USDA Forest Service, Pacific Northwest Region

2006 Forest Insect and Disease Conditions Report

Native Insects

Mountain Pine Beetle, *Dendroctonus ponderosae*

Hosts: Jeffrey pine, lodgepole pine, ponderosa pine, sugar pine, western white pine, whitebark pine.

Mountain pine beetles occur throughout the range of the pine type in the Pacific Northwest. Both adults and larvae feed in the phloem layer of the inner bark, producing one generation per year. Fungi introduced by the beetles clog the conductive tissues of attacked host trees and contribute to tree mortality. Some infestations have resulted in extensive mortality over large areas. Dense stand conditions continue to predispose areas to mountain pine beetle infestations.

In 2006, 587,610 acres were affected, with 6.73 trees per acre (TPA), compared to 757,969 acres affected, with an average of 8.01 TPA killed in 2005. Overall, decreases in mortality were reported in all host types except sugar pine.

Lodgepole Pine

Tree mortality in lodgepole pine decreased in both acreage and intensity. A true comparison of 2005 and 2006 is difficult due to the severe fire season in the Pacific Northwest. Many of the fire areas were in lodgepole pine dominated stands. Nevertheless, total reported affected acres decreased from 606,023 acres, 9.31 TPA in 2005, to 431,177 acres, 8.44 TPA in 2006.

Areas mapped with significant levels of mortality were in north central Washington on the administered by the Forest Service on the following National Forests (NF): Okanogan NF (51,038 acres), the North Cascades National Park (9,031 acres with 16.14 TPA), and the Colville Indian Reservation (15,217 acres with 4.31TPA); and in central Washington on the Wenatchee NF (30,439 acres) and the Yakama Indian Reservation (27,543 acres with14.57 TPA). In Oregon, significant levels of mortality were in central and south central Oregon on the Deschutes NF (71,448 acres) and the Fremont NF (96,551 acres).

Ponderosa Pine

More affected acres were mapped in the ponderosa pine type in 2006, but at a slightly lower intensity compared with 2005. In 2005, 98,620 acres with 1.58 TPA were mapped, compared with 108,714 acres with 1.34 TPA mapped in 2006.

The most significantly affected areas included lands administered by the Forest Service on the Fremont NF (39,661 acres with 1.06 TPA), the Deschutes NF (21,160 acres with .67 TPA) in Oregon, and the Wenatchee NF (5,769 acres with 2.72 TPA) in Washington; Affected acres on the Glenwood Reporting Area in Washington decreased significantly from 2005 with 10,889

acres at 1.45 TPA, to 2006 1,124 acres with 1.29 TPA; the Yakama Indian Reservation also showed a decrease in acres from 2005 with 10,501 acres averaging 1.26 TPA, to 1.300 acres, 2.06 TPA in 2006.

Sugar Pine

Activity in sugar pine increased from 796 acres 2005 to 2,835 acres in 2006. Due to the ecological importance of this rapidly disappearing species, observers attempt to record individual tree mortality to better assist land managers.

In 2006, the highest recorded sugar pine mortality was 1,766 acres with .57 TPA on the Warm Springs Indian Reservation.

Western White Pine

MPB activity in western white pine decreased, from 11.117 acres (1.87 TPA) in 2005, to 9,726 acres (0.98 TPA) in 2006. Significant areas of mapped mortality include the Fremont Reporting Area (3,966 acres, .69 TPA) and the Mt. Hood Reporting Area (2,151 acres, .76 TPA).

Aerial detection of western white pine mortality is difficult because it is often found as a minor component in mixed conifer stands and has a color signature very similar to that of Douglas-fir.

Whitebark Pine

Affected acres in the whitebark pine type decreased from 41,413 acres (5.98 TPA) in 2005, to 35,202 acres (4.5 TPA) in 2006. Between 1997 and 2006 an estimated 835,000 mature whitebark pine trees have killed. This is a significant contrast to the previous ten year period when only 15,000 trees were reported killed.

Dense stand conditions continue to predispose areas to mountain pine beetle infestations. Highest levels of mortality were reported on lands administered by the Forest Service on the Fremont NF, 8,797 acres, (2.45 TPA), the Okanogan NF, 13, 457 acres (6.64 TPA), and the Wenatchee NF, 6,425 acres (6.44 TPA). High mortality was also noted on the Yakama Indian Reservation, 1,276 acres with 8.11 TPA.

Douglas-fir Beetle, *Dendroctonus pseudotsugae*

Hosts: Douglas-fir

Douglas-fir beetles occur throughout the range of Douglas-fir and are considered the most important bark beetles which cause mortality in Douglas fir. Normally they breed in felled, injured, or diseased trees. The females bore into the bark and tunnel upward through the phloem. Tree mortality occurs when phloem continuity is disrupted by beetle larval galleries or by fungi introduced by the beetles. Mortality is widely scattered when at low levels. At times, these insects reach epidemic levels and kill apparently healthy trees over extensive areas.

We observed fewer acres affected by Douglas-fir beetles in 2006, but at elevated intensities. Mortality affected 76,968 acres with 1.72 TPA in 2005: in 2006 mortality was noted on 52,555 acres with 2.56 TPA.

Within the Colville Reporting Area in NE Washington, Douglas-fir mortality was mapped on 5,288 acres (7.74 TPA). Other Reporting Areas with significant mortality include: Wenatchee RA

(6,633 acres, 3.39 TPA), Mt. Baker-Snoqualmie (5,089 acres, 1.62 TPA), and Olympic National Park (3,806 acres, .56 TPA).

Fir Engraver, *Scolytus ventralis*

Hosts: True firs

Fir engravers infest true firs in western forests. These beetles attack pole-sized and mature trees, causing significant mortality during and following periods of drought. Trees infected with root disease are especially subject to attack. Trees defoliated by Douglas-fir tussock moth, western spruce budworm or Modoc budworm also are likely to be attacked. These beetles commonly breed in logging slash and windthrown trees.

Acres reported affected by fir engraver decreased for the third straight year, from 540,630 acres with 1.72 TPA in 2005, to 197,348 acres, with 1.32 TPA in 2006.

The most significant fir engraver activity occurred in Washington. The following Reporting Areas were mapped with high mortality: Colville NF 12,652 acres, 1.71 TPA, Colville Indian Reservation 4,572 acres, 2.27 TPA, Gifford Pinchot NF 7,234 acres, 1.45 TPA, Mt Baker-Snoqualmie NF, 32,575 acres, 1.10 TPA, Okanogan NF, 4.283 acres, 3.13 TPA, Olympic National Park, 17,477 acres, .91 TPA, Wenatchee NF, 17,692 acres, 3.34 TPA, and Yakama Indian Reservation, 6,351 acres, 3.27 TPA. In Oregon, the most significant fir engraver was on the Umatilla NF, 12,655 acres with .83 TPA, and the Wallowa-Whitman NF, 10,918 acres with .73 TPA.

Pine Engraver Beetles, *Ips* spp.

Hosts: ponderosa pine

Pine engraver beetles affect all species of pine but are most notable for their effect on ponderosa pine. Populations commonly build up in weakened trees, improperly treated logging and thinning slash, and windthrow. High populations in warm, dry years may kill large numbers of apparently healthy saplings and pole-sized trees as well as tops of mature trees.

Acres affected by pine engraver beetles decreased for the third straight year, from 27,601 acres with 2.25 TPA, in 2004 to only 5,357 acres with 1.95 TPA in 2006. The Wenatchee Reporting Area was the only area that remained consistent, with 2,362 acres, 2.21 TPA, in 2005, and now 2,416 acres (2.39 TPA) in 2006.

Western Pine Beetle, *Dendroctonus brevicomis*

Hosts: ponderosa pine

Western pine beetles periodically kill large numbers of ponderosa pine in the Pacific Northwest. Normally, these beetles breed in large, old trees; in windfalls; in trees affected by root disease; or in trees weakened by drought, overstocking, or fires. Under epidemic conditions, they will attack

and kill trees of all ages having bark sufficiently thick to protect the insect during development. Two generations per year of this beetle are typical in the Pacific Northwest.

Acres affected and mortality intensities were reported at slightly higher levels in 2006, compared with 2005. Aerial determination of ponderosa pine affected by western pine beetle versus mountain pine beetle is challenging. Observers attempted to attribute large tree (>20" dbh – diameter at breast height, 4.5 ft. from ground) mortality to western pine beetle, and use ground based information to assist in making the distinction in smaller sized trees. Total acres affected increased from 70,137 acres, 1.10 TPA, in 2005, to 72,316 acres, .86 TPA, in 2006. Large tree mortality (>20" dbh) was estimated to have occurred on 25,616 acres, at a rate of 1.21 TPA.

Highest levels of mortality occurred within the following Reporting Areas in Washington: Glenwood Reporting Area 15,124 acres, 2.16 TPA; Wenatchee Reporting Area 15,980 acres, 2.07 TPA; and Yakama Indian Reservation 14,815 acres, 2.01 TPA. In Oregon, the highest levels occurred on the Ochoco Reporting Area 4,512 acres, .65 TPA.

Spruce Beetle, *Dendroctonus rufipennis*

Hosts: Engelmann spruce

Spruce beetles infest all species of spruce and are the most significant mortality agent of mature spruce trees. Populations build up in windthrown trees. Stand susceptibility can relate to a variety of factors including geographic location, tree diameter, basal area, and percentage of spruce in the canopy.

All reported mortality in Oregon and Washington in 2006 was in Engelmann spruce. Reported acres affected decreased from 39,802 acres, 18.2 TPA in 2005 to 30,852 acres, 20.90 TPA in 2006. The majority of mortality occurred on lands administered by the Forest Service within the Okanogan Reporting Area. This area experienced numerous large wildfires in the spruce/fir/lodgepole forest types.

On the Okanogan Reporting Area, acres with mortality decreased from 38,235 acres, 18.72 TPA in 2005, to 25,735 acres, 23.46 TPA in 2006.

Douglas-fir Tussock Moth, *Orgyia pseudotsugata*

Hosts: Douglas-fir, true firs

The primary hosts of the Douglas-fir tussock moth are Douglas fir, grand fir, subalpine fir and white fir. Early instar larvae feed on the current year's foliage as the shoots elongate and later instars feed on all foliage. Normally this insect occurs at very low population levels; however it experiences cyclic population increases every 7 - 13 years, and populations can have significant impacts on resources when these eruptive outbreaks occur.

There were no areas of visible defoliation caused by tussock moth recorded in 2006. The Douglas fir tussock moth Early Warning System traps show a slight increase in trap catches in some areas.

Western Spruce Budworm, *Choristoneura occidentalis*

Hosts: Douglas-fir, true firs, Engelmann spruce, western larch

Western spruce budworm is a common defoliator of conifers in the Pacific Northwest. Budworm outbreaks commonly occur in the true fir/Douglas-fir forest types east of the Cascade Mountains crest. Larvae feed primarily on new buds and foliage. On western larch, larvae not only feed on the needles but also sever new shoots. Repeatedly defoliated trees experience substantial radial growth reduction and, if defoliation is great enough, are predisposed to lethal infections by root pathogens or attack by various bark beetles. Fire prevention and suppression during this century have eliminated many major fires and nearly all surface fires. As a consequence, host trees have increased, resulting in an abundant and expanding source of the budworm's favorite food: shade-tolerant, late-successional species such as true fir.

Areas of visible defoliation increased from approximately 352,210 acres in 2005 to 593,726 acres in 2006. Oregon increased from 254 acres to nearly 38,000 acres, and Washington State went from approximately 352,000 acres to 555,748 acres in 2006. In addition to the increase in areas of detectable defoliation, there was a significant intensification of the defoliation throughout the affected area (over twice as many acres in the heavy category, and nearly 1.5 times as much in both the light and moderate categories.

Reporting Area Highlights include:

Reporting Area	Survey Year	Acres Affected
Gifford-Pinchot	2005	696
	2006	13,137
Malheur	2005	254
	2006	33,778
North Cascades National Park	2005	10,320
	2006	18,142
Okanogan	2005	64,133
	2006	91,820
Wenatchee	2005	259,725
	2006	410,194
Yakama Indian Reservation	2005	6,186
	2006	18,096

Western Blackheaded Budworm, *Acleris gloverana*

Hosts: western hemlock (preferred), Sitka spruce, white spruce, true firs, Douglas-fir, and mountain hemlock

Larvae feed within buds and on current year's foliage and can cause top-kill, growth loss, and, sometimes, death of the host. Defoliation becomes apparent in June and July as partially eaten needles dry and turn red, giving crowns of host trees a red or brown appearance. Weather plays an important role in regulating budworm populations. Relatively warm, dry days in June through August following a warm September in the previous year can result in a rapid increase in blackheaded budworm. Natural controls have resulted in significant decreases of blackheaded budworm populations. Some wasps parasitize budworm eggs, larvae, and pupae. A virus, fungi, and larval starvation also have contributed to budworm declines. Songbirds are also effective natural enemies.

No areas of western blackheaded budworm defoliation have been reported since 2003.

Pandora Moth, *Coloradia pandora*

Hosts: ponderosa pine, Jeffrey pine, lodgepole pine

In the Pacific Northwest Region, Pandora moths occur in central and southern Oregon, preferring the pumice soils. Periods of heavy defoliation during outbreaks can weaken trees, making them more susceptible to bark beetle attacks. Due to the 2-year life cycle (feeding in alternate years), and the fact that terminal buds are not eaten, trees often have an opportunity to recover. Native Americans traditionally lit ground fires to roast the pupae, which provided a source of protein.

A special survey is conducted in even years to coincide with the insect's life cycle. In 2006, Pandora moth defoliation was detected on 11,058 acres. Of this, only 1,124 acres were mapped in the moderate defoliation category, the remaining acres were mapped as "light." The bulk of the defoliation occurred within a short distance of Highway 97, between Sand Creek to the north and Calimus to the south. The affected lands were a mix of federal (Winema National Forest) and private lands. A 794 acre polygon isolated from the majority of the other defoliated areas was detected west of Bear Butte Lookout, mostly on private lands.

Phantom Hemlock Looper, *Nepytia phantasmaria*

Hosts: Douglas-fir, western hemlock

The primary hosts of the phantom hemlock looper are western hemlock, although western red cedar, Sitka spruce, true firs, and pines have also been recorded as hosts.

Larvae feed first on the new foliage, then on the old. Outbreaks of phantom hemlock looper are often not observed because they tend to be local and sporadic. Populations of phantom hemlock looper have been found to be abundant in identified outbreaks of western hemlock looper and western blackheaded budworm.

Approximately 5,700 acres of defoliation were mapped in 2002. No areas of phantom hemlock looper defoliation have been mapped since 2002.

Western Hemlock Looper, *Lambdina fiscellaria lugubrosa*

Hosts: western hemlock and associated confers.

The primary hosts of the western hemlock looper are western hemlock; however, during outbreaks other associated conifer species are also defoliated, including western red cedar, true firs, Douglas-fir, spruces, western white pine and larch.

The larvae are wasteful feeders, chewing off needles at their bases and thus causing the stand to appear yellowish-red and brown in color. In heavy infestations, trees may be stripped in a single season. Defoliation starts in the upper crown, but as feeding progresses more and more of the crown is affected, increasing the risk of mortality. Late in summer, larvae are very mobile, crawling over tree trunks and shrubs, and dropping by silken threads from the trees to the ground.

Western hemlock looper has caused more mortality of western hemlock than has any other defoliator. Outbreaks generally last for 2 to 3 years on any one site, and mortality seems to be greatest in old growth, although 80 to 100-year old stands can be heavily defoliated. Outbreak collapse is usually brought about by the combined effects of pathogens, parasites, predators, and sometimes, adverse weather conditions or larval starvation.

Acres defoliated in Washington State decreased slightly from 2,307 acres in 2005, to 1,771 acres in 2006. Almost all the affected acres were on the Mt. Baker-Snoqualmie Reporting Area this year.

Insects: Non-Native

Balsam Woolly Adelgid, *Adelges piceae*

Hosts: true firs

The balsam woolly adelgid (BWA) is an introduced insect that has had significant impact on grand fir, silver fir and subalpine fir in Washington and Oregon. It can kill trees slowly by infesting the twigs or branches, or quickly, by infesting the bole. It also causes gouting of branch nodes. During the 1950's and 1960's it caused extensive mortality primarily along the Cascade Range. Since that initial mortality, BWA damage has been chronic and subtle and is not often visible from the air.

In 2006, balsam woolly adelgid activity was detected on fewer acres in Region 6, but at somewhat higher intensities. Over 108,000 acres of BWA damage were detected in 2005, compared to a total of 91,350 acres affected in 2006. Better detection methods for BWA have resulted in a steady increase in areas mapped. Data would indicate an eastward trend of spread and intensification.

Acres affected by BWA fluctuated throughout Region 6. The Gifford-Pinchot Reporting Area decreased from 8358 acres in 2005, to 4316 acres in 2006. The Malheur Reporting Area increased from 2,474 acres in 2005 to 6,386 acres in 2006. Mt. Rainier National Park stayed fairly constant, with 4,656 acres in 2005, then 4,583 acres in 2006. The Olympic National Park

Reporting Area decreased from 10,069 acres in 2005, to 8,039 acres in 2006. The Umatilla Reporting Area decreased from 22,873 acres in 200t, to 9,790 acres in 2006. The Wallowa-Whitman Reporting Area decreased from 36,037 acres in 2005, to 22,918 acres in 2006. The Wenatchee Reporting Area increased from 3,712 acres in 2005 to 6,269 acres in 2006. And finally, the Willamette Reporting Area decreased from 6,259 in 2005 to 4,119 acres in 2006. Once the insect infests an area changes in acres of infestation may be a result of weather factors or decrease in host type.

Gypsy Moth, *Lymantria dispar*

Hosts: oaks, apple, sweet gum, and other hardwoods

While no defoliation has been observed in either state, pheromone traps continue to catch moths. These catches represent either new introductions or populations not completely eradicated by previous treatments. In 2006, traps captured 47 moths in Bend Oregon, Subsequent ground surveys located larvae, adults and new egg masses at a residence, and 537 acres were identified for a potential eradication project in 2007. In Kent Washington, a small reproducing population was found near a strip mall. This area is also proposed for a 2007 eradication project. In addition, an Asian gypsy moth was captured near St. Helens, OR. One Asian moth is usually the trigger for an eradication project. A 640 acre eradication project is proposed for 2007 in the St. Helens area.

Larch Casebearer, *Coleophora laricella*

Hosts: western larch

Ideal timing for a larch casebearer survey in the Pacific Northwest is in June; however, most of the surveys in larch type occur in late July through early September. Poor visibility due to large wildfires delayed the start of our aerial survey season in 2006.

Approximately 337 acres were mapped in 2006 compared to 2,532 acres mapped in 2005. It should be noted, however, that a training flight conducted in June over the Mt. Hood National Forest detected widespread defoliation throughout the host type.

Introduced parasites released in the Pacific Northwest in the early 1960's and established years ago, along with needle diseases on larch, helped maintain low levels of casebearer for many years. As casebearer populations declined, so did the introduced parasites. Parasites are expected to respond to the increasing casebearer population, although there may be several more years of defoliation before they increase to effective levels. Refoliation of larch in late summer typically masks most of the defoliation, and as a result these trees are not as evident to observers later in the season. The ability of larch to refoliate is one of the reasons we do not expect to see tree mortality as a result of this insect. Accurate assessment of the casebearer situation would require extensive aerial survey in early June, rather than late summer.

Diseases: Native

Annosus Root Disease, caused by *Heterobasidion annosum*

Hosts: true firs, pines, and hemlocks

Annosus root disease causes damage primarily in partially harvested white and grand fir stands in southern and eastern Oregon and eastern Washington. Damage from root and stem decay also occurs in subalpine fir, red fir, noble fir, pacific silver fir, and mountain hemlock, especially in partially harvested stands and in wounded trees. Mortality is high where annosus root disease and fir engravers occur together. Despite high infection levels in true fir stumps cut 20-25 years ago, mortality of surrounding conifer regeneration is low in northeastern Oregon, but infection levels are high especially in sapling grand fir, subalpine fir, Engelmann spruce, and Douglas-fir. Annosus root disease in low-elevation western hemlock occurs primarily as a butt rot in wounded trees. Efforts are underway to artificially inoculate unwanted western juniper with *H. annosum* to create mortality centers in eastern Oregon. Ponderosa pine and associated western juniper are frequently infected and often killed on drier sites east of the Cascades.

Armillaria Root Disease, caused by *Armillaria ostoyae*

Hosts: conifers

Armillaria root disease causes serious mortality losses east of the Cascade Range in mixed-conifer stands. It is the most commonly encountered root disease in Oregon and Washington. True firs sustain the most losses; however, in localized areas Douglas-fir and ponderosa pine mortality can be significant. Several large Armillaria clones exist throughout the region. Thinning of young conifers has been shown to significantly increase tree growth rates and reduce mortality caused by Armillaria root disease in the Cascade Range of Oregon and Washington. Permanent plots on the Winema National Forest were examined in 2005. Ten years after commercial thinning, shelterwood harvesting, and group selection cuts, crop-tree mortality caused by Armillaria root disease is, at least, not exacerbated by harvesting, and at most, reduced by the silvicultural methods tested. Assessing species resistance on a site-by-site basis and discriminating for the more resistant species during stand management activities are considered the most effective means of reducing disease spread and tree mortality. Infected trees are often attacked by bark beetles. Efforts continue to validate the Western Root Disease Model in Armillaria-affected forests.

Black Stain Root Disease, caused by *Ophiostoma wageneri*

Hosts: Douglas-fir, ponderosa pine

In southwestern Oregon, black stain root disease is the most commonly encountered disease in Douglas-fir plantations. High-risk areas are those where disturbances, such as thinning, road building or soil compaction, have occurred or where road maintenance equipment injured roadside Douglas-firs. Infected larger individuals are found scattered in previously entered forest stands.

Black stain root disease continues to be observed on ponderosa pine east of the Cascades; it is widespread on the southeastern portion of the Malheur National Forest. Some smaller localized infestations are known in the Deschutes National Forest and in portions of the Blue Mountains. Black stain root disease is seen infrequently in eastern Washington. Pacific Northwest Research Station scientists are investigating relationships with natural and prescribed fire, vector insects, and management strategies.

Cytospora canker of true firs, dwarf mistletoe, sawfly (unknown species), and fir engraver beetle complex, *Cytospora abietis, Arceuthobium* spp., *Neodiprion* sp. *and Scolytus ventralis*

Hosts: true firs

The various agents of this complex are widely distributed throughout Oregon and Washington wherever true firs occur. Activity levels of each agent typically fluctuate more-or-less independently among locations and over time. *Cytospora abietis* is a weak, canker-inducing fungus that attacks stressed trees. It commonly infects branches bearing dwarf mistletoe infections (described below), causing branch death. Conifer-feeding sawfly larvae feed on old foliage, temporarily weakening trees and slowing their growth. Outbreaks are usually sporadic and subside quickly. Fir engraver beetle (described above) activity is strongly associated with tree stress.

Aerially detected damage increased from 2,916 acres in 2005 to 6,687 acres in 2006. Most of the aerially detected damage occurred within the Rogue River and Siskiyou Reporting Areas.

Aerial observers sometimes mistake the color signature of cytospora with that of balsam woolly adelgid. Incidence was associated with mature noble fir and silver fir stands located near ridge tops, and is probably related to drought stress.

Laminated Root Rot, caused by *Phellinus weirii*

Hosts: highly susceptible – Douglas-fir; mountain hemlock; white, grand, and Pacific silver fir

Laminated root rot is the most serious forest tree disease west of the Cascade Mountain crest in Washington and Oregon. Overall, an estimated eight percent of the area with susceptible host species is affected in this portion of the Region. Locally, 15 to 20 percent of an area may be affected. East of the Cascade crest, laminated root rot affects mixed-conifer stands north of the Crooked River in central and northeastern Oregon, and throughout eastern Washington.

Besides the highly susceptible hosts listed above, the other true firs, spruce, larch, and hemlock are intermediately susceptible; lodgepole, sugar, and western white pine are tolerant; cedars, redwood, and ponderosa pine are resistant, and all hardwoods are immune. Effects of the disease include significant changes in species composition, size, and structure. Regeneration of susceptible species in root disease centers may not grow beyond sapling and pole-size trees. Hardwood trees and shrubs often increase their site capacity. Infected conifers are often attacked by bark beetles.

PNW Research Station scientists recently have shown that stump removal and fertilization of *P. weirii*-infested stands affect mortality and growth of planted Douglas-fir, 20 years after treatment.

Dwarf Mistletoes, *Arceuthobium* spp.

Hosts: conifers

Dwarf mistletoes are present on approximately 9.5 million acres of forested lands in the Pacific Northwest Region. Their status changes little from year to year. However, long-term impacts, including reducing growth, mortality, deformity, and top-kill, are significant, particularly in unmanaged stands. Most conifer species are affected to some degree. Douglas-fir dwarf mistletoe is abundant east of the Cascades and in southwestern Oregon. Western larch dwarf mistletoe causes significant effects in northeastern Oregon and eastern Washington. The intensity of dwarf mistletoes in eastern Oregon and Washington and in southwest Oregon is closely related to fire ecology. Lack of frequent, periodic fire in the last century has allowed infection levels to increase on many sites, especially those where mistletoe was not culturally controlled. New management policies including green tree retention requirements and restrictions on silvicultural treatment of certain sensitive areas and large diameter trees will reduce sanitation opportunities, and allow mistletoe intensification in the future. New information about wildlife use of dwarf mistletoe is leading to retention of infected trees in some locations.

Swiss Needle Cast, caused by *Phaeocryptopus gaeumannii*

Hosts: Douglas-fir

Swiss needle cast, a fungal-caused foliage disease of coastal Douglas-fir, has caused significant volume growth loss estimated at 25% throughout coastal Oregon and parts of Washington. A combination of warmer winters, increasing acreages of Douglas-fir, and the presence of two distinctive lineages of the fungus may be the cause of the severe disease symptoms over the past 15 years.

A special survey was conducted in the spring 2006 for Swiss needle cast in the Coast Range of Oregon. The survey determined that there was 324,584 acres (2005 had 207,090 acres) affected by Swiss needle cast in Oregon. Severe defoliation was mapped on 68,889 acres, mostly in Tillamook County, with the remaining areas mapped as moderate.

In 2006, 59 Douglas fir stands in the northern Oregon Cascade foothills were examined for Swiss needle cast. Over the past five years, needle retention increased by 1.2 years. There were poor correlations between severity of Swiss needle cast and 5-year Douglas fir growth.

The disease is also severe in localized areas in coastal Washington, although no special surveys were conducted in this area.

Thinning of young trees has been recently been recently shown to result in improved volume growth of severely affected trees. Research on Swiss needle cast continues at Oregon State University and the PNW Research Station concerning growth impact, infection biology, nutrient imbalances, fungicide testing, and fertilizer and vegetation control.

Larch Needle Cast and **Larch Needle Blight**, caused by ***Meria laricis*** and ***Hypodermella laricis***

Hosts: western larch

Larch needle blight and larch needle cast, reported as a complex because of their similar signatures as viewed from the air, increased significantly from 4,011 acres reported in 2005 to 29,650 acres in 2006. High concentrations were mapped in the Colville and Wenatchee Reporting Areas, with lighter amounts mapped in the Kaniksu, Wenatchee, Okanogan and Northeast Washington Reporting Areas.

Concentrations of infections were quite localized and mainly involved dense thickets of seedlings and saplings. These foliage diseases were most severe in stands of western larch growing in moist grand fir and moist subalpine fir plant associations, as well as in riparian areas.

Lodgepole Pine Needle Cast, caused by ***Lophodermella concolor***

Hosts: lodgepole pine

Appearance of this needle disease on lodgepole pine is sporadic and strongly influenced by weather conditions. Infected trees will shed foliage prematurely, and vigor and growth may be reduced with successive years of infection. Trees are affected with heavy discolorations of the lower crowns of lodgepole pine. Areas mapped as affected by lodgepole pine needle cast in 2006 totaled 651 acres, a decrease from the 3,312 acres reported in 2005.

Over 82% was mapped on the Umpqua, Colville and Fremont Reporting Areas.

Diseases: Non-Native

Port-Orford-cedar Root Disease, caused by ***Phytophthora lateralis***

Hosts: Port-Orford-cedar, Pacific yew

The annual aerial survey reported evidence of Port-Orford-Cedar root disease on 10,669 acres, 1.19 TPA in 2006, up from 9,336 acres, 0.86 TPA in 2005. These acres are located in the Coos-Douglas Reporting Area in southwest Oregon.

Mapping of surviving Port-Orford-Cedar inside the Biscuit fire perimeter was completed: http://fhm.fs.fed.us/posters/posters06/biscuit_fire.pdf.

Biscuit Fire landscape patterns showed that both Port-Orford-Cedar and *Phytophthora lateralis* acres were reduced post fire. Mapped Port-Orford-Cedar acres declined from 89,980 to 23,282 (25.9% of pre-fire acres). Mapped *Phytophthora lateralis* acres were reduced from 3,022 to 835 (27.6% of pre-fire acres).

Post-fire, Port-Orford-Cedar is more strongly associated with riparian areas.

Areas of serpentine soils that still have Port-Orford-Cedar tended to burn with greater severity than non-serpentine soils with post-fire Port-Orford-Cedar. In the Oregon portion of the Biscuit Fire, approximately 34% of Port-Orford-Cedar acres on serpentine soils (3,958 of 11,824 acres) were characterized by dead trees with or without needles. This compares to 13% of Port-Orford-Cedar acres on non-serpentine soils (1,571 of 12,037 acres) characterized by dead trees with or without needles.

Hosts growing adjacent to streams, in swamps, along drainage ditches, and low-lying areas downhill from roads suffer by far the greatest impacts. Roadside sanitation has been shown to successfully remove 100% of Port-Orford-Cedar under 7 inches dbh along twenty miles of road on the Illinois Valley Ranger District in southwest Oregon. The roadside sanitation work was accomplished by service contract at a cost of $300 to $400 per acre or $2,700 to $3,600 per road mile (9 treatment acres / road mile). Removal of Port-Orford-Cedar from infested sites reduces the potential for pathogen export. Removal of Port-Orford-Cedar from uninfested sites reduces the potential for pathogen establishment.

White Pine Blister Rust, caused by *Cronartium ribicola*

Hosts: western white pine, sugar pine, whitebark pine

Cronartium ribicola was introduced to the west coast in 1910. Its impacts include top-kill, branch flagging, and tree mortality. While much of the mortality associated with this disease occurred earlier in the century, its impacts are still great in wild populations of five-needled pines throughout their range. Locally, this disease, in combination with mountain pine beetle, still kills many host trees. Of particular concern are the effects of blister rust in whitebark pine at high elevations in the Cascades and in the Blue and Wallowa Mountains and in sugar pine in southwest Oregon where about 45 percent of stands with host components are affected.

An attempt was made to identify areas symptomatic of blister rust through aerial survey beginning in 1994. Blister rust is known to occur extensively throughout the range of susceptible host type. Observers mapped approximately 995 acres in 2006, down from 2,211 acres in 2005. With the exception of blister rust in whitebark pine (which grows at higher elevations and in more open conditions), blister rust is very difficult to detect from the air.

Sudden Oak Death, caused by *Phytophthora ramorum*

Hosts: tanoak, others

Phytophthora ramorum, the causal agent of Sudden Oak Death (SOD), was first discovered in Oregon by aerial survey in July 2001. Since fall of 2001, state and federal agencies have been attempting to eradicate *P. ramorum* from infested sites by cutting and burning all infected host plants and adjacent apparently uninfected plants, and treating stumps to prevent sprouting. At of the end of 2006, the area under federal and state quarantine is 21.5 mi^2 near Brookings, Curry County, Oregon. 139 new infected trees in 35 disease centers on approximately 40 acres were discovered in 2006, bringing the cumulative (2001-2006) infested area in Curry County to 128

acres. Two of the new infested sites were found outside of the quarantine zone; one of these sites was discovered using stream baiting techniques. The infested sites occur on lands administered by the USDA Forest Service, USDI Bureau of Land Management, Oregon State Parks, private industrial and private non-industrial forestlands.

2006: In Oregon and Washington, nursery surveys, surveys of the forest environs adjacent to nurseries, and general forest areas were surveyed using the national survey protocol. Streams within the quarantine zone, adjacent to the quarantine zone, and in host-type in other portions of western Oregon were monitored using stream baiting techniques. Oregon had 13 confirmed *P.ramorum* – positive nurseries. In all cases eradication activities were carried out using the appropriate protocol for the site.

Two aerial surveys were done in Oregon for SOD in 2006. In June, 280,000 acres were flown using fixed wing aircraft. The helicopter survey follow-up encompassed 145,000 acres. In October, 280,000 acres were again flown using fixed-wing followed by a survey of 171,000 acres using helicopter.

Animal Damage

Bear Damage, *Ursus americanus*

Hosts: Douglas-fir, western hemlock, and Port-Orford-cedar

Loss of crop trees and reduction in value due to feeding by bears is a widespread problem in the Pacific Northwest. Bark peeling by black bear can kill trees, and result in stain, decay, breakage, and loss of value in trees that are not killed outright. Bears are attracted to thinned plantations and feed on trees from April to July. Bears tear off large patches of bark and feed on the cambium, and can damage many trees per day. Loss in merchantable volume in Douglas-fir trees that have suffered past bear damage can run 7 to 10 percent.

Acres with trees killed by bear as interpreted by aerial observers increased from 271,976 acres (2.52 TPA) in 2005 to 344,909 acres (1.91 TPA) in 2006. Note that bear damage and root disease damage can have similar aerial signatures, and ground truthing of aerial observation is necessary.

Nursery Insects, Diseases, & Other Agents

Aphids, unidentified species

Host: Oregon ash, red-osier dogwood

Aphid populations built up to damaging levels in containerized ash and dogwood at one nursery. Two separate populations were treated with Safer soap. The soap treatments and sanitation of infested seedlings provided sufficient control.

Black Vine Weevil, *Otiorhynchus sulcatus*

Hosts: containerized conifers, hardwoods, and shrubs

Monitoring was conducted weekly from April through August at one nursery. Root weevil activity was observed in mid-June. Two treatments of chlorpyrifos were made. Damage was minimal.

Cranberry Girdler, *Chrysoteuchia topiaria*

Host: conifers

Monitoring for the girdler was done with the standard pheromone trap system at one nursery. Routine monitoring of seedlings in the seedbeds during the growing season did not reveal any significant damage. Nursery personnel will continue to monitor seedlings for girdler damage during lift and pack. No chemical treatments were used.

Fungus Gnats, Family Sciaridae

Hosts: containerized conifers, native shrubs

Fungus gnat populations became a problem in two crops of conifers growing in Q-plugs at one nursery. A fair amount of mortality was caused by feeding damage on young roots. Five applications of Gnatrol (*Bacillus thuringiensis)* reduced gnat populations and prevented further damage. At another facility, the fungus gnat population built up in containers of native shrub species. Removal of empty containers, doubles, algae and weeds, and placement of yellow sticky traps across the trays reduced the population to acceptable levels.

Leafroller Moths, Family Torticidae

Hosts: western red cedar

Western red cedar seedlings at one container facility were damaged by feeding by the leafroller moth larvae. The damage was not extensive enough to require treatment.

Lygus Bug, *Tropidostepes* spp.

Hosts: conifers

Monitoring for the lygus bug was done with the yellow sticky trap system at one nursery. Insect levels were low for most of the season and then increased rapidly toward the end of July. Two treatments with Asana were made after high insect numbers were noted. Inspection of seedlings in the seedbeds revealed minor damage on the plants during the growing season. Nursery personnel will continue to monitor seedlings for lygus damage during lift and pack.

Root Weevils, unidentified species

Hosts: red alder

Red alder seedlings at a container facility were damaged by feeding by root weevil larvae. The damage was not extensive enough to warrant treatment.

Corky Root Syndrome, *Cylindrocarpon destructans* and *Fusarium* species

Hosts: western white pine, sugar pine

A minor amount of mortality attributed to root disease caused by *Cylindrocarpon destructans* and *Fusarium* species was observed in bareroot sugar pine and western white pine at one nursery during the growing season. Culling due to this problem during lift and pack was insignificant.

Fusarium Root Rot, *Fusarium proliferatum*

Hosts: sugar pine

Fusarium proliferatum was the apparent cause of sugar pine mortality in styroblock containers at two facilities. Sanitation of symptomatic seedlings was sufficient to prevent buildup of inoculum and minimize further losses at one facility. The other facility also reduced humidity by reducing the frequency of irrigation and venting greenhouses after irrigation. In lots with losses greater than one percent, one cause was determined to be germination of more than two seedlings per cell. Once seedlings were thinned to one per cell, the incidence of disease was reduced. In another lot the seed coats did not drop off as quickly as other seedlots, apparently giving the fungus an opportunity to infect the cotyledon needle tips.

Gray Mold, *Botrytis cinerea*

Hosts: conifers

Foliage blight caused by gray mold damaged containerized incense cedar, Port-Orford-cedar, western hemlock and western red cedar seedlings at two facilities. Another facility experienced a minor amount of gray mold on containerized western white pine and whitebark pine in a cooled and humidified greenhouse. The nurseries controlled the disease by spacing seedlings to increase air flow, knocking water off foliage after irrigation in the fall, continuous checks for and removal of infected foliage, and treatments with chlorothalonil, propiconazole or Zerotol.

Leaf Spots, *Marssonina populi*

Hosts: black cottonwood

One treatment of Benomyl was used to control black spot in containerized black cottonwood seedlings at one nursery.

Needle Cast, unidentified species
Hosts: sugar pine

Sugar pine rootstock, grown outdoors, was infected by an unidentified needle cast fungus due to favorable conditions created by heavy fall precipitation. When the trees were taken into a greenhouse for grafting the infected needles were removed. The grafted trees were treated with chlorothalonil prior to shipment.

Phytophthora Root Rot, unidentified *Phytophthora* species
Hosts: conifers

One nursery is continuing to irrigate bareroot crops with untreated water. The water was sampled periodically for *Phytophthora* species during the growing season. No *Phytophthora* species were found in water within the nursery system. No evidence of Phytophthora root disease was observed in the field. Monitoring of water and crops will be continued.

Canada Geese, *Branta canadensis*
Hosts: grasses

Canada geese continued to cause damage in beds of grass grown for seed at one nursery. Damage is minimized by planting species that the geese use for forage a greater distance from the nursery reservoir where they congregate. No control treatments were used.

Jackrabbits, *Lepus* species
Hosts: conifers

Jackrabbits caused a fair amount of damage in bareroot conifer seedlings of several species at one nursery. They caused a noticeable amount of damage by biting the tops off seedlings in random areas and also by creating runs. No control treatments were used.

Seed Orchard Insects, Diseases, & Other Agents

Cone Beetle, *Conophthorus* species
Hosts: ponderosa pine, western white pine

Minor damage was reported from one western white pine orchard. At one ponderosa pine orchard the cones were bagged to prevent damage. The treatment was effective but labor-intensive.

Cone Midge, unidentified species

Hosts: Douglas-fir

A survey by FHP personnel at one seed orchard indicated that cone midges were present on Douglas-fir trees. The trees were treated with esfenvalerate to protect the cone crop.

Cooley Spruce Gall Midge, *Adelges cooleyi*

Hosts: Douglas-fir

Adelgids were found infesting rootstock grafts at one orchard. The trees were treated with horticultural oil to prevent further damage, and to prevent the adelgid population from building up and spreading to other trees.

Douglas-fir Cone Gall Midge, *Contarinia oregonensis*

Hosts: Douglas-fir

Minor *Contarinia* damage of the 2006 cone crop was noted during longitudinal cut-face counts in early August at one orchard. The cone crop yielded bushel amounts slightly below what would be considered average. Duff vacuuming was conducted on three acres in fall 2005 (which were also treated with imidacloprid in 2006) as a means of removing overwintering habitat. Capsule injection of imidacloprid was applied to 25 acres in late winter 2006. An aerial application of esfenvalerate was applied to 27 orchard acres in early spring 2006 for the primary purpose of reducing Douglas-fir gall midge damage. At another orchard where medium to high levels of damage were observed, two orchard blocks were treated with Asana. The treatment was very effective. Next year three blocks at this orchard will probably be treated with Asana.

Douglas-fir Cone Moth, *Barbara colfaxiana*

Hosts: Douglas-fir

Cone moths caused significant damage in one Douglas-fir seed orchard where no protection was used. Trees with a large proportion of damaged cones were left unharvested.

Douglas-fir Seed Chalcid, *Megastigmus spermotrophus.*

Hosts: Douglas-fir

Megastigmus was noted during longitudinal cut-face counts in early August at one of the orchards. Damage was considered very minimal. No chemical control measures were used.

False Chinch Bug, *Nysius* species

Hosts: Port-Orford-cedar

Damage from false chinch bugs contributed to a reduction in the percentage of filled seed in controlled crosses of containerized stock. The orchard experimented with control treatments and is assessing the results.

Western Conifer Seed Bug, *Leptoglossus occidentalis*

Hosts: sugar pine, western white pine

At one western white pine orchard seed bugs were observed for the first time. The damage was discovered just before harvest so there was no treatment. The crop was good in spite of the damage. The orchard is considering alternatives for treatment next year. They may bag cones as a preventive measure. At a sugar pine orchard a few seed bugs were observed where cotton cone bags had been installed during late winter. Damage to the harvested seed was believed to be minor.

Western Red Cedar Gall Midge, *Phytophaga thujae*

Hosts: western red cedar

This insect was observed for the first time at one of the orchards. They are probably coming from western red cedars growing in riparian areas near the orchard. Treatment may be needed next year to prevent damage to cones in orchard trees that were treated with gibberillic acid to stimulate cone production.

Cypress Canker, *Seiridium cardinale*

Hosts: Port-Orford-cedar

Cypress canker continues to affect a small number of trees in a containerized orchard. Diseased trees are removed and destroyed.

Phytophthora Root Disease, *Phytophthora cinnamomi*

Hosts: whitebark pine

In one orchard, *Phytophthora cinnamomi* caused mortality in three year old whitebark pine seedlings in test frames used for testing resistance to white pine blister rust. The affected seedlings and soil were removed and destroyed. A new water treatment system and improvements in preventive measures, early detection and sanitation will be used to reduce damage from this disease in the future.

Phytophthora Root Disease, *Phytophthora cryptogea*

Hosts: sugar pine

During the fall of 2005, researchers from Oregon State University and personnel from Forest Service Forest Health Protection identified root disease caused by *Phytophthora cryptogea* throughout one sugar pine orchard. The disease is by far the largest cause of tree mortality in this orchard. Approximately 300 sugar pine trees died during 2006 due to this root disease.

Phytophthora Root Disease, *Phytophthora lateralis*

Hosts: Port-Orford-cedar

Several Port-Orford-cedars in a containerized orchard in a greenhouse were killed by *Phytophthora lateralis*. The affected trees and containers were removed and destroyed. Sanitation and management practices will be used to prevent the spread of inoculum from infected to healthy trees in the future. In addition, the floor of one greenhouse will be paved with concrete this year to make cleaning easier and prevent formation of puddles that harbor inoculum.

Phytophthora Root Disease, *Phytophthora pseudotsugae*

Hosts: bristlecone pine, western white pine

Phytophthora pseudotsugae caused mortality in bristlecone pine and western white pine seedlings in test frames used for testing resistance to white pine blister rust. The affected seedlings and soil were removed and destroyed. The remaining seedlings were treated with metalaxyl. A new water treatment system and improvements in preventive measures, early detection and sanitation will be used to reduce damage from this disease in the future.

Mid-Spring Frosts

Hosts: Douglas-fir

Two mid-spring frosts caused cone and seed production losses of sixty percent at one orchard.

Black Bear, *Ursus americanus*

Hosts: western white pine

Bark was stripped from sixty to seventy trees at one orchard. Chicken wire was wrapped around the trees as soon as the damage was found. A game fence that was previously installed around the orchard will be rebuilt.

Coyote, *Canis latrans*

Hosts: sugar pine

Several coyotes damaged the irrigation system at one seed orchard. The coyotes were hazed and scared away.

Western Gray Squirrel, *Sciurus griseus*

Hosts: sugar pine

Western gray squirrels destroyed about 135 bagged sugar pine cones. The squirrels are hunted with a pellet rifle under a State permit. About 17 squirrels were killed in 2006.

Summary Table

Insect or Disease	State	Ownership	Acres Infested	Volume Killed (m3)	# Trees Killed
Douglas-fir Beetle	OR	federal	5,700	1,018,300	4,600
		state	2,400	828,400	13,000
		private	4,800	1,010,800	3,600
	WA	federal	19,600	10,633,700	90,700
		state	7,900	1,843,100	13,000
		private	12,100	3,431,000	20,600
Fir Engraver	OR	federal	48,600	1,701,400	29,100
		state	4,700	169,400	2,400
		private	17,900	686,200	10,800
	WA	federal	64,700	7,077,800	105,900
		state	32,700	3,220,100	53,800
		private	28,600	3,516,900	58,600
Mountain Pine Beetle	OR	federal	321,700	21,610,800	1,494,400
		state	26,800	3,016,900	183,700
		private	34,800	898,600	61,700
	WA	federal	118,300	19,324,900	1,445,000
		state	57,800	8,420,300	609,900
		private	28,100	2,281,100	159,200

Insect or Disease	State	Ownership	Acres Infested	Volume Killed (m3)	# Trees Killed
Western Spruce Budworm	OR	federal	37,600	0	0
		state	0	0	0
		private	400	0	0
	WA	federal	474,500	0	0
		state	36,500	0	0
		private	44,700	0	0
Western Pine Beetle	OR	federal	9,400	613,700	10,400
		state	500	42,500	500
		private	3,500	188,200	3,800
	WA	federal	9,200	1,006,900	18,500
		state	21,500	2,492,900	42,900
		private	28,300	3,123,800	58,200
Douglas-fir Tussock Moth	OR	federal	0	0	0
		state	0	0	0
		private	0	0	0
	WA	federal	0	0	0
		state	0	0	0
		private	0	0	0