2003 WASHINGTON FOREST HEALTH HIGHLIGHTS

Overview

General Data Information

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 key to monitoring forest insect and disease activity levels across the state. The aerial sketch-mapping 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 a two-mile swath of forestland and mark either on a digital touch screen or on a paper map any recently killed or defoliated trees they see. 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. 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!).

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.

Some Speculation

Several key factors will influence forest susceptibility to insects and diseases in the next few years in eastern Washington. Forests are generally overstocked with too much fir and not enough drought tolerant pine. These conditions stress host trees and make them more susceptible to pathogens. Additionally, the mild winter weather of the last several years increases the winter survival rate of insect pests.

- Populations of bark beetles thrive in drought years.
- Populations of the western spruce budworm appear to be rising in some of eastern Washington's forests.
- Populations of the Douglas-fir tussock moth will likely remain low statewide.

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. Observers attend several training sessions, including one just prior to the start of the season, where observations made by each observer are compared with those of other observers and then checked on the ground. Additionally, observers talk about what they are seeing with each other and the pilot as they go along.

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.

Survey Results

Washington has about 21 million acres of forest land. In 2003, over 1.9 million acres of this land contained elevated levels of tree mortality, tree defoliation or foliar diseases. This is up from about 1.8 million acres in 2002.

- Almost three million trees were recorded as recently killed, up from about 1.84 million trees in 2002.
- Western spruce budworm activity increased in eastern Washington.
- The hemlock looper outbreak in the Mt. Baker area has mostly subsided.

The warm sunny weather allowed us to complete the survey in record time this year. We finished the bulk of the survey by August 23rd - a new record! We later re-flew the Mt. Baker area to make sure we did not miss portions of the hemlock looper outbreak there. We also returned to the Fawn Peak complex wildfire area in the Northeast Cascades when temporary flight restrictions associated with fire suppression had been lifted.

Unfortunately, we again had a few problems with the automated sketch mapping system and had to fly the San Juan Islands and other isolated areas on paper maps. New refinements to the software made the system more solid and versatile, but it was still often temperamental.

Smoke from fires in Montana, Oregon and British Columbia made visibility less than ideal, but since there were relatively few fires in Washington, we were generally pretty lucky.

General Forest Conditions

The USDA Forest Service regularly measures Washington's forest size and condition.

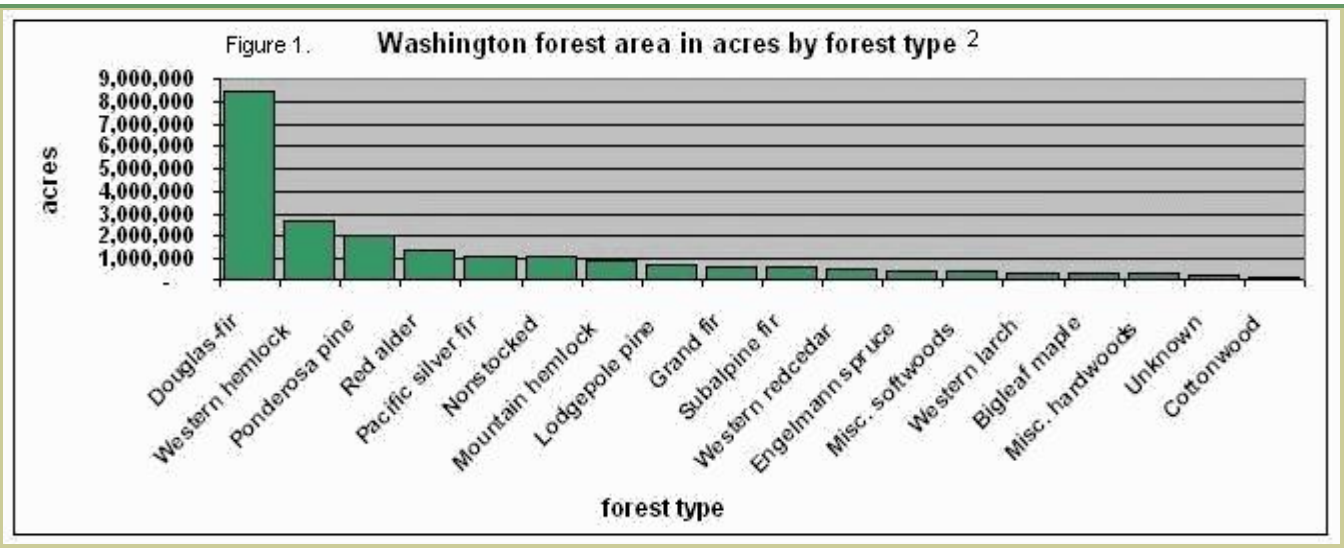
The National Forests are monitored by the Forest Service (Region 6).State and Private forest land is measured by the Forest Inventory and Analysis group of the Pacific Northwest Research Station. Private landowners also have their own inventory systems.

The following information came from federal surveys completed between 1988 and 1997. Although a more recent cycle of inventory measurements was completed for Washington in 2002, those data were not available for reporting. The information will be updated in the 2004 Washington Forest Health Highlights report and other more formal publications that will be produced by the Forest Service.

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

Table 1: Number of acres of forest land by forest type. 1

Douglas-fir	8,414,038
Western hemlock	2,685,372
Ponderosa pine	2,073,058
Red alder	1,403,420
Pacific silver fir	1,116,463
Nonstocked	1,102,992
Mountain hemlock	928,213
Lodgepole pine	754,878
Grand fir	531,803
Subalpine fir	515,754
Western redcedar	508,696
Engelmann spruce	348,331
Misc. softwoods	333,990
Western larch	304,468
Bigleaf maple	287,584
Misc. hardwoods	244,152
Unknown	203,394
Cottonwood	118,409
Total	**21,875,015**

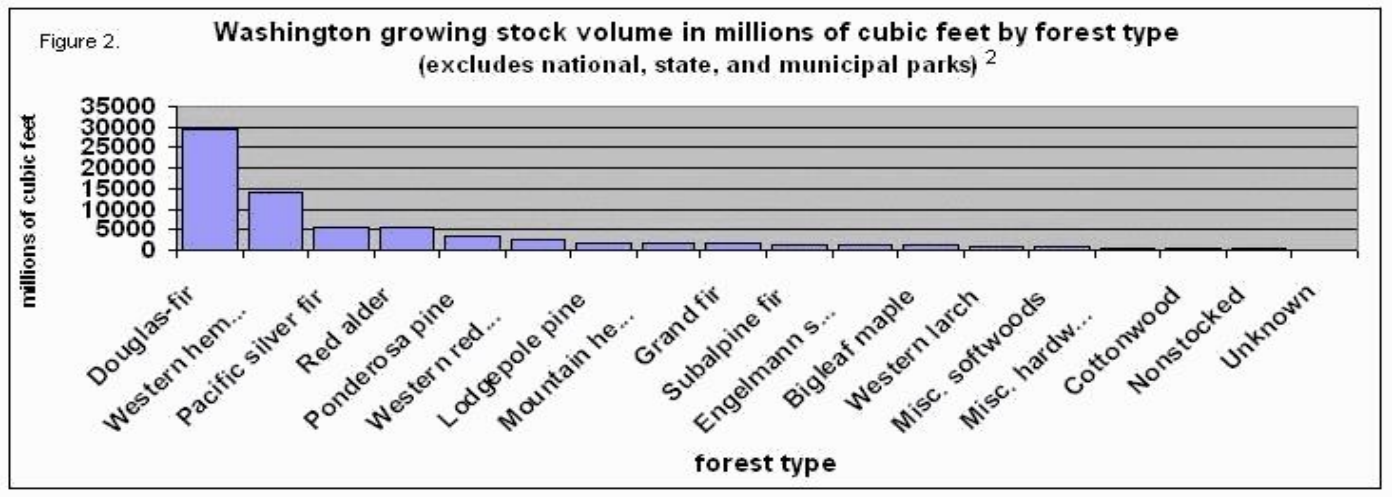


In addition to the number of acres covered, forests are measured in the volume of wood present. A “cubic foot” of wood is a piece of wood that is one foot tall, one foot wide, and one foot thick. An eight-inch diameter log that is ten feet long contains about 3.5 cubic feet of wood.

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

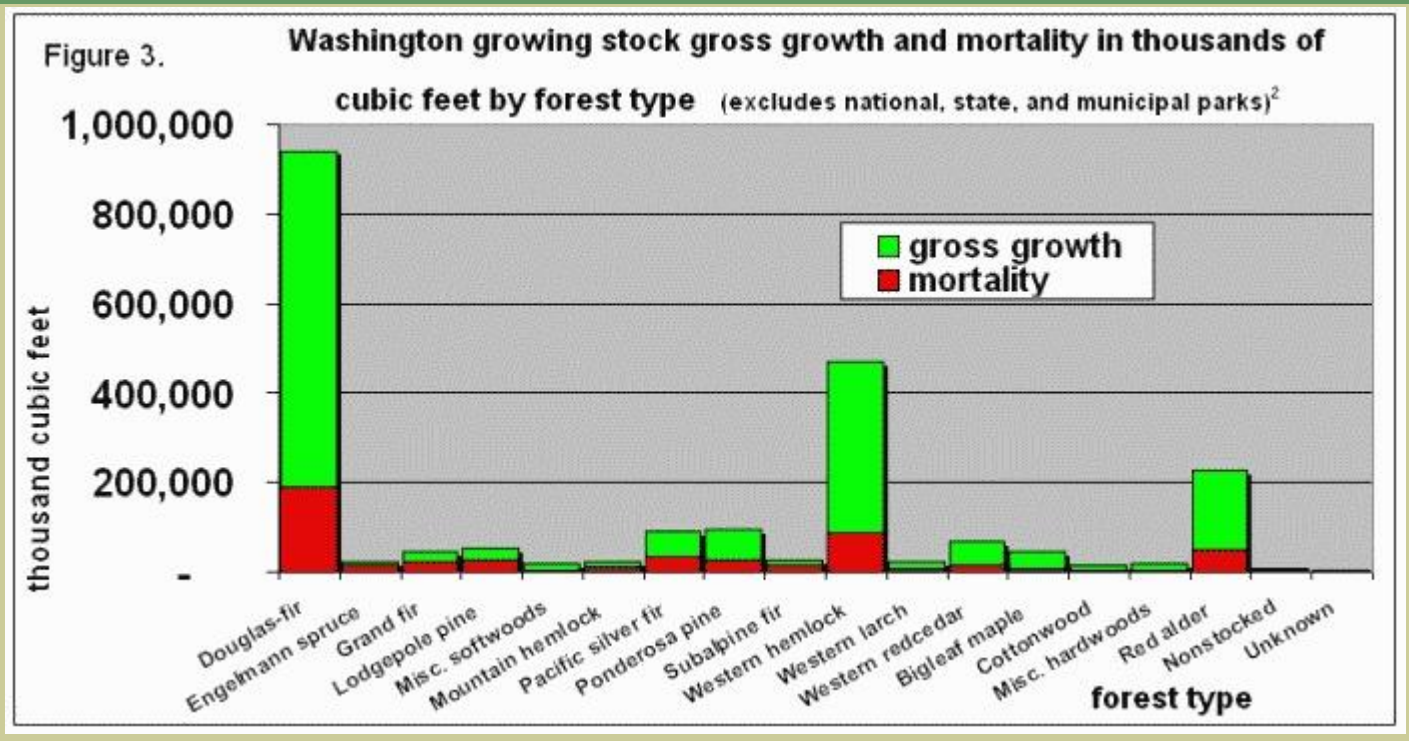
Table 2: Wood Volume in Washington Forest Types. 1

Douglas-fir	29,514
Engelmann spruce	1,293
Grand fir	1,711
Lodgepole pine	1,868
Misc. softwoods	793
Mountain hemlock	1,787
Pacific silver fir	5,606
Ponderosa pine	3,275
Subalpine fir	1,380
Western hemlock	13,904
Western larch	880
Western redcedar	2,646
Bigleaf maple	1,113
Cottonwood	280
Misc. hardwood	488
Red alder	5,404
Nonstocked	239
Unknown	74
Total	**72,256**

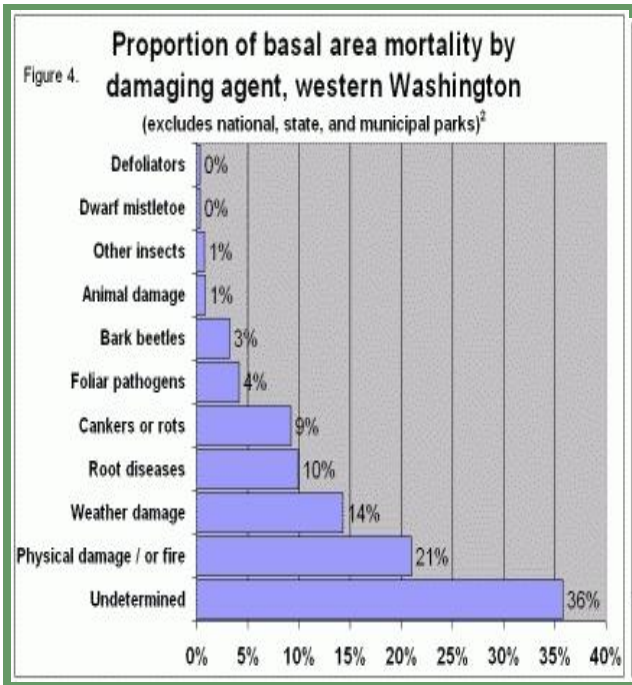


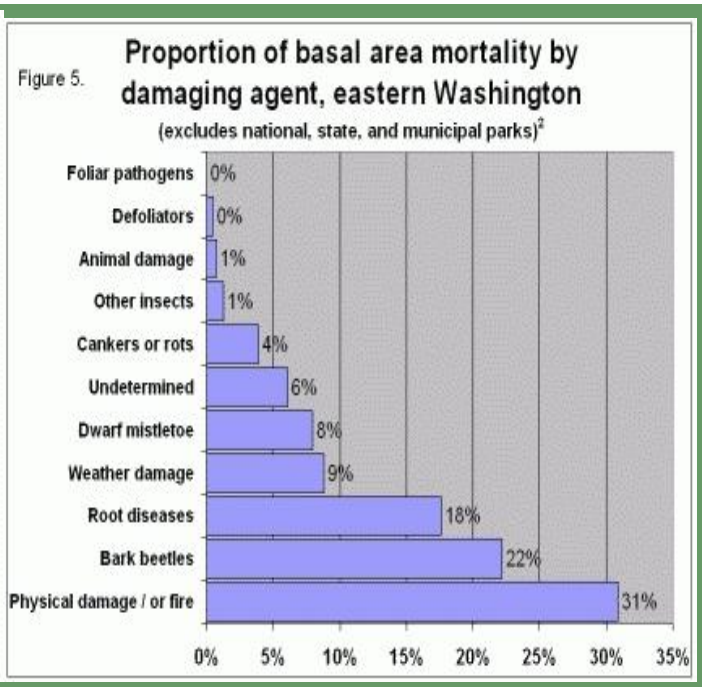
As forest trees continue to grow, some also die. The ratio of mortality (death) to growth provides information on whether forests are increasing or decreasing. If growth is greater than mortality then the ratio is greater than one and the forest volume is increasing. If growth equals mortality then the ratio equals one, and the forest volume is unchanged. If mortality is greater than growth then the ratio is less than one, more trees are dying and the forest live volume is decreasing.

The data in Figure 3 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 redcedar and bigleaf 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 trees removed by logging and land clearing, insects, diseases, fire, wind and a variety of other agents cause tree death. In western Washington (Figure 4), 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 (Figure 5) trees were most often killed by physical damage or fire, bark beetles, and root disease.





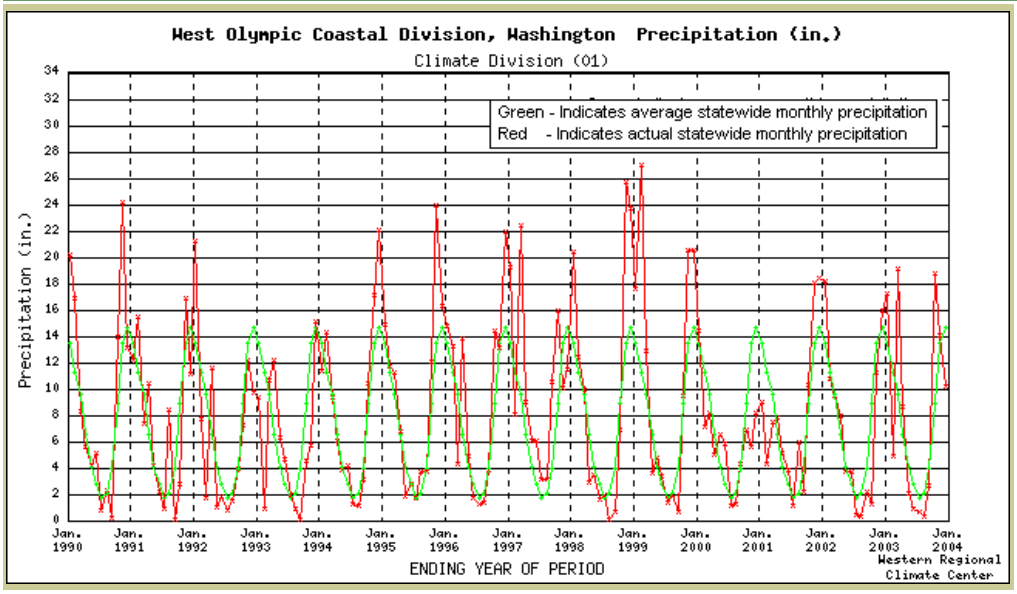
1. Hiserote, B. and K.L. Waddell. 2003. The PNW – FIA Integrated Database User Guide: Version 1.3. Internal Publication: Forest Inventory and Analysis program, Pacific Northwest Research Station. Portland, Oregon.
2. Prepared by Paul Dunham, Forest Inventory and Analysis program, Pacific Northwest Research Station. Portland, Oregon. Re-formatted by Jeff Moore, Washington Department of Natural Resources. Olympia, Washington.

Animal and Abiotic

Drought

According to the National Weather Service, May through August 2003 were the driest months on record for Washington! Precipitation on the east side was well below any previous records. In late summer the wood in dead and fallen trees of 3-8" diameter was drier than kiln dried lumber!

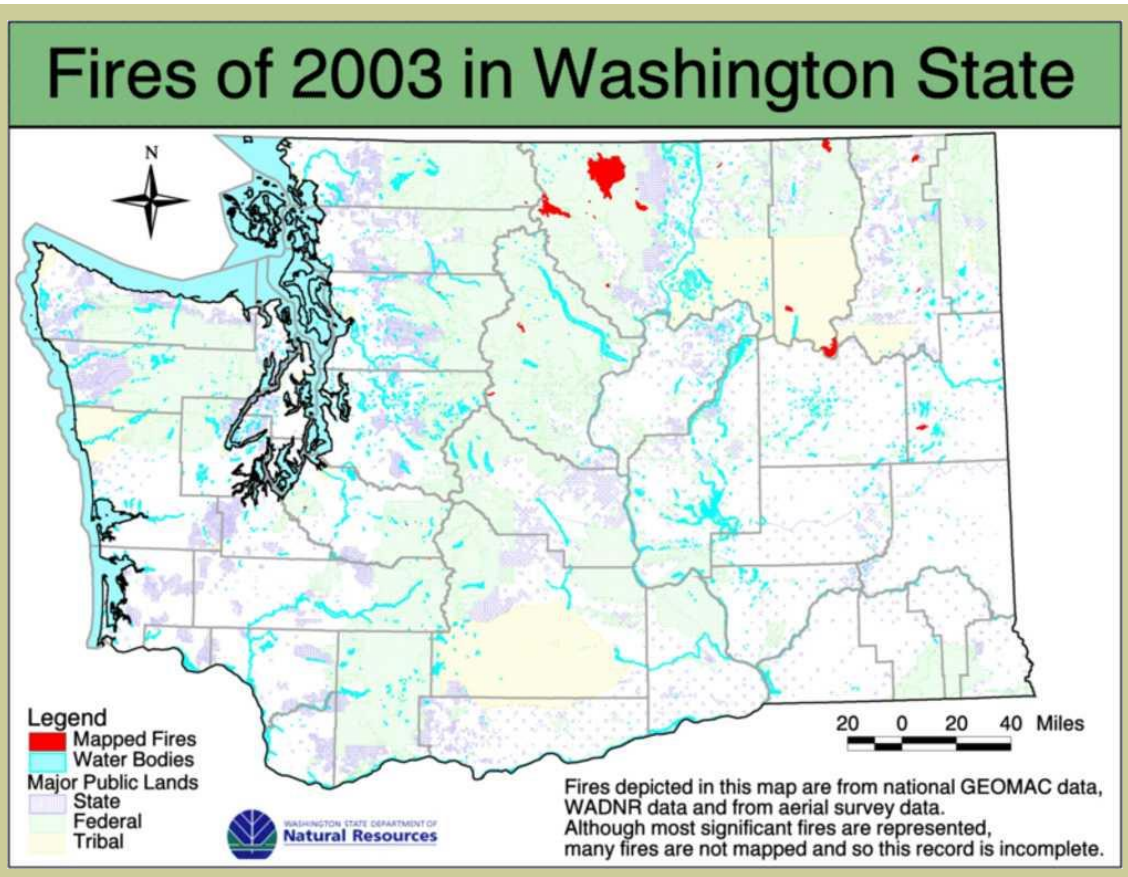
The west side was also incredibly dry with every area (other than the coast) at or below any previous low precipitation records dating back to the late 1800's!



This abnormally dry weather has once again stressed trees already suffering from several years of summer drought. This makes them vulnerable to insect and disease disturbance agents. Landscape levels of tree mortality continue.

Fire

Fire is a natural and integral part of most forest ecosystems. In the absence of fire, tree species, stocking levels and age class compositions change and the average tree health may deteriorate.



Despite the record breaking drought of the summer of 2003, Washington had surprisingly few large fires, especially when compared to its neighbors Idaho, Montana and British Columbia.

Aerial view of the Fawn Creek fire complex as seen from the 2003 aerial survey. Flight restrictions and poor visibility make for challenging survey conditions.

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

Bear Damage

Black bears in western Washington will often feed on the inner bark of pole sized trees in the spring time before other food sources become available. A single bear can damage and kill hundreds of young trees each season.

Another increase in bear damage was seen in western Washington. Areas that exhibit particularly heavy mortality include the Capitol State Forest south of Olympia, the Quinault Indian Reservation, and the forested areas around Morton and Lake Ozette.

Over 260,000 acres with bear damage were recorded in 2003, up from 112,000 acres in 2002.

We map these pole-sized plantation trees as having been killed by black bear spring feeding activity, but since there have been several years of dry conditions, much of this damage could be caused by drought and/or root disease.

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

Trees killed by spring bear feeding as seen from the air

Diseases

Sudden Oak Death (SOD)

This newly discovered non-native disease caused by the fungus like organism *Phytophthora ramorum* was recently discovered in California and southern Oregon.

SOD has a large and growing host list including several oak species. While our only native oak species, Oregon white oak, is considered immune, local hosts include:

- rhododendron
- big leaf maple
- vine maple
- Douglas-fir
- evergreen huckleberry
- Pacific madrone
- manzanita

In the spring of 2003, SOD was discovered in a nursery in Des Moines, Washington on plants imported from an infected nursery in Oregon. All infected plant material in the Des Moines nursery was destroyed. So far, there is no evidence that this disease has spread to or become established in the natural environment of Washington.

In spring 2003, DNR conducted a survey of 33 nursery perimeters and five general forest sites in western Washington. Samples of symptomatic leaves were analyzed at the Washington State Department of Agriculture's plant pathology laboratory, but no *Phytophthora ramorum* was detected.

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

Swiss Needle Cast

Swiss needle cast (SNC) is a fungus with small fruiting bodies that in large quantities looks 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. Several factors influence the severity of SNC including:

- proximity to the coast
- south facing slopes
- valley bottoms

If you believe an area to be at risk of high levels of SNC it is crucial to select local tree sources and to favor alternate species such as hemlock or alder.

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

White Pine Blister Rust

White pine blister rust (WPBR) is the most destructive disease of 5-needle (white) pines in North America. Since its introduction into Washington, 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 Ribes spp. as an alternate host.

White pine blister rust causes cankers on branches and eventually the main stem 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, especially main stem cankers, which eventually result in topkill. Branch flagging (retention of red needles on dead branches) is the most obvious symptom of white pine blister rust and is caused by girdling cankers that kill branches rapidly.

This exotic disease has already decimated western white pine across much of its range to the extent that new mortality is not well recorded by aerial survey. The surviving widely scattered western white pines are still dying, but do not often meet the threshold of groups of five or more trees.

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.

Recent surveys of the western white pine resource in Washington revealed infection levels of up to 100% in some geographical regions. The Washington DNR is currently performing a study of WPBR in juvenile white pine (less than 5 years old) with increased genetic resistance to WPBR. Our investigations have revealed high levels of infection in some geographical regions of Washington.

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

Fir Engraver Beetle

Fir engraver beetle is a native bark beetle that attacks and kills, or strip kills, weakened true fir trees.

Almost 300,000 acres with scattered true fir mortality were mapped throughout eastern Washington, up from 82,750 acres in 2002. Droughty conditions likely precipitated this event. Most of the affected trees were not in the overstory, but larger trees were also affected.

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

This photo was taken during the 2003 aerial survey northeast of Spokane. The red and yellow trees are recent mortality. The smaller ones are mostly true fir and the larger are ponderosa pine.

Pine Bark Beetles

Pine bark beetle populations continue at epidemic levels with more than 330,000 acres of mortality mapped statewide.

Extensive areas with scattered overstory ponderosa pine mortality were mapped north and west of Spokane.

Mountain pine beetle continues to kill lodgepole pine, even up to its western extent in the North Cascades.

Furthermore, in the Cascades there was yet another marked increase of activity by mountain pine beetle in whitebark pine with almost 13,000 acres with mortality mapped, up from about 1,700 acres in 2002. 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.

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

Citrus Long-horned Beetle

The citrus long-horned beetle is a wood boring insect native to Asia where it is a major pest. It is a close relative of the Asian long-horned beetle which is having a huge impact in New York, Chicago and, most recently, Jersey City.

This exotic invader was found in two different locations in Washington in 2001. In Tukwila, where some beetles were actually seen escaping into the surrounding greenbelt, a massive tree removal, inspection, quarantine program was initiated.

More than 20,000 trees were inspected in 2003 for signs of the woodboring pest with completely negative results so far! Monitoring efforts and other precautions are still ongoing. If this wood-boring pest were to become established here with no natural controls such as predators, parasites or diseases, many hardwood trees such as bigleaf maple, cottonwood and horse chestnut would be damaged.

An adult CLB. Notice the speckled pattern on its back vs. the banded pattern of our native banded alder borer.

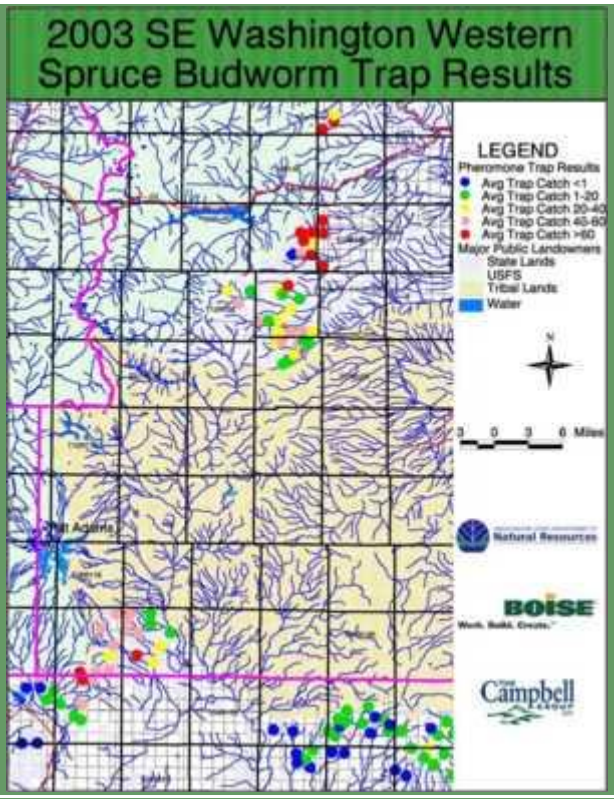
Western Spruce Budworm

A new defoliation event occurred this year on the east slopes of the North Cascades with almost 2,300 acres of defoliation recorded. In addition, the budworm outbreak in southwest Washington made a pronounced resurgence this year with 136,500 acres of defoliation recorded in southeast Washington in 2003. The Yakima area was again active, and the areas around Bumping Lake and Rimrock Lake showed continued activity with yet another impressive spread to the west and north from previous years.

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

- 1999:189,700
- 2000:383,000
- 2001:236,000
- 2002:56,567
- 2003:138,797

Multiple landowners monitor pheromone traps as an early warning of rising populations. The map on the right shows the trapping results for 2003.



Additional areas of light defoliation were likely not mapped because it is very difficult to detect lightly defoliated trees from the air in smoky conditions. Moreover, Douglas-fir beetle is active in many areas where repeated defoliation has weakened trees, but often goes undetected since these trees are denuded of foliage.

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

Douglas-fir Bark Beetle

Beetle populations continue at outbreak numbers for the last several years, and overstocked, drought-stressed, mature trees allow populations of beetles to persist at epidemic levels in some areas.

Almost 74,000 acres with Douglas-fir mortality were mapped in eastern Washington in 2003. Although down substantially from the last few years, Douglas-fir beetle continues to kill large numbers of mature Douglas-fir in Spokane, Pend Oreille, and Stevens counties!

Tree damage from the ice storm of 1996-1997, followed by prolonged droughts continues to stress trees!

In the southeastern Cascades, forests previously defoliated by the western spruce budworm are now experiencing mortality due to the Douglas-fir beetle.

Aerial view near Omak, WA. The yellow/red trees are recent mortality and the gray trees were killed in previous years.

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

Spruce Bark Beetle

The spruce bark beetle is usually present in small numbers in weakened and windthrown spruce trees. However, periodic outbreaks can occur where extensive windthrow events or large areas of overmature spruce exist. Unlike most other bark beetles they typically need two years to complete their life cycle.

The spruce beetle outbreak of the last few years in the northeast Cascades near Tiffany Mountain has largely subsided. This is largely because most of the suitable host trees have already been killed. However, there were scattered areas of elevated mortality in eastern Washington. Here are the recent statewide acres with mortality:

- 2001: 24,272
- 2002: 27,527
- 2003: 19,106

The more distant, gray-appearing trees were all killed by spruce beetle

For additional information got to: http://www.na.fs.fed.us/spfo/pubs/fidls/sprucebeetle/sprucebeetle.htm

Douglas-fir Tussock Moth(DFTM)

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

DNR monitors about 190 pheromone trap sites in Washington.

These trapping results are integrated with those of other landowners to provide early warning of rising DFTM populations. Overall, 2003 trap catches were very low indicating stable, low populations.

DFTM outbreaks throughout the northwest have mostly subsided from 2000-2002.

Area of defoliation from DFTM on Tekoe Mountain south of Spokane on the Idaho border.

Oregon outbreaks have also subsided and Idaho observers detected just a small area of activity in the Owyhee mountains of southeastern Idaho in 2003.

For additional information go to: http://www.fs.fed.us/r6/nr/fid/dftmweb/index.shtml

Western Hemlock Looper

The western hemlock looper is a native defoliator of hemlock and interspersed conifers.

The outbreak north and east of Mt. Baker has mostly subsided! Only 1,411 acres were mapped in 2003, down from approximately 35,215 in 2002 and 17,000 acres in 2001.

Over 7,500 acres with scattered hemlock mortality were mapped where hemlock looper defoliation has occurred in recent years. Bark beetles and root diseases combined with the direct effects of defoliation likely contributed to tree death.

No current hemlock looper or phantom hemlock looper damage was observed in the vicinity of Granite Falls this year. This defoliation event appears to have collapsed. Since hemlock looper is primarily a defoliator of older forests with a complex multi-layered growth hemlock, uniformly 55-60 years of age, with little understory was unlikely to sustain a prolonged outbreak. structure of western hemlock, this area of second

For additional information go to: http://www.pfc.cfs.nrcan.gc.ca/entomology/defoliators/loopers/west_hemlock_e.html

Gypsy Moth

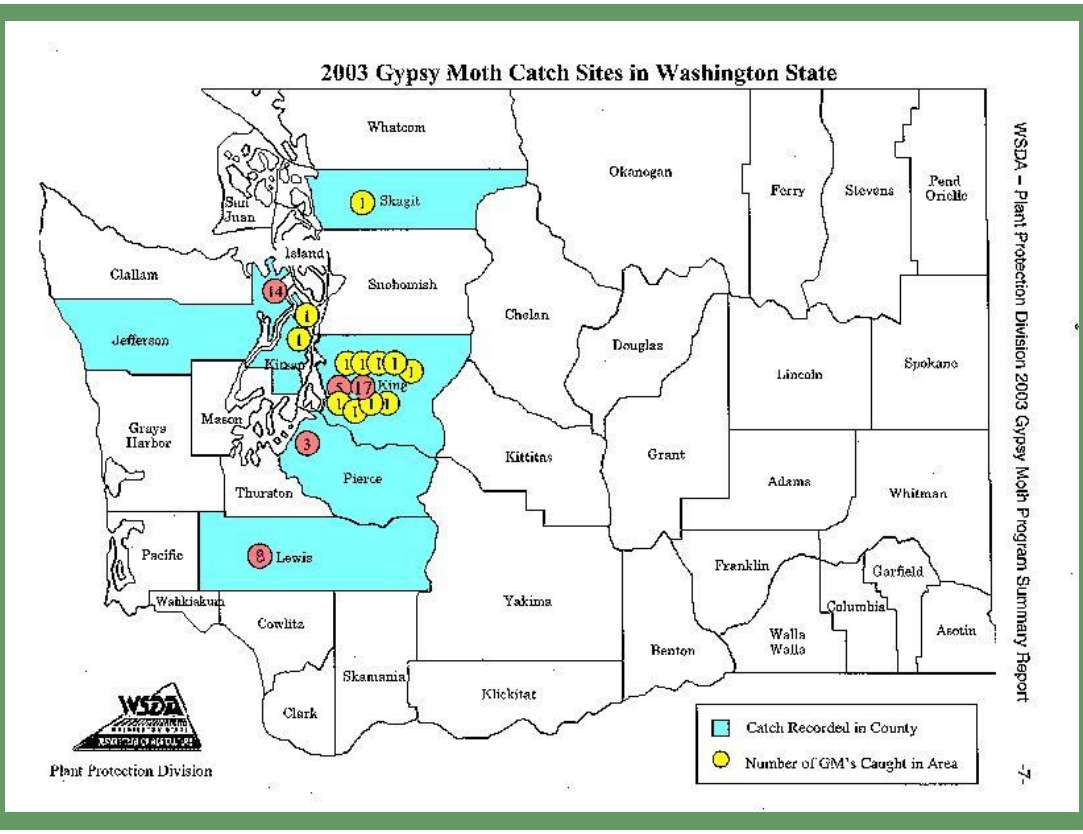
Gypsy moth is a non-native defoliator of many broadleaf trees and shrubs. The Asian variety could also significantly damage conifers.

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 where it continues to spread and cause extensive damage. The Asian gypsy moth, an even greater threat, has yet to become established in North America.

Fifty-nine moths were trapped statewide in 2003. This number is higher than the 17 moths trapped last year, but still well below the average of 77 moths caught annually over the previous ten years. All catches were in western Washington.

Multiple moth catches occurred in Bellevue, Port Ludlow, Mayfield Dam (Lewis County), Seattle and Fife. These areas were inspected for other life stages of gypsy moth and will be more intensively trapped in 2004.



Multiple life stages (egg, larva, pupa or adult) were found at Port Ludlow, Bellevue and Mayfield Dam (Lewis County) where the Washington Department of Agriculture is proposing eradication projects for 2004.

No moths were caught for the second year in a row in Vader where eradication projects occurred in 2002 and 2001. One moth was trapped in the Crown Hill neighborhood of Seattle where an eradication project was conducted in 2002. Both of these areas will continue to be monitored.

For additional information got to: http://www.forestry.ubc.ca/fetch21/FRST308/lab5/lymantria_dispar/gypsy.html

Other Defoliating Insects

A new defoliation event was detected in Idaho, which also spilled into Washington in Pend Oreille County. It appears that this is mainly caused from **western blackheaded budworm** with **western spruce budworm** mixed in.

For additional information go to: http://www.forestry.ubc.ca/fetch21/FRST308/lab5/acleris_gloverana/budworm.html

Almost 25,500 acres of **western tent caterpillar** defoliation were mapped around the Puget Sound lowlands and the San Juan Islands this year. More activity was seen this year than in recent years. Several years of droughty conditions have likely contributed to this situation. Although the outbreak declined on Whidbey Island, it continued on Vashon Island and the Kitsap Peninsula. Many suburban areas that were the most heavily defoliated were not flown due to various flight restrictions in central Puget Sound.

For additional information go to: http://www.forestry.ubc.ca/fetch21/FRST308/lab5/malacosoma_disstria/tent.html