2006 WASHINGTON FOREST HEALTH HIGHLIGHTS
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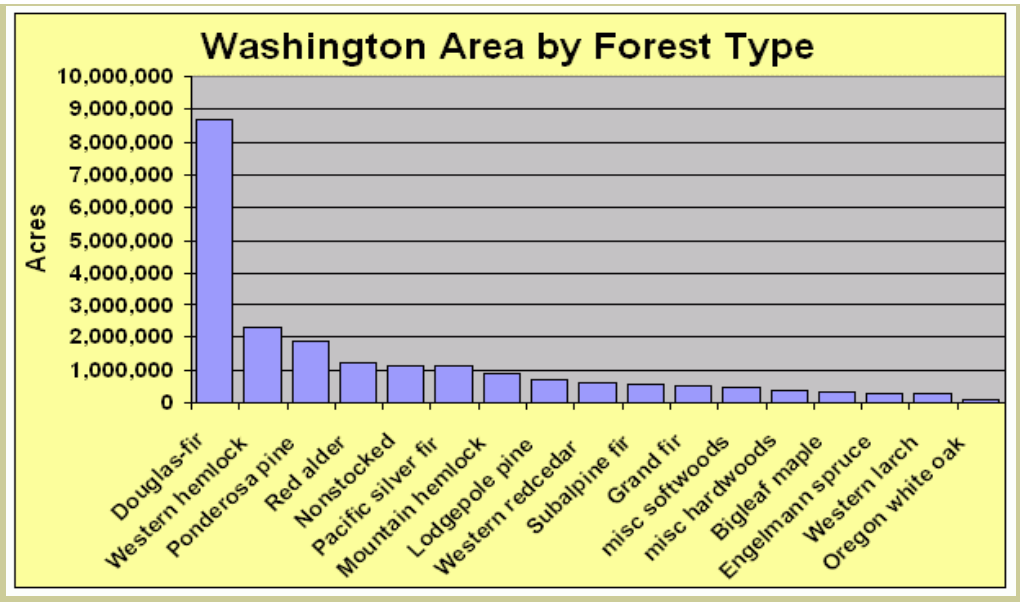
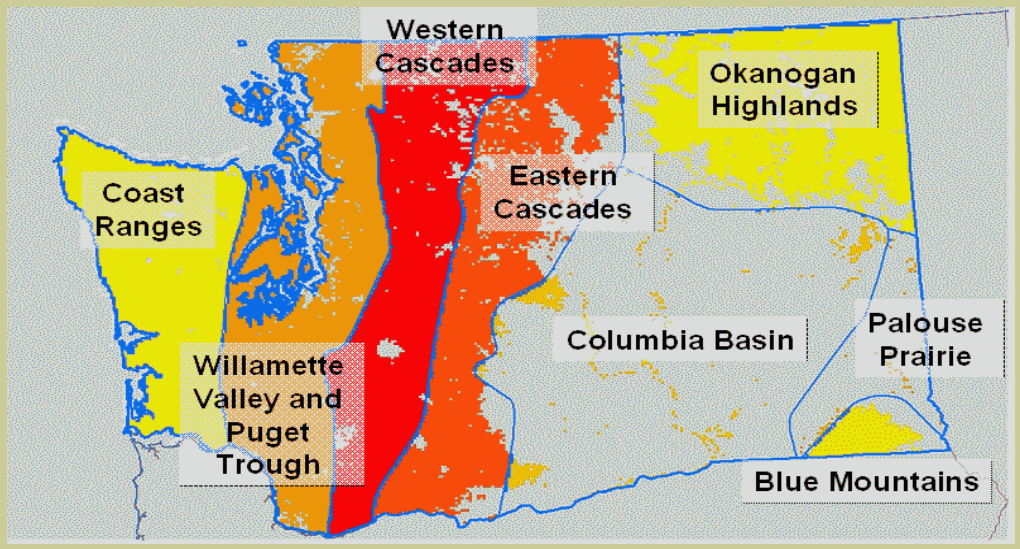
General Forest Conditions

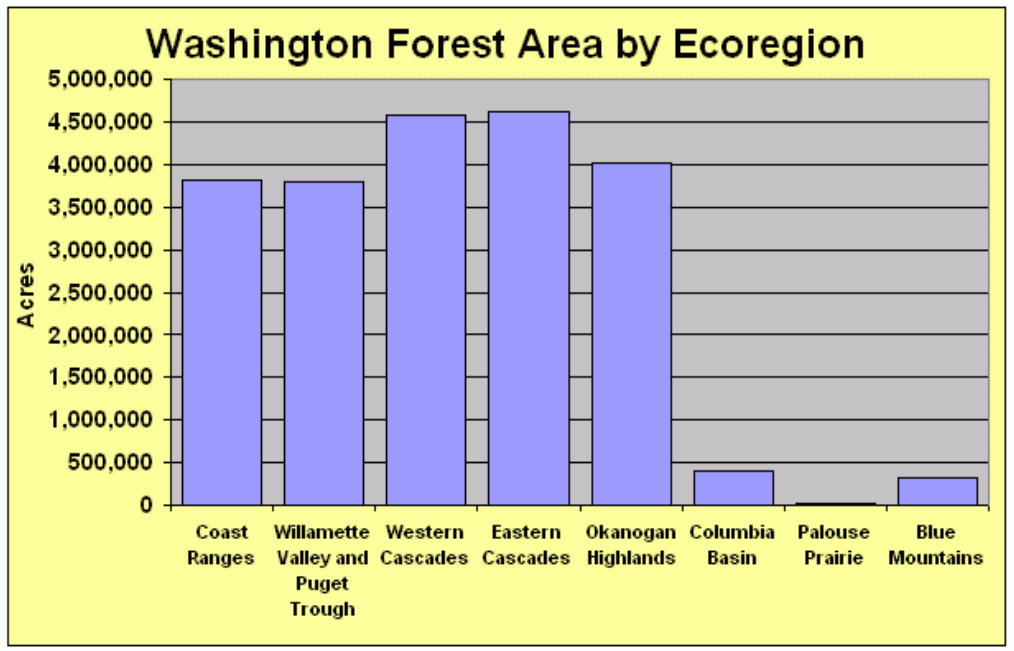
The USDA Forest Service Forest Inventory and Analysis (FIA) program measures and monitors Washington's forests for current forest condition, growth, and trends. They remeasure a portion of a statewide grid of permanent plots annually. They also analyze remotely sensed data such as aerial photographs.

FIA information indicates that Washington has approximately 22 million acres of forest land which are mostly dominated by conifer species such as Douglas-fir, western hemlock and ponderosa pine. Red alder, big leaf maple and cottonwood are the most prevalent broadleaf species. Forests are classified by "forest type" named for the dominant tree on the site.

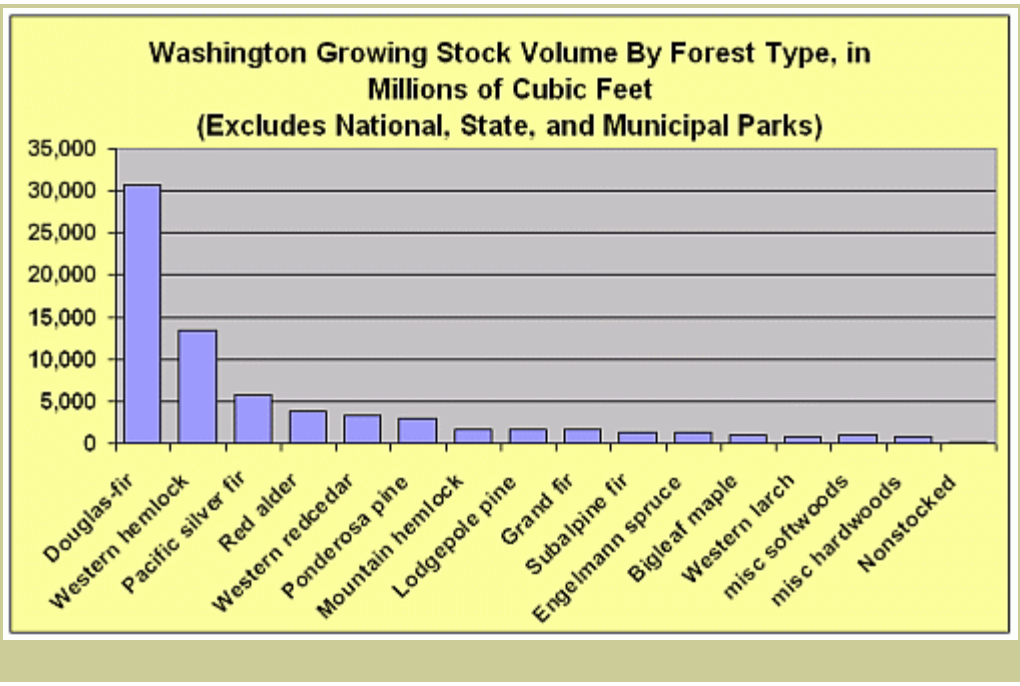


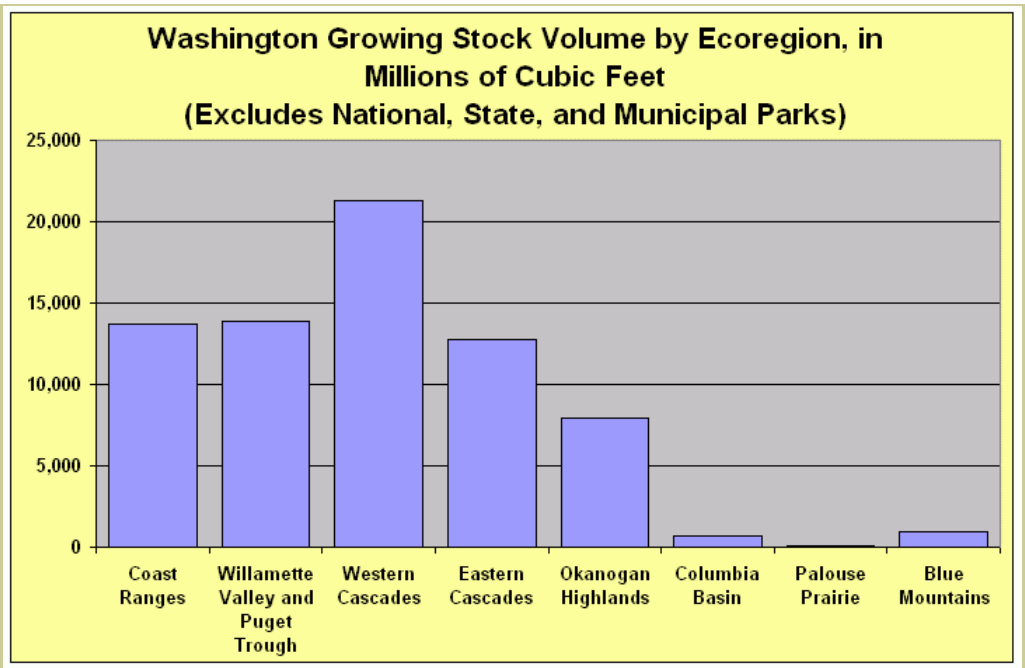
Map of Washington's Eco-Regions





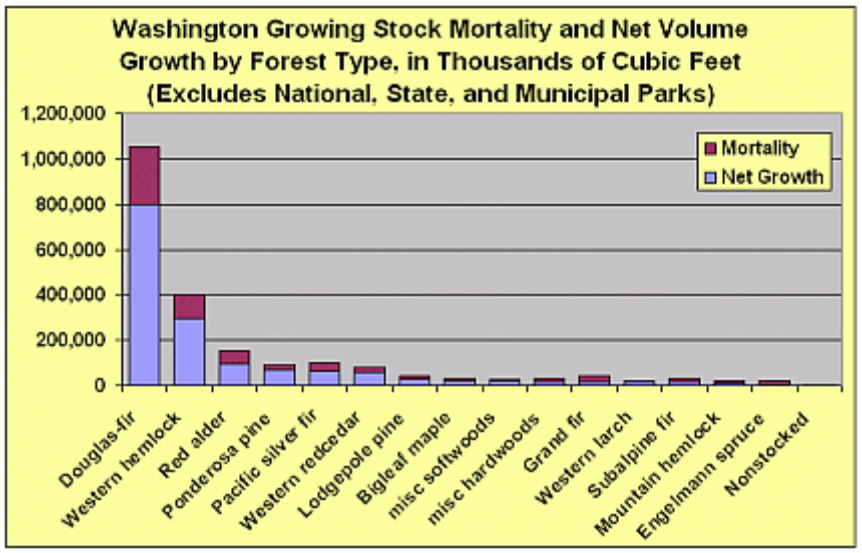
In addition to the number of acres covered, forests are also measured by the volume of wood present. A "cubic foot" of wood represents a piece of wood that is one foot tall, one foot wide, and one foot thick. For example, an eight-inch diameter log that is ten feet long contains about 3.5 cubic feet of wood.

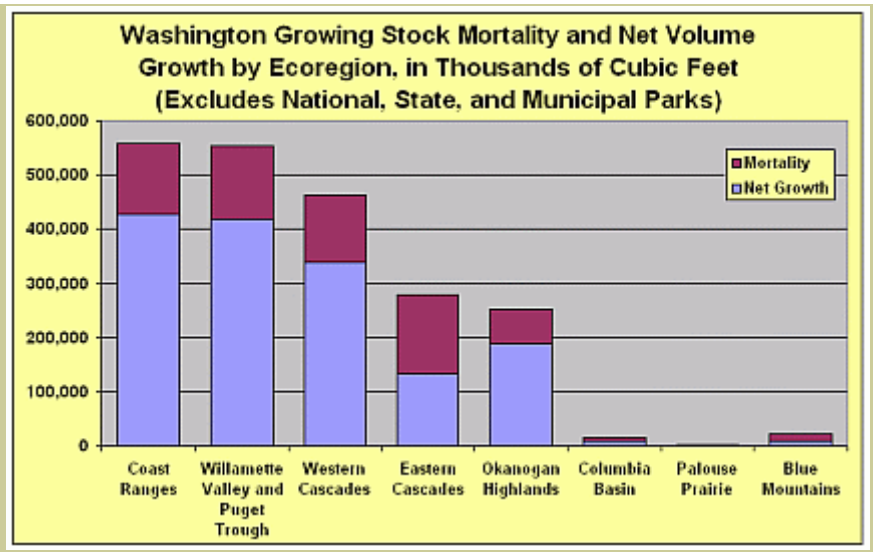




The live trees in Washington's forests total approximately 72,256 million cubic feet of wood. Sixty percent of this wood is Douglas-fir (29,514 million cubic feet, 40.8%) and western hemlock (13,904 cubic feet, 19.2%). The major eastern Washington conifers are ponderosa pine, grand fir and western larch. The relatively dry eastern Washington forests contain much less wood because they have fewer, smaller trees and cover less land area.

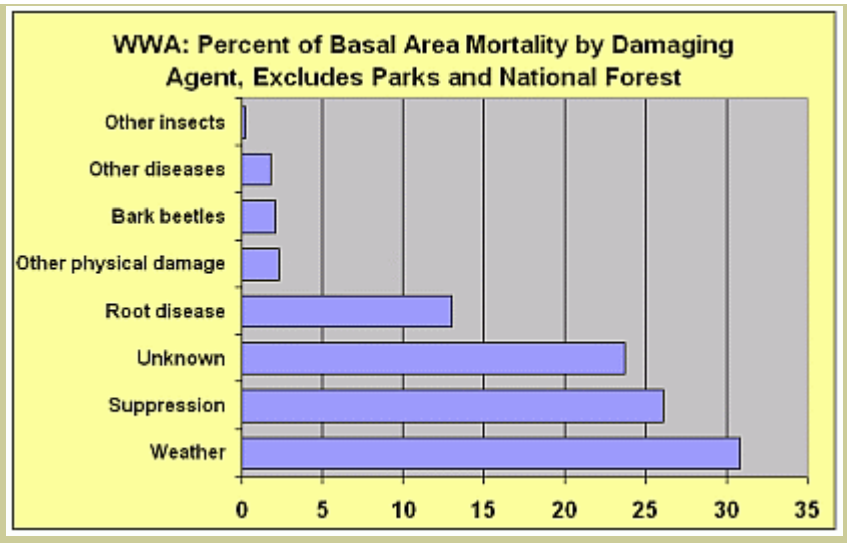
Forest Mortality: As most forest trees continue to grow, a few also die. The ratio of mortality (death) to growth provides information on whether forests are increasing or decreasing in different ways. If growth is greater than mortality then this ratio is greater than one and the forest volume is increasing. If growth equals mortality then this ratio equals one, and the forest volume is unchanged. If mortality is greater than growth then this ratio is less than one, more trees are dying and the forest live volume is decreasing.

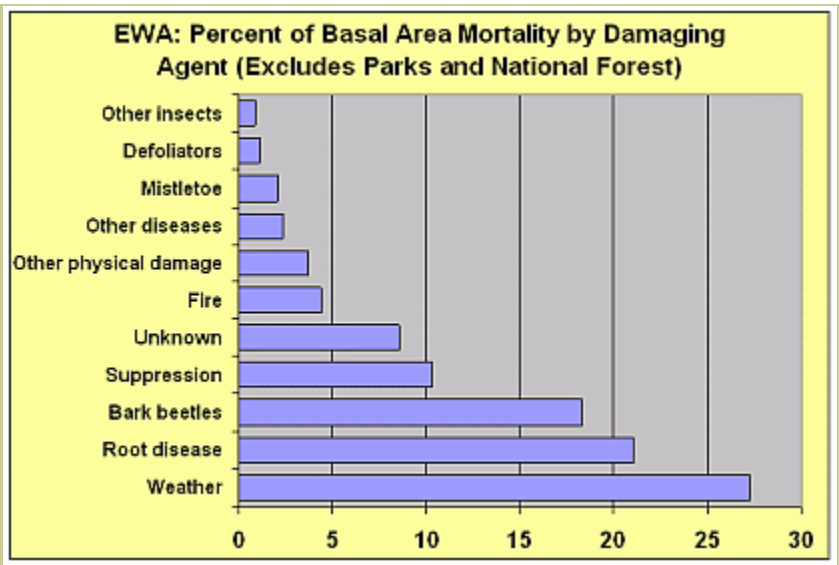




FIA data indicate that some forest types are increasing in volume and some are declining. The average ratio of mortality to net growth in Washington, outside national, state, and municipal parks is 2.68, indicating that growth is more than twice as large as mortality. In Douglas-fir, western hemlock, western red cedar and big leaf maple forests, growth is about four times mortality. Lodgepole pine, grand fir and mountain hemlock forests have growth that is about equal to mortality. Mortality exceeds growth in Engelmann spruce and subalpine fir forests.

In addition to those removed by logging and land clearing, trees are also killed by insects, diseases, fire, wind and a variety of other agents. In western Washington, when the cause of death could be determined, it was most often attributed to physical damage or fire, weather damage, and root disease. In eastern Washington trees were most often killed by physical damage or fire, bark beetles, and root disease.





Land Conversion: Changing forest land to non-forest uses such as urbanization is of great concern in Washington. Recent FIA measurements provide the following conversion estimates. They indicate that forest land conversion rates were higher in the 1990's than the 1980's and that private timberland is being converted at a higher rate than public lands.

Conversion Estimates	1980-1990	1990-2001
Percent of private timberland converted to nonforest:	2.83	3.28
Percent of non-National Forest converted to nonforest:	1.87	2.12
Percent of all forestland converted to nonforest:	1.19	1.33

Laws and policies limit the sale or reduction of the state and federal forest land base so the number of publicly owned forested acres tends to remain fairly constant. Some categories of forest land are adjusted when general forest is shifted to preserved status, but the forest condition itself persists.

In Washington, there have been major changes in the pattern of private forest land ownership in recent years as large timber companies have sold large tracts of land to small private landowners. This can result in a loss of forest land to roads and development, reduced timber production, wildlife habitat fragmentation, and increased cost for landowner services such as road maintenance and fire protection. Small privately owned forest lands are considered most at risk of conversion to non-forest uses such as development because of their proximity to existing urban areas, popularity of woodland home sites, and diversity of owner objectives. Additional information will be available as the patterns are measured in future years.

For more information go to: http://www.treesearch.fs.fed.us/pubs/9865

2006 Survey Results

Washington has about 21 million acres of forestland. In 2006, almost 2 million acres of this land contained elevated levels of tree mortality, tree defoliation or foliar diseases. This is a substantial decrease from 2005 which had over 2.5 million acres with mapped damage and is similar to 2004 and 2003 which each had about 1.9 million acres of forestland affected.

- Almost 4 million trees were recorded as recently killed. This is just over half of the 7.3 million trees recorded as recently killed in 2005, but still up from prior years when 3.0 and 1.8 million trees were recorded in 2004 and 2003, respectively.

- Western spruce budworm activity showed another dramatic increase in activity along the eastern slopes of the North Cascades, most notably in Chelan and Okanogan counties. Numerous small "hotspots" were mapped in many areas of Northeastern Washington for the first time in many years.
- Mountain pine beetle activity continues at epidemic levels along the eastern slopes of the Cascades although the number of trees killed has gone down from last year. This, at least temporarily, breaks the steady rise of pine beetle activity over the past several years. Pine bark beetle populations continue to rise throughout Northeastern Washington, and activity in high elevation whitebark pine continues to increase.

Aerial Survey Overview

The Washington Department of Natural Resources and USDA Forest Service strive to help landowners identify and manage forest insect and disease problems.

An annual, aerial sketch mapping survey is the key to monitoring forest insect and disease activity levels across the state. The survey is flown at 90-130 mph, about 1,500 feet above ground level. In recent years we have incorporated a new digital system utilizing GPS linkup with touch screens for recording damage. We have been consistently incorporating newer and better satellite imagery as well.

Two observers (one on each side of the plane) look out over a two-mile swath of forestland and mark either on a digital touch screen or on a paper map groups of recently killed or defoliated trees.

They then record a code for the agent that likely caused the damage (usually inferred from the size and species of trees and the pattern or "signature" of the damage) and the number of trees affected. Usually not every tree in the indicated area is affected or killed. No photos are taken.

The results are then made available to interested landowners as maps, electronic data, and summary reports. Covering nearly all of Washington's forests with the aerial survey costs only about 1/3 of a cent per acre (that's three acres for a penny!).

Here is the breakdown of the acres flown during the survey in 2006:

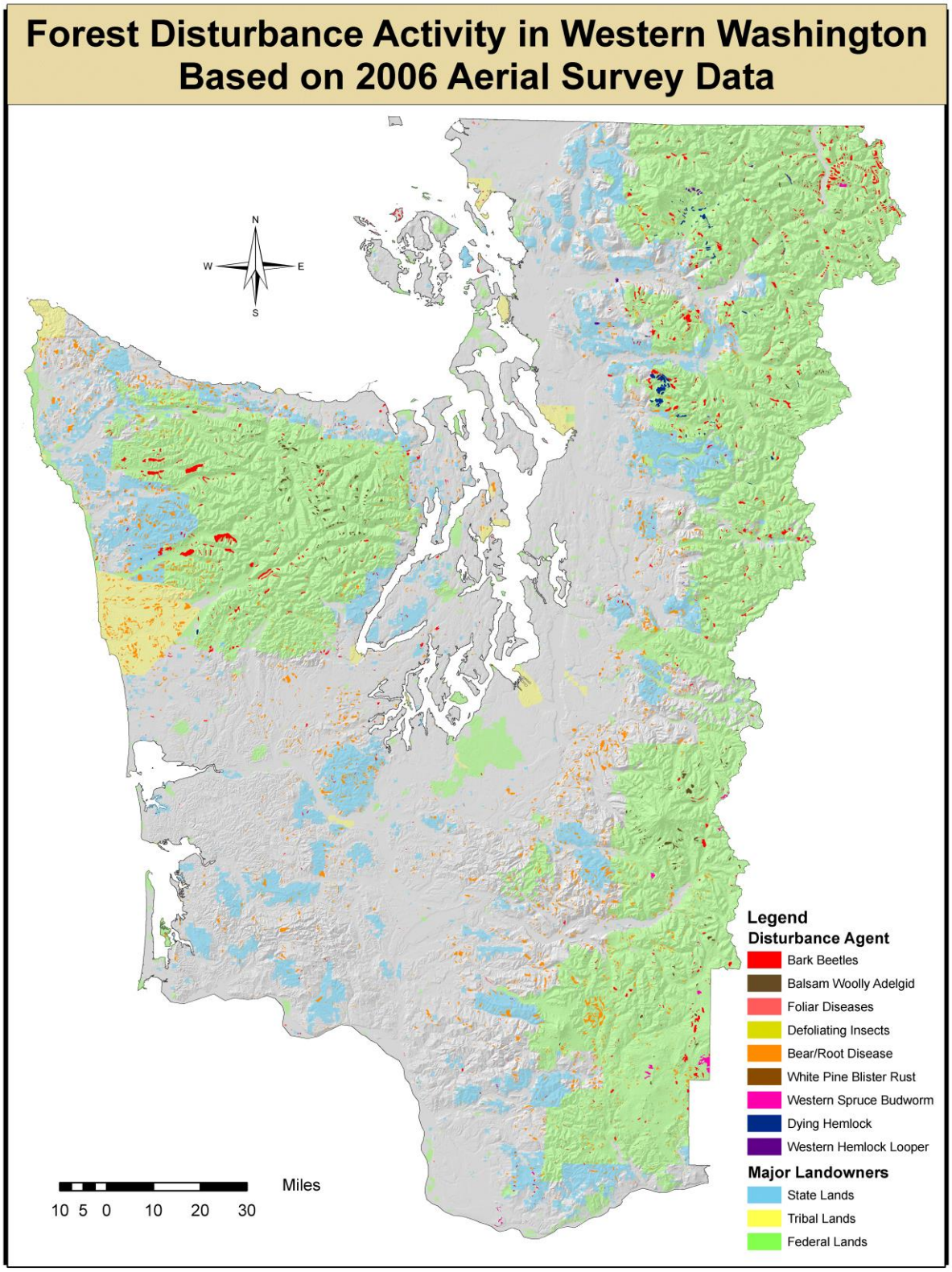
- Federal =9,488,642
- Tribal = 1,570,955
- State = 2,128,965
- Private = 7,015,755
- Washington total = 20,204,317

These maps and reports produce excellent trend information and historical data. Moreover, they represent a great tool for a quick look at what could be going on in your neck of the woods.

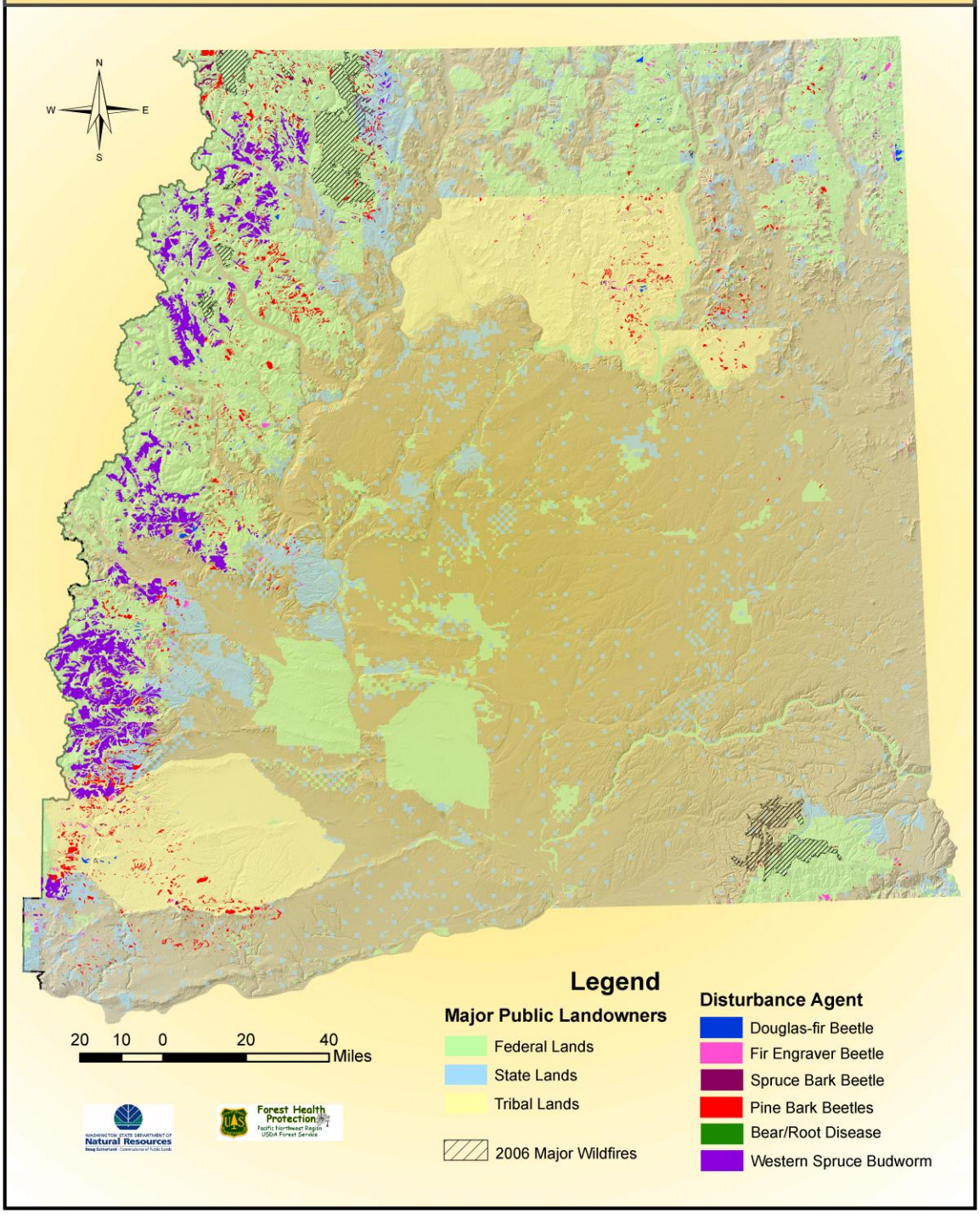
Survey maps are now available almost as soon as they are flown! Just go to: http://www.fs.fed.us/r6/nr/fid/as/quad06/index.shtml and click on the map you want to view. These pages can take one to several minutes (depending on your connection speed) to load because they are memory intensive. From there you can plot out the entire map or you can zoom in and view an area of particular interest. This resource can provide timely information for pest evaluations and forest management work.

For cartographers or GIS users, this data set is available at: http://www.fs.fed.us/r6/nr/fid/as/index.shtml

It is also available for employees of the Department of Natural Resources via our Citrix Quick Data Loader under Forest Disturbance.



Forest Disturbance Activity in Eastern Washington Based on 2006 Aerial Survey Data



Historical data going back to 1980 are also available on request.

NEW PUBLICATION An new **Field Guide to the Common Diseases and Insect Pests of Oregon and Washington Conifers**, produced by the US Forest Service Pacific Northwest Region, is now available. It is a comprehensive guide full of superb color photos. Search for: Goheen, E.M. and E.A. Willhite. 2006. Field Guide to Common Diseases and Insect Pests of Oregon and Washington Conifers. R6-NR-FID-PR-01-06. USDA Forest Service, Pacific Northwest Region. 327 pages.

Forest Susceptibility

Several key factors influence forest susceptibility to insects and diseases:

- Mild winter temperatures enhance insect pest overwintering success.
- Droughty summer conditions stress host trees and make them more susceptible to pathogens.
- Outbreak populations of insect pests already occur throughout much of Eastern Washington.
- Stand stocking levels need to balance site conditions. Overcrowded forests are more vulnerable to damage.
- Tree species composition should favor drought tolerant pine and larch rather than Douglas-fir and true fir.

Predicted forest disturbance trends:

- Forests in Eastern Washington are generally overstocked with too much fir and not enough drought tolerant pine, due primarily to past harvesting practices and fire exclusion.
- The absence of severe winter weather increases the survival rate of insect pests.
- Repeated summer droughty conditions the last several years 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.

Disclaimer

Aerial observers are familiar with forest trees, insects and diseases. They are trained to recognize various pest signatures. There is always at least one observer in the plane who has three or more years of sketch mapping experience. However, it is very challenging to quickly and accurately identify and record damage observations. Aerial survey does not allow much time for second-guessing or second chances. Mistakes occur. Sometimes the wrong pest is identified. Sometimes the mark on the map is off target. Sometimes damage is missed. Our goal is to correctly identify and accurately map within ¼ mile of the actual location at least 70% of the time. Ground checking and landowner feedback generally indicate excellent success at detecting major occurrences of insect and disease activity. Please provide us feedback if you encounter errors or have problems obtaining the maps or data.

Diseases

Sudden Oak Death (SOD)
Phytophthora ramorum

***Phytophthora ramorum* (*P. 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.**

Phytophthora ramorum was found in 25 western Washington nurseries in 2004, 16 nurseries in 2005, and 12 nurseries in 2006. This organism was brought to the Washington nurseries on plants (mostly camellia,

rhododendron, pieris, and viburnum) shipped from other states. The infected plants within the nurseries were destroyed to prevent further spread of the organism.

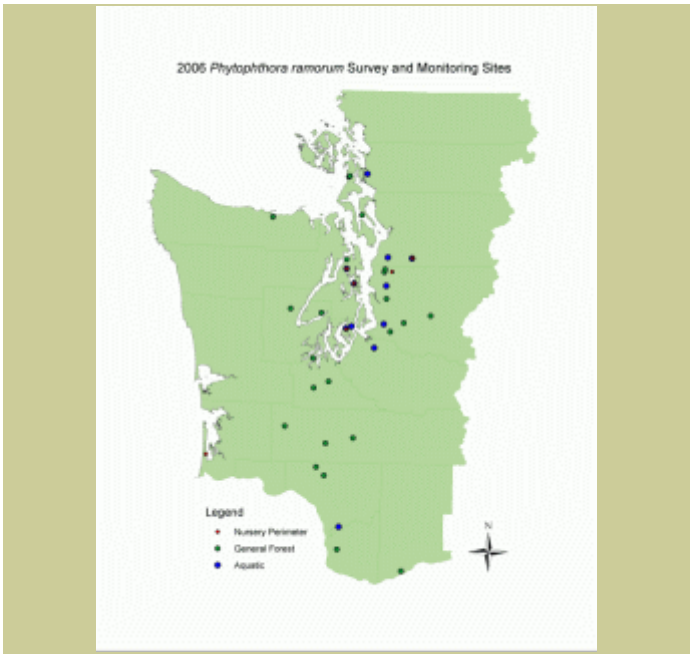
As more is learned about this pathogen, the list of hosts susceptible to the disease continues to grow. Sudden Oak Death suggests that the disease primarily affects oak trees, however, our only native oak species, Oregon white oak, is not highly susceptible. Native plant species in Washington that are hosts of *P. ramorum* include, but are not limited to:

- rhododendron
- big leaf maple
- vine maple
- Douglas-fir
- grand fir
- Pacific yew
- cascara
- evergreen huckleberry
- Pacific madrone
- manzanita
- Woods' rose
- maidenhair fern
- salmonberry
- poison oak
- Oregon ash
- pink honeysuckle
- false Solomon's seal
- California hazelnut
- American cranberry
- California wood fern

For a complete host list go to: http://www.aphis.usda.gov/plant_health/

For SOD Photos go to:http://www.wadnr.gov:81/htdocs/rp/forhealth/2006highlights/sodhostphotos.pdf

Shoot die-back on Douglas-fir caused by *Phytophthora ramorum* on Douglas-fir in California. Notice how it looks much like frost damage.



Surveys were conducted in 2003, 2004, 2005 and 2006 to try and detect this exotic pathogen in Western Washington. Susceptible and potential host plant materials were examined around the perimeters of nurseries, in state parks, national forests, and general forested areas. In 2005 and 2006, aquatic monitoring plots were established to try and detect *P. ramorum* in flowing waters.

Since 2003, 100 nursery perimeters, 79 general forest, and 21 aquatic areas have been surveyed by DNR. A total of 1,071 susceptible and potential host plant material samples were collected and sent to the Washington State Department of Agriculture's plant pathology laboratory for analysis.

In January 2006, *P. ramorum* was found outside of one Washington nursery. The nursery previously contained positive *P. ramorum* plant stock and pest eradication efforts had been taken. However, the

pathogen still spread outside of the nursery through movement in stream water. Monitoring and detection surveys for this pathogen have been underway in efforts to prevent its spread outside of the stream.

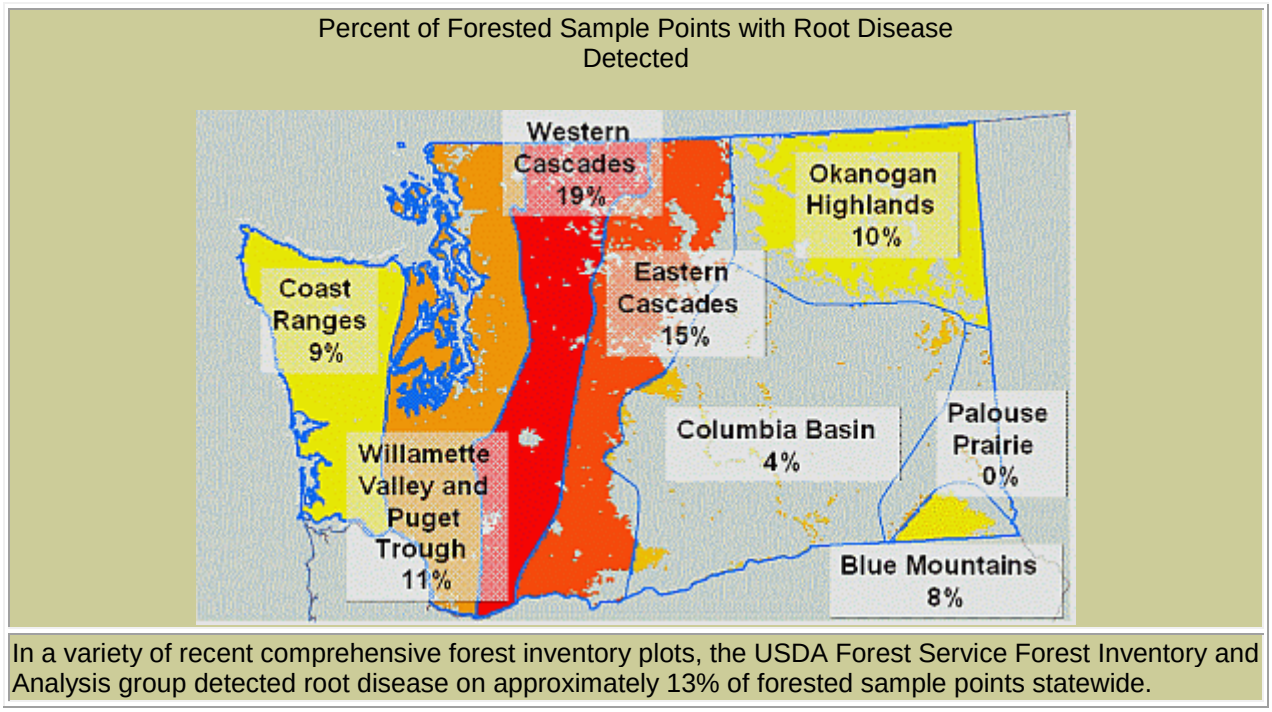
Until 2006, *P. ramorum* had not been detected in DNR surveys and has not been detected since. Monitoring of *P. ramorum* continues throughout Western Washington.

For additional information go to this website http://www.fs.fed.us/r6/nr/fid/widweb/wid-rd.shtml#rd-7

Root Disease

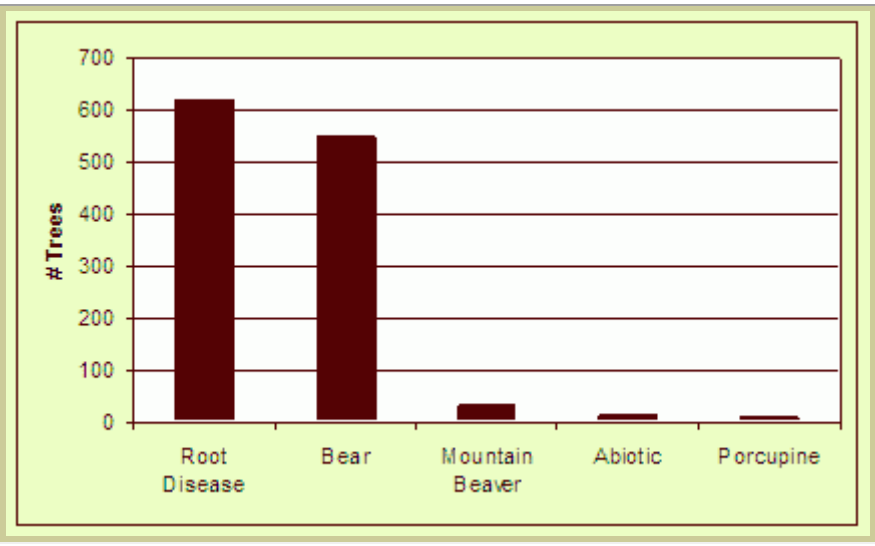
Root diseases, caused by fungi that eat the roots of living trees, are an important forest health problem in Washington. They kill trees, slow tree growth and can persist to infect new trees until decaying roots and stumps rot away. Often, affected trees tend to blow over before they die. The most important root diseases in Washington are laminated root rot (*Phellinus weirii*), Armillaria root disease (*Armillaria ostoyae*), and Annosum root and butt rot (*Heterobasidion annosum*).

Root diseases can be difficult to identify because they are underground or inside the tree's tissues. Damage can develop over a long period of time, mimicking other causal agents such as drought or other types of root injury.



In a variety of recent comprehensive forest inventory plots, the USDA Forest Service Forest Inventory and Analysis group detected root disease on approximately 13% of forested sample points statewide.

In 2004, a DNR ground survey of sites with scattered dead trees attributed in the aerial survey to "Bear Damage" revealed that 46% actually had root disease as the primary tree killer.



1,223 trees were examined in 2004. Primary mortality agents were fungi and bears.

Annosum root and butt rot (*Heterobasidion annosum*) Study

In 2004, the DNR began investigating the *Heterobasidion annosum* infections levels in fresh hemlock stumps on the Olympic Peninsula. The stumps were inspected immediately following stand thinning and the following infection rates were found:

- 83.3% with Annosum root and butt rot (186 stumps)
- 17.7% without Annosum root and butt rot (40 stumps)

The fresh stumps were treated with borax, a chemical used to prevent new *Heterobasidion annosum* infections. The hemlock stumps without *H. annosum* in 2004 (40 stumps) were re-inspected in 2006 to determine the effectiveness of the borax treatment. The following infection rates were found:

- 25% with Annosum root and butt rot (10 stumps)
- 75% without Annosum root and butt rot (30 stumps)

Western hemlock stand used in study

Treatment of freshly cut stump with borax to try and prevent new infections	
	Stump with *Heterobasidion annosum* caused decay

For more information go to http://www.fs.fed.us/r6/nr/fid/pubsweb/rootdiseases.shtml

Dwarf Mistletoe (*Arceuthobium spp.)*

Dwarf mistletoes are parasitic plants that grow on Washington conifer trees. They slow tree growth, cause conspicuous growth deformities called witches brooms, and can kill trees. Some birds and animals use dwarf mistletoe plants and seeds for food or nest in the brooms. Dwarf mistletoe plants spread by emitting seeds that fall onto other hosts or are incidentally carried from tree to tree by birds and small mammals. The infections are slow to develop, but are very persistent. Aerial survey does not detect dwarf mistletoe infections or impacts. In recent years a variety of USDA Forest Service Forest Inventory and Analysis (FIA) projects have used ground surveys to assess dwarf mistletoe infection levels.

Eastern Washington has several dwarf mistletoe species that are quite host specific. Western dwarf mistletoe (*Arceuthobium campylopodum*) infects ponderosa and lodgepole pine. Lodgepole pine dwarf mistletoe (*Arceuthobium americanum*) infects only lodgepole pine. Douglas-fir dwarf mistletoe (*Arceuthobium douglasii*) infects only Douglas-fir. Larch dwarf mistletoe (*Arceuthobium laricis*) infects western larch, subalpine fir and several other conifers.

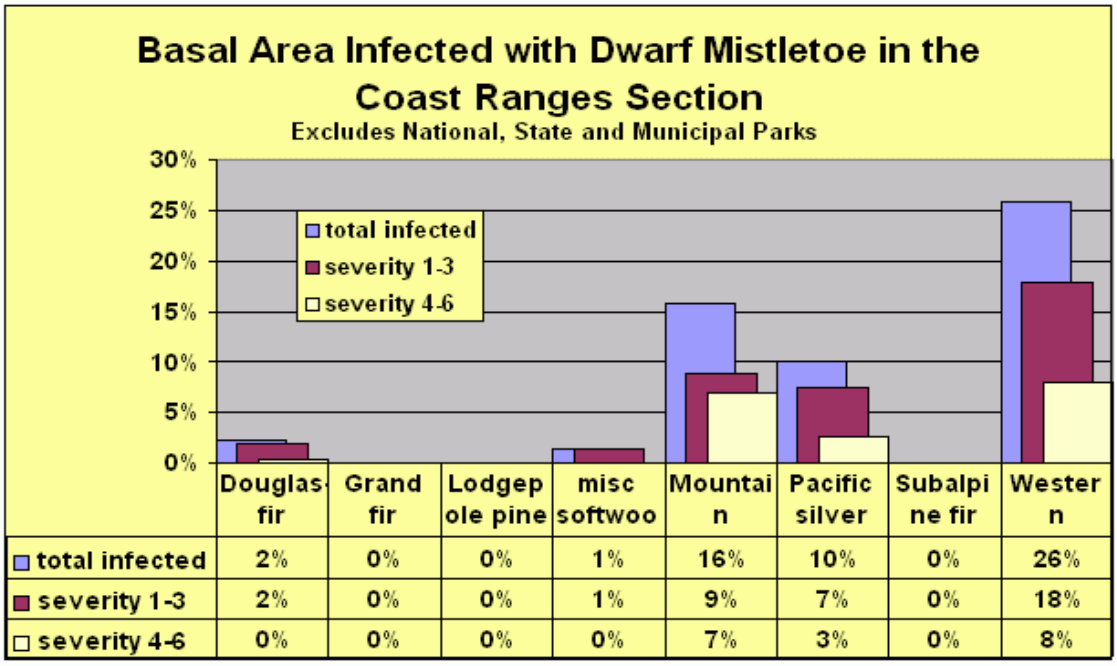
This young ponderosa pine is so infected with dwarf mistletoe that it will likely not live long

Notice the dwarf mistletoe induced witches brooms on this mature hemlock

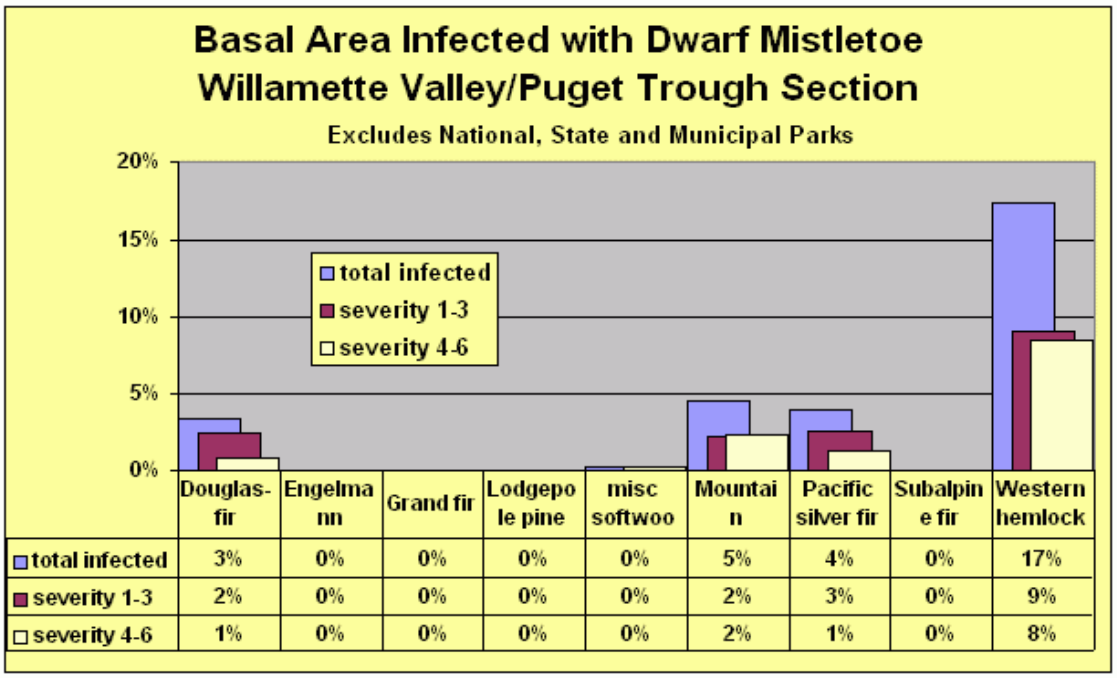
There is just one species of dwarf mistletoe in western Washington, the hemlock dwarf mistletoe (*Arceuthobium tsugense*) which infects western and mountain hemlock; Pacific silver, subalpine and noble firs; coastal lodgepole, western white and whitebark pine.

FIA data indicate that approximately 26% of the western hemlock basal area in the Coast Range is dwarf mistletoe infected, 22% of the western hemlock basal area in the Western Cascade Ecoregion is infected, and 17 % of the western hemlock basal area in the Puget Trough is infected. On state and private forest lands, these may be lower than historic levels because much of the oldest hemlock where dwarf mistletoe infections would have been well-established has been harvested.

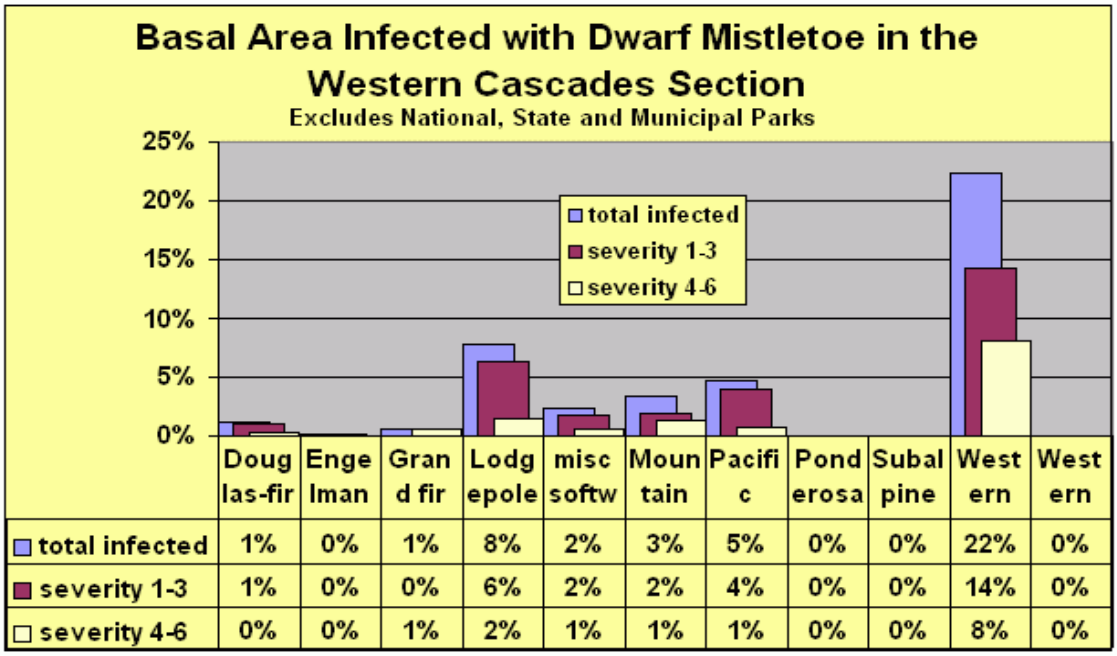
FIA has identified very high levels of dwarf mistletoe infection in Douglas-fir, ponderosa pine, and western larch in the Columbia Basin Ecoregion where approximately 30 to 40% of the basal area of these species are infected. High infection levels are also observed in the Eastern Cascades Ecoregion where approximately 20-28% of the basal area of western larch, lodgepole pine and Douglas-fir are dwarf mistletoe infected. In eastern Washington forests, dwarf mistletoes are likely much more prevalent than was historically normal because of selective harvesting practices that left mistletoe infected trees on the landscape and because of the reduction in low severity fires that naturally kept trees less crowded and killed highly flammable dwarf mistletoe infected trees.



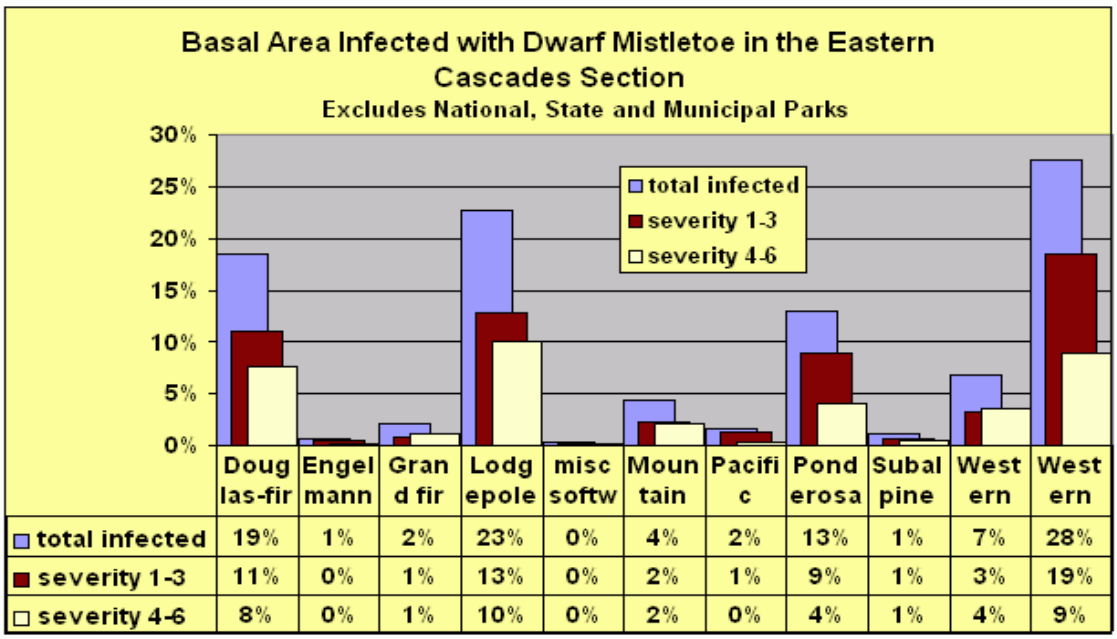
	Douglas-fir	Grand fir	Lodgepole pine	misc softwoo	Mountain	Pacific silver	Subalpine fir	Western
total infected	2%	0%	0%	1%	16%	10%	0%	26%
severity 1-3	2%	0%	0%	1%	9%	7%	0%	18%
severity 4-6	0%	0%	0%	0%	7%	3%	0%	8%



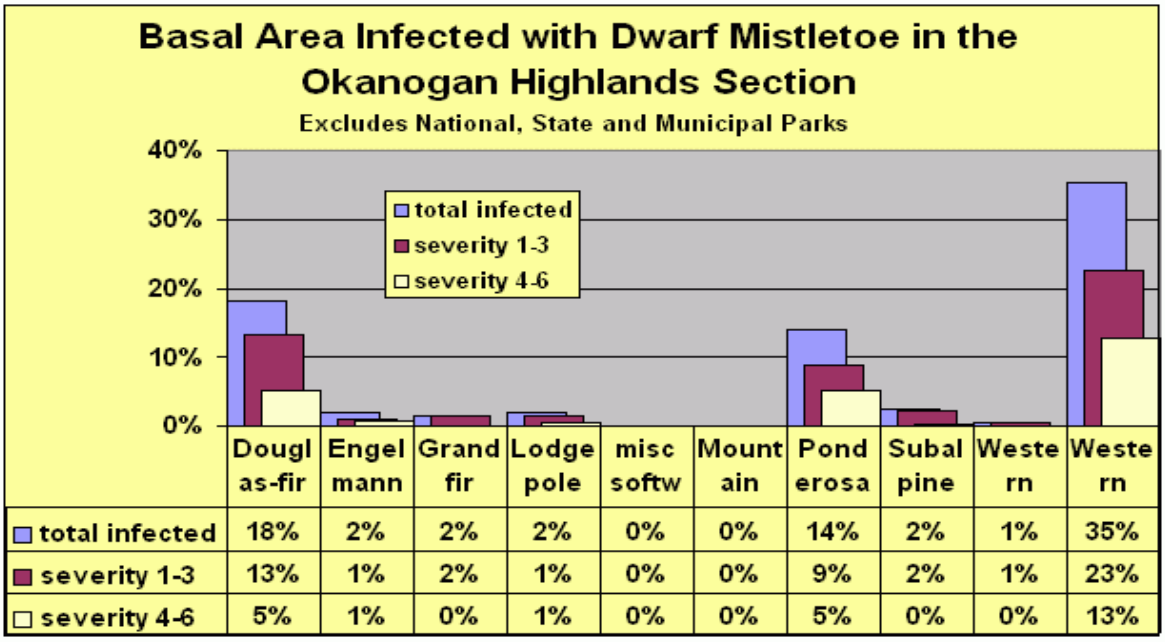
	Douglas-fir	Engelmann	Grand fir	Lodgepole pine	misc softwoo	Mountain	Pacific silver fir	Subalpine fir	Western hemlock
total infected	3%	0%	0%	0%	0%	5%	4%	0%	17%
severity 1-3	2%	0%	0%	0%	0%	2%	3%	0%	9%
severity 4-6	1%	0%	0%	0%	0%	2%	1%	0%	8%



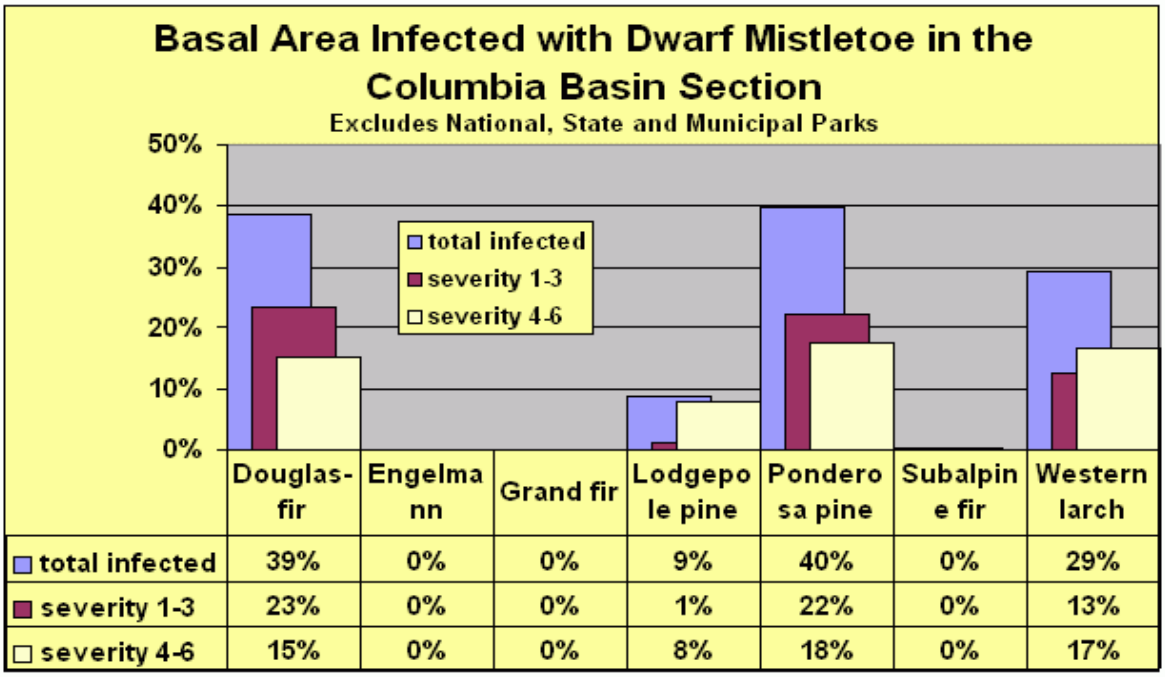
	Douglas-fir	Engelman	Grand fir	Lodgepole	misc softw	Mountain	Pacific	Ponderosa	Subalpine	Western	Western
total infected	1%	0%	1%	8%	2%	3%	5%	0%	0%	22%	0%
severity 1-3	1%	0%	0%	6%	2%	2%	4%	0%	0%	14%	0%
severity 4-6	0%	0%	1%	2%	1%	1%	1%	0%	0%	8%	0%



	Douglas-fir	Engelmann	Grand fir	Lodgepole	misc softw	Mountain	Pacific	Ponderosa	Subalpine	Western	Western
total infected	19%	1%	2%	23%	0%	4%	2%	13%	1%	7%	28%
severity 1-3	11%	0%	1%	13%	0%	2%	1%	9%	1%	3%	19%
severity 4-6	8%	0%	1%	10%	0%	2%	0%	4%	1%	4%	9%



	Douglas-fir	Engelmann	Grand fir	Lodgepole	misc softw	Mountain	Ponderosa	Subalpine	Western	Western
total infected	18%	2%	2%	2%	0%	0%	14%	2%	1%	35%
severity 1-3	13%	1%	2%	1%	0%	0%	9%	2%	1%	23%
severity 4-6	5%	1%	0%	1%	0%	0%	5%	0%	0%	13%



	Douglas-fir	Engelmann	Grand fir	Lodgepole pine	Ponderosa pine	Subalpine fir	Western larch
total infected	39%	0%	0%	9%	40%	0%	29%
severity 1-3	23%	0%	0%	1%	22%	0%	13%
severity 4-6	15%	0%	0%	8%	18%	0%	17%

For more information: http://www.fs.fed.us/r6/nr/fid/widweb/wid-mt.shtml

Swiss Needle Cast (SNC)
Phaeocryptopus gaumanni (Rohde) Petrak

Swiss needle cast is a fungus with small fruiting bodies which in large quantities look like soot on the underside of Douglas-fir needles. In severe cases, the needles become chlorotic (yellow) and fall off prematurely. This slows the growth of the tree and gives it a sparse appearance.

Swiss needle cast was found along the coastal areas of Washington again this year, but in the last few seasons, the disease has not seemed to be as severe as in previous years. Additionally, in Oregon where the SNC problem is more widespread and severe, the Oregon Department of Forestry has found no

significant difference in incidence or severity over the past few years and have found an overall decrease since the mid 1990's.

Several factors influence the potential severity of Swiss needle cast for any given site.
These include:

- Proximity to the Pacific Ocean Coasts
- South facing slopes
- Valley bottoms

Swiss needle cast causes yellowing and early needle drop. Notice the absence of older interior needles and the chlorotic appearance of new foliage on these young saplings near Mount Pilchuck.

In areas at risk of high levels of SNC, it is beneficial to select local tree sources and to diversify forest plantations with alternate species such as western hemlock, western redcedar, Sitka spruce or red alder.

For additional information: http://www.fs.fed.us/r6/nr/fid/mgmtnote/swissnc.pdf

White Pine Blister Rust (WPBR)
Cronartium ribicola (J. C. Fisch.)

White pine blister rust is the most destructive disease of 5-needle (white) pines in North America. Since its introduction into Washington in the early 1900's, it has caused widespread mortality throughout the range of its hosts. White pine blister rust infects all 5-needle pines, including western white pine and whitebark pine, and requires an alternate host such as currants (*Ribes spp.*) or indian paintbrush.

White pine blister rust causes cankers on branches and main stems of infected pines. Cankers on smooth-barked trees will often have a rough center surrounded by a diamond-shaped orange lesion of infected bark. On older trees with rough bark, the leading edge of infection is not apparent. Older cankers are rough and blistered in appearance.

Girdling cankers are often resinous. Main stem eventually result in topkill or whole tree mortality.
Branch flagging is the most obvious symptom of white pine blister rust. It is caused by girdling cankers that kill branches rapidly.

This exotic disease has already depleted western white pine across much of its range. The surviving widely scattered western white pines are still dying, but are not well recorded by aerial survey because they often do not meet the threshold of groups of five or more recently killed trees.

Washington's other five-needle susceptible host whitebark pine, grows in high elevation alpine areas. These trees provide a critical role in watershed protection and wildlife habitat. White pine blister rust has been slower to spread into these areas, but widespread infection is now occurring. Drought and blister rust have weakened whitebark pine to the point that mountain pine beetle is causing widespread mortality.

Western white pine was once an integral part of the forest ecosystems of Washington. In the last two decades the USDA Forest Service and the University of Idaho have established breeding programs to genetically enhance western white pine (WWP) for resistance to this exotic disease. During this time, WADNR has been steadily increasing the outplanting of WWP seedlings, including genetically enhanced (F2 progeny) on state lands.

A 2002 survey of WWP saplings and mature trees in Washington revealed infection levels of up to 100% in some geographic regions. Because the source of these trees was unknown, infection levels on genetically enhanced white pine were still uncertain. High infection levels in WWP saplings suggest that mortality due to blister rust may be underestimated by excluding juvenile (four years or less in age) white pine from studies. Between 2002 and 2005, 22 permanent plots were established across Washington to assess the development of white pine blister rust in young plantations of F2 progeny WWP. Twelve plots were established in 2002/2003 and 10 more plots in 2005. Blister rust infection levels ranged from 0% to 95% across the 22 permanent plots. Approximately 1% of the WWP were killed by stem girdling blister rust cankers.

Four out of twelve plots established in 2002/2003 had blister rust infection rates of 0-1%. Two out of ten plots established in 2005 had blister rust infection rates of 0-1%. The greatest number of cankers on one tree was 28 and these were cankers that were located within six inches of the main stem. The highest regional blister rust infection rates (48%) were in the Northwest Region of Washington, which includes areas west of the Cascade crest and north of Seattle to Canada. These 22 plots will continue to be monitored. Efforts are currently underway to establish six new F3 WWP progeny resistant trials.

For additional information: http://www.fs.fed.us/r6/dorena/rust/

Insects

Fir Engraver Beetle
Scolytus ventralis (LeConte)

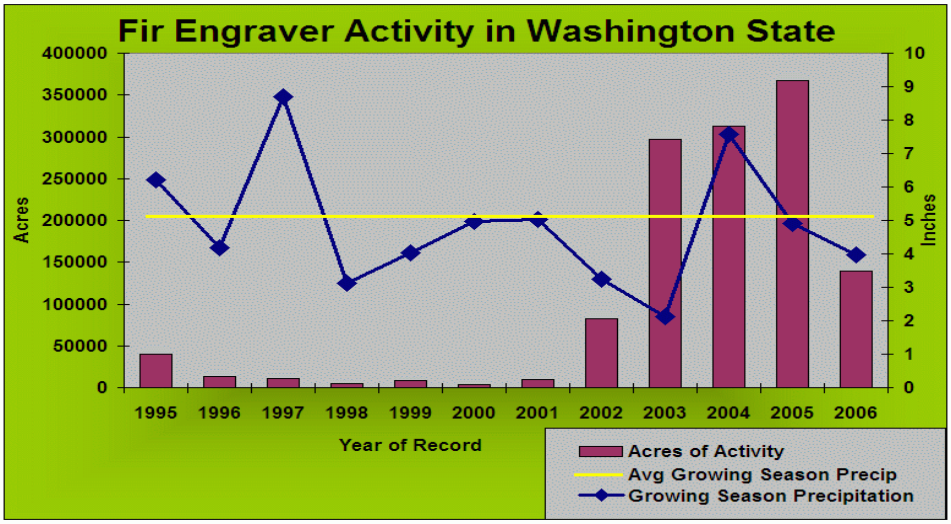
Fir engraver beetle is a native bark beetle that attacks and kills, or strip kills, weakened true fir trees. Scattered true fir mortality was mapped throughout Eastern Washington again this year. Droughty conditions likely precipitated and exacerbated this event. Most of the affected trees were in the understory, but larger trees were also affected. True fir mortality will likely increase where Western spruce budworm are active.

Nearly 140,000 acres with scattered true fir mortality were mapped throughout Eastern Washington in 2006. This is down markedly from the over 368,000 acres in 2005, 313,000 acres in 2004, 300,000 acres in 2003, 82,750 acres in 2002 and almost none in years prior.

Most of the weakest drought stressed hosts have already been successfully attacked.

For additional information: http://www.fs.fed.us/r6/rogue/swofidsc/beetles/firengraver.html

Historical Fir Engraver Beetle Activity and Drought Correlation:



Pine Bark Beetles

Mountain Pine Beetle
Dendroctonus ponderosae (Hopkins)

Western Pine Beetle
Dendroctonus brevicomis (LeConte =*barberi* Hopkins)

Pine Engraver Beetles
Ips species

Pine bark beetle populations continue at epidemic levels at the landscape level with more than 267,000 acres with elevated levels of mortality mapped statewide. Mountain pine beetle continues to kill lodgepole pine even up to its western extent in the North Cascades, and early signs indicate that outbreak conditions over much of Northeastern Washington are developing.

Acres with recent elevated pine bark beetle activity in Washington:

- 2006: 267,000
- 2005: 554,000
- 2004: 430,000
- 2003: 330,000

A massive outbreak is occurring in British Columbia, just north of our state border.

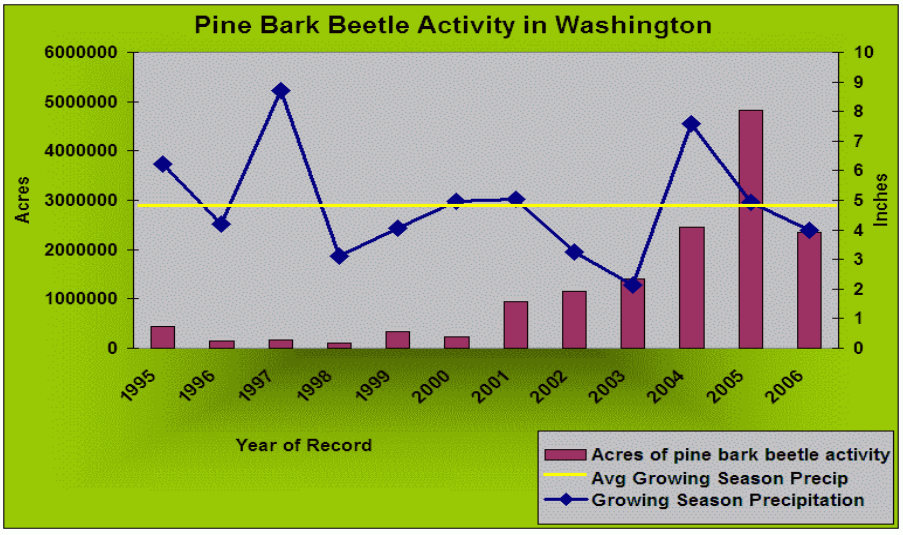
This view is from west of Oroville, looking north into British Columbia.

Furthermore, in the Cascades there was continued activity by mountain pine beetle in whitebark pine with over 24,000 acres with mortality mapped, down from the 38,000 acres in 2005, but up from about 7,000 acres in 2004 and 13,000 acres in 2003.

These trees have been weakened by white pine blister rust for many years, and the current high populations of mountain pine beetle in nearby lodgepole pine combined with droughty conditions have increased the susceptibility of whitebark pine to mountain pine beetle. These slow growing alpine trees are crucial to healthy watersheds and many species of wildlife.

For additional information go to: http://www.ext.colostate.edu/pubs/insect/05528.html

Historical Pine Bark Beetle Activity in Washington correlated with Drought:



Western Spruce Budworm (WSBW)
Choristoneura occidentalis (Freeman)

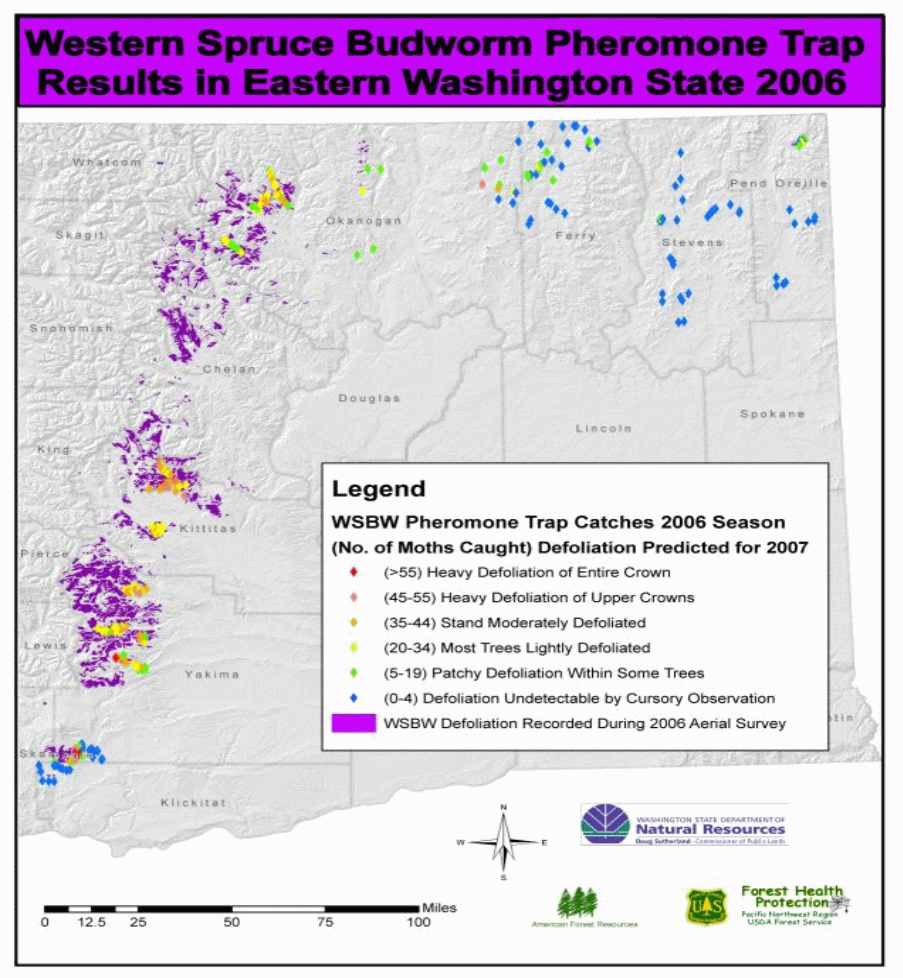
Defoliation along the east slopes of the North Cascades expanded again this year. In fact, areas of defoliation were seen all along the Eastern Cascades. Several isolated "hotspots were recorded in many areas of Northeastern Washington as well.

- Despite the smoky conditions which made detection of lightly defoliated areas difficult, more acres with defoliation were recorded in 2006 than any year since 1992!

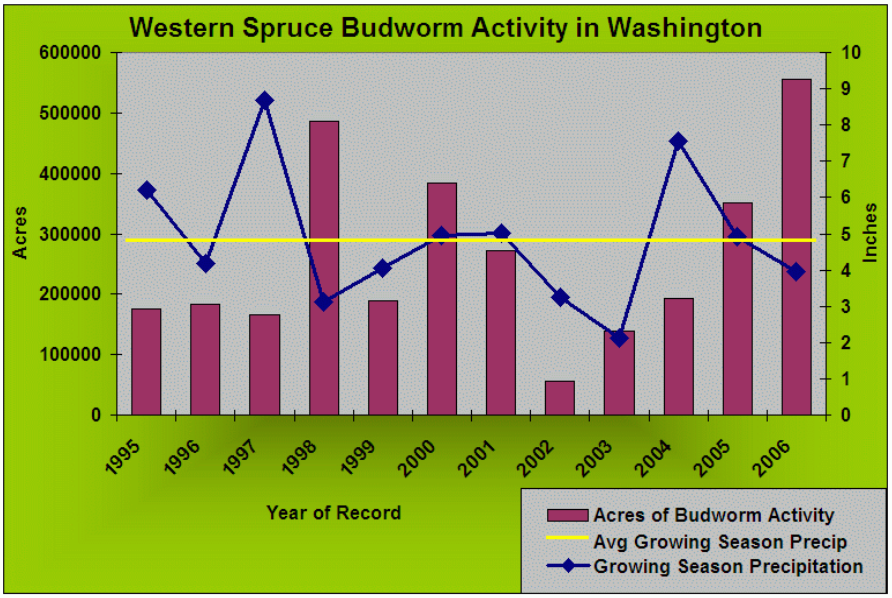
- The outbreak along the Idaho border continues, and for the first time in many years, several hotspots of isolated activity were also detected in Okanogan County.
- Pheromone trap data indicate defoliation will continue in most currently infested areas and expand in Okanogan and Ferry counties in 2007.
- Douglas-fir beetle is active in many areas where repeated defoliation has weakened trees. However, this often goes undocumented by aerial survey because we record freshly dead trees with red needles. Defoliated trees' foliage has been eaten so it is difficult to discern freshly killed trees.
- WSBW defoliation is highly apparent along major east-west travel routes such as Hwy 12 near Rimrock Lake and Hwy 20 near Mazama. Affected trees have a red/grey color with sparse or no needles and many have dead tops.

The total number of affected acres mapped in Washington over the last several years are:

- 1999: 189,700
- 2000: 383,000
- 2001: 236,000
- 2002: 56,567
- 2003: 138,797
- 2004: 193,191
- 2005: 352,000
- 2006: 556,000



Historical Western Spruce Budworm Activity and Drought Correlation:



For Additional Information go to:
http://www.forestry.ubc.ca/fetch21/FRST308/lab5/choristoneura_occidentalis/budworm.html

Douglas-fir Beetle
Dendroctonus pseudotsugae (Hopkins)

Outbreaks of Douglas-fir beetle have been ongoing for the last several years. Defoliated, overstocked, drought-stressed, mature trees allow populations of beetles to persist.

Less Douglas-fir beetle damage was mapped in Washington than in recent years, but a larger proportion, about half, occurred on the Westside most notably in areas around North Bend East of Seattle and east of Mt. Rainier.

The Douglas-fir beetle outbreak in Spokane, Pend Oreille, and Stevens counties has finally subsided. Beetle populations have killed overstocked, drought-stressed, mature trees where tree damage from the ice storm of 1996-97, followed by prolonged drought, resulted in mortality on most of the suitable host type over the last several years.

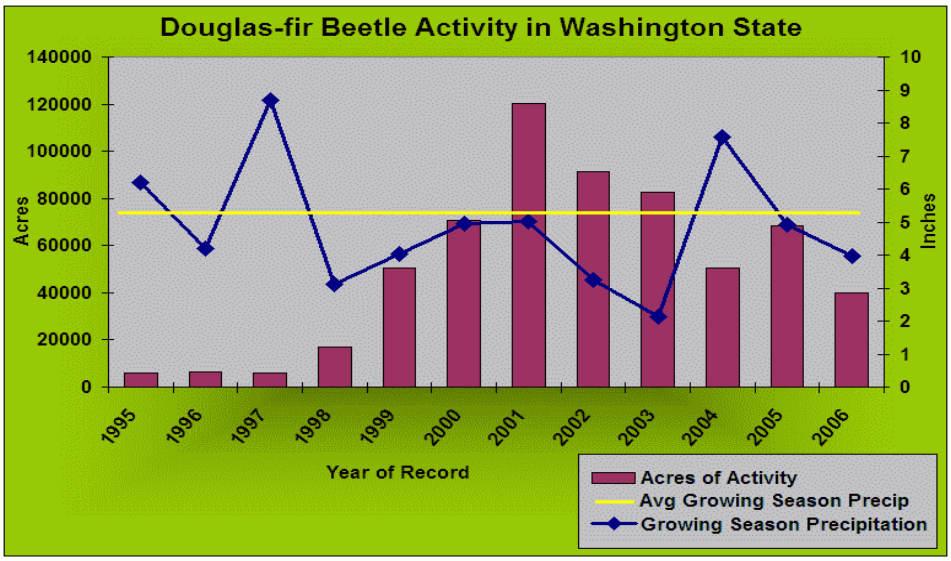
Mortality is expected to rise in areas defoliated by western spruce budworm throughout the eastern slopes of the Cascades and along the Idaho state border.

About 40,000 acres with elevated activity was mapped by aerial survey in 2006. This is down significantly from the almost 69,000 acres mapped in 2005.

Aerial view near Omak WA. The yellow/red trees are recent mortality and the gray trees were killed in previous years. These older dead trees are not mapped during aerial survey.

In coming years, Douglas-fir beetle caused mortality is expected to further increase in the eastern Cascades as Western spruce budworm defoliation increases.

Historical Douglas-fir Beetle Activity and Drought Correlation:

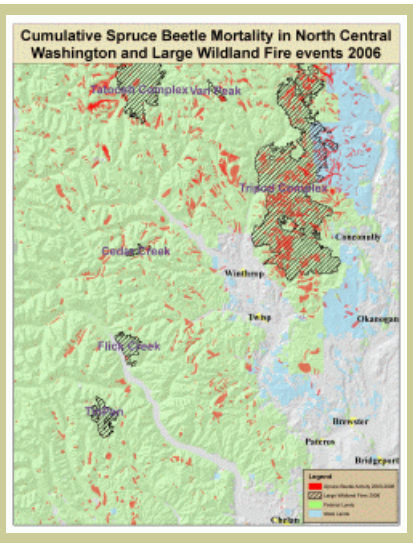


For Additional Information go to: http://www.fs.fed.us/r6/rogue/swofidsc/beetles/douglasfir.html

Spruce Beetle
Dendroctonus rufipennis (Kirby)

The spruce bark beetle is usually present in small numbers in weakened and wind-thrown spruce trees. However, periodic outbreaks can occur where extensive windthrow events or large areas of overmature spruce exist. Spruce beetles typically need two years to complete their life cycle, but can mature in one year if conditions are mild.

In Eastern Washington, spruce are primarily riparian species. They grow dense and crowded along most of our higher elevation streams and lakes. When a spruce beetle outbreak irrupts, every host tree greater than 4 inches diameter can be killed in 2-3 years. The resulting forest, dominated by dead trees, is then available to burn in a hot wildfire. The resulting landscape is then prone to mass wasting and erosion. Water quality can be severely degraded over the short term.



The spruce beetle outbreak of the last few years in the northeast Cascades near Tiffany Mountain and surrounding areas burned in the Tripod Complex Fire. Additional areas to the west are showing increasing spruce beetle activity.

The recent statewide acres with elevated mortality are:

2001: 24,272
2002: 27,527
2003: 19,106
2004: 23,207
2005: 39,604
2006: 30,626

When spruce beetle populations reach epidemic levels, extensive mortality can occur rapidly.

For Additional Information go to: http://www.na.fs.fed.us/spfo/pubs/fidls/sprucebeetle/sprucebeetle.htm

Douglas-fir Tussock Moth (DFTM)
Orgyia pseudotsugata (McDunnough)

Douglas-fir tussock moth is a native defoliator of Douglas-fir and true fir trees. It typically exists at low numbers, but periodically irrupts into huge populations which can completely defoliate trees in a single season, producing widespread mortality and top kill.

Defoliation from DFTM on Tekoe Mountain south of Spokane, August 2002.

Substantial activity is presently occurring in California and historically, defoliation starts a few years later in Washington. DNR monitors about 180 pheromone trap sites in Washington. Most areas trapped did not yield significant numbers of moths, but a few widespread individual plots, such as in Molson and Palmer Lake (Okanogan County), Keller Ferry (Lincoln County), and Dusty Mountain Meadows (Okanogan County), for the second year in a row had higher DFTM catches. No contiguous plots in any area caught high numbers of moths.

No defoliation from DFTM was mapped in 2006, however some defoliation in these areas mapped by aerial survey could have been mistakenly attributed to Western spruce budworm. No ground information is available.

For Additional Information go to:
http://www.forestnet.com/timberwest/archives/March_April_05/battling_bugs.htm

Gypsy Moth
Lymantria dispar (L.) (Goodwin)

Gypsy moth is a non-native defoliator of many broadleaf trees and shrubs. In addition, the Asian variety can also significantly damage conifers.

Gypsy moth is not established in Washington. Each year the Washington State Department of Agriculture deploys pheromone traps to detect new introductions. Eradication efforts follow if populations appear to be breeding.

The European gypsy moth has become established in the eastern US and Canada where it continues to spread and cause extensive damage. The Asian gypsy moth, an even greater threat, is not yet established in North America.

Seventy-five moths were trapped statewide in 2006. This number is right at the average of 76 moths caught annually over the previous eleven years, but more than twice the catch of 2005.

All moths caught were of the European strain. Multiple moth catches were located in Kent (45 moths), Olympia (7 moths), Bangor and Federal Way (4 moths each), and Monroe, Seabeck and Smokey Point (2 moths each). Gypsy moth egg masses were found at Kent and eradication efforts are proposed there for 2007.

Eradication efforts were completed in two areas of Washington in 2006. Madison (Seattle) and Rosemont (Bellevue) were treated with B.t.k. These areas and all multiple-catch areas will be intensively trapped in 2007. Single male Asian gypsy moths were caught in 2004 along the Idaho border near Spokane and in 2006 near St. Helens, Oregon. Both of these areas will be intensively trapped in 2007 and some additional traps will be placed in Washington as well.

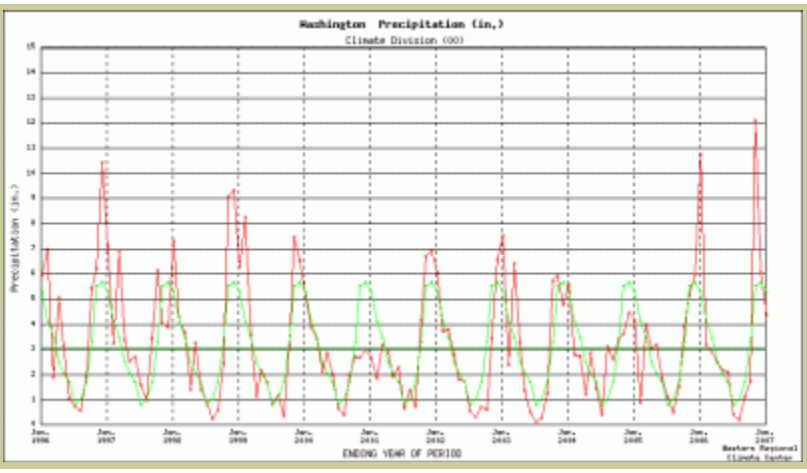
For Additional Information go to:
http://www.forestry.ubc.ca/fetch21/FRST308/lab5/lymantria_dispar/gypsy.html

Animal and Abiotic

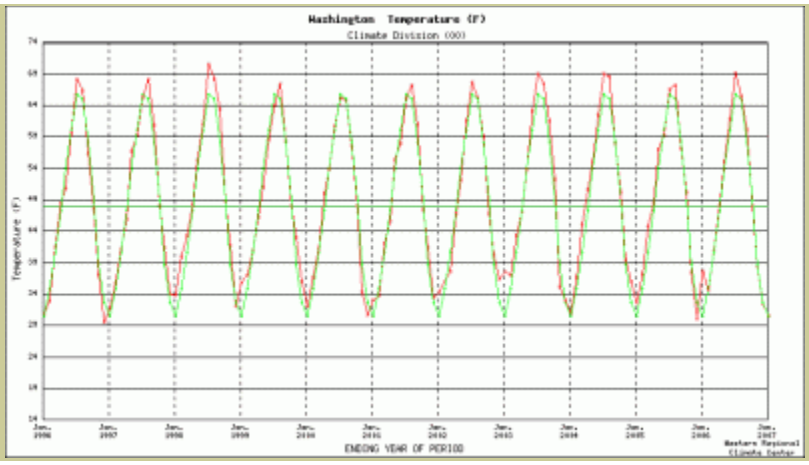
Drought

Following on the heels of one of the wettest winters on record, Washington soon progressed into one of the driest and hottest summers on record.

Following a wet early spring which may have aided many trees in successfully repelling beetle attacks, summer hit with full force. Records were tied or broken last winter for the most consecutive days of precipitation and most precipitation in a 24 hour period. Records were tied or broken last summer for most days without any measurable precipitation. It was also the warmest January-July on record in the United States. Globally, 2005 was the warmest year on record.



For Eastern Washington the summer drought continued with 1000-hour fuel moistures again dropping to the 8% mark by mid August. Late summer rains were slow in coming and the fire season was long and busy.



Washington has an annual summer drought climate pattern. Little of the yearly precipitation falls in late summer, limiting tree growth until moisture is replenished in late September or October. Many insects and diseases have evolved to take advantage of water-stressed trees, so the “growing season” precipitation (June through September) can indicate both tree stress and insect or disease success.

The last ten years (1997-2006) have included two growing seasons with above normal precipitation, three growing seasons of near normal precipitation, and five growing seasons of below normal precipitation statewide (see charts below). A five-year period of low growing season precipitation (1998 through 2003, with intense effects in 2002 when the fall rains did not arrive until early November) caused significant direct drought effects such as tree death and top kill.

For Washington State, long term drought, identified by below normal growing season precipitation levels and low soil moisture levels, continues to affect forests and insect and disease populations. Landscape levels of tree defoliation and mortality are likely to continue. Trees on dry sites with thin soils are most likely to be affected. Western hemlock, with shallow roots, is very susceptible to drought. Overcrowded forests and trees with injured roots are also highly susceptible.

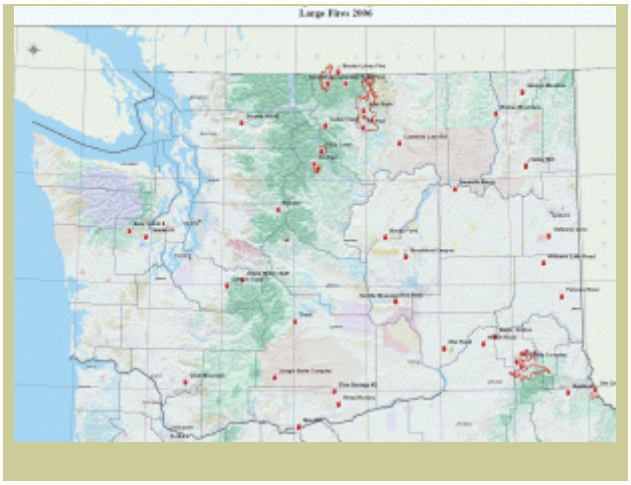
How drought conditions correlate with historical activity of key disturbance agents. See previous sections of this report: Douglas-fir beetle, pine bark beetles, fir engraver beetle, western spruce budworm.

For Current Washington Drought Conditions go to: http://drought.unl.edu/dm/monitor.html

Fire

Washington had a very active fire year with nine large fires east of the Cascade Mountains, primarily from Lake Chelan northwards, but also one large fire in the Blue Mountains. Over 462,000 acres burned in Washington. Compared to the previous 5-year average, 2006 had about 16% more fires and much higher acreage burned. Low precipitation, low humidity, frequent winds, lightning, and concentrations of insect-killed dead and dying trees created extremely dangerous conditions.

These fires created unusually smoky surroundings for a prolonged period of time which resulted in a very late completion of our aerial survey season. In fact we did not finish the survey until the end of September and likely missed many of the more subtle damage signatures on the ground such as light defoliation, due to smoke.



A record 9.5 million acres burned this year nation wide, surpassing the previous record of 8.7 million acres in 2005. In fact, “five of the worst ten years since 1960 have occurred in the past seven years in terms of acres burned” according to the National Interagency Fire Center.

For additional information go to: http://www.wadnr.gov:81/base/fire.html

Bear Damage/Root Disease
Ursus americanus (Pallus)/*Phellinus weirii* (Murr.) Gilb.

In 2006, the aerial survey identified about 236,000 acres of recent scattered mortality of young plantation Douglas-fir. This was virtually unchanged from 2005. We assign groups of similar, pole sized, newly dead trees the attribute “Bear Damage”. Based on ground checking observations of over 100 “Bear Damage” polygons in 2004 and an additional 40 polygons in 2005, this code should really be thought of as a combination 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 checked contained at least some root disease, and sometimes root disease was the sole agent.

Areas that exhibit particularly heavy “bear damage” mortality include the Quinault Indian Reservation north to Neah Bay and, increasingly, the area east of Mt. St. Helens.

Black bears damage trees when they feed on the soft cambial tissues inside the bark of saplings and small trees. This feeding occurs from April through September, but is highest in April through the peak month of June as hungry bears come out of hibernation and other forage is scarce. Bark is more loosely held on to the tree during this time in order to accommodate the fast growing, early sapwood. Tree feeding is higher in areas that lack salmonberry or false dandelion which are preferred forage during this time period.[1]

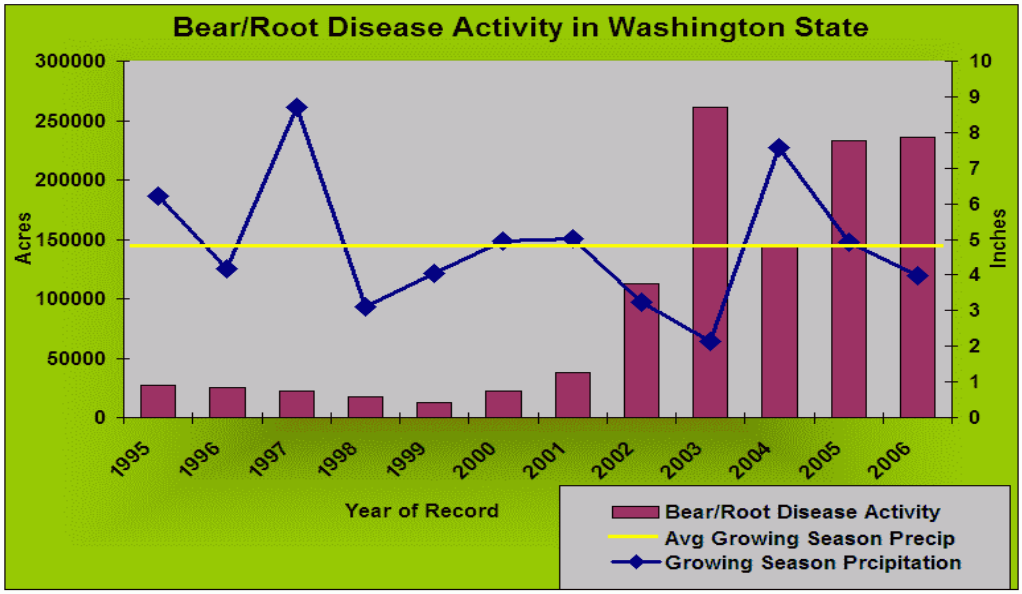
A single bear can injure or kill hundreds of trees in a single season. Bears tend to choose the biggest and healthiest trees to feed on and will often injure two or more trees for every one they kill.

Since legal restrictions on bear hunting were increased in 1996, black bear populations in Washington State have nearly doubled and the incidence of bear damage to trees has steadily increased.

Root disease incidence is likely also on the increase as Douglas-fir is replanted into areas containing significant root disease inoculum and droughty summer conditions make trees more susceptible.

Bear Damaged Tree

Historical Bear Damage Activity Chart



For Additional Information go to: http://www.wdfw.wa.gov/wlm/game/blkbear/blkbear6.htm

1 (Poelker J. P. and Hartwell D. H., 1973 "Black Bear of Washington" Biological Bulletin No. 14 Olympia, WA)