Forest Health Highlights in Washington—2008

Washington State Department of Natural Resources
Forest Health Program
February 2009

Forest Health Highlights in Washington—2008

Contributors:

Jeff Moore[1]
Amy Ramsey[1]
Glenn Kohler[1]
Karen Ripley[1]
Alison Nelson[2]
Dan Omdal[1]

[1]Washington Department of Natural Resources
[2]U.S. Department of Agriculture, Forest Service

Table of Contents

List of Figures

Summary

Washington has nearly 22 million acres of forestland. In 2008, over 1.36 million acres of this land contained elevated levels of tree mortality, tree defoliation or foliar diseases. This is almost unchanged from the 1.4 million acres reported in 2007. Previous annual totals were:

2006: 1.9 million acres 2005: 2.5 million acres 2004 and 2003: 1.9 million acres

Drought conditions and warm, dry spring weather tend to increase tree stress and insect success, driving up damage. Wet spring weather tends to increase acres affected by foliage diseases. Areas that have experienced major wildfires are not surveyed for two years following the event, which can temporarily decrease acres of damage. Some of this year's significant highlights include:

- Nearly 5.3 million trees were recorded as recently killed.
- Western spruce budworm activity showed another dramatic increase in activity along the eastern slopes of the North Cascades especially in the Teanaway area of western Kittitas County, Chelan County and Okanogan County. Very little activity was detected in the Mt. Adams area and northwestern Yakima County, which have been affected for many past years, especially in 2005 and 2006. Pheromone trap catches indicate it is likely activity across northeastern Washington (eastern Okanogan County, Pend Oreille County) will continue to increase in size and severity.
- Two areas of Douglas-fir tussock moth defoliation totaling approximately 300 acres were detected in northern Okanogan County. DFTM Defoliation has not been detected in Washington since 2002.
- Pine bark beetle activity continues across Eastern Washington with almost 300,000 acres of forestlands experiencing elevated levels of mortality. Mortality is concentrated in the Chelan-Sawtooth Wilderness, the Chelan Mountains, the upper Yakama Indian Reservation and the Naches River watershed. Pine bark beetle activity also is scattered across Spokane County and the lower-treeline forests of Klickitat County.
- Nearly 25,000 acres of western Washington forestland experienced wind damage caused by two major windstorms in early December, 2007. This is less damage than was recorded (29,000 acres) by a special aerial survey conducted specifically for blowdown detection along the coastal areas of Washington in March, 2008.The earlier survey covered a much smaller area and was flown on a tighter grid. Many affected areas were rapidly salvaged and no longer contained fallen trees when the summer survey occurred later in the summer. For more information about this special blowdown survey go to: http://www.dnr.wa.gov/Publications/rp_fh_2008_blowdownreport.pdf

Weather and Forest Health

Figure 1. In the absence of fire or management in pine forests, the trees grow too dense and become increasingly stressed over time.

Forests in Eastern Washington are generally overstocked with fir which has replaced drought tolerant pine which was preferentially removed during past harvesting practices. Fir also regenerates well in shady conditions resulting in overly dense reproduction in the absence of periodic fire.

Additionally, the absence of severe winter weather increases the survival rate of insect pests. These conditions stress host trees and make them susceptible to pathogens. Current outbreaks of bark beetles and defoliating insects are likely to continue and become more severe in many places.

Drought

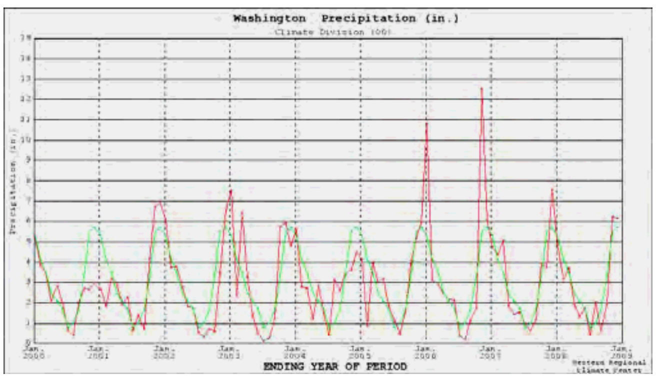

Figure 2. Ten year precipitation chart for Washington State. *Green =average precip* *Red = actual precip*

Three of the last five years have experienced normal to near normal summer precipitation and the recent absence of severe summer drought has been a welcome respite. However, no year has received above normal summer precipitation since 1997 and this has likely maintained high insect populations for many years. The summer of 2008 started out extremely dry and by mid-August the fuel moisture levels were bone dry, setting the stage for catastrophic wildfires. During this time, trees were generally experiencing drought stress. However, a single rain event in mid-August brought much needed relief and, overall, Washington received near normal summer precipitation.

Fire

The 2008 fire season started out strong, but ended with a whimper fairly early after a significant rain event in mid-August followed by weather that was fairly cooperative for fire fighting efforts. This was fortuitous since privately contracted fire fighting resources that Washington typically relies on were in California, which was experiencing an early, intense and prolonged fire season with over 1400 fires burning simultaneously. The smoke from these fires and other fires in Oregon caused widespread smoky conditions that at times spread northward into Washington creating unfavorable conditions for conducting aerial survey. Overall, the fire season for Washington was slightly below normal with nearly 90,000 acres burned statewide.

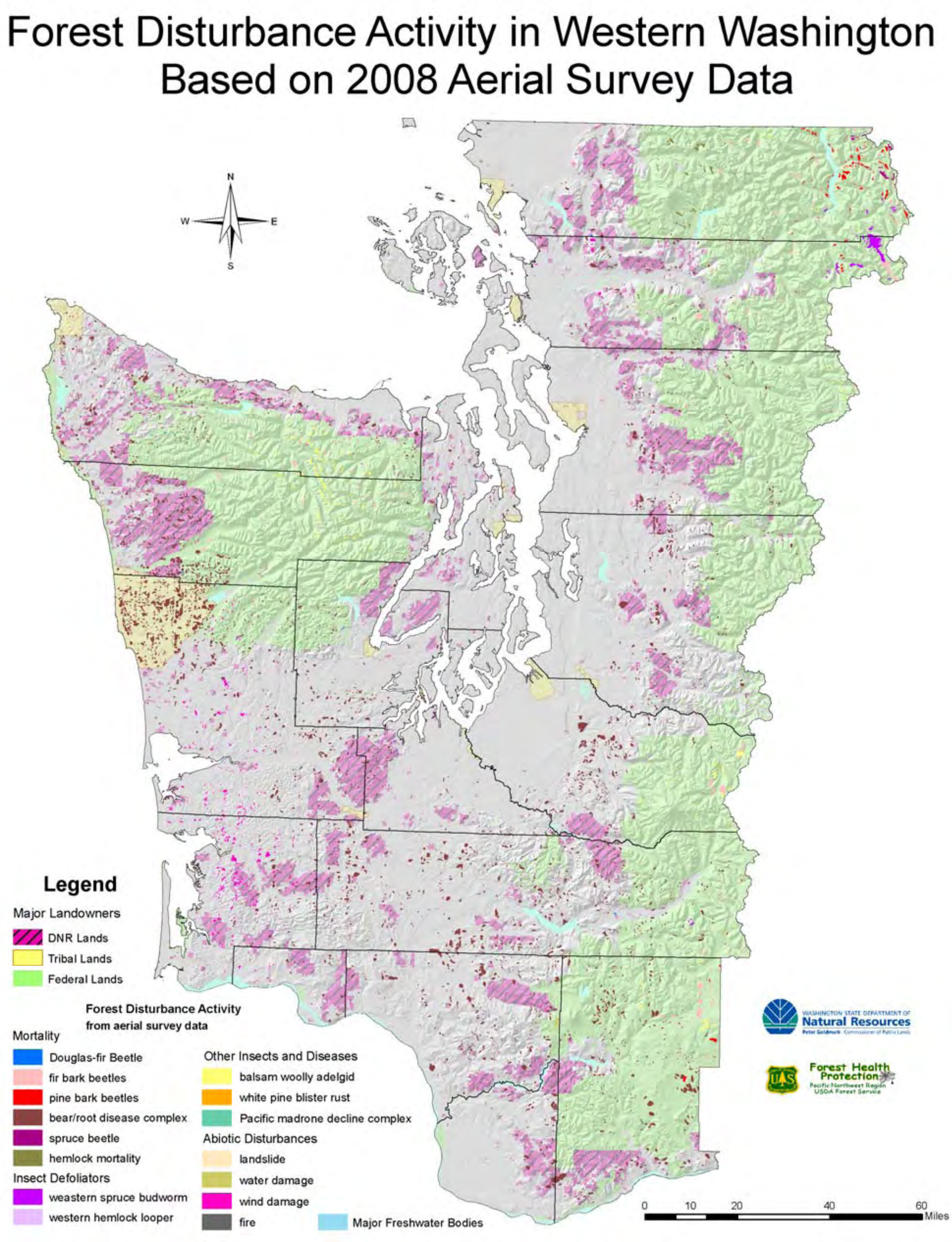

Figure 3. Forest disturbance map of Western Washington composed from 2008 aerial survey data.

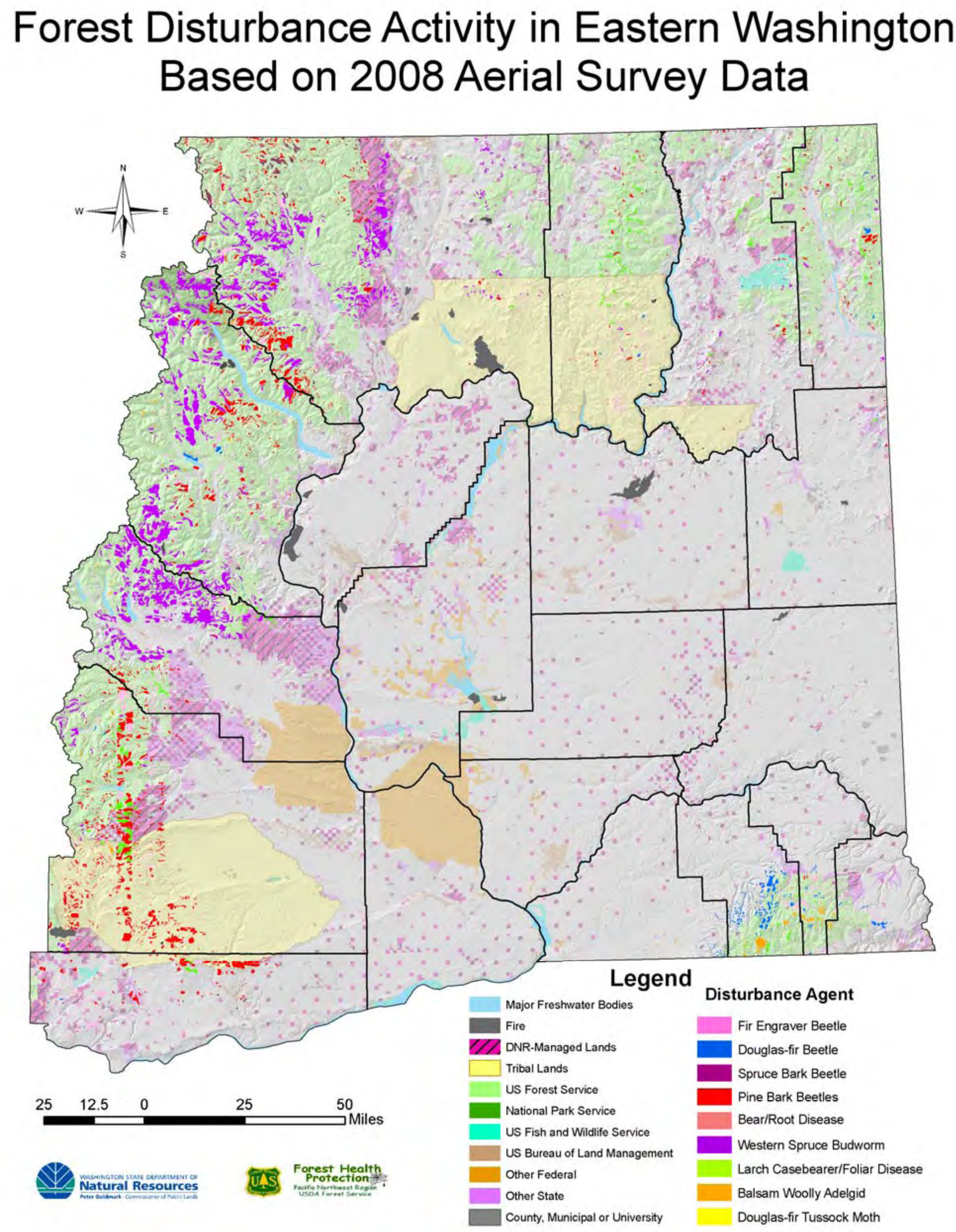

Figure 4. Forest disturbance map of Eastern Washington composed from 2008 aerial survey data.

Insects

Bark Beetles

Fir Engraver Beetle (*Scolytus ventralis*)

More than 181,000 acres of elevated mortality were recorded; making 2008 a below-average year compared to recent activity levels (Fig. 6). High insect populations were probably offset by the near normal rainfall during the summer months, as well as prior colonization of the most susceptible host over the last several years.

- 2007: 236,000
- 2006: 140,000
- 2005: 368,000
- 2004: 313,000
- 2003: 299,000

Figure 5. Recent and older mortality in riparian mixed conifer community with activity from fir engraver in grand fir and mountain pine beetle in lodgepole pine.

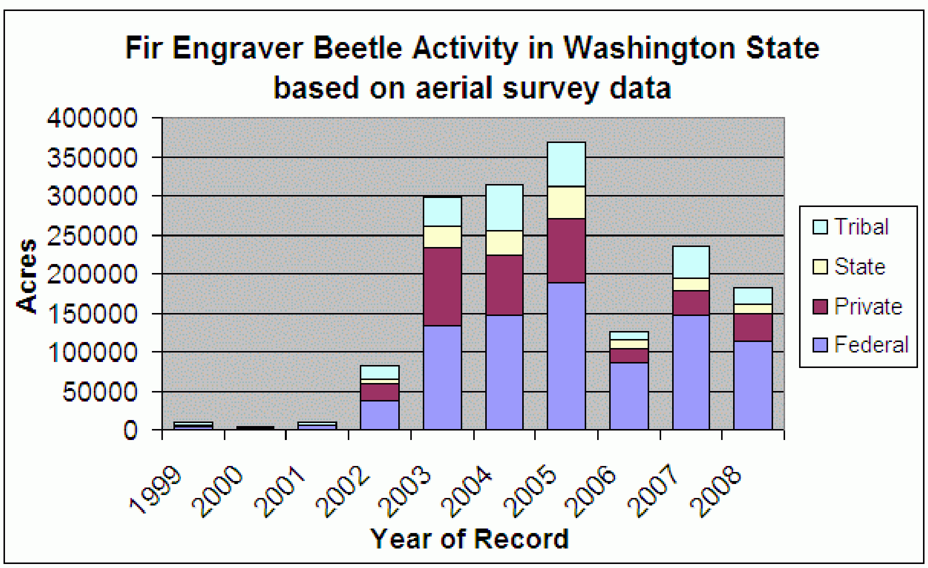

Figure 6. Ten year trend for total acres affected by fir engraver beetle in Washington.

Figure 7. Adult fir engraver beetle. Like other bark beetles, adults are about the size of a grain of rice and rely on the power of large populations to successfully kill susceptible trees.
. *Photo: USDA Forest Service*

Douglas-fir Beetle (*Dendroctonus pseudotsugae*)

Figure 8. A small isolated pocket of Douglas-fir killed by Douglas-fir beetle.

More than 36,000 acres of activity were recorded, which is a significant drop from recent years (Fig. 9). Most of the current activity is concentrated in the Blue Mountains with additional small isolated pockets throughout the Northeast Region of the state. Future beetle activity will likely increase as defoliation by the western spruce budworm continues to intensify and spread. Many of these recently-killed trees are not visible during the aerial survey since they are devoid of foliage. The increase in Douglas-fir beetle (DFB) activity in the Blue Mountains in 2007 and 2008 was precipitated by Douglas-fir trees killed and damaged in the Columbia Complex fire of 2006. East of the Cascades, DFB activity is most commonly associated with drought, defoliation, and fire. There was very little DFB activity west of the Cascades in 2008, where increases in damage tend to be associated with root disease and weather events that kill host trees.

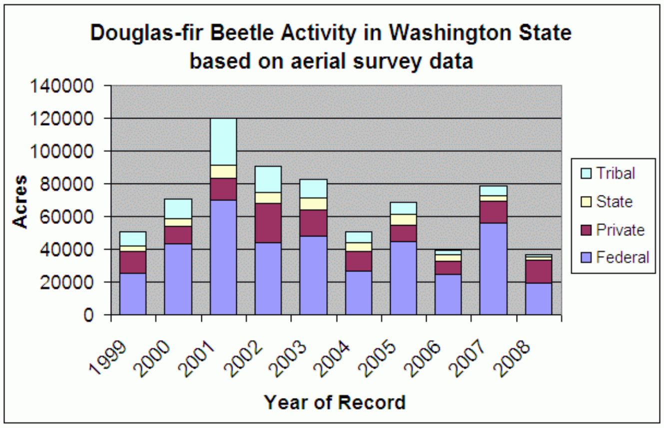

Figure 9. Ten year trend for total acres affected by Douglas-fir beetle in Washington.

Spruce Beetle (*Dendroctonus rufipennis*)

Figure 10. Riparian spruce killed by spruce bark beetle.

Most of the spruce mortality observed in 2008 was again in high elevation forests east of the Cascade crest in Okanogan County. The 24,366 acres of mortality mapped was significantly less than the last three years. Spruce is an important riparian species that becomes susceptible to beetle attacks during periods of drought. Spruce beetle outbreaks may also occur following windthrow events. The photo (Fig. 10) shows older spruce mortality with young Douglas-fir in the foreground defoliated by western spruce budworm.

Pine Bark Beetles (*Dendroctonus ponderosae, Dendroctonus brevicomis, & Ips spp.*)

Nearly 300,000 acres of activity were recorded as high insect populations continue to kill trees at the landscape level throughout much of the eastern slopes of the Cascade Range.

Mountain pine beetle has been very active in and around North Cascades National Park for several years and activity there continues to move westward. Activity also appears to be increasing throughout much of the northeastern part of the state.

- 2007: 255,000
- 2006: 267,000
- 2005: 554,000
- 2004: 430,000

Figure 11. Old and recent mountain pine beetle killed lodgepole pine.

Figure 12. Larvae and larval galleries of mountain pine beetle.

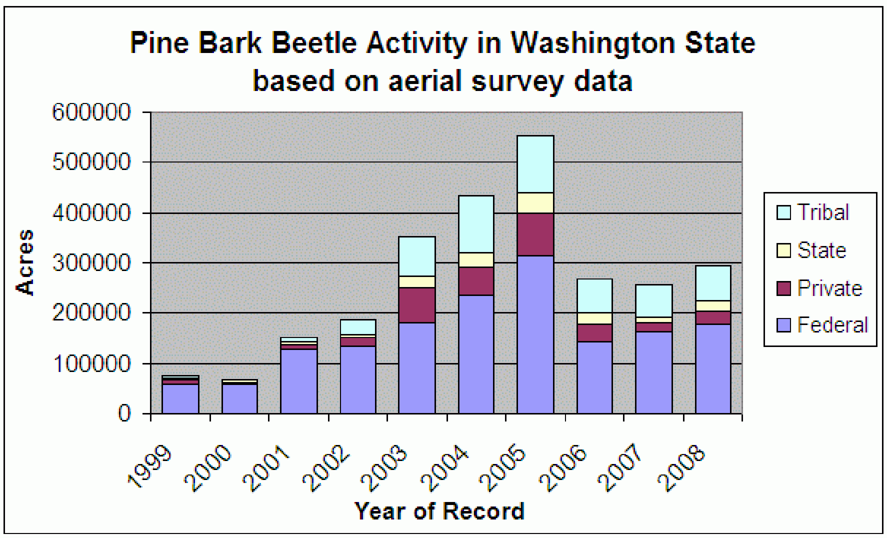

Figure 13. Ten year trend for total acres affected by pine bark beetles in Washington.

Western Spruce Budworm (*Choristoneura occidentalis*)

The good news is that ongoing budworm outbreaks in the Mt Adams/Yakama Indian Reservation area and northwestern Yakima County have mostly subsided (Fig. 17). The bad news is that budworm activity in many other areas of Eastern Washington increased. Activity in the North Cascades National Park drastically increased and spread even further north and west spilling over into Western Washington (see Figure 2, far north).

Defoliation in northeastern Washington still occurs in discrete areas which continue to expand in size, severity and number of areas defoliated. Over 450,000 acres with defoliation were mapped during the 2008 survey making it an unusually active year (Fig. 16).

Figure 14. First year budworm defoliation in Eastern Washington (notice the larch are unaffected).

Increasingly overstocked and over mature stands of suitable host (Douglas-fir and grand fir) promote this severe and widespread outbreak. Pheromone trap results indicate continued defoliation in 2009, especially in the Wenatchee area (Fig. 17).

- 2007: 355,000
- 2006: 556,000
- 2005: 352,000
- 2004: 193,000

Figure 15. Sixth and last instar larva of Western Spruce Budworm.

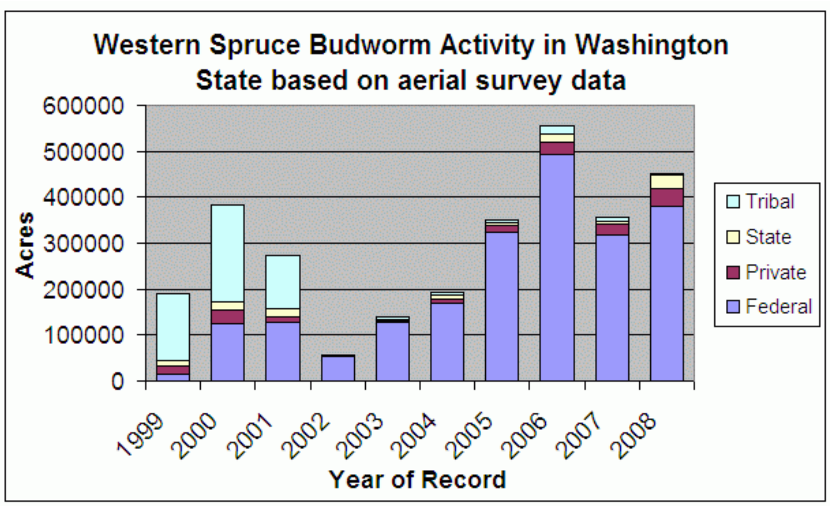

Figure 16. Ten year trend for total acres affected by western spruce budworm in Washington.

Western Spruce Budworm Pheromone Trap Results in Eastern Washington 2008

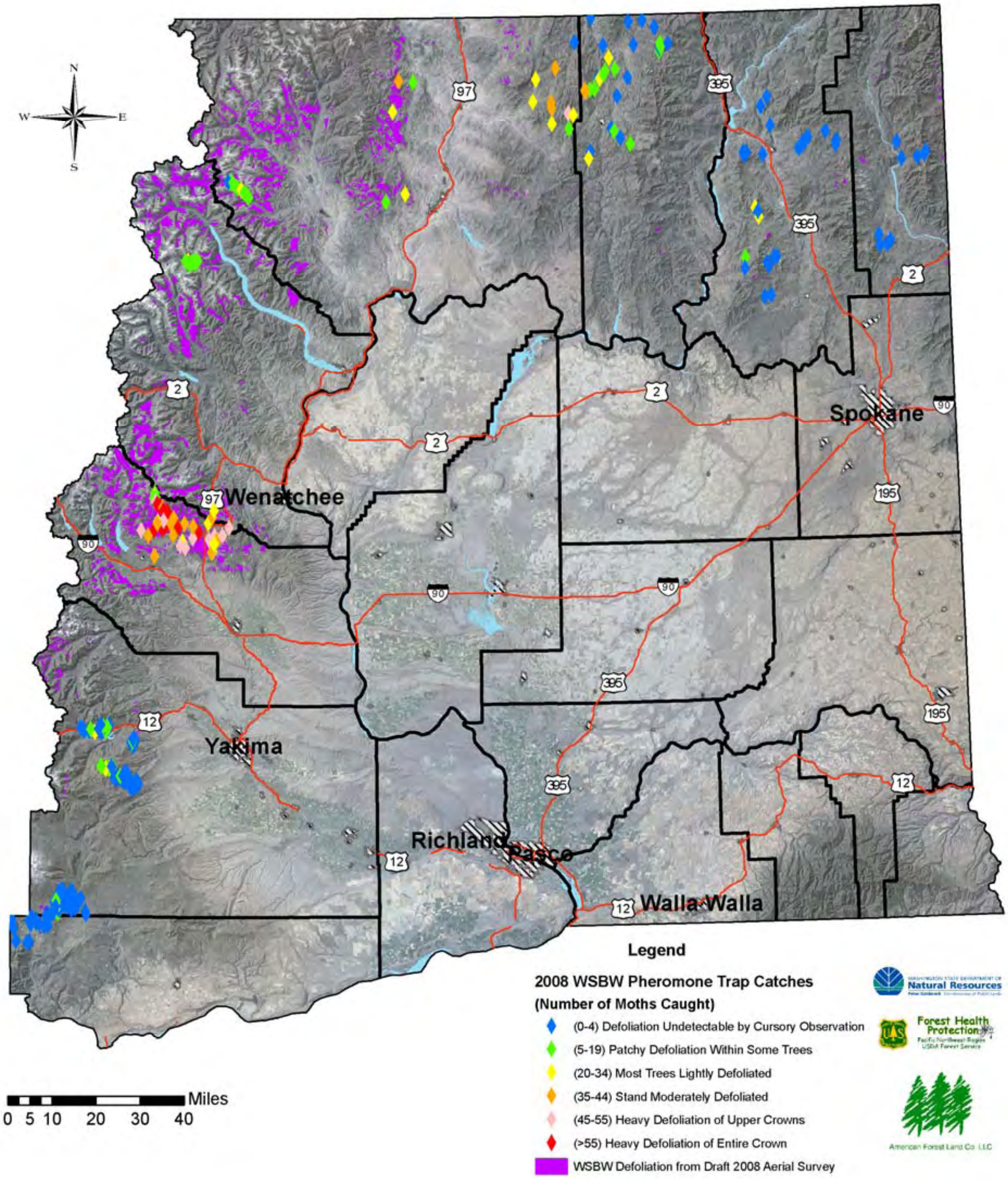

Figure 17. Western spruce budworm pheromone trap catch results for 2008 and defoliation detected by the 2008 aerial survey.

Douglas-fir tussock moth (*Orgyia pseudotsugata*)

Pheromone traps used for monitoring have been showing recent increases in catches in several areas of Eastern Washington, mostly in Okanogan County, and it appears that we are on the verge of the next periodic outbreak (Fig. 18). Significant areas of defoliation were detected near Palmer Lake and Molson (approximately 300 acres) and quite possibly near Alta Lake.

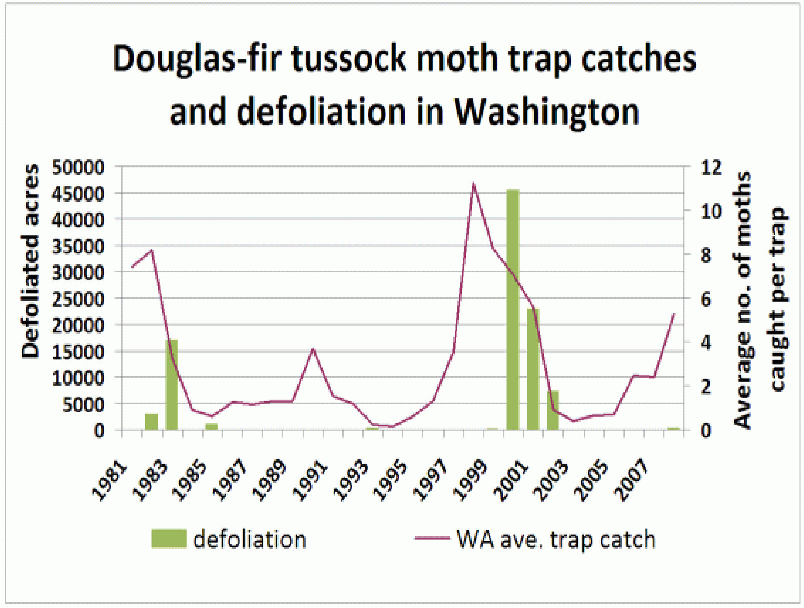

Figure 18. Correlation of DFTM pheromone trap catches with observed defoliation.

Figure 19. Ornamental spruce trees north of Colville defoliated by Douglas-fir tussock moth in 2008.

Approximately 50 egg masses were collected from each of two locations and will be tested for the presence of nuclear polyhedrosis virus, which, if present in high concentration, would indicate that a widespread outbreak is unlikely due to this natural control. The most likely scenario for the next few years is a dramatic increase in the size, number, and severity of defoliated areas unless suppression or host reduction efforts are undertaken in affected areas.

Gypsy Moth (*Lymantria dispar*) NON-NATIVE

The Washington State Department of Agriculture is primarily responsible for gypsy moth detection and eradication on state and private lands. Twenty-one moths were trapped statewide in 2008, making it the second year in a row of below-average catches. No eradication efforts were conducted in 2008, but multiple moth catches were detected in Ft. Lewis (Pierce County), Wauna on the Kitsap Peninsula, Pt. Roberts in Whatcom County and again in Kent (King County). Egg mass detection surveys are being undertaken in these areas, and, if a population center is located, eradication efforts may be proposed for the 2009 season.

Figure 20. Gypsy moth larva. *Photo: Colorado State University Extension*

Larch Casebearer (*Coleophora laricella*) NON-NATIVE

Larch casebearer is an exotic insect that feeds on foliage of western larch. Areas of moderate to high activity were recorded throughout much of Eastern Washington. It is unknown how much of this is attributable to casebearer or to needle diseases (see disease section below), but both are likely active. In 2008, more than 70,000 acres of larch casebearer/foliar disease signature were recorded in Washington. Most of the affected areas were in northeastern Washington in Ferry, Stevens, and Pend Oreille Counties. It takes several years of this activity to cause serious injury to larch.

Figure 21. Symptomatic larch.

Branch and Terminal Insects

Balsam Woolly Adelgid (*Adelges piceae*) NON-NATIVE

The balsam woolly adelgid (BWA) is an exotic (European-origin) aphid-like insect that feeds on the stems and twigs of trees in the genus *Abies*. In Washington, BWA has likely been fairly widespread since the 1950s. Subalpine fir, Pacific silver fir, grand fir and noble fir are affected. The most serious effects are extreme reactions to the adelgids' saliva that cause growth deformities, reduced foliage, reduced vigor, and tree death. It can also act as a predisposing factor for fir engraver beetle. A link is also suspected between BWA-caused weakness and persistent defoliation by western spruce budworm in some parts of the eastern Cascades.

Figure 22. Swelling (gouting) around buds and branch nodes caused by BWA. *Photo: Ladd Livingston, Idaho Department of Lands*

Trees grown outside their native range, or at lower elevation portions of their native range are most susceptible to BWA damage. Over the long term, the most susceptible trees will die off leaving, hopefully, those that are more tolerant of BWA. Unfortunately, warmer climate and longer growing seasons are likely to be beneficial to BWA and detrimental to its host trees.

In 2008, nearly 45,000 acres were affected by BWA in Washington. This is less than 2007 (59,000 acres) but more than 2006 (36,000 acres). BWA damage was recorded at high elevations on both the west and east slopes of the Cascades. High elevations of the Olympic Peninsula and Blue Mountains were also affected (Figs. 3 and 4).

It is challenging to detect balsam woolly adelgid infestations and mortality with aerial survey techniques, but surveyors have had good success identifying affected trees based on dark colored arboreal lichens that are more numerous and more visible when tree foliage is missing.

Figure 23. "Wool"-covered BWA females as they appear during summer. *Photo: Ladd Livingston, Idaho Department of Lands*

Diseases

Cankers

Alder Canker (*Neonectria major*)

Stem defects of red alder (*Alnus rubra*) were initially noted in Washington state in 1998 on privately managed timberlands. The symptoms were commonly found on red alder stands in southwest Washington, ranging in severity from spot-like bark lesions to severely canker-caused tree mortality, and tended to be most associated with trees approximately 13 years old and in stands with densities greater than 400 trees per acre.

Figure 24. Multiple cankers on main stem of red alder.

Figure 25. Canker on main stem of red alder.

Figure 26. Plot locations for red alder canker survey.

After further investigation, the fungal pathogen *Neonectria major* was found in association with the cankers on the stems and branches of living and recently killed trees, as well as recently thinned slash. A comprehensive survey of red alder stands in western Washington was conducted in spring 2007 to further evaluate the incidence and severity of the *Neonectria* cankers.

A majority of the 45 survey plots were located in riparian areas (Fig. 26). The results show that *Neonectria* is widely distributed across western Washington and is a rather benign pathogen in naturally regenerated, riparian associated ecosystems. No variables were quantified to determine the aggressiveness of *Neonectria*, but in most cases, the fungus did not appear to discolor the xylem or cause major structural defects.

White Pine Blister Rust (*Cronartium ribicola*) NON-NATIVE

Around 1910, *Cronartium ribicola*, the causal organism of white pine blister rust, was introduced into western North America. All five-needle pines are susceptible to this disease, including whitebark pine (*Pinus albicaulis*) and western white pine (*Pinus monticola*) in Washington. Widespread mortality of both species has and continues to occur.

Figure 27. White pine blister rust canker on western white pine.

Whitebark pine populations are typically located at high elevation alpine areas in the Cascade Mountains. The species is ecologically important, with the seeds serving as food for a variety of squirrels, rodents, bears and the Clark's nutcracker. The species is slow growing and there are several ecological limitations for successful reproduction. These factors, combined with increased mortality by white pine blister rust and mountain pine beetle attacks, makes whitebark pine a species of concern. The USDA Forest Service continues to actively work with this species in order to conserve its presence on the landscape.

Western white pine, Washington's other five needle susceptible pine, was once an integral part of the forest ecosystems of Washington, but populations have significantly declined due to white pine blister rust. Populations tend to grow in habitats that are much less extreme than the alpine areas of the whitebark pine, usually in mid to low elevation mountains, extending all the way to sea level in some locations. In the last two decades the USDA Forest Service and the University of Idaho have established breeding programs to genetically enhance western white pine for resistance to white pine blister rust. The Washington Department of Natural Resources (DNR) has been outplanting western white pine seedlings, including those genetically enhanced (F2 and more recently F3 progeny), on state lands.

Monitoring of 22 sites planted with F2 progeny has revealed that white pine blister rust infection levels are increasing in most areas with tree age. F3 progeny families, which are the 3rd generation of resistance-bred trees, were planted in 2007 across six sites in Washington. These sites will be monitored into the future for the development of white pine blister rust cankers and tree mortality. Pruning the lower branches of a tree that is susceptible to white pine blister rust is a prescription used to reduce the number of rust infections. Western white pine pruning trials may be installed spring 2009 in efforts to evaluate the effectiveness of the prescription in Washington.

Root Diseases

Annosus Root and Butt Rot (*Heterobasidion annosum*)

Heterobasidion annosum causes root and butt-rot in many tree species growing in Washington, but recent research work has focused on western hemlock forests near the Pacific Ocean coast on the Olympic Peninsula.

The form present in those forests is the “S type”, which causes internal wood decay, but is typically not a tree killer. Spores of the fungus infect freshly cut stumps surfaces or fresh basal stem wounds, both of which are created during forest harvesting. New infections also can occur when uninfected roots come into contact with infected roots.

Figure 28. Western hemlock research stand with Annosus root and butt disease.

In the fall of 2008, data were collected in order to quantify the effects of thinning and patch-cutting on western hemlock stands infested with *H. annosum*. The research area is near the coast on the Olympic Peninsula and the forest is prone to tree blow down when storms and high winds move through the area. High winds can cause stem breakage in trees with *H. annosum* because the internal stem decay column can extend several meters above the level of the ground. High winds also can cause complete tree blow down, root ball and all, because Annosus also can severely decay the roots of trees. Results from the study will be reported in the 2009 Forest Health Highlights report.

Armillaria Root Disease (*Armillaria* sp.)

Both conifer and hardwood trees in Washington are susceptible to Armillaria root disease. There are many plant species that can be infected and there are many species of *Armillaria* that can infect. While several species of *Armillaria* are found on the wet, western side of the Cascade Mountains of Washington, these species are generally less aggressive saprophytic decomposers that only kill trees that are under some form of stress. There also are several species of *Armillaria* found on the dry, eastern side of the Cascade Mountains in Washington and these can cause tree mortality. Areas with *Armillaria* mortality may look like patches or circles of dying trees.

Figure 29. *Armillaria* mushrooms on young Douglas-fir.

In 2008, three new research plots in will be installed in *Armillaria* root disease infected areas near Mount Adams. Survival of four different conifer species will be tracked in heavily infested areas in an effort to provide options for forest managers when they are dealing with *Armillaria* root disease issues.

Laminated Root Rot (*Phellinus sulphurascens*) (may also be known as *Phellinus weirii*)

Laminated root rot is the most common root disease in Western Washington. It appears to be widespread throughout the range of Douglas-fir. While most conifers are susceptible to laminated root rot, some species are more susceptible than others. Douglas-fir is one of the most susceptible species, while hardwoods are immune. Laminated root rot often increases the water stress of a tree and can predispose larger and older trees to Douglas-fir beetle attack.

Laminated root rot infections can cause mortality in trees of all sizes and ages. When infected trees die or are cut, the fungus may live saprophytically for decades in colonized stumps. If seedlings of susceptible species are planted near previously infected stumps, they are very likely to get infected. The disease incidence will likely increase over time if a diseased site is naturally seeded or replanted with Douglas-fir or other susceptible species.

Figure 30. Delamination of wood, characteristic of laminated root rot.

Figure 31. Brown, crust-like fruiting structures on roots of young Douglas-fir.

Foliar Diseases

Swiss Needle Cast (*Phaeocrytopus gaeumannii*)

Swiss needle cast affects only Douglas-fir and occurs across the Douglas-fir region where climatic conditions are cool and moist. Trees infected by *P. gaeumannii* may exhibit yellowing and browning of infected previous year's needles shortly after current needles emerge. One- and two-year-old needles are lost in summer with needle loss beginning in the bottom of the crown and progressing upward. Severely infected trees may have only current season's needles left in fall. Close examination of infected needles reveals rows of tiny black fruiting bodies (pseudothecia) in the stomatal openings on the underside of the needles. The individual fruiting bodies are black and spherical (up to 0.1mm or 0.004 in diameter) and heavy infections appear as two black streaks on the underside of the needle along each side of the mid-rib.

Fruiting bodies are easily seen with a hand lens.

Surveys have been conducted in western Washington since 1999 to monitor the incidence and severity of Swiss needle cast (Figures 32 and 33).

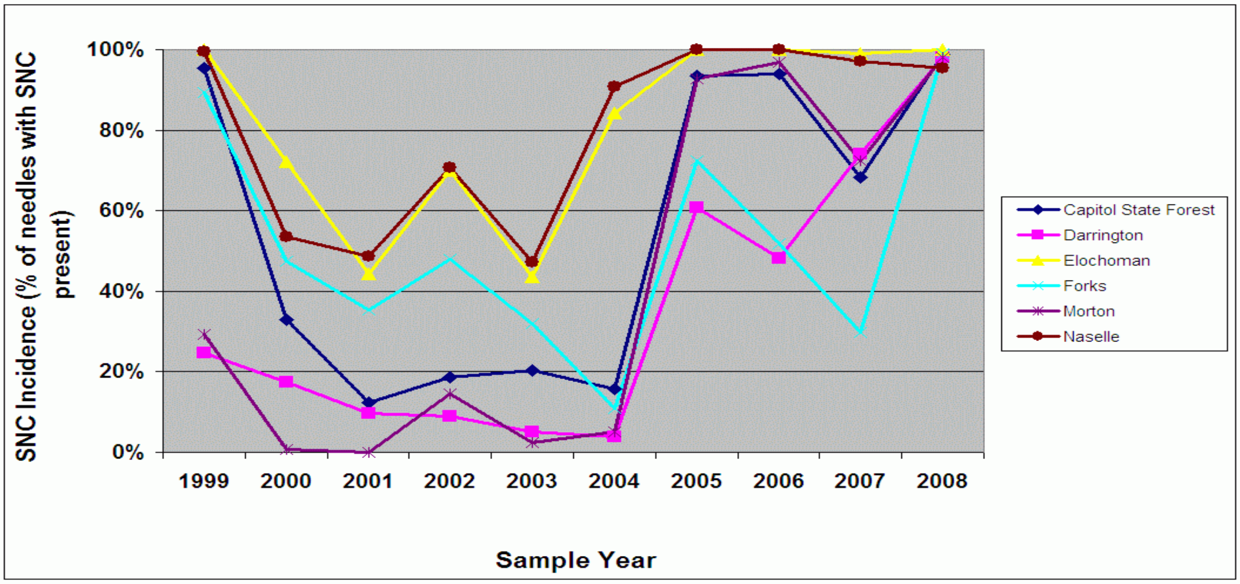

Figure 32. Average percentage of needles infected each year of the Swiss needle cast survey.

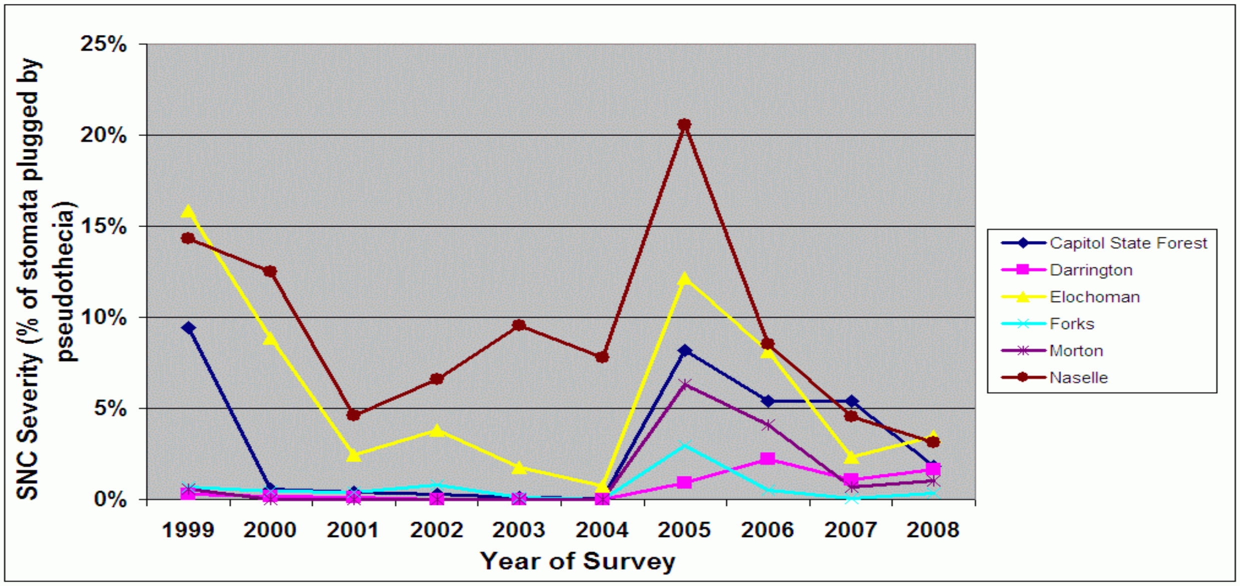

Figure 33. Average percentage of stomata on each needle with perithecia (fruiting bodies).

P. gaeumannii causes growth loss in Douglas-fir and those that are severely infected incur serious economic damage to Douglas-fir growing in plantations and Christmas tree farms. Management strategies include planting trees from local zones and elevations. When conducting thinning and harvesting operations, management should also include replanting of species other than Douglas-fir in severely infected areas. Swiss needle cast can be controlled by using a fungicide in Christmas tree farms, however, fungicides are not recommended operationally in forest environments at this time.

Other Diseases

Sudden Oak Death (*Phytophthora ramorum*) NON-NATIVE

Phytophthora ramorum, the causal agent of Sudden Oak Death (SOD), ramorum leaf blight, and ramorum dieback, is responsible for killing native oak and tanoak trees in California and Oregon. Western Washington is at high risk for SOD due to the presence of known *P. ramorum* hosts in the natural environment, suitable climatic conditions (extended periods of moist weather and mild temperatures), and the presence of nurseries receiving positively identified *P. ramorum* host stock.

While Washington's native oak species (Oregon White Oak) is not threatened by *P. ramorum*, Pacific madrone, maple, cascara, huckleberry, rhododendron, grand fir, and Douglas-fir are some of the susceptible native hosts.

In 2008, eleven aquatic sites in western Washington were monitored for the presence of *P. ramorum* (Fig. 34). Aquatic monitoring is the most sensitive test available to date for detecting *P. ramorum* on a landscape scale.

A positive sample was detected again in the Sammamish River and work continues in order to identify the source of the *P. ramorum* inoculum.

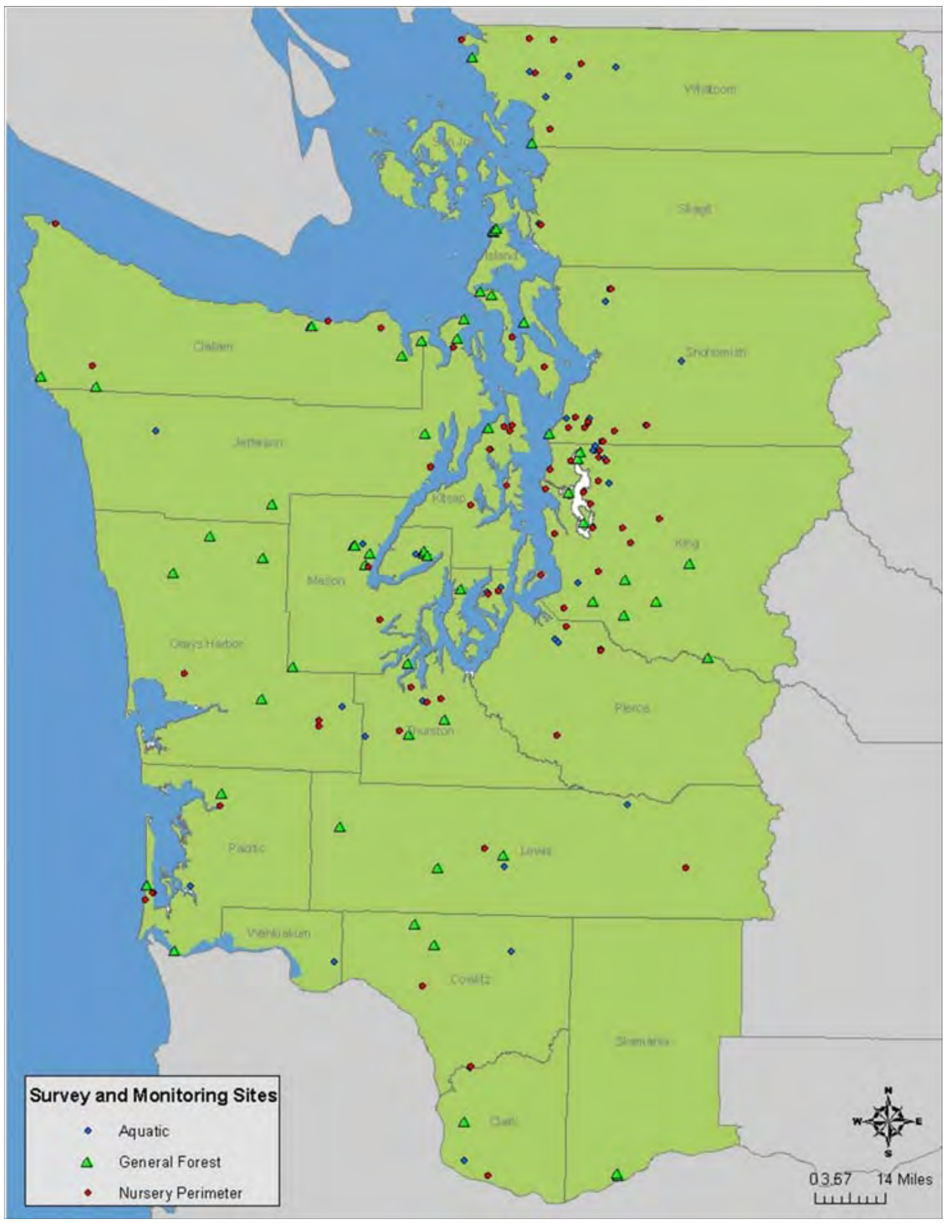

Figure 34. *Phytophthora ramorum* monitoring and sampling sites, 2003 to 2008.

Animals

Bear Damage (*Ursus americanus*) / Root Disease

While conducting the aerial survey, groups of similar, pole sized, newly dead trees are assigned the attribute "Bear Damage". Based on ground checking observations, this code should really be thought of as a complex of bear girdling, root disease, drought stress, and mountain beaver girdling. Bear feeding activity is likely still the primary mortality agent even though most areas contain at least some root disease, and sometimes root disease is the sole agent. Particularly heavy "bear damage" mortality was observed from Grays Harbor north to Neah Bay (Fig. 3).

Figure 35. Black bears damage trees during the spring by peeling the bark and eating the cambium.

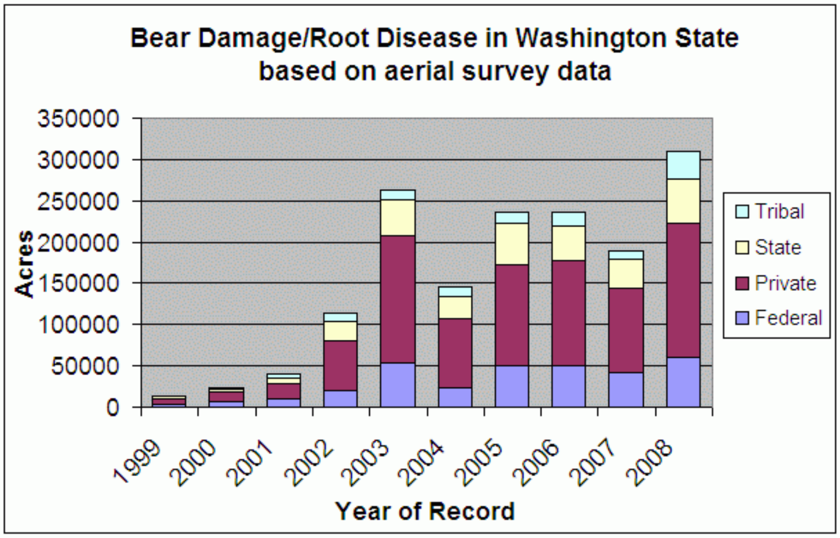

Figure 36. Ten year trend for acres affected by bear damage in Washington.

Nearly 310,000 acres of elevated mortality were recorded during the 2008 aerial survey making it one of the most active years on record.

- 2007: 184,000
- 2006: 236,000
- 2005: 233,500
- 2004: 145,000

Abiotic Damage

Wind

An extratropical cyclone of unusual magnitude occurred December 1-3, 2007. This was actually two storms over a three day period with heavy rain and wind gusts of up to 145 mph. It caused widespread windthrow along coastal areas. The Grays Harbor and Willapa Bay areas were the most severely impacted. The regular survey captured nearly 25,000 acres of windthrow. In addition, DNR conducted a special survey in March specifically for this event and recorded 29,000 acres of windthrow. Much of this damage was salvage logged as soon as possible and was likely cleaned up prior to the regular aerial survey. Morover, both surveys likely under reported the true extent of the event since in many areas the blowdown was “hidden” from aerial viewers by surviving overstory. Western hemlock was the most severely affected as they are shallow rooted and often infected with root disease. Damage was greatest along the edges of recently harvested areas and in riparian no cut zones which typically involved a great deal of red alder. Read the full report at: http://www.dnr.wa.gov/Publications/rp_fh_2008_blowdownreport.pdf

Figure 37. Area of heavy windthrow caused by the December 2007 storms.

Aerial Survey

The aerial survey is flown at 90-120 mph about 1,500 feet above ground level. Two observers (one on each side of the plane) look out over two-mile swaths of forestland and mark either on a digital touch screen or a paper map any recently killed or defoliated trees they see. They then code the agent that likely caused the damage (inferred from the size and species of trees and the pattern or “signature” of the damage) and the number of trees affected. No photos are taken. Observers can ask the pilot to turn the plane around and go back if they are having difficulty identifying damage, but usually there isn’t much time for second-guessing or second chances. It is very challenging to accurately identify and record damage observations at this large scale and errors occur. Sometimes the wrong pest is identified. Sometimes the mark on the map is off target. Sometimes damage is missed. The goal is to correctly identify and accurately map within ¼ mile of the actual location at least 70% of the time.

On the other hand, the program obtains increasingly helpful background imagery for the automated system. Newer satellite photography showing recent management activity allows for a more accurate placement of damage. In addition, aerial observers are familiar with forestry and forest pests and are trained to recognize various pest signatures. There is always at least one observer in the plane who has three or more years of sketchmapping experience.

Each damage area (polygon) is assigned a code for the damage agent. These codes are defined in the legend of the aerial survey maps. The agent code is followed by number of trees affected; number of trees per acre affected; or intensity of damage (L-Light, M-Moderate, H-Heavy). If more than one agent is present in a polygon, codes are separated by an exclamation point (!). When interpreting data and maps, do not assume that the mortality agent polygons indicate total mortality within the area. Depending on the agent code modifier, only a small proportion of trees in the polygon may be recently killed.

Data and Services

Aerial survey is highly cost effective for the amount of data collected. These maps are great tools for a quick look at what might be going on in specific areas, and they produce excellent trend information and historical data.

Digital information: The digital download site has changed and is now a nationwide geospatial portal. Customers can still download and print out draft survey maps almost as soon as they are flown, but now you request the digital file, which is then packaged and sent to your email address as an attachment.

Go to: http://svinetfc8.fs.fed.us/aerialsurvey/Default.aspx?tabid=31 and click on the map you want to obtain. For cartographers and GIS users, we offer these data sets, as well as historical data, trend analysis, and summary statistics electronically, go to: http://www.dnr.wa.gov/BusinessPermits/Topics/Data/Pages/gis_data_center.aspx. This information is also available as far back as 1980 for Oregon and Washington, go to: http://www.fs.fed.us/r6/nr/fid/data.shtml. Most digital data are usually sent within a few minutes.

In addition, cooperative annual highlights reports are available on-line, go to: http://www.dnr.wa.gov/ResearchScience/Topics/ForestHealthEcology/Pages/rp_foresthealth.aspx. This site will be updated annually with the latest information on exotic pest problems, insect and disease outbreaks and recent trend information for Oregon and Washington. Major insect and disease identification and management information, resulting damage illustrations, and graphical trend analysis of Washington's various forest health issues also are included.

A great new reference publication produced by the US Forest Service Northwest Region, "Field Guide to Diseases and Insect Pests of Oregon and Washington Conifers", is now available. Obtain a copy by calling toll free at (866) 720-6382 or go to: http://bookstore.gpo.gov/actions/GetPublication?stocknumber=001-000-04731-1

Contacts and Additional Information

Department of Natural Resources - Forest Health Program

Karen Ripley
Forest Health Program Manager
(360) 902-1691
karen.ripley@dnr.wa.gov

Mike Johnson
Forest Health Specialist (Eastern WA)
(509) 684-7474
mike.johnson@dnr.wa.gov

Glenn Kohler
Forest Entomologist (Olympia)
(360) 902-1342
glenn.kohler@dnr.wa.gov

Dan Omdal
Forest Pathologist
(360) 902-1692
dan.omdal@dnr.wa.gov

Amy Ramsey
Forest Pathologist
(360) 902-1309
amy.ramsey@dnr.wa.gov

Jeff Moore
Agricultural Research Technologist III
(360) 902-1320
jeff.moore@dnr.wa.gov