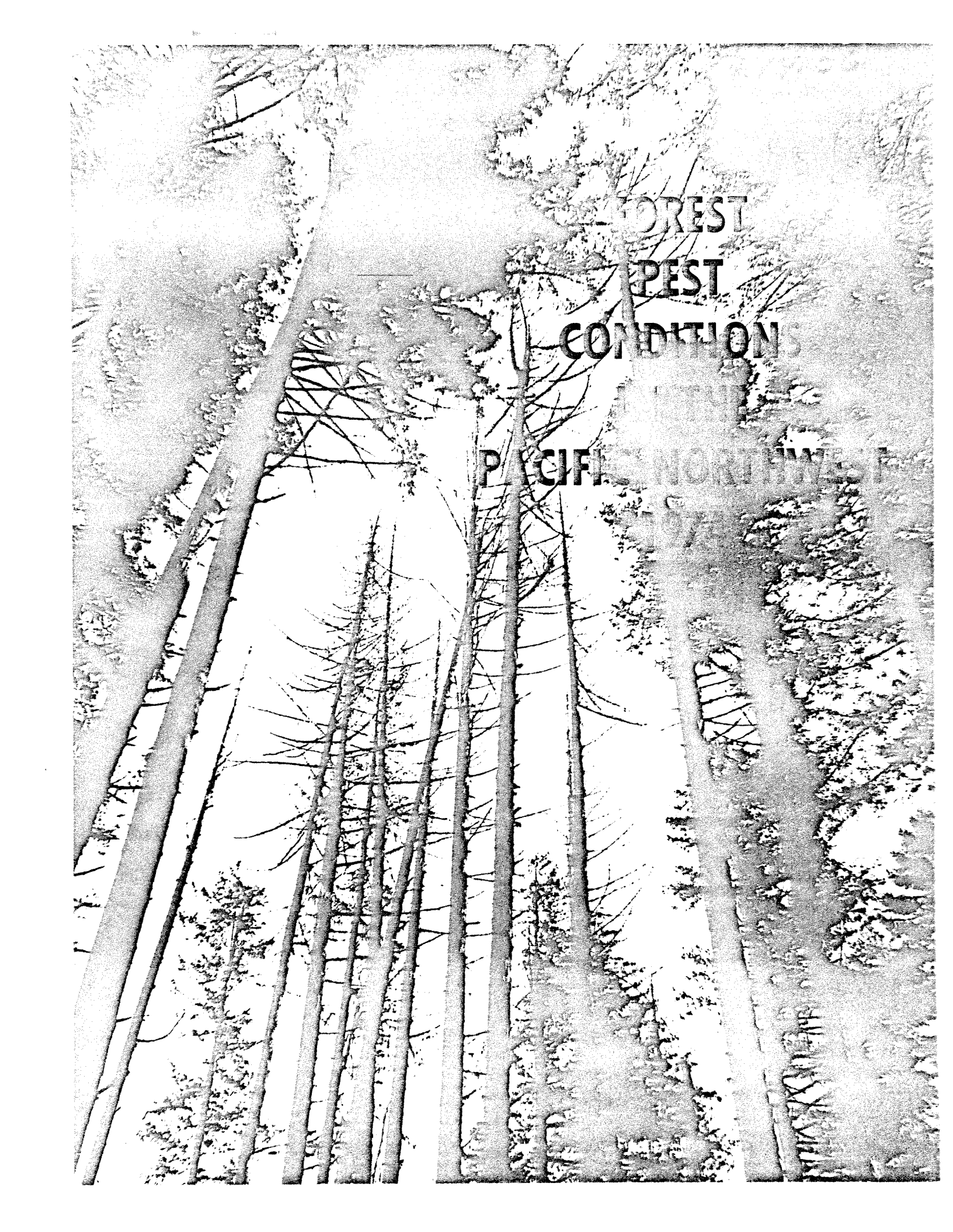
FOREST
PEST
CONDITION
PACIFIC NORTHWEST

This is the 27th annual report of forest pest conditions in Oregon and Washington based on cooperative surveys sponsored by the Northwest Forest Pest Action Council. The combined efforts of many organizations and individuals made these surveys possible. Special acknowledgment is made to the principal cooperators, Oregon State Department of Forestry and Washington State Department of Natural Resources and the surveillance efforts of private, State, and Federal foresters.

The photograph illustrates a typical root disease center caused by *Phellinus* (Poria) *weirii* in a Douglas-fir stand. The occurrence of this disease often causes a circular stand opening ringed by affected trees in all stages of decline.

The primary damage caused by the fungus appears to be tree mortality; growth reduction and butt rot being less important. When susceptible tree species such as Douglas-fir are maintained on infested sites for several rotations, volume productivity is greatly reduced.

Indirectly, this disease may contribute to additional losses by bark beetles, such as the Douglas-fir beetle, which are attracted to weakened trees.

PHOTO CREDIT: Dr. David W. Johnson, Plant Pathologist, U.S. Forest Service, Portland, Oregon.

FOREST PEST CONDITIONS IN THE PACIFIC NORTHWEST

1974

Donald J. Curtis
and
David W. Johnson

May 1975

INSECT AND DISEASE CONTROL
STATE AND PRIVATE FORESTRY
PACIFIC NORTHWEST REGION
FOREST SERVICE
U.S. DEPARTMENT OF AGRICULTURE

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INTRODUCTION

Forest insect outbreaks were detected and recorded during aerial and ground surveys made in cooperation with the Washington State Department of Natural Resources and the Oregon State Department of Forestry. Ground surveys were made to verify aerial survey findings, detect low-level pest populations, and to evaluate stand conditions.

The volume of timber killed by bark beetles, except for the pine engraver (= Oregon pine Ips), was estimated from counts of dead trees made during the aerial survey. Volume losses resulting from defoliators, sucking insects, pine engravers and diseases were not estimated.

The extent of all insect outbreaks is summarized in Table 1. Volume losses caused by the various bark beetles are summarized in Table 2. Other insect infestations are summarized in Table 3 by land ownership and classification. Diseases are not summarized in tabular form.

Included in this status report is a listing of active forest insect and disease projects being conducted by the U.S. Forest Service, State and Private Forestry (R-6) and the PNW Forest and Range Experiment Station; Oregon State Department of Forestry (OSDF), Washington Department of Natural Resources (WDNR); Portland State University (PSU); University of Washington (UW); and Washington State University (WSU).

INSECT CONDITIONS IN BRIEF

Bark beetle activity increased in both Oregon and Washington in 1974. All recorded pests except the mountain pine beetle in western white pine and the silver fir beetle in Pacific silver fir, caused more damage this season than in the previous year.

Douglas-fir beetle losses were slightly more than twice those recorded in 1973. Extensive tree killing, presumably triggered by brood buildup in ice storm-damaged, drought-weakened, and diseased trees occurred over nearly 8,000 acres in the Cascade Mountains between Packwood and Randle, Washington.

Fir engraver damage more than doubled in Oregon and decreased slightly in Washington. An unusual outbreak of the flatheaded fir borer, developing in drought-weakened Douglas-fir, caused tree killing on approximately 5,800 acres in southern Oregon between Roseburg and Medford.

The volume of mountain pine bettle-caused mortality in lodgepole pine stands in eastern Oregon, estimated at 79.7 mm bd. feet, has more than doubled since last year. This is a result of recorded tree killing on nearly 423,000 acres of host type concentrated on the Umatilla and Wallowa-Whitman National Forests and adjacent State and private lands.

Western pine beetle losses in both Oregon and Washington have more than doubled since 1973. Increased activity was observed on the Fremont, Malheur, Ochoco, and Winema National Forests and on the Warm Springs Indian Reservation in Oregon.

Defoliation caused by the western spruce budworm in north central Washington and the Modoc budworm in south central Oregon substantially increased this year.

Douglas-fir tussock moth populations significantly decreased following the application of DDT on 350,205 acres of infested forest lands in Oregon and Washington this past season.

The results of post-spray sampling indicate that Douglas-fir tussock moth populations have significantly declined in Oregon and Washington. Some additional defoliation was observed during the 1974 survey. However, no significant defoliation was observed in any of the treatment areas and only one new center, totaling less than 10 acres was recorded.

Larch casebearer defoliation was again observed in both States. No formal surveys were conducted; however, field observers indicated that the intensity of damage appeared to be generally less than last year.

Populations of Modoc budworm, more than doubling in area of visible feeding, caused light defoliation over approximately 90,000 acres of white fir type in the Gearhart and Warner Mountains on the Fremont National Forest. Western spruce budworm infestations have nearly doubled in area since 1973. Variable amounts of defoliation occurred over approximately 574,000 acres of Douglas-fir and true fir forests on the Okanogan and Wenatchee National Forests and the North Cascades National Park. One new infestation center, totaling 7,200 acres and consisting primarily of light defoliation, was observed on the Warm Springs Indian Reservation. One center of sugar pine tortrix observed in the North Warner Mountains caused light defoliation over 760 acres of lodgepole pine.

Sucking insect activity, caused by balsam woolly aphid, decreased in Oregon. However, specimens and damage resulting from this pest were found on subalpine fir near the headwaters of Tiger Creek on the Walla Walla Ranger District, Umatilla National Forest, in May of 1974. This is a new record and a significant range extension as this aphid had never been found east of the Cascade Mountains in Oregon.

Table 1.—Summary of forest insect infestations in Oregon and Washington during 1974 (in acres).

Insects[1]	Oregon	Washington	Regional Total
Bark Beetles:			
Douglas-fir beetle (westside)	2,850	11,130	13,980
Douglas-fir beetle (eastside)	6,870	6,890	13,760
Douglas-fir engraver	170	0	170
Spruce beetle	850	3,250	4,100
Fir engraver	31,620	9,630	41,250
Flatheaded borer	5,750	0	5,750
Mountain pine beetle(L)	442,610	4,950	447,560
Mountain pine beetle(S)	2,020	0	2,020
Mountain pine beetle(P)	55,380	12,320	67,700
Mountain pine beetle(W)	3,750	26,980	30,730
Pine engraver	15,760	1,250	17,010
Western pine beetle	106,110	4,540	110,650
Silver fir beetle	0	680	680
All bark beetles	673,740	81,620	755,360
Defoliators:			
Sawflies on larch	560	0	560
Sawflies on knobcone pine	1,080	0	1,080
Spruce budworm	98,750*	564,460	663,210
Douglas-fir tussock moth	30,930	40	30,970
Sugar pine tortrix	760	0	760
All defoliators	132,080	564,500	696,580
Sucking Insects:			
Balsam woolly aphid	11,500	11,320	22,820
All sucking insects	11,500	11,320	22,820
All insects	817,320	657,440	1,474,760

[1]Mountain pine beetle infestations are separated by tree species: L, lodgepole pine; S, sugar pine; W, western white pine; P, ponderosa pine.
*Includes 89,570 acres of Modoc budworm in southeastern Oregon.

MAJOR BARK BEETLE PROBLEMS

The volume of timber killed by all bark beetles, except the Oregon pine ips, is determined from data recorded during the annual aerial detection survey. This is done by estimating the number of infested trees in each observed outbreak and applying an average volume for each tree. These volumes vary according to tree species, size class, and area infested. Volume losses caused by each of the various bark beetles are listed in Table 2.

Volume losses resulting from Oregon pine ips outbreaks are not estimated because the infestations are usually located in stands which contain trees of unmerchantable size. Ips outbreaks are recorded by damage intensities — light, moderate, or heavy. The acres of ips damage are listed in Table 3.

DOUGLAS-FIR BEETLE, *Dendroctonus pseudotsugae* Hopk.

Nearly three quarters of the 14,000 acres of mortality caused by this insect occurred on the Siskiyou and Umpqua National Forests and the Coos-Douglas area in Oregon and on the Gifford Pinchot and Mt. Baker-Snoqualmie National Forests in Washington.

The heaviest concentration of tree killing occurred on the Packwood and Randle Ranger Districts on the Gifford Pinchot National Forest within and adjacent to the Davis Mountain roadless area.

The stands located within this outbreak, initially weakened by drought and the occurrence of root diseases were severely damaged by ice and wind storms which occurred during the winters of 1970 and 1972.

The windthrown timber produced enormous amounts of suitable breeding material necessary for the buildup of large populations in storm damaged and disease weakened trees.

A combination of favorable environmental factors, including an abundance of weakened host material, large populations of overwintering beetles, and a prolonged period of sub-normal precipitation, largely accounts for the continuation of this outbreak in 1974.

Nearly two-thirds of an estimated 92 million board feet of dead, green infested, and storm-damaged green timber is now being harvested using both conventional high-lead and helicopter logging systems.

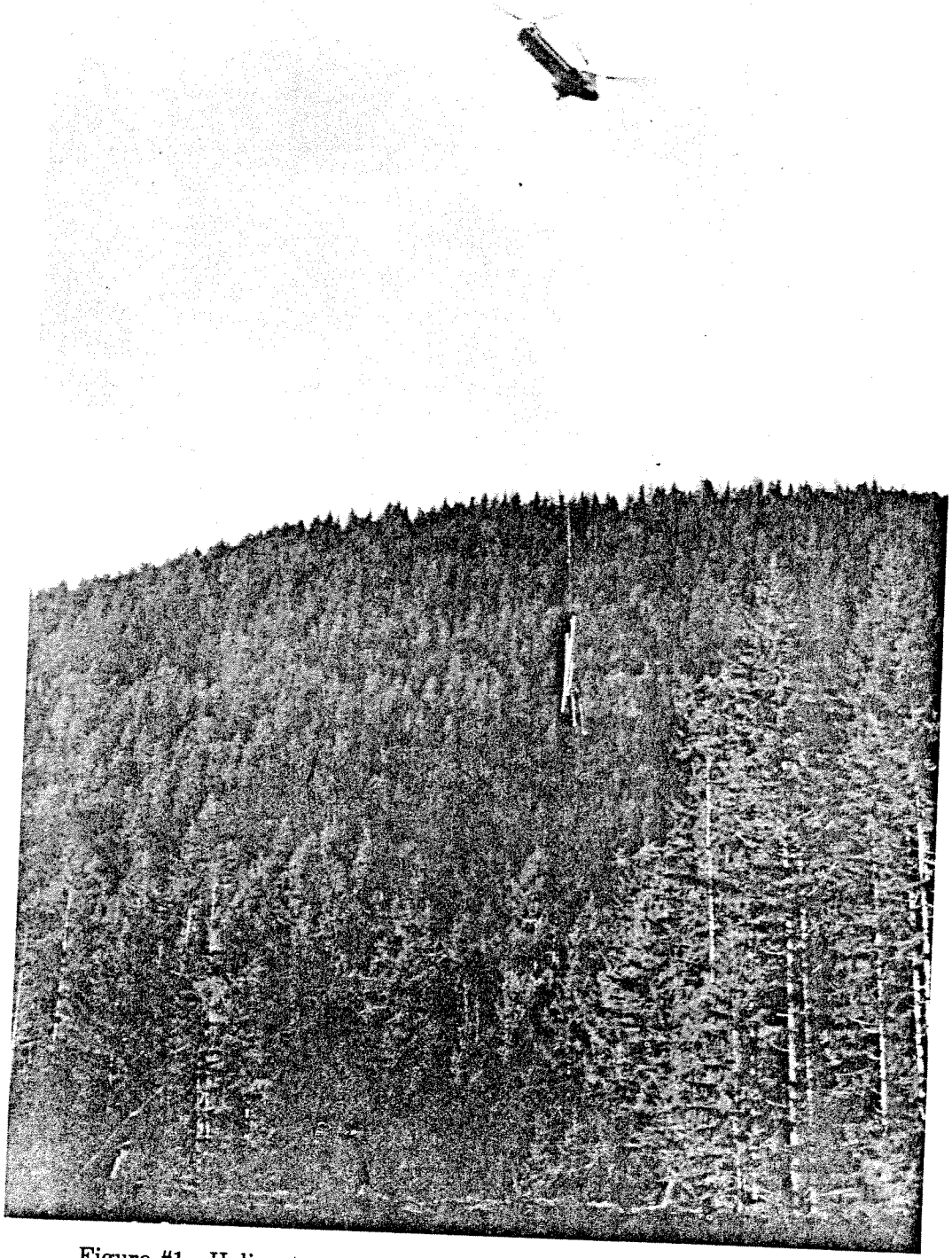


Figure #1—Helicopter yarding of Douglas-fir beetle infested timber near Davis Mountain.

Emergency measures have been undertaken by Forest personnel to insure that all needed logging will get underway this winter. The target date for sale completion is May 1, 1975, before the new broods emerge to infest other trees (see map of Douglas-fir beetle activity).

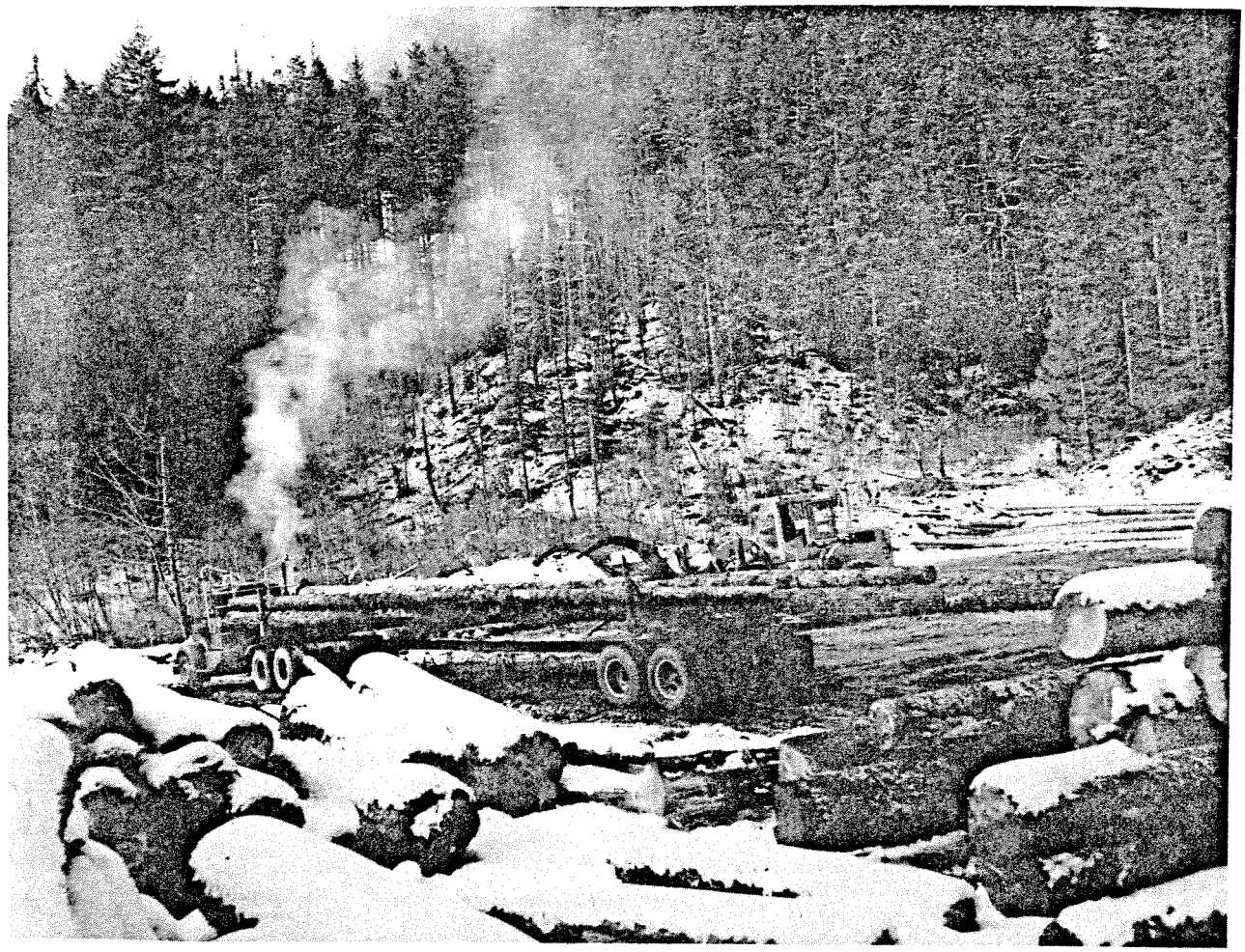


Figure #2—Loading logs at helicopter landing.

FIR ENGRAVER, *Scolytus ventralis* Lec.

The scattered killing of true firs, on approximately 41,000 acres of forest land in eastern Oregon and Washington has more than doubled since 1973. The heaviest damage has occurred on portions of the Malheur, Umatilla, and Wallowa-Whitman National Forests in Oregon and on the Colville, Okanogan, and Wenatchee National Forests in Washington. Losses are expected to increase in areas that have been severely defoliated by either the Douglas-fir tussock moth or the western spruce budworm.

FLATHEADED FIR BORER, *Melanophila drummondi* (Kirby)

Scattered tree killings was observed on approximately 5,800 acres of forest lands in southwestern Oregon between Roseburg and the Oregon-California State line. Most of the affected stands occur on dry, rocky sites located along the foothills of the Rogue and Umpqua River drainages in the vicinity of

Riddle, Grants Pass, Medford, and Ashland. The probable cause of this outbreak is attributed, in large part, to the effect of adverse weather conditions on host trees. Most of the Willamette and southwestern valleys experienced record or near-record low temperatures during December of 1972 followed by below normal precipitation in 1973.

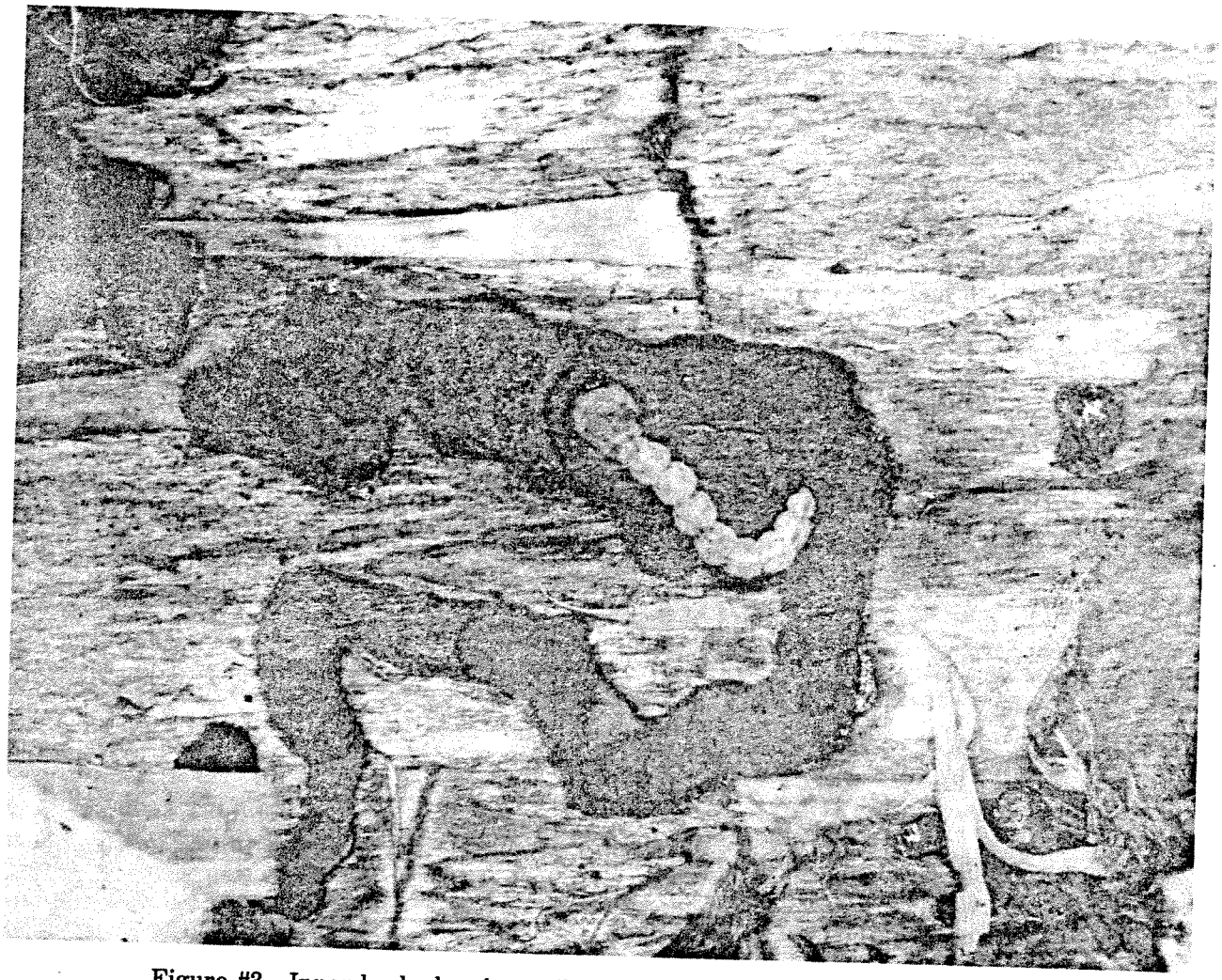


Figure #3—Inner bark showing nail-shaped larvae and frass-packed gallery.
Photo Credit: LeRoy Kline, Oregon State Forestry Department.

The trend of this outbreak is not known. However, tree killing is expected to subside with the occurrence of normal precipitation.

MOUNTAIN PINE BEETLE, *Dendroctonus ponderosae* Hopk.

This pest continued to cause serious losses in lodgepole pine stands in Oregon. An estimated 80 million board feet of timber has been killed this past year. Nearly three-quarters of this loss has occurred on the Umatilla and Wallowa-Whitman National Forests. The most serious tree killing is now occurring on the Ukiah and Dale Ranger Districts of the Umatilla National Forest and the La Grande and Baker Ranger Dsitricts of the Wallowa-Whitman National Forest.

In addition to the already sizable volume loss, this outbreak has reduced land values, and increased fire hazard through fuel type changes. This infestation is expected to expand and intensify within the remaining lodgepole pine type on the four Districts.

No control is being considered. However, changes in management planning which reflect the need for timely salvage and rehabilitation are now being cooperatively formulated by the two Forests.

Lodgepole pine mortality in Washington, estimated at approximately 250,000 board feet, was found at many widely scattered locations.

The acres of mountain pine beetle infestations in lodgepole pine recorded between 1971 and 1974 in Oregon and Washington are summarized below:

AREA	YEAR			
	1971	1972	1973	1974
Oregon	248,470	273,670	233,240	422,610
Washington	1,530	2,960	2,490	4,950
TOTAL	250,000	276,630	235,730	427,560

Damage to western white pine stands in the mountainous regions of both Oregon and Washington has decreased since 1973. In Oregon, the majority of the 2.7 million board feet of mortality occurred on the Willamette National Forest. In Washington, nearly two-thirds of the 8 million board feet of volume loss occurred on the Okanogan and Wenatchee National Forests.

Nearly all of this western white pine mortality has occurred within wilderness areas or on high elevation inaccessible lands where salvage logging will not be considered.

Region-wide, the acres of infested pole-size ponderosa pine has increased. Outbreaks now occurring over approximately 55,000 acres in eastern Oregon have caused an estimated 3.2 million board feet of mortality. Nearly two-thirds of the total acreage and volume loss is located on mixed ownership within and adjacent to the Wallowa-Whitman National Forest. The areas of heaviest tree killing occur on the south and eastern slopes of Mt. Emily; along the south side of the Powder River in Sumpter Valley; and south of Baker in the vicinity of Bald and Dooley Mountains. In Washington, outbreaks occurring over approximately 10,500 acres have caused an estimated 500,000 board feet of mortality. The majority of this activity was observed on portions of the Colville National Forest and the Colville and Spokane Indian Reservations.

This problem is basically related to overstocking. Ponderosa pine stands in this condition are generally more susceptible to attack by mountain pine beetle. Thinning stands to reduce the basal area per acre will improve stand vigor and reduce or eliminate the incidence of this beetle.

SPRUCE BEETLE, *Dendroctonus rufipennis* (Kirby)

Tree killing continued in Engelmann spruce stands on the Okanogan National Forest in Washington. Elsewhere in the Region, spruce beetle populations appear to be increasing. Aerial detection survey findings indicate numerous widely scattered new patches of mortality. Nearly all of the estimated 1 million board feet of killed timber occurred within wilderness areas or inaccessible high elevation lands. In Oregon, all of the losses occurred on the Wallowa-Whitman and Umatilla National Forests. In Washington, heavy damage was observed on portions of the Okanogan and Colville National Forests.

WESTERN PINE BEETLE, *Dendroctonus brevicomis* Lec.

Outbreaks of this beetle in mature ponderosa pine have more than doubled since last year. Increased

activity was observed on the Fremont, Malheur, Ochoco, and Winema National Forests and Warm Springs Indian Reservation in Oregon and the Yakima Indian Reservation in Washington. Elsewhere in Oregon, outbreaks have greatly decreased on the Deschutes, Mt. Hood, and Wallowa-Whitman National Forests.

Volume estimates from the aerial detection survey reveal a Regionwide loss of approximately 7.1 million board feet. Outbreaks in Oregon accounted for nearly 6.5 million board feet.

The acres of western pine beetle infestations recorded between 1971 and 1974 in Oregon and Washington are summarized below:

AREA	YEAR			
	1971	1972	1973	1974
Oregon	59,200	124,800	47,060	106,110
Washington	9,840	240	1,850	4,545
TOTAL	69,040	125,040	48,910	110,655

Losses caused by this beetle can be reduced by continuing an aggressive sanitation-salvage program in overmature ponderosa pine stands. Logging infested trees aids in reducing beetle populations.

Table 2.—Summary of 1974 bark beetle infestations in Oregon and Washington excluding Oregon pine ips

Insects[1]	Infestation centers	Area	Number of trees	Volume
Oregon:	**Number**	**Acres**	**Number**	**Board feet**
Douglas-fir beetle (east side)	134	6,870	2,572	2,174,280
Douglas-fir beetle (west side)	190	2,850	4,540	7,663,200
Douglas-fir engraver	3	170	40	52,100
Engelmann spruce beetle	15	850	285	71,250
Fir engraver	332	31,620	13,633	3,583,770
Flatheaded borer	222	5,750	6,152	11,135,120
Mountain pine beetle (L)	1,167	422,610	1,139,714	79,710,680
Mountain pine beetle (S)	12	2,020	510	287,800
Mountain pine beetle (W)	140	3,750	5,845	2,734,400
Mountain pine beetle (P)	638	55,380	58,916	3,522,370
Western pine beetle	577	106,110	8,928	6,873,350
Oregon total	3,430	637,980	1,241,135	117,808,320
Washington:				
Douglas-fir beetle (east side)	56	6,890	3,565	1,960,750
Douglas-fir beetle (west side)	102	11,130	5,799	5,021,160
Engelmann spruce beetle	24	3,250	3,890	972,500
Fir engraver	99	9,630	6,805	1,754,000
Mountain pine beetle (L)	52	4,950	3,580	250,600
Mountain pine beetle (W)	278	26,980	19,170	8,659,200
Mountain pine beetle (P)	265	12,320	10,651	537,160
Western pine beetle	33	4,540	452	267,780
Silver fir beetles	4	680	55	71,250
Washington total	913	80,370	53,967	19,494,400
Regional total	4,343	718,350	1,295,102	137,302,720

[1]Mountain pine beetle infestations are separated by tree species: L, lodgepole pine; S, sugar pine; W, western white pine; P, ponderosa pine.

DEFOLIATORS

DOUGLAS-FIR TUSSOCK MOTH, *Orgyia pseudotsugata* Mcd.

Populations of this pest were reduced to nearly nondetectable levels following the application of DDT on 350,205 acres of infested forest lands in Oregon and Washington this past summer.

Some additional defoliation was observed within and adjacent to research study sites in the Blue Mountains; in portions of the Eagle Cap Wilderness area; and in the untreated breaks of the Snake River Canyon.

However, no significant defoliation was observed within any treated areas and only one new center totaling less than 10 acres was found in Stevens County, Washington. Evaluations made in the fall of 1974 indicate that this population center has collapsed.

The results of the 1974 fall egg mass survey confirmed the effectiveness of the control effort. No egg masses were found in any of the treatment areas except on the Pomeroy Unit in the vicinity of Anatone Butte. These populations are expected to decline without causing any additional damage.

The results of sampling in untreated portions of the outbreak revealed a natural insect population collapse probably caused by virus and other natural control agents. Past histories have shown that a nuclear polyhedrosis virus disease has caused several tussock moth populations to decline. This usually happens later in the season after considerable feeding has occurred.

Figure #4.—Crew collecting foliage during post-spray sampling. Colville Indian Reservation.

During the summer of 1974 following completion of the suppression project approximately 2,200 miles of timber land road system in Oregon and Washington were surveyed outside of treatment areas in an attempt to find active populations. No new population centers were found. However, low-level populations were found for the fourth season at Mares Egg Spring on the northwest side of Upper Klamath Lake on the Winema National Forest in south central Oregon. Very low populations are expected in this area again in 1975.

LARCH CASEBEARER, *Coleophora laricella* (Hbn.)

Larch casebearer infestations continued to spread in western larch stands throughout eastern Washington and northeast Oregon. No infestations have yet been observed in the Cascade Mountains of either State or in the Ochoco Mountains of central Oregon. No formal detection surveys were conducted this year. However, field observers indicated that defoliation was generally less than that of last year. This may, in part, have been a result of the cool and damp weather which existed throughout much of the Pacific Northwest this last spring.

MODOC BUDWORM, *Choristoneura viridis* Free.

Populations of the insect, more than doubling in area in 1974, caused light defoliation over approximately 90,000 acres of white fir type on the Fremont National Forest. This is the northern portion of a larger outbreak which occurs throughout the Warner Mountains in both Oregon and California.

The current level of defoliation has not resulted in serious tree damage. Cone production has been apparently affected and some scattered top-killing has been observed in isolated locations that have sustained 3 years of continuous defoliation. However, no mortality has been observed within any portion of this outbreak in Oregon.

These outbreaks are expected to continue next year. However, egg mass data indicate that populations will be lower in the spring of 1975. This decline in populations, although not fully determined, is attributed in part, to the effects of starvation and unseasonably cold and wet weather which occurred in early July during the larval feeding period.

Summary of Modoc Budworm Infestations in Oregon, 1972-1974

Land Classification	**Acres of defoliation by Year**		
	1972	1973	1974
Fremont N.F.	5,810	20,840	86,810
Warner Mountains	0	0	2,760
Gerhart Mountains			
TOTAL	5,810	20,840	89,570

WESTERN SPRUCE BUDWORM, *Choristoneura occidentalis* Free.

Infestations of the western spruce budworm have nearly doubled in area since last year. Approximately 600,000 acres of Douglas-fir and true fir stands have been defoliated to some extent in 1974. The majority of the damage has occurred on the Okanogan and Wenatchee National Forests and the North Cascades National park in north central Washington. Scattered feeding, totaling less than 2,000 acres, has occurred on the Wallowa-Whitman National Forest in northeastern Oregon. A new center, totaling 7,200 acres and consisting primarily of light defoliation, was recorded in the Oregon Cascades on the Warm Spring Indian Reservation.

Some apparent top-killing has occurred as a result of continuous defoliation over the past 4 years in Washington. It is generally believed that most of the affected stands can sustain some additional feeding before control action will need to be considered. Impact data suggests that top-kill and tree mortality does not occur until after 3 to 5 years of continuous feeding by the budworm.

These outbreaks are expected to continue in 1975. The results of a fall egg mass survey indicate that moderate to high egg populations exist in 10 of 11 areas sampled in north central Washington. A hazard rating which considers both current and previous defoliation and egg mass density indicate that top-killing and/or tree mortality will occur in portions of 4 of the 11 units in 1975. These include the Teanaway, Twisp River, Lookout Ridge-Gold Creek, and Early Winters areas. Additional areas not sampled, but which are also expected to suffer some mortality and top-killing include Wolf Creek, Cedar Hills, Fish Creek and Prince Creek. All of these affected areas, with the exception of the Teanaway, are located north of Lake Chelan on the Okanogan National Forest.

No operational control is being considered in 1975. However, plans are being developed for a 1975 pilot aerial spray project using fenitrothion, a nonpersistent chemical.

The test which will involve approximately 10,000 acres will be part of a national effort by the Forest Service to find effective and environmentally suitable chemicals for control of the budworm.

The proposed tests will, hopefully, lead to the registration of one or more new chemicals to combat the budworm, should a control effort be considered necessary in 1976 or later.

Summary of Western Spruce Budworm Infestations in Oregon and Washington, 1970-1974

Land Classification	Acres of Defoliation by year				
	1970	1971	1972	1973	1974
Oregon					
Wallowa-Whitman N.F.	13,780	28,200	23,030	48,210	1,980
Warm Springs, I.R.	0	0	0	0	7,200
Total	13,780	28,200	23,030	48,210	9,180
Washington					
North Cascades N.P.	0	0	3,990	14,690	23,900
Okanogan N.F.	240	15,900	86,310	66,570	176,480
Wenatchee N.F.	0	2,360	85,180	144,230	277,960
Non-Federal	0	0	26,990	56,640	86,120
Total	240	18,260	202,470	282,130	564,460
Regional Total	14,020	46,460	225,500	330,340	573,640

SUGAR PINE TORTRIX, *Choristoneura lambertianae* (Busck)

A new center, totaling 720 acres and consisting primarily of light defoliation in lodgepole pine type, was observed in the vicinity of Drake Mountain (North Warner Mountains) on the Lakeview Ranger District, Fremont National Forest. The trend of this infestation is not known. However, no serious damage is expected next year.

SUCKING INSECTS

BALSAM WOOLY APHID, *Adelges piceae* (Ratz.)

Insect detection surveys during the summer of 1974 recorded a significant reduction in the number and size of areas damaged by the balsam wooly aphid. The amount of visible damage detected during the annual aerial survey was 22,820 acres, compared with 118,400 acres recorded during 1973. Most of this damage occurs on the Willamette, Mt. Hood and Deschutes National Forests in Oregon and the Gifford Pinchot and Mt. Baker-Snoqualmie National Forests in Washington.

This reduction in aphid damage can probably be attributed to lower than normal temperatures in the mountains of western Oregon during the winter of 1972-73. Recently researchers have found that freezing is fatal to overwintering aphids and the probability of freezing increases as temperatures fall below -5 degrees, with no survivors at -35 degrees no matter how brief the exposure.

However, it has been found that even in areas of extremely low temperatures, snow cover serves to protect a sufficient portion of the aphid population to assure the survival of the aphid infestation. With a return to more normal winter temperatures, aphid populations are expected to rapidly build up from the residual population below the snowline.

In addition, a new infestation, not detectable from the air, was found in a small grove of subalpine fir near the headwaters of Tiger Creek on the Walla Walla Ranger District, Umatilla National Forest, in May of 1974. The results of a recent ground survey indicate that the insect is established in the subalpine type within a 3-mile radius of the initial find. Bole dissections indicate that host trees have been infected for at least 7 years. No top-killing or tree mortality has been observed and no damage has been observed on any grand fir (see attached map for location of infestations).

Table 3.—Summary of 1974 defoliation, sucking insect and Oregon pine Ips infestations in Oregon and Washington.

Insects	Oregon		Washington		Regional total	
	Infestation centers	Area	Infestation centers	Area	Infestation centers	Area
	Number	**Acres**	**Number**	**Acres**	**Number**	**Acres**
Defoliators:						
Sawflies on larch	2	560	0	0	2	560
Sawflies on knowcone pine	13	1,080	0	0	13	1,080
Spruce budworm	41	98,750*	168	564,460	209	663,210
Douglas-fir tussock moth	31	30,930	1	40	32	30,970
Sugar pine tortrix	1	760	0	0	1	760
All defoliators	88	132,080	169	540,542	257	696,580
Sucking Insects:						
Balsam woolly aphid	171	11,500	56	11,320	227	22,820
All sucking insects**	171	11,500	56	11,320	227	22,820
Other:						
Oregon pine ips	311	15,760	15	1,250	326	17,010
All other	311	15,760	15	1,250	326	17,010
All damage	572	159,460	283	557,984	855	736,410

*Includes 89,570 acres of Modoc Budworm in southeastern Oregon.
**Does not include the Blue Mountain infestation.

OTHER INSECTS

ALDER LEAF BEETLE, *Altica ambiens* (Lec.)

This insect caused extensive defoliation of red alder on the Gifford Pinchot National Forest in the vicinity of Trout Lake, Washington.

EUROPEAN PINE SHOOT MOTH, *Rhyacionia buoliana* (Schiff.)

Synthetic pheromone was used operationally for the first time as a survey tool in 1974. Baited sticky traps, placed in the field from May-July, were used to attract and detect shoot moth in Jackson, Josephine, Clackamas, Washington, Multnomah and Umatilla Counties in Oregon. Adult male moths were found at Hermiston, Hat Rock Park, McNary Dam, McNary Golf Course, and in a residential area of Pendleton, all within Umatilla County.

No moths were detected in the other five counties.

COOLEY SPRUCE GALL APHID, *Adeges cooley* (Gill)

This aphid was active at several locations in the Willamette Valley and throughout the metropolitan Portland area. Moderate to heavy aphid populations have infested 1-0 Douglas-fir stock in an industrial wood products firm nursery near Canby, Oregon. Infestations on ornamental spruce result in both tip galling and needle drop. Mortality which occurs only after repeated infestations, has not been observed.

DOUGLAS-FIR ENGRAVER, *Scolytus unispinosus* (lec.)

Scattered top-killing of drought-weakened Douglas-fir was detected on the Mt. Hood and Umpqua National Forests in Oregon. No damage was observed in Washington. Control efforts against this pest is limited to salvage of merchantable infested frees and those of declining vigor within outbreak centers.

DOUGLAS-FIR TWIG WEEVIL, *Cylindrocopturus furnissi* (Buch.)

Larvae were found infesting twigs of Douglas-fir in a plantation near Drain, Oregon. Approximately 10% of the 4,000 trees in the plantation were infested.

These attacks often deform trees and retard growth but seldom result in widespread mortality. Under natural forest conditions, the damage resulting from attacks on weakened or suppressed trees is usually not observed. Noticeable infestations usually occur in plantations growing on "off sites", on old burns or on dry sites, particularly gravel soils. This type of damage usually becomes apparent during or immediately following periods of drought.

GYPSY MOTH, *Porthetria dispar* (L.)

An adult male was captured this past summer in a pheromone trap placed in a residential area in Seattle, Washington. No additional moths were captured during a more comprehensive trapping program.

Additional evidence of gypsy moth has been found on mobile homes in Coeur d'Alene, Idaho and in Bend and Pendleton, Oregon. The find at Bend included dead larvae and an old egg mass. Followup surveys are planned for 1975.

LARCH SAWFLY, *Pristiphora erichsonii* (Wtg.)

The infestations on the Warm Springs Indian Reservation have subsided. However, two new small centers were detected on the Mt. Hood National Forest in the vicinity of Sherwood on the East Fork of Hood River. Control is not considered necessary because parasites and predators usually reduce sawfly populations within one or two years.

OREGON PINE IPS,*Ips pini* Say

Outbreaks in second-growth ponderosa pine, occurring at about the same level as in 1973, resulted in approximately 17,000 acres of mortality. Infestations in Oregon accounted for 92 percent of the Regional losses with nearly 44 percent of the damage located on the Malheur National Forest. Tree killing in Washington, amounting to 1,250 acres, was widely scattered.

PANDORA MOTH, *Coloradia pandora* Blake

Second-year larvae caused variable amounts of defoliation on nearly 10,000 acres of lodgepole pine in the vicinity of China Hat Butte on the Deschutes National Forest in central Oregon. Pupal samples indicate a highly variable population. Some adult emergence is expected in the summer of 1975. Control is not recommended.

SAWFLY, *Neodiprion* sp.

These sawflies again caused light defoliation of knobcone pine on the Rogue River and Siskiyou National Forests in southwest Oregon. These scattered outbreaks have been occurring for several eyars but have not caused tree mortality.

SILVER FIR BEETLES, *Pseudohylesinus* spp.

Small patches of light to moderate tree killing occurred on the Mt. Baker-Snoqualmie and Olympic National Forests and in Mt. Rainier National Park. No outbreaks were observed in Oregon. Salvage logging of infested trees and those of declining thrift within an outbreak center on National Forest land is encouraged.

SILVER SPOTTED TIGER MOTH, *Halisidota organtata* Pack.

This insect caused light defoliation of ornamental pine and Douglas-fir near Hebo, Oregon on the Siuslaw National Forest.

DISEASE CONDITIONS IN BRIEF

The incidence of foliage diseases and weather injuries increased dramatically in 1974. Both forest nurseries and forest stands were affected. Damage by gray mold blight was common in many western Oregon and Washington nurseries. Several Christmas tree plantings suffered losses from foliage rusts and weather injuries. Weather damage was suspected as a primary contributing factor in the intensive mortality of Douglas-fir and ponderosa pine in southern Oregon.

Root rots, dwarf mistletoes, and heart rots continue to be the most important forest disease problems in the Pacific Northwest. There is very little, if any, yearly change in the incidence of these diseases.

NURSERY DISEASES

Gray mold blight, caused by *Botrytis cinerea* Pers., damaged seedlings in many forest nurseries located in western Oregon and Washington. The increase in damage is directly attributable to the prolonged wet weather which extended into late June. The disease, which is most damaging in dense beds, can be prevented by thinning nursery beds to promote air circulation and drying of the foliage. Several fungicides including Bordeaux, maneb, zineb, ferbam, captan, and thiram are effective in preventing the disease.

Fusarium top-blight, caused by species of *Fusarium,* is common in many forest nurseries. This disease also can be prevented by avoiding excess moisture on foliage for long periods. Benlate has been found to be effective in preventing the disease in studies conducted by the Washington State Department of Natural Resources.

Several seed protectant fungicides including Arasan 42-S, Arasan 75, Benlate 50W, Captan 50 WP, and Captan 75 were tested on Douglas-fir at the Wind River Nursery (USFS). The results of these tests indicated that these seed treatments did not improve emergence or survival when compared to nontreated (control) seeds. Low levels of pathogenic soil fungi were cited as one of the major reasons for the lack of success of the treatments. These studies should not be interpreted as an indication that seed treatments are not a potentially useful tool for the nursery manager.

Several nursery bed treatments including the application of dolomite (lime), sulfate of potash, and soil

ripping were compared for effectiveness in reducing Douglas-fir seedling losses at the Wind River Nursery. Statistical analysis of the numbers of surviving seedlings at the end of the first year revealed no differences between the treatments.

Fumigation of nursery beds at the Bend Nursery (USFS) with methyl bromide-chloropicrin mixture (67-33 percent) increased the survival of emerged ponderosa pine seedlings by 116 to 128 percent of the nonfumigated controls. *Pythium* spp. and *Fusarium* spp. were responsible for most of the losses of seedlings noted.

FOLIAGE DISEASES

Douglas-fir needle rust, caused by *Melampsora occidentalis* Jacks., damaged several Christmas tree plantings in Oregon and Washington in 1974. In some instances trees were so severely affected that they were rendered worthless for marketing. One of the alternate hosts for the rust is black cottonwood. Damage can be reduced by removing cottonwood trees from the immediate vicinity of Douglas-fir Christmas tree plantations.

Douglas-fir needle blight, caused by *Rhabdocline pseudotsugae* Syd., was detected on 2.5 percent of the plantations examined during a regional survey from 1969 to 1971.

Bynum's blight, caused by *Lophodermella morbida* Staley & Bynum, was recorded on 2.5 percent of plantations examined. This disease is restricted to offsite planted ponderosa pines on the Willamette and Umpqua National Forests at elevations ranging from 3,100 to 4,000 feet.

Other foliage diseases observed this year included *Melampsora abieticapraearum* Tub. on approximately 200 acres of grand fir on the Yakima Indian Reservation; a *Dothistroma-Lophodermium* needle cast complex on lodgepole pine along the Oregon coast; a larch needle cast, caused by *Hypodermella laricis* Tub., in several larch stands in eastern Washington and northeastern Oregon.

ROOT DISEASES

PORT-ORFORD-CEDAR ROOT ROT, *Phytophthora lateralis* Tucker and J. Milb.

A roadside survey for Port-Orford-cedar root rot, caused by *Phytophthora lateralis,* was conducted on three districts of the Siskiyou National Forest in 1974. Approximately 55 percent of the 450-plus miles of roads surveyed had infected trees. This represents a very discouraging and dramatic increase in the spread of the disease since 1964 when a similar survey indicated the disease had very limited distribution on the Forest. The spread of the disease is linked to road construction activities and logging. A plant pathologist, who will devote full-time to research on the disease for at least a year, has been hired by Oregon State University with funds supplied by Coos, Curry, and Douglas Counties.

BLACK STAIN ROOT DISEASE, *Verticicladiella* sp.

Black stain root disease, caused by *Verticicladiella* sp., has recently been reported in the Region, but its potential for damage has not been assessed. A plantation disease survey conducted from 1969 to 1971 has extended the known geographic range of the disease in the Pacific Northwest. The disease was found on the following National Forests: Gifford Pinchot, Mt. Baker-Snoqualmie, Olympic, Siuslaw, Umpqua, Wallowa-Whitman, and Willamette. Although the disease was noted in 3.0 percent of the units examined, it was seldom responsible for the death of more than a few trees in any one infection center.

ARMILLARIA ROOT ROT, *Armillaria mellea* Vahl. ex Fr.

Armillaria root rot, caused by *Armillaria mellea,* was the most common and widely distributed disease found in plantations according to the regional survey. Thirty percent of the units examined contained *A. mellea*-infected trees. This fungus primarily attacks weakened, less vigorous trees. Good planting practices and maintenance of stand vigor by silviculture will reduce the hazard of most stands to Armillaria root rot.

An 8-year study on the effects of precommercial thinning in a ponderosa pine stand on the Deschutes National Forest indicated that losses of potential crop trees to Armillaria were greater in non-thinned than thinned plots. It would be premature to assume that thinning to the specifications used in this study (spacing about 15 feet by 15 feet) would serve as a control measure in similar stands; however, land managers should not defer precommercial thinning in overstocked ponderosa pine stands infected with the disease.

ANNOSUS ROOT ROT, *Fomes annosus* (Fr.) Karst.

The first large-scale use of borax treatments to prevent infection of freshly-cut stumps by the root rot fungus *Fomes annosus* was made on the Fremont National Forest in September 1974. Ponderosa pine stumps were treated on approximately 150 acres adjacent to an infected plantation. The cost of material and application averaged $4.50 per acre.

LAMINATED ROOT ROT, *Poria weirii* (Murr.) Murr.

A change in the generic name of *Poria weirii* to *Phellinus weirii* (Murr.) Gilb. has been suggested by Dr. Robert Gilbertson, a recognized authority on the taxonomy of the Polyporaceae. Of the major root diseases in the Region, *P. weirii* is generally recognized as the greatest danger to sustained production of Douglas-fir on infested sites. Persistence and gradual spread of the fungus from one rotation of susceptible tree species to the next is a threat to succeeding stands and results in reduced site productivity.

Silvicultural practices such as the planting of less susceptible tree species and the planting of mixed tree species have the most promise for reducing losses to the disease.

A regional survey of plantations indicated 13.6 percent of the units examined contained infected trees.

A guide to reduce losses to laminated root rot in the Pacific Northwest is being developed by the U.S. Forest Service.

STEM DISEASES

DWARF MISTLETOE, *Arceuthobium* spp.

Seed production by the Douglas-fir dwarf mistletoe, *Arceuthobium douglasii* Engel. and larch dwarf mistletoe, *A. laricis* (Piper) St. John, was very poor in 1974. Unfortunately, in contrast, ponderosa pine dwarf mistletoe, *A. campylopodum* Engel., produced a bumper crop.

During 1974 the Insect and Disease Control Group provided assistance and made recommendations for control of dwarf mistletoe in infected stands on the Colville, Fremont, Mt. Baker-Snoqualmie, Mt. Hood, Ochoco, Okanogan, Siskiyou, Siuslaw, Umatilla, Wallowa-Whitman, and Willamette National Forests.

In 1974 the U.S. Forest Service conducted a survey of 30 lodgepole pine stands and found large losses to stem diseases occurring in eastern Oregon and Washington.

Western gall rust caused by *Endocronartium harknessii* (J.P. Moore) Y. Hirat. was present in 23 stands (77 percent) infecting more than 25 percent of the trees; dwarf mistletoe was present in 20 stands (67 percent); Stalactiform rust, caused by *Peridermium stalactiforme* Arth. and Kern., was present in 8 stands (27 percent), and Atropellis canker, caused by *Atropellis piniphila* (Wear) Lohm. & Cash was found in 9 stands (30 percent).

A guide to reduce losses to these major diseases in lodgepole pine stands is being developed by the Insect and Disease Control Group.

DEFECTS AND DECAY

A slide tape program entitled "Defect estimation in white fir on the Rogue River National Forest — a guide for cruisers" was prepared by the U.S. Forest Service.

A study was made by the U.S. Forest Service on the extent of defect and decay associated with top-kill in Douglas-firs and grand firs caused by the Douglas-fir tussock moth outbreak near Burns, Oregon from 1963 to 1965. Decay was minimal in both species, however, visible defect (stain and wetwood) was common in grand firs. Visible defect extended about 8 feet below the junction of the live and dead tops of grand fir.

WEATHER INJURY

Weather related injuries to several tree species were very noticeable throughout the Region in 1974.

Extensive drought injury and scorch occurred over much of western Washington. Extremely high temperatures during one week in early June were suspected as the cause of damage to succulent foliage. Nearly all the grand firs in Washington Christmas tree plantations suffered some damage. Noble firs and Douglas-firs were affected to a lesser degree.

Scattered groups of Douglas-firs and ponderosa pines of all ages exhibited top-kill, cankers, twig and branch death along the west shore of Lake Chelan, Washington. Death of sapling-sized trees was noted. Damage was most prominent on shallow, rocky, droughty soils adjacent to the lake shore. Insect damage caused by long-horned beetles, *Cerambycidae* spp., was common in affected trees. A deficit in precipitation combined with low water-holding capacity of the soil and above average temperatures indicates moisture stress as the initial cause of the damage.

Extreme cold weather experienced during December 1972 is suspected as the initial cause of injury and mortality to extensive areas of Douglas-firs and ponderosa pines in southern Oregon between Roseburg and Medford. An area around Canyonville and Riddle was highly visible from Interstate Highway 5 and subsequently generated considerable news coverage in 1974. Secondary damage by bark beetles was evident in stressed and dead trees.

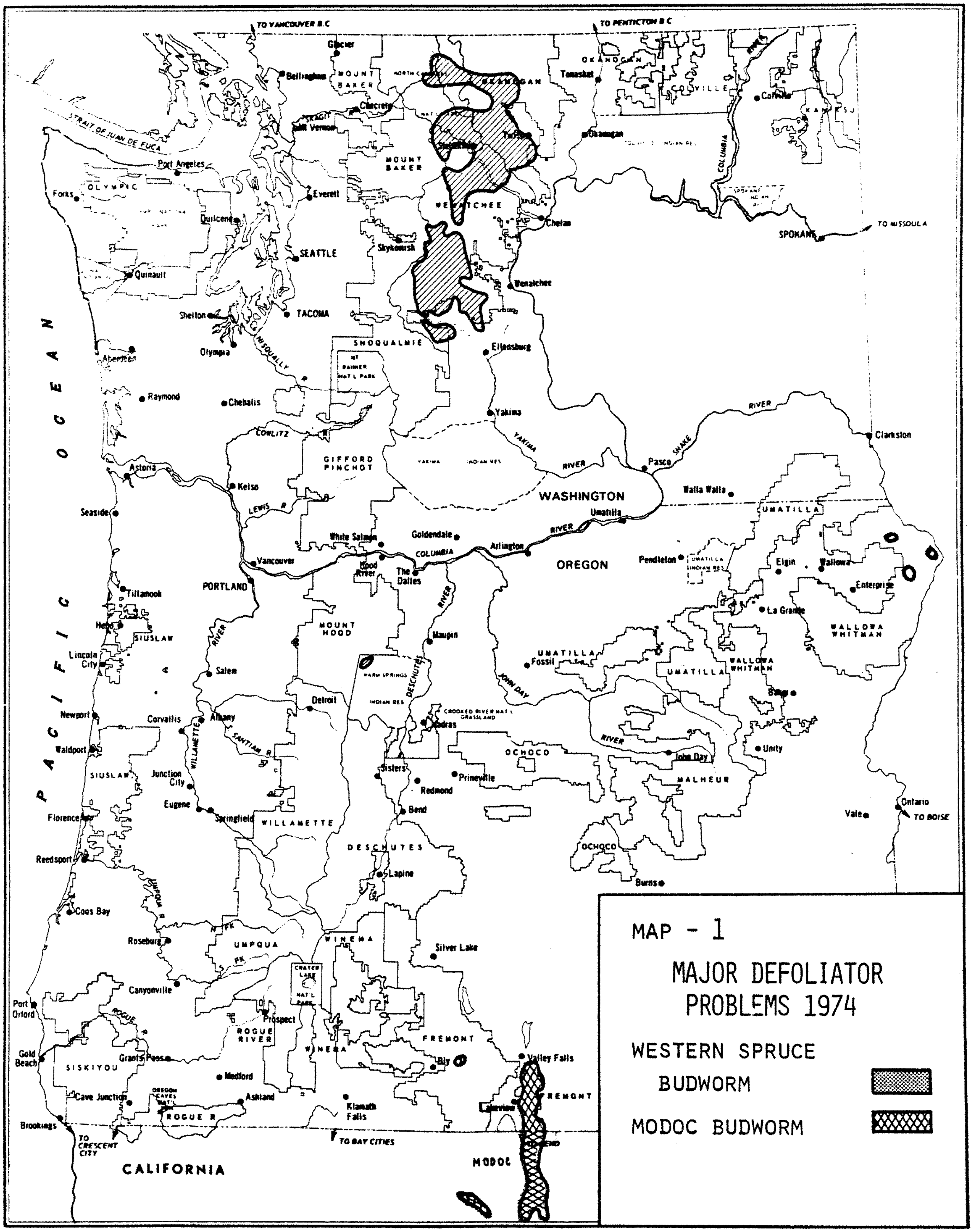
Freeze damage was also common on conifers in the vicinity of Olympia, Washington. Tops were killed back 5 to 10 feet.

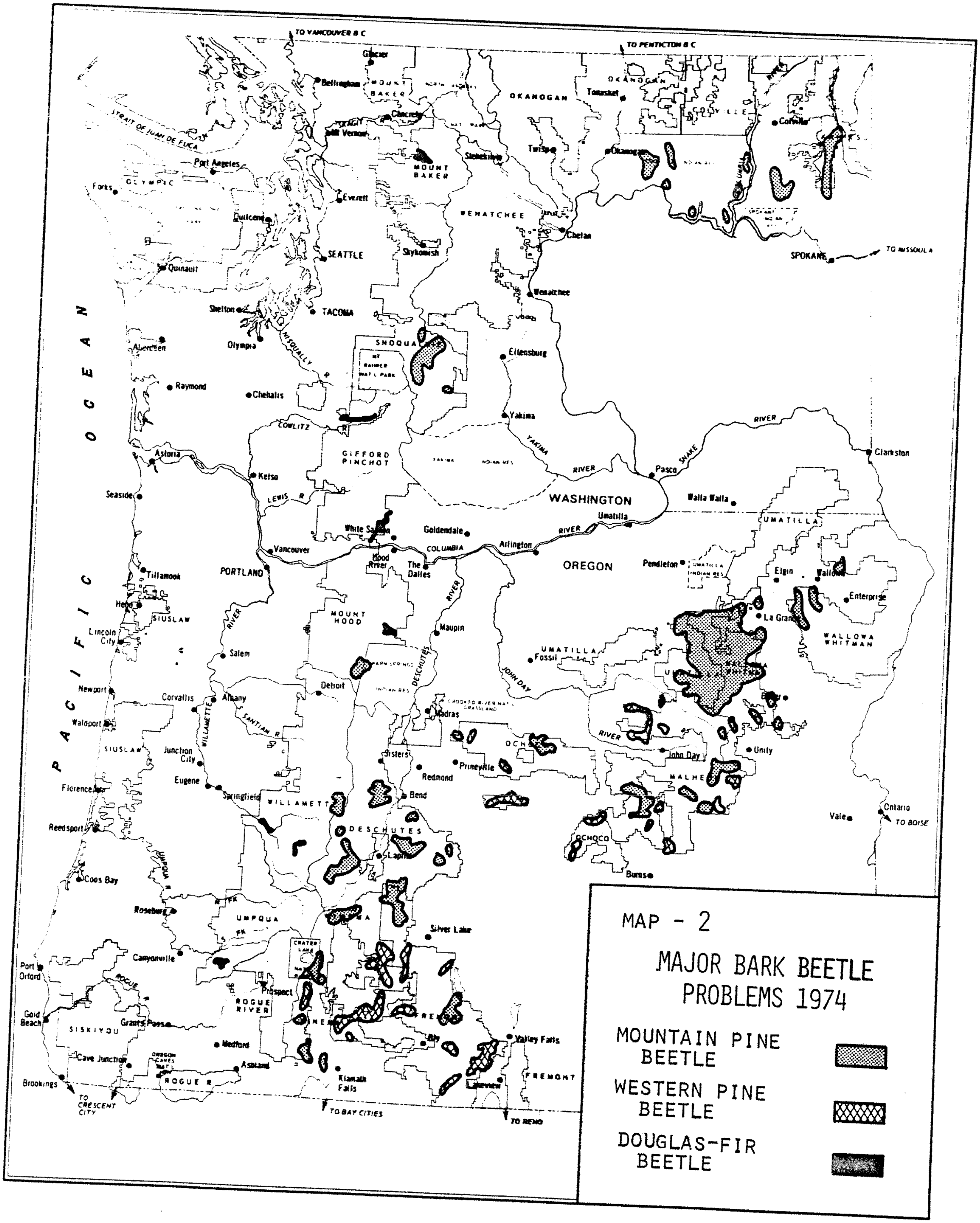
A study of cankered and top-killed Douglas-firs in a plantation on the Mt. Baker-Snoqualmie National Forest revealed that freezing temperatures occurring prior to the hardening-off of woody tissues was probably responsible for the damage. The selection of species and seed sources that are adapted to each planting site is the best method of preventing this type of damage.

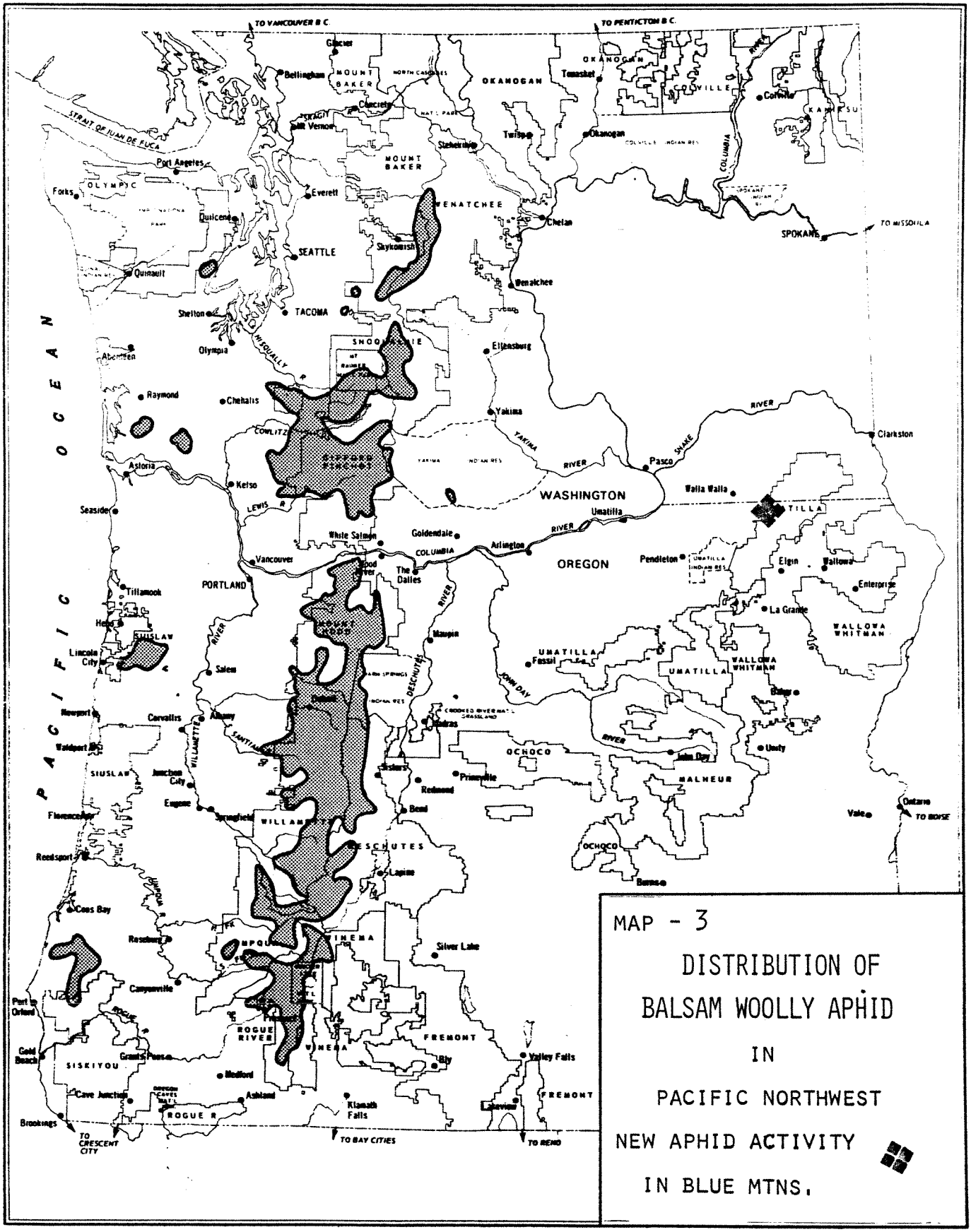
APPENDIX

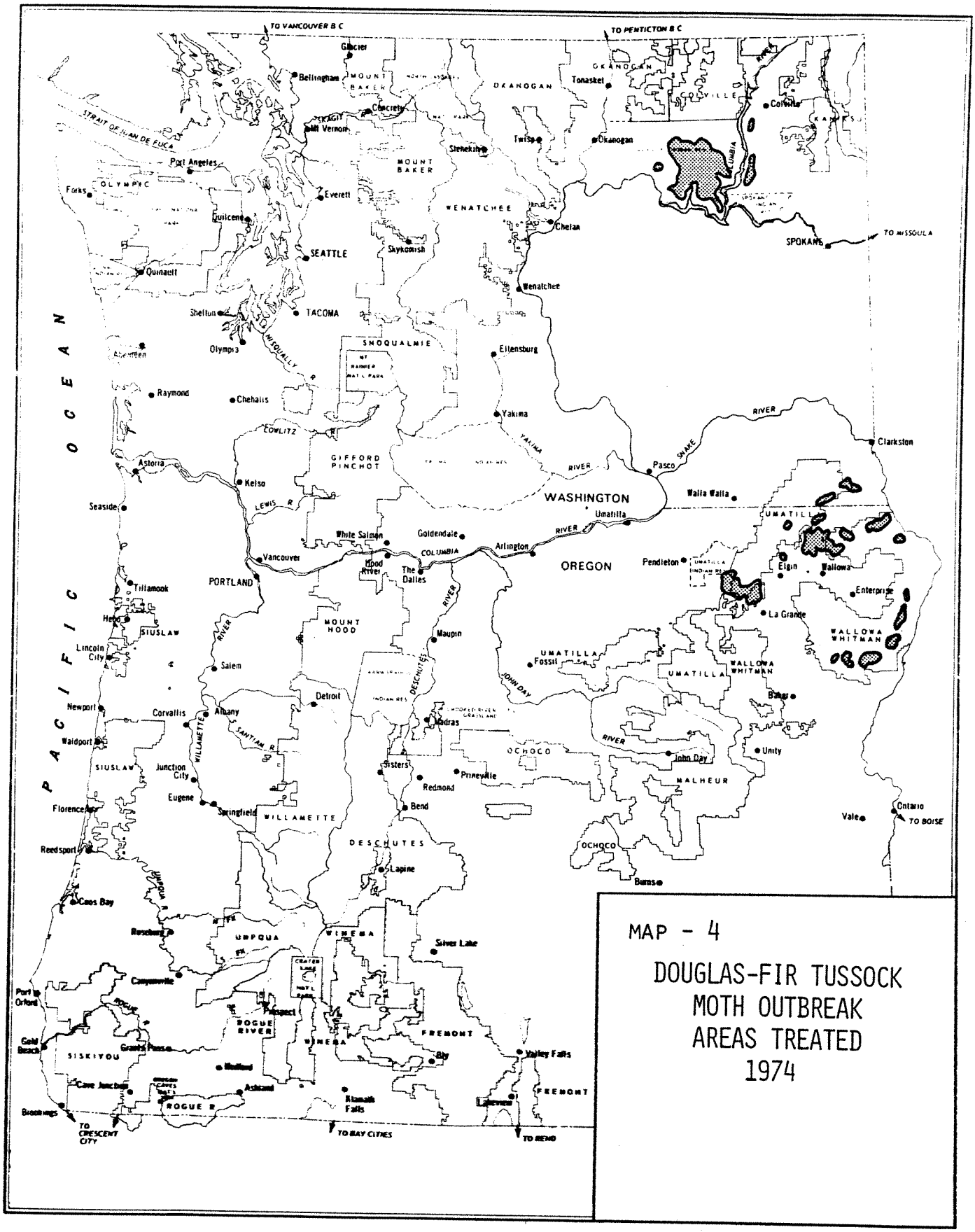
MAPS

1. Distribution of western spruce budworm and Modoc budworm in the Pacific Northwest.
2. Distribution of mountain pine beetle, western pine beetle, and Douglas-fir beetle in the Pacific Northwest.
3. Distribution of balsam woolly aphid in the Pacific Northwest.
4. Douglas-fir tussock moth outbreak areas treated with DDT in 1974.


MAP - 1
MAJOR DEFOLIATOR PROBLEMS 1974
WESTERN SPRUCE BUDWORM
MODOC BUDWORM
TO VANCOUVER B.C.
TO PENTICTON B.C.
TO MISSOULA
TO BOISE
TO BAY CITIES
TO CRESCENT CITY
PACIFIC OCEAN
WASHINGTON
OREGON
CALIFORNIA
STRAIT OF JUAN DE FUCA
Bellingham
Port Angeles
Forks
Everett
SEATTLE
TACOMA
Olympia
Aberdeen
Raymond
Chehalis
Quilcene
Quinault
Shelton
Skykomish
Chelan
Wenatchee
Ellensburg
Yakima
Tonasket
Okanogan
Colville
SPOKANE
Clarkston
Pasco
Walla Walla
Umatilla
Arlington
Goldendale
White Salmon
Kelso
Astoria
Seaside
Vancouver
PORTLAND
Hood River
The Dalles
Tillamook
Lincoln City
Newport
Waldport
Salem
Albany
Corvallis
Detroit
Maupin
Madras
Sisters
Redmond
Prineville
Bend
Junction City
Eugene
Springfield
Florence
Reedsport
Coos Bay
Roseburg
Canyonville
Port Orford
Gold Beach
Brookings
Grants Pass
Cave Junction
Medford
Ashland
Klamath Falls
Prospect
Silver Lake
Valley Falls
Lakeview
Fossil
Pendleton
Elgin
Wallowa
Enterprise
La Grande
Baker
Unity
John Day
Burns
Vale
Ontario
Lapine
GIFFORD PINCHOT
MOUNT BAKER
SNOQUALMIE
WENATCHEE
OKANOGAN
COLVILLE
MOUNT HOOD
SIUSLAW
WILLAMETTE
DESCHUTES
OCHOCO
MALHEUR
UMATILLA
WALLOWA WHITMAN
UMPQUA
WINEMA
ROGUE RIVER
SISKIYOU
FREMONT
MODOC
COLUMBIA RIVER
SNAKE RIVER
YAKIMA RIVER
JOHN DAY RIVER
DESCHUTES RIVER
WILLAMETTE RIVER
SANTIAM R
COWLITZ
LEWIS R
ROGUE R
UMPQUA R
NISQUALLY R
CROOKED RIVER NAT'L GRASSLAND
WARM SPRINGS INDIAN RES
YAKIMA INDIAN RES
CRATER LAKE NAT'L PARK
MT RAINIER NAT'L PARK
OREGON CAVES NAT'L MON.


MAP - 2
MAJOR BARK BEETLE PROBLEMS 1974
MOUNTAIN PINE BEETLE
WESTERN PINE BEETLE
DOUGLAS-FIR BEETLE
PACIFIC OCEAN
WASHINGTON
OREGON
TO VANCOUVER B C
TO PENTICTON B C
TO MISSOULA
TO BOISE
TO RENO
TO BAY CITIES
TO CRESCENT CITY
STRAIT OF JUAN DE FUCA
OKANOGAN
WENATCHEE
GIFFORD PINCHOT
MOUNT HOOD
UMATILLA
WALLOWA WHITMAN
SIUSLAW
WILLAMETTE
DESCHUTES
OCHOCO
MALHEUR
UMPQUA
ROGUE RIVER
SISKIYOU
FREMONT
CRATER LAKE
SNAKE RIVER
COLUMBIA RIVER
YAKIMA RIVER
JOHN DAY RIVER
DESCHUTES RIVER
WILLAMETTE RIVER
LEWIS R
COWLITZ
Bellingham
Mt Vernon
Port Angeles
Forks
Everett
SEATTLE
TACOMA
Olympia
Shelton
Aberdeen
Raymond
Chehalis
Kelso
Astoria
Seaside
Vancouver
PORTLAND
Tillamook
Salem
Corvallis
Albany
Newport
Eugene
Springfield
Reedsport
Coos Bay
Roseburg
Grants Pass
Medford
Ashland
Brookings
Gold Beach
Klamath Falls
Lakeview
Valley Falls
Silver Lake
Bend
Redmond
Prineville
Sisters
Madras
Maupin
The Dalles
Hood River
White Salmon
Goldendale
Arlington
Umatilla
Pendleton
Walla Walla
Pasco
Clarkston
Yakima
Ellensburg
Wenatchee
Chelan
Twisp
Tonasket
Okanogan
Colville
SPOKANE
Elgin
La Grande
Enterprise
Unity
John Day
Burns
Vale
Ontario
Fossil
Detroit
Prospect
Canyonville
Cave Junction
Port Orford
Florence
Junction City
Lincoln City
Waldport
Quilcene
Quinault
Skykomish
Glacier
Concrete


MAP - 3
DISTRIBUTION OF
BALSAM WOOLLY APHID
IN
PACIFIC NORTHWEST
NEW APHID ACTIVITY
IN BLUE MTNS.
WASHINGTON
OREGON
PACIFIC OCEAN
PORTLAND
SEATTLE
TACOMA
SPOKANE
OKANOGAN
WENATCHEE
MOUNT BAKER
SNOQUALMIE
GIFFORD PINCHOT
OCHOCO
MALHEUR
UMATILLA
WALLOWA WHITMAN
FREMONT
SISKIYOU
ROGUE RIVER
WILLAMETTE
DESCHUTES
COLUMBIA
YAKIMA
SNAKE RIVER
JOHN DAY
TO VANCOUVER B.C.
TO PENTICTON B.C.
TO MISSOULA
TO BOISE
TO BAY CITIES
TO RENO
TO CRESCENT CITY



MAP - 4

DOUGLAS-FIR TUSSOCK MOTH OUTBREAK AREAS TREATED 1974

LISTING OF ACTIVE FOREST INSECT AND DISEASE PROJECTS FOR THE PACIFIC NORTHWEST[1] 1975

Compiled by Donald J. Curtis, Entomologist
and Dr. David W. Johnson, Plant Pathologist
U.S. Forest Service, Portland, Oregon

[1]Includes only projects conducted by the U.S. Forest Service, State and Private Forestry (R-6) and PNW Forest and Range Experiment Station (PNW); Oregon State Department of Forestry (OSDF); Washington Department of Natural Resources (WDNR); Oregon State University (OSU); Portland State University (PSU); University of Washington (UW); and Washington State University (WSU). Projects are listed in the above order.

FOREST INSECTS

BARK BEETLES

Douglas-fir Beetle
Methods for using aggregation pheromones to survey populations of Douglas-fir beetle (PNW).

Fir Engraver
Population dynamics of fir engraver (WSU).
Host resistance of grand fir (WSU).

Flatheaded Fir Borer
Flatheaded fir borer impact in southern Oregon (OSDF).
Biology and life history of the flatheaded fir borer (OSU).

Mountain Pine Beetle
Evaluation of mountain pine beetle in second-growth ponderosa pine stands on the Colville Indian Reservation, Washington (USFS, R-6).
Mountain pine beetle impact survey on the Umatilla and Wallowa-Whitman National Forests in northeast Oregon (USFS, R-6).
Severity of tree killing by mountain pine beetle in relation to ponderosa pine stand density and site quality (PNW).
Effects of tree killing by mountain pine beetle on poletimber stands of ponderosa pine (PNW).
Thinning second-growth stands of ponderosa pine to prevent outbreaks of mountain pine beetle (PNW, R-6).
Brood production—both endemic and epidemic conditions—in lodgepole pine in the Blue Mountains and the Deschutes Basin in Oregon, part of Integrated Pest Management Program, University of California (WSU).

Pine Engraver
Ips pini brood production in ponderosa pine thinning slash (PNW).

DEFOLIATORS

Douglas-fir Tussock Moth
Douglas-fir tussock moth impact survey in northeast Oregon and the Colville Indian Reservation, Washington (USFS, R-6).
Evaulation of foliage saved by application of DDT on Douglas-fir tussock moth populations in Blue Mountains of northeast Oregon (USFS, R-6).
Population dynamics of Douglas-fir tussock moth (PNW).
Preliminary models of Douglas-fir tussock moth population dynamics and stand effects. (PNW, OSU).
Mortality factors in endemic populations of Douglas-fir tussock moth (PNW, Univ. of California).
Methods for monitoring long-term population trends of Douglas-fir tussock moth (PNW, R-6).
Methods for early detection of virus disease in populations of Douglas-fir tussock moth (PNW).
Methods for predicting virus epizootics in populations of Douglas-fir tussock moth (PNW).

Natural transmission of pathogenic viruses in populations of Douglas-fir tussock moth (PNW).
Variation in susceptibility of Douglas-fir tussock moth to pathogenic viruses (PNW).
Variation in virulence of viruses pathogenic to Douglas-fir tussock moth (PNW).
Defoliation of grand fir and Douglas-fir in relation to larval densities of Douglas-fir tussock moth (PNW).
Tree mortality, top-kill, and growth loss of grand fir and Douglas-fir in relation to population densities of Douglas-fir tussock moth (PNW).
Douglas-fir tussock moth frass and litter production under Douglas-fir and grand fir trees (PNW, Eastern Oregon College).

Host and site relationships in outbreaks of Douglas-fir tussock moth (PNW).
Distribution of Douglas-fir tussock moth outbreaks in relation to forest habitat characteristics (PNW, Eastern Oregon College).
Delineation of areas affected by Douglas-fir tussock moth according to stand and site characteristics (PNW, University of Idaho).
Climatic factors in the population dynamics of Douglas-fir tussock moth. (PNW, UW).
Synchrony of Douglas-fir egg hatch and larval dispersal with host tree phenology. (PNW).
Dispersal of early instar larvae of Douglas-fir tussock moth. (PNW).
Behavior of early instar larvae of Douglas-fir tussock moth, with particular reference to dispersal potential. (PNW).
Identification and bioassay of foliage chemicals influencing feeding behavior of Douglas-fir tussock moth. (PNW).
Influence of food quality on larval development and female fecundity of Douglas-fir tussock moth. (PNW).
Effectiveness of *Bacillus thuringiensis* and a natural polyhedrosis virus for suppression of Douglas-fir tussock moth populations. (PNW)
Effectiveness of new formulations of *Bacillus thuringiensis* for suppressing populations of Douglas-fir tussock moth. (PNW, R-1).
Effectiveness of Sevin-4-Oil, Dylox, and reduced rates of DDT for suppressing populations of Douglas-fir tussock moth. (PNW, PSW, R-1, R-6).
Effectiveness of Orthene for suppressing populations of Douglas-fir tussock moth. (PNW, Chevron Co.).
Identification, synthesis, bioassay, and field applications of sex pheromones of Douglas-fir tussock moth and other *Orgyia* species. (PNW, Oregon Graduate Center).
Methods for mass producing the nuclear polyhedrosis virus of Douglas-fir tussock moth. (PNW).

Larch Casebearer
Aerial survey of larch casebearer defoliation to more fully determine extent of infestations in Oregon and Washington. (USFS, R-6).
Evaluation of candidate parasites of larch casebearer and propagation of promising species for introduction into the western United States. (PNW).
Comparison of single versus multiple species parasite introduction strategies against larch casebearer. (PNW, INT, R-1, R-6, WDNR, OSDF).

Western Spruce Budworm
Western spruce budworm impact survey on the Okanogan and Wenatchee National Forests, Washington. (USFS, R-6).
Field testing of fenitrothion on the Okanogan and Wenatchee National Forests, Washington. (USFS, R-6).
Identification, bioassay, and field applications of the pheromones of western spruce budworm and other *Choristoneura* species. (PNW, Canadian Department of Forestry).
Qualitative differences among populations of western *Choristoneura* species. (PNW).

Lodgepole Needle Miner
Population dynamics of lodgepole needle miner. (PNW).
Host and site relationships in outbreaks of lodgepole needle miner. (PNW).
Effects of lodgepole needle miner infestations on productivity of lodgepole pine stands. (PNW)

SUCKING INSECTS

Balsam Woolly Aphid

Detection surveys to determine distribution of balsam woolly aphid in the Blue Mountains of Oregon and Washington. (USFS, R-6).
Population dynamics and balsam woolly aphid in the Blue Mountains of Oregon. (USFS, PNW, R-6)
Adelges piceae population and damage trends in grand and subalpine fir stands. (PNW).
Ground surveys of balsam woolly aphid in Washington State. (WDNR).

Cooley Spruce Gall Aphid
Population dynamics of *Adelges cooleyi* in young stands of Douglas-fir. (PNW).
Effects of *Adelges cooleyi* on foliage production and growth of young Douglas-fir. (PNW).
Effects of stand management practices on populations of *Adelges cooleyi.* (PNW)

REPRODUCTION INSECTS

Sitka Spruce Weevil
Susceptibility of Sitka spruce races, exotic spruce species, and spruce hybrids to damage by *Pissodes strobi.* (PNW).
Biology and host-selection behavior of Sitka spruce weevil. (PNW, UW).
Spruce weevil resistance studies. (WDNR).
Sitka spruce weevil damage survey on outplantings on State and private land in northwest Washington. (WDNR).
Sitka spruce weevil impact studies. (UW).
Sitka spruce weevil hazard rating studies. (UW).

European Pine Shoot Moth
Identification, synthesis, bioassay, and field applications of the *Rhyacionia buoliana* sex pheromone. (PNW, Oregon Graduate Center).

NURSERY INSECTS

Western Pales Cutworm
Determination of cutworm impact at Wind River Nursery. (USFS, R-6).

OTHER

Release of cinnabar moth on State and private lands in Oregon. (OSU, USFS, R-6)
Ecological relationship between various insects and down or moribund Douglas-fir. (UW).

ROOT DISEASES

Poria weirii
Poria root rot impact determination, Region-wide survey. (USFS, R-6).
Management guidelines to reduce losses from laminated root rot in the Pacific Northwest Region (USFS, R-6; USFS, PNW; OSDF, OSU).
Detection of *Poria weirii* root rot centers in the Pacific Northwest with aerial photography, Mt. Hood, Siuslaw, and Willamette National Forests. (USFS, R-6).
Infection hazard by *Poria weirii* basidiospores. (USFS, PNW).
Requirements for growth and development of *Poria weirii* from basidiospores. (USFS, PNW).
Effect of N, P, and K on *Poria weirii* survival. (USFS, PNW).
Effect of incorporated chipped slash on *Poria weirii* survival. (USFS, PNW).
Resistance to *Poria weirii* of outplanted conifer species. (USFS, PNW).
Development of alder-hemlock stands on *Poria*-infested sites. (USFS, PNW, OSU).
Development of alder-Douglas-fir stands on *Poria*-infested sites. (USFS, PNW, OSU).
Effect of urea or interplanted alder on *Poria weirii* disease development in a 10-year old Bouglas-fir plantation. (USFS, PNW).
Comparison of populations of soil organisms antagonistic against *Poria weirii* in soils under red alder, Douglas-fir, and alder-fir mixtures. (USFS, PNW).
Effects of light, nutrients, and growth regulators in sporophore production by *Poria weirii.* (USFS, PNW).
Effects of red alder on *Poria weirii*-inhibiting phenolics and fatty acids in soil. (USFS, PNW).
Transformation of *Poria-weirii*-stimulating compounds into inhibiting compounds by red alder. (USFS, PNW).

Administrative study - control of Poria root rot by whole tree logging. (OSDF).
Biological control of *Phellinus weirii* by planting resistant tree species. (WDNR).
Longevity of *Poria weirii* in Douglas-fir stumps. (OSU; USFS; PNW).
Development of *Poria weirii* in young Douglas-fir plantations. (OSU)
Red alder as a biological control of *Poria weirii* root rot of Douglas-fir. (OSU; USFS, PNW, and industry).
Studies on *Poria weirii* in relation to variation in morphology and forest disease relationships. (UW)

Fomes annosus

Evaluation of *Fomes annosus* root rot in a ponderosa pine-Jeffrey pine plantation, Fremont National Forest, Oregon. (USFS, R-6).
Colonization of western hemlock stumps by *Fomes annosus* after a precommercial thinning operation. (WDNR).

Armillaria mellea

Effect of precommercial thinning on ponderosa pine, *Pinus ponderosa* infected with *Armillaria mellea*, Sisters Ranger District, Deschutes National Forest. (USFS, R-6).
The biology and control of *Armillaria* in ponderosa pine. (OSU; WDNR; industry).

Rhizina undulata

Rhizina undulata Fr.: Distribution and damage appraisal, western Oregon and Washington, Region-wide survey. (USFS, R-6; OSDF; WDNR).
Studies on the biology of *Rhizina undulata* in respect to the cause of Rhizina root rot in plantations of Douglas-fir. (UW).

OTHER ROOT DISEASES

Studies on Verticicladiella root disease of Douglas-fir. (OSU)
Root rot of Port-Orford-cedar. (OSU)

DECAYS

Decay and cull in upper-slope species. (USFS, PNW).
Decay in shade tolerant advanced reproduction. (USFS, PNW).
Decay associated with scars in second growth timber. (USFS, PNW).
Role of nitrogen fixing bacteria in wood decay. (USFS, PNW).
The biology and pathology of *Polyporus volvatus* (sapwood decay). (WSU)

DWARF MISTLETOES

Development of simulated yield tables for dwarf mistletoe-infested ponderosa pine. (USFS, PNW).
Determining mistletoe impact for forest survey plot records. (USFS, PNW).
Relationship of stand age and dwarf mistletoe infection in hemlock reproduction. (USFS, PNW).
Pruning ponderosa pine from above to minimize dwarf mistletoe spread. (USFS, PNW).
Effect of dwarf mistletoe on Douglas-fir growth and mortality in thinned and unthinned stands. (USFS, PNW).
Effects of urea fertilization on height growth of dwarf mistletoe-infected seedlings. (USFS, PNW).
Wallrothiella arceuthobii and *Septogleum* sp. as biological controls of dwarf mistletoe. (USFS, PNW).
Evaluation of dwarf mistletoe control projects in precommercial-sized stands. (WDNR).
Dwarf mistletoe on ponderosa pine. (OSU; USFS, PNW).
Anatomy of the endophytic systems of *Arceuthobium tsugense* on *Tsuga heterophylla.* (PSU).
Pigment analysis in several species of *Arceuthobium* and *Phoradendron.* (PSU).
Stem anatomy of *Arceuthobium tsugense.* (PSU).
Stem anatomy of *Arceuthobium globosum.* (PSU).
Phyto-sociological systems with *Arceuthobium douglasii* along the Cascade Range in Oregon. (PSU).
Anatomical aspects of establishment of *Arceuthobium campylopodum* on *Pinus ponderosa.* (PSU).
The biochemical nature of viscin. (PSU).
Distribution of *Arceuthobium douglasii* in western Oregon. (PSU).

The relationship between light intensity and seed production in *Areuthobium douglasii.* (PSU).
The pattern of distribution and activity of *Arceuthobium tsugense* on open stand and closed stand *Tsuga heterophylla.* (PSU).
The phototropic and geotropic responses of *Arceuthobium campylopodum* radicles in *vitro.* (PSU).
Host-parasite morphology during the period of transition from free-living seedling to dependent parasite using *Arceuthobium campylopodum* on *Pinus ponderosa.* (PSU).

NURSERY DISEASES

Field evaluation of seed protectant fungicides at the Wind River Nursery, 1974. (USFS, R-6).
Wind River Nursery bed treatments applied in 1973 and effects on soil pathogens and seedling survival. (USFS, R-6).
The effect of soil fumigation and sulfur amendment treatments on populations of *Pythium* spp., *Fusarium* spp., ponderosa pine seedling emergence and survival in the Bend Pine Nursery. (USFS, R-6).
Mycorrhizal protection of Douglas-fir seedlings against *Fusarium* root rot. (USFS, PNW).
Mycorrhizal protection of Douglas-fir roots against soil phytotoxins. (USFS, PNW).
Methodology of inoculating container-grown tree seedlings with selected mycorrhizal fungi. (USFS, PNW).
Collection, storage, and germination of spores of mycorrhizal fungi for nursery inoculation. (USFS, PNW).
Survival and growth of mycorrhizal versus non-mycorrhizal container-grown Douglas-fir seedlings after outplanting. (USFS, PNW).

FOLIAGE DISEASES

The progress of *Lophodermella morbida* on off-site ponderosa pine plantations. (USFS, PNW).
Evaluation of fungicides to control *Lophodermium* needle diseases in ornamentals. (WDNR).
Life history studies of *Elytroderma deformans.* (OSU).

STEM RUSTS

U.S. Forest Service (R-6) rust-resistant pine program, Dorena Project, Umpqua National Forest. (USFS, R-6).

NONINFECTIOUS DISEASES

Evaluation of dieback in Douglas-fir plantations, Baker River Ranger District, Mt. Baker-Snoqualmie National Forest. (USFS, R-6).
Biological evaulation of damaged trees in Douglas and Jackson Counties. (USFS, R-6; OSDF).
Forest ecosystems monitoring for SO^2 damage in the area surrounding the Northwest Alloys Magnesium Plant, Addy, Washington, Colville National Forest. (USFS, R-6; USFS, R-1; WSU; Northwest Alloys).

DISEASE SURVEYS - GENERAL

Evaluation of diseases in National Forest plantations in the Pacific Northwest, Region-wide survey. (USFS, R-6).
Survey of lodgepole pine stands in R-6 to determine disease incidence, Region-wide survey. (USFS, R-6).
A survey of diseases of range plants of Washington. (UW).

MISCELLANEOUS STUDIES

Defect in Douglas-fir and grand fir top-killed by the Douglas-fir tussock moth, Malheur National Forest. (USFS, R-6).
Quantitative and qualitative addition of nitrogen to soils by red alder as a function of time. (USFS, PNW).

Nitrogen fixation by the bacterial genus *Beijerinckia* in forest soils. (USFS, PNW).
Effect of ozone as an air-pollutant on nitrogen fixation and microflora of leaf surfaces of Douglas-fir and red alder. (USFS, PNW).
Enzyme and auxin production by mycorrhizal fungi. (USFS, PNW).
Effect of mycorrhizal fungi on micronutrient uptake by hosts. (USFS, PNW).
Host specificity of endomycorrhizal fungi. (USFS, PNW).
Systematics and ecology of mycorrhizal fungi and mycorrhizal classification. (USFS, PNW).
Effect of artificial lighting and non-lighting on growth and quality of styro block grown Sitka spruce. (WDNR).
Growth and disease reduction of containerized trees under different watering and nutrifying regimes. (WDNR).
Diseases of forest trees. (OSU).
Evaluations of decomposition rates of the Douglas-fir biomes within young-growth Douglas-fir stands (UW).
Determining the effects of sewage sludge on decomposition of foliage and wood within a Douglas-fir stand. (UW).
Fungi of the State of Washington and the Pacific Northwest. (WSU)
Interactions among root-rot fungi and bark beetles. (WSU).
Biology, cytology, and systematics of *Hyoxylon* and allies. (WSU).
Biology of *Hypoxylon serpens.* (WSU).

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