated through timely salvage of down wood and the use of pheromone capsules to protect high value trees.

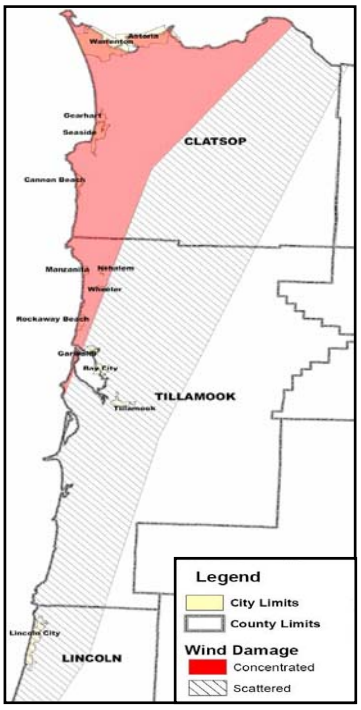


Figure 24 – Area affected by the December 2007 storm.

White Pine Blister Rust

White Pine Blister Rust, caused by the non-native fungus *Cronartium ribicola*, has been present in Oregon since the 1920's and continues to cause extensive damage to all native 5-needle pines (western white pine, sugar pine, white-bark pine, and limber pine) (Figure 25). Western white pine is planted in many areas to increase diversity and to take advantage of its tolerance to Laminated root rot and low temperatures. Recent surveys in the Oregon Coast range suggest very high rust hazard despite the very low population of western white pine in that area. Even when using genetically rust-resistant seedlings, careful suite selection and live-branch pruning are necessary to grow it successfully.

White pine blister rust, (along with the mountain pine beetle) also is causing substantial damage to the high elevation white-bark pine forests near timberline, which are particularly threatened because of their unique ecology.

Figure 25 – White pine blister rust: swollen infected branch and main stem canker on western white pine, Polk County, Oregon. Oregon Department of Forestry photo.

Root Diseases

Several root diseases continue to affect Oregon forests, in many cases causing substantial damage. The degree of damage often reflects past management practices and fire exclusion, which have resulted in overstocked stands with a large component of disease-prone shade-intolerant species. Laminated root rot is the most destructive of these root diseases statewide, and is most damaging to Douglas-fir, true firs, and mountain hemlock. Armillaria root disease and Annosum root disease are particularly damaging in southern and Eastern Oregon. Root diseases do not lend themselves to detection by aerial survey, so annual damage trends are lacking. Manipulating the composition of stands to favor disease-tolerant tree species can mitigate root disease losses.

Other Damage

Ozone Damage

Ozone is formed when emissions from combustion engines (cars, trucks, etc.) interact with sunlight on warm sunny days. High levels of ozone can damage plants (including trees), leading to growth loss, increased susceptibility to diseases, and mortality. The Oregon Department of Forestry and the US Forest Service cooperates in a national ozone-monitoring program. Each year in late July and August, indicator plants are monitored for ozone injury in 36 sampling hexagons distributed throughout the state (Figure 26). To date, ozone injury to plants has not been detected in any of the Oregon plots.

Figure 26 – Ozone monitoring plots typically are located at high elevation sites where damage is most likely to occur.

Black Bear Damage

In the Pacific Northwest, black bears can damage forest trees in the spring of the year by peeling the bark and eating the succulent inner tissue (Figure 27). Partial peeling can reduce tree growth and vitality, and introduce decay that lowers wood quality and eventually may result in mortality. Long-term trends in bear damage are determined from special aerial surveys of approximately 7 million acres of the Coast range and Western slopes of the Cascade Range. These surveys fly closer flight lines than the regular statewide survey, and occur in June or early July when damage is most visible.

Figure 27 – Black bear damage trees during spring in Western Oregon by bark peeling and feeding on inner tissues. (Washington Dept of Fish & Wildlife photo)

Damage estimates based on aerial survey observations are adjusted using a ground verification factor obtained from previous studies. Adjustments are necessary as there are a number of other agents that cause significant damage in these areas each year. In 2007, damage was observed on over 38,000 acres in Western Oregon (Figure 28). Although the survey estimate this year was greater than the ten-year average of 28,000 acres, it represented a 20% decrease from levels observed the previous year. Analyses of mapped polygon size distribution and dying tree counts within polygons suggest that the relatively high acreage estimates in 2007 are likely due to agents other than bear, such as root disease, insects or drought.

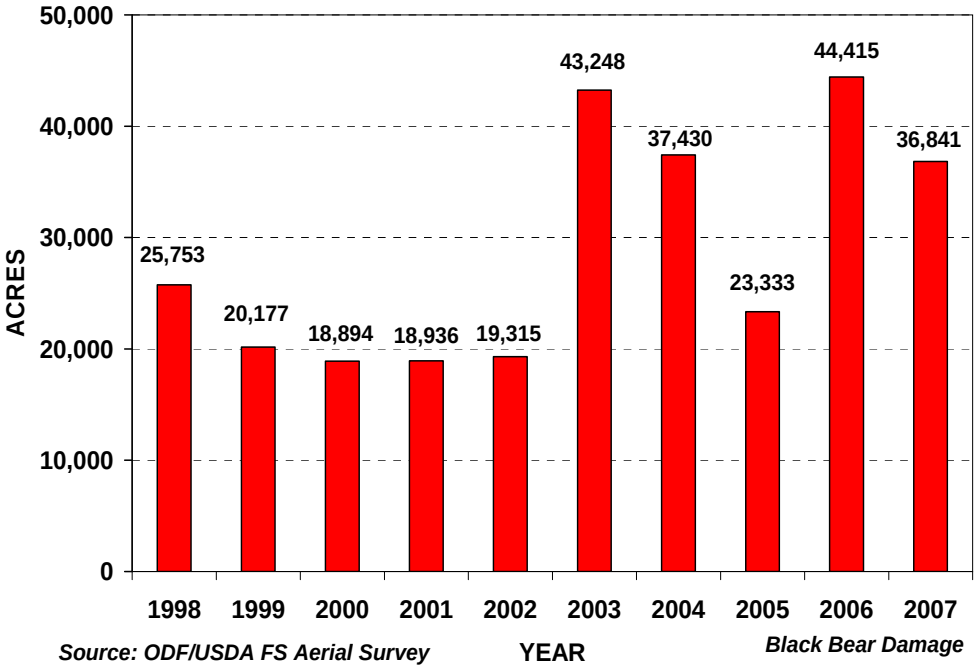


Figure 28 – Ten-year trend in bear damage for tracking counties in Western Oregon. Acres are adjusted according to a previously determined ground verification factor.

Contacts and Additional Information

If you have questions about forest insect and disease activity in Oregon, please contact one of these regional or field offices:

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