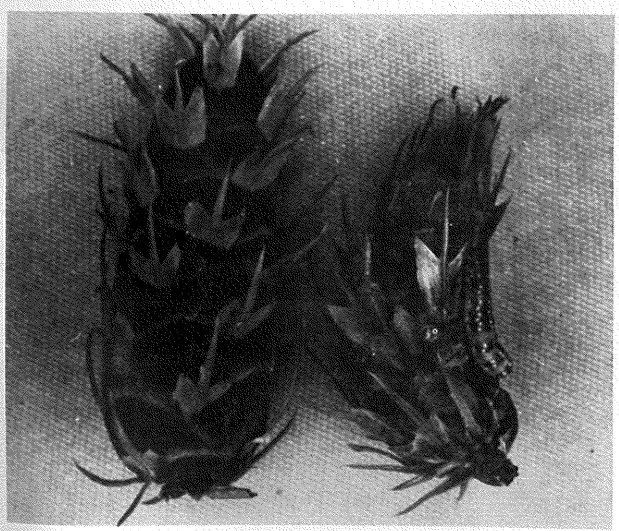
FOREST INSECT AND DISEASE CONDITIONS IN THE UNITED STATES, 1972



FOREST SERVICE
U.S. DEPARTMENT OF AGRICULTURE

FOREWORD

This publication, issued annually since 1951, documents the forest insect and disease conditions in the United States as reported by professional forest entomologists and pathologists throughout the country. A brief description of the national insect and disease detection and evaluation program and how it contributes to the preparation of this report seems appropriate.

The USDA Forest Service and many State forestry or agriculture departments have staffs of professional forest entomologists and pathologists located in many parts of the country that, on a cooperative basis, carry out the following activities: (1) Detect insect and disease outbreaks, (2) evaluate their significance, and (3) recommend action needed to reduce their impact. These activities cover all forested lands in the United States regardless of ownership.

Detection of outbreaks is done in a number of ways. Included are: (1) Systematic aerial surveys by trained observers who locate and map outbreak boundaries; (2) use of remote sensing techniques such as photographing vast areas with infrared, true color, or other films; (3) ground examination of permanent detection plots; and (4) working with the public to encourage reporting of areas of suspected epidemic insect or disease activity.

The most specialized job of the State or Federal forest entomologist or pathologist is to accurately evaluate the outbreak after it has been detected. These evaluations are of three major kinds:

—A meaningful *biological evaluation* to determine the significance of an insect or disease outbreak, its probable cause, and the damage that can be expected with or without suppression.

—A *benefit-cost evaluation* to weigh the cost of suppression and any adverse effects against the values saved.

—An *environmental evaluation* to determine adverse impacts from the suppression method planned for use, the measures required to hold these impacts to a minimum, and consideration of alternatives, including the impact of taking no action.

Information from these evaluations is used in making a decision on action to take. Sometimes the recommendation is to take no action. This may be the case when the biological evaluation shows: 1) The outbreak will decline from natural causes, 2) no satisfactory controls are available, or 3) economic or environmental considerations rule out control efforts. Frequently, the recommendation for control is cultural or mechanical, such as thinning the stand to provide for thriftier, more resistant trees. Often the most satisfactory control is chemical spraying or cutting and burning. Biological controls are recommended when considered feasible.

Detection and evaluation findings, accumulated at many field locations, are given to our major field headquarters, who, in turn, submit them to the Washington Office for preparing this report. We gratefully acknowledge the work of these specialists in the nationwide pest management program and the program cooperators whose efforts make the report possible. Special thanks go to Pathologist H. Daniel Brown, Northeastern Area, State and Private Forestry, St. Paul Field Office, and Entomologist Jerald E. Dewey, Forest Service, Region 1, Missoula, Mont., who helped in compiling this year's report.

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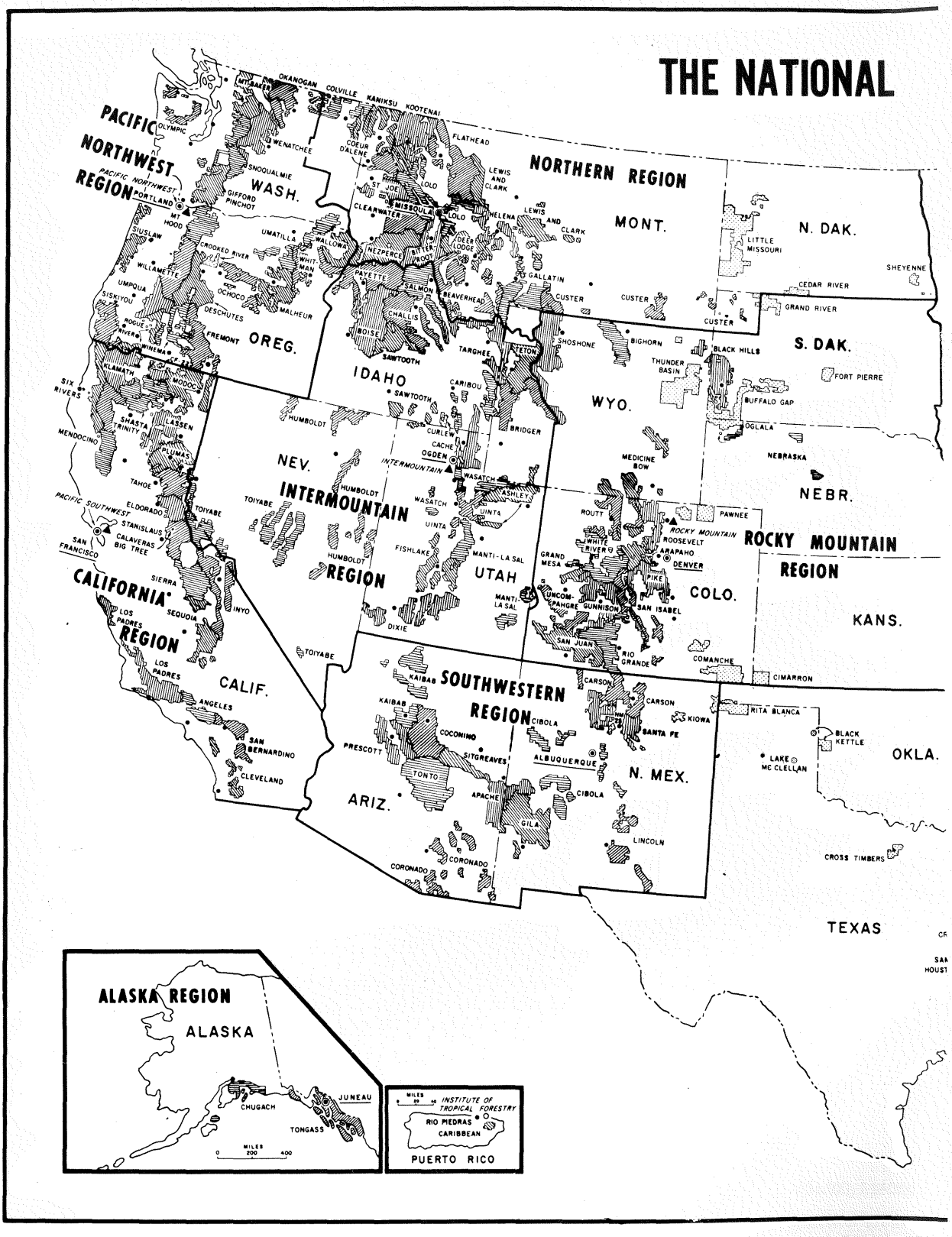
Cover photo: Cone and seed insects and disease have an impact on natural regeneration and production goals in seed production areas, seed orchards, and tree breeding orchards: *Upper left,* comparison of normal Douglas-fir cone and one injured by a spruce budworm larva; *lower right,* a normal 1-year-old slash pine cone and one badly damaged and swollen from Southern cone rust disease.

CONTENTS

This publication reports research involving pesticides. It does not contain recommendations for their use, nor does it imply the uses discussed here have been registered. All uses of pesticides must be registered by appropriate State and/or Federal agencies before they can be recommended.

CAUTION: Pesticides can be injurious to humans, domestic animals, desirable plants, and fish or other wildlife—if they are not handled or applied properly. Use all pesticides selectively and carefully. Follow recommended practices for the disposal of surplus pesticides and pesticide containers.

Issued August 1973


THE NATIONAL
PACIFIC NORTHWEST REGION
PACIFIC NORTHWEST
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INTERMOUNTAIN REGION
ROCKY MOUNTAIN REGION
CALIFORNIA REGION
SOUTHWESTERN REGION
WASH.
OREG.
IDAHO
MONT.
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WYO.
NEBR.
NEV.
UTAH
COLO.
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OKLA.
TEXAS
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ARIZ.
CALIF.
OLYMPIC
MT. BAKER
OKANOGAN
COLVILLE
KANIKSU
KOOTENAI
FLATHEAD
COEUR D'ALENE
WENATCHEE
SNOQUALMIE
GIFFORD PINCHOT
PORTLAND
MT. HOOD
SIUSLAW
UMATILLA
WALLOWA
WHITMAN
NEZPERCE
CLEARWATER
MISSOULA
LOLO
HELENA
LEWIS AND CLARK
DEER LODGE
BITTERROOT
GALLATIN
BEAVERHEAD
CUSTER
LITTLE MISSOURI
SHEYENNE
CEDAR RIVER
GRAND RIVER
CROOKED RIVER
WILLAMETTE
UMPQUA
SISKIYOU
ROGUE RIVER
OCHOCO
DESCHUTES
MALHEUR
FREMONT
WINEMA
KLAMATH
MODOC
SIX RIVERS
SHASTA TRINITY
LASSEN
PLUMAS
MENDOCINO
TAHOE
ELDORADO
TOIYABE
STANISLAUS
CALAVERAS BIG TREE
SAN FRANCISCO
PACIFIC SOUTHWEST
SIERRA
SEQUOIA
INYO
LOS PADRES
ANGELES
SAN BERNARDINO
CLEVELAND
SALMON
CHALLIS
BOISE
SAWTOOTH
TARGHEE
TETON
SHOSHONE
BIGHORN
THUNDER BASIN
BLACK HILLS
FORT PIERRE
BUFFALO GAP
OGLALA
NEBRASKA
MEDICINE BOW
CARIBOU
CURLEW
CACHE
OGDEN
BRIDGER
INTERMOUNTAIN
WASATCH
ASHLEY
UINTA
HUMBOLDT
FISHLAKE
MANTI-LA SAL
DIXIE
ROUTT
PAWNEE
ROCKY MOUNTAIN
WHITE RIVER
ROOSEVELT
ARAPAHO
DENVER
GRAND MESA
UNCOMPAHGRE
GUNNISON
SAN ISABEL
PIKE
SAN JUAN
RIO GRANDE
COMANCHE
CIMARRON
KAIBAB
COCONINO
PRESCOTT
SITGREAVES
TONTO
APACHE
CIBOLA
ALBUQUERQUE
CARSON
KIOWA
SANTA FE
RITA BLANCA
BLACK KETTLE
LAKE MC CLELLAN
GILA
LINCOLN
CORONADO
CROSS TIMBERS
ALASKA REGION
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JUNEAU
CHUGACH
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INSTITUTE OF TROPICAL FORESTRY
RIO PIEDRAS
CARIBBEAN
PUERTO RICO
MILES
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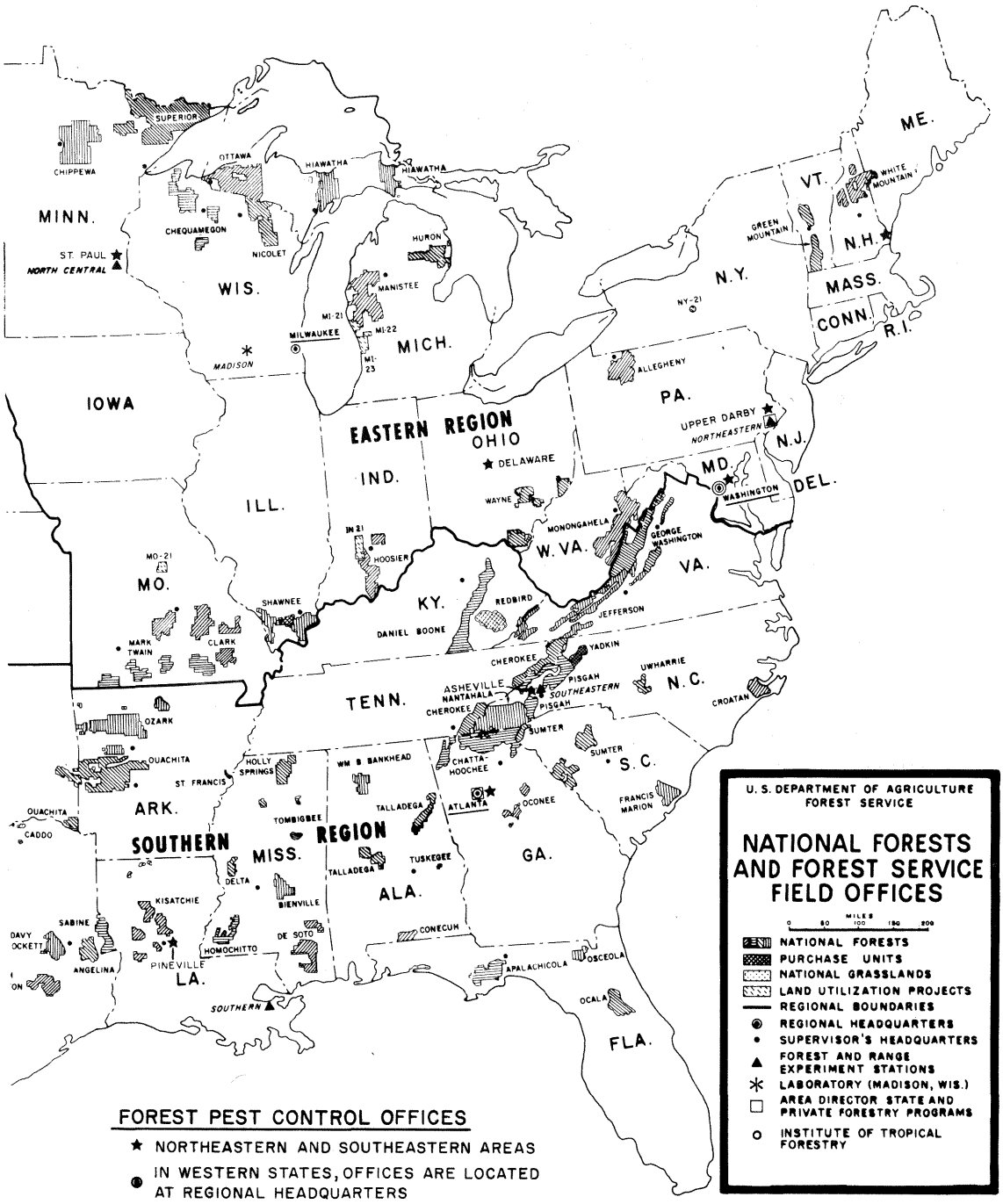
FOREST SYSTEM



Forest Pest Control offices are located at the following addresses; see map on pp. iv-v.

USDA Forest Service
Federal Building
Missoula, Mont. 59801

USDA Forest Service
Federal Center Building
Denver, Colo. 80225

USDA Forest Service
Federal Building
517 Gold Avenue S.W.
Albuquerque, N. Mex. 87101

USDA Forest Service
Federal Office Building
324 25th Street
Ogden, Utah 84401

USDA Forest Service
630 Sansome Street
San Francisco, Calif. 94111

USDA Forest Service
P.O. Box 3623
Portland, Oreg. 97208

USDA Forest Service
6816 Market Street
Upper Darby, Pa. 19082

USDA Forest Service
Federal Courts Building
St. Paul, Minn. 55112

USDA Forest Service
P.O. Box 365
Delaware, Ohio 43015

USDA Forest Service
P.O. Box 5895
Asheville, N.C. 28803

USDA Forest Service
2500 Shreveport Highway
Pineville, La. 71360

USDA Forest Service
1720 Peachtree Rd.
Suite 800
Atlanta, Ga. 30309

USDA Forest Service
Federal Office Building
P.O. Box 1628
Juneau, Alaska 99801

USDA Forest Service
80 Daniel St.
Portsmouth, N.H. 03801

NATIONAL SUMMARY

Western Conditions

Bark beetles were probably the most damaging forest insects in the Western States in 1972. Major epidemics were reported for mountain pine beetle, Douglas-fir beetle, and spruce beetle.

Mountain pine beetle activity was reported in Washington, Oregon, California, Idaho, Montana, Wyoming, Utah, South Dakota, and Colorado, with greatest losses on the Targhee National Forest of Idaho and Wyoming where more than 200 million board feet of prime timber is dying. This infestation already has destroyed several hundred million board feet of timber over the past decade. It has now spread deep into Yellowstone National Park and is progressing into the Gallatin and Beaverhead National Forests of Montana. A mountain pine beetle outbreak has killed nearly 25 million board feet of timber on the Wallowa-Whitman National Forest in Oregon. Also in Oregon, significant lodgepole pine killing occurred on the Deschutes, Fremont, Umatilla, and Winema National Forests and Crater Lake National Park. Heavy losses to western white pine occurred on the Clearwater, St. Joe, Coeur d'Alene, and Kaniksu National Forests of northern Idaho where mountain pine beetle activity seems to be enhanced by trees already weakened by white pine blister rust. Dense, second growth ponderosa pine stands near Missoula, Mont., sustained epidemic beetle populations for the third consecutive year. Some control is being realized by silvicultural thinning, a practice that reduces stand susceptibility to attack. Overstocked second growth ponderosa pine also is being attacked in the Black Hills of South Dakota. Over 400,000 trees were reported killed in 1972 in this area. Smaller centers of mountain pine beetle activity occurred throughout the western host type.

Douglas-fir beetle activity was at a high level in 1972. The massive outbreak in the North Fork–Clearwater River area of Idaho continued at an epidemic level, killing an additional 24 million board feet of prime sawtimber. An estimated 22 million board feet was killed in Oregon and Washington. A spotty but extensive infestation occurred on the Targhee National Forest in Idaho and Wyoming. This outbreak was probably triggered by the presence of storm-damaged trees. Scattered patches of Douglas-fir beetle activity were common in most western Regions. A pheromone, methylcyclohexanone, was field tested in Washington, Oregon, and Idaho to repel Douglas-fir beetles from selected trees and areas. Though test results have not been completely evaluated, it appears this may be a usable tool in manipulating beetle populations.

Spruce beetle damage was at a lower level in most western forests than that reported in 1971. An exception was Alaska, where heavy mortality on approximately 70,000 acres near Grading Bay was detected. Smaller outbreaks (5,000–6,000 acres) occurred near Cook Inlet. An estimated gross volume of 1.7 billion board feet was killed in 1972 in the Cook Inlet basin. Most of this was on State and private land and the Kenai National Moose Range. An infestation on the Kenai Peninsula has increased tenfold since 1970 and now encompasses 60,000 acres. An estimated 1 million board feet of timber was killed in high elevation spruce stands in Oregon and Washington. A high percentage of the merchantable spruce volume in the Manti-LaSal National Forest in Utah has been destroyed by an outbreak that has persisted since 1969. It is expected to continue until most of the larger trees are killed. Outbreaks in Wyoming, Colorado, and New Mexico decreased dramatically in 1972 from natural factors. However, recent windstorms have created conditions that may enhance new outbreak centers next year in these States.

The western pine beetle was very active in parts of California, specifically, on the Shasta-Trinity, Sequoia, Mendocino, and Lassen National Forests. Some increased activity was also reported on the Ochoco, Fremont, and Malheur National Forests of Oregon.

Major defoliation problems in the West were caused by the western spruce budworm, Douglas-fir tussock moth, pine butterfly, larch casebearer, and hemlock sawfly.

Western spruce budworm infested areas increased significantly in size throughout most of the insect's range. In Montana and northern Idaho, over 4.5 million acres are infested. A survey on the Nezperce National Forest showed 138,000 acres have suffered permanent injury (top kill and/or tree mortality). Regeneration is being seriously impaired by budworm injury that prevents cone production or causes cone destruction. In eastern Washington, budworm defoliation spread from 18,000 acres in 1971 to over 200,000 acres in 1972. Outbreaks are continuing in Oregon, southern Idaho, western Wyoming, Colorado, and northern New Mexico.

The most acute defoliation problem in the West is the Douglas-fir tussock moth. This insect is capable of killing trees in 1 or 2 years. The situation in Oregon and Washington is critical. Visible defoliation was observed on 196,000 acres. Surveys made last fall indicate the infestation may approach 500,000 acres in 1973. It's estimated that up to 1 billion board feet of timber may be killed as a result of this outbreak. Increased tussock moth activity is also reported in Idaho, Nevada, and parts of California. Isolated reports of Douglas-fir tussock moth also came from Colorado, Montana, New Mexico, and Arizona.

The pine butterfly severely defoliated ponderosa pine in Montana and Idaho. About 40,000 acres of defoliation occurred in the Bitterroot National Forest in Montana. Another 36,000 acres were defoliated on the Nezperce and Payette National Forests in Idaho.

The larch casebearer continued to inflict heavy damage, primarily growth reduction, throughout northern Idaho. It is continuing to spread in Oregon and Washington and expected to eventually infest all larch stands in both States. Attempts at biological control were accelerated in 1972 by the release of two new species of parasites in Oregon, Washington, Idaho, and Montana.

An outbreak of the hemlock sawfly has spread to 23,000 acres in southeast Alaska. One season of defoliation has caused hemlock and spruce mortality on some acres. Evaluations indicate the outbreak will persist through 1973.

Some mortality of true firs occurred on 82,000 acres in Oregon and Washington from balsam woolly aphid injury.

The western hemlock looper caused noticeable defoliation on 10,000 acres of grand fir in Idaho. This is the first documented report of this insect building up in Idaho since a devastating outbreak in the late 1930's.

The Eurasian pine aphid, an insect introduced into Hawaii in 1970, is threatening pine plantations throughout the State. Attempts at control are underway using chemicals and biological agents.

Dwarf mistletoes were the most destructive disease agents again in 1972. The annual growth loss is estimated to be 147 million cubic feet of timber in Oregon and Washington. The impact of mistletoes in the Intermountain Region is estimated to be 135 million board feet per year. Cultural control of dwarf mistletoes is being conducted throughout most of the West.

Root diseases destroy a tremendous volume of timber each year in western forests. Annosus root rot, laminated root rot, armillaria root rot, verticicladella root rot, and poria root rot were the most widespread and damaging root rots reported in 1972.

The trunk rot *Echinodontium tinctorium* (E. and E.) caused a high degree of cull in mature and overmature grand fir and western hemlock in northern Idaho.

Western gall rust is very widespread and continues to cause extensive limb girdling and top killing in some areas. It was found killing 4 to 6-year-old ponderosa pine seedlings in Nebraska.

White pine blister rust continues to cause heavy mortality throughout the western white pine type. The future of western white pine and sugar pine is greatly enhanced due to rust resistant tree programs. Some 50,000 seedlings

were artificially inoculated with the fungus in Oregon in 1972 as a part of the selection program.

Air pollution was reported damaging trees in California, Idaho, Montana, and Arizona.

Eastern Conditions

The southern pine beetle in the South and the gypsy moth and spruce budworm in the North are the most damaging insects in the Eastern United States. Other major insects include the Ips engraver beetle, black turpentine beetle, balsam woolly aphid, sawflies, oakworms, tent caterpillar, variable oak leaf caterpillar, the large aspen tortrix, and a pine looper.

The southern pine beetle increased in intensity and area throughout most of the South. Control efforts largely were directed at removal and salvage of infested trees. Evaluations indicate the infestation will continue in 1973. The following tabulation shows the reported acreages infested and volumes salvaged in 1972 through September:

State	Acres infested	Volume salvaged
Alabama	15,000,000	17,000,000 bd. ft.
Arkansas	400,000	600,000 bd. ft.
Georgia	9,000,000	3,000,000 bd. ft.*
Louisiana	8,000,000	31,800,000 bd. ft. and 32,000 cords
Mississippi	1,600,000	4,005,000 bd. ft.
North Carolina	6,700,000	3,600,000 bd. ft.
South Carolina	4,300,000	3,000,000 bd. ft.*
Texas	8,685,000	18,200,000 bd. ft.*
Virginia	4,600,000	1,600 cords

* From Federal lands only.

Additional tree mortality due to the southern pine beetle was reported occurring in Tennessee, Maryland, and Delaware.

Ips engraver beetles caused an estimated loss of 2 million trees in northern Florida. Increased Ips activity was also noted in North Carolina, Texas, and Arkansas.

The range of established gypsy moth infestations increased somewhat to the west and south of the 1971 boundary of infestation. However, total acreages defoliated by the gypsy moth in 1972 were slightly less than in 1971. Male moths were trapped as far west as Minnesota, Iowa, and Missouri, and south into North Carolina, South Carolina, and Tennessee. Small spot infestations have been located in southern Michigan and northern Ohio. Chemical control, primarily with carbaryl, was applied to 174,180 acres in cooperative projects with the States of New York, New Jersey, and Pennsylvania. This was about half the area treated in 1971.

Spruce budworm outbreaks intensified in 1972. About 2.5 million acres of spruce-fir type were defoliated in Maine, and another 1.5 million acres in Minnesota. Sizable areas in Michigan also suffered from budworm damage. The insecticide Zectran was aerially sprayed on 500,000 acres of budworm infested forests in Maine with satisfactory control. Additional acreage will require treatment in 1973 to prevent significant losses. Balsam fir saplings and reproduction have been killed over a 10,000 acre area on the Superior National Forest, Minnesota, as a result of 3 to 5 years of defoliation.

A balsam woolly aphid infestation continued in the 60,000 acres of Fraser fir type in the southern Appalachian Mountains. Suppression measures were carried out in high-use, high-value acreages on the Pisgah National Forest and Mount Mitchell State Park in North Carolina.

Sawflies defoliated several species of conifers in both the North and South. The jack pine sawfly defoliated about 30,000 acres of jack pine in upper Michigan. The European pine sawfly was found for the first time in Wisconsin, and was responsible for defoliation in Michigan, Illinois, Ohio, and Missouri in 1972. The loblolly pine sawfly caused damage in

portions of Missouri and Illinois. The red-headed pine sawfly defoliated over 3,000 acres of red pine in New York as well as some in Vermont, Michigan, and Wisconsin.

The forest tent caterpillar was epidemic throughout much of the East. The most extensive outbreaks occurred in the southern States. About 415,000 acres were defoliated in Louisiana and another 30,000–50,000 acres of heavy defoliation occurred in the Tensaw and Mobile River Basins of Alabama and smaller outbreaks occurred in Florida, Kentucky, North Carolina, and Texas. Forest tent caterpillar activity declined greatly in the Northeastern States in 1972. The largest outbreak reported was in Pennsylvania where 22,000 acres were moderately defoliated.

The red-humped oakworm caused defoliation on 600,000 acres of oak in Michigan. This is the third consecutive year for this outbreak in some areas. A smaller outbreak in Iowa increased from 1,000 acres in 1972 to 5,000 acres in 1972.

The large aspen tortrix caused moderate to severe aspen defoliation in the northern part of the Lake States and Maine. The gross area affected in the Lake States is about 2 million acres. Although the outbreak is in its fourth year in some areas, no tree mortality has occurred.

Oak wilt continued in about the same areas and at about the same intensity as reported in previous years. An area surveyed in North Carolina showed a slight increase in the number of diseased trees over 1971.

Entire Christmas tree plantations of red and Scotch pine have been destroyed in the Adirondacks due to scleroderris canker. About 30 major infection centers are known in northeastern New York. Some damage is also occurring in the Lake States.

Atmospheric pollution is suspected of injuring pecan and walnut flowers in Indiana, and burning pine needles in the Appalachian Mountains. In addition, several probable pollutant-damaged pine stands occur in North and South Carolina and Tennessee.

Other diseases of local importance include white pine root decline, armillaria root rot, anthracnose, lophodermium needle cast, rhizosphaera needle rust, hypoxylon canker of aspen, sirococcus shoot blight, southern fusiform rust, comandra blister rust, pitch canker, brown spot, cylindrocladium root rot, and black root rot.

Dutch elm disease continues to be the most serious disease in the Northeastern States. The only areas of declining activity are those where elms have been almost eliminated. The most severe damage occurred in Indiana, West Virginia, and Pennsylvania but the disease has recently become widespread in the Southeast, infecting trees in all States except Louisiana and Florida.

Annosus root rot was most damaging in young pine plantations. Heavy mortality has forced land managers to clearcut plantations in some areas of Arkansas, Louisiana, Mississippi, and Alabama. Significant losses are occurring in South Carolina, Tennessee, southern New England, and elsewhere. The disease has nearly disappeared from some known infection centers in Indiana.

White pine blister rust caused significant damage to Christmas tree plantations and timber stands in localized areas. Much of the damage and the control efforts have centered in the southern Appalachians, encompassing several million acres primarily in Virginia and North Carolina.

FOREST INSECT AND DISEASE CONDITIONS BY REGIONS

ALASKA (R–10)

by
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Conditions in Brief

The spruce beetle continued to be the most damaging forest insect pest in Alaska. Several new outbreaks and many continuing ones caused tree mortality of varying intensity throughout most of the mature white spruce stands on the Kenai Peninsula. Additional outbreaks of recent origin, causing widespread and extremely heavy mortality in white spruce on the west side of Cook Inlet, were detected this past summer.

Defoliation caused by the hemlock sawfly was observed at several locations in the southern portion of southeast Alaska. Among these was an outbreak in the Ward Creek drainage near Ketchikan which caused heavy defoliation and resulted in top-killing and some tree mortality. Another outbreak occurred between Thorne Arm and Princess Bay on Revillagigedo Island. Western blackheaded budworm larvae were collected for the second year at many sampling points on the Ketchikan and Kasaan Ranger Districts and were newly recorded at a number of locations on the northern half of the Tongass National Forest. No projects were undertaken to control insects in 1972.

The forest disease situation is little changed from 1971. Hemlock dwarf mistletoe and dieback continue to be the most serious disease problems in the second-growth stands of southeast Alaska. Considerable winter drying of conifers was observed in both southeast Alaska and portions of the Kenai Peninsula.

Status of Insects

Spruce beetle, *Dendroctonus rufipennis* (Kby.). A newly detected outbreak, now in progress for the third or fourth year, has caused considerable mortality to white spruce stands on seven townships of State and Tyonek Indian Reservation lands stretching from the McArthur River Delta northeast to the Beluga River on the west side of Cook Inlet. The areas of heaviest mortality—amounting to severe stand destruction on approximately 70,000 acres—are located along the Chakachatna River Delta; in the Straight, Nikolai, and Chuitkilnacha Creek drainages near Trading Bay; and on portions of the Tyonek Indian Reservation between Congahbuna Lake and the Chuitna River.

The cause of this outbreak and the time when it began is not definitely known. However, it is assumed that the extensive petroleum exploration in this area from 1965–1968, which produced vast amounts of down material and the severe drought years of 1968–1969 in the Cook Inlet basin resulted in conditions suitable for brood development. Past records indicate that most major outbreaks are triggered by natural catastrophes or relatively large-scale, man-related disturbances coinciding with periods of prolonged moisture deficiency. The trend of this infestation is not definitely known. However, it is expected to continue until most suitable host material has been depleted. Possibilities of extensive salvage harvest are being explored by the State.

Additional small outbreaks, amounting to approximately 5,600 to 6,000 acres, occur on Bureau of Land Management lands along the

southwest shore of Cook Inlet near Mt. Iliamna. They are located in Sitka spruce stands adjacent to several areas of blowdown which occurred in 1967 and 1968. The trend of these infestations is not known; however, additional mortality is expected in 1973. Estimated acreage and gross volume of mortality by ownership class resulting from spruce beetle outbreaks in the Cook Inlet basin follow: [1]

Ownership class	Acres infested	Estimated gross volume (M board feet)
Kenai National Moose Range	149,800	596,300
Bureau of Land Management	5,700	35,000
Tyonek Indian Reservation	12,000	82,500
State & Private	253,700	1,001,500
Total for all ownerships	421,200	1,715,000

[1] Acreages determined by sketch mapping and dot grid computation on 1:250,000 scale maps.

Spruce beetle activity on the northern half of the Kenai Peninsula has decreased following 6 years of outbreak that have resulted in extensive mortality of mature white spruce. Infestations are still active in the Swanson Lakes area and between Barabara and Phalarope Lakes but are declining as available host material is destroyed.

The most serious outbreak now in progress on the Kenai Peninsula occurs south and west of Lake Tustumena on State and private lands located between Clam Gulch and the Anchor River. The number of red-topped trees has increased tenfold in this area since 1970, and tree killing is now in progress over an estimated 60,000 acres. A combination of favorable environmental factors, including an abundance of host material, large populations of overwintering beetles, and a continuation of drought promises additional tree killing and an enlargement of this outbreak in 1973.

Conditions on National Forest land on the eastern half of the Kenai Peninsula are more encouraging than in the past few years. Chronic infestation in many areas on the Chugach National Forest has become endemic. Examination of temporary study plots located within the perimeter of the 1969 Russian River Burn indicates that spruce beetle populations have collapsed following the depletion of fire-damaged host material. Beetles showed a strong preference for trees with green crowns and partially burned lower boles and root systems. Beetles were, however, unable to develop the large vigorous broods necessary to culminate in attack of green standing trees. Green, healthy trees were rarely attacked, and no attacks were observed in severely burned trees.

The infestations active in the East Fork drainage since 1967 subsided by 1972. Very little new spruce mortality was observed from the air, and few newly attacked trees were detected by ground sampling. Examination of 1969 and 1971 blowdown in the Resurrection Creek drainage indicated that light, widely scattered broods exist but pose no immediate threat to standing green trees. Emerging populations are expected to infest portions of the remaining green blowdown during 1973 and 1974.

Spruce beetle activity in southeast Alaska is occurring on State, private, and National Forest lands in the vicinity of Sitka. The mortality, confined to trees that were severely defoliated by spruce aphid populations in 1970, has resulted in a significant amount of damage to the esthetically valuable overmature spruce in and around the Saw Mill Creek Campground located on the Sitka Ranger District.

Western black-headed budworm, *Acleris gloverana* (Wlshm.). Populations of this pest are slowly increasing throughout the Tongass National Forest. Larvae have been collected for the second year in a row at many sampling locations on Revillagigedo Island and the eastern half of Prince of Wales Island and were newly recorded at a number of locations north of Frederick Sound this season. No defoliation was observed during the aerial detection survey. However, both larval feeding and budworm eggs have been observed in many areas where sawfly populations are now active. In

some cases, understory hemlock have supported defoliation.

An increase in budworm activity is expected on Revillagigedo Island near Ketchikan and at several locations on Prince of Wales Island in 1973.

Hemlock sawfly, *Neodiprion tsugae* (Midd.). Defoliation, covering approximately 23,000 acres, was observed at many locations in southeast Alaska from Etolin Island south to Moira Sound on Prince of Wales Island. Most of the newly visible feeding, nearly 14,000 acres, occurred on Revillagigedo Island and the east side of Prince of Wales Island.

The damage varies from light to moderate except in the Ward Creek drainage near Ketchikan. One season of defoliation has resulted in hemlock and spruce mortality and some top-killing within portions of a 1,200-acre outbreak occurring in patchy distribution from Ward Cove to Talbot Lake. An additional outbreak, less severe but much more widespread, occurred between Thorne Arm and Princess Bay east of Ketchikan.

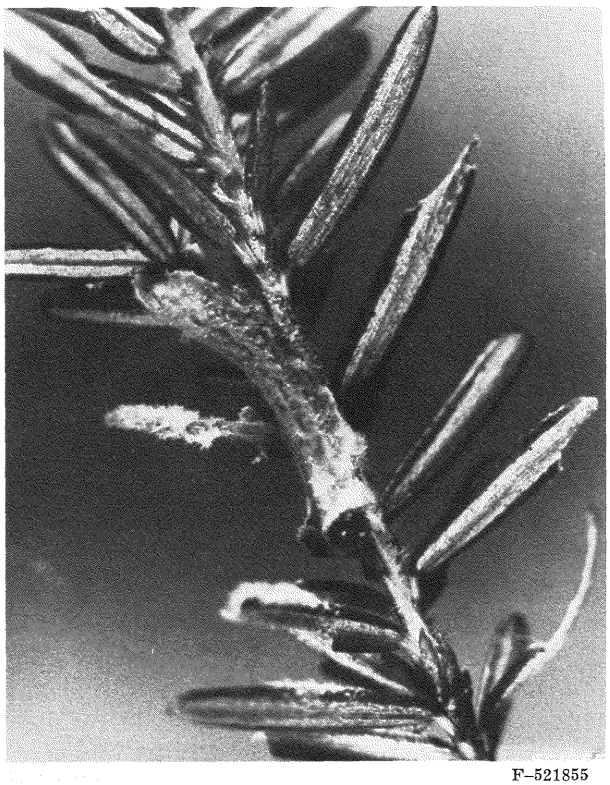

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Figure 1.—Hemlock sawfly larva infected with the *Entomophthora sphaerosperma* (Alaska).

Egg sample data indicate that a moderate to heavy population of sawfly and a moderate population of black-headed budworm will occur in these same areas next year. Combined sawfly and budworm feeding in 1973 is expected to result in additional tree killing in this high-use recreation area. The feasibility of a field experiment to test a promising suppression material is being investigated. Some natural mortality due to the fungus *Entomophthora sphaerosperma* (Fres.) has been observed (fig. 1).

A general increase in sawfly populations, with additional new defoliation and some mortality in older centers, is expected to occur throughout much of the southern portion of the Tongass National Forest in 1973.

Saddle-backed looper, *Ectropis crepuscularia* (Schiff.). Larval survey data indicate that populations of this pest are very low. Larvae were found at only one of 140 sampling locations in southeast Alaska.

Green-striped forest looper, *Melanolophia imitata* (Wlk.). Very low larval populations of this looper were found at 17 of 140 sampling locations this past season. Two or more larvae were collected at only three locations in southeast Alaska.

Status of Diseases

Hemlock dwarf mistletoe, *Arceuthobium tsugense* (Rosend.) G. N. Jones. In FY 1972 a total of 975 acres of dwarf mistletoe suppression work was conducted on the Petersburg Ranger District of the North Tongass National Forest. Treatment was conducted on only those portions of individual clearcut units supporting mistletoe-infected residual trees. The average cost of treatment if calculated for the entire clearcut unit was $16.41 per acre.

Direct control, consisting of felling residual hemlock in harvest units after clearcutting, is employed to minimize infection in second-growth stands. Control efforts are expected to increase as forest management becomes more intensive.

Hemlock dieback, *Sirococcus strobilinus* (Preuss.). This fungus continues to cause growth reduction, tree deformity, and limited mortality in young stands of western hemlock at Thomas Bay near Petersburg.

The rate of infection remains at about the same level as last year. However, the disease has spread and can now be found in all of the cutting units in this area. Additional infection centers have been observed at many new locations in the southern portion of southeast Alaska this year.

This disease is now apparently infecting Sitka spruce as well as western hemlock. A survey of stands at Thomas Bay indicates that a high percentage of the spruce reproduction is exhibiting disease symptoms which correspond with those of Sirococcus-infected hemlock. Random sampling indicates that 15–20 percent of the spruce have dead terminals or aborted terminal buds producing multiple tops. These symptoms appear in all height classes but are most commonly observed in trees 5–8 feet tall. Spruce exhibiting these particular symptoms have not yet been observed at other locations in southeast Alaska.

Western gall rust, *Peridermium harknessii* J. P. Moore. This rust disease of lodgepole pine was commonly observed throughout southeast Alaska. Limb girdling and some top-killing has occurred. However, the most common damage seems to be trunk malformation, resulting in reduced crown growth.

Needle cast, *Lophodermium piceae* (Fckl.) v Toehn. This needle disease was observed throughout southeast Alaska again in 1972. Reports of locally heavy infections were received from Ketchikan and Juneau.

Needle rust. *Chrysomyxa ledicola* (Pk.) Lagerh. The damaged caused by this rust was highly localized and occurred at a few widely scattered locations in southeast Alaska and the Kenai Peninsula.

Winter drying. Unseasonably warm temperatures during the late winter and early spring, accompanied by strong winds, caused winter drying of conifers in portions of southeast Alaska and the Kenai Peninsula. Approximately 45,000 acres of damage due to this drying was observed in Sitka spruce stands located between the Doame and Italio Rivers on the Yakutat unit of the Chatham Ranger District. The damage, characterized by foliage browning, was generally light to moderate except in the vicinity of the Tanis River drainage where severe desiccation resulted in heavy needle drop and extensive bud killing over approximately 2,800 acres. Favorable climatic conditions could result in some build up of spruce beetle activity in the damaged stands.

Severe defoliation was observed over 4,300 acres on Heceta Island and several small islands in the Gulf of Esquibel. No mortality was discovered; however, the effects of the drying were evident throughout the summer.

Additional damage of a similar nature was observed on several hundred acres of mountain hemlock in the vicinity of Johnson Pass on the Kenai Peninsula. The damage in this area, superficially resembling the effects produced by herbicide application, was confined to the upper crowns of trees not covered by snow. Some top-killing and a great deal of bud damage were observed.

OREGON AND WASHINGTON (R–6)

by
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Conditions in Brief

Bark beetle losses remained at about the same level as last year. Douglas-fir beetles caused considerable mortality in western Oregon and Washington. The most significant bark beetle damage in eastern Oregon resulted from mountain pine beetle activity in lodgepole pine. All defoliating insects in Oregon and Washington except the black-headed budworm had higher than normal populations.

Although black-headed budworm populations peaked last year, there was considerable carryover into this year. The Douglas-fir tussock moth demonstrated its periodic population explosion capability. A dramatic increase in populations of this moth occurred in northeast Oregon and southeast Washington where the number of defoliated acres visible from the air expanded from zero in 1971 to nearly 200,000 acres in 1972. Severe tree mortality occurred in small scattered areas within the zone of infestation. About 500,000 acres will possibly be defoliated to some degree in 1973 and some direct control action will be necessary. Spruce budworm populations also increased greatly in 1972. Over 200,000 acres of true fir and Douglas-fir were defoliated to varying degrees in central and north central Washington. Although some severe tree defoliation is expected in 1973, very little, if any, tree mortality will occur. No direct control action is planned.

Dwarf mistletoes continue to be a major cause of growth loss and mortality in the Pacific Northwest. Root rot diseases, particularly Poria root rot, are increasing in importance as more intensive management is practiced in second-growth stands. The future of western white pine and sugar pine looks promising through the efforts of the Regional tree improvement and blister rust-resistance testing project. Several foliage diseases are causing growth loss and mortality in local areas. These include needle casts of Scotch pine and ponderosa pine and leaf blight of Oregon myrtle.

Status of Insects

Douglas-fir beetle, *Dendroctonus pseudotsugae* Hopk. This beetle killed an estimated 22 million board feet of Douglas-fir in Oregon and Washington, almost 20 million of which was in the western areas. The heaviest concentrations of tree killing were observed in the Columbia River Gorge on the Mt. Hood National Forest in Oregon and the Gifford Pinchot National Forest in Washington where an ice storm in January 1970 caused extensive tree damage. The high tree mortality of 1972 is a result of large beetle broods that developed in this ice-damaged material during 1970 and 1971. Biological evaluations indicated that the beetle population is now declining rapidly. Hence, little additional tree killing is expected in 1973. Losses east of the Cascade Mountains were lower than last year.

During the spring and summer of 1972, the repellency of the pheromone, methylcyclohexanone, was field-tested on susceptible Douglas-fir trees and logs in two test areas; one in Washington and the other in Oregon. Results of this cooperative project involving Regions One and Six, the Intermountain and Pacific Northwest Forest and Range Experiment Stations, and both States indicate that this chemical shows promise in reducing the number of beetle attacks on windthrown Douglas-fir trees.

Mountain pine beetle, *Dendroctonus ponderosae* Hopk. This beetle continues to cause serious problems in the lodgepole pine stands of central Oregon. The largest infestation center is in the upper drainages of the Grand Ronde River on the La Grande Ranger District, Wallowa-Whitman National Forest where an estimated 24.8 million board feet of timber was killed. Elsewhere in Oregon, significant lodgepole pine killing also occurred on the Deschutes, Fremont, Umatilla, and Winema National Forests and Crater Lake National Park. In Washington, damage was very light and widely scattered. Mountain pine beetle attacks in western white pine stands continued throughout the Cascade Mountain Range. The majority of the losses still occur in roadless areas on the Mt. Hood and Willamette National Forests in Oregon and the Snoqualmie National Forest in Washington. Tree killing in young ponderosa pine stands was widely scattered throughout eastern Oregon and Washington with no significant outbreaks developing in 1972.

Western pine beetle, *Dendroctonus brevicomis* LeC. Infestations increased in mature and overmature ponderosa pine stands in central Oregon on the Ochoco, Fremont, and Malheur National Forests. In Washington, tree killing was less than normal. Aerial observers discovered only four small infestation centers.

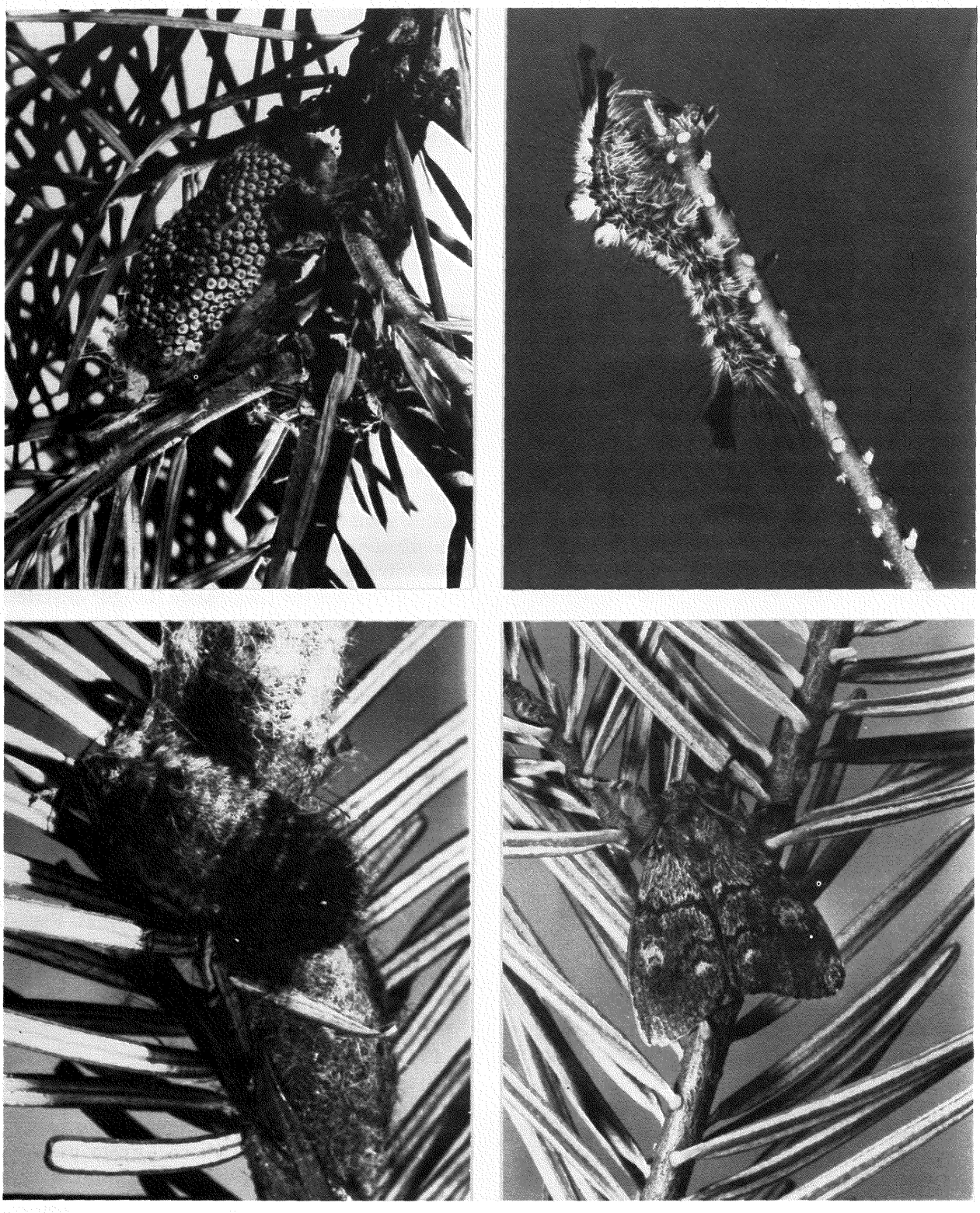

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Figure 2.—Life stages of the Douglas-fir tussock moth: *A*, Eggs, *B*, Larva, *C*, Pupae and female adult, *D*, Male adult (Oregon).

No major changes in levels of tree killing are expected to occur next year in either State.

Spruce beetle, *Dendroctonus rufipennis* (Kby.). The spruce beetle continued to remain active in Engelmann spruce stands in the high elevations of Oregon and Washington. Much of the damage occurred in inaccessible areas of the Okanogan National Forest in Washington where an estimated 1 million board feet of timber was killed.

Fir engraver, *Scolytus ventralis* LeC. Killing of true fir by the fir engraver was scattered throughout the forests of eastern Oregon and Washington. Losses declined sharply from 45.9 million board feet reported in 1971 to 2.3 million board feet in 1972. Heaviest losses this year were in central Oregon on the Ochoco and Umatilla National Forests.

Douglas-fir tussock moth, *Hemerocampa pseudotsugata* McD. (fig. 2). Tussock moth populations reached serious levels over much of eastern Oregon and Washington. A total of 196,050 acres of defoliation were visible from the air. In the Blue Mountains of northeast Oregon and southeast Washington where the largest infestation center was discovered, light to heavy defoliation occurred on 173,600 acres of Douglas-fir and true fir. Significant tree mortality was observed on 10,670 acres (fig. 3). Fall egg surveys indicate that the 1973 population may be larger and that up to 500,000 acres may be defoliated to some degree. In north central and northeast Washington, light to heavy defoliation occurred in small and scattered patches on the Wenatchee and Okanogan National Forests, Colville Indian Reservation, and on State and private lands in Okanogan, Lincoln, and Steven Counties. Fall egg counts indicate the population trend in these areas will be variable. Elsewhere throughout eastern Oregon and eastern Washington, tussock moth larvae were collected at

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Figure 3.—Aerial view of Douglas-fir killed by the tussock moth (Eastern Oregon).

several monitoring plots indicating that populations are higher than normal.

During the summer of 1972, two insecticides, Zectran and pyrethrin, were field-tested as DDT substitutes for control of the Douglas-fir tussock moth. Zectran results were encouraging, but more tests are needed before it can be recommended for operational control.

Western spruce budworm, *Choristoneura occidentalis* Free. Defoliation by this pest is again reaching serious levels after several years of little or no visible defoliation. In Washington, on the Okanogan and Wenatchee National Forests, the defoliation increased from 18,000 acres in 1971 to over 200,000 acres in 1972. Top killing is occurring in some of the most heavily defoliated areas. Much of the defoliation is occurring in roadless drainages and high elevations. The outbreak on the Wallowa-Whitman National Forest in Oregon continues, but the size and intensity of defoliation decreased. Elsewhere in Oregon and Washington, western spruce budworm larvae were commonly encountered on the defoliation monitoring plots. All outbreaks are being monitored to determine the trend of the budworm population. Defoliation is expected to continue; however, no control is planned for 1973. Historically, control is not needed until after 4 to 5 years of continuous feeding by the budworm.

Spruce budworm, *Choristoneura virdis* Free. This budworm, often referred to as the "green form," reappeared in the Warner Mountains on the Fremont National Forest in southern Oregon. Light to moderate defoliation was detected on 5,810 acres. No control is planned for 1973.

Western blackheaded budworm, *Acleris gloverana* Wlshm. The high populations of the blackheaded budworm have declined in Washington. Minor defoliation of western hemlock occurred on the Olympic Peninsula and the Mt. Baker and Gifford Pinchot National Forests where heavy to severe defoliation was reported in 1971. This year, moderate defoliation increased on the Snoqualmie and Wenatchee National Forests. No defoliation occurred in Oregon. Populations are expected to decline next year. The only significant damage resulting from this outbreak has been scattered top-kill of western hemlock in the most heavily defoliated areas on the Olympic Peninsula.

Larch casebearer, *Coleophora laricella* Hbn. The larch casebearer continues to spread in the Wallowa and Blue Mountains of northeast Oregon and southeast Washington. The spread of this moth is expected to continue until all larch stands in both States are infested. In northeast Washington, all larch stands have been infested for several years. The casebearer has not been found in the Cascade Mountains of either State. Little, if any, mortality has occurred in Oregon or Washington from casebearer defoliation, but estimates of growth reduction in heavily defoliated trees range from 70 to 95 percent. Parasite releases were made for the first time in northeast Oregon and southeast Washington. Adults of *Dicladocerus westwoodii* West. and *Agathis pumila* (Ratz.) were released on the Umatilla National Forest at two locations.

Balsam woolly aphid, *Adelges piceae* (Ratz.). Balsam woolly aphid infestations were little changed from last year. This past year some mortality of subalpine, Pacific silver, and grand fir occurred on 82,000 acres in Oregon and Washington. Most damage in Oregon was on the Mt. Hood, Rogue River, Umpqua, and Willamette National Forests. In Washington, most damage was on the Gifford Pinchot and Snoqualmie National Forests. The recent infestation on the Olympic Peninsula of Washington expanded from 600 acres in 1971 to over 900 acres in 1972.

Western pine-shoot borer, *Eucosma sonomana* Kearf. This is a native insect which attacks laterals and terminals of young ponderosa and lodgepole pines. In 1972, two ponderosa pine plantations were selected to measure current terminal growth impact. One plantation was located on the Ochoco National Forest and the other on the Winema National Forest in central Oregon. The results, using paired tree plots, indicated a significant 1.3-inch reduction of growth on the Ochoco plan-

tation and none on the Winema plantation. The Ochoco plantation had a site index of 71 as compared to 84 on Winema. Additional impact evaluations are planned.

Other insects. Silver fir beetles, *Pseudohylesinus* spp., caused minor tree killing of true firs on the Mt. Baker National Forest and at scattered localities on the Olympic Peninsula in Washington. No tree killing by this beetle was observed in Oregon. The pine engraver, *Ips pini* (Say), caused only minor damage in young ponderosa pine stands. Most damage was in eastern Oregon; while eastern Washington, as has been the case in the past few years, had very little damage. Sawflies, *Neodiprion* spp., caused light defoliation of knobcone pine on the Siskiyou National Forest in southwestern Oregon. Sawfly feeding on true firs was common throughout southern Oregon. The pandora moth, *Coloradia pandora* Blake, caused light to heavy defoliation on nearly 4,000 acres of ponderosa and lodgepole pine on the Deschutes National Forest in central Oregon. High populations of the California tortoiseshell butterfly, *Nymphalis californica* (Bdv.), were common throughout Oregon and Washington this past summer. Snowbrush ceanothus, *Ceanothus velutinus* Dougl., the principal host, was completely defoliated at several locations. New infestations of the European pine shoot moth, *Rhyacionia buoliana* (Schiff.), were discovered in a nursery in Multnomah County, Oreg. during the spring detection survey. After all infested trees were destroyed, fall surveys showed no remaining or new infestations.

Status of Diseases

Dwarf mistletoes, *Arceuthobium* spp. Dwarf mistletoes continue to be a major cause of growth loss and mortality in the Pacific Northwest. The annual growth loss is estimated at 147 million cubic feet of timber. In 1972, intensive and extensive surveys for dwarf mistletoes were conducted on 460,000 acres. The efficiency of mistletoe evaluation surveys has been increased by collecting data on mistletoe infestations during stand examinations. This approach enables silviculturists to make prescriptions for the stand as a whole, taking into account the mistletoe-infested and disease-free areas. The treatment of infested stands is achieved as an integral part of normal stand management.

Efforts to learn more about the biology and impact of dwarf mistletoes in true fir, lodgepole pine, Douglas-fir, and western hemlock stands are being expanded by the Pacific Northwest Region and the Pacific Northwest Forest and Range Experiment Station. An administrative study designed to measure the growth impact of dwarf mistletoe in thinned ponderosa pine stands was initiated in 1972.

Laminated root rot, *Poria weirii* Murr. *Poria weirii* is recognized as one of the most important problems in management of second growth Douglas-fir stands. A campground on the Gifford Pinchot National Forest was closed to overnight use primarily because of the potential hazard posed by Poria-infected trees. During the summer of 1972, several methods of estimating the impact of this serious root disease in west side Douglas-fir stands were tested. Impact estimates were attempted for three major forest resources; timber, recreation, and wildlife. Further refinement of techniques is planned for next year.

Hopefully, methods developed can be adapted for use with other important root disease fungi, including *Fomes annosus* (Fr.) Karst and *Armillaria mellea* Vahl. ex Fr.

White pine blister rust, *Cronartium ribicola* Fischer. The future of western white pine and sugar pine looks very promising. *Ribes* spp. eradication, as a method of white pine blister rust control, has been completely phased out in Region 6 following a final evaluation completed in the spring of 1972. Blister rust-resistant western white pine and sugar pine developed by the Forest Service Tree Improvement Project at Dorena, Oreg., are being planted on several National Forests. Resistance testing is continuing at an accelerated pace. Some 50,000 seedlings were artifically inoculated with the fungus during the fall of 1972 as a part of the selection program.

Needle cast of Scotch pine, *Lophodermium* spp. The most striking disease outbreaks were reported in Scotch pine Christmas tree plantings in several west side Oregon and Washington counties. One, and possibly two, species of *Lophodermium,* including *L. pinastri* (Schrad. ex Fr.) Chev., have caused severe defoliation of trees destined for the Christmas tree market. Some growers with a large amount of growing stock have applied fungicides to prevent infection. The Rocky Mountain and Pacific Northwest Forest and Range Experiment Stations are studying the diseases. The incidence of diseases such as these will likely increase if growers continue to cultivate exotic, offsite species.

Leaf blight of oregon myrtle. This leaf blight caused by several bacteria, and fungi including *Pseudomonas* sp., *Kabatiella* sp., and *Colletotrichum* sp., resulted in severe defoliation of trees located in picnic areas and campgrounds in southwestern Oregon. Branch dieback has occurred on trees affected for two or more seasons. It appears likely that additional dieback will occur from 1972 defoliation. The trend of this disease is unknown and no controls are available.

Bynum's blight, *Lophodermella morbida* Staley. This foliage disease of offsite ponderosa pine has caused substantial growth loss as a result of repeated defoliation; however, mortality is light. Small-scale tests of chemicals applied to foliage at the time of budbreak and continued at 2-week intervals until full needle length was reached indicated that 2 percent (W/V) Daconil 2787 provided the best protection.

Nursery diseases. *Pythium* and *Fusarium* spp. have caused severe losses of ponderosa pine and lodgepole pine in the Bend Nursery. The application of methyl bromide-chloropicrin mixture (67–33 percent) in September 1971 significantly reduced the numbers of these fungi that could be isolated from the soil. Additional studies are planned to determine the long-term effects of this fumigant and other treatments on seedling growth and pathogenic fungi.

Frost injury to the terminal growth of 35 percent of the seedlings at the Wind River Nursery, Carson, Wash., was noted in March 1972. Only 2 percent of the seedlings were killed by frost or winter injury. The impact of frost was most noticeable on 1–0 stock and seed lot sources from lower elevations in southern Oregon. An irrigation system has been installed to prevent future frost damage. An ice coating will be applied to the seedlings as a protective cover during frost periods.

Miscellaneous diseases. Several canker fungi, including *Cytospora abietis* Sacc. and *Phomopsis* spp., caused terminal and branch dieback of Douglas-fir in plantations located in southwestern Oregon. Infected trees appeared to be predisposed to infection by frost, snow, or ice injuries.

CALIFORNIA AND HAWAII (R–5)

California

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Conditions in Brief

Forest insect pest activity increased somewhat in 1972 but generally remained at a moderate level. Damaging infestations of some defoliators, such as the Douglas-fir tussock moth, sawflies and needle miners, continued in several areas. A notable spreading and intensification of scale damage to sugar pine took place. Bark beetle depredations increased, but for the most part remained localized and scattered, despite well below average rainfall this year throughout most of California. Only the north coast had average or above precipitation. Consequently, there were many reports of plant damage due to drought and in portions of the southern Sierra Nevada Mountain range there was some defoliation of the oaks due to reduced soil moisture. There was a noticeable reduction in reports of foliage diseases

throughout the State. The reported high incidence of lightning struck trees, east of the Sierra Nevada mountains, portends increased opportunity for successful bark beetle attacks in 1973.

Verticicladiella wageneri was found attacking three new hosts—western white, sugar, and knobcone pines—in northwestern California.

Unknown cankers were found on two hosts; on young ponderosa pine in El Dorado, Madera, and Amador Counties, and on young Douglas-fir in Trinity County. At present, work is being conducted by pathologists at the Regional Office, USDA Forest Service, to identify these fungi.

Ozone damage was detected on Jeffrey pine on San Emigdio Mountain. This is the first report of heavy ozone damage in the San Joaquin air basin.

Status of Insects

Western pine beetle, *Dendroctonus brevicomis* LeC. The McCloud Flats infestation of the western pine beetle, first reported as a serious problem in 1967, continued during 1972 on the Shasta-Trinity National Forest. Suppression of the epidemic by salvage logging of infested trees was attempted with some success in 1968 and 1969. Field testing of synthetic pheromones (attractants) for western pine beetle control started in 1971 and was continued in 1972. Depending on analysis of existing data, the use of pheromones may be continued on an experimental basis in 1973. In 1972, commercial thinning and harvest timber sales were initiated to improve the tree composition and density of the pine stands in the area. This management program is expected to reduce tree susceptibility to bark beetle attacks and thereby reduce tree killing to a normal level.

During 1972, a western pine beetle epidemic developed around the Red Mountain burn of 1970 in the Sequoia National Forest. Attempts to avoid this outbreak, by salvaging dead and dying trees after the fire, fell short of the objective because of various restraints on logging. Now, due to recent developments in helicopter logging, it may be possible to remove most of the infested trees by air, and an aerial salvage logging sale will be offered during the winter season in an attempt to suppress the outbreak (fig. 4).

Numerous other spots of tree killing by the western pine beetle were reported in northern California, most prevalently on the Mendocino and the Lassen National Forests. In southern California, the western pine beetle continued killing ponderosa and Coulter pine trees around Lake Arrowhead. Serious air pollution injury, urbanization, and drought damage are the major reasons for this continuing infestation.

Mountain pine beetle, *Dendroctonus ponderosae* Hopk. Tree killing by the mountain pine beetle has been conspicuous in the recreation forests around Lake Tahoe. Here, overdense lodgepole pine stands, further weakened by side-effects of urbanization, suffer from increased beetle attacks and tree mortality. Also, in southern California, the mountain pine beetle continues to attack smog-damaged ponderosa pine trees around Lake Arrowhead in the San Bernardino National Forest.

Continued mortality of large sugar pine from mountain pine beetle attacks was most apparent at Butt Lake on the Plumas National Forest. Here, many vulnerable sugar pines were killed by this beetle during the summer of 1972 in mixed stands also infested by the Douglas-fir beetle.

A flip-up stereoscope headset and a translucent light board makes the use of large format, aerial color transparencies feasible in the field (fig. 5). This aids in locating and checking areas of activity of bark beetle and other forest pests.

Douglas-fir beetle, *Dendroctonus pseudotsugae* Hopk. Between 100 and 200 large Douglas-fir trees have been invaded by Douglas-fir beetles near Butt Lake, Plumas National Forest. The infestation is believed to have originated in storm-felled trees that went down during the winter of 1970 and subsequently provided host material to increase the beetle population in 1971. Since the infestation

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Figure 4.—Helicopter salvage of bark beetle-infested and fire-damaged timber on the San Bernardino National Forest, California

is readily accessible for logging, chances for removing the infested Douglas-fir and associated infested sugar pine appear good and plans for salvage are underway.

Jeffrey pine beetle, *Dendroctonus jeffreyi* Hopk. This beetle continues to infest high risk Jeffrey pine trees around Big Bear Lake, San Bernardino National Forest. Tree killing has more than doubled over 1971, and is the highest in the past 5 years. The first helicopter salvage logging operation in California was successful in harvesting mature and fire-damaged Jeffrey pine on the Bear Burn immediately west of the Lake.

California flatheaded borer, *Melanophila californica* Van Dyke. The California flatheaded borer continues to cause high Jeffrey pine mortality at Garner Valley, San Bernardino National Forest and in the Laguna Mountains, Cleveland National Forest. In the Laguna Mountains, Jeffrey pine losses were the highest on record.

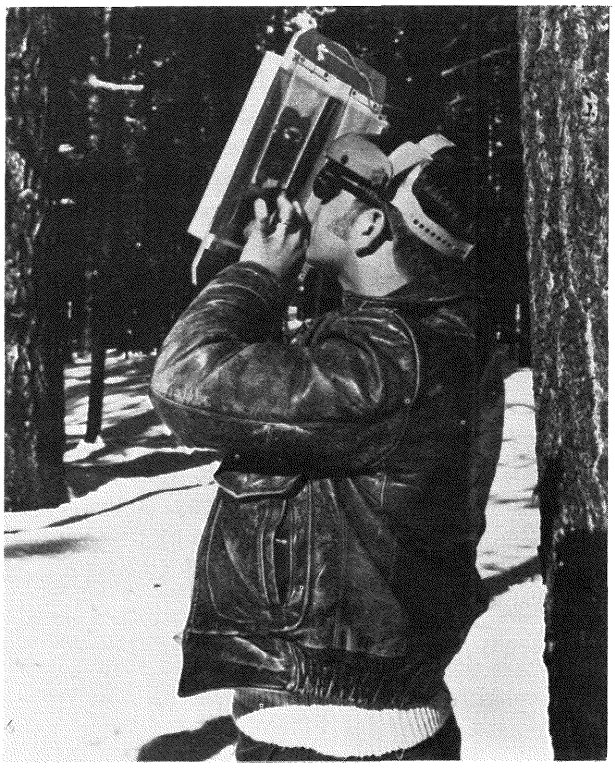

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Figure 5.—A flip-up stereoscope headset and translucent light board for field use of large format, aerial color transparencies in checking forest pest activity.

Pine engraver beetles, *Ips* spp. A long spring and summer drought, with periods of excessively high temperatures, predisposed pine stands to engraver beetle damage. Localized outbreaks developed in numerous pine areas. The beetles commonly responsible were *Ips paraconfusus* Lanier or *I. pini* (Say). In most problem areas, the adverse weather conditions were aggravated by logging and thinning disturbance or severe site conditions.

Some representative problem areas were:

· Rattlesnake Meadows, Sequoia National Forest, where increased tree killing occurred in a thinning and dwarf mistletoe control project.

· Spring Gulch, Trinity County, where tree killing in a hybrid (Monterey x knobcone) plantation followed late fall thinning.

· Dow Butte, Lassen National Forest, where several outbreaks developed in areas logged in 1971 or thinned in the summer of 1972.

· Ladder Butte, Lassen National Forest, where tree killing developed on generally poor, lava cap-type sites.

· Fort Hill, Glenn County, where tree killing followed logging.

· Crestview Burn, Inyo National Forest, where many trees damaged in a fire of July 1972 were attacked later in the summer.

Large patch killing of knobcone pine, reported from areas of the Shasta-Trinity and Sierra National Forests, are also believed to be epicenters of pine engraver beetle activity.

Numerous additional spots of suspected pine engraver beetle damage were seen during aerial flights.

No chemical control efforts specifically for pine engravers were reported during the year. Indication of a trend towards increased precipitation and improved tree growing conditions suggest that no direct control will be needed in the immediate future.

Fir engraver beetle, *Scolytus ventralis* LeC. Fir engraver beetles continued killing groups of true fir trees in northern California, but tree mortality apparently declined from the 1971 level. The most notable areas in 1972 were Shields Creek on the Modoc National Forest and scattered locations around Mt. Shasta.

Douglas-fir tussock moth, *Hemerocampa pseudotsugata* McD. The severe outbreaks of the Douglas-fir tussock moth reported in 1971 have subsided and other threatening infestations detected at that time failed to develop into damaging outbreaks. However, in 1972, the pest remained active over much of the white fir belt of the Sierra Nevada range where nine new areas of obvious defoliation developed in scattered locations of the Eldorado, Stanislaus, and Sierra National Forests. Most of these spots are 100 to 300 acres in size except one that approaches 2,000 acres. Preliminary evaluations indicate a threatening tussock moth population still resident in two or three of these areas, but all known locations have not yet been checked due to access difficulties. Surveys of the early larval stages of development will be made in 1973 to determine tussock moth population levels in known and suspected infestations.

White fir sawfly, *Neodriprion abietis* (Harr.). For the third or fourth year, the white fir sawfly caused increased damage during 1972. Defoliation, severe enough to be readily visible from the air, occurred in sizable areas. On the Plumas National Forest, three infestations—at Grizzly Ridge, Nelson Creek, and Snoring Springs—covered approximately 20 square miles. Smaller outbreaks were apparent on the Lassen National Forest, at Soda Ridge; on the Tahoe National Forest, at Deadman Peak; and on the Modoc National Forest at Knox Mountain.

Evaluations of the outbreaks on the Plumas National Forest detected sufficient virus infections and parasitisms in the sawfly population to suggest that the epidemic had reached its peak and would decline in 1973.

Needle miners. An increase in the defoliation of various pine species by needle miners was evident in 1972. Surveys conducted during the summer in Yosemite Park showed the lodgepole needle miner, *Coleotechnites milleri* (Busck.), maintains a large population in the Tuolumne Meadows outbreak and some additional areas of damage were detected. Severe defoliation has already taken place in some "back-country" locations and serious defoliation is expected in 1973 in some of the high-use recreation areas, particularly around Tenaya Lake.

Another needle miner (*Coleotechnites* sp.) on Jeffrey pine was detected for the first time on about 2,000 acres at Big Bear Lake, San Bernardino National Forest. This pest had previously been confined in a chronic infestation west of Big Bear, at Snow Valley, where it had subsided in 1971, but then increased again to 200 acres in 1972. An unidentified needle miner also defoliated knobcone pine at two locations in northern California, near Mt. Shasta.

Scale insects. A spreading infestation of the black pineleaf scale, *Nuculaspis californica* (Coleman), is severely stressing sugar pine trees in a broad, mid-elevation belt from about Stirling City, Butte County to Mt. Shasta in Siskiyou County. This pest has also been reported on ponderosa pine at Soldier Mountain, Lassen National Forest, and on Jeffrey pine at Rocky Pass, Cleveland National Forest.

An evaluation of the infestation on sugar pine near Mt. Shasta, where the problem has persisted for at least 2 years, indicated the outbreak would continue next year.

There are indications that the large, persistent infestation of the pinyon needle scale, *Matsucoccus acalyptus* Herb., is declining in Ventura and Kern Counties. On the Sequoia National Forest, a small but severe infestation of the pinyon needle scale threatens trees in Kennedy Meadows Campground where about 900 trees were protected with an application of a 0.5 percent dimethoate spray. Research on the biology and natural enemies of this scale is continuing at the University of California at Riverside.

Insects damaging plantations and young trees. The continuing problem of the fir coneworm, *Dioryctria abietella* (Grote), attacking valuable grafts in seed orchard trees reached catastrophic proportions in 1972 when approximately 50 percent of all unprotected pine grafts were infested. However, field tests indicate that lindane sprays are highly effective in preventing this damage and the process to register lindane for this use will be initiated in the near future.

The orange tortrix, *Argyrotaenia citrana* (Fernald), was discovered severely defoliating 2-year-old Douglas-fir seedlings at the Forest Service Nursery in Humboldt County. A small test application of Zectran emulsion spray provided a moderate level (65 percent) of control for this pest.

Other pests causing some increased damage in plantations and young trees during the year were the pine needle sheath miner, *Zelleria haimbachi* Busck., and the pine reproduction weevil, *Cylindrocopturus eatoni* Buch. The widespread infestation of the pine resin midge, *Cecidomyia piniinopis* O.S., continued to decline but caused some damage in localized areas.

The western pine tip moth, *Rhyacionia bushnelli* Busck., which was discovered in San Diego County for the first time in 1971, con-

tinues to spread in Christmas tree plantations. It has not yet been detected in native stands.

Hardwood defoliators. Infestations of the California tortoise-shell butterfly, *Nymphalis californica* (Bdv.), were much reduced from the 1971 high population levels. The satin moth, *Stilpnotia salicis* (L.) continued to defoliate cottonwood trees northeast of Alturas in the Modoc National Forest.

Status of Diseases

Black staining root disease, *Verticicladiella wagenerii* Kendrick. A new infection center of *Verticicladiella wagenerii* was found adjacent to the Ranger Lewis Summer Home Tract, 2 miles east of Gasquet in the Six Rivers National Forest. The infection center was approximately 60 acres in size and the disease is continuing to spread. The fungus is infecting western white, sugar, and knobcone pines. This is the first report of *V. wagenerii* infecting any of these tree species. New infection centers on Douglas-fir were found in the Tahoe, Klamath, and Stanislaus National Forests, and on private land in Mendocino County.

In southern California, *V. wagenerii* is continuing to kill pinyon pine in San Bernardino National Forest, but this infestation has not changed significantly since the report last year.

Annosus root rot, *Fomes annosus* (Fr.) Cke. A *Fomes annosus* survey of Yosemite Valley was completed late in 1971. One hundred disease centers were found in 24 developed sites. Forty-four additional centers were found outside developed sites. Eighty-eight centers, encompassing 6 acres, were mapped in developed sites and permanent plots were established for future observation. Dead trees in the mapped centers included 506 ponderosa pines (mean d.b.h. 23.5 inches), 99 incense-cedars (mean d.b.h. 13.7 inches), eight white firs (mean d.b.h. 18.0 inches), and two lodgepole pines (each 14 inches d.b.h.).

On December 7, 1971, high winds swept Yosemite Valley. A number of large conifers and hardwoods were broken off or uprooted. Of 31 conifers found on the ground during a post-storm survey through the developed area, 16 had *Fomes annosus* root decay; four had *Armillaria mellea* Vahl. ex Fr. root decay; one had either *Fomes annosus* or *Armillaria;* two broke at *Peridermium harknessii* Moore galls; one split at a "schoolmarm"; four were uprooted by a falling, decaying oak; one decaying snag broke off; and only two live trees broke off due to the effects of the wind alone. A later survey disclosed a number of additional broken snags in *Fomes* centers but none had uprooted.

Phloem necrosis of Douglas-fir, *Dermea pseudotsugae* Funk. New infection centers of *Dermea pseudotsugae* were found in Del Norte, Siskiyou, and Trinity Counties. The fungus is causing the most damage on the Happy Camp Ranger District, Klamath National Forest, where it was first discovered in 1970 on the Little Douglas plantation. *D. pseudotsugae* is continuing to spread throughout the Douglas-fir in this plantation and could potentially eliminate the Douglas-fir component of the plantation. Some natural reproduction in the area is also infected, but the trees are scattered and damage is of little economic significance.

Red band needle blight, *Scirrhia pini* Funk & Park (*Dothistroma pini*) Hulb. This disease appeared relatively inactive in plantations infected in past years. However, the disease potential has not been reduced and where a susceptible host and favorable environmental conditions are present, the fungus is still quite active. On the Westbrook Ranch in Del Norte County, and on Simpson Lumber Company land in Humboldt County, where there have been recent plantings of bishop and Monterey pine, the fungus caused severe defoliation and many trees were killed.

Nursery Diseases. *Botrytis cinerea* (Fr.) Pers., caused severe losses in parts of two nursery beds of 6-month-old giant sequoia (*Sequoiadendron giganteum*) seedlings at the Forest Service Nursery near Placerville in El Dorado County. Because of the severity of the problem in the field, and the possibility of continued infection during seedling storage and shipment, a series of fungicide control

tests were conducted by the Pacific Southwest Forest and Range Experiment Station, University of California Agriculture Service, and the Regional Office of the Forest Service. In the trials conducted, Benlate was the only field-applied fungicide that gave adequate control.

Ozone damage. Ozone damage continues at the same high level in the San Bernardino and Angeles National Forests. The rate of mortality in the Jeffrey and ponderosa pine has increased to 4 percent per year, and there is evidence that the impact of oxidant air pollution on associated conifers and hardwoods is increasing.

Damage on Jeffrey pine was detected for the first time at San Emigdio Mountain, Kern County, and on ponderosa pine on Figueroa Mountain, Santa Barbara County. The ozone damage on San Emigdio Mountain is the first report of heavy damage in the San Joaquin air basin. Cooperative studies are underway to measure trend and to determine the impact of ozone damage on a mixed-conifer ecosystem.

HAWAII

by
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Conditions in Brief

Hawaii's Cooperative State Forest Pest Action Program was initiated in July 1971. In previous years, relatively little consideration was given to the protection of forests from injurious organisms. The primary objective of the program is to plan, develop, and conduct a statewide project to protect forests and their products from insects and diseases. Included in the area of responsibilities are commercial and non-commercial forests on 1.9 million acres of land.

Survey and detection operations were developed for all of the islands. Efficient methods of sampling were used to determine the abundance of suspected and known pests. This is necessary to evaluate the significance of outbreaks and to determine when control is feasible and warranted.

The most destructive insects were the Eurasian pine aphid which attacks pines, the black twig borer and associated microorganisms which have caused the death of a number of the native trees, and lepidopterous defoliators which caused widespread damage to monkeypod and kiawe stands throughout the State.

Significant forest disease problems in Hawaii during 1972 were the ohia and koa decline, koa rust, needle cast fungi, and several as yet undetermined microorganisms isolated from dead and dying native tree stands.

Observations have been made on several tree and shrub species showing dieback and decline on all the islands of the State. The shoestring fungi *(Armillaria mellea)* and *Plagithmysus* spp. appear to be associated with the mamani decline problem on Hawaii. On Kauai, investigations of severe dieback on silk oak, ohia and koa showed heavy infestation by *Plagithmysus* and several associated but as yet unidentified fungi (fig. 6).

Status of Insects

Eurasian pine aphid, *Pineus pini* Koch. This insect is one of the most injurious of Hawaii's accidentally introduced forest pests. The pest was first discovered on the island of Hawaii in 1970. It is a serious threat to pine plantings in forest areas throughout the State. Eradication is being attempted on the island of Maui with chemicals, and biological control measures are underway on the island of Hawaii. It is too soon to appraise the effectiveness of these operations.

Acacia psyllid, *Psylla uncatoides* (Ferris & Klyver). It has been reported by all islands that this immigrant pest (1966) caused seasonal damage to young native koaia and koa trees. The psyllid populations also cause the

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Figure 6.—Gallery of *Plagithmysus bilineatus*, a cerambicid beetle that may be associated with decline of the Ohia tree (Hawaii).

development of sooty mold as a result of their honeydew secretions. It is also suspected that this insect may be assisting in the distribution of the koa rust, a fungus infection which seriously interferes with the orderly growth pattern of these trees, causing wilting and death of terminals.

Black twig borer, *Xylosandrus compactus* (Eichhoff). Increased attention is now being given to problems associated with this wood borer. Since the original discovery of this pest in Hawaii in 1961, the beetle has unfortunately become widespread throughout the Hawaiian Islands. Host plants now number more than 70, ranging from orchids to large forest trees. The problem reported here together with previous reports indicate that the black twig borer poses serious threat to forests in Hawaii. The specific conditions under which it can cause serious damage are not known and need to be determined. Stains and lesions from fungus or other organisms have definite association with borer holes and twig deaths. Studies of this pest including microorganisms will be continued.

Monkeypod moth, *Polydesma umbricola* Boisduval. Only isolated moderate to heavy defoliation to monkeypod trees was reported on all major islands. Varying numbers of this pest were noted under loose bark and debris of affected trees.

A gelechiid moth, *Aristotelia* sp. (probably xylospila). Heavy galling was noted on native manono trees throughout the wet forests of Oahu during winter months.

Carolina coniferous aphid, *Cinara carolina* Tissot. Severe sporadic outbreaks of this aphid have occurred on both Maui and Kauai islands. Fifty percent of the examined slash and loblolly pines yielded high population of nymphs and adults on young flushing terminals. Population peaks seem to occur during the early months of the year with a pronounced dip during the summer. Although detrimental, new growths often appear even after prolonged attacks.

Koa bug, *Coleotichus blackburniae* White. Sightings of this elusive, endemic pest were quite common on *Acacia confusa* trees during the late spring and early summer months. Activity was unnoticeable for the remainder of the year.

Monkeypod-kiawe caterpillar, *Melipotis indomita* (Walker). Larval populations under

loose bark and debris of kiawe and monkeypod trees fluctuated from light to heavy with a sharp decline in late fall. Light trap collections on Oahu indicated pronounced peaks in adult populations during March, June, and October. When numerous, these caterpillars cause tremendous defoliation of monkeypod canopies throughout the State.

Greenhouse thrips, *Heliothrips haemorrhoidalis* (Bouche). This species has recently been found in abundance on koa saplings at the 914 meter elevation level in the Laupahoehoe Forest Reserve on the island of Hawaii. The foliage of attacked plants becomes heavily spotted with excrement and conspicuously discolored. The only known parasite is a tiny wasp, *Megaphragma mymaripenne,* which attacks the eggs of the thrips. There is little information on this insect in Hawaii although it has been recorded here since 1910.

A weevil, *Nesotocus munroi* Perkins. Boring by this endemic beetle has been conspicuous on native olapa trees throughout the year. Heavy larval populations have been observed in hundreds of acres of dying olapa trees in the Kohala Forest Reserve. Pathogenic organisms were suspected as primary in the decline although definite pathogens could not be isolated from apparently diseased materials. Root disorders or nutrient deficiencies are a possibility.

Status of Diseases

Ohia and Koa Decline. (fig. 7) The epidemic decline of ohia and koa forests on the windward slopes of the island of Hawaii has extended to an area of approximately 50 x 15 statute miles and continues to build in intensity. Within the 120,000-acre Hilo Forest Reserve alone, the area of healthy forests has decreased from 53,000 acres in 1954 to 43,000 acres in 1965. These figures are based on 1954 and 1965 aerial photographs. Overflights of the area in 1970 to 1972 show that large portions of the forests observed as healthy in 1965 are now seriously

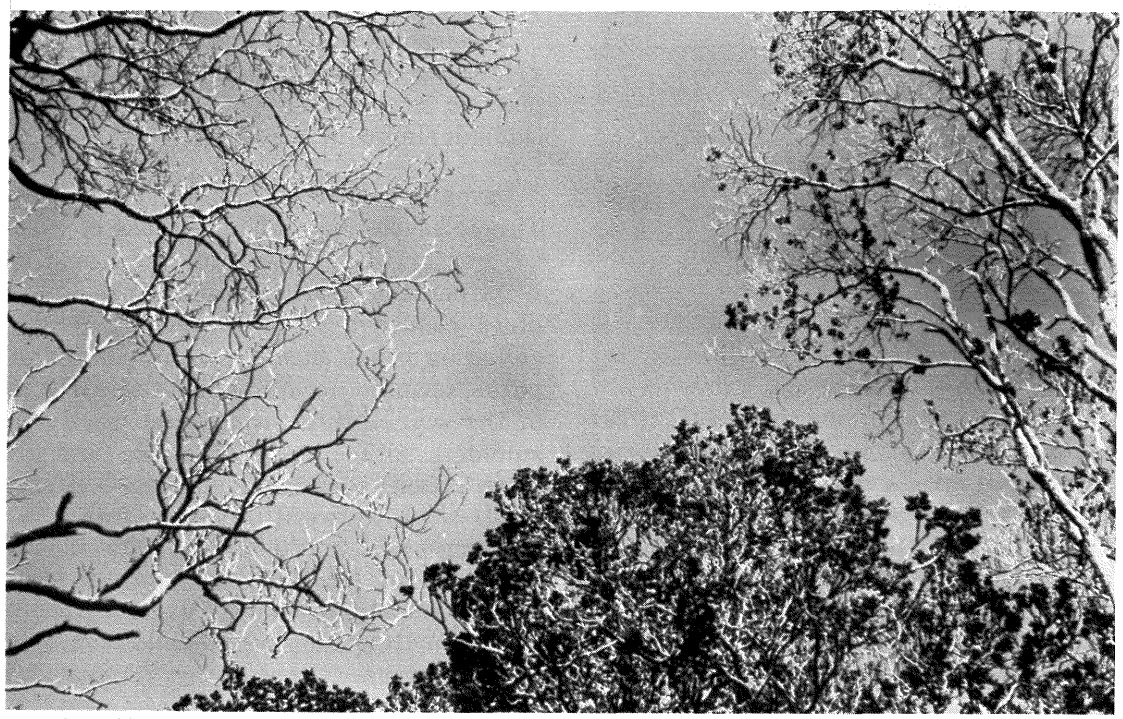

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Figure 7.—Ohia decline disease. Tree on left is dead. Tree on right has severely declined. Tree at bottom shows little evidence of decline.

affected, and the decline condition has moved rapidly south on the island. It now is widespread in the Hilo, Upper Waiakea, Olaa, and Kilauea Forest Reserves and in Hawaii Volcanoes National Park. Ten potentially pathogenic fungi have been isolated from declining trees and some have been associated with boring insects. The decline condition has also been found affecting *Myrsine* spp. and *Cheirodendron guadichaudii*. Present efforts are directed by a team approach of several agencies to determine the extent and rate of spread of the decline and its cause.

Koa rust, *Uromyces koae* Arth. Koa rust activity in forested areas in Hawaii seems to be increasing considerably, and we suspect that the new immigrant psyllid, *Psylla uncatoides*, may be involved in the distribution of rust spores. Native koa branches infected with the rust eventually die. A new species of koa rust is now being identified.

Armillaria root rot, *Armillaria mellea* (Vahl) Quel. Armillaria root rot was found to be causing a severe root decay on native koa trees in the Keanakolu area of the island of Hawaii. Root decay by the fungus has made the trees susceptible to windthrow and many have already fallen. The major concern is what the effect of the fungus in the soil and old roots will be on subsequent regeneration. Plots will be established on these lands to study this effect and to determine whether koa can be brought to maturity. *A. mellea* is causing root decay in several other species of forest trees on Oahu, Hawaii, Kauaii, and Maui but as yet surveys have not been conducted to determine either extent or severity.

Pine needle cast, *Lophodermium australe* Dearn. Moderate to heavy terminal dieback of needle clusters was noted on several hundred Monterey pine trees on Lanai island. Many of the trees involved had died, presumably due to this infection. Evaluation plots will be established to follow the progress of the disease on a year-to-year basis.

Mistletoe, *Korthalsella complanata* (Tiegh) Engl. Mistletoe has been found infecting koa trees of all ages on most of the islands. Although tree mortality has not been observed, the mistletoe causes both branch and trunk deformity.

INTERMOUNTAIN STATES (R–4)[1]

by
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Conditions in Brief

Bark beetles remain the most destructive group of insects in the Intermountain Region. The most damaging is the mountain pine beetle in lodgepole pine in portions of southeast Idaho and western Wyoming. Regionwide, populations are on the decline, but in some areas of the Targhee National Forest and Grand Teton National Park, serious tree killing persists. In the Targhee infestation, beetle populations are encroaching the Moose Creek Plateau and threatening a large timber sale. Hopefully, most of the timber can be removed before the beetle exerts its full impact.

The spruce beetle continues to kill large volumes of Engelmann spruce in high elevation stands in north central Utah. The most damaging and aggressive outbreak is in the Manti Division of the Manti-LaSal National Forest. The Hilgard Mountain infestation to the south on the Fishlake National Forest remains low. Douglas-fir beetle populations and resulting damage is decreased from last year, but one new outbreak, triggered by storm-caused debris, cropped up on the Targhee National Forest.

The ubiquitous defoliator complex continues to damage Douglas-fir, true fir, and ponderosa pine stands in the Region. Western spruce budworm defoliation increased over that recorded last year, but evaluation surveys indicate a decline in both intensity and extent of damage

[1] Includes forested lands in Utah, Nevada, southern Idaho, western Wyoming, and eastern California.

for 1973. More than 6,000 acres of mature ponderosa pine were defoliated by the pine butterfly. Even more aggressive activity, including top kill and possibly some tree mortality, is predicted for next year. Douglas-fir tussock moth activity emerged in two isolated outbreaks in southern Nevada.

Dwarf mistletoe control projects were approved and financed for 569 acres. However, all unobligated funds, approximately two-thirds, were withdrawn to finance southern pine beetle control projects. Data were gathered in infested and uninfested lodgepole pine stands for comparison with Region 2 conditions. The computer program developed by the Rocky Mountain Station will be used to make the comparison and can be modified if Region 4 conditions differ from Region 2.

Two *Fomes annosus* infection centers were found. The use of borax on freshly cut stumps on ski areas on the Wasatch National Forest was approved. Studies of fungus spread, impact, and spore dispersion are being planned.

Dutch elm disease may become a problem in ornamental elms in the future.

A recreation area hazard survey was conducted on selected campgrounds. The data have not been analyzed as yet.

Status of Insects

Mountain pine beetle, *Dendoctronus ponderosae* Hopk., Infestations continue to decline regionwide but, in some areas, epidemic conditions persist. The largest and most active infestations are on the Targhee National Forest in Idaho and Wyoming, and in Grand Teton National Park, Wyoming. In the Warm River area of the Targhee National Forest, where intensive control was terminated 2 years ago, the infestation has resurged and combined with the large outbreak in Yellowstone National Park; it is now encroaching on the Moose Creek plateau and threatening more than 200 million board feet of prime timber. Salvage logging is now underway in the Warm River area, but it will have little effect on the expanding beetle population. To the north, in many of the lower elevations of the Moose Creek area, beetle numbers and tree mortality have increased many fold but in the high regions of the plateau, tree killing is still low. By maintaining an aggressive and orderly harvesting schedule, most of the threatened timber can be utilized before extensive damage occurs.

In Grand Teton National Park, Wyoming, heavy tree killing is occurring in the corridor between Jackson Lake and Yellowstone National Park. This is the southern part of the huge outbreak encompassing almost the entire south half of Yellowstone National Park. In adjacent Teton Wilderness and Teton National Forest, very little beetle activity is in progress.

Douglas-fir beetle, *Dendroctonus pseudotsugae* Hopk. The long standing and damaging outbreak in mature and overmature Douglas-fir stands throughout many southern Idaho forests, maintained its downward trend for the second straight year. In local areas (such as the Fairfield Ranger District, Sawtooth National Forest) a high incidence of tree killing remains, but in the absence of storm debris and other brood-nurturing media, insect populations will continue to decline. One deviation from this optimistic outlook is on the Targhee National Forest, where storm-caused debris triggered a spotty but extensive infestation over the northern half of the Forest. An evaluation survey indicates that above normal tree killing will continue for the next 2 years. Efforts are underway to salvage as much of the infested material as possible. Elsewhere in the Region, the Douglas-fir beetle remains at a very low level.

***Ips* spp. and secondary insects.** These insects characteristically build up following a mountain pine beetle outbreak. They multiply in tops of lodgepole pine killed by the mountain pine beetle; and during the waning years, they move into the smaller, weaker trees. On the Targhee National Forest, Idaho, the situation is unusually severe, since during the past 2 years, high winds have broken millions of green as well as dead trees and created even more plentiful breeding material. Because of the extensiveness of these insects and their association with the mountain pine beetle, their

overall impact, which was considerable, cannot be accurately measured.

Elsewhere in Wyoming and southern Idaho, tree killing continues but at a reduced level. Widely scattered outbreaks persist near McCall, Idaho, and in both divisions of the Bridger National Forest, Wyoming. Even less intensive infestations exist in portions of the Caribou National Forest, Idaho, and the Cache National Forest, Idaho and Utah; but they are only the aftermath of past epidemics. Small but aggressive infestations are depleting lodgepole stands in and near Flaming Gorge National Recreation Area, Ashley National Forest, and in the Stillwater Fork of the Bear River, Wasatch National Forest, Utah.

Stands of stagnant second-growth and mature ponderosa pine are under attack by the mountain pine beetle in widely separated outbreaks near Flaming Gorge National Recreation Area; in Bryce Canyon National Park, Utah; and on State and private lands near Cascade, Idaho.

High elevation whitebark and limber pine stands in southeast Idaho and western Wyoming are now under attack by the mountain pine beetle. These infestations result partly from nearby infested lodgepole pine stands and partly from localized buildups.

In one area on the Boise National Forest, Idaho, *Ips* spp. beetles caused heavy losses of ponderosa pine adjacent to a timber sale. The infested trees were spotted, felled, and burned.

Spruce beetle, *Dendoctronus rufipennis* (Kby.), spruce beetle activity, triggered by abnormal quantities of both scattered and concentrated windthrow, continues at damaging levels in high elevation spruce stands in north central Utah. The most widespread and damaging infestation is along most of the north facing slopes of the Huntington Creek drainage, Manti-LaSal National Forest. This infestation has been in progress since 1969 and, in some areas, a high percentage of merchantable volume has been killed. An evaluation survey indicates no decrease in the high rate of tree mortality, and that tree killing will continue until most of the larger trees are killed or unforeseen natural control factors intervene.

Natural factors, chiefly host depletion, are responsible for the decline of the long standing infestation south of Hilgard Mountain, Fishlake National Forest. A planned trap tree and timber sale program on the Beaver Ranger District was never carried out because of operator disinterest. The status of this infestation is unknown.

Roundheaded pine beetle, *Dendroctonus adjunctus* Blandf. This primary killer of mature and overmature ponderosa pine, for several years a serious problem in recreation sites and a summer home area on the Las Vegas District, Toiyabe National Forest, Nevada, continues to decrease. Such control efforts as felling and treating or removing the infested trees may have been locally effective, but the overall decline in the beetle population was due to natural factors. Salvage of infested trees on a maintenance basis will continue.

Western spruce budworm, *Choristoneura occidentalis* Free. Two widely separated and persistent infestations continue to plague portions of the Douglas-fir-true fir stands of southern Idaho and western Wyoming. Both infestations (one in the Payette and Boise National Forests, Idaho, and the other in the Bridger, Targhee, and Teton National Forests, Wyoming) increased in area but decreased slightly in intensity of damage. In the Payette infestation, top kill of mature trees and some mortality of the suppressed understory occurred in Fall Creek. No serious permanent damage was noted in the Bridger infestation. The outlook for 1973 is optimistic—egg mass evaluation surveys indicate a slight lessening in defoliated area but a sizeable decrease in feeding damage. Many trees that sustained repeated, heavy defoliation, may now have a year to recover.

A synthesized pheromone of the western spruce budworm, known as Soolure, was tested this summer in the Payette infestation to determine its potential as a survey tool. The pheromone is deployed from a sticky trap suspended in the tree crown. Periodic counts are made of trapped adults (fig. 8). The data have not yet been analyzed.

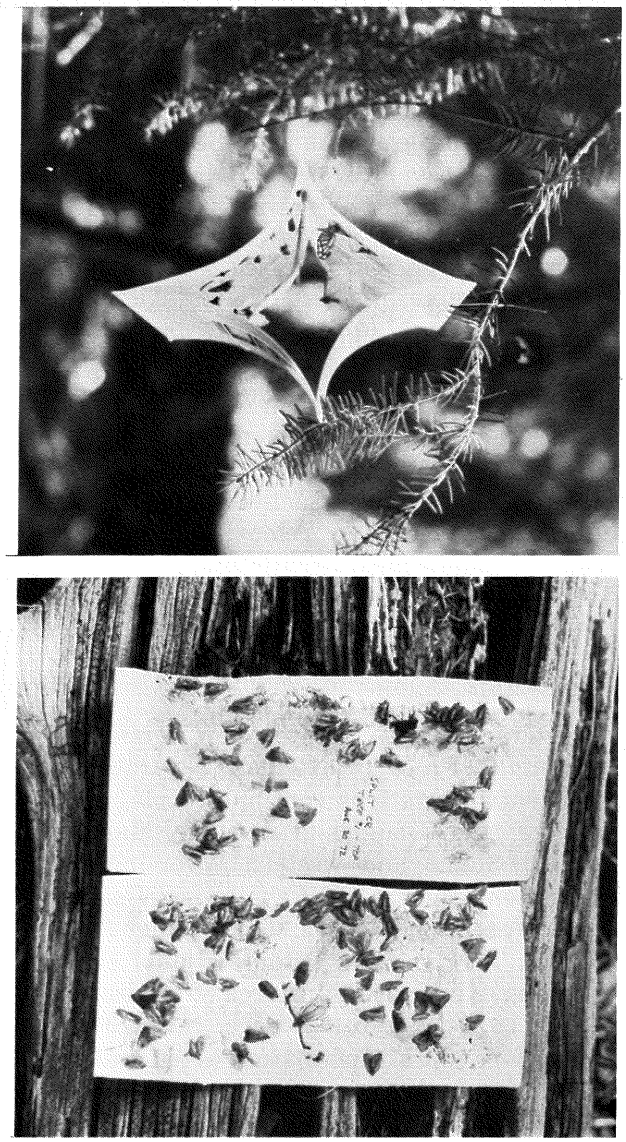

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Figure 8.—Sticky trap containing Soolure, a synthetic sex attractant of western spruce budworm. The pheromone attacks only budworm males; other insects are trapped by accident *(top)*. The sticky trap is opened to count captured budworms. The large winged insect at right is a pine butterfly trapped accidentally *(bottom)* Payette National Forest, Idaho.

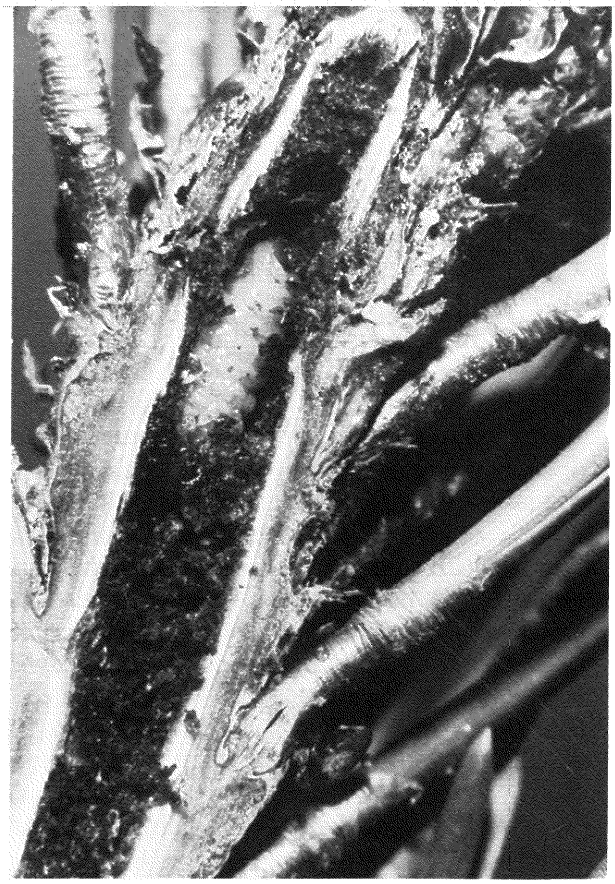

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Figure 9.—Lodgepole terminal weevil larva, *Pissodes terminalis*, which stunts and deforms young lodgepole pine (Ashley National Forest, Utah).

Lodgepole terminal weevil, *Pissodes terminalis* Hopp. This insect is widespread throughout the lodgepole pine type. Terminal damage of varying intensity has been reported in regeneration areas of the Targhee and Sawtooth National Forests, Idaho, and the Wasatch and Ashley National Forests, Utah. In some areas, trees have sustained repeated attacks. Due to recent efforts to increase the harvest of mountain pine beetle-threatened lodgepole pine and create more reproduction sites, and the fact that the weevil seems to prefer young, open-grown trees, this insect has the potential of becoming a serious problem (fig. 9).

Pine butterfly, *Neophasia menapia* (Feld. & Feld.). Butterfly flights were observed throughout most of the ponderosa pine type in the Region. This defoliator reached epidemic status on more than 6,000 acres in the northern half of the Payette National Forest, Idaho. This is an extension of the severe outbreak to the

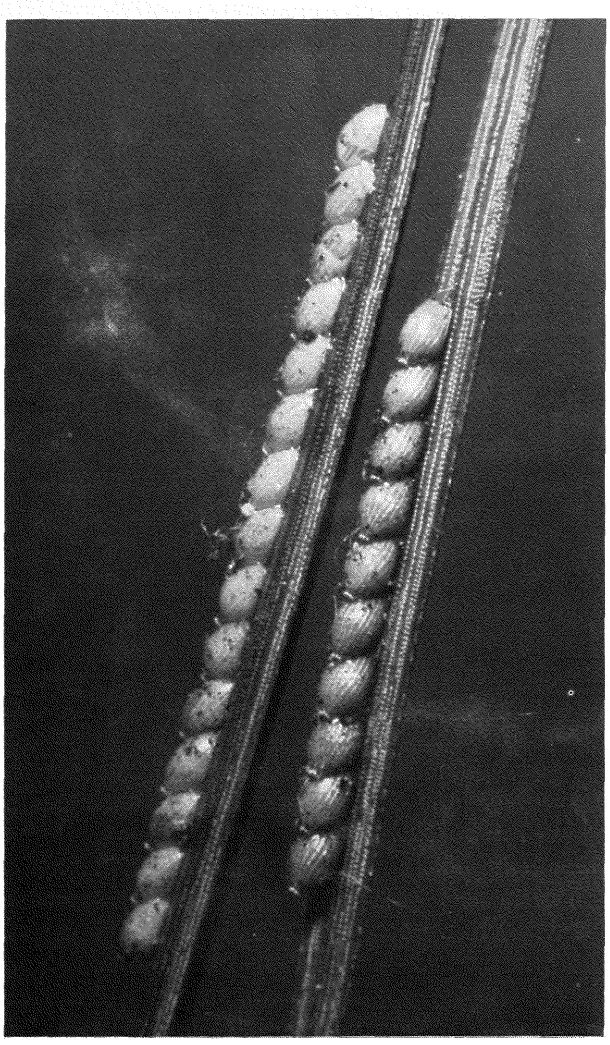

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Figure 10.—Pine butterfly egg masses on needles of ponderosa pine (Payette National Forest, Idaho).

north across the Salmon River on the Nezperce National Forest. Although defoliation was classed as light to medium, fall egg mass surveys (fig. 10) indicate an increase in both intensity and extent of damage in 1973. In some areas, top kill and possibly mortality of the most heavily defoliated trees may occur. A few pine butterfly adults were unintentionally caught in western spruce budworm pheromone traps in Bryce Canyon National Park, Utah.

Douglas-fir tussock moth, *Hemerocampa pseudotsugata* McD. The Douglas-fir tussock moth reached noticeable proportions on white fir and Douglas-fir in parts of the Virgin and Spring Mountains of southern Nevada. White fir sustained heavier damage than Douglas-fir, and in one area—near a Boy Scout camp in the Spring Mountains—patches of mature trees as well as reproduction were completely defoliated.

The long-standing and fluctuating infestation in Douglas-fir on Bureau of Land Management and State and private holdings in Owyhee County, Idaho, declined as expected. In one area near Silver City, which had experienced repeated defoliation, an undetermined amount of tree mortality occurred.

A sawfly, *Neodiprion fulviceps* (Cresson). This insect defoliated a small isolated stand of ponderosa pine for the third consecutive year in Clear Creek, Fishlake National Forest, Utah. Surprisingly, many of the most heavily defoliated trees are still alive, and if secondary insects (such as *Ips* spp.) do not attack them, many may yet survive.

Status of Diseases

Dwarf mistletoe, *Arceuthobium* spp. Dwarf mistletoe continues to be the most serious disease problem in the Intermountain Region. Lodgepole pine dwarf mistletoe, *A. americanum* Nutt. ex. Engelm., caused severe impact on lodgepole pine in southeastern Idaho, western Wyoming, and northern Utah. Western dwarf mistletoe, *A. campylopodum* Engelm. f. *campylopodum,* is prevalent and damaging on ponderosa pine in western and central Idaho and Jeffrey pine in western Nevada. Southwestern dwarf mistletoe, *A. vaginatum* (Presl.) Willd. subsp. *cryptopodum* (Engelm.) Hawks. and Wiens, is commonly found throughout the range of ponderosa pine in southern Utah and Nevada. Douglas-fir dwarf mistletoe, *A. douglasii* Engelm., is common throughout the Region and is probably the most damaging of the dwarf mistletoes.

Estimates from timber survey data, forest timber management plans, and research results revealed that impact (growth loss and mor-

tality) is 135 million board feet per year. This is probably a conservative figure.

This summer, data were gathered to determine whether dwarf mistletoe–infected lodgepole pine stands in Region 4 are comparable with those in Region 2. If they are, the program developed by Meyers, Hawksworth, and Stewart for simulating yields in infected lodgepole stands can be applied in this Region. If conditions are not similar, the program can be modified for Region 4 conditions. It is anticipated that this program will be of great use to the forest managers in deciding for or against suppression work.

Annosus root rot, *Fomes annosus* (Fr.) Karst. Two *Fomes annosus* infection centers were found during the course of other work. The first center was at Incline Village at the north end of Lake Tahoe, and probably was caused by construction activities. The other was found on Ditch Creek, North Fork Ranger District, Salmon National Forest, killing ponderosa pine reproduction. Fresh cut stumps from logging operations created the infection court.

The Pesticide Use Coordinating Committee approved the use of "Borax" on freshly cut stumps for prevention of *Fomes annosus* infection. Stumps created in development or expansion of ski areas have been treated with the preventive chemical.

Dutch elm disease, *Ceratocystis ulmi* (Buism.) C. Moreau. This summer, a report was received via the Colorado State Forester's office that Dutch elm disease had been observed on the Utah State Capitol grounds. The report was investigated and found in error. However, we believe it is only a question of time before this disease will be found at a number of localities in the Intermountain Region, since it is presently in Grand Junction, Colo.; Boise, Idaho; and surrounding towns.

Hazard trees on recreation areas. Twelve recreation areas were sampled this summer to determine the type and extent of tree diseases that are a hazard to the recreation user. When the data have been summarized and analyzed, a report will be written and distributed.

NORTHERN ROCKY MOUNTAINS (R–1)[2]

by

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Conditions in Brief

Western spruce budworm defoliated 4.6 million acres of Douglas-fir, true fir, and spruce in western Montana and northern Idaho. The larch casebearer caused heavy defoliation on the Kaniksu, Coeur d'Alene, St. Joe, and Clearwater National Forests. Mountain pine beetle caused heavy losses in western white pine in northern Idaho and eastern Washington, in ponderosa pine near Missoula, Mont., and in lodgepole pine on the Gallatin National Forest in Montana and Yellowstone National Park in Wyoming. The massive epidemic of Douglas-fir beetles in the North Fork Clearwater River drainage in northern Idaho continued but at levels lower than in 1971. Pine engraver infestations decreased. The Douglas-fir tussock moth defoliated shade trees in Coeur d'Alene, Idaho, and Spokane, Wash., and in forested areas near Kettle Falls, Wash., and St. Maries, Idaho. The pine butterfly epidemic mushroomed from 8,800 acres in 1971 to nearly 70,000 acres in 1972 on the Nezperce and Bitterroot National Forests; infestations are expected to increase in 1973. The western hemlock looper was epidemic for the first time in 30 years in the North Fork Clearwater River drainage in northern Idaho; additional damage is expected in 1973. The ash borer and carpenter worm are causing damage in North Dakota shelterbelts.

Root rots in younger stands and stem decays in overmature stands are causing significant management problems. Dwarf mistletoes are still causing significant growth loss. Douglas-fir needle cast caused severe defoliation in localized areas in western Montana and northern Idaho. Fluoride pollution caused injury to vege-

[2] Includes forested lands in Montana, northeastern Washington, northern Idaho, North Dakota, and northwestern South Dakota, and National Park Service land in northwestern Wyoming.

tation in the Butte and Columbia Falls, Mont. areas. Sulfur oxides are causing injury to vegetation near Anaconda, Mont. and Kellogg, Idaho.

Status of Insects

Mountain pine beetle, *Dendroctonus ponderosae* Hopk. Infestations continued in western white pine on the South Fork Salmon River on the Colville and Kaniksu National Forests. Heavy losses occurred in western white pine on the Clearwater and St. Joe National Forests and adjoining State and private lands in northern Idaho where the insect is associated with trees weakened by white pine blister rust (*Cronartium ribicola* Fisch.). Dense second growth ponderosa pine stands in Ninemile Creek west of Missoula, Mont., sustained epidemic beetle populations for the third consecutive year. Epidemic beetle populations continue in lodgepole pine on the Gallatin National Forest in Montana and Yellowstone National Park in Wyoming. Localized beetle activity occurred in lodgepole pine near Cliff Lake on the Beaverhead National Forest and in ponderosa pine on the Northern Cheyenne Indian Reservation near Lame Deer, Mont. The outbreak in mixed ponderosa pine and lodgepole pine on the Lincoln Ranger District, Helena National Forest, continued for the fourth consecutive year. An outbreak on State lands near St. Regis, Mont. intensified.

Douglas-fir beetle, *Dendroctonus pseudotsugae* Hopk. The massive epidemic in the North Fork Clearwater River in northern Idaho continued in 1972 at a somewhat lower level than in 1971, and destroyed an estimated 24 million board feet of sawtimber. Localized areas of beetle infestation occurred on lands administered by the Bureau of Land Management in the Centennial Valley in southwestern Montana. This beetle invaded and killed trees weakened by "red belt" or winter drying in the Bridger Mountains on the Gallatin National Forest.

Pine engraver, *Ips pini* (Say). Infestations decreased in 1972. Localized group killing was associated with logging, road building, and other construction activities. Hot spots occurred in the Garnet Mountains and on the Flathead Indian Reservation in western Montana, in the Buffalo Creek drainage south of Helena, Mont., and in the Stranger Creek drainage on the Colville National Forest. Infestations associated with pine looper in ponderosa pine on the Northern Cheyenne Indian Reservation decreased to a low level. Engraver populations associated with mountain pine beetle (*Dendroctonus ponderosae* Hopk.) continue to deplete lodgepole pine stands near St. Regis, and ponderosa pine stands in the Ninemile Creek drainage, both on the Lolo National Forest.

Western spruce budworm, *Choristoneura occidentalis* Free. Western budworm defoliated 4.6 million acres in 1972, an increase of 200,000 acres since 1971. A damage survey on the Nezperce National Forest showed permanent injury (top kill and/or tree mortality) on 138,000 acres of Douglas-fir and true firs. The budworm has reduced the cone crop on the Lolo and Clearwater National Forests to the point where the Forests have been unable to collect the seed necessary for regeneration of cutover areas.

Larch casebearer, *Coleophora laricella* (Hbn.). This defoliator of western larch is now established throughout the range of western larch in the Region. Heaviest damage occurred on the Kaniksu, Coeur d'Alene, St. Joe, and Clearwater National Forests. Defoliation on the Colville National Forest consisted of patches of conspicuous defoliation interspersed with areas of negligible defoliation. Noticeable damage in western Montana occurred in the vicinity of Flathead Lake, Columbia Falls, and the Swan Valley.

Pine butterfly, *Neophasia menapia* (Feld. and Feld.). The outbreak on the Bitterroot National Forest increased from 4,600 acres in 1971 to about 40,000 acres in 1972. The infestation on the Nezperce National Forest increased from 4,200 acres in 1971 to about 30,000 acres in 1972. Localized outbreaks occurred on the Lolo National Forest, the Flathead Indian

Reservation, and the National Bison Range near Ravalli, Mont. (fig. 11). An egg mass survey indicates the infestations will persist for at least 1 more year. The parasite-predator complex is rapidly increasing in numbers; parasitism exceeds 50 percent at some locations, and predation accounts for the death of many eggs, larvae, and pupae (fig. 12).

Douglas-fir tussock moth, *Hemerocampa pseudotsugata* McD. Localized infestations continued in shade and ornamental trees in Coeur d'Alene and Troy, Idaho, and in Spokane and Penix Canyon, Wash. Egg masses were abundant within a 100-acre logging unit near Charles Butte, St. Joe National Forest; noticeable defoliation is expected in this area in 1973. Moderate to heavy defoliation occurred on 300 acres of privately owned Douglas-fir south of Kettle Falls, Wash.

F-521866

Figure 11.—Defoliation of ponderosa pine caused by the pine butterfly (Bitterroot National Forest, Montana).

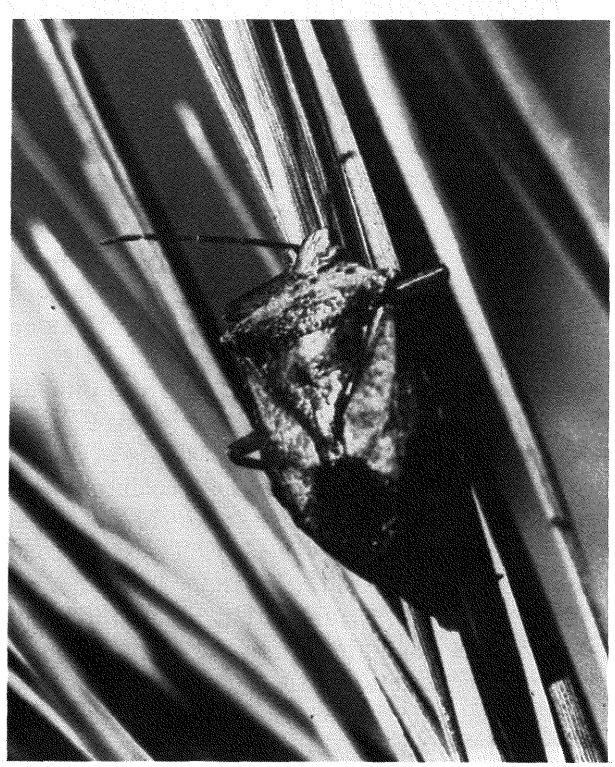

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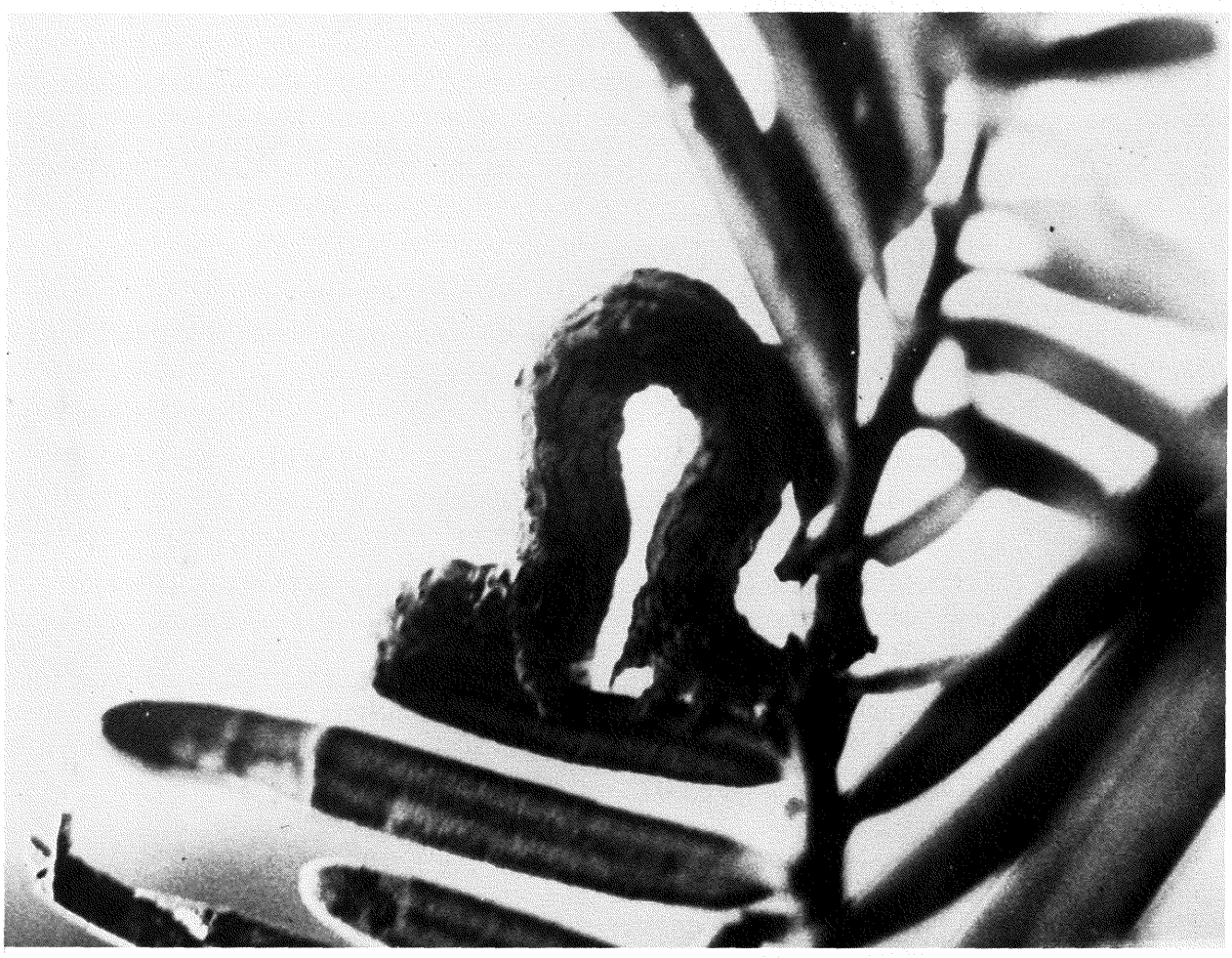
Figure 12.—*Apateticus bracteatus* (Fitch) a predator of pine butterfly eggs, larvae, and pupae (Bitterroot National Forest, Montana).

Western hemlock looper, *Lambdina fiscellaria lugubrosa* Hulst (fig. 13). This insect was epidemic for the first time in 30 years in the Region. Patches of defoliation from 6 to 60 acres in size occurred in the North Fork Clearwater River drainage in northern Idaho. A total of 6,000 acres of hemlock looper defoliation was mapped during an aerial survey. Light feeding injury occurred on grand fir, western redcedar, and western hemlock, and moderate to heavy defoliation occurred on understory huckleberry. Flights of looper moths were conspicuous as far north as Coeur d'Alene, Idaho, indicating that the looper may cause additional damage in 1973.

Pine looper, *Phaeoura mexicanaria* (Grote). The infestation in the Long Pine Mountains



F-521868

Figure 13.—Western hemlock looper larva (Montana).

and the Ekalaka Hills, Custer National Forest, declined in 1972. Trees that were reddened by feeding injury in 1971 have recovered; only occasional tree mortality resulted from the outbreak. Parasitized and diseased larvae were common; the infestation is expected to remain at a low level in 1973.

Other insects. Sugar pine tortrix, *Choristoneura lambertiana* (Busck), defoliation was conspicuous on lodgepole pine on the Flathead National Forest. The variable oak leaf caterpillar (*Heterocampa manteo* (Dbldy.)) infestation in North Dakota declined from 4,510 acres in 1971 to 1,360 acres in 1972; no permanent injury has yet occurred. The ash borer, *Podosesia syringae fraxini* Lugger, infested 51 percent of 96 shelterbelts surveyed in North Dakota. The carpenter worm, *Prionoxystus robiniae* (Peck), was found in 28 percent of the same shelterbelts.

Status of Diseases

Root diseases. *Armillaria mellea* (Vahl ex Fr.) Kummer was endemic in most forested areas, but caused considerable losses in mature subalpine fir and pole-sized ponderosa pine on the Lolo National Forest and in mature

Douglas-fir on the Kaniksu National Forest. *Poria weirii* Murr. infected Douglas-fir, grand fir, western redcedar, ponderosa pine, and western white pine on the Coeur d'Alene, Kaniksu, and St. Joe National Forests. *Fomes annosus* (Fr.) Cke. was found as a root rot in young ponderosa pine plantations on the Colville National Forest and in young western redcedar on the Clearwater National Forest. The fungus was found as a butt rot in subalpine fir on the Coeur d'Alene National Forest and in grand fir on the Clearwater National Forest. *Polyporus schweinitzii* Fr. decay was found in abundance in mature white pine and Douglas-fir on the St. Joe and Clearwater National Forests. A brown to black stain possibly caused by a *Verticicladella* sp. was found in grand fir on the St. Joe National Forest.

Stem diseases. *Fomes pini* (Thore ex Fr.) Karst. is common and attacks all coniferous species. *Echinodontium tinctorium* (E. and E.) E. and E. is causing a high degree of cull in mature and overmature grand fir and western hemlock.

Cankers and galls. Cankers caused by *Atropellis* spp. were common in lodgepole pine, ponderosa pine, and western white pine. *Cronartium ribicola* Fisch. continues to cause western white pine mortality throughout the western white pine type. *Peridermium harknessii* Moore was widespread on ponderosa pine. *Cronartium comandrae* Pk. was locally heavy on lodgepole pine. *Tubercularia* sp. and *Cytospora* sp. were found causing cankers and dieback in willow, white poplar, Siberian elm, Russian olive, and box elder in North Dakota shelterbelt plantings.

Dwarf mistletoes. *Arceuthobium* spp. were controlled on approximately 4,000 acres. One crossover infection of the lodgepole pine dwarf mistletoe, *A. americanum* Nutt. ex. Engel., was found on the Beaverhead National Forest. *A. americanum* on lodgepole pine was found for the first time in the Bearpaw Mountains in eastern Montana on the Rocky Boy's Indian Reservation.

Needle cast diseases. *Elytroderma deformans* (Weir) Darker, in conjunction with the pine butterfly, caused some mortality in polesized ponderosa pine in the Bitterroot Valley of western Montana. *Lophodermella arcuata* (Darker) Darker was frequently found causing defoliation of western white pine in northern Idaho. *Rhabdocline pseudotsugae* Syd. was locally severe on Douglas-fir in northern Idaho and western Montana. *Dothistroma pini* Hulb. caused defoliation of young ponderosa pine on the Clearwater and Kaniksu National Forests.

Needle rusts. *Pucciniastrum goeppertianum* (Kuehn.) Kleb and/or *P. epilobii* Otth. were found on grand fir seedlings on west side forests.

Air pollution. Fluoride pollution from an aluminum reduction plant at Columbia Falls, Mont., continued at about the same level in 1972 as in 1971. Damage was still occurring up to 5 air miles from the plant. Fluoride damage to vegetation also occurred up to 6 air miles from a chemical plant producing phosphorous near Butte, Mont. Smelters at Anaconda, Mont., and Kellogg, Idaho, are emitting excessive amounts of sulfur oxides and causing acute and chronic injury to vegetation (fig. 14).

CENTRAL ROCKY MOUNTAINS (R–2)[3]

by
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Conditions in Brief

Bark beetles were again the most important insect pests in the Central Rocky Mountains. Mountain pine beetle populations increased in ponderosa pine stands in the Black Hills of South Dakota and along the Colorado Front Range. Populations also increased in lodgepole pine in the Arapaho and Routt National Forests in Colorado and the Medicine Bow and

[3] Included forested lands in Colorado, Kansas, Nebraska, South Dakota, and eastern Wyoming.

F-521869

Figure 14.—Depletion of soil and vegetation resulting from sulfur dioxide and other pollutants from lead and zinc smelters.

Shoshone National Forests in Wyoming, as well as adjacent State, BLM, and private lands in both States.

Spruce beetle activity has declined considerably, especially in the Gunnison National Forest, where winter mortality and woodpecker predation significantly reduced the overwintering larval population. The most persistent spruce beetle infestation in the Region continues in the Medicine Bow National Forest.

Western spruce budworm defoliation decreased to 90,500 acres in 1972. Defoliation by tent caterpillar made a definite upswing at several locations in the Region. The lodgepole terminal weevil continues to kill terminals in lodgepole pine sapling stands on the Routt, Roosevelt, and Medicine Bow National Forests.

Dwarf mistletoe of lodgepole pine is gradually being brought under control on an increasing acreage of commercial forest stands in Wyoming and Colorado through a coordinated dwarf mistletoe control and timber management program. The impact of the disease can be reduced in proportion to intensity of management applied. Removal of dwarf mistletoe-infected overstory trees was reported for 1,500 acres of commercial forest lands in Colorado and Wyoming in 1972. The disease will con-

tinue to cause deformity and slow growth in untreated commercial and noncommercial stands.

Western gall rust was found killing 4- to 6-year-old ponderosa pine seedlings in the Pine Ridge area near Chadron, Neb. The disease, found on lodgepole and ponderosa pine in the Rocky Mountains and the northwestern United States, is capable of causing extensive seedling mortality.

New root disease centers have been detected in the pinyon pine-juniper type in central and southern Colorado. Two root disease pathogens —*Armillaria mellea* and *Verticicladiella wageneri*—have been identified with the problem, which is causing tree mortality and esthetic and economic impact in some housing subdivisions.

Dutch elm disease continues to kill American elm trees at the Bessey Ranger District in central Nebraska. The remaining high value elm trees will be replaced with other tree species as mortality occurs.

Status of Insects

Mountain pine beetle, *Dendroctonus ponderosae* Hopk. Mountain pine beetle continues to increase in lodgepole and ponderosa pine stands in the Region. In the Black Hills, the beetle is concentrated in the overstocked second-growth ponderosa pine stands which are stagnating. Tree mortality due to the beetles increased 33 percent over that reported in 1971. For 1972, the loss was estimated at 402,000 trees on all land ownerships in the Black Hills in South Dakota and Wyoming.

During the past decade, the beetles have been most active in the northern Black Hills around the Lead-Deadwood exemption area and west to include Spearfish Canyon. Now the infestation has spread to the south with intense activity as far south as Custer, S.Dak. Scattered infestations in single trees and small groups occur throughout the Black Hills.

Direct control by application of ethylene dibromide or by felling and burning of infested trees has been practiced every year since 1967. Despite the direct control effort, the beetles have increased and intensified within the old persistent areas, and have spread throughout the Black Hills.

Thinned second-growth ponderosa pine stands remain free of epidemic mountain pine beetle populations (fig. 15). Recognition of these benefits of stocking reduction has resulted in accelerated offerings of roundwood sales on both Federal and private lands in an effort to thin stands and also salvage the beetle-infested trees. In 1972, an estimated 50,000 infested trees were salvage logged, and 30,000 trees were either chemically treated or felled and burned.

Along the Colorado Front Range, the mountain pine beetle increased greatly during 1972. The total number of infested trees was estimated to be about 240,000. The problem is in ponderosa pine on intermingled ownerships of Federal, State, and private lands from Colorado Springs on the south to the Wyoming State line on the north. Overstocked small diameter stands and some mature stands suffer most of the attacks. To a lesser extent, the

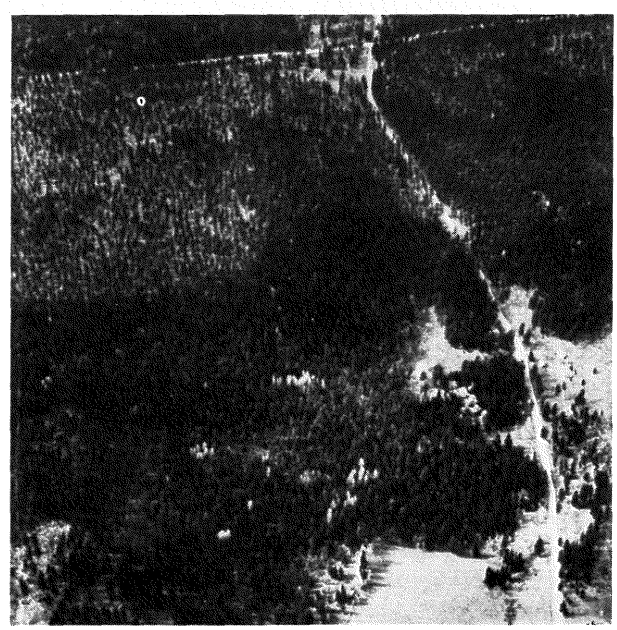

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Figure 15.—Groups of mountain pine beetle killed trees in unthinned stands in contrast to thinned stands near Lead, S. Dak.

beetles are successfully attacking many trees heavily infested with dwarf mistletoe. Urban expansion is complicating the mountain pine beetle problem in the Front Range. Tree susceptibility to beetle attack is increased by physical damage or disturbance during construction. Frequently, the new homeowners complain about their trees being killed by the beetles. Suppression in 1973 will be attempted only in a few key areas where there is sufficient interest and support by the local residents.

Mountain pine beetle continued to spread in lodgepole pine in Middle Park near Granby and Hot Sulphur Springs, and at Owl Mountain in North Park, Colo. A "hot spot" at Buffalo Peak on BLM and private lands was salvage-logged prior to beetle flight.

In Wyoming, an infestation in South Spring Creek of the Medicine Bow National Forest killed 12,000 lodgepole pine which were first attacked in 1971. This infestation has increased and has now spread into North Spring Creek. The persistent infestation near South Pass City and Atlantic City, Wyo., on private, BLM, and Shoshone National Forest lands increased in 1972, and about 20,000 trees were killed.

Spruce beetle, *Dendroctonus rufipennis* (Kby.). Spruce beetle activity has greatly decreased in all outbreak areas. On the Gunnison National Forest, timely salvage logging of the infested spruce, coupled with a natural population decline, brought the outbreak losses to a low level. The West Elk Wilderness infestation declined to a few small scattered groups in 1972. The most persistent infestation, in the Medicine Bow National Forest, has greatly decreased and is expected to continue at a lower level.

The greatest threat for spruce beetle buildup remains in the San Juan and Rio Grande National Forests, where considerable windthrow occurred during October 1971 and is still susceptible to the beetles.

Douglas-fir beetle, *Dendroctonus pseudotsugae* Hopk. This insect continues to cause mortality of Douglas-fir in small scattered groups almost exclusively in steep, rocky drainages throughout the Region. One infestation increased considerably in 1972 on the South Platte River drainage in the Pike National Forest and another was found on the Bighorn National Forest in northern Wyoming near the Tyrell Ranger Station.

Western spruce budworm, *Choristoneura occidentalis* Freeman. Budworm defoliation dropped from 113,000 acres in 1971 to 90,500 acres in 1972. In the San Isabel National Forest, defoliation decreased by 50,000 acres with the intensity of defoliation remaining about the same, mostly moderate. Some moderate defoliation is expected in 1973 along the Sangre de Cristo Range, with light feeding in the Wet Mountain Range. A new infestation area was discovered near Bear Creek north of the Spanish Peaks, primarily on private lands and extending into the San Isabel National Forest. Light defoliation occurred on 10,000 acres of the Roosevelt National Forest and adjacent lands west of Boulder, Colo. Increased defoliation of 7,500 acres was observed in the Rio Grande National Forest along the Conejos River.

Lodgepole terminal weevil, *Pissodes terminalis* Hopp. The lodgepole terminal weevil has caused considerable damage in lodgepole sapling stands. Not all affected areas are known. Damage by the weevil has been observed in the Roosevelt National Forest in the Buckhorn drainage and near Twin Sisters Lookout; in the Routt National Forest in various areas along the Michigan River; and in the Medicine Bow Division of the Medicine Bow National Forest. Four different stands—all within 3 miles of each other—in the Michigan River drainage, Routt National Forest, were evaluated for terminal weevil damage. Two of the four stands, which average 26 years of age, have been thinned within the last 5 years. For the thinned stands, 33 and 72 percent of the sample trees, respectively, showed recent terminal damage. In both of the other two stands (which had not been thinned) 36 percent of the sample trees showed either recent or older evidence of terminal damage. Periodic evaluations of these and other stands will be useful in determining interactions between terminal

weevil infestation and stand improvement practices.

Strawberry root weevil, *Otiorhynus ovatus* (L.). This insect was discovered in the Mt. Sopris Tree Nursery, White River National Forest, during the spring lifting of Engelmann spruce. Extensive damage was caused primarily by the immature beetles feeding on the bark of the root systems (fig. 16). Their feeding resulted in the loss of 400,000 spruce seedlings. The seedling beds were fumigated immediately after lifting for control, supplemented by baiting around each infested bed for any migrating adults that survived fumigation.

Pine butterfly, *Neophasia menapia* (Feld. & Feld.). Light defoliation of ponderosa pine by the pine butterfly was observed in the vicinity of Mount Rushmore National Memorial in the Black Hills and a low population of pine butterfly was observed during the aerial survey of the Pike National Forest near Woodland Park, Colo.

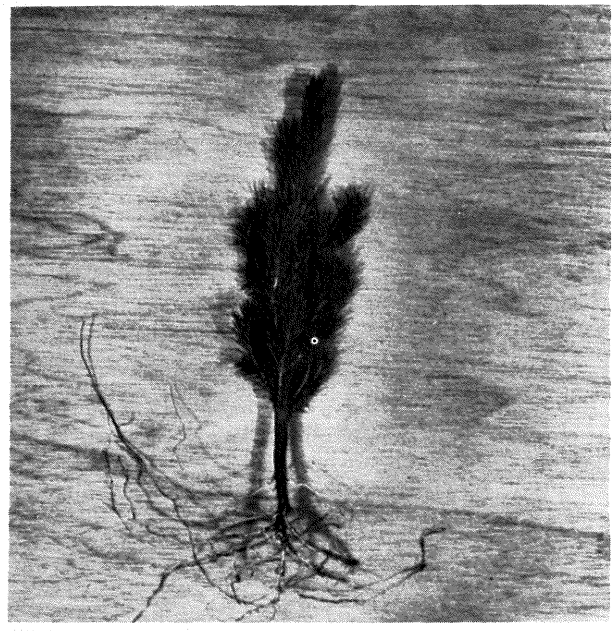

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Figure 16.—Engelmann spruce seedling with root damage (white areas) caused by larval feeding of the strawberry root weevil (Mt. Sopris Tree Nursey, White River National Forest, Colorado).

Other insects. Ornamental Colorado blue spruce were defoliated at the Ft. Carson military base by the Douglas-fir tussock moth, *Hemerocampa pseudotsugata* McD. Defoliation on a few trees had been about 80 percent during 1971 and when evaluated, sufficient first instar larvae were emerging to merit control. Consequently, most of the trees were treated with Zectran, resulting in decreased defoliation. Since all infested trees were not found in time, it is possible that limited treatment will be necessary in 1973.

Fall webworm, *Hyphantria cunea* (Drury), caused light defoliation of cottonwood along portions of the Arkansas River near Canon City, the Colorado River near Grand Junction, Clear Creek Canyon, Buckhorn Creek, St. Vrain River, and Cache la Poudre River in Colorado. Feeding was also observed on chokecherry, willow, and wildrose.

Western pine tip moth, *Rhyacionia bushnelli* Busck, and Southwestern pine tip moth, *R. neomexicana* Dyar, continue to infest pines in windbreaks in Nebraska. Southwestern pine tip moth caused severe damage in a 1958 plantation at Bull Creek, San Juan National Forest, in southwestern Colorado. Apparently the infestation has been building for the past several years. In 1971 and 1972, 90 percent of the terminals were infested as well as some laterals. Elsewhere on the forest, the tip moth problem varies and is apparently widespread throughout the pine type. Turkey Creek is particularly hard hit, natural regeneration being only one-half to two-thirds its normal height.

Pandora moth, *Coloradia pandora* Blake, larvae were discovered on Christmas trees cut on Pine Ridge at Chadron, Neb. (fig. 17). Ground checking of the area revealed a light larval population and light defoliation. The trend was not determined, but a rapid increase is not expected.

F–521872

Figure 17.—Pandora moth larva feeding on ponderosa pine (western Nebraska).

A needle miner, *Coleotechnites* sp. Infestation by this insect in ponderosa pine west of Golden and Boulder, Colo., caused severe defoliation of one-third of the trees in the affected area. Older needles were consumed while current growth was not. The infestation involved about 4,000 acres in an altitudinally restricted belt of 200–300 feet around the 6,000 foot contour level. The infestation is expected to decline without extensive damage. Another needle miner, tentatively identified as white fir needle miner, *Epinotia meritana* Hein., was discovered causing moderate defoliation in white fir on 20,000 acres around Sheep and Iron Mountains south of Gardner, Colo.

A tent caterpillar, *Malacosoma* sp. Populations of tent caterpillar increased throughout the Region. The greatest damage was at Cumbres Pass, where heavy defoliation of aspens occurred on 3,000 acres. Fruit tree leafrollers, *Archips argyrospilus* (Walk.), caused moderate defoliation on mountain mahogany, and light defoliation on chokecherry, skunkbrush, and wildrose on 3,000 acres in Boles Canyon, Black Hills National Forest.

The elm leaf beetle, *Pyrrhalta luteola* (Muller). This beetle skeletonized elm leaves in South Dakota, Nebraska, Kansas, and eastern Colorado. Feeding on individual trees was less severe in Nebraska during 1972, skeletonizing about 50 percent of the crowns as compared to 90 percent in 1971. Feeding damage was more evenly distributed in 1972, in contrast to intensive centers observed in 1971.

Status of Diseases

Dwarf mistletoes, *Arceuthobium* spp. Lodgepole pine dwarf mistletoe, *A. americanum* Nutt. ex Engelm., was controlled on 1,500 acres in Colorado and Wyoming. Evaluation surveys were completed on 4,000 acres.

The computerized LPMIST program for simulating yields of lodgepole pine stands [4] was utilized by National Forest personnel for making management decisions in at least 50 stands. The printouts provide information on growth impact from dwarf mistletoe and aid the land manager in setting priorities in timber stand improvement work.

Additional survey data were collected in 1972 for comparison with the 1971 study of dwarf mistletoe survey methods. The study will continue until a survey method is found that satisfactorily yields the data needed for the LPMIST program.

Data collected from 20 ponderosa pine stands in the San Juan National Forest are being analyzed to determine the mortality factor associated with southwestern dwarf mistletoe *A. vaginatum* subsp. *cryptopodum* (Engelm.) Hawks. & Wiens. Dr. Frank Hawksworth, from the Rocky Mountain Forest and Range Experiment Station, is cooperating in the study to determine if the simulated yield program for southwestern ponderosa pine [5] needs to be adapted for the San Juan National Forest.

[4] C. A. Meyers, F. G. Hawksworth, and J. L. Stewart. Simulating yields of managed dwarf mistletoe-infested lodgepole pine stands. USDA Forest Serv. Res. Pap. RM-72, 15 pp., illus. June 1971.

[5] C. A. Meyers, F. G. Hawksworth, and P. C. Lightle. Simulating yields of southwestern ponderosa pine stands, including effects of dwarf mistletoe. USDA Forest Serv. Res. Pap. RM-87, 15 pp., illus. April 1972.

A study on the feasibility of pruning lodgepole pine for dwarf mistletoe control established in 1966 was evaluated in 1972. The 20-acre study area, which contains unpruned trees that were visually classified mistletoe-free in 1966 and pruned trees that were infected in 1966, now show 26.3 percent of the unpruned and 51.2 percent of the pruned trees are infected with dwarf mistletoe. A complete description and results of the study will be published elsewhere.

Western gall rust, *Peridermium harknessii* V. P. Moore. Gall rust was found killing 4- to 6-year-old ponderosa pine in one stand in the Pine Ridge area near Chadron, Neb. About 50 percent of the seedlings examined were infected with the rust (fig. 18). Multiple infections occurred on some trees. If this type of damage is typical for other stands in the Pine Ridge area, it could be one of the major reasons for the scarcity of young reproduction. A timber survey of the Pine Ridge area conducted by staff personnel of the Nebraska State Extension Forester in 1967 showed 22 percent of the trees were infected by the rust. Twelve percent of the trees had stem cankers that resulted in a loss in merchantable volume.

A 500-acre stand of 25-year-old lodgepole pine in the Buffalo Ranger District of the

F–521873

Figure 18.—Western gall rust infection on ponderosa pine seedlings. Seedling on the left has several stem galls; seedling on the right has recently died (western Nebraska).

Bighorn National Forest was surveyed for western gall rust as well as dwarf mistletoe. The survey showed 16 percent and 11 percent of the trees were infected with dwarf mistletoe and western gall rust, respectively. The incidence of both diseases will be reduced in a proposed thinning contract, and the progress of both diseases will be measured in future evaluations.

Root diseases. Symptoms typical of the root and vascular disease *Verticicladiella wageneri* Kend. were observed on pinyon pine near Durango and Cortez, Colo., and in Mesa Verde National Park. Pinyon pine in housing subdivisions near Durango were being killed, causing a loss in the esthetic values of the property (fig. 19).

Several dead and dying pinyon pines in typical root rot centers were found infected with *Armillaria mellea* Vahl. ex Fr. near the San Isabel National Forest southeast of Poncha Springs. The trees are located on a dry rocky site readily visible from the highway. Samples of both diseases were collected for laboratory isolation and identification.

Dutch elm disease, *Ceratocystis ulmi* (Buism.) C. Mor. The disease continues to kill valuable shade trees in the Bessey Ranger District of the Nebraska National Forest near Halsey, Neb. Several suspect trees were verified by cultural isolations made by Dr. Glenn Peterson of the Rocky Mountain Forest and Range Experiment Station in Lincoln, Nebr. Dying elms will be replaced by other tree species.

Other diseases. Winter killing or injury was frequently detected in the ponderosa pine type in Colorado. The dead, bright red colored needles were particularly noticeable before the new growth emerged. The unusually prolonged

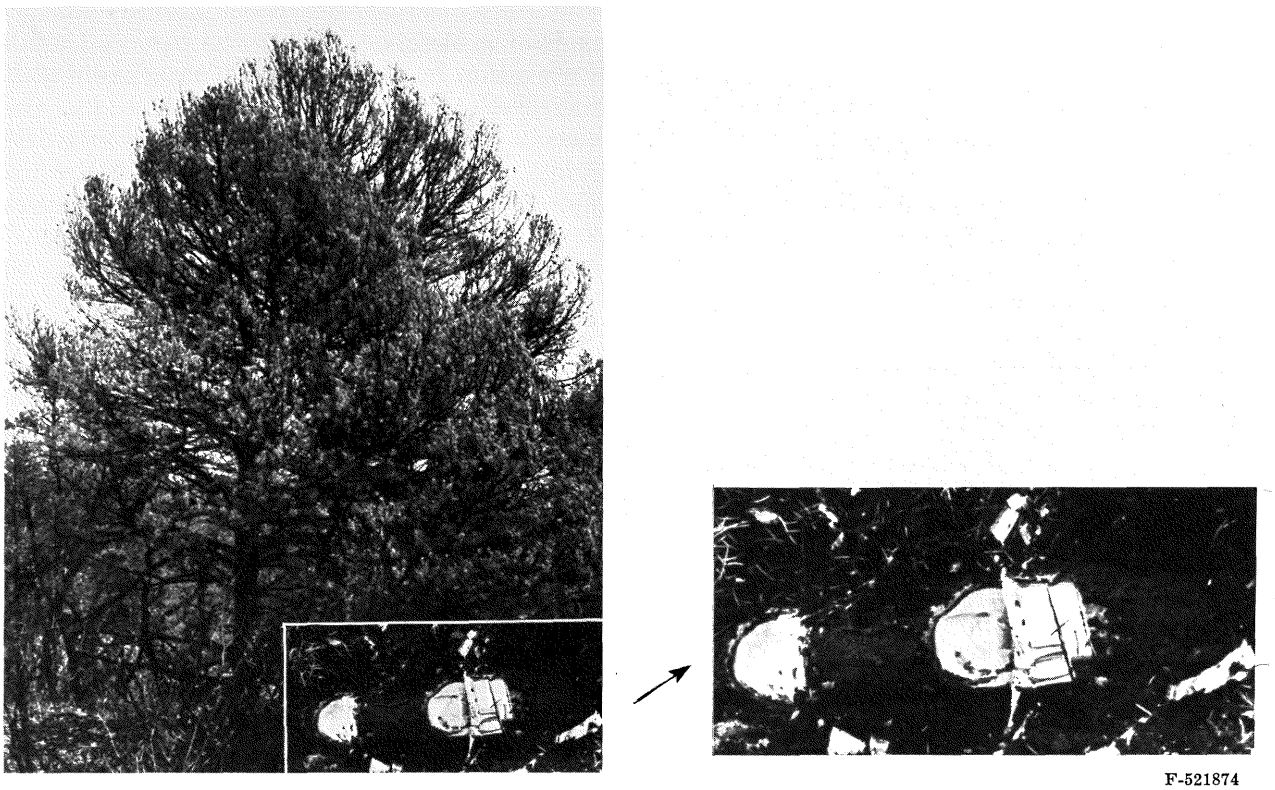

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Figure 19.—Recently dead pinyon pine killed by the root disease, *Verticicladiella wageneri*. Inset—typical stain that occurs in roots of infected trees (Colorado).

dry winds during the winter months have been blamed for much of this damage. Winter injury to lodgepole pine regeneration in older large cutovers in Colorado and Wyoming is quite noticeable in the spring of the year. Damage to terminals can result in a deformed crown. The overall impact of this disease or its duration is not yet known.

Serious dieback of whitebark pine was found in the Wind River Ranger District of the Shoshone National Forest. Partial to complete killing of the tree crowns was seen in small cutovers and in undisturbed stands. Fruiting bodies typical of a Discomycete were collected which have not yet been identified. Usually damage was greatest to that portion of the crown exposed above the snow.

F-521875

Figure 20.—Ponderosa pine trees stripped of foliage by hail during a severe storm (Ft. Apache Indian Reservation, Ariz.).

SOUTHWESTERN STATES (R–3)[6]

by
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Conditions in Brief

Drought, windstorms, and hail damage were major environmental factors affecting the insect situation in the Southwest. Forest stands of all types were severely drought-stressed. Both bark beetles and defoliators, responding to reduced tree vigor and declining biotic restraints, showed increased activity. Fall windstorms on the Fort Apache Indian Reservation and Kaibab National Forest, in the Douglas-fir and Engelmann spruce types, provided an ample food supply for bark beetles. Numerous areas of severe hail damage were noted throughout the Region this year. Many trees were completely stripped of their foliage (fig. 20). These areas are being closely watched for a possible bark beetle buildup.

Douglas-fir beetle damage has increased noticeably on National Forest and Park Service land in Arizona, and on the Navajo Indian Reservation in New Mexico. The roundheaded pine beetle epidemic in New Mexico (on the Lincoln National Forest and Mescalero-Apache Indian Reservation) is spreading northward into the Capitan Mountains. Spruce beetle populations on the Fort Apache Indian Reservation in Arizona are static. Populations in New Mexico remained at a low level.

Activity of defoliators is significant this year throughout the Region. White fir needle miner has become active at two locations in Arizona. Defoliation by the western tent caterpillar continued on National Forest and private lands in northern New Mexico, but the infestation by this pest near Tucson, Ariz., has declined. Douglas-fir tussock moth activity in Arizona is low. Defoliation by this pest occurred on ornamental spruce and fir trees at Los Alamos, N. Mex. The southwestern pine tip moth continued to damage ponderosa pine reproduction in Arizona. Populations of the western spruce budworm are low.

The most important disease agents were the dwarf mistletoes. Emphasis was given to application of dwarf mistletoe preventive meas-

[6] Includes all forested lands in Arizona and New Mexico and National Park Service land in western Texas.

ures in the management of timber stands. Considerable emphasis was also placed on evaluating air pollution injury to forest vegetation. A regionwide detection survey was conducted to determine both the extent of air pollution injury near existing sources, and the potential for injury in areas where new sources will be built in the near future.

Status of Insects

Douglas-fir beetle, *Dendroctonus pseudotsugae* Hopk. Douglas-fir beetle populations increased sharply this year. An abundant food source (from wind-thrown Douglas-fir) and weakened, drought-stressed host trees are the primary causes for the increase.

Several locations in Arizona showed increasing beetle activity. Approximately 500 trees were found infested with Douglas-fir beetle on the North Rim of Grand Canyon National Park. Groups of infested trees were also spotted from the air on the adjacent Kaibab National Forest.

In addition to the outbreak, an extensive blowdown, covering 2,000 acres of mixed conifer type, occurred in October on the Kaibab National Forest. Salvage logging of the down material is planned to reduce the possibility of a major outbreak.

A small pocket of beetle-infested Douglas-fir was successfully treated with ethylene dibromide at the Walnut Canyon National Monument. The 400 acres of susceptible host type within the monument area has incurred several beetle population flare-ups in the past.

Scattered Douglas-fir beetle damage has appeared on the Apache National Forest, south of Alpine, Ariz. Infested trees are located within and adjacent to cutting areas, and salvage logging is anticipated as an economical means of control.

Douglas-fir beetle activity was also noted in the Chuska Mountains near Washington Pass.

Spruce beetle, *Dendroctonus rufipennis* (Kby.). The Fort Apache Indian Reservation, near Whiteriver, Ariz., has the only active spruce beetle epidemic within the Region. A biological evaluation, conducted on 15,000 acres showed the infestation trend as static to decreasing (fig. 21). The Reservation was hit with strong winds during the fall of 1971. Wind-thrown spruce averaged one tree per acre, the majority of these infested. There is no indication that the infested stems will harbor enough brood to cause future damage to standing trees. The impact that this epidemic has had on resource uses and values of the spruce-fir forest is being studied by Region 3 in cooperation with the Bureau of Indian Affairs.

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Figure 21.—Spruce beetle survey crew using variable plot technique to gather stand structure and insect damage data (Santa Fe National Forest, New Mexico).

Spruce beetle populations at all other locations in the Region are at an endemic level. Natural factors have been primarily responsible for the decline.

A cooperative study between Regions 2, 3, and the Rocky Mountain Forest and Range Experiment Station was initiated this fall at Encampment, Wyo. The study involved a post-attack treatment of standing infested Engelmann spruce trees with four different dosage strengths of cacodylic acid. Results of this study will be available following the 1973 sampling.

Roundheaded pine beetle, *Dendroctonus adjunctus* Blandf. Populations remained heavy

on the Lincoln National Forest and adjacent Mescalero-Apache Indian Reservation in southern New Mexico. The infestation has spread to the northern limit of the ponderosa pine type in that area, the Capitan Mountains. Many newly-faded trees were evident during this year's aerial survey on both National Forest and Indian land, and the infestation presently totals 150,000 acres. The problem seems to be primarily one of an overstocked stand with poor vigor. Plots have been established throughout the infestation to measure the effect of the beetle on the tree resource.

At Riggs Lake, on the Coronado National Forest, near Safford, Ariz., chemical control completed in 1971 was successful in reducing a roundheaded pine beetle population. A post-suppression evaluation conducted in May 1972 showed no newly infested ponderosa pine trees.

Ips beetles, *Ips* spp. Ips activity increased in all forested areas in 1972. Much of the impetus for the increase was the extremely dry spring weather. In several areas, increased activity was associated with a continuous accumulation of logging and thinning slash.

Tent caterpillars, *Malacosoma* spp. Heavy defoliation by the western tent caterpillar, *M. californicum* (Pack.), continued in northern New Mexico, near Chama, and adjacent southern Colorado. The infestation now covers 8,000 acres of aspen on both private and National Forest lands. Caterpillar larvae on the tracks of the Cumbres and Toltec Scenic Narrow-gage Railroad again created a slippery condition, forcing the train to a temporary halt on the steeper sections of the route. Excessive defoliation over the last few years has been of major concern to some landowners since the altered habitat may reduce the big game food supply.

White fir needle miner, *Epinotia meritana* Hein. This needle miner is epidemic on 6,000 acres of white fir on the Apache National Forest near Alpine, Ariz. Forty study plots were established within the infestation to measure the effects of the needle miner on the forest resource. Analysis of the plot data showed defoliation within the current outbreak averaged 60 percent of the tree crown. Some white fir top-kill and mortality is expected. Since white fir has recently become a valuable source of lumber in the Region, the needle miner infestation could become an important economic problem if large-scale tree mortality should develop.

Western spruce budworm, *Choristoneura occidentalis* Free. The Eagle Nest Unit in northern New Mexico is the only area where the pest showed increased activity. Samples taken within the infested area showed defoliation as high as 17 percent of the tree crown and up to 5.6 new egg masses per 1,000 square inches of foliage. Populations at all other centers in the Region were endemic and static.

Southwestern pine tip moth, *Rhyacionia neomexicana* (Dyar). Moderate populations of this pest on 100,000 acres of the Sitgreaves National Forest, south of Winslow, Ariz., remained static. A cooperative study between Region 3 and the Rocky Mountain Forest and Range Experiment Station was initiated this year in the infested area. The study, which covers 100 acres, involves the use of a female pheromone to trap male moths. No results are available to date.

Other insects. The Douglas-fir tussock moth, *Hemerocampa pseudotsugata* McD., caused damage to ornamental spruce and fir trees in Los Alamos County, N. Mex. Tussock moth activity at other centers in New Mexico and Arizona is at a low level. Activity of the pinyon needle scale, *Matsucoccus acalyptus* Herb., is static in the Region. Prescott scale, *Matuscoccus vexillorum* Morr., caused damage to ponderosa pine in Los Alamos, N. Mex., and adjacent Santa Fe National Forest. A needle miner, *Coleotechnites* sp., damaged ponderosa pine trees near Flagstaff, Ariz. An unindentified noctuid moth defoliated box elder trees at Bandelier National Monument and on the Cibola National Forest near Albuquerque, N. Mex. Scarabaeid beetles, *Dichelonyx* sp.,

moderately defoliated Douglas-fir trees in a developed campground on the Santa Fe National Forest, N. Mex. Large numbers of several species of cicadas were noted throughout the Region this year. No apparent economic damage was caused by the cicadas.

Status of Diseases

Dwarf mistletoes, *Arceuthobium* spp. Dwarf mistletoes are the most widespread and destructive disease-causing agents in the forest lands of the Southwest. Of the nine dwarf mistletoes that occur in this area, Southwestern dwarf mistletoe, *Arceuthobium vaginatum* subsp. *crytopodum* (Engelm.) Hawks. and Wiens, which occurs on ponderosa pine and Apache pine, is the most important. Douglas-fir dwarf mistletoe, *A. douglasii* Engelm., on Douglas-fir, is next in importance. The seven other dwarf mistletoes that occur in the Southwest are of local importance. Annual losses caused by *A. vaginatum* subsp. *cryptopodum* may exceed 150 million board feet.

Emphasis in 1972 was placed on applying dwarf mistletoe preventive practices during cultural stand treatments. These practices, carried out over an estimated 56,000 acres during the year, included removal of residual infected trees from regeneration areas and harvest of poor-risk infected trees.

During 1972, first use was made of a simulation program for predicting yields in dwarf mistletoe-infested ponderosa pine stands. The program, which was recently developed by the Rocky Mountain Forest and Range Experiment Station for use in the Southwest, is expected to be a valuable aid in making control decisions.

Air pollution. In 1972, a Regionwide detection survey was again conducted for air pollution-caused forest diseases. Forty-seven areas in National Parks and Monuments, National Forests, Indian Reservations, Bureau of Land Management land, and private land were surveyed. Individual survey areas were located near major existing sources of atmospheric contamination, and in areas where major sources will exist in the near future.

Trees and associated vegetation in the surveyed areas were either examined for symptoms of acute sulfur dioxide injury or for symptoms which might later be confused with sulfur dioxide injury. Symptoms of acute sulfur dioxide injury were observed up to 7 miles away from copper smelters at Miami, Morenci, and San Manuel, Ariz. These symptoms were noted on Bureau of Land Management and private lands, as well as the Tonto, Apache, and Coronado National Forests. Foliage injury was most evident [7] close to the smelters at Miami and Morenci. In the other areas, foliage injury was limited to a few sensitive plants.

Observations made during surveys conducted in the past 2 years suggest that acute sulfur dioxide injury is probably confined to mesic areas within 10 miles of air contamination sources. Future surveys will focus primarily on areas where injury is occurring, and on areas where new sources are expected in the near future.

A cooperative study with the University of Arizona is now underway which will determine symptomatology and relative susceptibility of selected southwestern forest tree and plant species. Results of this study will increase the effectiveness of current air pollution surveys.

Root disease. Preliminary investigation indicated that *Fomes applanatus* (Pers. ex S. F. Gray) Gill is associated with windthrow of aspen in a recreation area on the Carson National Forest. An evaluation of this problem will be made in 1973.

Armillaria root rot. *Armillaria mellea* (Vahl.) Quel., continued to cause mortality in a 10-year-old ponderosa pine plantation on the Santa Fe National Forest. Mortality in the plantation was about 6 percent in 1972.

Rusts. Limb rust, *Peridermium filamentosum* Pk., continued to cause some mortality in ponderosa pine. Spruce broom rust, *Chrys-*

[7] 66 percent or more of the leaf area killed on an individual tree or plant on 66 percent or more of the total trees or plants of that species in the survey area.

omyxa arctostaphyli Diet., and fir broom rust, *Melampsorella caryophyllacearum* Schroet., are important in several recreation areas where they are associated with bole deformation, spiketop, and mortality. No direct control is being undertaken for diseases of this type. Land managers are encouraged to reduce losses by removing poor-risk trees during normal intermediate cuttings.

A scouting survey was conducted in north central Arizona and north central New Mexico to determine if long-range spread of white pine blister rust, *Cronartium ribicola* Fischer, had occurred. No evidence of this disease was found on either white pine or ribes.

A leaf rust disease defoliated aspen on approximately 5,120 acres of the Lincoln National Forest. A detection survey will be conducted next year to note the progress of this rust disease.

Needle cast. Needle cast of ponderosa pine was at an endemic level in 1972. The three needle cast fungi, which have been associated with widespread damage in the past, are *Elytroderma deformans* (Weir) Dark., *Davisomycella ponderosae* (Staley) Dublin, and *Lophodermella cerina* (Dark.) Dark. A 31-year-old ponderosa pine plantation on the Lincoln National Forest that was severely defoliated by *L. cerina* in 1967 and 1968 suffered little permanent damage. Twenty-eight trees on a permanent plot in the plantation were re-examined in 1972. Twenty-three of these trees had regained a full complement of foliage. The other five had died, but the cause of death could not be determined.

Winter injury. Pinyon pines on the Cibola National Forest that were injured by cold weather in January 1971 have not recovered. One hundred trees on three permanent plots were re-examined in 1972. Forty of the trees had suffered 50 percent or greater branch mortality. Three had died, apparently from the combined effects of cold injury and drought.

SOUTHERN AND SOUTHEASTERN STATES (R–8)[8]

by
SOUTHEASTERN AREA—FOREST PEST MANAGEMENT STAFF
Environmental Protection and Improvement
Atlanta, Georgia

Conditions in Brief

In 1972, the southern pine beetle outbreak involved 60.9 million acres of which 56.2 million were State and private and 4.7 million were Federal lands in 10 States. Fifteen National Forests involving 30 Ranger Districts in eight States were affected by the outbreak. Populations were still on the increase as winter approached. Additional mortality was attributed to Ips engraver beetles and the black turpentine beetle in some areas of Virginia, North Carolina, Florida, Louisiana, Texas, and Arkansas.

Most species of defoliators common to the South were locally destructive. Pine sawflies were most troublesome in seed orchards and plantations in South Carolina, Arkansas, and Tennessee. An oakworm complex was responsible for extensive defoliation to oaks in western Louisiana and eastern Texas. The forest tent caterpillar again heavily defoliated 30,000 acres in Alabama and infested 400,000 acres in Louisiana. Male gypsy moth trap catches continued to increase in Virginia, North Carolina, and South Carolina.

Preliminary 6 months data are quite promising from the pilot study to evaluate the pathological inoculation method for southern fusiform rust to be used for testing slash and loblolly pine seedling resistance to the rust. The method will be operationally tested on unknown seed lots, using automated inoculation equipment, in early 1973. Fusiform rust impact evaluations were initiated in forest tree nurseries and field plantations during 1972.

[8] Includes forested lands in Alabama, Arkansas, Florida, Georgia, Kentucky, Louisiana, Mississippi, North Carolina, Oklahoma, South Carolina, Tennessee, Texas, and Virginia.

Fomes annosus was causing severe damage in a number of slash and loblolly pine plantations on the Atomic Energy Commission's Savannah River Plant near Aiken, S. C. Preliminary data taken on the Yazoo-Little Tallahatchie Flood Prevention Project in Northern Mississippi indicated that annosus root rot was becoming established in most of the pine plantations thinned 3 to 4 years ago. Both of these areas were old agricultural sites with sandy and loess soils where no stump treatments were made after thinning.

Dutch elm disease has become widespread through all the Southeastern States except Florida and Louisiana. It has been detected in 25 North Carolina counties, primarily in the northeastern and north central parts of the State, and in five additional counties in South Carolina making a total of seven to date. It was also spreading throughout Alabama and Mississippi.

Comandra blister rust was detected for the first time in Kentucky. It was found in a young loblolly pine plantation in the northwestern part of the State.

Brown spot needle blight, Cylindrocladium root rot, black root rot, and damping-off continued to cause serious losses and mortality in many of the forest tree nurseries in the South.

Senna seymeria, a parasitic weed, was causing damage and mortality to young pine plantations in Florida. This weed has been reported to be causing damage in other parts of the Southeastern Area.

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Figure 22.—Rapid salvage removal of southern pine beetle-infested trees aids in effective, economical suppression.

Status of Insects

Southern pine beetle, *Dendroctonus frontalis* Zimm. A southern pine beetle outbreak in Georgia currently covers 9 million acres in 46 counties in the central and northern part of the State. Results of a cooperative evaluation during the fall of 1972 indicated an estimated 146,000 infested trees on State and private land within the survey area. The Atlanta urban area was one of the most severely affected portions of the State. Southern pine beetle populations were also high on Federal lands in Georgia. More than 3 million board feet of infested timber was salvaged from Federal lands during 1972 (fig. 22). In the fall of 1972, there were more than 2 million board feet of infested timber on a 214,000-acre survey unit including one district of the Oconee National Forest, the Piedmont National Wildlife Refuge, and the Hitchiti Experimental Forest in central Georgia. Infestations were also causing tree mortality on the Chattooga and Tallulah Districts of the Chattahoochee National Forest in northeast Georgia.

Southern pine beetle activity increased dramatically on State and private lands in North Carolina during the summer of 1972. By fall, the outbreak covered 6.7 million acres in 40 counties. More than 3.6 million board feet of timber were salvaged from July to October of 1972. An evaluation conducted by North Carolina during August 1972 estimated that there were 2,494 spots averaging 48 trees within the outbreak area. Beetle populations also increased on Federal lands in North

Carolina during 1972. High levels of infestation were noted in western North Carolina on the Tusquittee Ranger District of the Nantahala National Forest and the Cherokee Indian Reservation. Similar conditions existed on the Uwharrie National Forest in central North Carolina.

Beetle activity continued to increase in South Carolina during 1972. Outbreaks on State and private land were centered on 3.5 million acres in nine northwestern counties. Fall surveys indicated that infestations were generally at a high level and increasing on 800,000 acres of National Forest lands. On the Andrew Pickens District of the Sumter National Forest and the Witherbee and Wambaw Districts of the Francis Marion National Forest, activity increased extensively from localized infestations. Surveys in the fall of 1972 indicated that there were 6,000 infested trees on the two districts of the Francis Marion National Forest and 22,000 infested trees on the Andrew Pickens District. An estimated 4,000 infested trees were also located on the 400,000-acre Enoree Division of the Sumter National Forest. More than 3 million board feet of infested timber were salvaged from National Forest Lands in South Carolina during the year.

Southern pine beetle activity in Tennessee was restricted to the western portion of the State. Locally heavy infestations were present on the Tellico Ranger District of the Cherokee National Forest and the Great Smoky Mountains National Park.

Southern pine beetle populations in the Piedmont section of Virginia increased dramatically during the summer of 1972. More than 1,300 spots were detected over the 16-county outbreak area covering 4.6 million acres. Over 1,600 cords were salvaged within the outbreak area. Populations were generally normal in other parts of Virginia. The outbreak on the Delmarva Peninsula along the eastern shore continued to decline during 1972.

After 10 years of sporadic infestations in Alabama, the southern pine beetle increased dramatically on 15 million acres throughout the 40-county area during 1972. A Statewide aerial survey located infestations ranging from one to several thousand trees. Fourteen million board feet of timber was salvaged during January-September. An August biological evaluation indicated that 23 million board feet of pine timber were infested. Southern pine beetle caused significant tree mortality on 900,000 acres of the Bankhead, Talladega, and Tuskegee National Forests in Alabama. The Talladega and Bankhead National Forests had over 200 infested trees per thousand acres host type during the late summer. Three million board feet of pine timber were salvaged between July and September on National Forest land.

Surveys conducted by the Mississippi Forestry Commission indicated an increase of southern pine beetle infestations in 9 counties in southwest Mississippi. The heaviest concentration of beetles was in Copiah County. New infestations were reported in Lowndes, Lauderdale, Clarke, and Kemper Counties in east Mississippi. The total acreage in the outbreak area was 1.6 million. Mississippi salvaged 3 million board feet from January to September. Biological evaluations on the 189,000 acre Homochitto National Forest in Mississippi confirmed a high level of southern pine beetle activity. There were approximately 175 infested trees per thousand acres host type. Brood densities were high (366 insects per square foot). During July-September, 1972, 1,005,000 board feet of pine timber were salvaged.

Southern pine beetle activity increased in one south Arkansas county during 1972. In Ashley County, an estimated 600,000 board feet was salvaged between January-September. The only other active infestation was in Union County, but no significant timber loss was reported.

The 1972 outbreak area in Louisiana covered 7.5 million acres in 20 parishes. Thirty-one million board feet and 32,000 cords of pine timber were salvaged between January and September in an extensive effort to reduce losses. Evaluations indicated that 80 trees per thousand acres of host type were infested. Areas of greatest activity were in the southwest portions of Calcasieu and Morehouse Parishes. The Kisatchie National Forest maintained a high level of infestation over 500,000

forested acres in central Louisiana. There were 89 trees per thousand acres host type infested on the Forest which lies in the center of the 20-parish outbreak. Over 800,000 board feet were salvaged by commercial sale between July and September.

The southern pine beetle continued to cause pine timber loss on 8 million acres in east Texas. Fifteen million board feet were salvaged between January and September. The number of spots detected quadrupled since September 1971. The southern pine beetle infested 685,000 acres of National Forest land in Texas during 1972. Innocuous populations increased to damage-causing numbers on the Davy Crockett and Sam Houston National Forests where over 200,000 board feet of pine timber were salvaged between July and September. The beetle was also very active on the Angelina and Sabine National Forests. Approximately 3 million board feet of timber were salvaged between July and September on these two forests.

The distribution of the southern pine beetle in 1972 is shown in figure 23.

Black turpentine beetle, *Dendroctonus terebrans* (Oliv.). Populations of this beetle continued to cause localized damage in 1972. Spots of up to 10 trees were reported in the Coastal Plain and Piedmont sections of Virginia. Increased activity was also reported in Florida. Infestations were also reported in five counties in North Carolina. Populations remained static in Arkansas during 1972. A few localities reported increased activity due to dry weather, lightning, or logging activity. The most serious damage was reported along logging access roads in Camden, Ark. Small salvage sales were conducted to remove infested trees. A buildup of black turpentine beetle was observed in areas of recent cutting operation on the Evangeline District of Kisatchie National Forest, Louisiana. Activity in east Texas increased during the summer, being especially high in the Lincoln, Tex. area. Salvage has been used for suppression purposes, and lindane was used in isolated situations in high value areas.

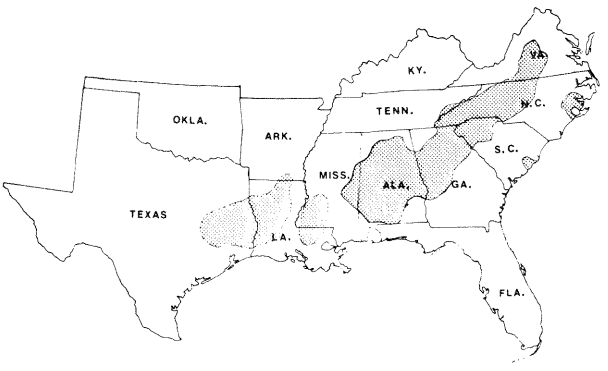

Figure 23.—Gross area infested by the Southern pine beetle in 1972.

Ips engraver beetle, *Ips* spp. Florida reported a 38 percent increase in insect-caused pine mortality during 1972 resulting primarily from *Ips* infestations. An estimated loss of 2 million trees representing more than 250,000 cords occurred in north Florida. Engraver beetle infestations were also reported in the Piedmont and mountain sections of North Carolina. Logging, damaged trees, poor soil conditions and dry weather contributed to increased *Ips* activity in northeast Texas during the summer. Above average mortality resulted in increased salvage of *Ips* spots. In general, *Ips* activity intensified throughout Arkansas during 1972. Some spots with 300–400 trees were located in the Hamburg, Ark. area. Most of the increased activity was attributed to a dry summer and severe electrical storms.

Balsam woolly aphid, *Adelges piceae* (Ratz.). The balsam woolly aphid infestation continued in the 60,000 acres of Fraser fir type in the southern Appalachian Mountains (fig. 24). Aerial detection surveys during June revealed increased tree mortality around many old infestations and several new infestations. The fir forest of Mount Rogers National Recreation Area in Virginia was the only major stand not infested. Suppression measures were carried out on Roan Mountain in the Pisgah National Forest and Mt. Mitchell State Park in North Carolina.

Pales weevil, *Hylobius pales* (Herbst.) (Fig. 25). Ten percent mortality occurred on 1,000 acres of pine seedlings attacked by *Hylobius*

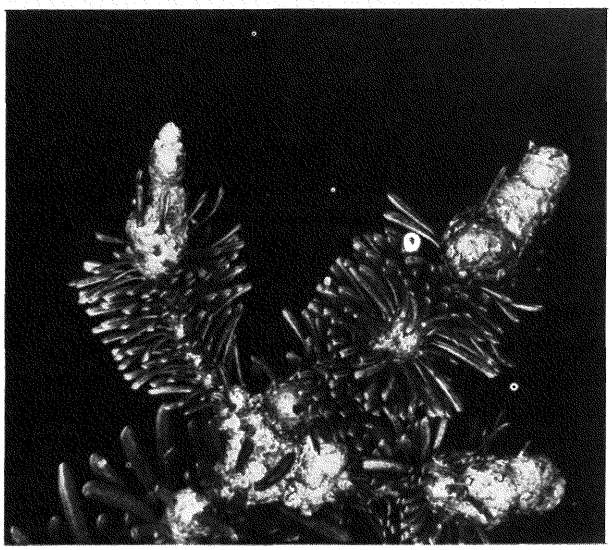

Figure 24.—"Gouting" of Fraser fir branch tips caused by the balsam woolly aphid (North Carolina).

pales (Hbst.) in Vernon Parish, La. Much of the area was planted within 6 months after logging.

The search for a substitute for DDT and aldrin to protect pine seedlings from the pales weevil was intensified. A cooperative field experiment was conducted this summer by the Southeastern Forest Experiment Station and the Southeastern Area, Forest Pest Management Group to evaluate carbofuran and dursban as possible alternatives to the organochlorine insecticides. These two pesticides were selected after an extensive screening program conducted by the PSW Pesticide Screening Lab. Tests showed them to be highly toxic to the weevil, reasonably safe to handle and have a minimum adverse impact on the environment.

F-521880

Figure 25.—Pales weevil and the damage caused by feeding on a young seedling (North Carolina).

Deodar weevil, *Pissodes nemorensis* Germ. Damage to terminals of loblolly pine caused by the deodar weevil occurred in locations throughout western Tennessee. Terminal mortality caused by this insect was also reported in King George County, Va. Large numbers of weevils were active in Hempstead County, Ark. Some top-kill attributed to *P. nemorensis* was observed in pulpwood stands in northern Mississippi.

Sawflies. An outbreak of the pine sawfly, *Neodiprion excitans* Rohwer, and the redheaded pine sawfly, *N. lecontei* (Fitch) on the Francis Marion Seed Orchard in South Carolina caused some severe defoliation in loblolly, shortleaf, and longleaf pine.

Defoliation of loblolly pine resulting from infestations of Arkansas sawfly, *N. taedae linearis* Ross, ranged from 50 to 100 percent in western Kentucky. With the exception of isolated stands in the western part of the State, populations of the Arkansas sawfly in Tennessee were generally at low levels during 1972. Populations of the Virginia pine sawfly, *N. pratti pratti* (Dyar), were also low. The heaviest infestations, with defoliation ranging from 40 to 70 percent, occurred in south-central Kentucky. The redheaded pine sawfly, *N. lecontei* (Fitch), caused mortality and severe defoliation of young pine plantings in the progeny test and outplanting plantation in Tennessee. Populations of the redheaded pine sawfly were lower than normal in Virginia during 1972. Infestations of the red-headed pine sawfly were reported in Columbia, Hempstead, and Saline Counties, Arkansas. The

largest infestation was found in a 120-acre tract of 2-year-old pine seedlings on International Paper Company land in Columbia County. This sawfly defoliated loblolly pine in Wood, Rusk, Panola, Colorado, and Walker Counties, Texas.

Seed orchard insects. Destruction of new shoot growth by the Nantucket pine tip moth, *Rhyacionia frustrana* (Comstock), continued as the major insect related problem on the Federal seed orchards in North and South Carolina. The tip moth's potential for causing serious damage increased substantially with the discovery that it will attack the young conelets of shortleaf pine, *Pinus echinata* Mill. Control of the pest was erratic. Good early season control was maintained with currently recommended pesticides, but later in the season when the moth's generations overlapped, it became increasingly difficult and costly to keep damage to a tolerable level. Tip moth damage was light to moderate on loblolly and shortleaf pine at the Erambert, Stuart, and Ouachita Orchards during 1972.

Adult June beetles, *Phyllophaga* spp., were a problem this year at the Stuart Seed Orchard and the State nursery near DeRidder in Louisiana. Damage was found on the conelets and foliage of loblolly, slash, and shortleaf pines. The damage occurred when the strobili were vulnerable or when the vegetative buds were still succulent. Of the eight species of June beetles identified at the orchard to date, only one, *Phyllophaga micans* (Knoch), has been found to feed on the conelets.

Light to heavy damage from the midge (*Contarina* sp.) occurred throughout the loblolly pine at the Erambert Seed Orchard in Mississippi. Scattered infestations of scale insects (Coccidae) were noted in longleaf pine on the area. Coneworm, *Dioryctria* spp., damage was not a serious problem in any of the seed orchards this year. Heavy damage occurred to second year Virginia pine and white pine cones on the Edwards State Seed Orchard, Morganton, N. C. The cone moth, *Eucosma tocullionana* Heinrich, was responsible. The second year cone losses were estimated at 15 percent in the white pine and 46 percent in the Virginia pine.

Town ant, *Atta texana* (Buckley). The town ant partially or completely defoliated individual trees over a 1,000 acre area of pine seedlings in Vernon Parish, La. (fig. 26). No attempt was made to control the ant. Town ant populations increased in Shelby and San Augustine Counties in Texas during 1972. Four other east Texas Counties sustained scattered damage.

Forest tent caterpillar, *Malacosoma disstria* Hbn. Moderate infestations were reported on 5,000 acres in Marion County in west-central Florida. Heavy defoliation was reported on 1,200 acres of lowland forest in northeastern North Carolina. Oak was the primary host in infestations on a 117-acre area near Madison, Ky. An aerial survey conducted over the Tensaw and Mobile River Basins in Alabama, classified 30,000 of 50,000 acres as heavily defoliated. An estimated 415,000 acres in southern Louisiana were also defoliated by the forest tent caterpillar. Most of the Louisiana defoliation was southwest of Lake Maurepas, west of Lake Verret, and east of Lake Palourde. Surveys in Texas detected an increase in damage. Large caterpillar populations resulted from an above average egg mass production by the insect in 1971.

Orange-striped Oakworm, *Anisota senatoria* (J. E. Smith). Red oaks from Woodville, Tex., to Leesville, La., and from Lufkin, Tex., to Shreveport, La., were moderately to heavily defoliated by the orange-striped oakworm. Defoliation by the yellow-necked caterpillar, *Datana ministra* (Drury), overlapped that of the orange-striped oakworm around Leesville, La.

Variable oak leaf caterpillar, *Heterocampa manteo* (Dbldy.). Heavy populations in Arkansas did not materialize as in the past 2 years. Defoliation was common in 15–20 acre blocks from the Ozarks to Caddo Parish, La. and west to Marshall County, Okla. Heaviest defoliation was in an area from Texarkana, Ark., to Hooks, Tex. Parasites were observed attacking the caterpillars.

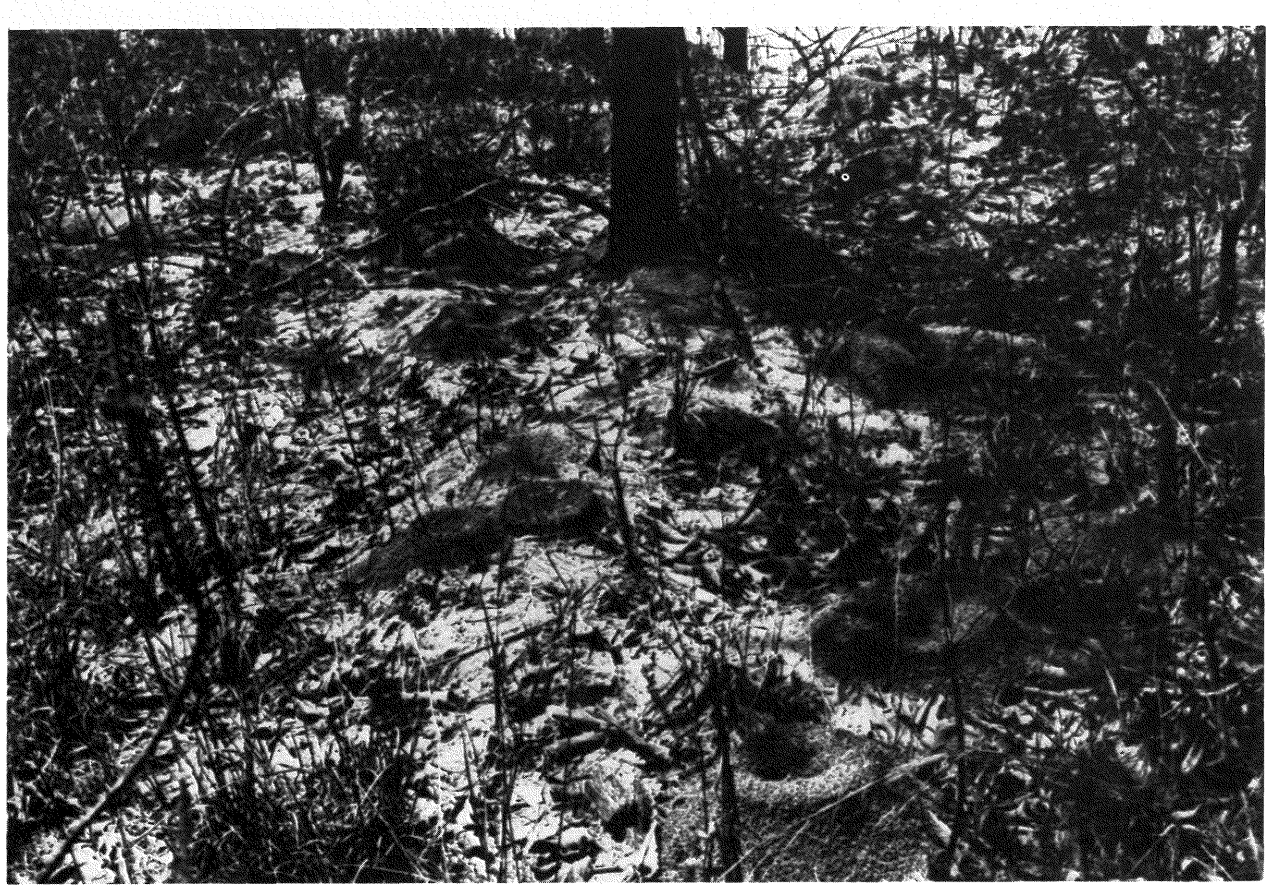

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Figure 26.—Mounds of the town ant showing loblolly pine seedlings that have been defoliated by the insect (Kisatchie National Forest, Louisiana).

Walkingstick, *Diapheromera femorata* (Say). Widespread defoliation over 16,000 acres was reported on the Ozark National Forest, Ark. Walkingstick defoliation was present for the fourth straight year on the Quachita National Forest. Although an estimated 25,000 acres of upland hardwood was defoliated, defoliation was lighter compared with the past 3 years.

Fall webworm, *Hyphantria cunea* (Drury). Infestations of the fall webworm were reported in Virginia, North Carolina, South Carolina, and Kentucky. Unusually heavy infestations occurred in the coastal plain of South Carolina. The red- and black-headed strains of fall webworm were common in the southern two-thirds of Arkansas. Most damage to pecan in the southern half of the State was moderate to heavy.

Gypsy moth, *Porthetria dispar* (L.). The 1972 trapping program in Virginia yielded 215 positive trappings of male moths in 25 counties. Counties along the eastern shore continued to have the highest concentrations of positive trap sites. In North Carolina, a single male moth was trapped from each of seven counties; all but two of these moths were trapped near rest areas or campgrounds. Two moths were trapped in two eastern border counties in Tennessee. Five moths were trapped from three counties in South Carolina (two of which were along the eastern shore), none were trapped in Kentucky, Georgia, or Florida.

The mahogany shoot borer, *Hypsipyla grandella* (Zeller). This insect caused damage to young mahogany and spanish cedar plantations in Puerto Rico and St. Croix, V. I. The larvae of the shoot borer attacks the new

growth terminal shoots by boring into the tissues of both tree species. There are at least eight generations of the insect each year. Insecticide tests have been recently established to try to suppress this insect. Carbofuran granules showed the most promising results so far.

Status of Diseases

Southern fusiform rust, *Cronartium fusiforme* (A&K) Hedge & Hunt. Initial results of the Forest Pest Management Group's evaluation of an inoculation method for use in testing slash and loblolly pine seedling resistance to fusiform rust have been very promising. A final report of the results of this evaluation will be released in June 1973. The method will be tested operationally during the early part of 1973 using automated inoculation equipment on seed lots of unknown resistance. Fusiform rust impact evaluations were established in six southern forest tree nurseries during the spring of 1972. Preliminary data indicate that infection rates on non-sprayed plots will be as high as 50 percent. This evaluation will be conducted annually for 5 years and will be expanded to other nurseries in 1973. Work plans for a pilot Statewide rust impact survey have been approved for establishment in Florida during January 1973. Permanent rust impact plots will be established during the early part of 1973 in the Southeastern States where rust is most severe (fig. 27).

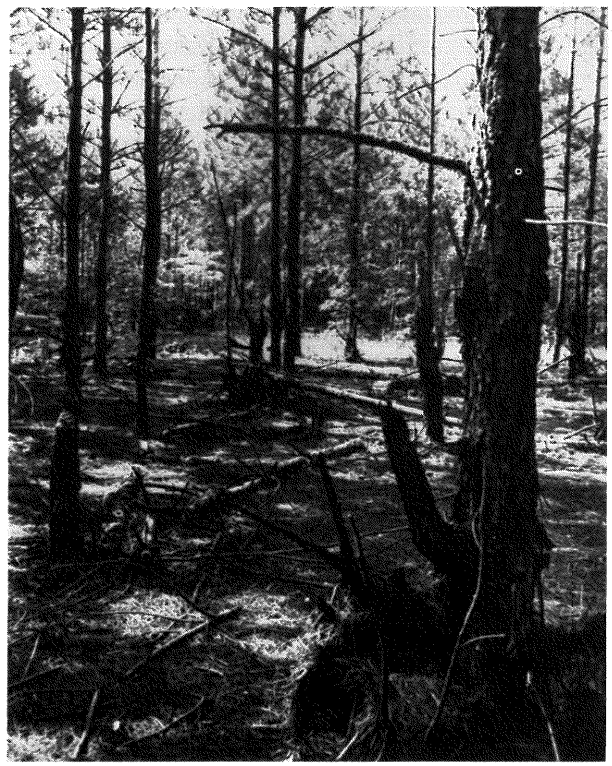

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Figure 27.—Slash pine in this plantation is rapidly deteriorating from fusiform rust (Georgia).

Annosus root rot, *Fomes annosus* (Fr.) Karst. This disease continues to cause damage in thinned pine plantations through the South (fig. 28). In some instances, heavy mortality has forced land managers to clear-cut plantations in Arkansas, Louisiana, Mississippi, and Alabama. A vigorous reforestation program from 1949 through 1960 resulted in the establishment of thousands of acres of loblolly and slash pine plantations, many of them presently undergoing the first or second thinning. However, the use of stump treatments and other recommended methods of preventing or reducing damage by *F. annosus* have not been widely accepted by private and industrial forest managers. Therefore, losses due to this

F–521882

Figure 28.—Annosus root rot center in a 22-year-old slash pine plantation in Louisana.

pathogen are expected to increase throughout the South during the next few years. An evaluation of 16 *Fomes annosus* infected loblolly and slash pine plantations on the Savannah River Project (Atomic Energy Commission) near Aiken, S. C., has revealed that many of the stands have severely deteriorated due to the disease. In 12 of the stands, 20 percent of the trees were dead or revealed symptoms in the field. The percentage of total trees infected ranged from 2 to 55 percent and the mean total infection was 27 percent. In one stand, 40 percent of the trees were dead with 15 percent of the live trees showing obvious infection. This particular problem is attributed to intensive thinning on well-drained sandy soils with an agricultural history.

Annosus root rot continues to occur and cause localized mortality in the Hiwassee Land Company's loblolly pine seed orchard in eastern Tennessee. A resurvey of the orchard in November 1972 revealed 13 newly infected trees and four killed trees. There were 25 infected trees in 1971 with approximately half of them dead. The seed orchard which includes approximately 1,300 superior tree grafts was moved to this new site during the past few years. The average age of the trees is 17 years. In 1971, the Company elected to treat the seed orchard trees with a combination soil drench-injection fungicide treatment using the fungicides Benlate and Dexon. The efficacy of this treatment is being evaluated by Forest Pest Management pathologists and the Tennessee Division of Forestry. However, the results to date are inconclusive.

An evaluation is currently in progress on 500,000 acres of planted pines in the Yazoo-Little Tallahatchie Flood Prevention Project in northern Mississippi. Preliminary results indicated the annosus root rot was just becoming established in many of the plantations thinned 3 to 4 years ago.

Third-year data was obtained from the annosus stump treatment pilot test. As yet there have been no symptom developments on any of the treated or non-treated residual trees in the stands.

Oak wilt, *Ceratocystis fagacearum* (Bretz) Hunt. Oak wilt continued to exhibit a general status quo in the Southeast during 1972. Surveys in Virginia, North Carolina, Kentucky, and South Carolina revealed very little change in disease distribution or incidence from that reported in previous years. A 14-country survey in Kentucky (primarily western) revealed no positive *C. fagacearum* infection. However, there was a slight increase in the number of diseased trees detected in five annually surveyed western North Carolina counties as compared to 1971. In addition, the disease was detected in two new counties in north-central South Carolina. No oak wilt suppression measures were employed in the Southeast in 1972.

Dutch elm disease, *Ceratocystis ulmi* (Buism.) C. Moreau. This disease has recently become widespread in the Southeast and has been detected in all States except Louisiana and Florida. The disease is generally widespread in the States of Kentucky, Virginia, Tennessee, and North Carolina. Dutch elm disease is generally found throughout Virginia, except for the northwestern tier of counties bordering West Virginia. The disease is also scattered throughout Kentucky and Tennessee. However, in Tennessee, damage is concentrated in the middle and western parts of the State. Diseased elms are being salvaged in the vast bottom lands of western Tennessee. The disease has been detected in 25 counties in North Carolina —primarily in the northeastern and north-central parts of the State. Dutch elm disease was detected in five additional counties (total of seven to date) in South Carolina during 1972. In Georgia, the disease is widespread from Macon northward. Numerous diseased elms have been detected and that followed up by appropriate sanitation control measures in Atlanta. Dutch elm disease is also becoming widespread in northwestern Alabama and northeastern Mississippi. Recent confirmation of the pathogen from samples collected near Kosciusko extends the range of the disease in Mississippi, approximately 40 miles to the south.

White pine blister rust. *Cronartium ribicola* Fischer. White pine blister rust caused local-

ized significant damage to eastern white pine esthetic values, Christmas trees, and some timber stands in two southeastern States in 1972. The rust developed into epidemic proportions in four young white pine timber stands and one Christmas tree plantation in two western Virginia counties. Permanent field plot data and field surveys revealed over 10 percent rust stem infection and 5 percent mortality in stands less than 10 years old. Ribes eradication control work was conducted by the Virginia Division of Forestry on 350 acres in Grayson and Augusta counties during the spring of 1972. Approximately 115,000 white pines were included in the eradication protection zone. The herbicide 2,4,5-T was used in this work. Ribes eradication work using the herbicide Silvex was again conducted on the Shenandoah National Park in Virginia in 1972. High-value recreation and esthetic white pine stands along the heavily used Skyline Drive represent the major areas of emphasis in this work. In addition, Ribes survey and eradication work was conducted in the blister rust high hazard areas of western North Carolina again this past year. This work represents a continuous and vigorous blister rust control effort in North Carolina since the 1930's. Ribes surveillance was conducted on 16,779 acres in six western North Carolina counties while control work was required on only 68 acres in two counties. It is also interesting to note that 66 percent of the white pines examined (over 100,000) were in Christmas tree plantations. The remaining blister rust control acreage in the southern Appalachians, encompassing several million acres primarily in Virginia and North Carolina, has been placed on either maintenance or *no future work* status.

Comandra blister rust, *Cronartium comandrae* Pk. Comandra blister rust has caused localized severe damage to young loblolly pine plantations and shortleaf pine natural stands in eastern Tennessee and northern Arkansas, respectively, during recent years. Results obtained from a USDA Forest Service-Tennessee Division of Forestry cooperative permanent plot study on the Cumberland Plateau in eastern Tennessee revealed 13 percent rust infection and 8 percent rust-caused mortality during the past 5 years. Infection ranged from 2 to 33 percent while mortality ranged from 1 to 23 percent. The majority of the rust infection and mortality was observed in the youngest tree age group (1 to 5 years). There was also a closely observed association and correlation between the incidence of rust infection and proximity and abundance of the alternate host—false toadflax—in affected stands. Finally, no significant rust infection cycles or "wave years" were observed as previously reported on lodgepole pine in the central Rocky Mountains. The most notable observation in this respect was a general decrease in rust infection and mortality as the plantation grew older. This is thought to result primarily from the shading effects of the larger trees on the intolerant toadflax. In addition, *C. comandrae* infection and mortality was initially detected in a young loblolly pine plantation in northwestern Kentucky by a specialist from Kentucky Division of Forest Insect and Disease in the spring of 1972. Plans are being made for a rust survey of the area surrounding the affected stands.

Pitch canker, *Fusarium lateritium f. pini* Hepting. This disease continued to attack scattered stands in Florida's northern pine forests. In 1969, attacks were confined to northern and northeastern Florida. This year, a 4,000 acre plantation in northwestern Florida near Panama City was found with a 30 to 40 percent pitch canker incidence. A 2-year evaluation of the 1969 Florida outbreak has revealed that those stands where infection was severe are actually capable of recovery to produce a useful pulpwood crop. In 1969, 33 percent of the trees were infected. However, the 1971 evaluation revealed that only 6.7 percent of the plantation's trees were lost as crop trees. The rest completely recovered except for bole deformation due to death of terminal leaders. In 2 years the plantation has recovered from an infected stand to a relatively healthy plantation. The actual growth loss due to the disease over the 2-year period was not ascertained.

Brown spot, *Scirrhia acicola* (Dearn) Siggers. Brown spot has been a serious threat to longleaf pine regeneration in the South for many years. However, during the 1970 and 1971 growing seasons, this disease caused severe damage to 2–0 and 3–0 eastern white pine seedlings at the Pinson State Nursery near Jackson, Tenn. Nursery personnel estimated that three-quarter million each of 2–0 and 3–0 white pine were either culled or held over due to the disease in 1971. Brown spot symptoms on 2–0 and 3–0 white pine were rather spectacular with pronounced needle browning, dying, and defoliation. Symptoms were most evident in the fall around October. No evidence of the disease was observed on 1–0 white pine at the nursery. Preliminary results obtained from a field study conducted at the Pinson Nursery in 1972 indicated that Bordeaux mixture (8–8–100) was most effective in controlling the disease. The nursery also obtained satisfactory operational results with Bordeaux mixture applied once per month this past year. Similar brown spot problems were observed on 2–0 eastern white pine in North Carolina and South Carolina State nurseries in October 1972.

Cylindrocladium root rot. *Cylindrocladium scoparium* Morgan and *C. floridanum* Sobers and Seymour. This disease was again a serious threat to 1–0 black walnut and yellow-poplar seedlings in southern nurseries in 1972. *C. scoparium* was isolated from diseased 1–0 black walnut seedlings obtained from the Pennyrile State Nursery in Kentucky in June. This fungus has also been recently isolated from diseased 1–0 yellow-poplar and 1–0 black walnut seedlings or seedbeds in two South Carolina State nurseries. At the new Piedmont State Nursery near Greenville, S. C., Cylindrocladium root rot has been diagnosed as the cause of over 75 percent mortality and disease cull losses to 100,000 1–0 black walnut this year. This represents a monetary loss to this nursery in terms of seedling sales of over $8,000.00. More recently, in October 1972, *C. scoparium* was isolated from symptomatic 1–0 yellow-poplar at the Pinson State Nursery in western Tennessee. Limited field observations revealed that as much as 50 percent of this year's 300,000 yellow-poplar seedling crop may be damaged at Pinson this year. *C. floridanum* has been isolated from both 1–0 black walnut and yellow-poplar at this nursery in past years. This brings the total known number of southern nurseries containing Cylindrocladium root rot *(C. scoparium* or *C. floridanum)* to 14 in eight States (fig. 29). Preliminary results of a field study in two North Carolina State nurseries testing the efficacy of several soil fungicides and fumigants for Cylindrocladium control showed that the preplanting soil fumigant MC-33 applied at 700 pounds per acre at 6-inch and 12-inch soil depths was most effective in controlling the disease.

Black root rot, *Sclerotium bataticola* Taub. (Davis) and *Fusarium oxysporum* Schlect. Black root rot continues to be a problem in some southern nurseries. This disease caused severe damage to 1–0 loblolly and slash pine seedlings this past spring at the St. Regis Paper Company Nursery in north-central Florida. Several thousand seedlings were damaged by the root rot even after preplanting soil fumigation with methyl bromide (brozone) at 350 pounds per acre. A gel formulation of methyl bromide provided the poorest and most inconsistent disease control results. One probable limiting factor at the Lee Nursery for successful soil fumigation is the soil composition, which is unfavorable for gas penetration and dispersion in the soil. The fungi causing black root rot were isolated this summer from damaged 1–0 loblolly pine seedlings at the Continental Can Paper Company Nursery at Statesboro, Ga. Finally, black root rot apparently continues to be favored by the hot, dry weather which is characteristic of the summers encountered in southern forest tree nurseries.

Damping off. Damping off and root rot in container grown pine seedlings were severe in Louisiana. The greenhouse-grown seedlings were part of a timber management pilot study on containerized seedlings. A *Fusarium* species was isolated from dead and dying seedlings. Damage was worse on longleaf pine, with shortleaf and loblolly less severely affected.

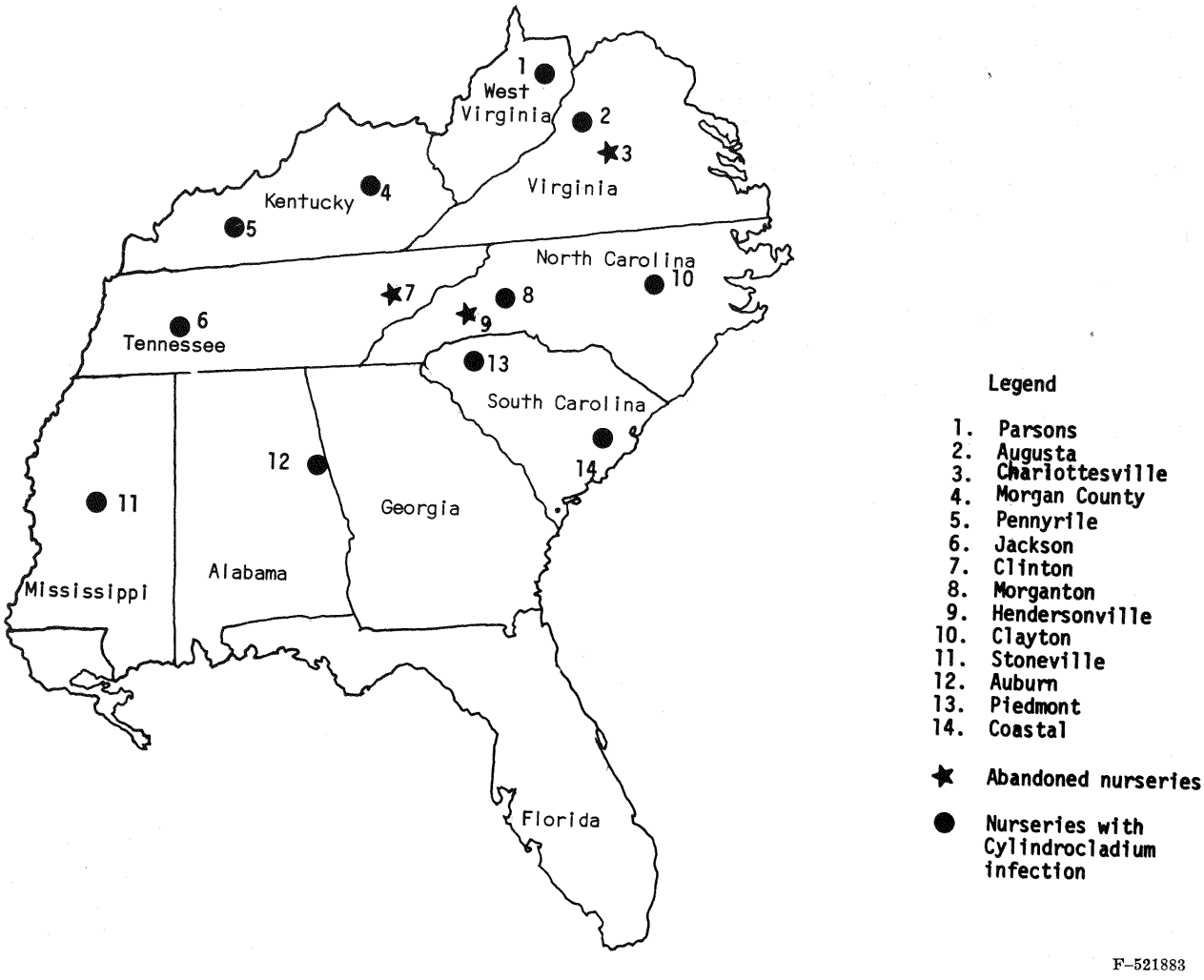

Figure 29.—Distribution of cylindrocladium root rot in Southern forest tree nurseries—1972.

Slash pine was little damaged by the fungus. Drenching with a captan-terrachlor mixture at 3 lb./100 gal. water stopped development of the disease. Transplanting of seedlings from tubes with multiple seedlings to tubes with no seedlings probably promoted the rapid spread of the fungus throughout the greenhouse. Two hundred seedlings of each tree species were planted in April 2 weeks after they had been drenched. About 44 percent of the longleaf seedlings died by the end of September. Most of this mortality occurred during the first 3 weeks after planting. Field losses in the other species were 41 percent for shortleaf pine, 39 percent for loblolly pine, and 23 percent for slash pine.

Chlorosis. Chlorosis was widespread in pine nurseries throughout the South this summer. The cause of the condition described as "summer chlorosis" is imperfectly understood. This year the standard treatment with an ironchelate resulted in unsatisfactory responses in many nurseries. Affected seedlings usually had poorly developed root systems with a reduced number of lateral roots. It is likely that the activity of soil borne pathogens such as *Pythium* and *Fusarium* contributed to the development of poor root systems which in turn were unable to produce vigorous seedlings.

Oak leaf curl. In June 1972, an unusual foliage disorder on oaks was observed in south-

west Mississippi. The disorder was noted chiefly on cherrybark oak, but similar damage was occasionally found on southern red oak. Leaves from affected trees exhibited an upward marginal curl. On cherrybark oaks, the marginal curl exposed the underside of the leaf, giving the entire tree crown a silver-grey appearance throughout. Aerial and ground surveys revealed the disorder over an area extending from Vicksburg south to Woodville and east to Gloster and Union Church. Affected trees have been examined by State and Federal entomologists, pathologists, plant physiologists, and soil scientists. Cause of the foliage disorder is still unknown.

Senna seymeria, *Seymeria cassiodes* Walt. Blake. This weedy plant parasite of pine roots (fig. 30) was first reported in Florida 2 years ago. It has now been determined that the plant is widely distributed through plantings on the Appalachicola National Forest in the Florida panhandle. Parasitism of older pine roots seems to cause no apparent damage, although some growth loss is suspected. However, mortality is believed to be occurring in young trees. Considerable damage due to the weed has been found in a 50-acre 2-year-old pine plantation. Approximately 30 percent of the seedlings have been affected and 10 percent are dead. Living affected trees show signs of considerable stress, in the form of shortened and yellowing needles, and needles in tufts at branch ends.

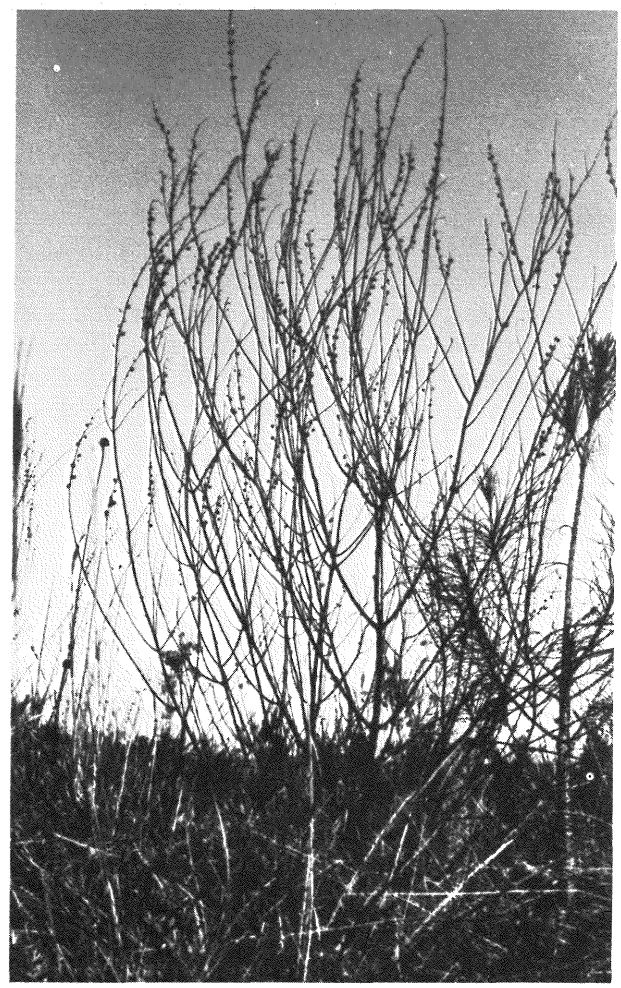

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Figure 30.—The parasitic weed, *Senna Seymeria*, in a young slash pine plantation in Florida.

Atmospheric pollutants. Needle tipburn continued to occur on eastern white pine in the southern Appalachian Mountains in 1972. Some 25 eastern white pine superior tree clones, involving approximately 950 trees obtained from three southeastern geographic seed sources, displayed characteristic tipburn symptoms and various degrees of damage (25 to 75 percent) at the Beech Creek Federal Seed Orchard in western North Carolina this past summer. Ozone and/or sulfur dioxide have been postulated as the most probable cause(s) of this problem. Field evaluations have been established to determine disease impact in the orchard and to provide possible remedial action for the orchard manager. In addition, several probable pollutant-damaged loblolly and shortleaf pine stands were examined in North Carolina, South Carolina, and Tennessee during the winter and spring of 1972. These stands included areas of approximately 4 square miles near Raleigh, N. C., 1 square mile near Orangeburg, S. C., and several square miles at Chattanooga, Tenn. Several different synthesized atmospheric pollutant industrial byproducts (other than SO_2 and O_3) have either been implicated or postulated as probable causes of these problems. Efforts to associate the disease symptoms and damage patterns observed with any fungal or insect causal agents have been negative to date.

Miscellaneous diseases. Widespread mortality of the imported mimosa or silktree (*Albizzia julibrissian* Durnzz.) has been observed throughout Louisiana, Mississippi, and Alabama. Cause of the mortality in most cases is the root rot fungus *Polyporus lucidus* Leys. ex. Fries. Mimosa wilt, caused by the fungus *Fusarium oxysporum f. perniciosum* (Hept.) Toole, is locally severe in many areas. No effective methods are presently available for controlling either disease and it is expected that increased mortality will eventually decrease the use of mimosa as a shade or ornamental tree in the South. Anthracnose, *Gnomonia veneta* (Sacc. & Speg.) Kleb., caused heavy defoliation of sycamore throughout the Mississippi River Delta and major river bottoms in east Arkansas, west Tennessee, northeast Louisiana, and northwest Mississippi during 1972. Branch dieback of short-leaf pine, due to cankering by *Atropellis tingens* Lohm. and Cash, was observed in several stands in eastern Oklahoma. Cankers generally were restricted to the lower, less vigorous branches. Juniper needle blight, *Phomopsis juniperovora* Hahn, continues to cause seedling mortality on eastern red cedar and Arizona cypress in southern forest tree nurseries. Pine needle rust, *Coleosporium* sp. (Cke.) was prevalent at the Stuart Seed Orchard in Louisiana during the spring. Various pine species were severely attacked with some needle defoliation. No significant growth loss by infected trees was observed. Sand pine mortality has been occurring at the Erambert Seed Orchard in Mississippi and the Munson Nursery in Northwest Florida. Trees 15 to 20 feet tall have been dying at the rate of 10 percent each year for the past several years. Affected trees turn pale green to yellow as symptoms progress and they die quite rapidly after initial symptoms appear. Dead and dying trees are lacking in healthy feeder roots and the root tips are usually killed and dark in color. A species of *Fusarium* has been isolated from distal roots and may be involved in the death of the trees. *Clitocybe tabescens* was causing the death of sand pine at the Munson Nursery.

Bud rot, due to *Phytophthora palmivora* (Butler), and stem bleeding, due to *Ceratocystis paradoxa* (Dade-Davison), were causing death of coconut palms in Puerto Rico and the Virgin Islands. Some control of these diseases is achieved by use of fungicides, sanitation, and prevention of wounds in the main stem.

NORTHEASTERN STATES (R–9)[9]

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Conditions in Brief

Defoliators were again the major insect pests in the Northeastern States in 1972. Defoliation of hardwood forests occurred on over 4,385,000 acres, with gypsy moth, red-humped oakworm, variable oak leaf caterpillar, and large aspen tortrix being the primary species involved.

Gypsy moth defoliation occurred most severely in Connecticut, Rhode Island, eastern New York, eastern Pennsylvania, and New Jersey. Suppression projects on approximately 174,500 acres were conducted to reduce high larval populations in areas with high-value forested properties in the four States. Incidence of gypsy moth males in trapping programs show a continued spread southward into Virginia and westward into western Pennsylvania and Ohio. Isolated incidences of gypsy moth have been recorded in Missouri, Michigan, Minnesota, and Iowa.

The red-humped oakworm–variable oak leaf roller complex occurred throughout the Lake States area, with the largest single area of severe defoliation in west Central Michigan. Private companies in Michigan treated residential areas to reduce the bothersome larval population. Populations of variable oak leaf caterpillar reported from Missouri last year collapsed in 1972.

[9] Includes forest lands in Illinois, Indiana, Iowa, Maine, Maryland, Massachusetts, Michigan, Minnesota, Missouri, New Hampshire, New Jersey, New York, Ohio, Pennsylvania, Rhode Island, Vermont, West Virginia, and Wisconsin.

The large aspen tortrix continued its infestations in the northern parts of the Lake States and occurred over much of northern Maine in 1972.

Spruce budworm was still the primary defoliator of conifers, affecting more than 4 million acres throughout the large outbreak area in northern Maine and northern Minnesota. Smaller infested areas in northern Michigan and Wisconsin were also present. Suppression activities were undertaken to reduce possible tree mortality. In Maine, over 500,000 acres were treated with 0.15 lbs. of Zectran.

A pine looper infestation on Cape Cod, Mass., nearly quadrupled in size of acreage infested from 1971 to 42,700 acres in 1972. Control was undertaken on 13,000 acres.

The major outbreak of Southern pine beetle on the Delmarva Peninsula in 1971 declined substantially this season but some residual loblolly pine mortality is still occurring.

Tree diseases continue to have their affect on timber growth and quality and forest land management for timber production and recreation usage. Dutch elm disease increased in severity in several areas and continues to spread in Minnesota and Wisconsin. Oak wilt appears to have reached a point of stability over much of its range. Scleroderris canker has been found in plantations in northeastern New York where it is also killing large Scotch pine. In the Lake States, where the disease was first found, spread and mortality in plantations of red pine are at about the same level as previous years. Annosus root rot, while still causing damage in New England, apparently has declined in incidence elsewhere within its range. Sirococcus shoot blight has increased materially in infested stands with red pine reproduction under infested sawtimber sized trees suffering most severely.

White pine blister rust continues to be present in white pine areas. A monitoring program has been developed to detect increases in rust infection. The overall program has been reduced as a result of an extensive evaluation conducted on State and private ownership land over the past several years. Pruning guidelines to reduce incidence in stands of young white pine in areas of moderate and high hazard have been developed.

Air pollution continues to be a problem in some localized areas near industrial development. This pollution incidence affects both hardwood and conifer species.

Weather exerted a major affect on many hardwood and conifer species with a late spring frost in June killing much of the tender foliar growth across the northern area of the Lake States.

Status of Insects

Gypsy moth, *Porthetria dispar* (L). The gypsy moth continues to be one of the prominent hardwood defoliators in the northeastern part of the area. Total acreage defoliated decreased in 1972 as shown by the following breakdown.

States	Acres Defoliated		Acres Treated	
	1971	1972	1971	1972
Connecticut	655,100	513,880	47,000	—
Maine	820	40	—	—
Massachusetts	18,800	20,480	—	—
New Hampshire	3,300	200	—	—
New Jersey	180,600	226,140	55,000	47,412
New York	479,150	177,605	241,000	43,000
Pennsylvania	89,000	404,060	23,000	24,800
Rhode Island	8,500	22,150	5,900	58,968
Vermont	4,500	4,215	—	—
Total acreage	1,439,770	1,369,130	371,900	174,180

This insect has been a major concern of forest land owners in New England and adjacent States since its introduction (in 1869) and spread from Massachusetts. Being an exotic species in the New England environment during its early period of activity, it did not have natural control factors to hold it in check. During the past year, control operations on 174,180 acres were conducted. The reduction from 1971 (by more than 50 percent) of acreage treated is an expression of more stringent controls to utilize pesticides only in those situations where high forest or urban values are concerned. As in 1971, Carbaryl was the primary insecticide used. Small acreages were treated with Trichlorofon (3,000 acres) and *Bacillus thuringiensis* (1,800 acres) in test programs.

Extensive trapping by Animal Plant Health Inspection Service (APHIS) revealed considerable extension of catches of male moths in areas west and south of the generally infested zone (fig. 31). Long distance spread was found to be accomplished by recreational vehicles travelling out of the general area of infestation in the East. A single female adult was reported in Minnesota inside a camper trailer from New Jersey. A house trailer was found with an egg mass and young larvae in Missouri. A male moth was trapped in central Iowa and in three counties in central lower Michigan (Isabella, Bay, and Mecosta Counties). Subsequent surveys in Isabella County indicate an established infestation. Viable egg masses were found in camping trailers in Jackson and St. Clair Counties. Survey data are incomplete at the time of this report.

Population levels in 1973 are expected to remain about the same as in previous years in areas of general infestation. However, an

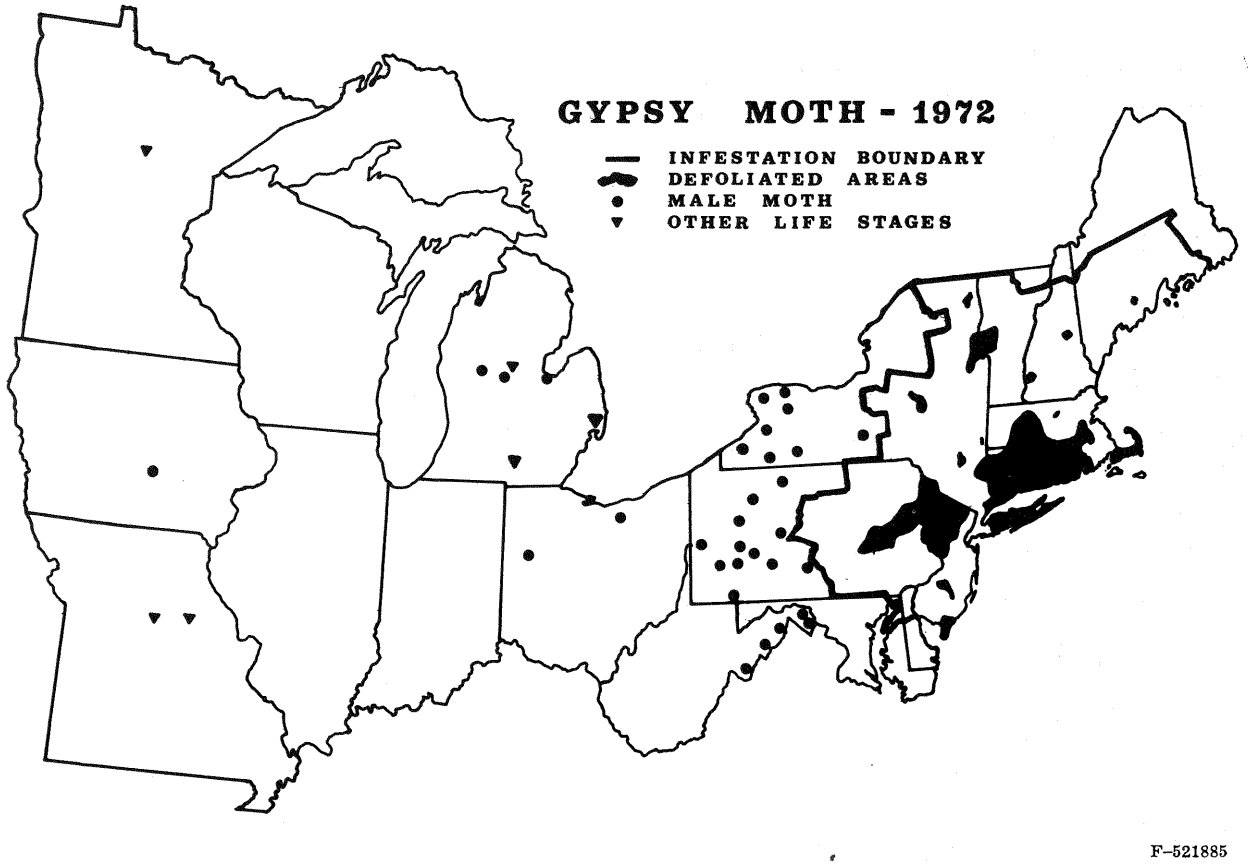

Figure 31.—Gypsy moth distribution in the Northeastern states in 1972.