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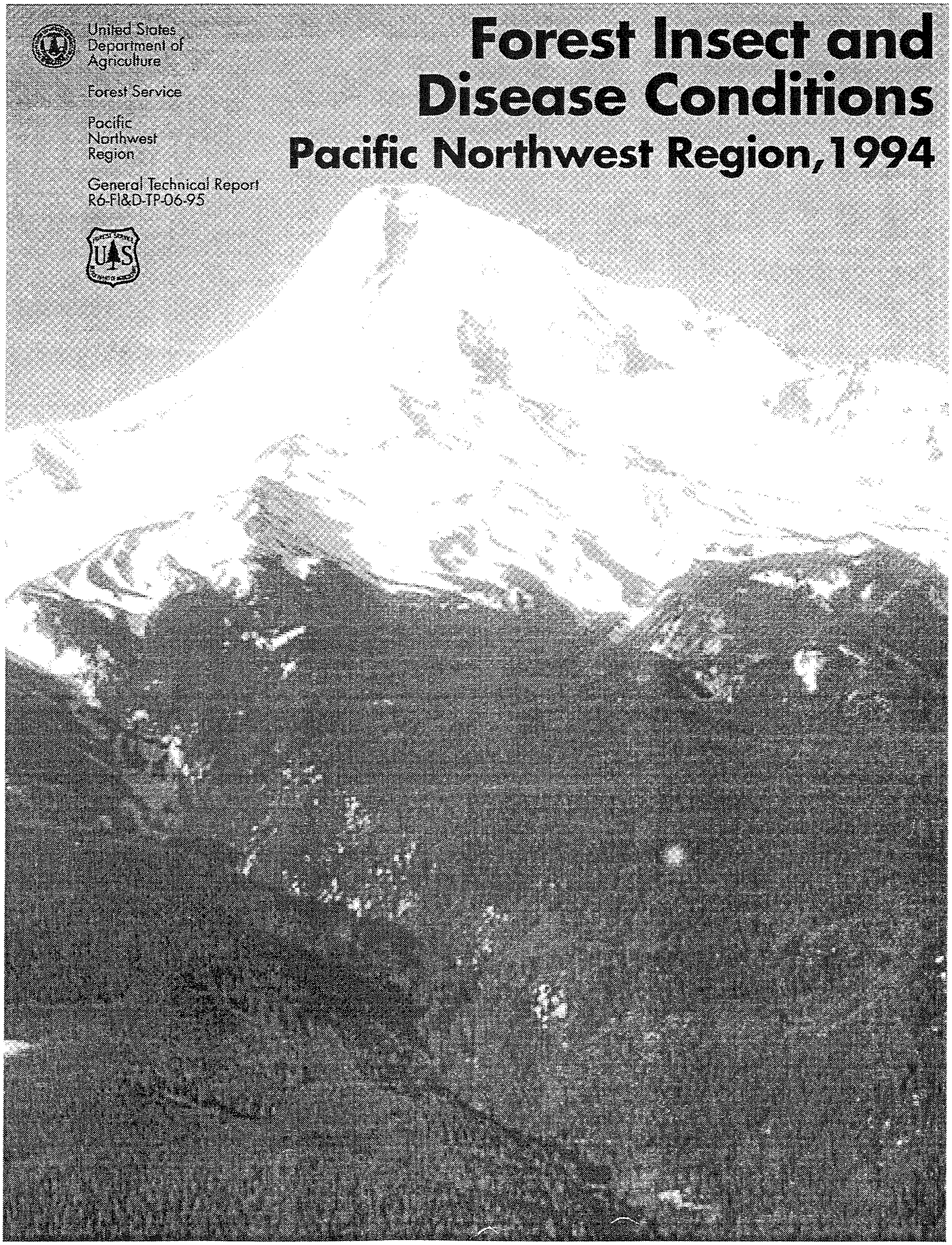
Forest Insect and Disease Conditions
Pacific Northwest Region, 1994



Forest Insect and Disease Conditions

Pacific Northwest Region, 1994

Compiled by Keith Sprengel

Pacific Northwest Region
Natural Resources
Forest Insects and Diseases

April, 1995

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NOTE: This technical center is located in the Columbia Gorge Ranger Station until the new Mt. Hood National Forest Headquarters building is completed.

Introduction

This report summarizes activities of the Forest Insects and Diseases (FID) staff and the status of forest insects and diseases in the Pacific Northwest Region for 1994, and looks at some trends leading up to 1994. Estimates of tree mortality, acres affected and locations of major insect activity are shown in tables and figures. Narratives reflect existing field conditions and, to a certain degree, the level of participation by area pathologists and entomologists in the preparation of this report.

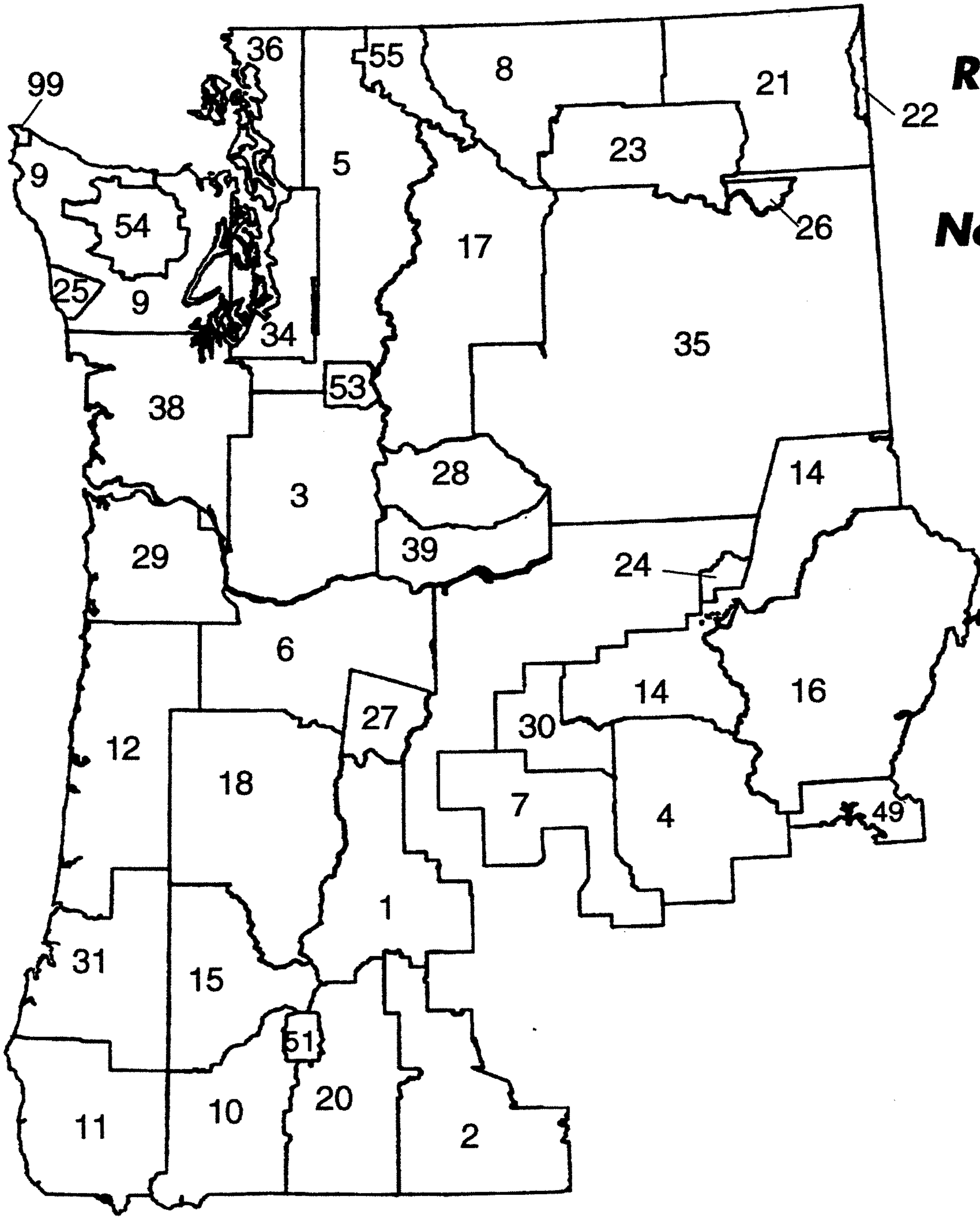
Trees affected by forest insects and diseases were detected and recorded during aerial and ground surveys made cooperatively by personnel from the USDA Forest Service, Oregon Department of Forestry, and Washington Department of Natural Resources. Detection flights were conducted over approximately 55,000,000 forested acres in Oregon and Washington.

Data included in this report are based on sketchmaps prepared by observers during aerial survey flights. Observers have just a few seconds to recognize color differences between healthy and damaged trees of different species; diagnose damage cause correctly; estimate the intensity or extent of damage; and record observations as accurately as possible on a 1:100,000 scale map. Numerous variables can affect the quality of the survey from which the bulk of the enclosed data is derived. Variations in visual conditions (most of the Region had poor visibility due to a record number of large, intense fires); damage (symptoms can be very similar from one host to another; for example, the appearance of western white pine infested with mountain pine beetle is difficult to distinguish from Douglas-fir infested with Douglas-fir beetle when viewed from an airplane); and observer skill can all affect the quality of the survey. In spite of these cautions, aerial sketch-mapping surveys are a cost effective way to rapidly estimate insect activity across large areas. These sketchmaps and the resultant data summaries provide an estimate of conditions and may differ from those observed on the ground. The aerial survey provides information on the current status of insect activity, and is important in examining insect activity trends by comparing previous and current survey data over large areas.

Specific information regarding insect and disease activity and trends for your area may be obtained at your FID area office.

Figure 1

Reporting Areas, Pacific Northwest Region



1	Deschutes N.F.
2	Fremont N.F.
3	Gifford Pinchot N.F.
4	Malheur N.F.
5	Mt. Baker-Snoqualmie N.F.
6	Mt. Hood N.F.
7	Ochoco N.F.
8	Okanogan N.F.
9	Olympic N.F.
10	Rogue River N.F.
11	Siskiyou N.F.
12	Siuslaw N.F.
14	Umatilla N.F.
15	Umpqua N.F.
16	Wallowa-Whitman N.F.
17	Wenatchee N.F.
18	Willamette N.F.
20	Winema N.F.
21	Colville N.F.
22	Kaniksu N.F.
23	Colville I.R.
24	Umatilla I.R.
25	Quinault I.R.
26	Spokane I.R.
27	Warm Springs I.R.
28	Yakima I.R.
29	Northwest Oregon
30	Central Oregon
31	Coos-Douglas
34	Puget Sound
35	Northeast Washington
36	Northwest Washington
38	Southwest Washington
39	Glenwood
49	Lookout Mountain
51	Crater Lake N.P.
53	Mt. Rainier N.P.
54	Olympic N.P.
55	North Cascades N.P.
99	Makah I.R.

Fire activity in 1994 obscured skies and prevented aerial reconnaissance of many areas within the region. Approximately 202,000 acres in the Colville, and 33,400 acres in the Wenatchee reporting areas were not flown due to fire activity or inadequate visibility.

At the request of the National Park Service over 78,600 acres were not flown on the Olympic peninsula in order to avoid disturbing marbled murrelet nesting sites. Over 21,000 acres were not flown in southwestern Washington due to persistent low clouds or fog. Over 1,500,000 acres were eliminated from the regular survey in northwest Oregon due to an earlier special survey conducted in June by the Oregon Department of Forestry to detect bear damage. Little activity by other causes was detected during the special survey, so it was decided to eliminate these areas from the regular survey to save money.

INSECTS

Insect conditions in the Pacific northwest are assessed, in large part, by annual aerial insect activity detection flights. Information and ground checking are provided by personnel from FID, and National Forest offices, and other federal and state agencies.

Defoliation caused by western spruce budworm, a common defoliator of conifers in the Pacific Northwest, was detected on approximately 123,000 acres. This represents the fewest reported acres affected in over 22 years. Levels of defoliation in 1994 were mostly in the light effects category. Trees repeatedly defoliated experience substantial radial growth reduction, and are often predisposed to attack by various bark beetles. Additional mortality can be expected on trees which have sustained repeated defoliation since the late 1980s.

For the third straight year, the bulk of the defoliation caused by Douglas-fir tussock moth occurred on the Burns Ranger District of the Malheur National Forest. High levels of natural predation and parasitism suggest further declines for 1995. Douglas-fir tussock moths eat the foliage of several tree species, including Douglas-fir, grand fir, and white fir. Acres of detected defoliation in 1994 are down from 1993 levels.

Defoliation caused by the pandora moths which was in its fifth generation in 1994, was detected over 369,000 acres of pines in central Oregon. Although mortality has not been noted, growth loss and possible mortality may follow successive years of outbreak level defoliation. Defoliation intensities in the moderate to heavy categories accounted for 58 percent of the acres reported.

Defoliation of western hemlock by western hemlock looper was mapped in western Washington with the most extensive activity being located on lands within the Mt. Baker-Snoqualmie National Forest and North Cascades National Park. The primary host for hemlock looper is western hemlock, although it will feed on other conifer species and understory shrubs found in association with western hemlock. Heavy, repeated defoliation during an outbreak can result in tree mortality. Outbreaks typically will last three years and are kept in check by natural biological controls.

While no defoliation caused by gypsy moths has been observed in either state, pheromone traps continued to catch moths. As a result of the trap catches further trapping and some eradication projects are planned for both Oregon and Washington. The gypsy moth is primarily a defoliator of hardwoods, but will also feed on the foliage of conifers when found in association with hardwoods.

Mortality associated with mountain pine beetle was down in all host types. Levels of mortality have remained fairly constant over the past five years, and are substantially lower than 1985-1989 levels. In some instances mortality of large individual western white pine and sugar pine is significantly altering stand composition. Mountain pine beetle occurs throughout the range of the pine type in the Pacific Northwest. Adults and larvae feed in the phloem layer of the inner bark, and often cause tree mortality, sometimes over extensive areas.

Western pine beetle activity decreased in acreage throughout most of the region in 1994 in both pole-sized, and large ponderosa pines. The western pine beetle is periodically destructive to ponderosa pine in the Pacific Northwest. Normally this beetle breeds in large, old trees, in windfalls, in trees infected by root disease, or in trees weakened by drought, over-stocking, or fires. Under epidemic conditions it will attack and kill trees of all ages having bark sufficiently thick to protect the insect in its development. Two generations per year of this beetle are typical in the Pacific Northwest.

Douglas-fir beetle activity was mapped on 73,700 acres in 1994. Repeated years of defoliation by western spruce budworm and Douglas-fir tussock moth will continue to contribute to host susceptibility and subsequent mortality. Douglas-fir beetle occurs throughout the range of Douglas-fir, and is considered the most important bark beetle which causes mortality in Douglas-fir. Normally it breeds in felled, injured, or diseased trees. The females bore into the bark and tunnel upward through the phloem. Eventually, girdling of the sapwood and clogging of the conductive tissues by fungi introduced by the beetles can result in mortality. The resulting mortality is widely scattered when at low levels. At times, the insect reaches epidemic levels and kills apparently healthy trees over extensive areas.

Fir engraver activity was at its lowest level in seven years, although various levels of mortality were mapped on over 357,900 acres. Fir engraver infests true firs in western forests. It attacks pole-sized and mature trees causing significant mortality during epidemics. Outbreaks often occur during and following periods of drought. Trees infected with annosus root disease are especially subject to attack. Trees defoliated by Douglas-fir tussock moth or western spruce budworm also are likely to be attacked. It commonly breeds in slash and windthrown trees.

DISEASES

Disease conditions in the Pacific Northwest are assessed by routine stand examinations, periodic vegetation surveys, and special surveys done by Agency personnel or during ground-based surveys and permanent plot monitoring sponsored by the Forest Insect and Disease staff in the Zone/Area/Technical Center or Regional offices.

In general, native diseases of forest trees are slow to spread and intensify. They do not cause the dramatic landscape-level mortality that is often associated with large scale insect outbreaks and their effects are rarely considered catastrophic by common definition. However, these effects can be highly significant over large spatial and temporal scales.

Root diseases, caused by several species of fungi, have significant effects on vegetation in forests of the Pacific Northwest. Root diseases alter forest structure and stocking. Openings may be created that continue to increase in size. Susceptible species reseeding into these openings may never reach more than seedling or sapling stage. Root diseases shift affect species composition and may shift successional pathways forward or backward. In some plant associations large brush patches may develop, whereas in others, late successional species are favored.

Root disease severity and occurrence are dependent upon site and stand history variables. In general, east of the Cascades, stands in late-successional stages with high proportions of shade tolerant species and histories of multiple stand entries have the highest levels of activity. West of the Cascades, site disturbance and regeneration of stands with susceptible species contribute to high levels of incidence and severity.

Root disease effects may be subtle and they are often difficult to detect. Root disease pathogens can persist for several decades in woody material in the soil so they may be present from one generation to the next on a site. They are often difficult to control. Reports of root disease incidence increase as routine stand examinations and surveys place greater emphasis on their detection. Approximately 8.5% of the acreage of commercial forest land on all ownership's is affected by root disease. Local reports may be as high as 17%.

Laminated root rot is the most serious disease of forests west of the Cascade crest and accounts for 60% of all root disease losses. Douglas-fir, grand fir, white fir, and mountain hemlock are readily infected and killed or windthrown when affected by this disease. Regeneration of these highly susceptible species usually does not survive beyond the sapling and pole stages. The causal fungus is very adept at surviving in the wood of roots and may remain viable for up to 50 years. Bark beetles are often found in association with laminated root rot pockets. Tolerant, resistant, or immune species are favored when stands are managed.

Armillaria root disease causes mortality to shade tolerant species in many late successional stage stands in eastern Oregon and Washington and in the Cascades of southwestern Oregon, particularly where past harvest and soil disturbance has occurred. Bark beetles are common associates in these areas. In some locations, ponderosa pine is also heavily damaged. Losses on lower elevation western slopes of the Cascades and in the Coast Range are usually confined to stressed sites or poorly planted trees.

Annosus root disease is being found with increasing regularity in stands which were entered 15-20 years ago, particularly as stump examination becomes routine. Tree mortality caused by the "S" strain of the fungus is found throughout the range of grand fir and white fir in the Pacific Northwest and is greatest where stands with large components of these species were selectively harvested. It is often found in association with fir engraver beetles. The fungus causes butt decay in western hemlock, however damage is not considered to be extensive unless stands are managed on rotations greater than 120 years. Annosus root disease is reported with increasing frequency in high elevation mountain hemlock, noble fir and Pacific silver fir; however its impact is unknown on those sites. The "P" strain of the fungus causes locally heavy mortality in dry ponderosa pine plant communities, particularly in south-central and northeastern Oregon and eastern Washington. It has also been found in association with low mortality levels of lodgepole pine, Douglas-fir and western larch regeneration adjacent to infected stumps. The Annosus Root Disease Model, a new extension to the Forest Vegetation Simulator (Prognosis) model is now available for simulating stands with annosus root disease.

Black stain root disease causes mortality in precommercial thinning-aged stands in southwestern Oregon, especially along skid trails, where stands were tractor logged, or where rotary blade brush cutting equipment has been used along roadsides. Large infected individual Douglas-firs scattered in stands that have been entered are being reported with increasing frequency. Black stain root disease is associated with mortality in overstocked ponderosa pine stands in south-central Oregon as well.

The impact from dwarf mistletoes changes little from year to year, however long term effects including growth loss, topkill, distortion, and mortality in unmanaged stands are great. All conifer species are affected to some degree. Dwarf mistletoes are present on approximately 9.5 million acres, mostly east of the Cascades. Annual timber volume losses are estimated at 131 million cubic feet. Douglas-fir dwarf mistletoe results in high levels of mortality in severely infected trees. Western larch dwarf mistletoe is extensive in north-central Oregon and eastern Washington.

Indian paint fungus is commonly found in older white and grand fir stands, particularly in moist grand fir and white fir plant communities east of the Cascades. Decay caused by the fungus is extensive in older trees.

Non-indigenous diseases often have dramatic effects on susceptible species. White pine blister rust causes topkill, branch flagging, and mortality throughout the range of western white pine, sugar pine and whitebark pine, making the management of those species difficult on high hazard sites. Annual losses are estimated at 15 million cubic feet. Rust resistant planting stock is available and being planted and interest in pruning diseased and susceptible trees is increasing, however serious concern exists for the health and survival of 5-needled pines in certain locations. This is particularly true in high elevation stands and on those overstocked stands where mountain pine beetle, combined with blister rust, is causing high levels of mortality.

Port-Orford-cedar root disease continues to cause substantial Port-Orford-cedar mortality on sites that are favorable in southwestern Oregon. Tree killing is concentrated in wet areas and where water drains downslope from roads.

Interest in diseases of hardwood trees and shrubs is increasing among both resource managers and plant pathologists. Streamside restoration and wildlife habitat enhancement projects have focused attention on the potential impacts of leaf spots and canker diseases of red alder, bigleaf maple, willow species, and Pacific madrone, in particular.

Table 1 – Pacific Northwest Region Summary Table 1994

Causal Agent	Host	Acres	# Trees
Balsam wooly adelgid	True Firs	18381	4348
Bear	Conifers	28534	14627
Blister rust	Five needle pines	3029	0
Douglas-fir beetle	Douglas-fir	73700	61177
Douglas-fir engraver	Douglas-fir	75	40
Douglas-fir tussock moth	Douglas-fir/true firs	26530	0
Engelmann spruce beetle	Spruce	449	215
Fir engraver	True firs	357846	244468
Fire	All species	13864	0
Larch needle cast	Western larch	3175	0
Maple discoloration	Bigleaf maple	320	0
Modoc budworm	White fir	2380	0
Mountain pine beetle	Lodgepole Pine	132379	393045
Mountain pine beetle	Ponderosa Pine	91594	88826
Mountain pine beetle	Sugar Pine	1999	646
Mountain pine beetle	Western White Pine	9886	3467
Mountain pine beetle	Whitebark Pine	1934	275
Needle miners	Lodgepole pine	15753	0
Oregon pine ips	Pines	5372	2530
Pandora moth	Ponderosa/lodgepole pine	369125	0
Port-Orford root disease	Port Orford cedar	23	5
Root disease	Conifers	3791	0
Satin moth	Aspen	3112	0
Silver fir beetle	Silver fir	26	10
Spruce aphid	Spruce	11400	8
W. balsam bark beetle	Sub-alpine fir	4196	1935
Water	Conifers	1158	0
Western hemlock looper	Western hemlock	30869	0
Western pine beetle	Large Ponderosa Pine	50161	29594
Western pine beetle	Pole-size Ponderosa Pine	75661	38198
Western spruce budworm	Douglas-fir/true firs	122985	0

DEFOLIATORS

Western spruce budworm, *Choristoneura occidentalis*

Western spruce budworm is a common defoliator of conifers in the Pacific Northwest. Budworm outbreaks commonly occur in the true fir/Douglas-fir forest type. Larvae prefer new foliage, but also feed on older foliage when new foliage is in short supply. On western larch, larvae not only feed on the needles, but also mine the woody portion of the shoots. Trees repeatedly defoliated experience substantial radial growth reduction, and are often predisposed to attack by various bark beetles. Increasingly effective fire prevention and suppression during this century have eliminated many major fires and nearly all surface fires. As a result, forests that have had no other disturbances, such as timber harvesting, have succeeded steadily toward climax and, consequently, an abundant and expanding source of the budworm's favorite food — shade-tolerant, late successional species.

Areas of visible budworm defoliation continued to decline regionwide. Total acres reported for 1994 were 123,000, compared to 331,500 reported in 1993. This represents a significant decline from the recent high of over 4.7 million acres reported in 1991. Approximately 118,000 acres were classified in the light effects category. Significant areas of detected budworm activity in eastern Washington occurred in Klickitat and Yakima counties. Approximately 50 percent of the detected activity was on Yakima Indian Reservation lands in the Pinegrass Ridge, Signal Peak and areas to the north and south of Cedar Valley. Scattered areas of defoliation were also mapped along the south slopes of Mt. Adams on the Gifford Pinchot National Forest. In the Colville reporting area over 2,200 acres were mapped in the Dunn mountain area, mostly on state and private lands. Over 33,000 acres of defoliation were detected in

Figure 2 – Acres of western spruce budworm-caused defoliation detected during aerial surveys in the Pacific Northwest Region, 1980 through 1994

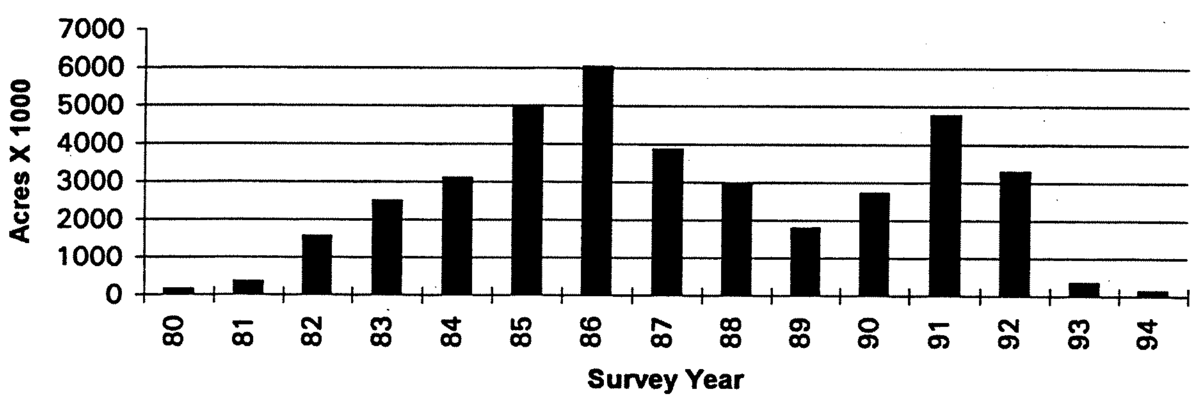
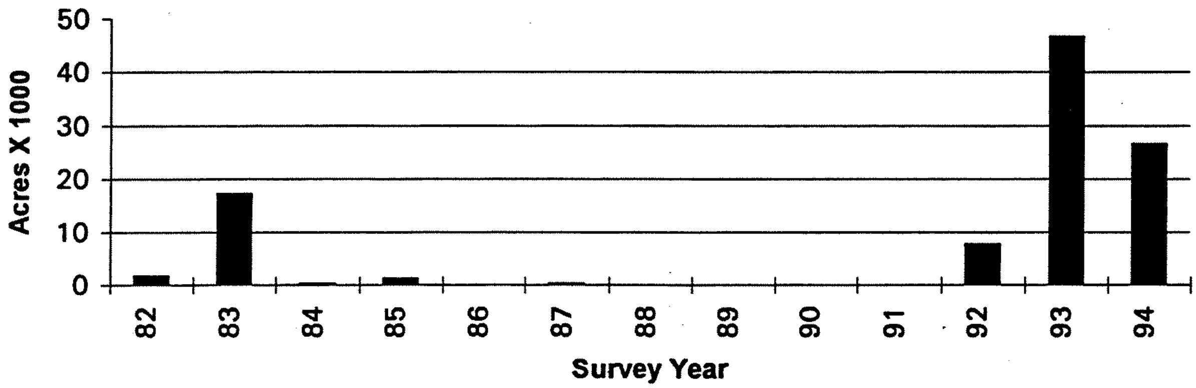


Figure 3 – Acres of Douglas-fir tussock moth-caused defoliation detected during aerial surveys in the Pacific Northwest Region, 1982-1994



Hood River county, Oregon in the vacinity of Mt. Defiance. This represents an increase from 1993 levels, but still substantially lower than 1992 levels reported in the same area. Some defoliation was also detected along the northeast slopes of Mt. Hood and within the Malheur reporting area. Areas which have sustained repeated defoliation since the late 1980's may continue to experience some mortality.

Douglas-fir tussock moth, *Orgyia pseudotsugata*

The tussock moth can eat the foliage of several tree species, but only three are considered primary hosts; Douglas-fir, grand fir, and white fir. Newly hatched and early instar larvae feed on current year's foliage freshly flushed from elongating shoots. Later instar larvae feed on all foliage.

Douglas-fir tussock moth activity was detected for the third straight year on the Burns Ranger District of the Malheur National Forest. Approximately 26,500 acres in the Gold Hill, Sugarloaf mountain, Rattlesnake, and Thompson spring areas were reported as having defoliation caused by Douglas-fir tussock moth. Reported acres in 1994 represent an approximate 20,000 acre decrease from 1993 levels. Results of adult population monitoring in the summer of 1994 as well as observed high levels of natural predation and parasitism suggest further declines for 1995.

Pandora moth, *Coloradia pandora*

The pandora moth is a defoliator of pines. Growth loss and possible mortality may follow successive years of outbreak level defoliation. Trees weakened by successive years of defoliation may also be more susceptible to bark beetle attack. The current pandora moth infestation in central Oregon is in its tenth year or fifth generation (this insect has a two year life cycle). Defoliation, the majority of which occurs in even-numbered years, has increased with every generation since the infestation began in 1988.

A special pandora moth survey conducted June 15, 1994 detected over 369,000 acres of defoliation. Defoliation intensities in the moderate to heavy categories accounted for 58 percent of the acres reported. The affected area was west and south of the area defoliated in 1992, and was centered near the community of La Pine, Oregon. Damage was evident along highway 31 from La Pine to milepost 20, along highway 97 from Sunriver to Gilchrist, and westward to the foothills of the Cascade Mountains. Both ponderosa and lodgepole pines were affected, but appeared to recover and produce new foliage shortly after the summer defoliation. Tree mortality has not been noted thus far in the defoliated areas. Several locations were examined for presence of the naturally occurring virus which, to date, had been fairly rare in the previous four larval generations of the pandora moth. In 1994, this virus was very evident throughout the defoliated area and dead larvae with viral symptoms were common. Nonetheless, many insects pupated successfully within the same areas. A small-scale study is currently underway to determine the level of adult survival and to predict moth flights for the 1995 season.

Western hemlock looper, *Lambdina fiscellaria lugubrosa*

The primary host for hemlock looper is western hemlock, although it will feed on other conifer species and understory shrubs found is association with western hemlock. Heavy, repeated defoliation during an outbreak can result in tree mortality. Outbreaks typically will last three years and are kept in check by natural biological controls.

Western hemlock looper caused defoliation was detected on 2,130 acres of North Cascades National Park and on 20,425 acres of Mt. Baker-Snoqualmie National Forest in 1994 (down from over 47,800 acres detected in 1993). Large polygons along tributaries of the Stillaguamish and Sauk Rivers were mapped in the Darrington area. The Bacon Creek drainage north of Marblemount, and several of the drainages emptying into Baker Lake and flowing from Mt. Baker exhibited light to moderate levels of defoliation. Ground surveys verified the presence of western hemlock looper in the Bacon Creek area.

Over 7,200 acres of defoliation were mapped on the Olympic peninsula, however, we were unable to visit these areas on the ground to verify the observations.

Hemlock sawfly, *Neodiprion tsugae*

Hemlock sawfly is found throughout the range of western hemlock in the Pacific northwest. The larvae feed primarily on older hemlock foliage. Heavy defoliation of hemlock by sawflies is known to cause reduced radial growth and top-kill. As forest defoliators, hemlock sawflies may ultimately influence both stand composition and structure in some areas where they occur. The sawflies themselves are a food source for numerous birds, other insects, and small mammals, as are many forest insects. Hemlock sawfly-caused defoliation was reported in 1993 within the Bull Run watershed along the Bull Run River just to the west and northwest of Big Bend Mountain. No hemlock sawfly-caused defoliation was detected during the 1994 aerial survey.

Gypsy moth (European, Asian, and central Siberian strains), *Lymantria dispar*

The gypsy moth is primarily a defoliator of hardwoods, but will also feed on the foliage of conifers when found in association with hardwoods.

While no defoliation has been observed in either state, pheromone traps continued to catch moths. These catches represent new introductions or populations not completely eradicated by the past treatments.

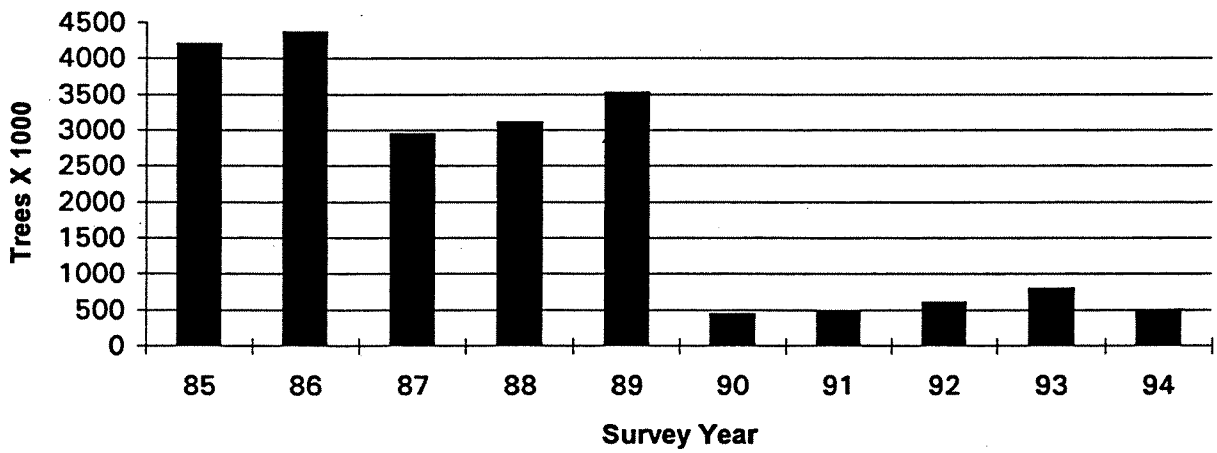
In Washington, two eradication projects totaling 18 acres were conducted using a ground application of *Bacillus thuringiensis* (B.t.). Gypsy moth survey in 1994 resulted in trap catches of 171 individuals. Of those so far typed, seven have been identified as the Asian strain. Eradication projects at Oakbrook (Pierce County) and Anacortes Port (Skagit County) are planned for 1995. The scientific panel has also recommended an eradication project in the Puyallup area as a result of two male moths trapped and identified as being of the central Siberian strain.

In Oregon, eradication projects were conducted in Multnomah and Clackamas counties. Two ground applications of B.t.

were used on 8.25 (seven acres in Clackamas county and a 1.25 acre site in Multnomah county) acres and three aerial applications were made on 270 acres in Carver (Clackamas county). Thirty-six moths were trapped in Oregon, all identified as the European strain. Eradication projects at Jacksonville (ground application of B.t.) and Veneta (aerial applications of B.t.) are planned for 1995.

It is expected that new introductions will continue as long as populations in the east persist and people move from the generally infested area to the Pacific Northwest.

Figure 4 – Tree mortality associated with mountain pine beetle in the Pacific Northwest Region, 1985 through 1994, all host types



BARK BEETLES

Mountain pine beetle, *Dendroctonus ponderosae*

Mountain pine beetle occurs 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. Feeding often girdles the tree resulting in tree mortality. Infestations, in some cases, have resulted in extensive mortality over large areas.

Total area affected by mountain pine beetle decreased from 546,000 acres (an average of 1.44 trees/acre) in 1993 to 237,800 acres (an average of 2.04 trees/acre) in 1994.

Mountain pine beetle in ponderosa pine: The mountain pine beetle breeds and com-

Figure 5 – Tree mortality associated with mountain pine beetle in ponderosa pine, 1990 through 1994

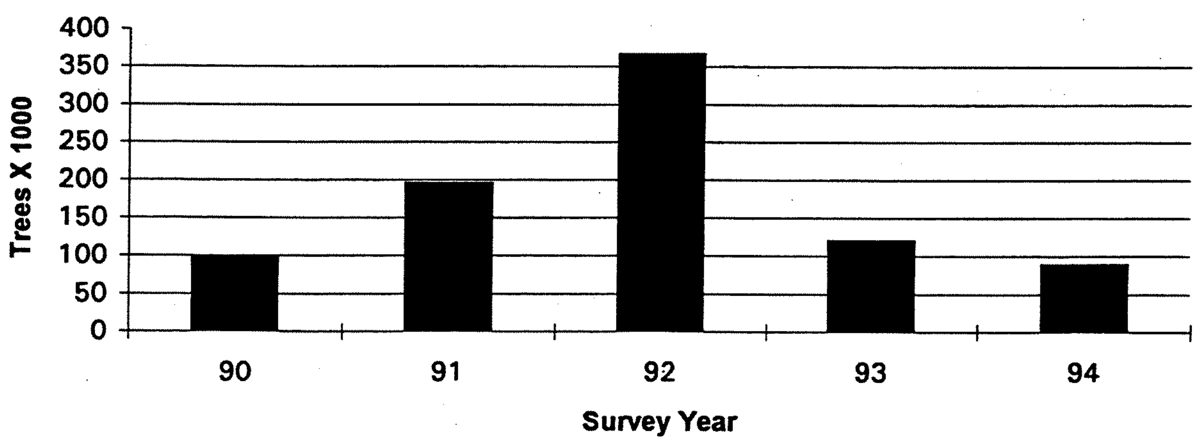
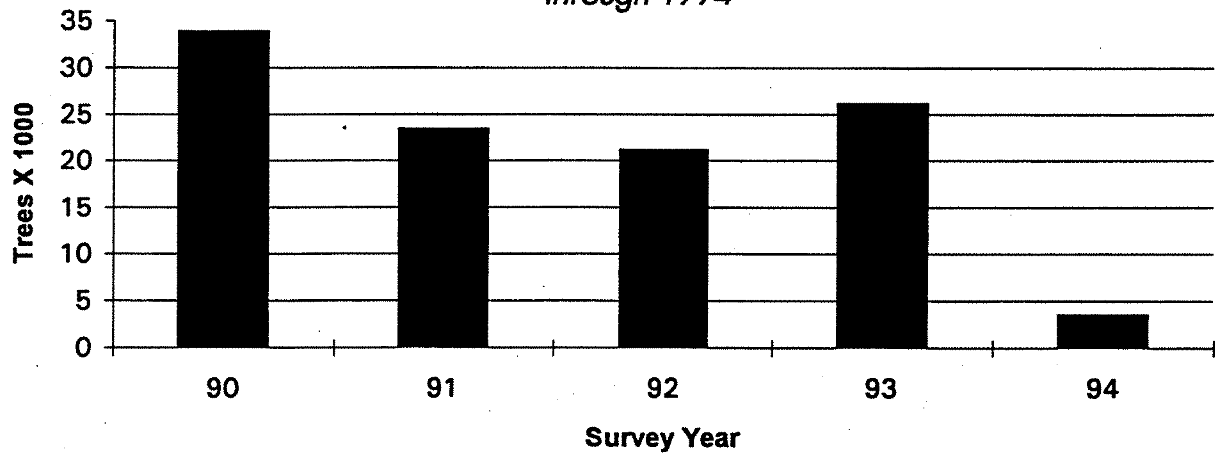


Figure 6 – Tree mortality associated with mountain pine beetle in western white pine, 1990 through 1994



pletes its life cycle in ponderosa pines of all ages, but has the greatest impact in dense immature stands generally of pole-sized trees. In those stands the insect frequently kills groups of several hundred trees.

The total acres of beetle activity decreased from 286,500 in 1993 to 91,600 in 1994. The total number of trees killed also decreased, although the average number of trees killed per acre increased from 1.44 to 2.04. Field checks in northeastern Washington revealed that in many areas the mortality which had been reported as mountain pine beetle in the past was actually western pine beetle. Reporting in 1994 reflected this information and resulted in an increase of mortality caused by western pine beetle and a decrease in that caused by mountain pine beetle. Scattered mortality occurred throughout much of the pine type within the Region. Notable mortality occurred within the Fremont (58,400 trees killed), Winema (6,000 trees killed) and Malheur reporting areas (9,900 trees killed).

Mountain pine beetle in sugar pine: Southwestern Oregon continues to experience a stand altering loss of large sugar pines due to mountain pine beetle and white pine blister rust. Sugar pines on dry sites within the lower elevations of its range are most affected. Aerial survey sketchmapping reporting standards require groupings of five or more trees, so many large single tree deaths are not recorded. The bulk of the 646 reported trees killed in 1994 were located within the Rogue River, Umpqua and Winema reporting areas. Although reported mortality levels are almost identical to 1993 levels, it represents a substantial reduction from 1992 levels.

Figure 7 – Tree mortality associated with mountain pine beetle in lodgepole pine, 1990 through 1994

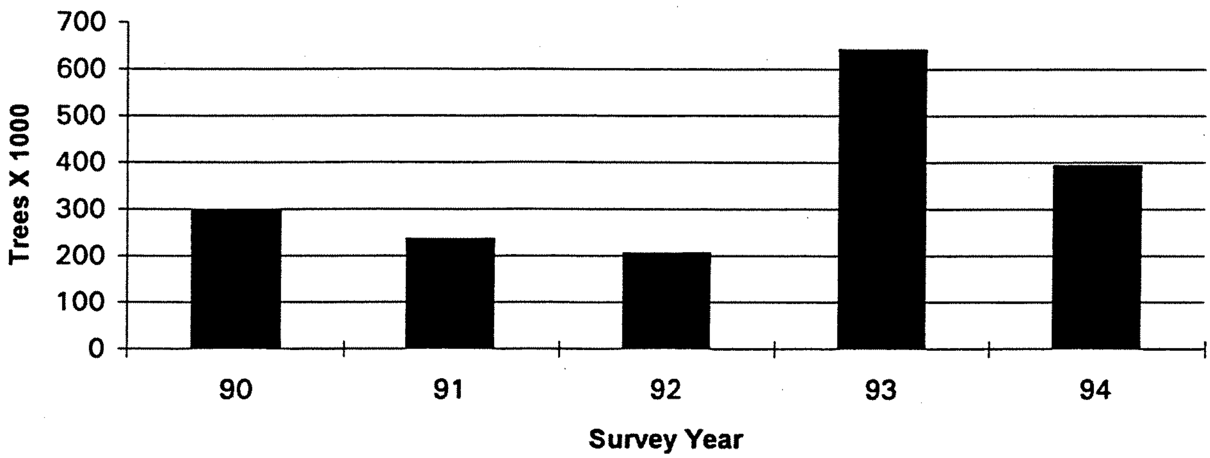
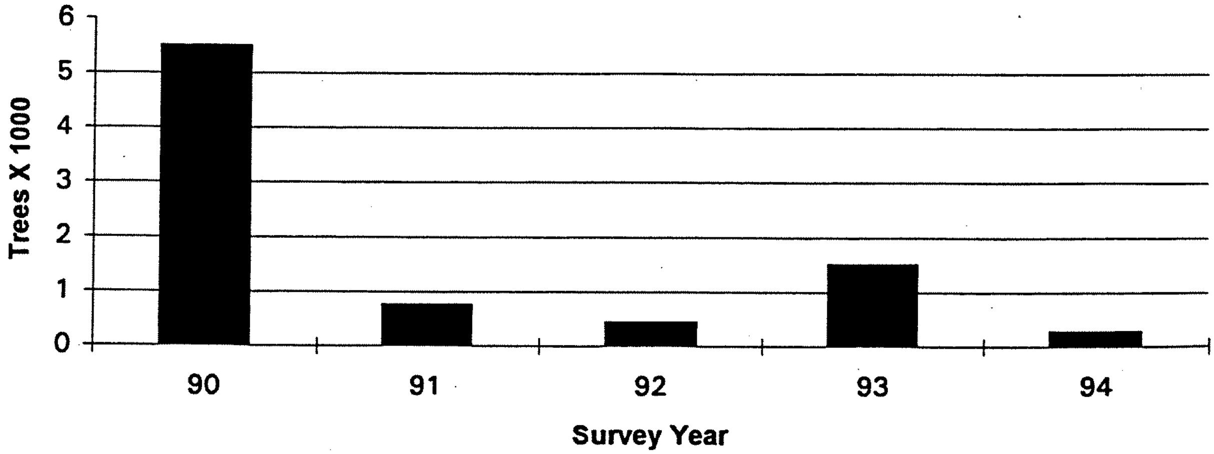


Figure 8 – Tree mortality associated with mountain pine beetle in white bark pine, 1990 though 1994



Mountain pine beetle in western white pine: Individual large western white pines continue to decline in many areas of its range due to mountain pine beetle and white pine blister rust. Attacks by mountain pine beetle are strongly correlated with host age. Trees greater than 250 years old tend to be more susceptible.

In southern Oregon, white pines in the higher elevations of its range seem to be most affected. Regionally, the number of trees reported killed decreased from over 26,000 in 1993 to approximately 3,500 in 1994. Ground checks indicate that much of the mortality was actually caused by western white pine blister rust or a combination of blister rust and mountain pine beetle. Highest levels of mortality occurred within the Deschutes and Winema National Forests and on the Warm Springs Indian Reservation. Approximately 400 trees were reported killed in North Cascades National Park.

Mountain pine beetle in lodgepole pine: In lodgepole pine, the mountain pine beetle infests mature forests, often decimating them over extensive areas. Increased susceptibility to infestation occurs in mature forests with high stocking levels.

A substantial decrease in the acres affected and the number of trees killed was reported in 1994. Reported number of trees killed in 1993 was 639,700 compared to 393,000 in 1994. Over 276,500 trees were reported killed in the Okanogan reporting area, with 151,200 dead trees being mapped in the

Figure 9 – Tree mortality associated with western pine beetle in large ponderosa pine in the Pacific Northwest Region, 1985 through 1994

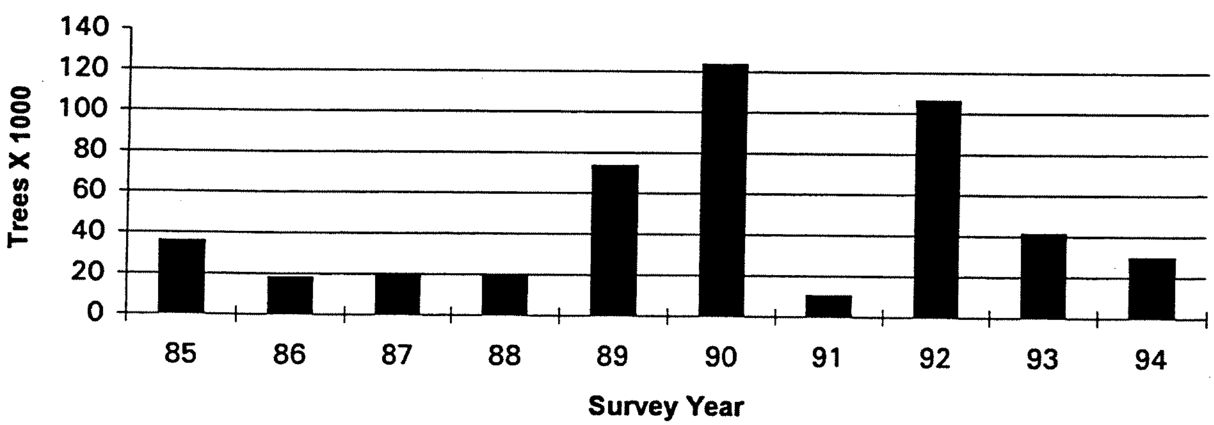
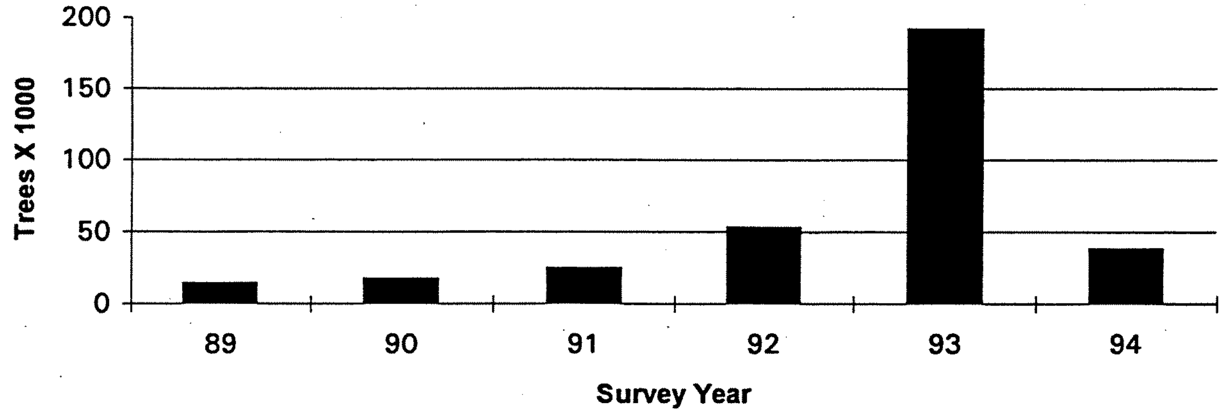


Figure 10 – Tree mortality associated with western pine beetle in pole-size ponderosa pine in the Pacific Northwest Region, 1989 through 1994



Loomis block on Washington Department of Natural Resources lands. Approximately 80,300 dead lodgepole pine trees were mapped on the Deschutes National Forest.

Mountain pine beetle in whitebark pine: White pine blister rust, fire exclusion and mountain pine beetle continue to cause decline in whitebark pine throughout its range in the Pacific Northwest.

Reported tree mortality was one fifth the reported levels of 1993. Some of the current mortality can be attributed to blister rust and some of the decrease in reported current mortality can be attributed to the removal of the host type from the landscape. Informal ground surveys conducted in 1994 found that many areas are severely affected by blister rust. Additional surveys and studies are planned for 1995.

Western pine beetle, *Dendroctonus brevicomis*

The western pine beetle is periodically destructive to ponderosa pine in the Pacific Northwest. Normally this beetle breeds in large, old trees, in windfalls, in trees infected by root disease, or in trees weakened by drought, over-stocking, or fires. Under epidemic conditions it 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.

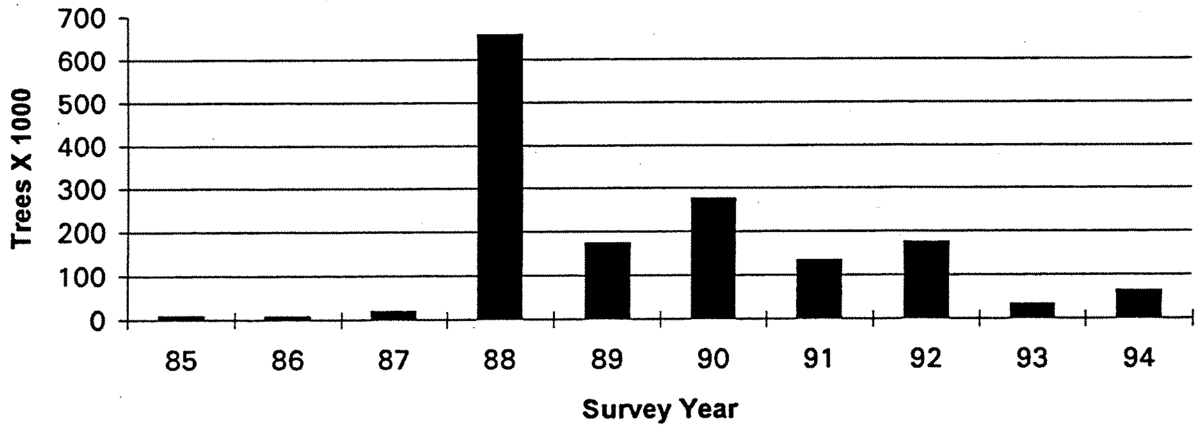
Reported western pine beetle activity decreased in acreage throughout most of the region in 1994. In large ponderosa pine, detected acres of western pine beetle fell from 186,600 (0.22 tree/acre) in 1993 to 50,160 (0.59 tree/acre) in 1994. Notable decreases in reported mortality occurred within the Malheur, Ochoco, Wallowa-Whitman, and Colville Indian Reservation reporting areas. Higher moisture levels, and continued reduction of the live, large pine component from the forest may, in part, explain some of the decrease in reported mortality. The only notable increases in mortality occurred within the Fremont and Winema reporting areas.

With the exception of a slight increase on the Okanogan National Forest, reported mortality associated with western pine beetle in pole-size ponderosa pine decreased regionally. Acres affected fell from 189,717 (1.01 trees/acre) in 1993 to 75,661 (0.50 tree/acre) in 1994. The following reporting areas experienced substantial reductions in observed mortality: Rogue River National Forest, Colville Indian Reservation, Northeast Washington, and Glenwood.

Douglas-fir beetle, *Dendroctonus pseudotsugae*

Douglas-fir beetle occurs throughout the range of Douglas-fir, and is considered the

Figure 11 – Tree mortality associated with Douglas-fir beetle in the Pacific Northwest Region, 1985 through 1994



most important bark beetle which causes mortality in Douglas-fir. Normally it breeds in felled, injured, or diseased trees. The females bore into the bark and tunnel upward through the phloem. Eventually, girdling of the sapwood and clogging of the conductive tissues by fungi introduced by the beetles can result in mortality. The resulting mortality is widely scattered when at low levels. At times, the insect reaches epidemic levels and kills apparently healthy trees over extensive areas.

Detected Douglas-fir beetle activity increased from 50,600 acres (an average of 0.6 tree/acre) in 1993 to 73,700 acres (an average of 0.83 tree/acre) in 1994. Substantial increases in acres of observed mortality were mapped within the Umatilla, Wallowa-Whitman and Malheur reporting areas. The majority of the mortality was reported on federal lands. The only area reporting a significant decrease in mortality was the Gifford Pinchot National Forest. Drought, root diseases and repeated years of defoliation by western spruce budworm and Douglas-fir tussock moth have contributed to host susceptibility.

Pine engraver beetles, *Ips* spp.

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, slash and windthrow. High populations in warm, dry years may kill large numbers of apparently

Figure 12 – Acres affected by Oregon pine IPS in the Pacific Northwest Region, 1985 through 1994

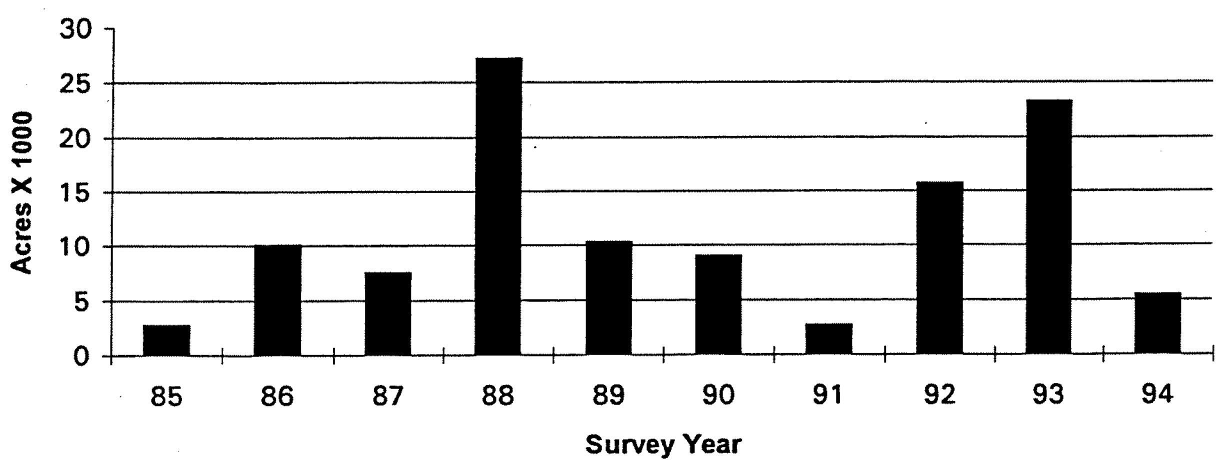
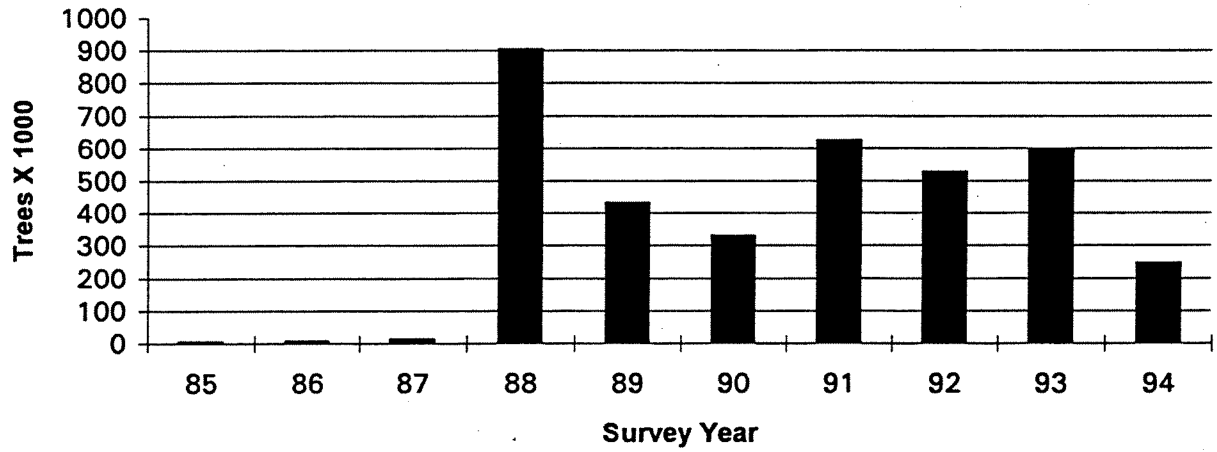


Figure 13 – Mortality associated with fir engraver in the Pacific Northwest Region, 1985 through 1994



healthy saplings and pole-sized trees as well as the tops of mature trees.

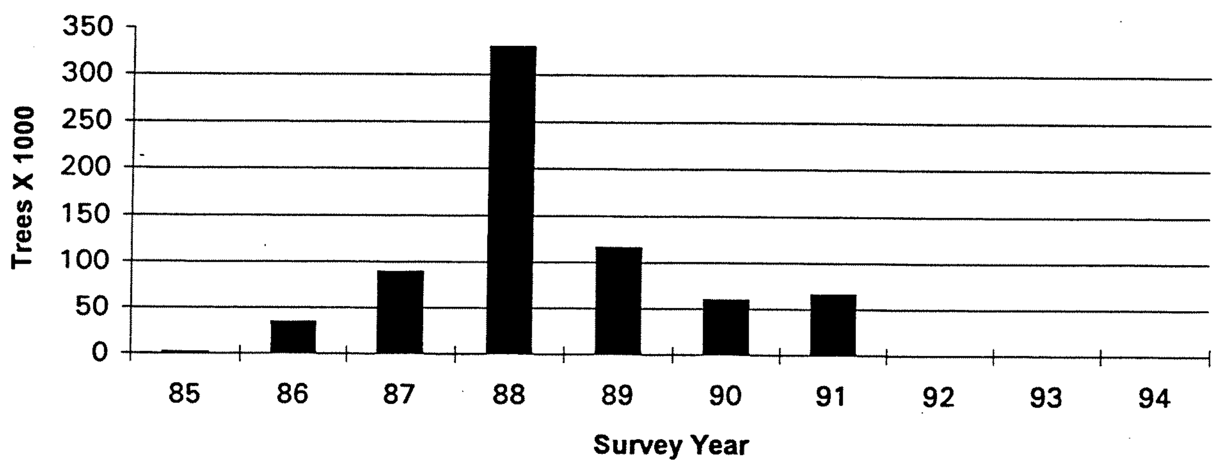
Aerially detected pine engraver activity decreased after three straight years of increases. Total reported acres for 1994 were 5,372, compared to 23,200 in 1993. The majority of the reported acres were within the Malheur and Glenwood reporting areas.

Fir engraver, *Scolytus ventralis*

Fir engraver infests true firs in western forests. It attacks pole-sized and mature trees causing significant mortality during epidemics. Outbreaks often occur during and following periods of drought. Trees infected with annosus root disease are especially subject to attack. Trees defoliated by Douglas-fir tussock moth or western spruce budworm also are likely to be attacked. It commonly breeds in slash and windthrown trees.

Fir engraver activity decreased from 473,300 acres (an average of 1.25 trees/acre) in 1993 to 357,900 acres (0.68 tree/acre) in 1994. Significant decreases in observed mortality were noted within the Fremont, Rogue River and Warm Springs Indian Reservation reporting areas. The only observed increase occurred on the Colville National Forest.

Figure 14 – Mortality associated with Engelmann spruce beetle in the Pacific Northwest Region, 1985 through 1994



Spruce beetle, *Dendroctonus rufipennis*

The spruce beetle infests all species of spruce and is 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. No significant activity was reported in 1994.

Silver fir beetle, *Pseudohylesinus sericeus*

Hosts of the silver fir beetle include true firs, Douglas-fir, and western hemlock. Mature silver fir is one of the most common hosts in the Pacific Northwest. Usually the silver fir beetle attacks windthrown, felled, injured, and severely suppressed trees.

The Gifford Pinchot National Forest reported the largest incidence of silver fir beetle with over 2,600 trees affected in 1993, no significant areas were reported in 1994. A ground check was made of the Gifford-Pinchot National Forest in the spring of 1994 to check on areas reported infested with silver fir beetle. A combination of fir engraver, silver fir beetle, and tephra damage were all detected.

Western balsam bark beetle, *Dryocoetes confusus*

Western balsam bark beetle in combination with woodstaining, pathogenic fungi have contributed to the further decline of subalpine fir in the west.

Reported activity of this insect was usually light and scattered. The only areas reporting mortality of 300 or more trees were the Okanogan and Wenatchee National Forests. Other insects causing significant impacts in subalpine fir include fir engraver and balsam woolly adelgid.

OTHER INSECTS

Balsam woolly adelgid, *Adelges piceae*

The balsam woolly adelgid, a native of Europe, can slowly kill trees by infesting the twigs and branches, or quickly by infesting the bole. It also causes gouting in the tree crown and sometimes on the bole. This is an introduced insect which has become well established in the Pacific Northwest.

Although the total number of acres reported affected by balsam woolly adelgid increased; (16,424 in 1993 compared to 18,381 in 1994), overall tree mortality declined; (10,576 trees killed in 1993 compared to 4,348 in 1994). The Olympic peninsula had the highest levels of mortality reported in the Region. Over 2,500 trees were reported killed in the Olympic National Park.

Satin moth, *Leucoma salicis*

Satin moth-caused defoliation of aspens was detected primarily within the Okanogan and Colville reporting areas. The satin moth is a native of Europe.

Total acres of defoliation detected in 1994 were 3,112. Private lands within Ferry and Okanogan counties were most severely affected; although reported acres of defoliation were half the 1993 levels.

ROOT DISEASES

Laminated root rot , *Phellinus weirii*

Laminated root rot is the most serious forest tree disease west of the Cascade Mountains crest in Washington and Oregon. Overall, an estimated eight percent of the area with susceptible species is affected in this portion of the Region. In some locations survey data indicates that as much as 15 to 20 percent of the area is affected. East of the Cascade crest, reports of laminated root rot increased as awareness increased. Where this disease does occur significant damage modifies species composition; Douglas-fir and grand fir are readily infected and are removed from the stand via mortality and windthrow. Regeneration of these species will not survive beyond sapling or pole size before they are killed. Fire, and it's influence on seral species establishment and dominance, kept this disease in check. Proliferation of shade tolerant species has allowed this disease to increase in severity on infected sites and to spread radially across root contacts, increasing the area infected over time. Hardwood trees and shrubs, which are immune to the fungus, often increase their site occupancy. Where stand activities have occurred, managers have favored retention or planting of immune or resistant species to keep tree mortality and disease spread within acceptable levels.

Laminated root rot is located in a few known areas on the Wallowa-Whitman National Forest. Mt. Emily, including the Five Points drainage, has a substantial amount of this root disease. Several small areas of infestation are known in the Ladd Canyon area and on the east face of the Elkhorn Mountains. The Kuhn Ridge area is one of the few areas on the east side of the Forest where this disease has been detected. On the Umatilla National Forest severe laminated root disease occurs on the Walla Walla Ranger District and one small portion of the Heppner Ranger District. Laminated root disease was recently found on the east side of the Malheur National Forest in the Fox Creek drainage on the Long Creek Ranger District.

Armillaria root disease, *Armillaria ostoyae*

The most significant mortality from this disease occurred east of the Cascade crest in mixed conifer stands. In some stands in eastern Oregon where soils are compacted or displaced, mortality was high and is expected to continue. True firs and Douglas-fir sustain the most mortality, however in localized areas ponderosa pine may be killed. Mortality west of the Cascade crest was usually confined to younger, stressed trees. Assessing species resistance on a site by site basis and discriminating for the more resistant species during stand management activities is considered the most effective means of controlling spread and mortality.

There are several areas on the Wallowa-Whitman National Forest where high levels of tree morality and poor regeneration are occurring in large contiguous areas due to development of virulent armillaria root disease infestation. Large armillaria centers occur in the upper South Fork Burnt River drainage on the Unity District, the Summit Spring Ridge on the LaGrande District, Kuhn Ridge on the Wallowa Valley District and others. A great many more areas, including mixed conifer communities on all Districts, have active armillaria, causing individual tree, small center mortality and discontinuous gap formation over the landscape. In these and many other armillaria-affected stands, extensive conifer mortality and reduced species diversity are considered impacts to management objectives. Armillaria has increased in incidence and severity as a result of recent human influences and activities. Partial cutting, entries and fire exclusion have allowed proliferation of shade tolerant species which are more susceptible to armillaria infection. Soil damage, the result of caterpillar yarding during seasons when soil moisture is high and soils are compactable, has lead to increased virulent armillaria activity in many instances. Recent vegetative management activities have strived to reduce these impacts by favoring less-susceptible hosts (restoring seral dominance) and placing high treatment priority on those stands being most impacted. Subsoiling compacted soils that are associated with virulent armillaria may have a beneficial affect. Research is planned to answer this question.

Armillaria root disease on the Malheur is the most important root disease on the Forest, primarily damaging sites with compacted soils, but also believed to be increasing due to stand conditions developing from suppression of ground fires.

Black stain root disease, *Ophiostoma wageneri*

In southwestern Oregon, black stain root disease was the most commonly encountered disease in Douglas-fir plantations. High risk areas are considered to be those where disturbances such as road building or soil compaction has occurred or where road maintenance equipment injured roadside Douglas-firs. Black stain root disease was observed with increasing frequency on ponderosa pine east of the Cascade crest. It is an important management concern where stocking level control is planned for poor quality overstocked stands.

Black stain root disease was discovered on the Heppner RD in 1993 with incidence and severity being infrequent and low. Black stain root disease in the southern portion of the Malheur National Forest is a significant management concern due to its rapid spread, overstocked conditions of many stands, and planned stocking level control.

Annosus root disease, *Heterobasidion annosum*

Annosus root disease was responsible for losses in many partially cut white and grand fir stands in southern and eastern Oregon and eastern Washington. Mortality was high where annosus root disease and fir engraver beetles operate as a complex. In eastern portions of the Region where many stands were cut 10-20 years ago, trees surrounding infected stumps are dying. Disease severity is expected to increase with time. Using stump treatments to protect recently cut white fir stumps from colonization by the fungus is policy on the Wallowa-Whitman National Forest. Annosus root disease was observed with increasing frequency in predominantly ponderosa pine stands on drier sites in eastern Washington and Oregon. The potential impacts of annosus root disease on mountain hemlock and Pacific silver fir in high elevation stands in the Cascade Range continue to concern resource managers. Annosus root disease in low elevation western hemlock stands primarily causes butt rot; with impacts being considered low unless stands are managed for rotations greater than 120 years.

On the Wallowa-Whitman National Forest, areas with most substantial annosus activity are those that had the earliest and heaviest fir removals and, where fir regeneration or residuals predominate. This fungus readily spread to new sites by airborne spores. Freshly-cut stumps are infected and the fungus may successfully out-compete other organisms and colonize the stump and root system over the following decade or two. Twenty years or so later, fir mortality may begin to occur around old fir stumps. This root disease in fir has not fully manifested itself since early removals on the Forest seldom included susceptible true fir. The bulk of the fir removal has occurred within the last 25 years and there will be considerable appearance of annosus as a result. Four years ago the Forest implemented a policy of treatment to reduce potential for further spread of this disease. Where true fir will be managed in the future, freshly-cut stumps will be treated with borax to prevent colonization by the airborne spores of the fungus.

Port-Orford-cedar root disease, *Phytophthora lateralis*

Port-Orford-cedar root disease was first reported in a Seattle nursery in 1923, but was not identified as such until 1942. By this time the fungus was widely distributed throughout Oregon and Washington. The disease causes extensive mortality on sites favorable for spread of its waterborne spores, especially along creeks, in low-lying areas, and below roads where water is channeled. Port-Orford-cedar on well drained sites usually escapes infection. Preliminary research results suggest that some resistance to the disease exists in Port-Orford-cedar populations.

Brown cubical butt rot, *Phaeolus schweinitzii*

Brown cubical butt rot is one of the most common root and butt rot in old Douglas-fir on the westside of the Cascades. Douglas-fir, western larch, ponderosa pine and lodgepole pine are frequently infected on the eastside. This is a commonly occurring pathogen in many developed recreation sites. Identification and careful monitoring is important in recreation sites where this disease occurs.

STEM DECAYS

Indian paint fungus, *Echinodontium tinctorium*

Indian paint fungus occurs primarily in grand fir. Many of the fir-dominated stands are predisposed to high levels of this stem decay. Extensive levels of decay can be expected in older trees in mature stands. Damage is highest in the wetter of the grand fir plant community series. Where fir has invaded pine-dominated stands, Indian paint fungus-caused decay is expected to be lower. Levels of decay are believed higher than those that occurred in natural conditions. The proportion of trees with extensive decay tends to be increased by: proliferation of fir stocking in stands once dominated by seral species, and kept in seral dominance by disturbances (fire); maintenance of fir stocking for wildlife cover concerns; retention of wounded trees on the site; and protection of old stands from replacement fire events. No disease simulation models are available which accurately predict this disease on a stand basis.

Red ring rot, *Phellinus pini*

Red ring rot is the most common heartrot of Pacific Northwest conifers. Most stands of old-growth Douglas-fir, pines, larch, hemlocks, and true firs exhibit some amount of this disease. The amount of decay caused by red ring rot tends to increase as one moves from stands in northern Oregon to those in southern Oregon. The most extensive decay is found in older stands, in pure stands of host trees, on steep slopes, on shallow soils and on sites predominated by secondary shrub, herb, forb vegetation.

DWARF MISTLETOES Arceuthobium spp.

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 reduced growth, mortality, deformity, and topkill, are significant, particularly in unmanaged stands. All conifer species are affected to some degree. Douglas-fir dwarf mistletoe was the most damaging tree disease east of the Cascade crest. Western larch dwarf mistletoe causes significant effects in northeastern Oregon and central to eastern Washington.

Larch stands throughout the Wallowa Whitman National Forest have a high level of infestation. Most stands with a larch component are infected and in mature to overmature trees the level of infestation is at least 50 percent. There are a few large continuous areas of relatively healthy larch. These stands probably resulted from a large fire that burned hot enough to remove the existing larch component. Removal of residual larch will remove the source of infection. Trees will be killed after years of heavy infection when crown deterioration results from brooming and broom breakage. Most trees die when their functioning crown is less than 10 percent of that of a healthy tree.

Douglas-fir mistletoe also results in high levels of mortality in severely infected trees. This mistletoe is also increasing in severity on the Wallowa-Whitman and Umatilla National Forests. Fire exclusion has greatly increased the proportion of fir on sites once kept in pine dominance. Use of unrecognized infected small trees as advanced regeneration in unevenaged management systems, has resulted in increased mortality and stand stagnation. Fire hazard on a landscape basis increases as brooms serve as fuel ladders. Considerable Douglas-fir beetle activity in severely mistletoe-infected trees was noticed in 1994.

Pine, Baker and Unity Ranger Districts of the Wallowa-Whitman National Forests all have ponderosa pine stands that are severely infected with western dwarf mistletoe. This mistletoe results in poor form, slower growth, and increased hazard to crown fire. It is recommended that infected pine stands be sanitized prior to embarking on unevenaged stand management, otherwise mistletoe infestation can quickly intensify. Single story, widely-spaced pine stands are only slightly impacted and easily manageable, even with moderate levels of mistletoe.

INSECTS AND DISEASES OF NURSERIES AND SEED ORCHARDS

Damping-off, *Fusarium* spp., *Pythium* spp.

Wind River, J. Herbert Stone and Bend Pine Nurseries, experienced an average of one percent mortality to damping-off. Fumigation, deep watering, and delayed fertilization helped control damping-off.

Fusarium root and hypocotyl rot, *Fusarium* spp.

Many species experienced scattered losses at the three nurseries.

Phytophthora root rot, *Phytophthora* spp.

Seedbed seedling damage was confined primarily to nursery beds with poor drainage or compaction layers in the rooting zone.

Gray Mold, *Botrytis* cinerea

Damage by gray mold has been kept low (less than one percent of crop damaged) through applications of fungicide, regulation of seedbed densities, and prompt removal of dead material, including pruned tops, from nursery beds.

Phoma tip blight, *Phoma* spp.

For the first time in four to five years, Phoma tip blight caused damage on 2-0 ponderosa pine at one nursery. Fertilization before May 10 and a moist spring resulted in succulent growth that was susceptible to Phoma infection.

Animal damage, rodents

At one nursery, extensive home building on adjacent open land appears to be driving rodent populations into the nursery beds. Gophers, rockchucks (pers. comm., Diane Hildebrand), mice, and rabbits have been observed.

REGION SIX FISCAL YEAR 1994 ACCOMPLISHMENTS REPORT

In fiscal year 1994, FID received funding from four sources (figure 1). A small percentage (5.7%) was passed directly through to the states of Oregon and Washington. The remainder went to support Regional Office overhead (27.3%) and to FID salaries and programs (67.0%).

Funds spent directly by FID came from two sources (figure 1): Forest Health Management (SPFT) and Treatment (SPFS+EPEP). Forest Health Management funds are tracked by activity and by land ownership. For FY94, FID work supported by Forest Health Management funds is summarized in figures 2 and 3 for separate FID offices. Treatment funds are tracked by target organism. In FY94, FID Treatment funds were targeted towards gypsy moth eradication (44.5%), other diseases (23.0%), western spruce budworm (15.5%), bark beetles (10.6%), dwarf mistletoe (3.5%), and other insects (3.0%).

Figure 15 – Region Six Fiscal Year 1994 Total Budget

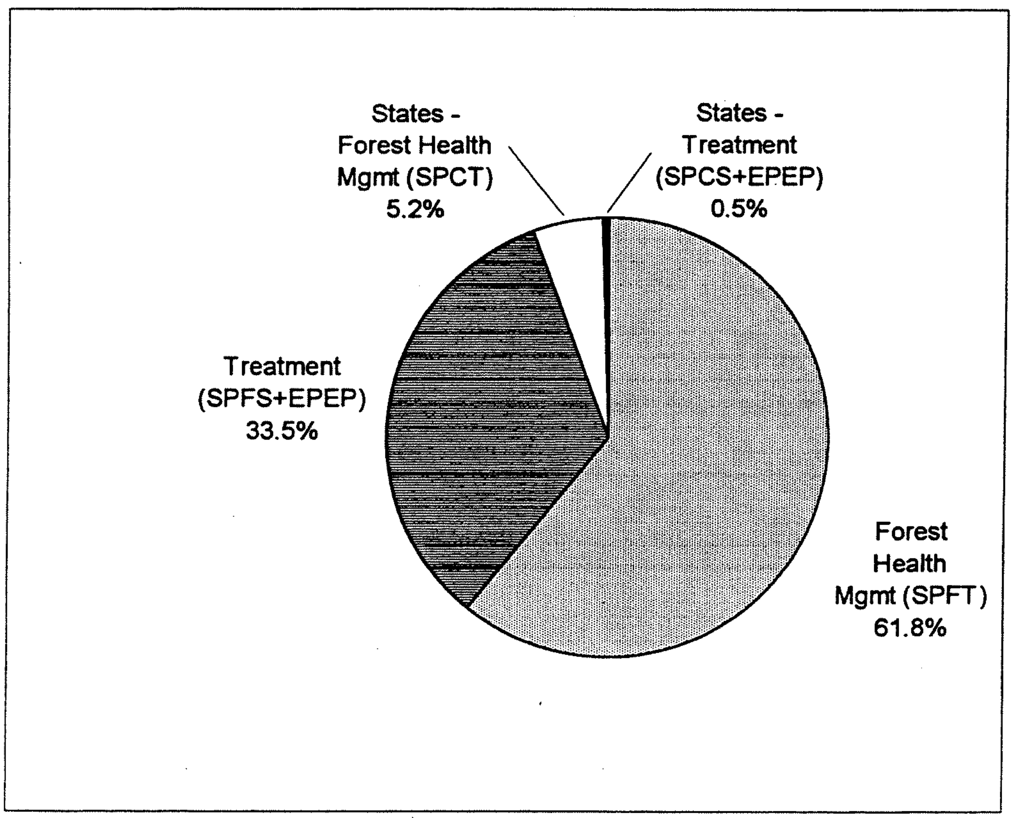


Figure 16 – Region Six Fiscal Year SPFT Activities

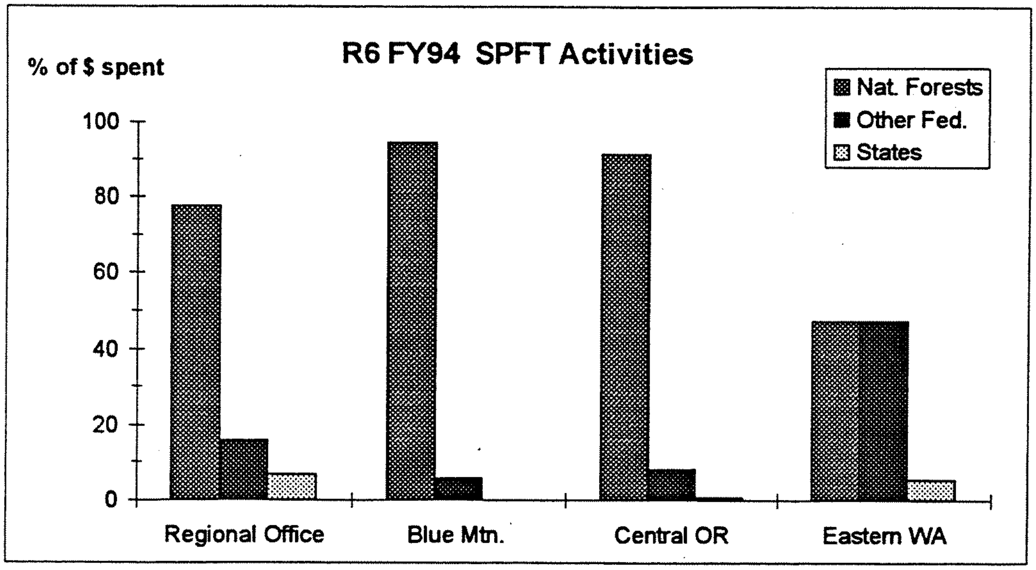
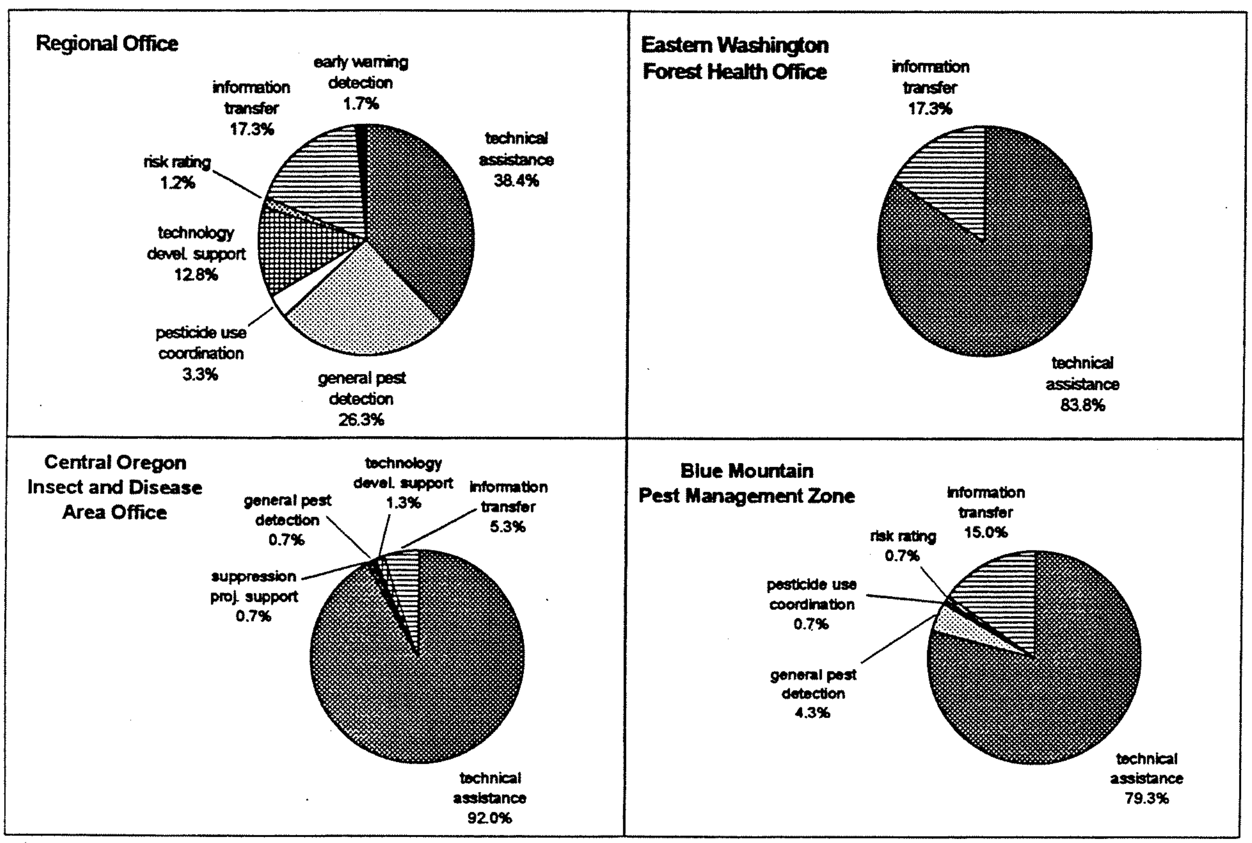


Figure 17 – Region Six Fiscal Year 1994 Forest Health Managment (SPFT) Activities



FOREST PEST MANAGEMENT REORGANIZATION

In 1994, the Forest Pest Management Staff became the Forest Insects and Diseases Group within the new Natural Resources staff, which is made up of the old Timber, Fish and Wildlife, Ecology/Range and Watershed, and Forest Pest Management Staff Units. In addition, we completed our decentralization by establishing the Southwest Oregon Technical Center and the Westside Technical Center. The area of responsibility for the Eastern Washington Zone was expanded, changing from a zone to a technical center. The Technical Centers differ from the Zones in that they have a program manager, and are planned, in the future to have four to six persons in each center. Some of the specialists in the centers also have regional or national expertise or responsibilities in addition to their area obligations.

The responsibilities of the FID staff within the RO has also changed as a result of both the creation of the Natural Resources Unit and the completion of the decentralization. The following is the current structure and staffing of FID in the RO and the field locations, as well as a brief description of the areas of responsibilities and duties:

Natural Resources - Forest Insects and Diseases Group

Regional Office:

- **Bob Devlin** - Director, Natural Resources
- **Max Ollieu** - FID Group Leader
- **Dave Bridgwater** - Remote Sensing/Exotics includes: aerial survey program management, exotic species coordination, and bark beetle specialist
- **Sally Campbell** - Plant Pathologist includes: plant pathology, Off-plot Forest Health Monitoring program
- **Tom Gregg** - Biometrics includes: sampling design/statistical analysis, modeling, and computer support
- **Shelly Hayden**[1] - Biological Technician includes: GIS data capture and manipulation; map production; aerial survey data collection
- **Diane Hildebrand** - Forest Nursery/Regeneration Pathology includes: nursery assistance; forest pathology support; mycology and other plant pathogens - biodiversity and ecology.
- **Julie Johnson** - Geographic Information Systems includes: systems integration; data distribution and support
- **Iral Ragenovich** - Entomology/Interagency includes: entomology coordination and evaluation, Technology Development Program coordination, Interagency/International coordination
- **Roger Sandquist** - Arthropod Biodiversity and Ecology/Reforestation Insects includes: reforestation assistance and support; invertebrate assistance and support.
- **Katharine Sheehan** - Modeling includes: insect and disease models, computer programming.
- **Fay Shon** - Forest/NEPA Planning includes: Vegetation Management EIS and mediated agreement; NFMA/NEPA; President's Plan/Eastside coordination; pesticide use coordination.
- **Gary Smith** - Integrated Pest Management includes: NAPIAP & NPIRS; pesticide use assistance and support; and Vegetation Management/NEPA assistance and support.
- **Suzanne Wiley** - Forestry Technician includes: survey support; map produc-

tion; aerial survey data collection; PC and publications support.

Southwestern Oregon Forest Insect and Diseases Technical Center

Serving the Siskyou, Umpqua, and Rogue River National Forests; Coos Bay, Medford, and Roseburg Districts of the Bureau of Land Management; other federally managed lands in southwestern Oregon.

- **Greg Clevenger,** Supervisor
- **Don Goheen** - Plant Pathologist/Entomologist
- **Ellen Michaels Goheen** - Plant Pathologist
- **Katy Marshall** - Forester/Plant Pathologist2

Westside Forest Insect and Disease Technical Center

Serving the Mt. Hood, Siuslaw, Willamette, Gifford Pinchot, and Olympic National Forests; Columbia River Gorge National Scenic Area; Eugene and Salem Districts of the BLM; Olympic National Park; Fort Lewis; other federally managed lands in western Oregon and Washington

- **Tom Ortman,** Supervisor
- **Jerry Beatty** - Program Manager/Plant Pathologist; regional FHM program coordinator; POC program coordinator
- **Bruce Hostetler** - Entomologist
- **Keith Sprengel** - Forestry Technician; regional aerial survey coordinator; hazard tree specialist
- **Elizabeth Willhite** - Entomologist

Eastern Washington Forest Health Technical Center

Serving the Wenatchee, Okanogan, Colville, and Mt. Baker-Snoqualimie National Forests, Yakima, Colville, and Spokane Indian Reservations; North Cascades and Mt. Rainier National Parks; other federally managed lands in eastern and north central Washington.

- **Elton Thomas,** Supervisor
- **Jim Hadfield** - Program Manager/Plant Pathologist; national ICS coordinator
- **Paul Flanagan** - Entomologist
- **Paul Hessburg** - Plant Pathologist/ Eastside Project representative2
- **Roy Magelssen** - Forestry Technician/ aerial application and calibration

Central Oregon Insect and Disease Area Office

Serving the Ochoco, Deschutes, Winema and Fremont National Forests; Warm Springs Indian Reservation; other federally managed lands in central Oregon

- **David Summers,** Supervisor
- **Andy Eglitis** - Entomologist
- **Jim Hart** - Forestry Technician2
- **Helen Maffei** - Plant Pathologist

Blue Mountain Pest Management Zone

Serving the Umatilla, Malheur, and Wallowa-Whitman National Forests; Umatilla Indian Reservation; other federally managed lands in northeastern Oregon

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Field offices were originally established to better serve Federal land managers at the field level. Prior to reorganization insect and disease management assistance was provided from FPM out of the Regional Office. Because of the distances to the field sites, entomologists and pathologists spent too little time each year on some Forests except when attached to suppression projects. Now with a Forest staff entomologist and pathologist, entomology and pathology information can be integrated more easily into every facet of District and Forest ecosystem management and planning.

Work planning is largely in response to requests and assigned priorities from Federal clients. Biological evaluations, largely for Environmental Assessment and Environmental Impact Statement input, are a major portion of the workload. Training of field crews, silviculture and other resource specialists is also emphasized. Most field crews in the area offices are or will be exposed to at least one day of insect and disease identification and basic management training annually.

[1] Bureau of Indian Affairs employee detailed to FID group

[2] positions partially funded by FID

TECHNICAL ASSISTANCE SUMMARY

Numerous technical assistance visits were made to the field in 1994. In addition to National Forests, these visits involved other agencies such as the Bureau of Indian Affairs and Bureau of Land Management. Most of the insect-related calls for technical assistance were associated with the prolonged drought which has affected areas of the Pacific Northwest Region over the past several years. Several administrative units dealt with large-scale fir mortality caused by the fir engraver. Technical assistance visits were needed to help develop salvage guidelines and schemes for risk-rating stands yet unaffected. Another drought-related area of concern was the loss of large overstory ponderosa pines in dense stands throughout many areas of the Region. These pines are being killed by the western pine beetle, and their death often causes dramatic changes in stand structure.

Several insect and disease training sessions were conducted in 1994. These sessions are being offered to a broader audience than in the past, with the intent of explaining the roles of insects and disease organisms in a broader context than simply as "pests".

Technical assistance was a high priority work area for the zone pathologists and entomologists, with assistance provided to assure that insect and disease influences are considered in District and Forest project planning.

ACTIVITIES

Guidelines for Viable Ecosystems - Ochoco NF

The central Oregon Insect and Disease area office has worked with the Ochoco National Forest to develop guidelines for managing viable ecosystems. The products of this effort will provide a framework for ecosystem management for the Forest. This framework is built on the distinct productivity levels associated with different plant association groups within forested environments. Each of these groups has its own disturbance regime, succession patterns, and potential habitats for other organisms. Within this context, insects and diseases are described as disturbance agents which influence plant succession and vegetative patterns on the landscape in each group of vegetative potentials. FID participation in the development of these guidelines has been an avenue for broadening the way in which insects and diseases are perceived and the understanding of their overall roles in the ecosystem are understood.

Watershed Analysis:

Watershed analysis is one of the principle analyses used to meet ecosystem management objectives of Forest plans. They are an ecosystem analysis at the watershed scale. Watershed analyses continue to be a high priority especially in areas where they are needed to support watershed restoration.

Forests will continue to work on watershed analyses in the coming years.

In Central Oregon, the Area Insect and Disease specialists were invited to participate in watershed analyses on three of the National Forests in the Area. The principal contributions from FID have been to present background information on how insect and disease organisms operate as agents of disturbance in the forest and how these disturbances affect the vegetative structure, species composition, and subsequent forest development. These contributions stem in part from work done previously in developing the "Management Guide for Viable Ecosystems" on the Ochoco National Forest. Our involvement in Watershed Analysis has helped the Forests understand the historic patterns of forest vegetation and how these compare to present-day conditions, which are often different as a result of extensive human intervention. We are examining the existing vegetation at the landscape level and describing the roles that insect and disease disturbance agents could play in shaping the vegetation of the future within these watersheds.

During FY 1995, the Blue Mountains Pest Management Zone will provide detailed input into the watershed analysis projects for the Wallowa-Whitman and the Umatilla Forests. The Malheur is using past biological evaluations from the Zone to identify issues on their analysis. The Zone is on the core team for the Wallowa-Whitman and consultant status on the Umatilla. Since insect and disease concerns are the driving factors in the health and current conditions of the eastside forested ecosystems, especially in the Blue Mountains, they are major issues in watershed analysis.

Much of the work will involve using the aerial survey, vegetation, and activity databases and use UPEST, which is an insect and disease risk rating calculator and now part of UTOOLS landscape and watershed analysis software. Hazard rating of a composite of 2-acre pixels for individual insect and disease risks are summarized as three levels of risk and presented visually and tabulated using a PARADOX-generated query of acre information. Comparisons of historical and current conditions are used to document the departure from natural range of variability. Potential projects will be identified for those communities that are at high risk to catastrophic impacts from biotic agents and fire.

Characterization of Canopy Gaps in the Blue Mountains:

This study examines how diseases, insects, human activities and other agents of disturbance can change the structure and function of forest ecosystems in the Blue Mountains. It emphasizes a holistic approach to describing disturbance and the impact of disturbance. This approach was developed in response to the recent emphasis placed on sustained management of resilient ecosystems by the USDA Forest Service. The study involves an interdisciplinary effort among research (J.E. Lundquist RM, S. Martin PNW), State and Private Forestry, Forest Pest Management (J.S. Beatty FPM R-6 and MAG, WO), and Wallowa-Whitman National Forest (see 1993 Pacific Northwest Region Conditions and Activities report for details of this study).

In 1994, field activities continued as we established four more plots in the Five Points analysis area on both managed and undisturbed sites. As in 1993, we used isopleths generated by densiometer readings to assess gaps in these stands for: 1) cause, predisposing conditions, and associated tree responses; 2) abundance and condition of snags and coarse woody debris; and 3) abundance of recolonizing vegetation. Data collected from 1993 plots are being analyzed and should be available later this year.

Forest Health Monitoring

The goal of the Forest Health Monitoring (FHM) program is to detect changes and trends in forest conditions and to report and interpret these changes at a national, regional, and, when possible, a State level. Efforts are undertaken jointly between the USDA Forest Service, the US Environmental Protection Agency, the USDI Bureau of Land Management, the USDA Soil Conservation Service, other Federal agencies, and state forestry agencies plus university, conservation, and nonprofit groups. Ongoing FHM work complements other efforts within the EPA Environmental Monitoring and Assessment Program, started in 1990.

California and Colorado are two of 14 States in which FHM Detection Monitoring activities have taken place. The western FHM program began in March 1991 when representatives from the California Department of Forestry and Fire Protection, and the Pacific Northwest Research Station identified potential partners, users, and cooperators. This led to an information needs and assessment workshop held in Sacramento, California on May 22 1994. Some 30 agencies and groups contributed suggestions at this meeting; another 30 groups were also identified as potential cooperators. Information needs assessment meetings were held in Oregon and Washington during November and December 1992, respectively. Grid points, aerial photos, and base maps are now being acquired and interpreted. Planning is also underway to begin operational FHM plot work in Oregon and Washington in Summer 1995. Regionalization of FID off-plot data with FHM on-plot data has begun. Operational field plot work in Alaska is not planned until Summer 1997; Hawaii may enter the program a bit later.

Northwest Pilot Study

In April, 1994, EPA's Environmental Monitoring and Assessment Program provided an additional $108,000 in funding to the West Region Forest Health Monitoring Program (FHM), to collect data for select FHM plots in Oregon and Washington. The study plan was developed by Tim Lewis (National Indicator Leader, BLM, Research Triangle Park, North Carolina) and FHM collaborators from Region 6, Oregon Department of Forestry, and the Washington Department of Natural Resources. Purpose of the study was threefold: to acquaint Oregon/Washington cooperators with field protocols before implementing full-scale detection monitoring; to test if some indicators like PAR might be more difficult to measure in the Northwest than in California or the East because of denser canopy and wetter environments; and to obtain base-line data for the Douglas-fir forest type, from the Pacific Coast to the Cascade Range crest. Funding limited team composition to three members, with one team for each State; teams were combined two weeks into the study after several crew members resigned. A total of 13 plots were measured in Oregon and 12 in Washington. The quality assessment/quality control (QA/QC) for the Northwest Pilot involved three measurements by the Northwest pilot crew of one grid plot in Oregon (Grand Ronde) and one in Washington (Cathlamet), in late June, mid-July, and early August. A separate QA/QC team, composed of certified experts in each indicator, spent one day at each site, either before or after the field team, and measured at least two of four subplots to calibrate the crews measurements and procedures. Lichens were collected once in July.

Work is ongoing to publish and distribute results from the Northwest Pilot Study. Because of flat budget predictions for the national program, it is unlikely that full implementation of the detection grid will begin this year in Oregon and Washington.

Off-Plot Regionalization

Sally Campbell (FPM/FID R6, Portland) convened a one-day meeting in Portland, October 12, 1994, for a dozen Forest Service, State, and BLM staff. The purpose was to develop standards to conduct and evaluate FPM aerial/ground surveys and to utilize Federal and non-Federal inventory data that could be linked with FHM plot data. This effort entails identifying minimum mapping units that can be used uniformly across California, Oregon and Washington. Standards do exist for the Eastern FHM region but topographic conditions, land ownership patterns, and current resolution of aerial survey data in the western states may justify use of other standards. Use of inventory data may require new analysis methods. The R6 Inventory Advisory Group will provide advice and assistance for this project.

Demonstration of Ecosystem Management Options

The Demonstration of Ecosystem Management Options (DEMO) project is a joint undertaking by the National Forests, Bureau of Land Management, Pacific Northwest Research Station, Oregon State University, and the University of Washington to establish a single comprehensive study applicable to westside Cascade Range forests. Specifically, the DEMO project is designed to contribute reliable and broadly applicable information on the ecosystem-level effects of different levels and patterns of green-tree retention within harvest units. The Umpqua National Forest in Oregon and the Gifford Pinchot National Forest in Washington each will have a total of four project areas. Several harvest units are associated with each project.

Forest Insect and Disease input into the project includes providing information on preharvest conditions of insects and diseases and following that activity after treatment. The first DEMO insect and disease survey occurred in the summer of 1994 at the Watson Falls DEMO site, Diamond Lake RD, Umpqua National Forest. The staff of the SW Oregon Forest Insect and Disease Technical Center completed a survey of six 32-acre harvest blocks and one 12-acre control unit, assessing the amount of area in root disease centers, impacts of root disease on crown closure, and noting the levels of activity of other insects and diseases. All seven units surveyed had substantial areas (31-62% of the unit) affected by armillaria root disease. Other agents present included laminated root rot, annosus root disease, black stain root disease, fir engraver, Douglas-fir beetle, mountain pine beetle, western pine beetle, white pine blister rust, and Grovesiella canker of white fir. White fir was the species most seriously impacted by root diseases although all conifer species on the sites were affected to some degree. The future of white fir in these stands is uncertain and root disease will greatly influence management outcomes. Information collected in this project will also be used to calibrate the Western Root Disease Model. Other DEMO sites will be surveyed on both Forests in 1995.

Prevention

The Blue Mountains Pest Management Zone strongly supports a prevention strategy for addressing current and future insect and disease epidemics. The Oregon Trail Interpretive Park on the LaGrande District (Wallowa-Whitman National Forest) will be treated with MCH (an anti-aggregative pheromone of the Douglas-fir beetle) and have green-infested Douglas-fir removed early in 1995 to lessen impacts from a current Douglas-fir beetle infestation.

There are other critical prevention needs in the Blue Mountains. Among these: the black stain root disease epidemic on the south Malheur; increasing bark beetle activity in overstocked small diameter ponderosa pine on the Malheur, Wallowa-Whitman, and Umatilla National Forests; excessive fuel loading related to defoliator- and bark beetle-caused mortality and the lack of natural ground fire throughout the Blue Mountains; loss of late and old structure (LOS) in designated oldgrowth and mature stands from insects and diseases responding to deviations from natural range of variability (NRV). The agency has recognized most of these management needs but implementation of a large-scale prevention strategy has yet to occur.

Port-Orford-Cedar Management Program

A comprehensive interregional program to control Port-Orford-cedar root disease and insure the presence and productivity of Port-Orford-cedar was instituted in 1988 by Pacific Northwest and Pacific Southwest Regions of the USDA Forest Service. The program enlists, supports, and coordinates the work of concerned foresters, ecologists, resource managers, and research scientists to make sure that Port-Orford-cedar remains a viable component within the forested ecosystems of the Pacific Northwest. Participants in the program include the Forest Service, Bureau of Land Management, National Park Service, state universities, private companies, state and local governments, and interested foreign countries.

Approaches taken in the Port-Orford-cedar program to insure the viability of the species and control the spread of the disease are implemented under the Forest Service policy of ecosystem management. A multi-agency and multi-resource coordinating group ensures that appropriate resources are dedicated to studies of both the host tree and the root disease pathogen. Members of the coordinating group include managers, ecologists, pathologists, foresters, silviculturists, and geneticists from the Forest Service research, National Forest System and State & Private Forestry units, the Bureau of Land Management, and universities. Management direction for the program is contained in the Port-Orford-cedar action plan, in forest plans of the four national forests within the natural range of Port-Orford-cedar, in the Bureau of Land Management draft guide for management of Port-Orford-cedar, and in the National Forest Management Act (NFMA) and the National Environmental Policy Act (NEPA).

An action plan, developed for National Forest System and Bureau of Land Management lands, provides direction for maintaining Port-Orford-cedar as a viable component of the ecosystem. The action plan provides direction for inventory and monitoring, research, public involvement and education, and management policy. Direction for monitoring the presence and movement of the disease, and the development and evaluation of control strategies, are included in the plan.

Research and administrative studies in progress as a result of the action plan include a search for natural resistance to the root pathogen, analysis of genetic variation of Port-Orford-cedar throughout its native range, development of a soil assay test for detection of the root pathogen in soil, and determination of spore longevity in the absence of Port-Orford-cedar.

Forest Insect and Disease Geographic Information System (GIS) data currently available

The annual regional aerial detection survey data has been digitized for the years 1980-1994. Each year's survey is separated into the following five digital layers: Budworm; Pine Beetle; Fir Beetle; Tussock Moth; and Other Damage. The western spruce budworm suppression project analysis areas for 1980-1992 are also complete. The Port-orford cedar range and *Phytophora lateralis* occurrence in R5 and R6 is available, but needs to have a field review before it will be considered final. A dwarf-mistletoe survey for the Deschutes was automated this year, as well as a Douglas-fir tussock moth trap locations layer. These are both linked to databases with related data.

Aerial Survey Database

Aerial survey data from 1969 through 1994 is being incorporated into PARADOX, a relational database. Information available will include: survey year and type, administrative boundaries and land ownerships, insect species and affected host types, acres affected, number of trees killed, and, where appropriate, associated estimated volume loses. Each field will be linked to a lookup table which will define the range of acceptable values within that field. Critical information regarding changes in administrative boundaries, peculiarities in data, and other pertinent information will be contained within memo fields as part of the lookup tables. Historic aerial survey data is being digitized and made available for import into PARADOX. Subsequent years' data will be appended to the master database as it becomes available.

GIS software/hardware accomplishment:

All GIS digital data was converted from Map Overlay Statistical System (MOSS) to arc/info last year, so now all analysis occurs in arc/info. However, we still maintain both arc/INFO and MOSS data sets because several cooperators still use (MOSS) format. Hardware being used is an IBM x-terminal that is connected to an IBM workstation via a local area network.

Recent projects/analysis that were aided/accomplished using FID's GIS:

Several FID projects have used GIS capabilities. One project is the annual reporting process of the Regional aerial detection survey. The GIS allows us to determine acreage, number of trees killed, MBF, MCF and spatial locations (by state, county, and specific land-ownership) of the insect activity mapped. It is also being used quite extensively for spatial analysis and display to determine the effectiveness of western spruce budworm suppression projects conducted during the past ten years. This year, the Washington Department of Natural Resources (WDNR) administrative map layer was updated, and reports are being generated for them by WDNR Region, District and Local Management Area. Digital data in many formats were provided and cartographic display products were generated for several customers, including various Forest Service and PNW units, Oregon Dept. of Forestry, Washington Depart. of Natural Resources, Bureau of Indian Affairs, Bureau of Land Management, Association of Oregon Loggers, and Oregon and Washington newspapers.

Analysis of the Effects of Suppression Projects on Subsequent Defoliation and Bark Beetle Activity

Many insecticide treatments have been applied to suppress western spruce budworm populations since the current Blue Mountains outbreak began in 1980. Several questions regarding the effectiveness of these treatments have arisen: What is the effect of treatment on defoliation in subsequent years? Is mortality caused by bark beetles higher in untreated areas than in treated areas? Is there any evidence of budworms from untreated areas invading adjacent treated areas? An analysis was initiated in 1993 that uses a GIS to answer those questions. Several maps are being overlaid using the ARC/INFO GIS system. Boundaries of all suppression projects aimed at western spruce budworm and/or Douglas-fir tussock moth populations from 1980 to the present have been digitized. Aerial survey observations of defoliation and bark beetle activity are also being digitized for this time period. Insect activity will be evaluated within suppression project boundaries, in adjacent areas, and region-wide. For each project, insect activity will be analyzed for three years prior to the project year, during the project year, and for four years following the project. Defoliation intensity levels will also be examined. This analysis was completed fall of 1994.

Western Spruce Budworm Permanent Plots

In 1986, permanent plots were established in 33 stands on two national forests in the Blue Mountains of northeastern Oregon. Approximately 30 plots were established in each of these stands. Defoliation, topkill, and mortality data have been collected annually on all plot trees. In addition, root disease, stem decay, and dwarf mistletoe information has been collected on all plots. In 1996, radial and height growth data will be collected for a subsample of plot trees in each stand.

The primary use of these data will be to develop topkill equations for the Western Spruce Budworm Damage Model, a computer simulation model which links to a tree growth model called the Forest Vegetation Simulator. In addition, this information will provide information about the relation of stand structure and composition to the level of budworm-caused effects, and the differences between insecticide-treated and untreated stands. These data also should be very useful in estimating the effects of budworm-caused defoliation on resources such as visual quality, wildlife habitat, fish habitat, recreation, and old growth habitat; and, in updating and streamlining of the Western Spruce Budworm Population Dynamics Model, a model which will be valuable in forest planning efforts.

1994 Douglas-fir Tussock Moth Pheromone Trapping

Douglas-fir tussock moths are trapped in Oregon and Washington each year as part of the Douglas-fir Tussock Moth Early Warning System, a cooperative monitoring effort involving the following state and federal agencies: Oregon Department of Forestry, Washington Department of Natural Resources, USDA Forest Service, and USDI Bureau of Land Management. This trapping has been done in Region 6 since 1979. Data gathered annually on the Early Warning System plots are used to monitor trends in Douglas-fir tussock moth population levels, and to detect incipient tussock moth outbreaks so that treatment alternatives may be evaluated and implemented in a timely manner.

California Gulch Bark Beetle/ Thinning Study

This study was installed in 1967 by Charles Sartwell, retired PNW research entomologist, and Bob Dolph, retired R6 Forest Pest Management entomologist, to ascertain whether thinning second-growth ponderosa pine stands would prevent or reduce tree mortality due to mountain pine beetle attacks. The study site is located near Baker City in northeast Oregon, on the Wallowa-Whitman National Forest. Five thinning treatments were applied: unthinned, 12x12 ft. spacing, 15x15 ft. spacing, 18x18 ft. spacing, and 21x21 ft. spacing. Data on tree mortality were collected in 1972, 1977, 1982, and 1992. Stocking, other insect and disease, and tree growth data also were collected in 1992. Analysis of this data is planned for 1995. Results of this study should provide useful information to land managers with second-growth ponderosa pine forests, and aid pine beetle model development and verification.

Region 6 Insect and Disease Guide

Region 6 Forest Insect and Disease staff are currently working to produce a forest insect and disease guide specific to Oregon and Washington. The guide will be designed to help inventory, cruising, and stand exam crews correctly identify forest insects and pathogens (or their diagnostic indicators),

TECHNOLOGY DEVELOPMENT

Joint R5 and R6 Technology Development Program Activity Review

Region 5, Forest Pest Management and Region 6, Forest Insects and Diseases conducted a joint activity review of the Technology Development Project Program at the regional level. The TDP program has been in existence since 1990 and the process has been evolving over that time. The review was conducted to determine whether the respective TDP processes were meeting the expectations of the regions, and to identify ways to improve the processes. The review had four objectives that focused on: 1) the regional TDP processes, 2) regional technology needs, 3) the TDP products from regionally sponsored projects, and 4) whether the products were being used. The review did not attempt to evaluate the TDP process at the national level, except in specific instances where the national process influenced the regional processes.

The review team consisted of Iral Ragenovich, Jerry Beatty, and John Kliejunas with input from Max Ollieu and John Neisess. A request for information was sent to all FPM and FID personnel in both regions, as well as to research and university individuals who have been actively involved with regionally sponsored TDP. Issue identified in the reponses were categorized into the four aspects (process, needs, products, and product-use) and evaluated. Recommendations were made for all issues.

The review found that, for the most part, the programs worked well, met our needs, and should be continued. It did identify some issues and recommended changes that would improve the efficiency of the programs. The next step is to develop an action plan that will identify ways to implement the recommendations. A review report was issued and is available.

Technology Development Projects

Since 1990, the region has sponsored or participated in 14 Technology

Development Projects. These are:

R6-90-01 Pest trend impact plots in the West. (E. Goheen, coordinator)

R6-90-25 Updating and testing the Douglas-fir tussock moth model. (Sheehan)

R6-90-26 Complex terrain flow model. (Hadfield)

R6-90-51 Implementing multi-pest/multi-resource version of INFORMS on the La Grande RD, Wallowa-Whitman NF. (Beatty)

R6-91-18 The development of prediction functions for drop size distribution of sprays emitted from aircraft. (Hadfield)

R6-91-32 Vegetation management modeling. (Smith)

R6-91-39 Evaluation of a new Bt strain. (Hostetler)

R6-91-40 Westwide monitoring of Megastigmus spermotrophus in Douglas-fir seed orchards using colored sticky panels. Sandquist)

R6-91-41 Evaluation of burning to reduce overwintering populations of gall midge pupae and seed chalcid larvae in Douglas-fir seed orchards (Sandquist)

R6-91-43 Aerial application of MCH to prevent damage by Douglas-fir beetle to standing green Douglas-fir in interior forests. (Bridgwater) and rate severity of effects. Pathogens and insects to be included in the guide have been identified, and the accompanying descriptive write-ups are nearly complete. Appropriate color photos and illustrative drawings are being compiled. The guide should be available in Summer 1995.

Current Vegetation Survey: Insect and Disease Information from Regional Vegetation Inventories

For several years, Forest Insect and Disease staff have been working with the Regional Vegetation Management group to develop more accurate and consistent methods for acquiring information on the incidence, severity, and effects caused by the major forest insects and diseases at a scale useful to watershed analysis and the forest planning process. Data elements necessary for adequately characterizing the structure, composition, and stocking level of forests and including information on major forest insects and pathogens were agreed to and incorporated into new Regional inventory procedures, the Current Vegetation Survey (CVS), in 1993.

The CVS is a permanent plot grid system, with the grid scale currently at 3.4 and 1.7 miles, that samples the range of vegetative conditions across all proclaimed National Forest lands in the Pacific Northwest. Sample units consist of 1 hectare circular plots with subsampling units designed to describe current vegetation.

Disease and insect information gathered on plots include damage and severity coding for all trees (live and dead) greater than 1.0 inch dbh. Higher priority is given to damage caused by bark beetles, root diseases, dwarf mistletoes, and defoliating insects. Up to 3 damage codes can be recorded for an individual tree. Severity codes are designed to provide information required by current disease and insect model extensions to the Forest Vegetation Simulator (Prognosis). Stumps with root disease are group tallied by diameter class. In addition, a root disease severity rating is estimated on five 1/20th acre subsampling units within the hectare plot to supply additional information for the Western Root Disease and Annosus Root Disease Models.

Forest Insects and Diseases worked with the Regional Inventory Coordinators during 1994, providing training in insect and disease identification to Forest crews and contract inspectors. Insect and disease identification demonstrations were also held on installed plots for several contractors. FID visited several installed plots over the season to check for accuracy and to answer questions by crew members. Similar activities are scheduled for 1995.

In addition, FID has developed a report that can be generated from sample unit data. The report provides the user with a stand table by tree species, detailed information on insects and diseases recorded on the plot, standing dead tree information including condition and wildlife use, a down woody material report, and an FVS-ready tree list that includes keywords describing current root disease conditions.

All indications are that information gathered during installation of CVS plots will accurately describe the incidence, damage, and severity of the major insect and disease groups and will be useful at Forest and Regional levels.

R6-91-71 Use of FSCGB to predict initial pesticide loading to forested watersheds. (Hadfield)

R6-93-01 Alternative technologies for management of soilborne diseases in bareroot forest nurseries. (Hildebrand)

R6-94-05 Streamlined western spruce budworm population dynamics model. (Sheehan)

R6-94-07 Optimal dose of MCH bubble capsules for protecting Douglas-fir from attack by the Douglas-fir beetle. (Ragenovich)

For information on any of the TDP listed, contact the FID sponsor. Of those projects listed above, seven are currently active or were completed in 1994. The following is a summary of these seven projects:

Project: Pest trend impact plots in the west (R4-90-01)

Summary: This Technology Development Project is a cooperative effort between Forest Pest Management (FPM) in Regions 1, 2, 3, 4, 5, 6, 10, Methods Applications Group (MAG); Forest Insect and Disease Research (FIDR); the National Forest System (NFS); the Bureau of Land Management (BLM) and the Bureau of Indian Affairs (BIA) to establish permanent plots for improving insect and disease damage estimates, validation of insect and disease models, and monitoring forest health throughout western forests. The permanent plots are being installed following consistent plot establishment, data collection, plot maintenance, and database management procedures. Plots are established in stands affected by dwarf mistletoes, root diseases, stem rusts, and western spruce budworm. They will provide data to improve the validation, calibration and development of pest models that predict pest behavior and impact through time. High priority is given to establishing new plots in unrepresented or under-sampled forest conditions and to incorporate existing plots/networks into standardized databases.

The objectives came about as part of a west-wide effort to integrate existing and new permanent plot information. Cooperators agreed to: 1) assemble a catalog of existing permanent plot systems in order to help Regional/Pest coordinators determine (a) which of the plot systems are suitable for the afore-mentioned pests and (b) what new plot systems needed to be established; 2) establish a series of permanent plots using standardized procedures for validation and calibration of the pest models for root disease, dwarf mistletoe and western spruce budworm; and 3) use statistically valid sampling and data collection procedures which meet model validation and calibration needs.

Results to date include:

1) A draft catalog, Catalog of Western Permanent Plots for Pest Impact Assessment was compiled and sent out in March 1991 with an updated version issued in May 1991.

2) A decision for a database was made in March 1991 and design stage was initiated. A Software Project Management Plan was prepared in 1993. A prototype database system was developed and demonstrated in 1993. A draft users guide and training were provided in 1994.

3) Plot installation for dwarf mistletoes and root diseases was initiated in FY 90 and continued through FY 95 (Regional Progress Reports with detailed accomplishments are on file at Flagstaff, AZ).

4) Methods for plot establishment for western spruce budworm were agreed upon during a workshop, plot establishment began in FY 92.

5) Mountain pine beetle was dropped and will be funded under other Technology Development projects.

6) Douglas-fir tussock moth was added.

7) Proposals to remeasure plots in mixed conifer and ponderosa pine in California were added in FY 1993 and continue in FY 1995.

8) A conifer stem rust subgroup was established in FY 93 and proposals for rust plots were developed for FY 94.

9) A beta version of the PTIPS was released in October 1993 for review and testing by a select group. In October 1994, a training session was held in Fort Collins for Regional users.

Literally thousands of plots are currently under the umbrella of this Technology Development Project. Previously established plots have been updated to conform to standards set by pest working groups and new plots continue to be established to fill data needs for new and existing models. Several agencies are involved as active partners in the project and Forest Insect and Disease Research scientists are participants in data collection and analysis on several plot systems. While many of the plots are directly managed and maintained by FPM, on some plot systems District and Resource Area personnel have primary plot establishment, data collection and plot maintenance responsibilities due to their keen interest in the information provided by these plots.

In Region 6, plot systems exist for western spruce budworm in mixed conifer stands of eastern Oregon, ponderosa pine dwarf mistletoe in even-aged stands throughout Washington and Oregon, Douglas-fir dwarf mistletoe in southwestern Oregon, root diseases in mixed conifer stands of eastern Oregon, laminated root rot in second growth Douglas-fir on the west slope of the Cascades, and white pine blister rust in sugar pine in southwestern Oregon. Future plot establishment will be focused on white pine blister rust in western white pine in western Oregon and Washington. Priority is given to maintaining and analyzing data from existing plots. Information gathered through this effort is expected to enhance both project level and large scale analyses and to assist in developing risk rating models for the forests of the Pacific Northwest.

Project: Updating and testing the Douglas-fir tussock moth model. (R6-90-25).

Summary: The objectives were to evaluate the current DFTM model, recommend changes in the model if appropriate, and conduct field studies to improve and/or test certain portions of the model.

The current DFTM model was evaluated by FPM (R5, R6, and MAG) and PNW representatives. A field study comparing traditional DFTM defoliation estimates with traditional western spruce budworm defoliation estimates was conducted. Based on the field study, observed DFTM defoliation patterns were simulated using the budworm Damage Model. Wickman's tree mortality observations from the mid-1970's DFTM outbreak in the Blue Mountains of northeastern Oregon were used to test both the current DFTM model and the Damage Model.

The evaluation of the current DFTM model is summarized in an unpublished report by Gillespie and others (1990). They report that the current DFTM model predicts defoliation on midcrown branches fairly well; however, midcrown branch defoliation is an inherently poor predictor of total tree defoliation, and the DFTM model is very sensitive to the branch/tree defoliation relationship. One approach to resolving this problem would be to expand the model to include the whole crown (not just a midcrown branch), but that would be a huge undertaking and was beyond the scope of this project. As an alternative, a damage model that takes defoliation patterns provided by the user and predicts the resulting changes in tree growth and mortality was evaluated. This damage model was originally developed for western spruce budworm, and required different estimates of defoliation than were traditionally recorded for DFTM. A field study was therefore conducted in Oregon and Idaho to develop methods for converting traditional DFTM defoliation estimates to those used by the Damage Model. These methods are described in Sheehan and others (1994a).

A second report (Sheehan and others 1994b) relies on Wickman's observations of defoliation and subsequent tree mortality and topkill during the mid-1970's DFTM outbreak in the Blue Mountains of northeastern Oregon. Both the current DFTM model and the budworm damage model (using three different options for translating observed defoliation into missing biomass) were evaluated, and in most cases the models performed poorly. For the budworm damage model, the most important source of error was probably our attempt to apply tree mortality equations that were developed for budworm to DFTM; those mortality equations generally underestimated the effects of short episodes of severe defoliation that are so typical of DFTM outbreaks. For the current DFTM model, the translation of midcrown branch defoliation to whole-tree defoliation was probably the most serious source of error.

In the second report, we recommend that the most cost-effective means of incorporating the effects of DFTM into FVS (Prognosis) simulations would be to develop a DFTM damage model. This new damage model would use defoliation patterns supplied by the user (as is the case for the budworm damage model) and the corresponding tree effects (mortality, topkill, and growth loss) reported by Wickman. It is possible that much of the computer coding, keywords, etc. could be lifted from the existing budworm damage model with minor modifications to form a new DFTM damage model. This task would be an appropriate undertaking for the Methods Application Group.

The computer code for the current DFTM model was revised in order to link it with the current FVS (Prognosis) version. No changes affecting how the model works were made, so no documentation was produced. Several reports were produced.

Cooperators:

Katharine Sheehan, R6; Eric Smith, MAG; Lance David, contractor, MACA; Nicholas Crooksten, INT; Tom Gregg, R6; Bruce Hostetler, R6; Richard Mason, PNW; Julie Weatherby, R4; John Wenz, R5; Boyd Wickman, PNW; Elizabeth Willhite, R6.

Project: Vegetation Management Modeling (R6-91-32)

Summary: The objective of the project is to develop interactive models for vegetation community development, and vegetation treatment efficacy for reforestation of principal vegetation types in the Pacific Northwest Region.

The main emphasis during the past year was the establishment of growth monitoring plots in Oregon and Washington and, concurrently, the development of a RVMM demonstration model. The plot installations provided a coherent and consistent extension of the modeling database based on a data set matrix, and sampling and data collection protocols. The purpose of the RVMM demonstration model was to evaluate diameter distribution prediction and stand table projection modeling approaches and to provide a shell for later versions of the model.

Using the data set matrix developed for the Coast Ranges as a guide, sampling and data collection protocols that support both tree-and stand-level modeling approaches were used to install nearly 100 growth monitoring plots in the Cascades during 1994 (Table 1). The establishment of growth monitoring plots was aimed at filling several gaps in the Cascades modeling database including competition effects (inter- and intraspecific), species representation, and stand age. The Cascades data set matrix focused on three plant associations indicating high, medium, and low site productivity; four tree height classes (0-5, 6-10, 15-20, more than 25 feet); three combinations of site preparation and tree release from associated vegetation, and two replications per cell (minimum of 72 cells). In practice, the number of matrix cells exceeds this minimum number due to the inclusion of intermediary tree height cells and additional cells in precommercially thinned stands. Each of the data set cells represents a 0.10 - 0.15 acre Douglas-fir measurement plot (PMP) containing four 0.01 acre competition measurement plots (CMPs). The initial plot measurement will be followed by remeasurement in 1995-96.

In addition to plot installation in the Cascades, 75 of the 98 Coast Ranges growth monitoring plots have been remeasured. Data formatting, cleaning, and summarization for growth and yield modeling analysis is in progress.

Using a simulator based on the tenth-year remeasurements of the CRAFTS Coast Range Competition Release Study as a shell, diameter distribution prediction models developed from the data collected in the Coast Ranges during 1992 were incorporated into a demonstration version of the young stand simulator for Douglas-fir. The simulator also includes predictions of height-diameter, crown width, and live-crown ratio and provides output files in ORGANON-compatible format.

A tree-level diameter increment function was developed using stand parameters and neighborhood vegetation in the CRAFTS Coast Range Competition Release Study. This tree-level approach provides an alternative to the existing stand-level function for investigating the effects of competing

Table 2 – The distribution of Regional Vegetation Management Model measurement plots for the Cascades by organization and site productivity class.

Organization	**Number of Cascade Range PMPs by Site Productivity**			
	Higher	Medium	Lower	Total
BLM	2	8	3	13
Willamette NF	0	8	12	20
Gifford Pinchot NF	3	4	7	14
Mt. Baker-Snoqualmie NF	0	3	5	8
Washington DNR	2	3	0	5
Champion International	7	4	0	11
Cavenham	2	2	1	5
Weyerhaeuser	13	7	2	22
Total	29	39	30	98

vegetation on young Douglas-fir. The approach was to use the first two 2-year growth increments from the database and use model forms analogous to those found in ORGANON, FVS, SYSTUM-1, and CRYPTOS. Attempts were made to incorporate tree size (diameter and height) and age, tree vigor and condition, tree position within the stand (BAL or basal area of trees larger than the subject tree), stand density, and competing vegetation into the growth function. The final equation includes competition indices based on herb and shrub cover, overtopping and encroaching cover, and cover of organic debris, and accounts for 74 percent of the variation observed in diameter growth of individual trees.

Static tree-level equations were developed to predict diameter (d15 and dbh), basal area of multi-stem hardwoods (d15 and dbh), total height (less than 140 cm and equal to or greater than 140 cm), and crown width for nine hardwood species and three conifer species in the Coast Ranges data set. These equations will be used to estimate attributes of trees that were not included in the subsampling scheme used to collect data.

Cooperators:

Peyton Owston, PNW Station, Corvallis
Don Connett, R6 Regional Office, Natural Resources
Steve Radosevich & Oregon State University Staff

Project: Evaluation of burning to reduce overwintering populations of gall midge pupae and seed chalcid larvae in Douglas-fir seed orchards. (R6-91-41).

Summary: The objective of the project was to evaluate the effectiveness of litter flaming as a means of controlling Douglas-fir cone gall midge and Douglas-fir seed chalcid.

Douglas-fir cone gall midge, *Contarinia oregonensis* Foot, and Douglas-fir seed chalcid, *Megagstigmus spermotrophus* Wachtl, are the two most destructive species associated with reduced seed yields in Douglas-fir seed orchards in western Oregon. Because of their cryptic habits, few non-chemical tactics for controlling populations of these species are available. However, their habit of overwintering in litter under host trees makes them vulnerable to litter treatment such as burning.

Initial assays in the lab indicated that midge larval mortality increased as temperature and duration of heat exposure increased and was maximized under dry conditions. Subsequent efforts to achieve these lethal temperatures at the Beaver Creek Seed Orchard during winter and spring 1993/94 were unsuccessful. Wet litter conditions prevented burning during much of the period, and flaming trials achieved maximum surface temperatures of up to 200 degrees C, but temperatures at the soil surface under litter were unchanged (Figures 1-3). We modified our experimental plan by adding a preliminary step to pulverize and dry the litter using standard flail chopper, but wet conditions continued to prevent heat penetration below the litter surface.

Our plan for next year calls for litter treatment in the fall to minimize available habitat for midge larvae.

Cooperators:

Entomologists Roger Sandquist, Christine Niwa, and Timothy Scholwalter, R6, PNW Station, and Oregon State University, respectively; Bill Randall, Area Geneticist; Peyton Owston, PNW Plant Physiologist; and seed orchard managers from R6, Weyerhaeuser, and other cooperators.

Project: Alternatives to Methyl Bromide Fumigation (R6-93-01)

The objectives for this nationwide project are to enhance implementation of IPM (Integrated Pest Management) and provide alternatives to methyl bromide fumigation. The project has three components as follows:

1) Develop and evaluate cropping and soil treatment regimes that can produce large numbers of high quality seedlings without chemical fumigation.

2) Collect, develop, and evaluate combinations of biocontrol agents and application methods for suppression of soilborne diseases of seedlings.

3) Develop accurate sampling and forecasting techniques for soilborne pathogens, especially species of Fusarium.

Summary: Nursery field trials are being conducted for comparing various cultural treatments including timing and depth of sowing; bare fallow (with and without cultivation); various organic amendments including sawdust, composts, and cover crops; various mulches including pine needles, sawdust and rice straw; and fumigation with methyl bromide or dazomet. Effects on soil biology, disease incidence, and on quantity and quality of conifer seedling crops are being compared. Some treatments are being repeated on subsequent crops and long term effects evaluated.

Laboratory and greenhouse evaluations of microorganisms as potential agents for control of pathogens and for enhancement of seedling growth began in 1994. Promising combinations will be field tested in subsequent years.

Genetic analysis of *Fusarium* species using molecular biological methods will lead to the development of assays that can accurately differentiate between pathogenic and non-pathogenic strains.

Field Studies

Field trials are in progress at 12 nurseries across the country, with the addition of Supertree Nursery (International Paper Co.) and Ashe Nursery (R8) in 1994. In Florida, field outplantings are also being established and will be monitored for latent disease development and seedling performance.

R8: Data from the first crop of slash pine indicate only subtle differences between treatments, including methyl bromide fumigation. No significant disease outbreaks occurred in 1994, and most seedling losses occurred early in the season as damping-off. Soil amendments are affecting soil chemistry in several ways, including organic matter, pH , and calcium. Long term and seedling effects are being monitored.

West: Data from eight nurseries indicate that conventional practices without chemical fumigation can result in high losses. Alternative practices produced results similar to those with fumigation, and perhaps better. The most successful treatments varied by nursery, and included bare fallow with or without tilling for many weeks prior to sowing, and early sowing with seeds covered by sawdust or hydromulch. Incorporating sawdust into the soil without additional nitrogen and before fallowing appears beneficial. Control of weeds without chemical fumigation will require more diligence and effort.

Highest levels of seedling mortality and lowest density were associated with high population levels of Fusarium spp. and sometimes *Pythium* spp. Low and moderate pathogen levels did not consistently correspond to levels of seedling mortality.

NA: For fall sown white pine, bare fallow with Agri-Lock soil stabilizer or sudan grass cover crop both resulted in many fewer seedlings than either methyl bromide or dazomet. Proportionally large decreases in organic matter from June to September indicate that the winter rye cover crop might not have been decomposed when treatments commenced in June.

Disease symptoms were most commonly associated with *Fusarium* spp. Other pathogens included species in the genera *Pythium* and *Rhizoctonia*. . Seedlings suffered from heat, moisture, and nutrient stress as well as disease.

Microorganism Collection and Evaluation

Nearly 300 *Fusarium* isolates have been collected and put into long-term storage at OSU. Pathogenicity tests continue on Douglas-fir. From over 500 potential biological control agents, 164 that inhibited a mixture of pathogenic *Fusarium* spp. are now in long-term storage at NC Station. Laboratory and greenhouse tests continue to test microbial interactions and pathogenic and beneficial effects on white pine seedlings.

Genetic Analyses of Fusarium

Characterization of scores of *Fusarium* isolates, including pathogenicity rating and genetic analyses continues. Analysis methods include isoenzyme studies, molecular karyotyping (using pulsed field electrophoresis), vegetative compatibility grouping, and analysis of restriction fragment length polymorphisms (after amplifying DNA with the polymerase chain reaction).

Cooperators:

Diane Hildebrand (R6); Robert James (R1); Jim Hoffman (R4); Susan Frankel (R5); Michelle Cram (R8); Joe O'Brien and Jill Pokorny (Northeastern Area); Jennifer Juzwik, Cindy Ocamb (North Central Station); Stephen Fraedrich (Southeastern Station); California Dept. Forestry and Fire Protection, Magalia Nursery; Ed Barnard, James Meeker, Steve Gilly (Florida Division of Forestry); David Mitchell, Beth Mitchell (University of Florida); Sandra Gould (University of Minnesota); Jeff Stone, Phil Hamm (Oregon State University); Alan Kanaskie (Oregon Dept. Forestry); Paige Axelrood (BC Research Inc.); Ken Woody (International Paper Co., Blenheim, South Carolina).

Project: A streamlined western spruce budworm population dynamics model (R6-94-05))

Summary: The objective is to produce a streamlined version of the western spruce budworm population dynamics model, including a user's guide.

After intensive analysis of the behavior and sensitivity of the western spruce budworm population dynamics model, and a review of pertinent literature published since the model was published, key factors would be extracted from the original model to create a new, streamlined version. This new model, to be named the Budworm Defoliation Model, would be incorporated into the FVS submittal system, and would be accompanied by a new user's guide. New output options will summarize the effects of budworm defoliation on foliage distribution as well as on tree growth and mortality. Model output files would be designed to feed directly into other models, such as those that simulate visual quality or wildlife habitat. The Defoliation Model would also be designed to serve as a chronic defoliator submodel of a multi-pest model.

Brief description of accomplishments and results:

In the first seven months of this project, we have:

1) Linked the budworm population dynamics model to a current FVS variant (which had not previously been done by MAG).

2) Documented the 100+ subroutines that make up the population dynamics model (including links to other subroutines and variables passed into and out of each subroutine).

3) Conducted a workshop at the joint Western Forest Insect Work Conference/ Western International Forest Disease Work Conference in March, 1994 regarding the proposed model. Several participants (including university and Canadian members) expressed interest in reviewing/evaluating the model.

4) Met with several research cooperators and FPM specialists to review and explore the research basis for proposed changes in the model; many more such meetings are planned for FY95.

5) Begun evaluation of portions of the population dynamics model, concentrating on those parts that are driven by weather. The 20 degree-day time step that is used in the population dynamics model will not be included in the defoliation model.

6) Begun programming a framework for the new defoliation model that uses an annual time-step rather than a 20 degree-day or daily time-step.

Cooperators:

Katharine Sheehan (R6); Eric Smith (MAG); Lance R. David (contractor, MACA); Ann M. Lynch (RM); Tommy F. Gregg (R6); Nancy J. Campbell (R1).

Project: Optimal dose of MCH bubble capsules for protecting Douglas-fir from attack by the Douglas-fir beetle (R6-94-07)

Summary: Previous research had demonstrated that MCH, a Douglas-fir beetle anti-aggregating pheromone, released from bubble capsules at the rate of 150 caps per hectare would effectively exclude beetle attack from the treated area. MCH could be used as a short-term treatment to protect high-value stands during an on-going outbreak. The objective of this project was to determine an effective lower dose rate.

Eight replications were installed in spring 1994 (three in northeastern Oregon, two in Montana, two in Idaho, and one in Utah). Each replication consisted of four treatments applied to a one hectare circular plots. The treatments were 0, 50, 100, and 150 MCH bubble capsules per hectare. Each bubble capsule contained 400 mg of MCH. Three Lindgren funnel traps baited with frontalin and seudenol were at the center of each plot. All plots have been surveyed and all trap samples have been processed. The data is currently being analyzed. Preliminary analyses indicate that all three MCH doses are equally effective. Mean percent infested host trees for the 0, 50, 100, and 150 capsule/ha treatments were 5.6, 1.2, 1.2, and 0.7%, respectively. All three MCH doses were significantly different from the check, but there were no differences between the three doses.

Cooperators:

Darrell Ross, OSU; Ken Gibson, R1; Ralph Thier, R4; Steve Munson, R4; Iral Ragenovich, R6; Gary Daterman, PNW Station.

INTERNATIONAL COOPERATION

Under the new FID Regional Office reorganization, Iral Ragenovich is responsible for International Coordination. The coordinator is the contact for requests for international technical assistance for the FID people in the region, and maintains contact with agencies in other countries involved in forest insect and disease related activities.

In 1994, the Central Oregon Insect and Disease Area Office hosted a visitor from the Chilean Ministry of Agriculture. The Chilean agency requested an informal training session to address exotic forest insects as a potential threat to Chile's forest resources. Miguel Poisson, a forester from Chile's Department of Agricultural Protection, arrived in Bend on October 24 and spent two weeks traveling throughout Oregon and Washington with area entomologist Andris Eglitis. Specific items of emphasis included discussion of bark beetles in the Northwest and attendance of the annual Gypsy Moth Review, a national meeting held this year in Portland, Oregon. Mr. Poisson spent several days in the field learning about the biology and effects of the bark beetles associated with pine species. At the Gypsy Moth Review, he was introduced to numerous regulatory personnel from USDA Animal and Plant Health Inspection Service, whose responsibilities in this country are similar to Mr. Poisson's in Chile. He was able to meet with colleagues from New Zealand, also in attendance at the gypsy moth meeting, and with various State Departments of Agriculture who share common interests. Other travels during the two-week period included visits to the USDA Forest Service Regional Office (Forest Insects and Diseases), the Washington State Department of Agriculture in Olympia, and the University of Washington to meet with specialists in exotic forest pests.

Dave Kershaw, New Zealand Ministry of Forestry, and Lindsay Bulman, New Zealand forest Research Institute, spent several days with members of the FID staff prior to the Annual Gypsy Moth Review held in Portland in October. They spent a day in the field on the Deschutes NF, and spent some time in the Regional Office learning about the aerial detection survey, GIS and our data base for insect and disease detection and monitoring. They also met with the Washington Department of Agriculture to discuss the state's program for trapping and monitoring for exotic insects, quarantines, and eradication activities.

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Appendices

Insect Activity Occurrence Maps

Insect Activity by Reporting Area

Submitting Insects and Diseases for Identification

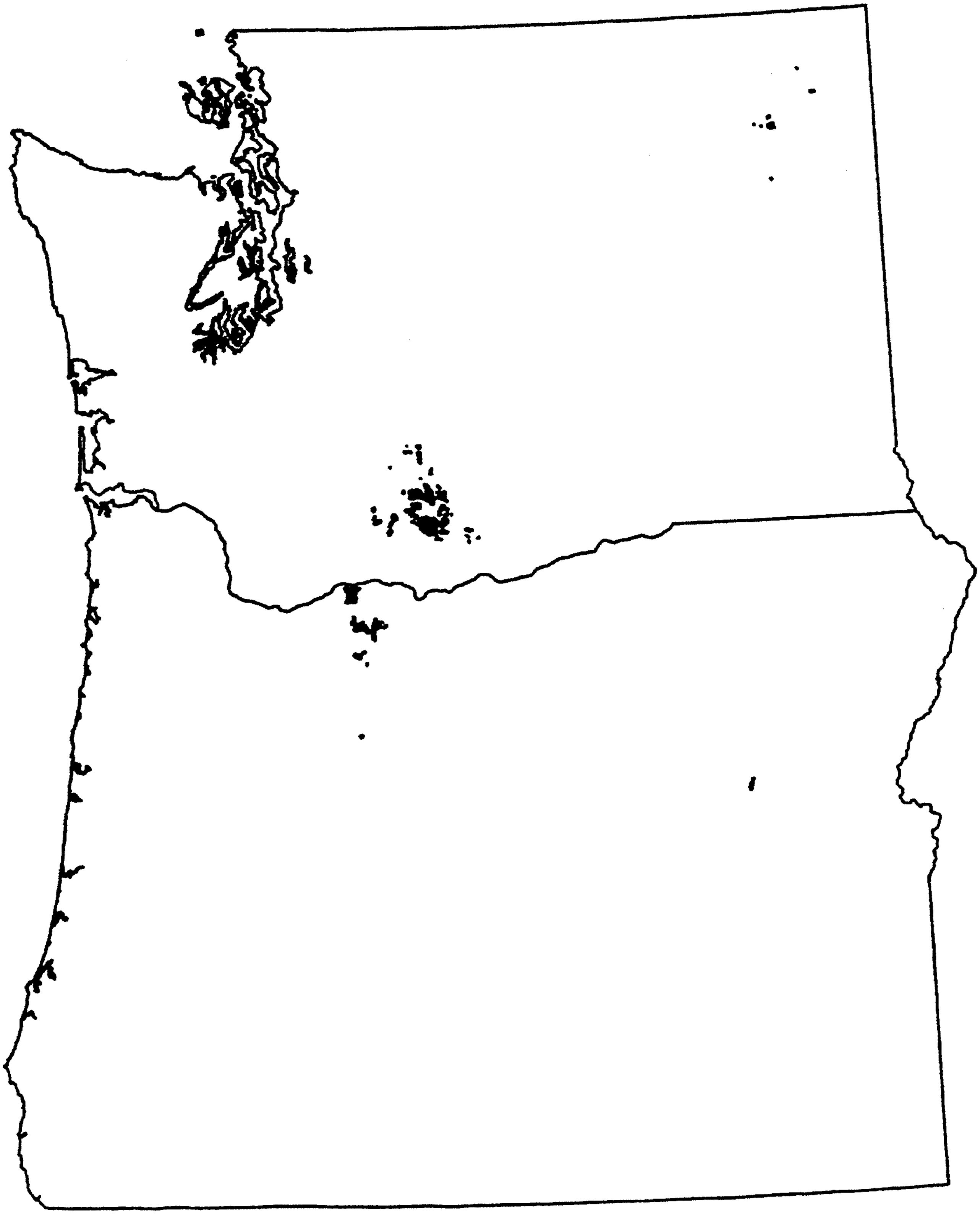

Figure 18 – Occurrence of defoliation associated with western spruce budworm in the Pacific Northwest Region in 1994

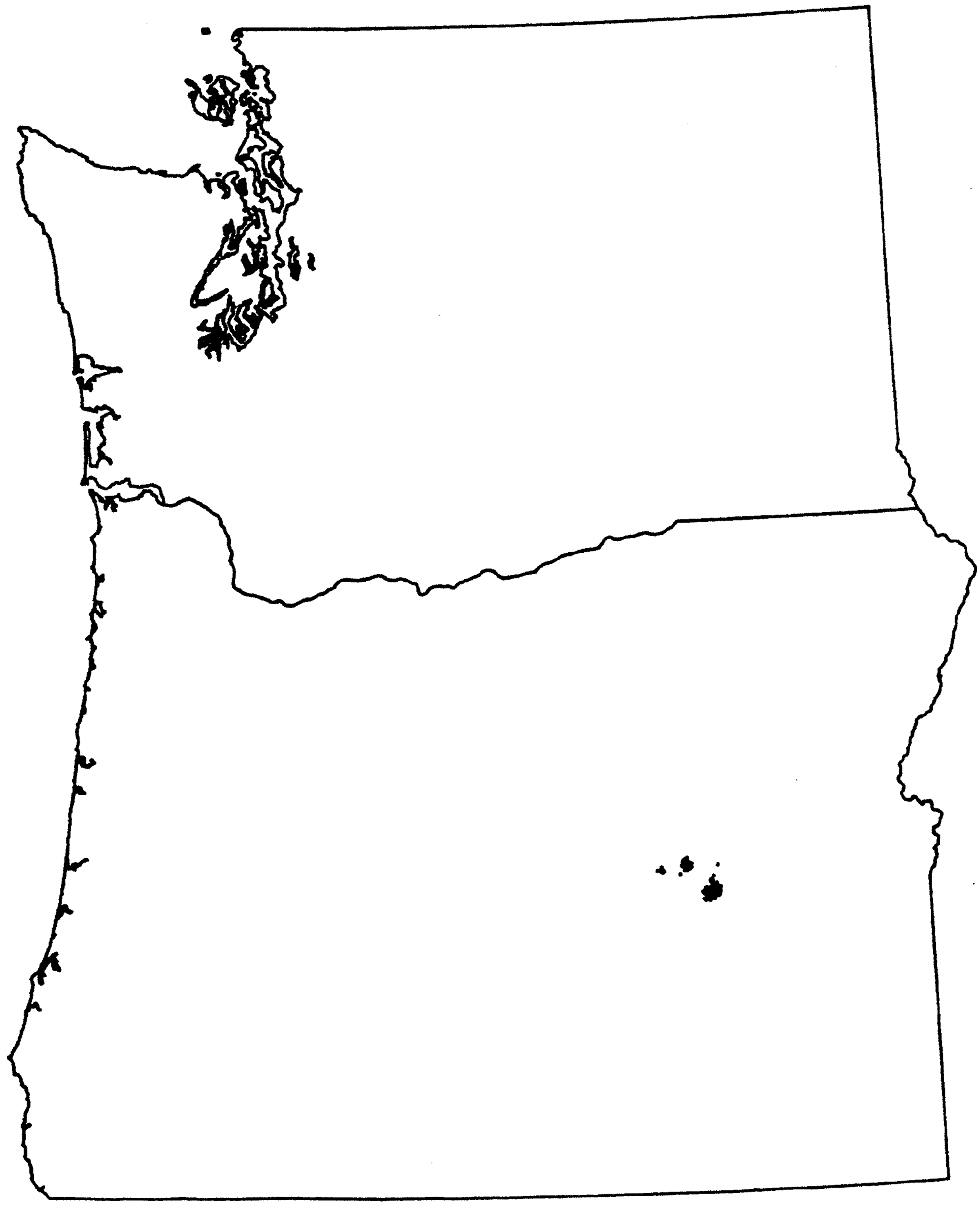

Figure 19 – Occurrence of defoliation associated with Douglas-fir tussock moth in the Pacific Northwest Region in 1994

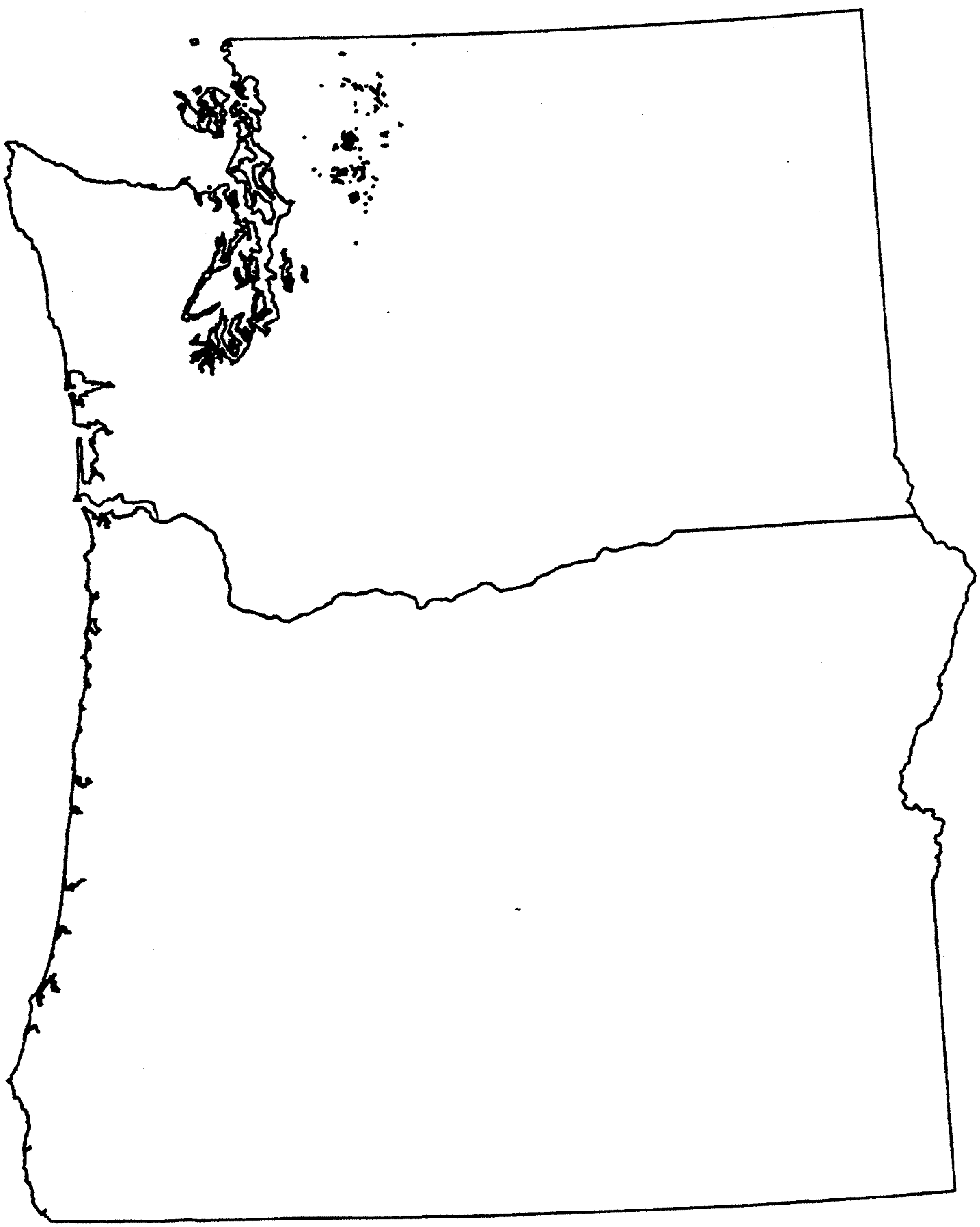

Figure 20 – Occurrence of defoliation associated with hemlock looper in the Pacific Northwest Region in 1994

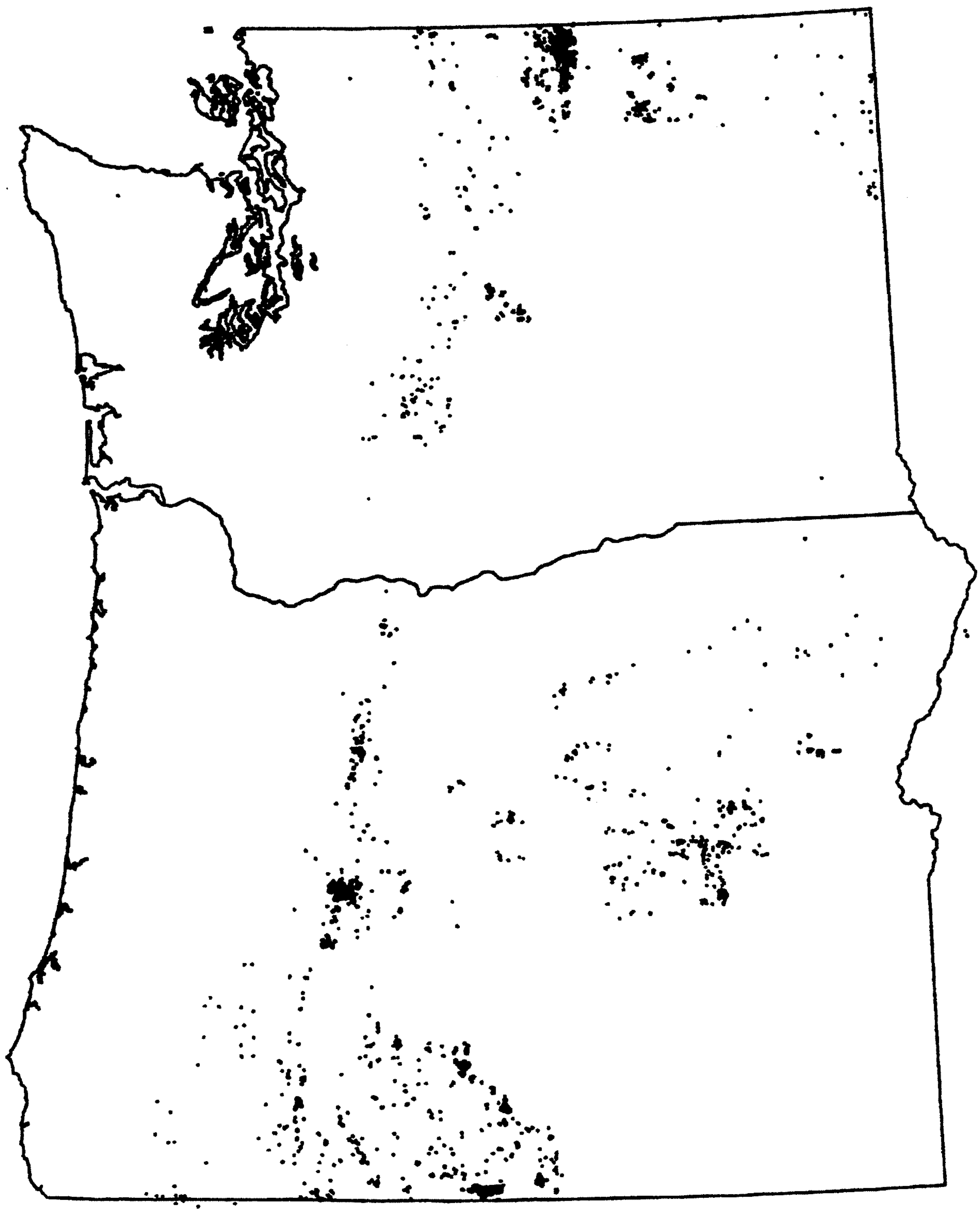

Figure 21 – Occurrence of tree mortality associated with mountain pine beetle in the Pacific Northwest Region in 1994

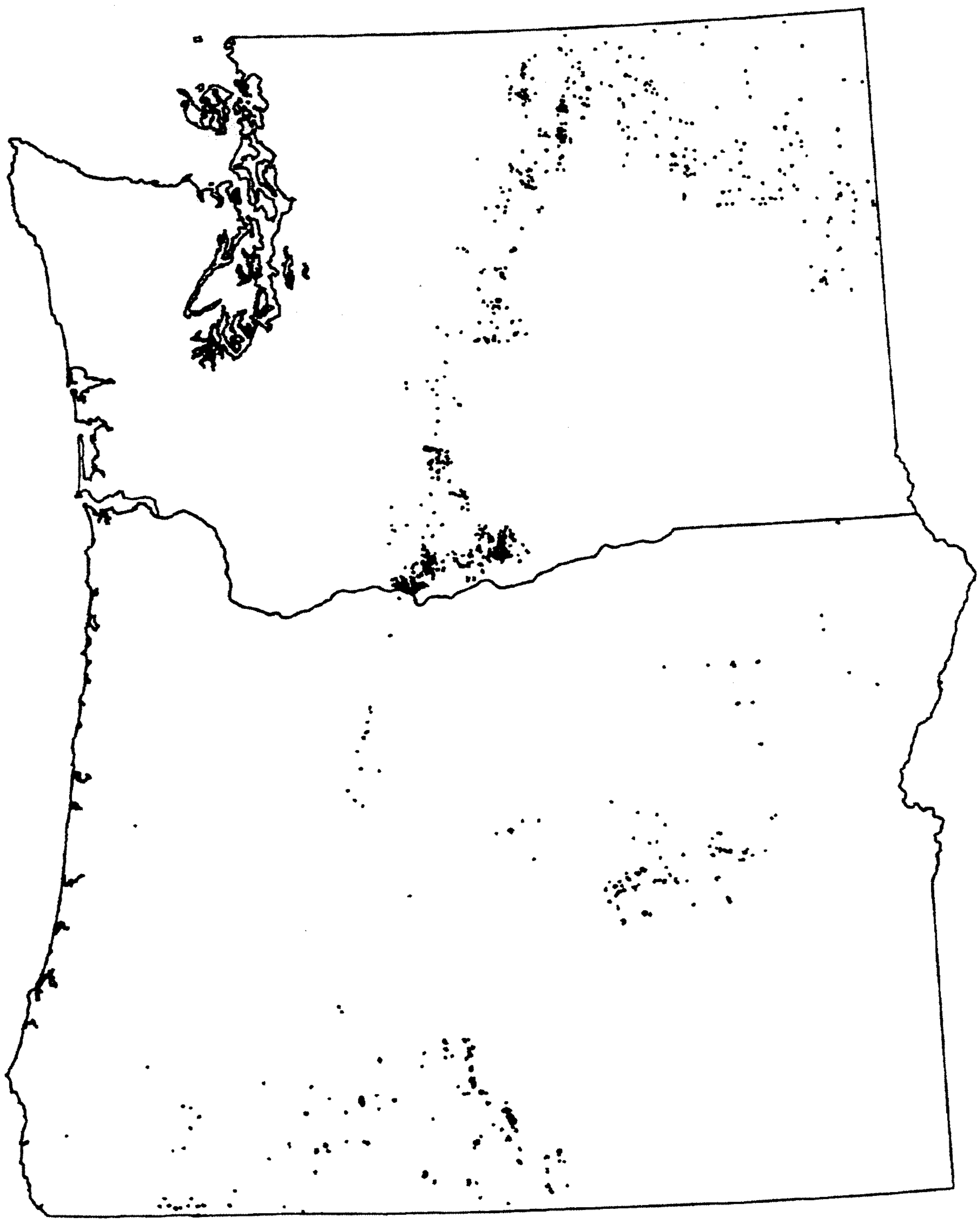

Figure 22 – Occurrence of tree mortality associated with western pine beetle in the Pacific Northwest Region in 1994

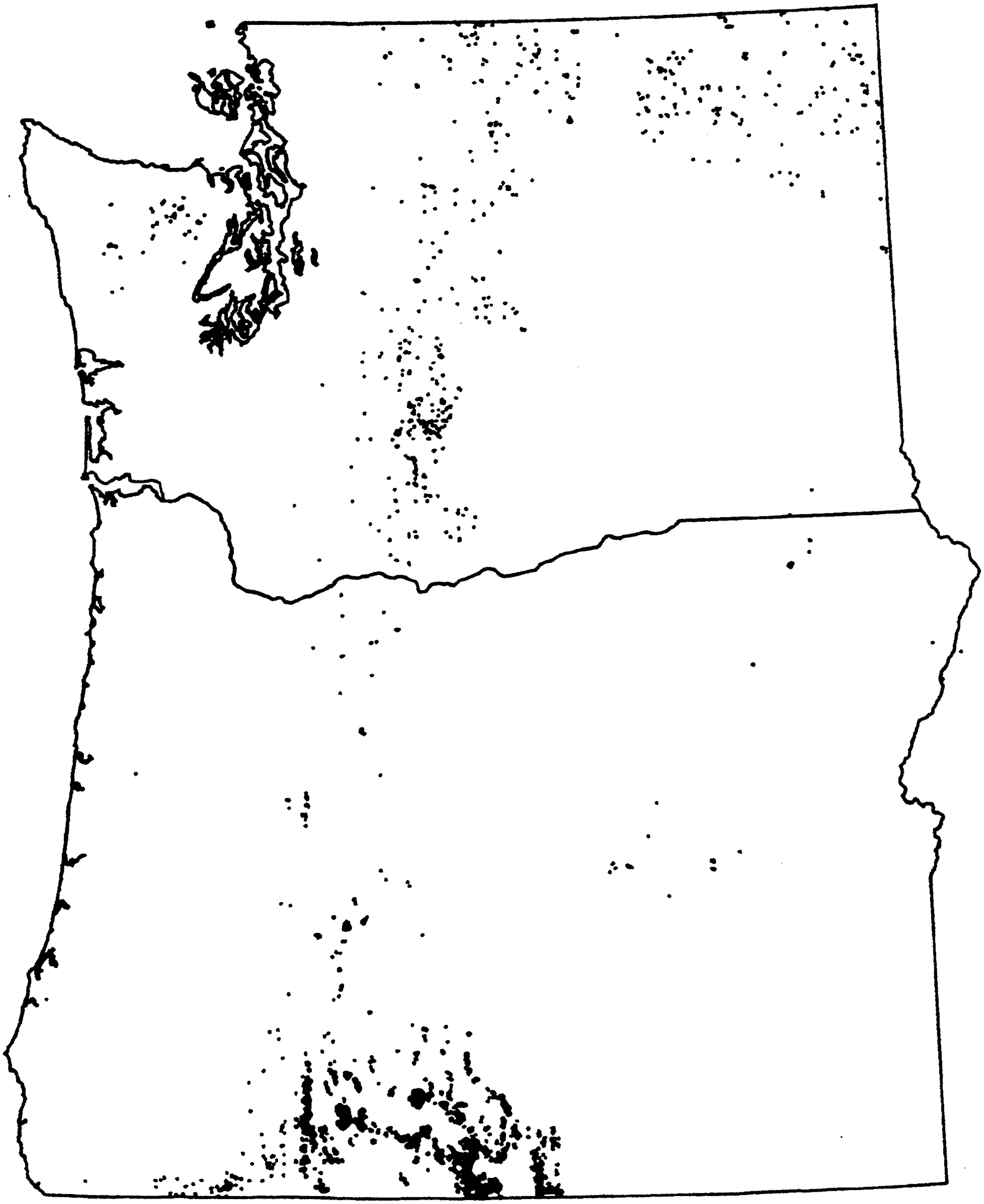

Figure 23 – Occurrence of defoliation associated with fir engraver in the Pacific Northwest Region in 1994

Table 3– Insect Activity by Reporting Area Pacific Northwest Region 1994

mpb/pp = mountain pine beetle in ponderosa pine
mpb/lp = mountain pine beetle in lodgepole pine
wpb/pt = Western pine beetle in pole-sized ponderosa pine
wpb/lt = Western pine beetle in large ponderosa pine

dfb = Douglas-fir beetle
wsb = Western spruce budworm
dftm = Douglas-fir tussock moth

	mpb/pp		mpb/lp		wpb/pt		wpb/lt		fir engraver		dfb		wsb	dftm
Reporting Area	acres	trees	acres	trees	acres	trees	acres	trees	acres	trees	acres	trees	acres	acres
Central Oregon	1309	1059					24	10						
Colville I.R.			2317	3655	6987	3762	1039	398	2385	706	201	100		
Colville N.F.	543	338	250	213	1461	813	585	286	3416	1594	1365	495	2264	
Coos-Douglas	9	5					22	10	24	5	60	20		
Crater Lake N.P.			185	65			11	5	654	170				
Deschutes N.F.	3582	1845	40336	80285			292	155	8150	7765	1069	481		
Fremont N.F.	46712	58446	6024	14377	318	55	20074	18525	208174	178928	23	30		
Gifford Pinchot N.F.			44	10	6	5			693	176	2098	724	3724	
Glenwood					36958	13519	1766	370	1029	190	697	210	8159	
Kaniksu N.F.							11	5	181	95	9	5		
Malheur N.F.	14860	9940	3782	3297			6070	1958	1087	381	6506	4412	1843	26530
Mt. Baker-Snoqualmie									551	205	3768	2678		
Mt. Hood N.F.	181	151	925	1274			219	130	576	333	2563	1094	35041	
Mt. Rainier N.P.			21	5					92	25	105	51		
North Cascades N.P.									451	170	338	158		
Northeast Washington	58	56	25	35	2025	1073	385	160	415	199	73	40	120	
Northwest Oregon														
Northwest Washington			418	99							1427	726		
Ochoco N.F.	5174	3387	76	45	568	173	5026	2321	949	374	527	224		
Okanogan N.F.	91	35	60907	276449	12810	11955	1204	470	5607	2854	418	220		
Olympic N.F.			21	5					327	105	2249	795		
Olympic N.P.									1815	970	795	249		
Puget Sound			23	15							738	389		
Quinalt I.R.											95	25		
Rogue River N.F.	362	221	652	241	620	206	1331	338	5540	2116	77	45		
Siskiyou N.F.	66	35			41	10	33	20	58	20	10	5		
Siuslaw N.F.							11	5	13	5	171	120		
Southwest Washington									19	5	507	185		
Spokane I.R.					394	211	264	110	129	25	15	10		
Umatilla I.R.											233	135		
Umatilla N.F.	936	1800	184	55			462	140	1525	456	29326	33625		
Umpqua N.F.	18	5	368	140	10	5	27	15	84	20	190	100		
Wallowa-Whitman N.F.	4620	2489	484	255			657	219	178	86	10946	8622	4	
Warm Springs I.R.	1075	438	6329	6353			821	366	818	234	1486	2426	598	
Wenatchee N.F.	5419	2550	718	919	9006	4950	1500	478	12247	6515	3758	1841	1285	
Willamette N.F.			278	147			12	5	1663	1747	1496	877		
Winema N.F.	6579	6026	8012	5106	13	20	6753	2787	96113	36360				
Yakima I.R.					4412	1426	1562	308	2883	1634	361	60	69947	

Submitting Insects and Diseases for Identification

The following procedures for the collection and shipment of specimens should be used for submitting samples to specialists:

I. Specimen collection:

1. Adequate material should be collected
2. Adequate information should be noted, including the following:
   a. Location of collection
   b. Date collected
   c. Collector
   d. Host description (species, age, condition, # or percentage of plants affected)
   e. Description of area (e.g., old or young forest, bog, urban);
   f. Unusual conditions (e.g., frost, poor soil drainage, misapplication of fertilizers or pesticides).
3. Personal opinion of the cause of the problem is very helpful.

II Shipment of specimens:

1. General: Pack specimens in such a manner to protect against breakage.
2. Insects: If sent through the mail, pack so that they withstand rough treatment.
   a. Larvae and other soft-bodied insects should be shipped in small screw-top metal containers with at least 70% isopropyl (rubbing) alcohol (you cannot mail more than 1 quart of alcohol per shipment). Make certain the bottles are sealed well. Include in each vial adequate information, or a code, relating the sample to the written description and information. Labels inserted in the vial should be written on with pencil or India ink. Do not use a ball-point pen, as the ink is not permanent.
   b. Pupae and hard-bodied insects may be shipped either in alcohol or in small boxes. Specimens should be placed between layers of tissue paper in the shipping boxes. Pack carefully and make certain that there is very little movement of material within the box. Do not pack insects in cotton.
3. Needle or foliage diseases: Do not ship in plastic bags. Sprinkle lightly with water before wrapping in newspaper. Pack carefully and make sure that there is very little movement of material within the box. Include the above collection information. For spruce and other conifers, include a description of whether current year's needles, last-year's needles, or old-needles are affected.
4. Mushrooms and conks (bracket fungi): Do not ship in plastic bags. Either pack and ship immediately, or first air dry and then pack. To pack, wrap specimens in dry newspaper and pack into a shipping box with more newspaper. If on wood, include some of the decayed wood. Be sure to include all collection information.

III. Shipping:

1. Ship as quickly as possible, especially if specimens are fresh and not air-dried. If samples cannot be shipped rapidly, then store in a refrigerator.
2. Include address inside shipping box. The outside of the box must be labeled: UN 1220 (A Post Office requirement when shipping flammable liquids).
3. Mark on outside: "Fragile: Insect-disease specimens enclosed. For scientific purposes only. No commercial value." Also, mark the outside of the box with: UN 1220.