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Forest Health Highlights In Oregon – 2008

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Front cover: Widespread mortality of mature lodgepole pine in southcentral Oregon due to mountain pine beetle. (Oregon Department of Forestry photo.)

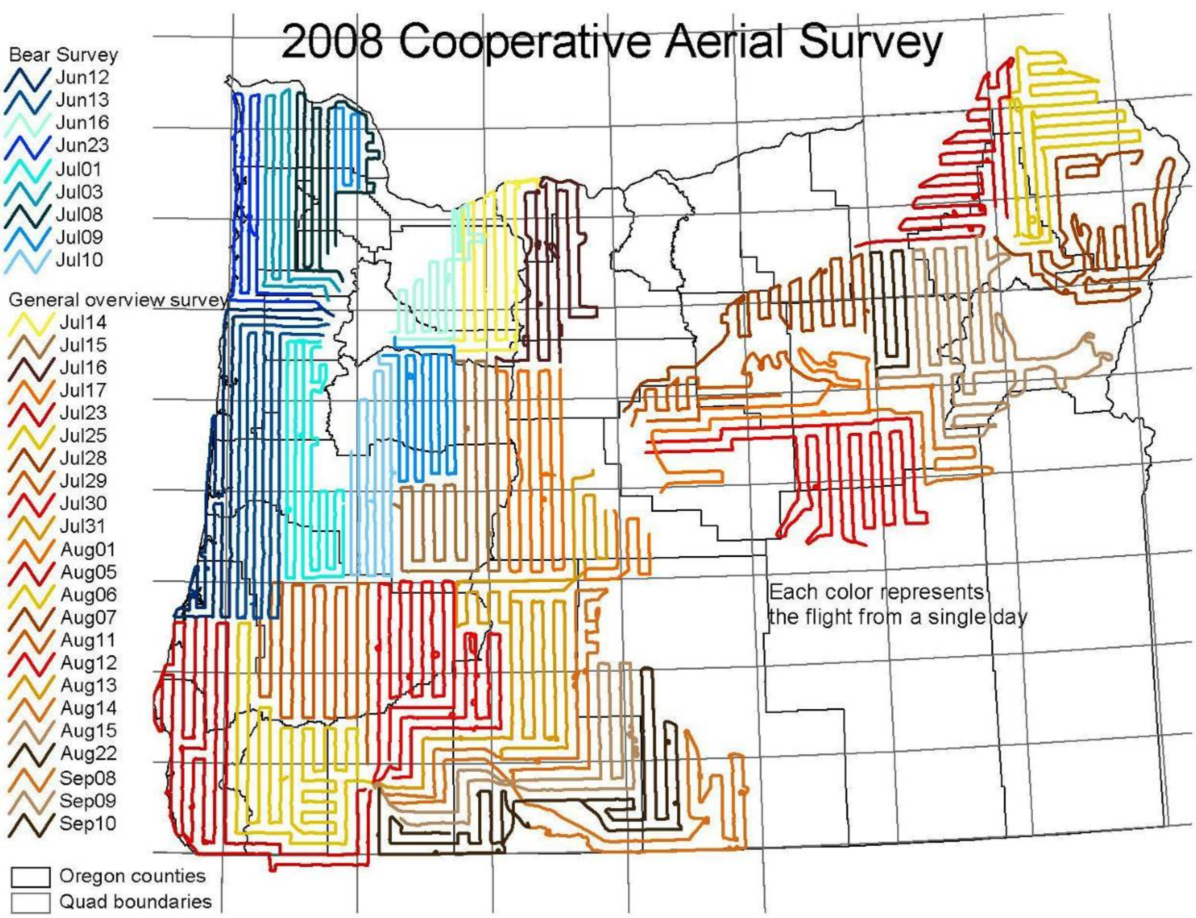


Figure 1 – Coverage area and flight lines for the 2008 statewide aerial survey of Oregon forest lands. (Photo by USDA Forest Service.)

Introduction

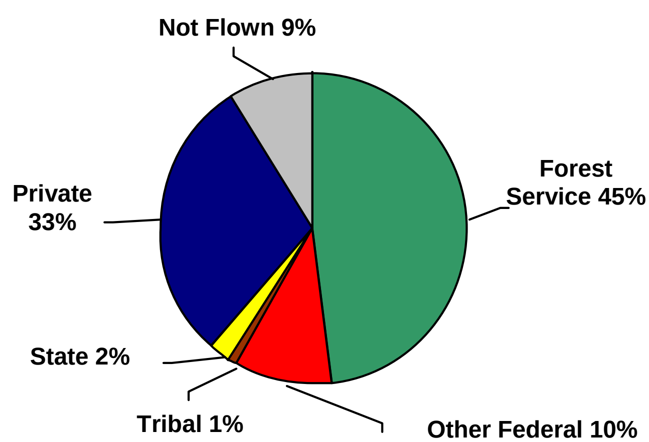
Insects and disease pathogens cause significant tree mortality, growth loss, and damage to large volumes of potential wood products each year. This can reduce management options for landowners, and contribute to hazardous forest fire conditions. However, these disturbance agents are a natural and necessary 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 2008. 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 1996 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 2008, SOD aerial surveys were conducted in February, May, July, and 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 2008 statewide survey of forest lands, over 910,000 acres of tree damage was observed. Of the total area affected by insects, bark beetles accounted for the majority of damage (76 percent), followed by sap-feeding insects (16 percent), and defoliators (8 percent). Declining bark beetle infestations in some areas in association with possible delayed signature development of certain defoliators appears to be largely responsible for

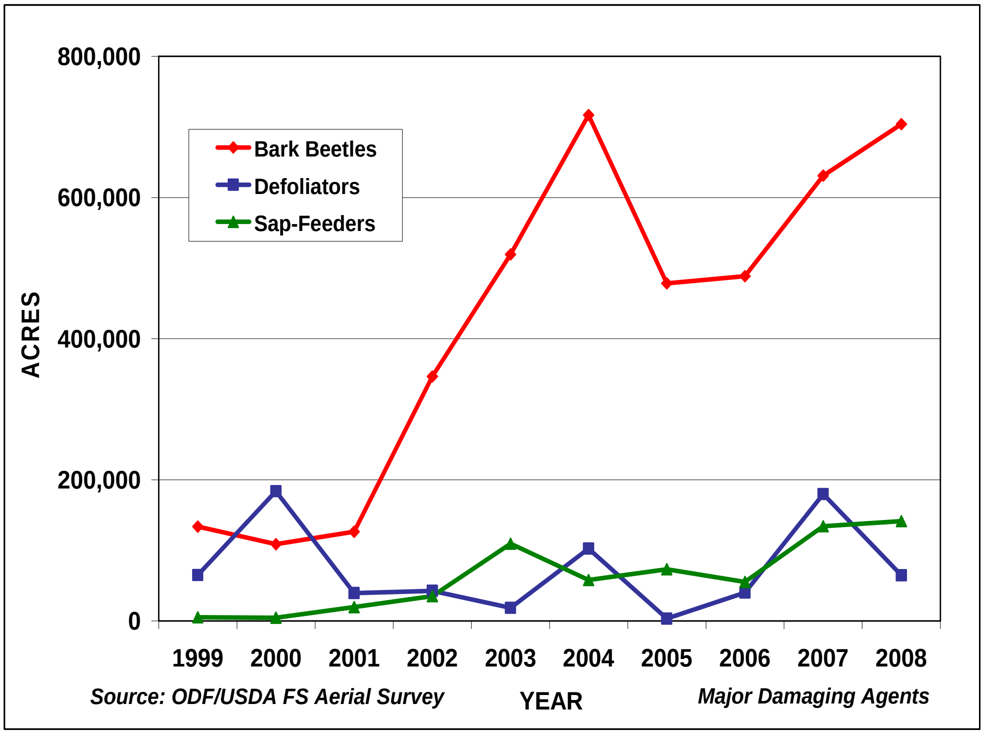


Figure 2 – Ten year damage trend for the major groups of insects affecting Oregon forests.

the overall 35,000 acre decline in damage detection this year. Consistent with recent trends, mountain pine beetle accounted for the majority of tree mortality in Oregon, with increasing areas affected by fir engraver and western pine beetle. The majority of defoliation and other damage detected this year were due to continued activity by Western spruce budworm, larch casebearer, and balsam woolly adelgid. Defoliation and crown damage of Oregon white oak also occurred in many areas of western Oregon this year.

Insects

Mountain Pine Beetle *(Dendroctonus ponderosae)*

The mountain pine beetle continues to cause widespread mortality of mature lodgepole pine stands in eastern Oregon as well as more localized damage to ponderosa and 5-needle pines. The affected area increased by over 30,000 acres this year, representing an 8th consecutive year of increase (Figure 3). The most severe outbreaks are concentrated on eastern slopes of the Cascades from Crater Lake to Mt. Hood and over large areas in the Fremont-Winema National Forests in Klamath and Lake Counties. Damage trends were not consistent, however, across geographic areas. While damage appeared less intense in many areas of Central and Northeast Oregon, dramatic increases continued to occur in the Klamath-Lake area. Substantial "spill-over" effects were also noted in this area as large beetle populations appeared to overwhelm normally more resistant hosts. This was most evident in mature ponderosa pine, but also occurred in small-diameter pines adjacent to heavily-infested lodgepole stands (Figure 4).

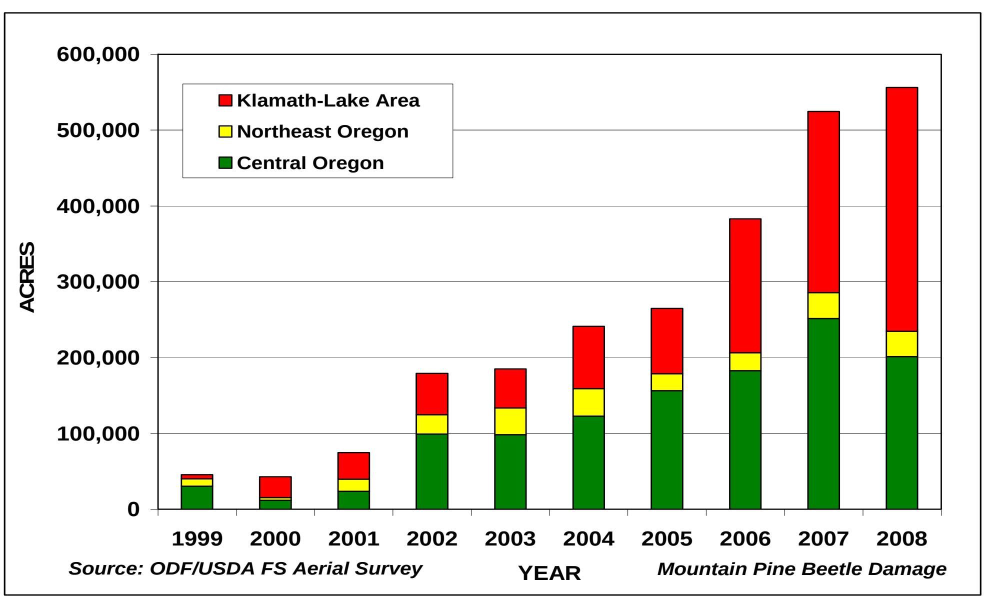
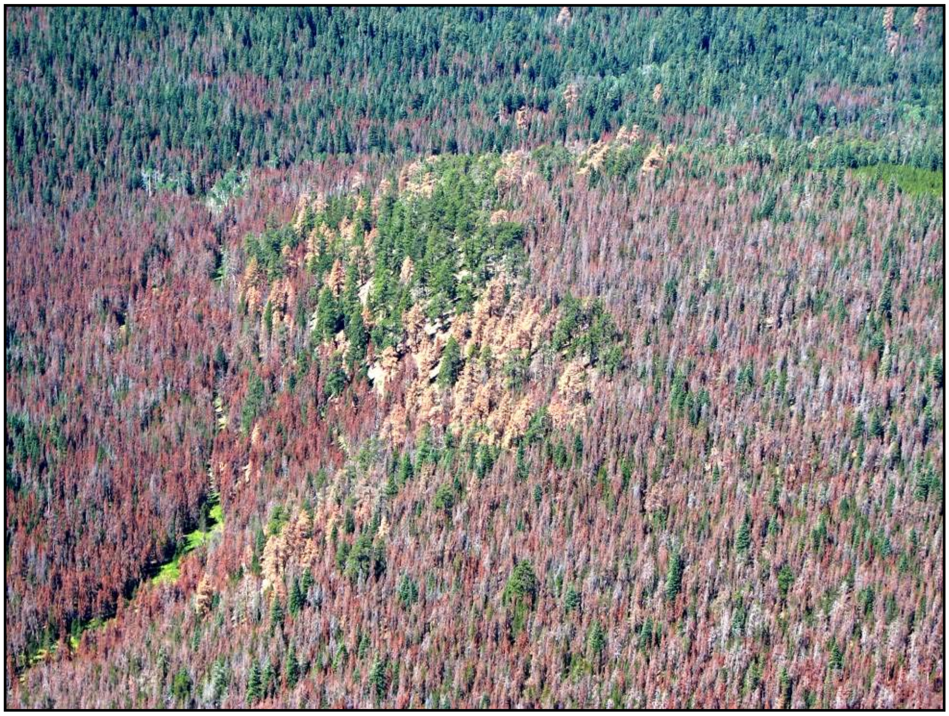


Figure 3 – Ten-year damage trend for mountain pine beetle in Oregon by geographic area.



Historically, outbreaks of mountain pine beetle have not been sustained once the mature lodgepole host was exhausted, so declines may be expected in some areas in coming years where this has occurred. While thinning lodgepole stands in outbreak areas has not proven effective in reducing further damage, ponderosa pine responds more favorably to thinning and can be used to reduce tree mortality in overstocked areas adjacent to large outbreaks.

Figure 4 – Mortality of normally resistant, large ponderosa pine can occur near mountain pine beetle outbreaks. (Oregon Dept of Forestry photo.)

Fir Engraver Beetle (*Scolytus ventralis*)

Historically, fir engraver outbreaks have caused high levels of true fir mortality in Oregon. In contrast to mountain pine beetle, increased damage is often more closely associated with environmental variables, particularly below-average moisture levels, than to stand conditions. In recent years, statewide damage has remained below the outbreak levels observed during 2002-2003, due in large part to continued normal to above-average moisture levels in many areas. In 2008, damage was detected on over 65,000 acres, similar to observations of the previous 2 years. There was again wide geographic variation, with declines observed in much of western Oregon, while damage increased in northeast Oregon, particularly in more drought-prone sites and along south-facing slopes (Figure 5).

Fir engraver needs only a small area of the bark to reproduce, so attacks can result in a variety of damage that includes dead branches, top-kill or tree mortality. Long-term losses may then be amplified, as these numerous "strip" attacks provide entrance for decay organisms. With below-average moisture levels already occurring in some areas and the predicted net decline in moisture across the region in coming years, damage from fir engraver may continue to increase.

Figure 5 – Damage to true firs from fir engraver is common at drought-prone sites and along south-facing slopes. (Oregon Dept of Forestry photo.)

Western Pine Beetle (*Dendroctonus brevicomis*)

Damage attributed to western pine beetle showed a significant increase to over 50,000 acres in 2008. These beetles usually breed in and cause mortality to individual, mature ponderosa pine, particularly those affected by root disease or fire damage. However, group-killing of young, small-diameter trees is also common in overly dense ponderosa pine plantations (Figure 6a). Areas of southwest and eastern Oregon are particularly susceptible to this damage pattern during periods of below-average moisture. Western pine beetle attacks can be confirmed by removing the bark from dying trees and exposing the characteristic criss-crossing feeding galleries (Figure 6b).

Figure 6a – Group-killing of small-diameter ponderosa pine by western pine beetle can occur in overly dense plantations. (Oregon Dept of Forestry photo.)

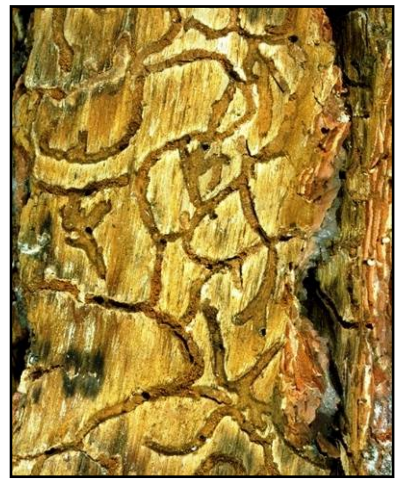


Figure 6b – Western pine beetle forms criss-crossing (S-shaped) galleries on the surface of the sapwood. (USDA Forest Service photo.)

Similar to most bark beetles, removing infested trees and thinning of overly dense stands can help to reduce additional mortality and preserve stands. These operations should include proper slash management to reduce the potential breeding sites that can lead to build-ups and additional damage from another bark beetle, the pine engraver (*Ips pini*).

Western Spruce Budworm (*Choristoneura occidentalis*)

Damage from western spruce budworm has been increasing in eastern Oregon since 2001; however, damage was observed on only 10,000 acres in 2008, a decline of 89 percent relative to the previous year. While it is possible that budworm populations collapsed in some areas, it appears more likely that the aerial "damage signature" (defoliation of the upper crown) that is used to identify budworm activity was delayed this year due to below average summer temperatures in many previously affected areas. Follow-up ground surveys in early fall consistently indicated a much higher degree of budworm defoliation than was initially observed during aerial surveys. As the development and feeding activity of many defoliator larvae is limited at lower temperatures, delays in the appearance of feeding damage may occur until conditions are more optimal for their growth and survival (Figure 7).

Figure 7 – Below-average summer temperatures can delay larval development and feeding by western spruce budworm. (USDA Forest Service photo.)

In affected areas, defoliation intensity continued to be low-to-moderate and was primarily restricted to the upper crown of large trees and diffuse damage over understory hosts. Thinning stands to improve stand vigor and increase species diversity are the best approaches to reducing future damage from budworm in more highly susceptible areas should the outbreak continue to expand.

Larch Casebearer *(Coleophora laricella)*

Figure 8 – The non-native larch casebearer is a small, silver moth with narrow-fringed wings that fold along the body at rest. (USDA Forest Service photo.)

Damage from the non-native larch casebearer moth was again observed in many areas of central and northeast Oregon (Figure 8). While damage from this insect appears to have been increasing over the last decade, aerial detection is often obscured due to survey timing and the co-occurrence of larch needle diseases in affected areas. In 2008, low-to-moderate intensity defoliation was detected on over 49,000 acres on the Mt. Hood, Wallowa-Whitman and Umatilla National Forests and adjacent private lands (Figure 9a/b). Aerial detection was 40 percent lower than the previous year, but this fluctuation appears to be more related to survey timing and abundance of foliar diseases than to actual reductions in larch casebearer damage. Ground surveys indicated its continued presence in previously affected areas, with foliar diseases most prevalent along riparian areas where greater moisture and humidity occur.

Figure 9a/b – The appearance of yellow-to-red crowns in western larch during early summer is often due to feeding by larch casebearer. (Oregon Department of Forestry photo.)

Balsam Woolly Adelgid (*Adelges piceae*)

The most widespread and damaging sap-feeding insect in Oregon is the balsam woolly adelgid. This non-native species caused widespread decline and mortality of true firs in western Oregon during the1950's and 1960's, and is currently infesting many areas of central and eastern Oregon (Figure 10). In 2008, damage was observed on over 140,000 acres, with tree decline and mortality most severe in stands of Pacific silver and subalpine fir. Scattered damage continues to occur along the Cascades from Mt. Hood south to the Rogue River, while more intense and widespread damage is prevalent in the Wallowa-Whitman and Umatilla National Forests, as well as in Hells Canyon National Recreation Area.

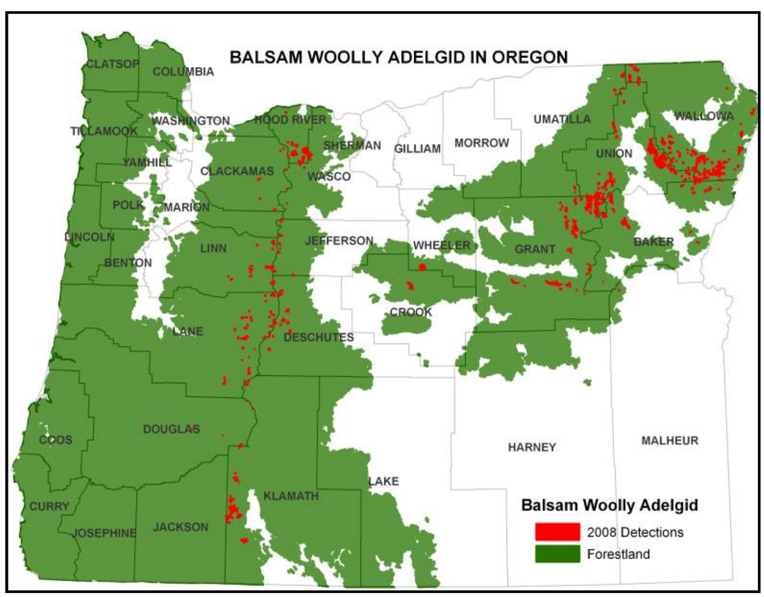


Figure 10 – Statewide detection of damage by the non-native, sap-feeding insect balsam woolly adelgid in 2008.

Branch infestations lead to gouting (swelling) on terminal and lateral nodes and buds, reducing the production of new foliage and cones, while stem infestations can disrupt phloem transport and lead to rapid crown decline and mortality (Figure 11a/b). Expansion of these infestations appears to be occurring unchecked and may significantly impact the future stand conditions of affected areas. Recently, long-term monitoring plots were established at sites in eastern Oregon and western Idaho to assess stand decline and regeneration. For higher-value trees, systemic insecticides can be used to control adelgid populations, but these are not practical to use in most forest settings.

Figure 11a/b – Balsam woolly adelgid infestations lead to progressive crown decline and often mortality. Signs of infestation include branch gouting (swelling) and woolly tufts on the stem. (Oregon Dept of Forestry photos.)

Defoliation and Damage to Oregon White Oak

Defoliation and branch "flagging" of Oregon white oak was noted in many areas of western Oregon this year. Approximately 1,600 acres of oak looper defoliation (*Lambdina fiscellaria somniaria*) was observed, with the largest areas concentrated on private land in Jackson County (Figure 12). Oregon white oak is the preferred host, but other hardwoods can be affected in mixed stands. Historically, large areas in the Willamette Valley have been defoliated by this insect, but no permanent damage usually results as outbreaks are short-lived and buds are not affected, allowing trees to flush normally the following year.

Figure 12 – The Western oak looper is a small, yellow-brown moth that periodically defoliates Oregon white oaks. (USDA Forest Service photo.)

Branch-flagging and crown dieback of Oregon white oak was widespread. Follow-up ground surveys indicated that in many areas this was the result of gall wasp damage, often in association with bark-chewing by squirrels. Bassettia gall wasps (*Bassettia ligni*) lay eggs under the bark of small branches, causing seed-like galls to form. As the larvae develop the bark area over the gall ruptures and may girdle affected branches. Gall wasp larvae are also commonly fed on by squirrels, which access them by bark-chewing (Figure 13 a/b). The combined damage often appears as clusters of dead branches in the crown, and can be particularly noticeable on open-grown trees (Figure 13 c/d). Long-term damage is usually minor on established, mature trees, but can be severe in younger oaks. Outbreaks of oak looper and gall wasp are periodic and no controls are necessary as high populations will subside naturally.

Figure 13a/b – Bassettia gall wasps create seed-like galls under the bark of Oregon white oak, which along with bark chewing by squirrels can kill smaller branches. (Oregon Dept of Forestry photo.)

Figure 13c/d – Periodic outbreaks of Bassettia gall wasps can result in clusters of dead branches and dieback in Oregon white oaks. (Oregon Dept of Forestry photo.)

Gypsy Moth *(Lymantria dispar)*

Approximately 18,000 gypsy moth pheromone traps were placed by the Oregon Department of Agriculture in 2008, which captured a total of 12 gypsy moths at one old and four new sites. All moths were determined to be the European (or North American) strain. Seven moths were captured within the city of Eugene, near a site where they were also found in 2007. Successive years of captures in an area indicate a breeding population may be present, and therefore an eradication spray project is planned for this area in spring 2009. No additional moths have been found at the three most recent eradication sites of Bend, St. Helens, and Shady Cove.

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 14). 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 including rhododendron, evergreen huckleberry, Douglas-fir, and Oregon myrtle. If *P. ramorum* is allowed to spread unchecked in Oregon, it would seriously affect 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.

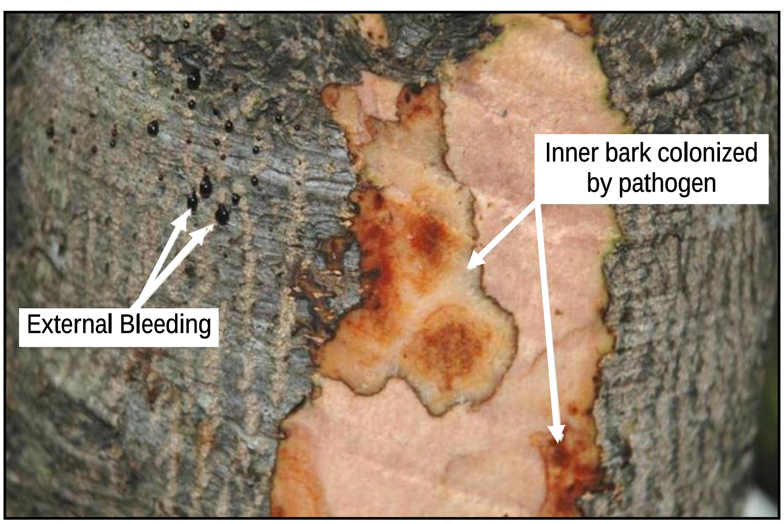


Figure 14 – Stem lesion, inner bark of tanoak (Lithocarpus densiflorus) caused by Phytophthora ramorum. (Oregon Department of Forestry photo.)

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 15). *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 15 – 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 (Figures 16a/b). During the first four years of the eradication effort, the number of new infested sites and infected trees decreased each year.

Figure 16a – Sudden Oak Death site following a broadcast burn to eradicate the pathogen, Phytophthora ramorum, in southwest Oregon.

Figure 16b – Sudden Oak Death eradication site following cutting, piling, and burning in a mixed tanoak-Douglas-fir stand, southwest Oregon. (Oregon Department of Forestry photo.)

In 2005, the area infested began increasing, and in 2007 and 2008 we found approximately 60 new infested sites each year (Figure 17a/b). Delays in completing treatments and consecutive years of unusually wet spring and early summer weather contributed to spread of the disease, forcing the expansion of the quarantine zone from 26 mi^2 to 162 mi^2 in early 2008.

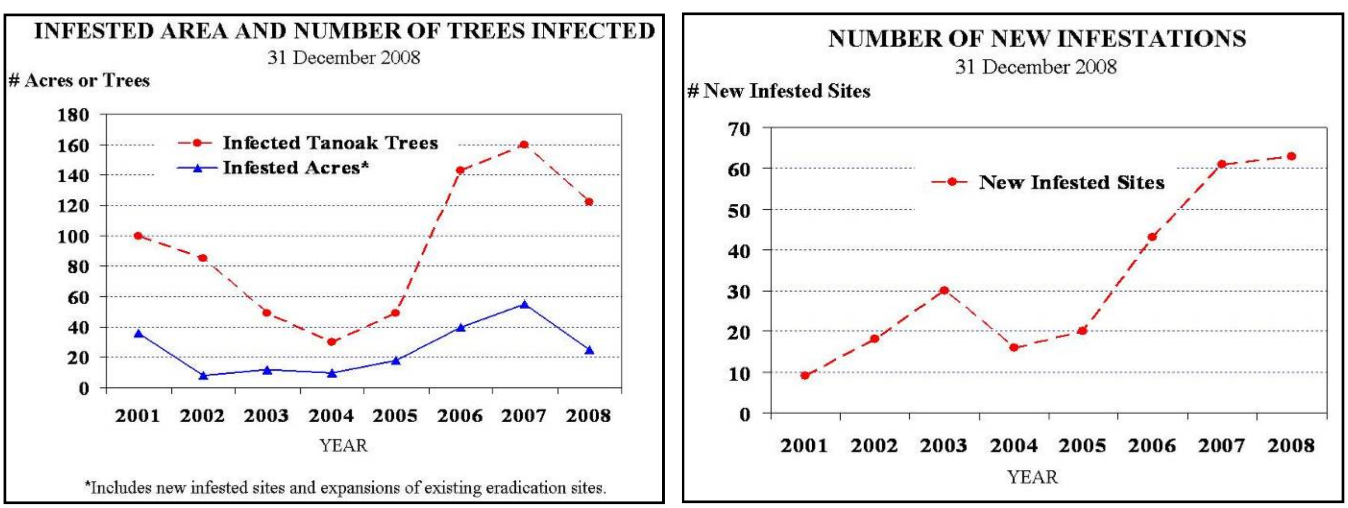


Figure 17a/b – Sudden Oak Death trends in southern Curry County, Oregon, 2001-2008.

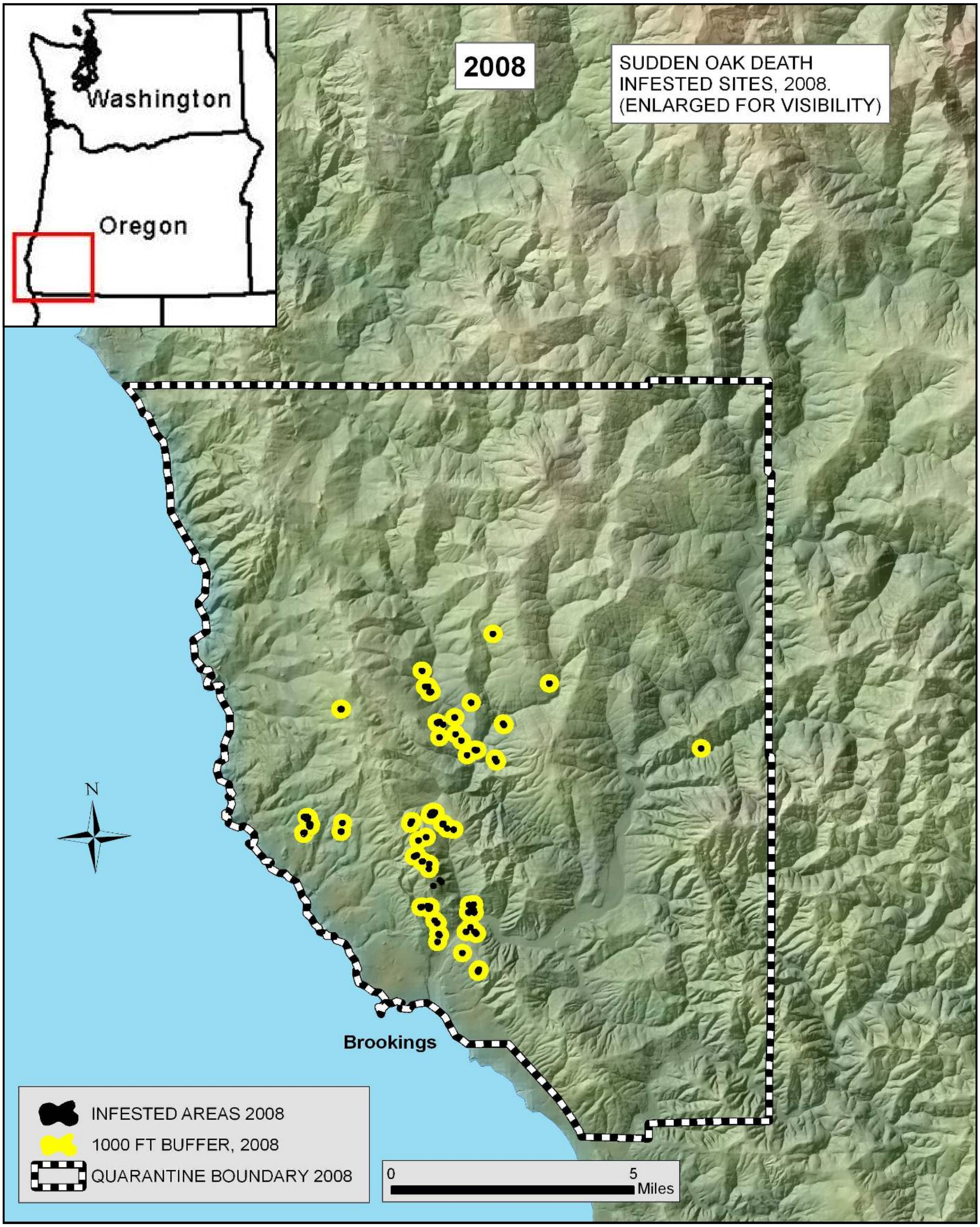
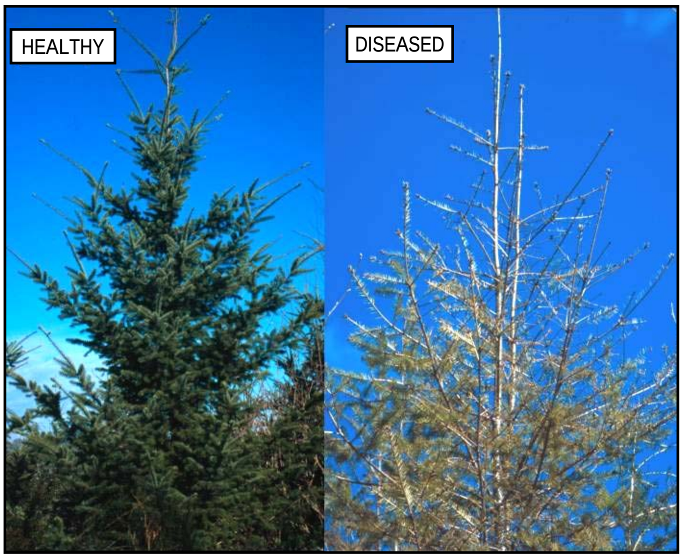


Figure 18 – Location of areas infested with Phytophthora ramorum during 2008 in southwest Oregon. Each site enlarged by yellow 1000 ft halo for visibility.

Most of the 2008 sites were small (less than 1 acre) and scattered near the center of the quarantine zone, and we found no significant expansion to the north. Of particular note is one new infested site 2 miles to the east of other known sites (Figure 18).

Between 2001 and the end of 2008 we completed eradication treatments on approximately 2,400 acres of forest at a cost of $4 million (fund sources: USFS (50 percent), State (34 percent), BLM (10 percent), APHIS (6 percent)). There is no compensation to landowners for the value of timber or other resources lost as a result of the eradication treatments.

Despite the new occurrences of *P. ramorum* in 2008, 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 the 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 2008 detection and eradication program cost was approximately $1.7 million. At this funding level we expect continued success at slowing the spread, but it is unlikely that we will completely prevent disease spread or eradicate the pathogen. A complete *P. ramorum* host list can be found at: http://www.aphis.usda.gov/plant_health/plant_pest_info/pram/downloads/pdf_files/usdaprlist.pdf
For more information on Sudden Oak Death, go to: http://nature.berkeley.edu/comtf/



Swiss Needle Cast

Swiss needle cast (SNC) is a disease of Douglas-fir foliage caused by the native fungus *Phaeocryptopus gaeumannii.* It causes needles to turn yellow and fall prematurely from trees, ultimately reducing tree growth and survival (Figure 19). 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.

Figure 19 – Swiss needle cast causes sparse yellow crowns in Douglas-fir (right) compared to healthy trees (left), western Oregon. (Oregon Department of Forestry photo.)

Growth loss as a result of Swiss needle cast correlates with foliage retention. High foliage retention (3 or 4 annual compliments) means less damage and better tree growth; low foliage retention (1 or 2 annual compliments) means more severe damage and reduced tree growth (Figure 20). Permanent plots in the Swiss Needle Cast Cooperative's Growth Impact and Pre-Commercial Thinning studies have been rated annually for Swiss needle cast (SNC) severity from 1998-2005 and in 2008. Foliage retention on branches collected in the spring of 2008 was lower than in 2005, decreasing by an average of 0.5 years.

Permanent plots in the Growth Impact study have been re-measured for a fourth growing period of four years' duration. Cubic volume growth of surviving trees on plots with severe Swiss needle cast (SNC) was compared to volume growth of plots with the highest foliage retention (3.6 years), suggesting relative growth losses up to 43 percent for 2004-2007 (minimum foliage retention of 1.47 years), and average losses of 21 percent (mean retention of 2.5 years). Growth loss due to Swiss needle cast in the Oregon Coast range is estimated

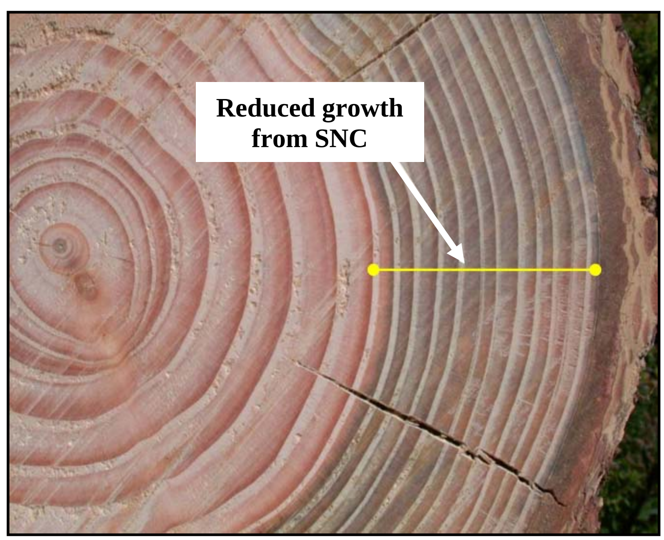


Figure 20 – Reduction in recent radial growth increment of Douglas-fir caused by Swiss needle cast, Tillamook, OR. (Oregon Department of Forestry photo.)

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.

Aerial surveys for SNC damage have been conducted each year since 1966 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.

The 2008 survey was not fully completed because of weather and aircraft availability. Three sample blocks were flown: Tillamook, Newport, and Coos Bay (Figure 21). Data from the sample blocks were used to estimate overall survey results. The data indicate that there was more visible SNC damage in 2008 (375,626 acres) than in 2007 (338,761 acres), continuing a slowly increasing trend since 2004 (Figure 22). 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.

For more information on Swiss needle cast, visit the website of the Oregon State University Swiss Needle Cast Cooperative (SNCC) at: http://www.cof.orst.edu/coops/sncc/index.htm

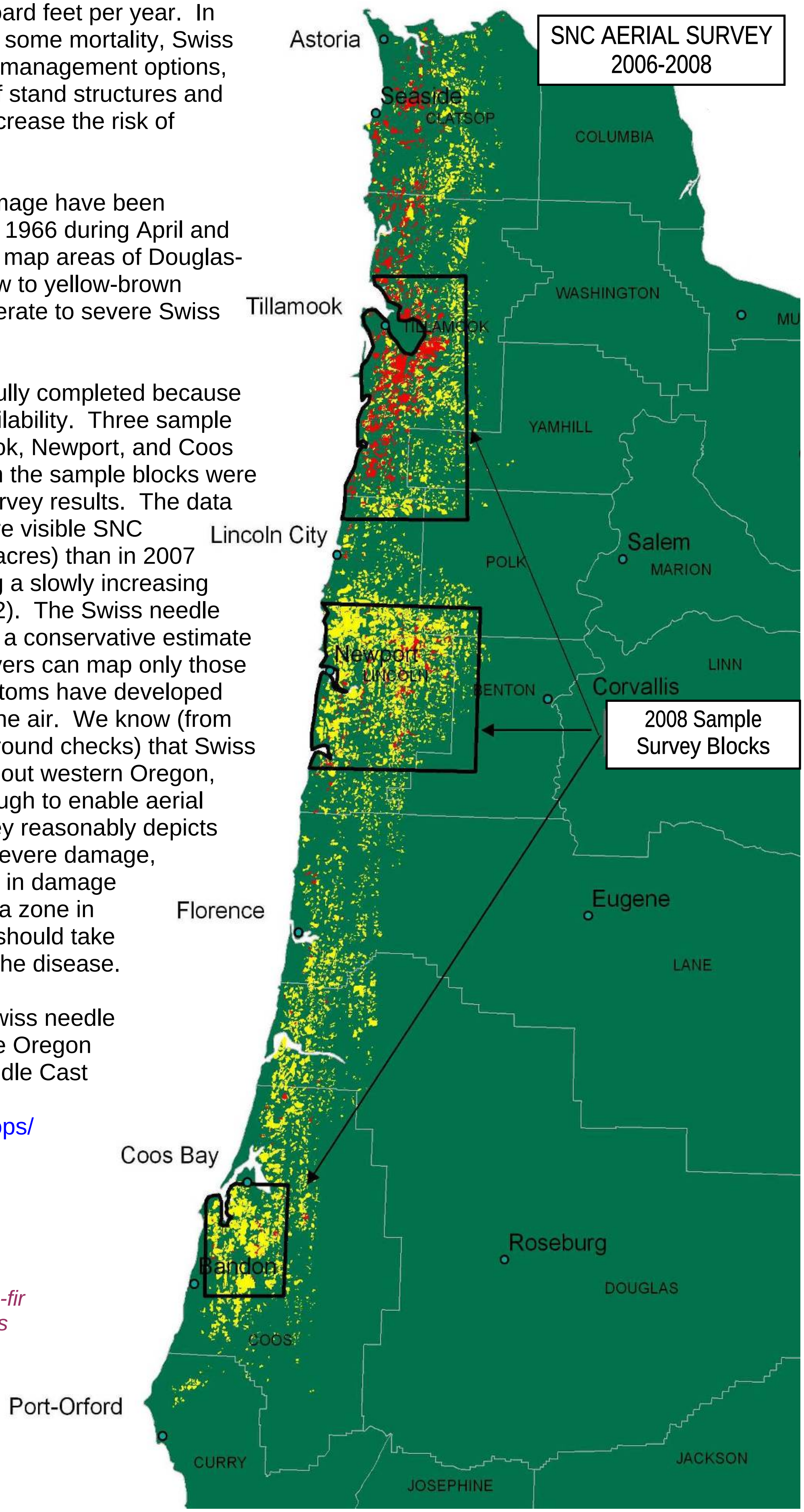


Figure 21 – Areas of Douglas-fir forest with symptoms of Swiss Needle Cast detected in the 2006-2008 aerial surveys. The 2008 survey was incomplete due to weather and aircraft availability. Yellow = moderate damage, Red = severe damage.

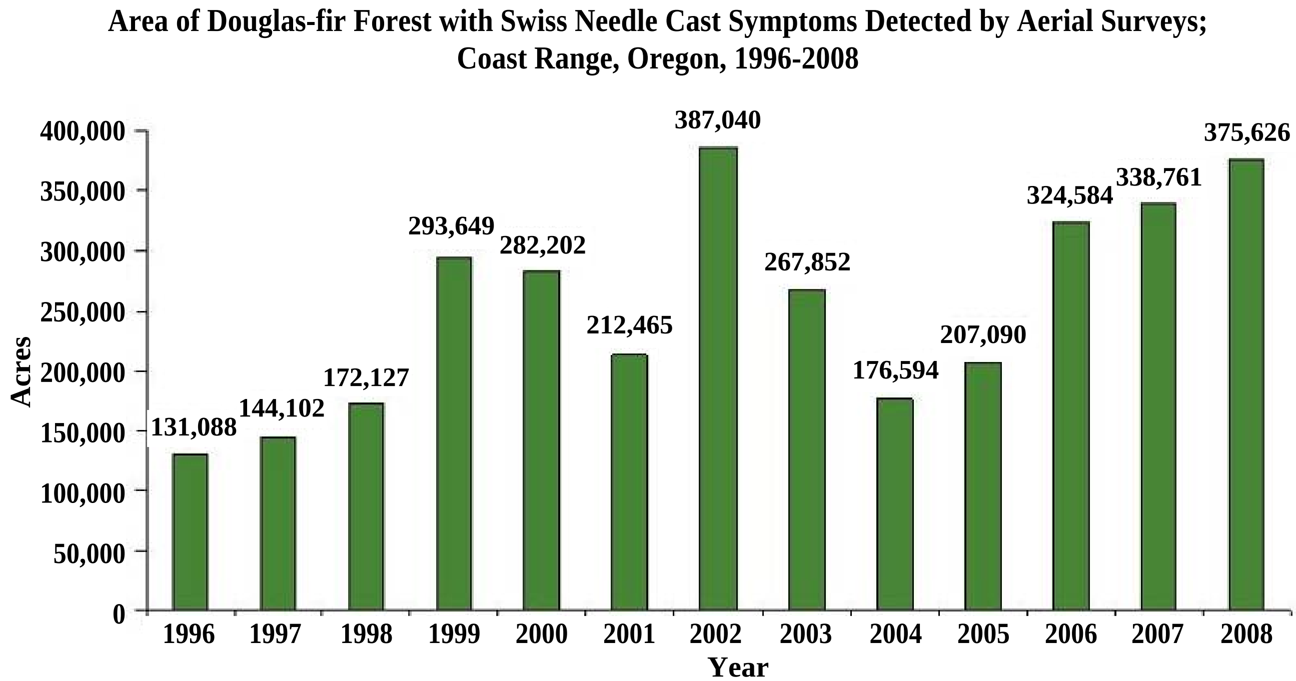


Figure 22 – Trend in area of Douglas-fir forest in western Oregon with symptoms of Swiss Needle Cast detected during aerial surveys in April and May, 1996-2008. Results for 2008 were estimated by extrapolating from three sample survey blocks.

Lingering Storm Damage

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 trees in parks and municipalities along the coast. Damage was most severe along the northern Oregon coast. In early 2008, shore pine and Sitka spruce in many locations showed severe needle reddening and loss, the result of heavy salt deposition during the storms (Figure 23). Many other plant species suffered damage as well.

Figure 23 – Salt damage to shore pine (left) and Sitka spruce (right) along the northern Oregon coast in early 2008, following the December 2007 storm. (Oregon Department of Forestry photo.)

Shore Pine Foliage Disease Flares Up Along South Coast

In May 2008, shore pines along the central and southern Oregon Coast displayed striking discoloration of the one-year old foliage (Figure 24 next page). The main cause was an outbreak of lodgepole pine needle cast (*Lophodermella concolor*) and red-band needle blight (*Mycosphaerella pini*), probably due to very favorable conditions for infection during the previous summer.

Figure 24 – Lodgepole pine needle cast and red band needle blight were highly visible in May 2008 along the southern coast. (Oregon Department of Forestry photo.)

Snow And Ice Damages Trees In Western Oregon

Freezing rain, heavy snow, and wind hit parts of northwest Oregon in December, 2008 causing severe local damage to many tree species. The heavy ice accumulation coupled with wet snow broke tops, large branches and whole trees along both sides of the Willamette Valley. Hardwoods suffered the most damage, with many tree and branch failures in landscape and forest situations (Figure 25).

Douglas-fir beetle outbreaks can occur following blow-down or breakage of larger diameter Douglas-fir trees. Populations often reach damaging levels one or two years following these events, and mortality of standing trees can occur. The severe winter storms that occurred in December 2007 and 2008 caused significant damage in many areas of western Oregon. Despite widespread salvage efforts, it is likely that large amounts of down material will remain and have the potential to lead to beetle outbreaks. Where salvage is not possible or at high-value sites, an anti-aggregant pheromone treatment (MCH) can be used to prevent further damage.

Figure 25 – Freezing rain and snow caused considerable damage to trees in the Willamette valley and elsewhere in northwest Oregon. (Oregon Department of Forestry photo.)

Heat Injury, Southwest Oregon

Unusually high temperatures in May in southern Oregon damaged new conifer shoots (Figure 26), caused premature needle drop, and discolored many tree species in Coos and Curry counties. Symptoms on conifers often resembled those of Swiss needle cast, while several hardwood species such as bigleaf maple and tanoak showed leaf damage from the intense heat.

Figure 26 – Unusually high temperatures in May in southern Oregon damaged new conifer shoots, caused premature needle drop, and discolored many tree species in Coos and Curry counties. (Oregon Department of Forestry photo.)

Incense Cedar Shoot And Foliage Disease

Incense cedar branch flagging and dieback have become increasingly obvious on incense cedar from Roseburg north to the Willamette Valley (Figure 27). The most common diseases associated with the symptoms are incense cedar rust (*Gymnosporangium libocedri*) and Seiridium canker (*Seiridium cardinale*). Both diseases are favored by warm moist conditions.

Figure 27 – Shoot and branch dieback on incense cedar associated with incense cedar rust and Seiridium canker. (Oregon Department of Forestry photo.)

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). 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.

Of particular note recently is the substantial damage from white pine blister rust (along with the mountain pine beetle) to high elevation whitebark pine forests along the crest of the Cascade Range and other mountainous areas (Figure 28 next page). Whitebark pine is an important species that tolerates the extreme environmental conditions of high elevation, where it catches and retains snow, stabilizes soils, and acts as a nurse tree for less hardy plant species. It provides cover and roosting sites for wildlife and its large nut-like seeds are high in fat and protein and supply food for many birds and mammals. The species also has considerable aesthetic and cultural value.

Surveys over several years by the USDA Forest Service, the National Park Service and others suggest that whitebark pine is more seriously threatened by white pine blister rust than previously believed. In central Oregon, whitebark stands closest to the Cascades crest had blister rust infection levels as high as 86 percent, with mortality as high as 77 percent from blister rust and mountain pine beetle combined. In the southern Cascades, blister rust incidence averaged 52 percent. Fortunately, the distribution of blister rust damage is quite variable, and some of the drier sites east of the Cascades had little or no rust infection.

Figure 28 – White pine blister rust: infected main stem of whitebark pine showing spore-producing blisters, Cascades Range, Klamath 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

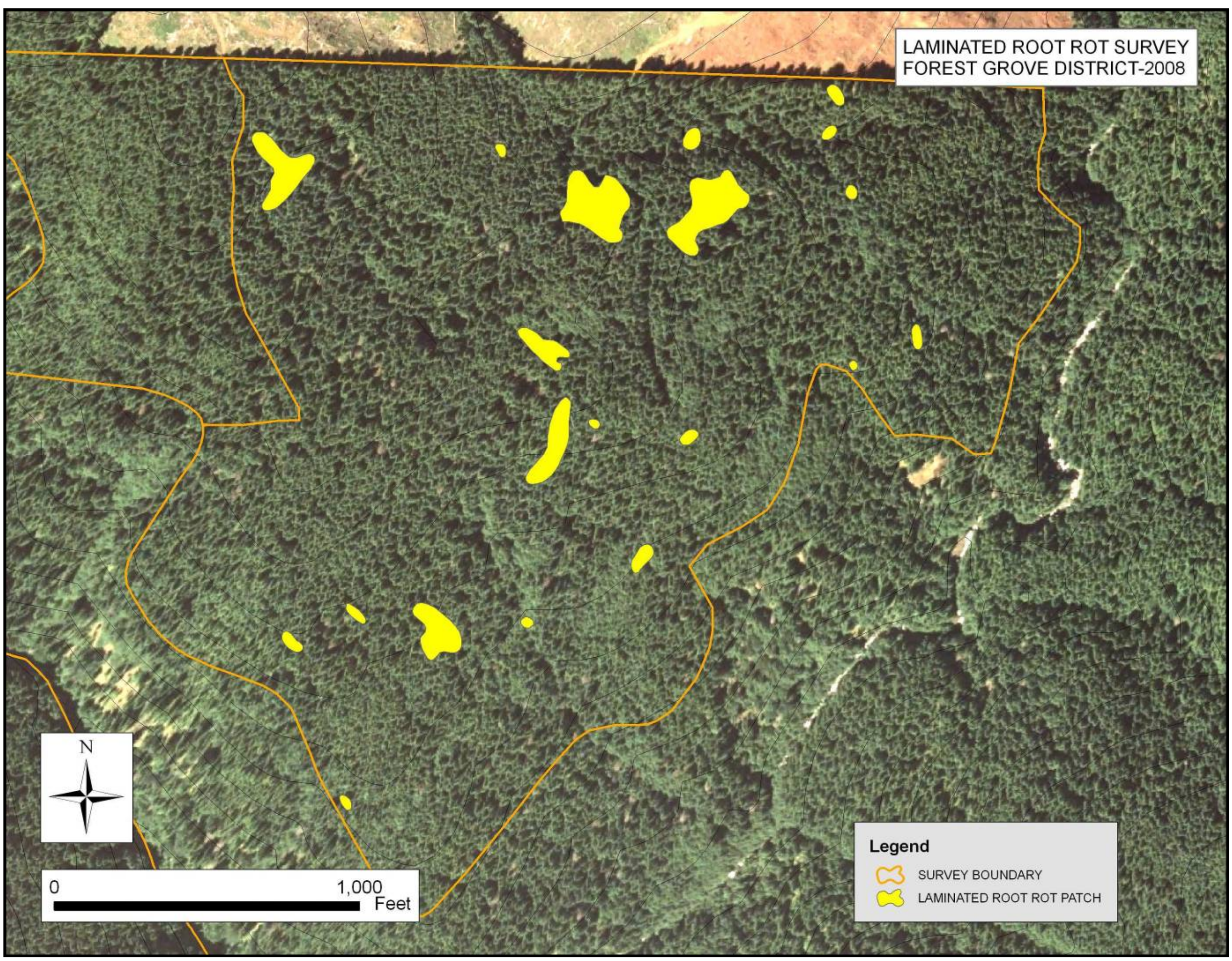


Figure 29 – Patches of laminated root rot in a 50 year old Douglas-fir stand, Washington County, Oregon. (Oregon Department of Forestry photo.)

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.

Laminated root rot, caused by the native fungus *Phellinus weirii,* is one of the most damaging diseases of Pacific Northwest conifers. It is particularly damaging to Douglas-fir in western Oregon, where three to five percent of the Douglas-fir forest type is infested. Occurrence is highest in northwest Oregon, where approximately ten percent of the Douglas-fir forest is infested. The pathogen decays tree roots and either kills trees directly or causes them to fall over while green. The disease is highly contagious, spreading from tree to tree across root contacts. This results in expanding disease patches that create openings in the stand where trees have died and fallen over. Although the openings have some benefit for plant diversity and wildlife habitat, the disease accounts for much loss of timber volume.

On State Forest lands approximately 1,500 acres are surveyed annually for root disease; GIS data layers and maps are then created showing the size and location of disease patches (Figure 29 previous page). Oregon Department of Forestry districts develop disease management plans based on the survey data and the specific management objectives for the stand. The root disease survey results become part of a permanent GIS layer, and as such provide a unique opportunity for monitoring the long-term interaction of silvicultural treatments, stand characteristics, and the severity of root disease.

Other Damage

Ozone Monitoring

Ozone is formed when emissions from factories, motor vehicles or power plants that burn fossil fuels 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 (Figure 30a). The Oregon Department of Forestry and the USDA Forest Service cooperate in a National ozone biosite monitoring program.

Figure 30a – Thinleaf huckleberry (left) and red elderberry (right) are bio-indicator plants for ozone injury. (Oregon Department of Forestry photo.)

Each year in late July and August, indicator plants are monitored for ozone injury in 35 sampling hexagons distributed throughout the state (Figure 30b). To date, ozone injury to plants has not been detected in any of the Oregon plots.

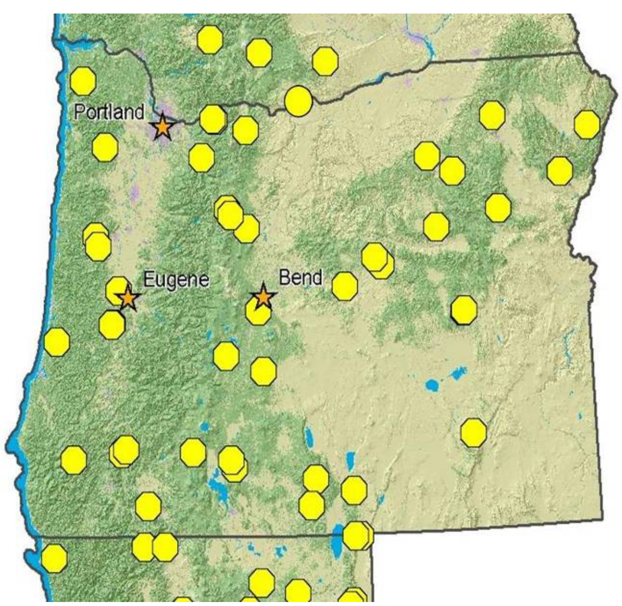


Figure 30b – Approximate location of ozone biosite monitoring plots, Oregon.

Black Bear Damage

In western Oregon, black bears damage a large number of trees each spring by peeling the bark and feeding on the inner tissues (Figure31a/b). Partial peeling can reduce tree growth and vigor, as well as provide entry for decay organisms that lower wood quality and may eventually cause mortality. Long-term trends in bear damage are determined from special aerial surveys of approximately 7 million acres along the Coast Range and western slopes of the Cascades. These surveys use closer flight lines than the statewide survey, and are flown in June or early July when damage is most visible.

Figure 31a/b – Black bears damage trees during spring in western Oregon by peeling the bark to feed on the inner tissues. (Washington Forest Protection Association 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 insect and disease agents that also cause tree mortality in these areas. In 2008, damage was observed on over 28,000 acres, which was similar to the 10-year average of 29,000 acres, but represented a 22 percent decrease relative to the previous year (Figure 32). Damage from root disease, insects, and drought are also common in areas that may be affected by bear; however, it is difficult to determine the relative contribution of each agent without ground surveys, which are not completed annually.

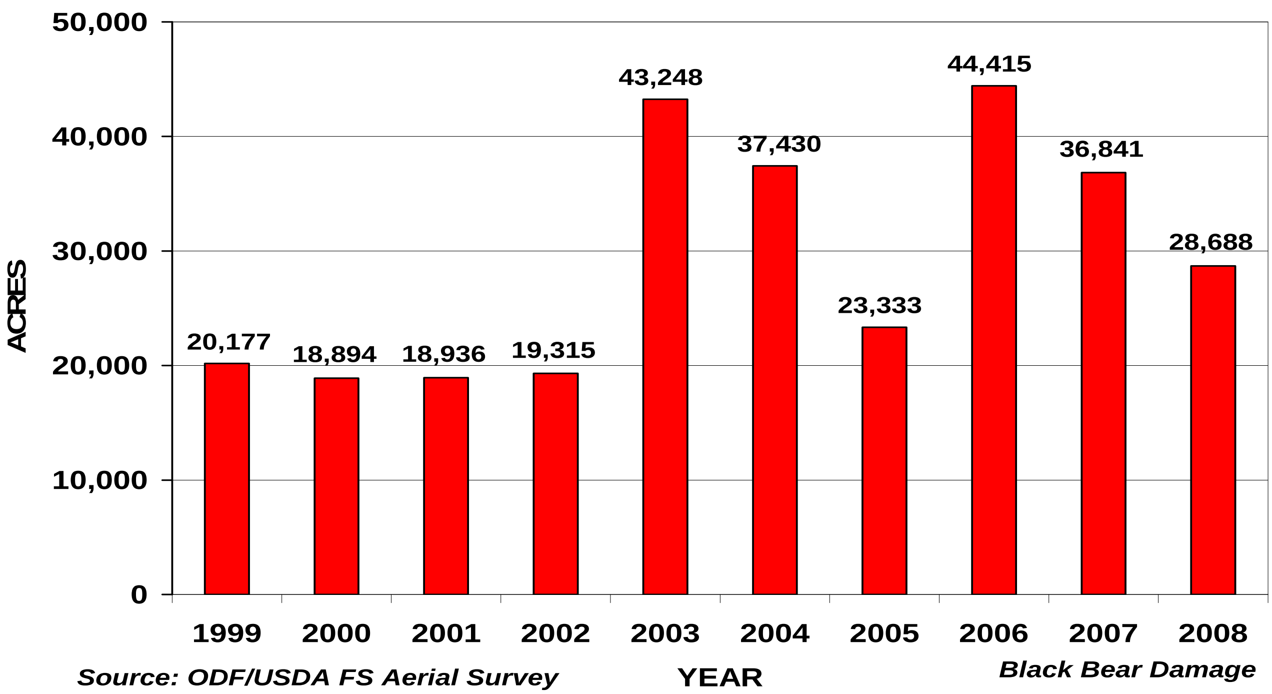


Figure 32 –Ten-year trend in bear damage for tracking counties in western Oregon. Acres are adjusted according to a previously determined ground verification factor.

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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