United States
Department
Of Agriculture

Forest Service

Forest Health Protection

December 2000

Forest Insect and Disease Conditions in the United States 1999

Healthy Forests Make A World of Difference

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PREFACE

This is the 49th annual report prepared by the U.S. Department of Agriculture Forest Service (USDA Forest Service) of the insect and disease conditions of the Nation's forests. This report responds to direction in the Cooperative Forestry Assistance Act of 1978, as amended, to conduct surveys and report annually on insect and disease conditions of major national significance. Insect and disease conditions of local importance are reported in regional and State reports.

The report describes the extent and nature of insect- and disease-caused damage of national significance in 1999. As in the past, selected insect and disease conditions are highlighted in the front section of the report. Maps are provided for some pests showing affected counties in the East and affected areas in the West. Graphs are provided for some pests showing acreage trends over the last several years. Also provided are tables showing acreages affected for selected pests by State by year for the last 5 years.

The second section of the report brings together insect, disease, and abiotic agent damage from each affected region under the organism's or agent's name. The organisms and agents are arranged alphabetically in the appropriate section--

- insects--native;
- insects--nonnative;
- diseases--native;
- diseases--nonnative;
- diseases--origin unknown;
- declines and complexes;
- seed orchard insects and diseases;
- nursery insects and diseases; and
- abiotic damage.

These categories are listed in the table of contents; there is no index.

The information in this report is provided by the Forest Health Protection Program of the USDA Forest Service. This program serves all Federal lands, including the National Forest System and the lands administered by the Departments of Defense and Interior. Service is also provided to tribal lands. The program provides assistance to private landowners through the State foresters. A key part of the program is detecting and reporting insect and disease epidemics and the effects of wind, air pollution, floods, droughts, and other agents. Detection surveys are conducted on a regular basis by State and Forest Service program specialists.

For additional information about conditions, contact the Forest Service office listed on the next page (see map for office coverage) or your State forester.

The Forest Service also prepared "America's Forests: 1999 Health Update," which highlights major forest health concerns. The report deals with exotic (nonnative) pests, the rural-urban-wildland interface, and the effects of weather and air pollution on forests.

The report is available on the Internet at:

www.fs.fed.us/foresthealth/annual_i_d_conditions/index.html

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This report is also available on the Internet at:
www.fs.fed.us/foresthealth/annual_i_d_conditions/index.html

CONTENTS

EXECUTIVE SUMMARY

Introduction

About one-third of the Nation's land area, 736.7 million acres, is forested; 380.3 million acres in the East and 356.4 million acres (including Alaska) in the West. Nationwide, these forests provide economic, social, and environment benefits. Native and nonnative (exotic) insects and diseases, as well as abiotic influences, affect the health and productivity of the forests.

Highlighted below are some of the major native insects and diseases of concern. Also highlighted are some nonnative insects and diseases that have been introduced into the United States. These pests either are causing serious damage or have the potential to do so.

Insects: Native

Southern pine beetle - affected acreage decreased from 6.8 million acres in 1998 to 6.2 million acres in 1999.

Mountain pine beetle - affected acreage increased from 290,900 acres in 1998 to 384,700 acres in 1999.

Spruce budworm - defoliation in Alaska decreased from 87,800 acres in 1998 to 700 acres in 1999. In the Great Lakes area, defoliation decreased from 305,500 acres in 1998 to 70,000 acres in 1999.

Western spruce budworm - defoliated acreage decreased from 843,100 acres in 1998 to 528,900 acres in 1999.

Spruce beetle - the infestation in Alaska further declined to 253,300 acres in 1999. Spruce beetle activity was generally low in the West.

Insects: Nonnative

Asian longhorned beetle – in 1999, three new infestations were found in New York bringing the total up to five. No new infestations in Chicago; count remains at three. Eradication measures continue.

Gypsy moth (European) - defoliated acreage increased from 363,300 acres in 1998 to 524,800 acres in 1999.

Common European pine shoot beetle - found in Ohio in 1992, this beetle is now known to occur in 11 States from New Hampshire to Wisconsin. The beetle is a threat to Christmas tree growers.

Hemlock woolly adelgid - introduced into Virginia in 1950, this insect now occurs from North Carolina to southern New England, killing hemlock trees in 3 to 5 years.

Pink hibiscus mealybug - first discovered in Grenada in 1994, this insect is spreading throughout the Caribbean. In 1997, it was discovered on the main island of Puerto Rico. In 1999, it was found on more than 25 Caribbean islands.

Diseases: Native

Fusiform rust - is the most damaging disease of pines in the South, affecting an estimated 13.9 million acres of pine.

Dwarf mistletoes - are native parasitic plants that grow on conifers and are the most serious disease of trees in the West. An estimated 29.0 million acres of conifers are infested.

Root diseases - are among the most serious pests in the West, especially in areas where root diseases and bark beetles work together.

Diseases: Nonnative

White pine blister rust - introduced around the turn of the century, it now occurs through the ranges of the five-needled pines and has caused extensive tree mortality.

Beech bark disease - introduced into North America about 1890, this disease is killing beech trees from Maine to Pennsylvania, with outlying areas in Virginia, West Virginia, North Carolina, and Tennessee.

Diseases: Origin Unknown

Dogwood anthracnose - first found in the 1970's, the disease is now in 22 Eastern States as well as Washington, Oregon, and Idaho. The disease kills both woodland and ornamental dogwoods, although resistant dogwoods are available at many nurseries.

Butternut canker - this casual fungus was identified in the late 1970's and occurs throughout most of the range of butternut. Much of the butternut resource has been destroyed, especially in the South. Resistance work is underway.

Part 1 National Highlights

Part 1 contains more information on selected insects and diseases, including some maps, tables, and graphs.

Part 2 Conditions by Agent

Part 2 provides more detailed information about the insects and diseases discussed here as well as others. The report also describes abiotic factors, such as wind and drought, that damage forests. Abiotic factors often predispose the trees to insect and disease buildups.

Part 1 National Highlights

Insect Conditions Highlights

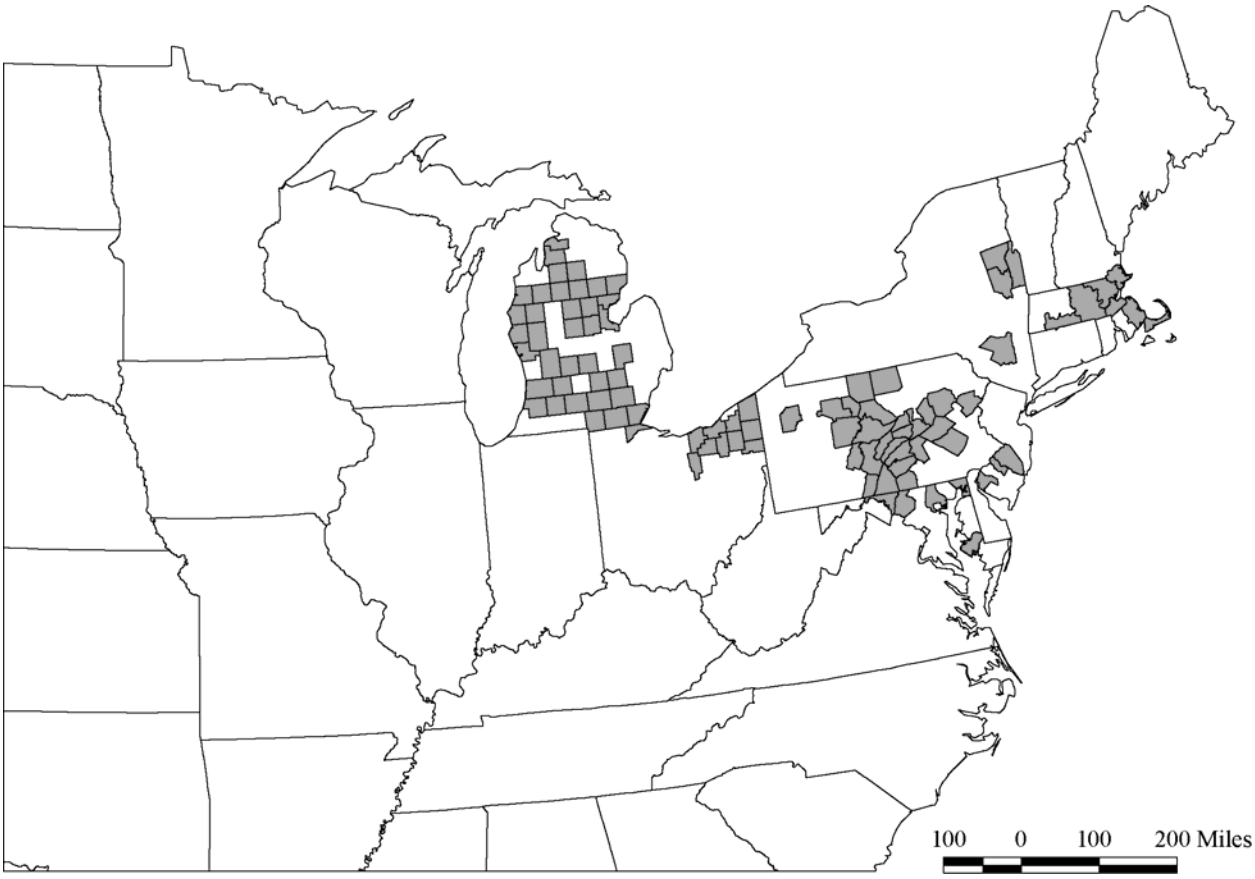
Gypsy moth

Lymantria dispar was intentionally brought into the Boston, Massachusetts, area from France in 1869 to start a silk industry. The moth escaped and continues to spread to the south and west. In 1999, all or parts of 15 States and the District of Columbia are considered infested. The infested States extend from New England to Virginia, West Virginia, Ohio, and Michigan.

Defoliation in the East increased from 363,300 acres in 1998 to 524,800 in 1999. Acreage defoliated declined in six States but large build-ups were reported in Ohio with an increase of 46,600 acres and Pennsylvania with an increase of 250,000 acres. A notable decline occurred in Michigan; a decrease of 125,100 acres. No defoliation has been observed in Indiana or Wisconsin, but moth catches are high and treatments continue in both States.

Although no defoliation was observed in either Oregon or Washington, male moths are being caught in pheromone traps. One of the 42 moths caught is the Asian form. Small suppression projects were carried out in each State. In Utah, 764 acres were treated in 1999. Gypsy moths continue to be trapped in low numbers in many places across the West.

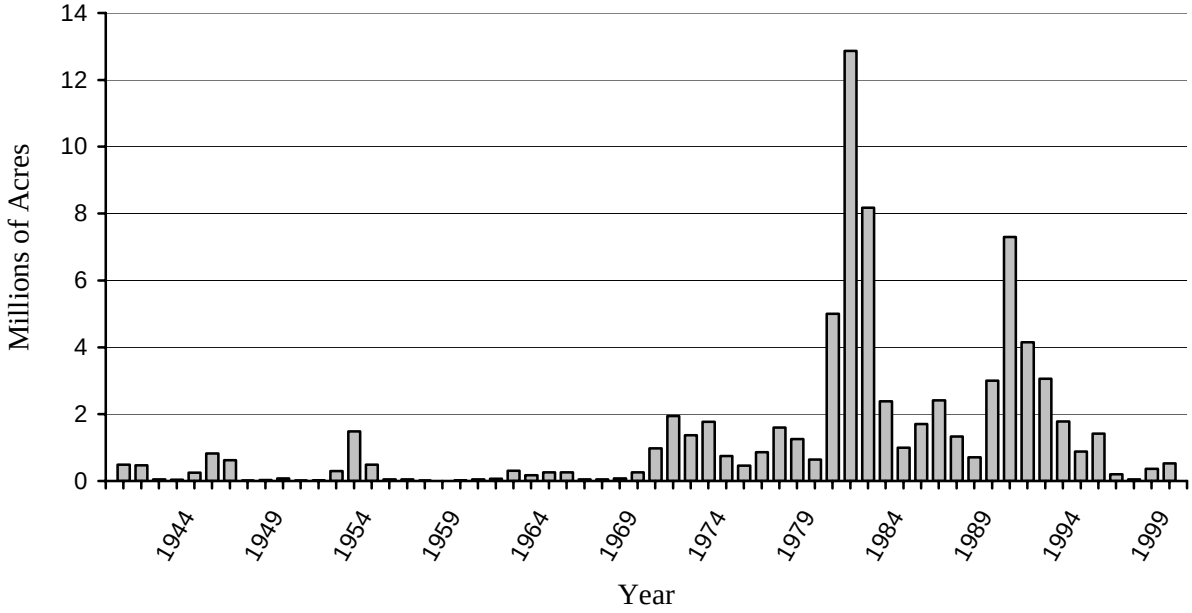
Eastern Counties Where Gypsy Moth (European) Defoliation Was Reported, 1999



Acres of Aerially Detected Gypsy Moth (European) Defoliation, 1995-1999

State	1995	1996	1997	1998	1999
Connecticut	2,700	1,400	0	0	0
Delaware	65,500	500	0	0	0
Maine	0	100	0	0	0
Maryland	93,900	11,200	700	500	1,200
Massachusetts	8,700	7,000	100	12,900	9,800
Michigan	85,900	5,000	36,900	301,700	176,600
New Hampshire	1,700	0	0	0	0
New Jersey	39,600	27,800	1,900	1,800	1,400
New York	200	16,300	2,200	9,400	6,000
Ohio	34,400	49,000	5,000	1,600	48,200
Pennsylvania	132,500	6,700	0	31,600	281,600
Rhode Island	0	4,000	0	3,000	0
Vermont	0	0	0	0	0
Virginia	849,000	0	0	0	0
Washington, DC	0	0	0	0	0
West Virginia	103,000	70,700	500	800	0
Total	1,417,100	199,700	47,300	363,300	524,800

Gypsy Moth (European) Defoliation, 1940-1999



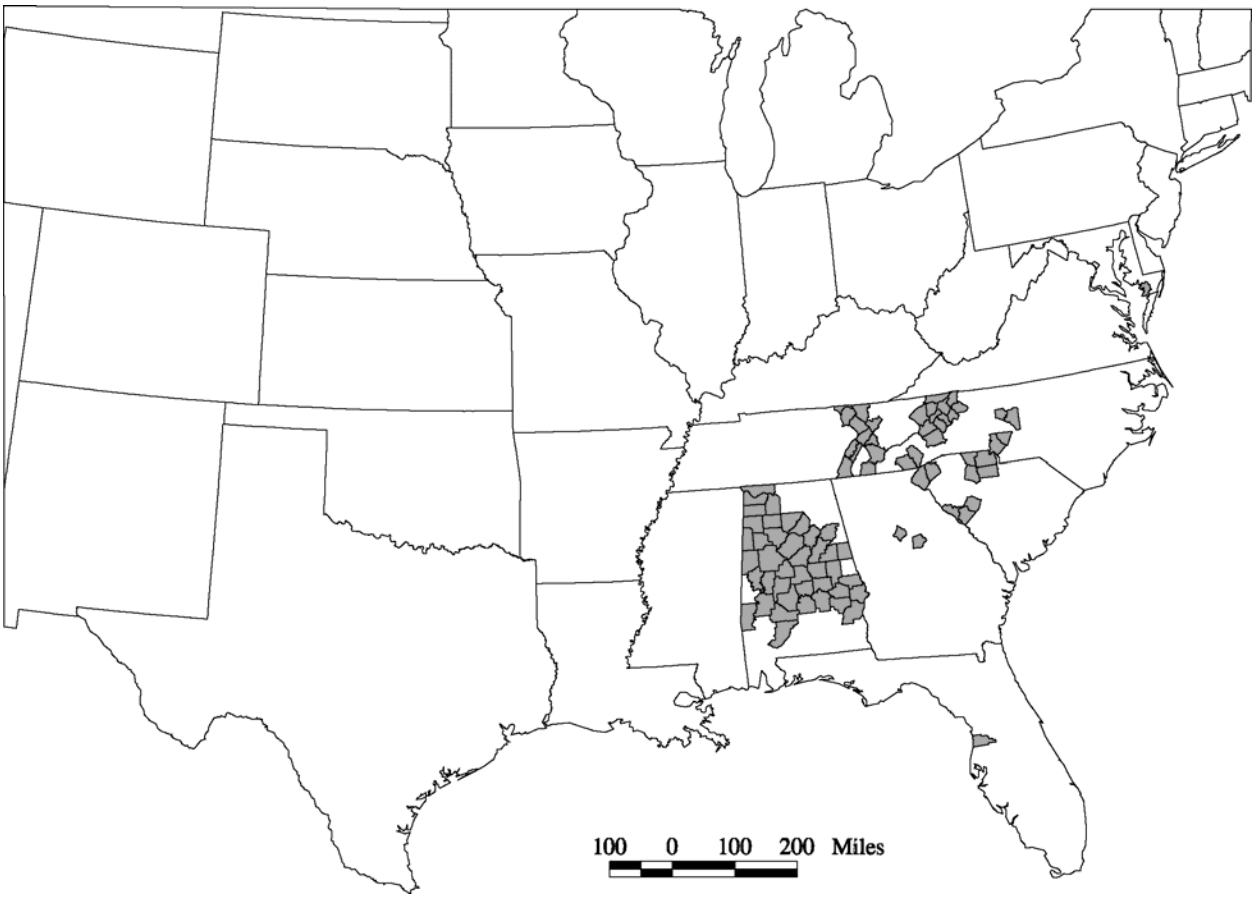
Southern pine beetle

Dendroctonus frontalis, a native insect, is the most destructive of the eastern species of bark beetles. Southern pine beetle populations are epidemic in some parts of the South almost every year. Infestations usually start in trees weakened by disease, lightning strikes, excessive age, storm damage, or other stress factors. Populations can build quickly as there are three to seven generations per year. Shortleaf, loblolly, Virginia, and pitch pines are preferred hosts.

In 1999, most of the beetle activity occurred in Alabama, Georgia, North Carolina, South Carolina, and Tennessee. Of the affected acreage, 81 percent is in Alabama where 41 of the 67 counties are affected. The outbreaks abated in the southern coastal area of North Carolina, but beetle activity occurred in the State's western piedmont and mountain counties. Beetle outbreaks in Tennessee increased by 650,000 acres to 685,000 acres. Outbreaks occurred in both the eastern foothills and mountain counties and in the southwestern area of the State. In South Carolina, the extremely hot 1999 summer caused many spots to collapse.

*Outbreak level is defined as having one or more multi-tree infestations per 1,000 acres of host type.

Counties Where Southern Pine Beetle Outbreaks Were Reported, 1999

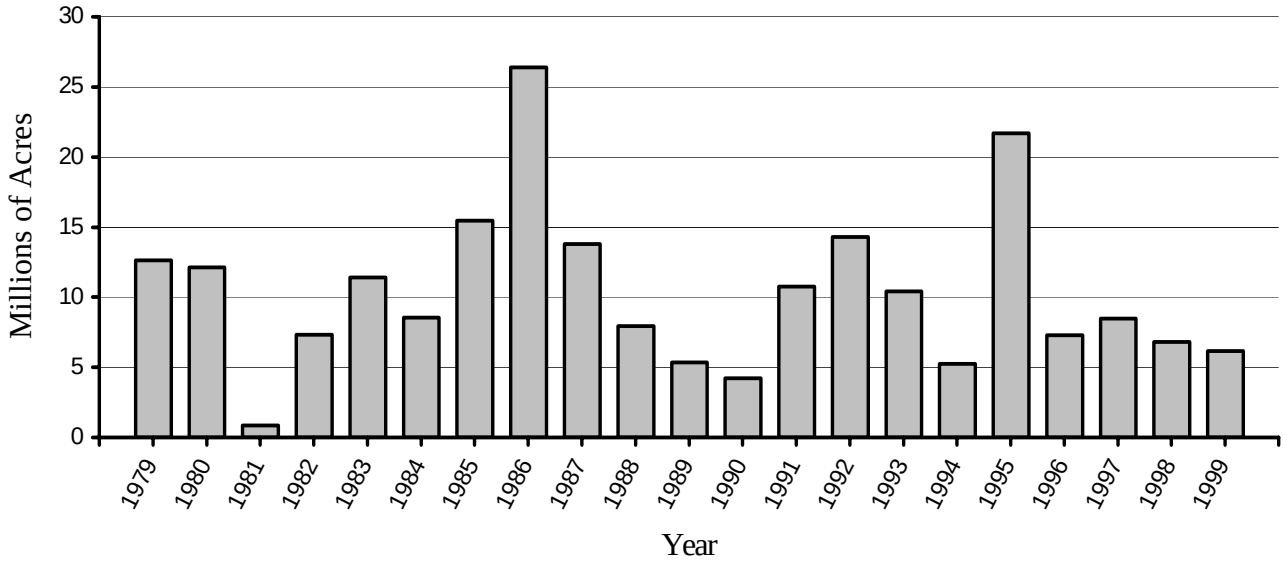


Acres (in thousands) of Southern Pine Beetle Outbreaks in the Southern Region (R-8), 1995-1999*

State	1995	1996	1997	1998	1999
Alabama	6,552.4	1,177.9	4,535.5	5,241.3	5,002.0
Arkansas	2,112.9	1,420.6	0.0	0.0	0.0
Florida	736.0	0.0	401.1	0.0	40.0
Georgia	1,326.0	101.3	312.9	65.0	171.0
Kentucky	0.0	0.0	0.0	0.0	0.0
Louisiana	2,908.8	165.3	110.0	228.0	0.0
Mississippi	2,714.3	1,150.9	892.1	73.0	0.0
North Carolina	2,755.6	747.1	702.3	234.0	252.0
Oklahoma	0.0	0.0	0.0	0.0	0.0
South Carolina	2,542.9	2,496.6	843.0	944.0	8.7
Tennessee	0.0	41.2	30.3	35.0	685.0
Texas	0.0	0.0	649.6	0.0	0.0
Virginia	27.0	0.0	0.0	0.0	0.0
Total	21,675.9	7,300.9	8,476.8	6,820.3	6,158.7

* Acres of outbreak are acres of host type having one of more multi-tree spots per 1,000 acres.

Southern Pine Beetle Outbreaks in the Southern Region (R-8), 1979-1999*



* Does not include Delaware, Maryland, or West Virginia, which are in the Eastern Region (R9)/Northeastern Area.

Mountain pine beetle

Dendroctonus ponderosae is a native bark beetle that attacks lodgepole, ponderosa, sugar, western white, and other pines. The beetle ranges throughout western pine forests from Canada into Mexico. Beetles infest mature lodgepole pine and both mature and overstocked stands of other pines. Dense stand conditions continue to predispose areas to the beetle.

Mountain pine beetle populations increased in Montana and northern Idaho for the third consecutive year to 144,000 acres in 1999. About 95 percent of the beetle-killed trees are lodgepole pine. Beetle damaged acreages increased in Colorado for the fifth consecutive year and is increasing in South Dakota and Wyoming also.

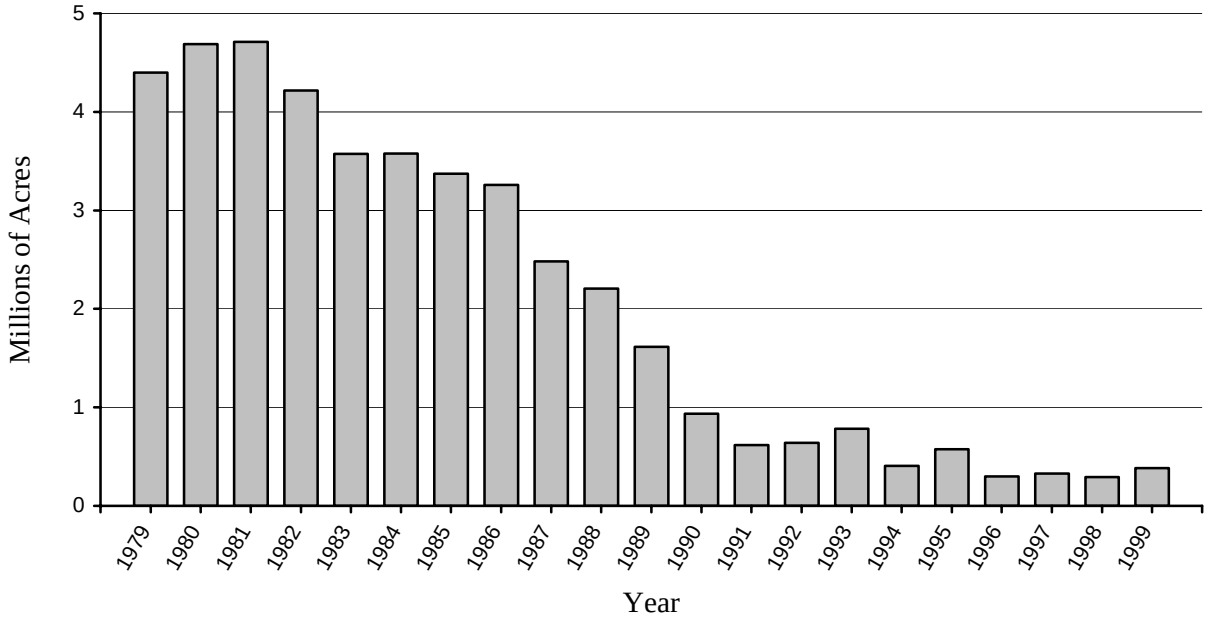
In the Pacific Northwest, three consecutive years of decreasing affected acreages ended in 1999. About 111,148 acreas are affected compared to 95,800 acres in 1998. Increases were in all host types except ponderosa pine.

Mountain Pine Beetle Outbreak Areas, 1999

Acres (in thousands) of Mountain Pine Beetle Outbreak, 1995-1999

State	1995	1996	1997	1998	1999
Arizona	0.2	2.2	10.0	7.4	0.0
California	58.9	25.1	15.2	26.8	9.7
Colorado	4.7	12.8	22.2	23.1	71.8
Idaho	13.9	33.4	54.0	81.6	84.3
Montana	31.3	27.6	33.4	39.2	77.4
Nevada					1.4
New Mexico	0.4	1.1	0.1	0.0	0.0
Oregon	234.4	112.6	82.3	65.5	46.2
South Dakota	2.6	2.2	9.4	10.0	19.0
Utah	20.9	24.6	20.9	4.5	3.7
Washington	205.9	56.7	74.7	30.3	65.0
Wyoming	2.3	1.7	6.7	2.5	6.2
Total	575.5	300.0	328.9	290.9	384.7

Mountain Pine Beetle Outbreaks, 1979-1999



Spruce budworm

Choristoneura fumiferana is a native insect found in northern New England, New York, Pennsylvania, the Great Lakes Region, and Alaska. Balsam fir is the preferred host, but the insect also feeds on white, red, and black spruce. Topkill and tree mortality may result from budworm feeding. Outbreaks generally begin in extensive and continuous areas of mature and overmature balsam fir.

In the East, the only reported budworm caused defoliation was in the three county areas in extreme northeast Minnesota. Defoliation declined from 256,400 acres in 1998 to 70,000 acres in 1999. This is the 46th consecutive year of budworm defoliation in Minnesota.

In Alaska, the budworm outbreak of more than 5 consecutive years declined. Little or no tree mortality was associated with the outbreak although top-kill was prevalent.

Eastern Counties Where Spruce Budworm Defoliation Was Reported, 1999

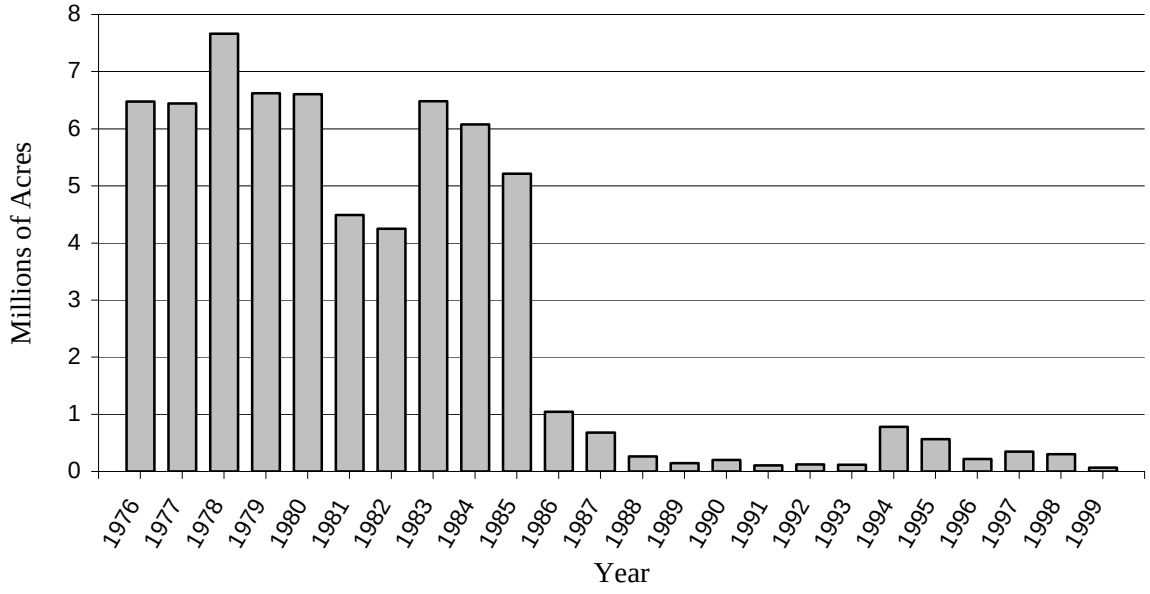
Acres (in thousands) of Aerially Detected Spruce Budworm Defoliation in the Eastern United States, 1995-1999

State	1995	1996	1997	1998	1999
Maine	0.0	0.0	0.0	0.0	0.0
Michigan	51.2	12.9	61.6	33.0	0.0
Minnesotta	505.0	207.6	276.2	256.4	70.0
New Hampshire	0.0	0.0	0.0	0.0	0.0
New York	0.4	0.0	0.0	0.0	0.0
Pennsylvania	0.0	2.0	0.0	0.0	0.0
Vermont	0.0	0.0	0.0	0.0	0.0
Wisconsin	12.5	0.0	9.6	16.1	0.0
Total	569.1	222.5	347.4	305.5	70.0

Acres (in thousands) of Aerially Detected Spruce Budworm Defoliation in Alaska, 1995-1999

State	1995	1996	1997	1998	1999
Alaska	279.1	235.9	38.4	87.8	0.7

Spruce Budworm Defoliation in the Eastern United States, 1976-1999



Western spruce budworm

Choristoneura occidentalis is a native insect occurring in the Rocky Mountains from Arizona and New Mexico north to Idaho and Montana and also in Washington and Oregon. The insect causes topkill, loss of growth, and some tree mortality. The budworm feeds primarily on Douglas-fir and true firs.

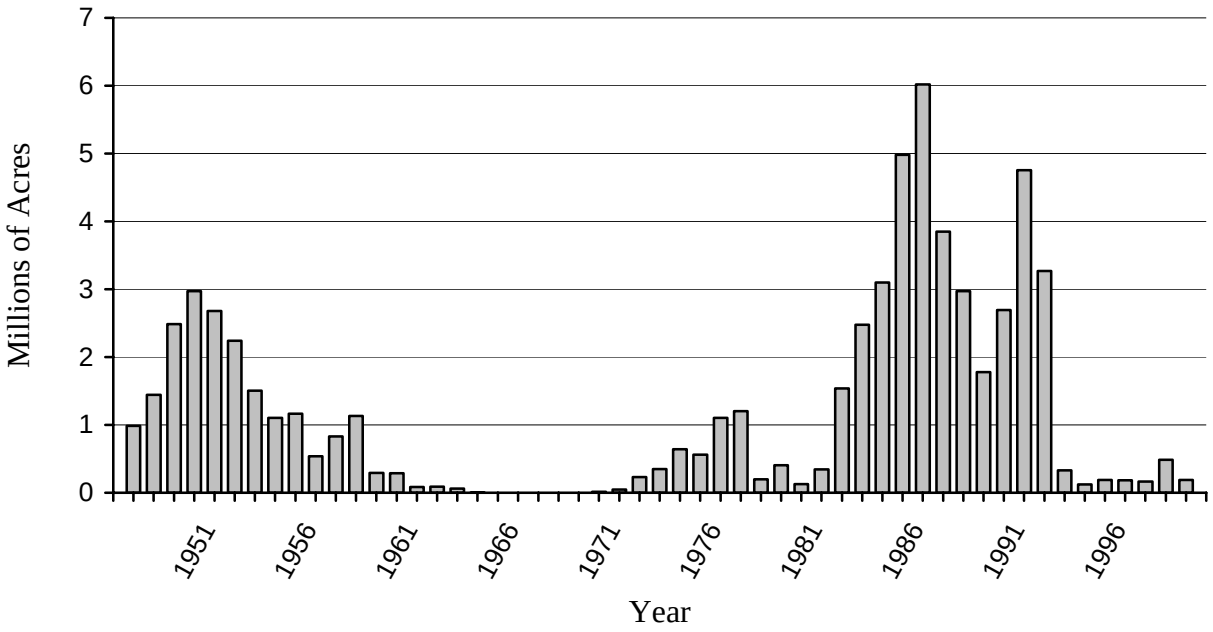
No budworm-caused defoliation was observed from the air in Montana and northern Idaho in 1999, however, pheromone trap counts were up significantly in some areas. Populations appear to be rebuilding, but remain low. About 41,000 acres of defoliation occurred in southwestern Colorado. Also, budworm defoliated 10,500 acres in Arizona and 282,600 acres in New Mexico. In the Pacific Northwest, areas of aerially visible defoliation decreased by 297,100 acres to 189,700 acres; all in Washington.

Western Spruce Budworm Defoliation Areas, 1999

Acres (in thousands) of Aerially Detected Western Spruce Budworm Defoliation, 1995-1999

State	1995	1996	1997	1998	1999
Arizona	7.0	3.0	1.1	10.1	10.2
California	0.0	0.0	0.0	0.0	0.0
Colorado	97.0	21.8	0.0	15.8	41.0
Idaho	0.0	0.0	0.0	0.0	3.6
Montana	0.0	0.0	0.0	0.0	0.0
New Mexico	183.8	123.9	197.1	310.5	282.6
Oregon	14.9	1.0	0.0	0.0	0.0
Utah	0.0	0.0	0.0	19.9	1.2
Washington	175.1	183.2	165.9	486.8	189.7
Wyoming	0.0	0.0	0.0	0.0	0.6
Total	477.8	332.9	364.1	843.1	528.9

Western Spruce Budworm Defoliation in the Pacific Northwest Region (R-6), 1947-1999

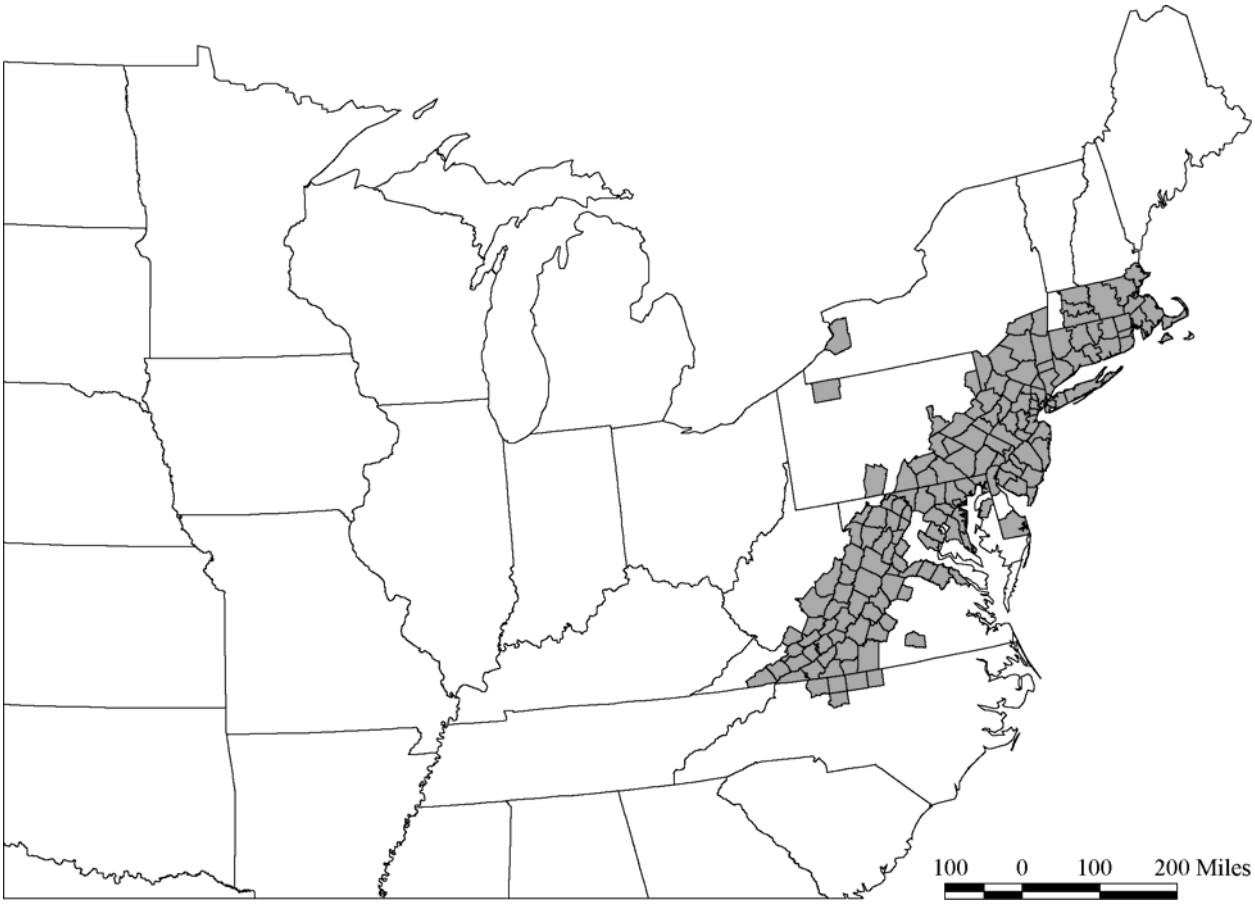


Hemlock woolly adelgid

Adelges tsugae was introduced into the east coast near Richmond, Virginia, in 1950. The adelgid poses a serious threat to eastern hemlock and Carolina hemlock; tree mortality usually occurs 3 to 5 years after attack. By the early 1990's, the adelgid had spread into 11 States from North Carolina to Massachusetts, causing extensive hemlock decline and tree mortality. The adelgid continues to spread in the north with new townships and counties added to the list of those with infested hemlock.

The adelgid was introduced into the west coast from Asia in 1924 and is now found in British Columbia, Washington, Oregon, and California. The adelgid appears to be innocuous in the West as little damage is reported.

Eastern Counties Where Hemlock Woolly Adelgid Was Reported, 1999

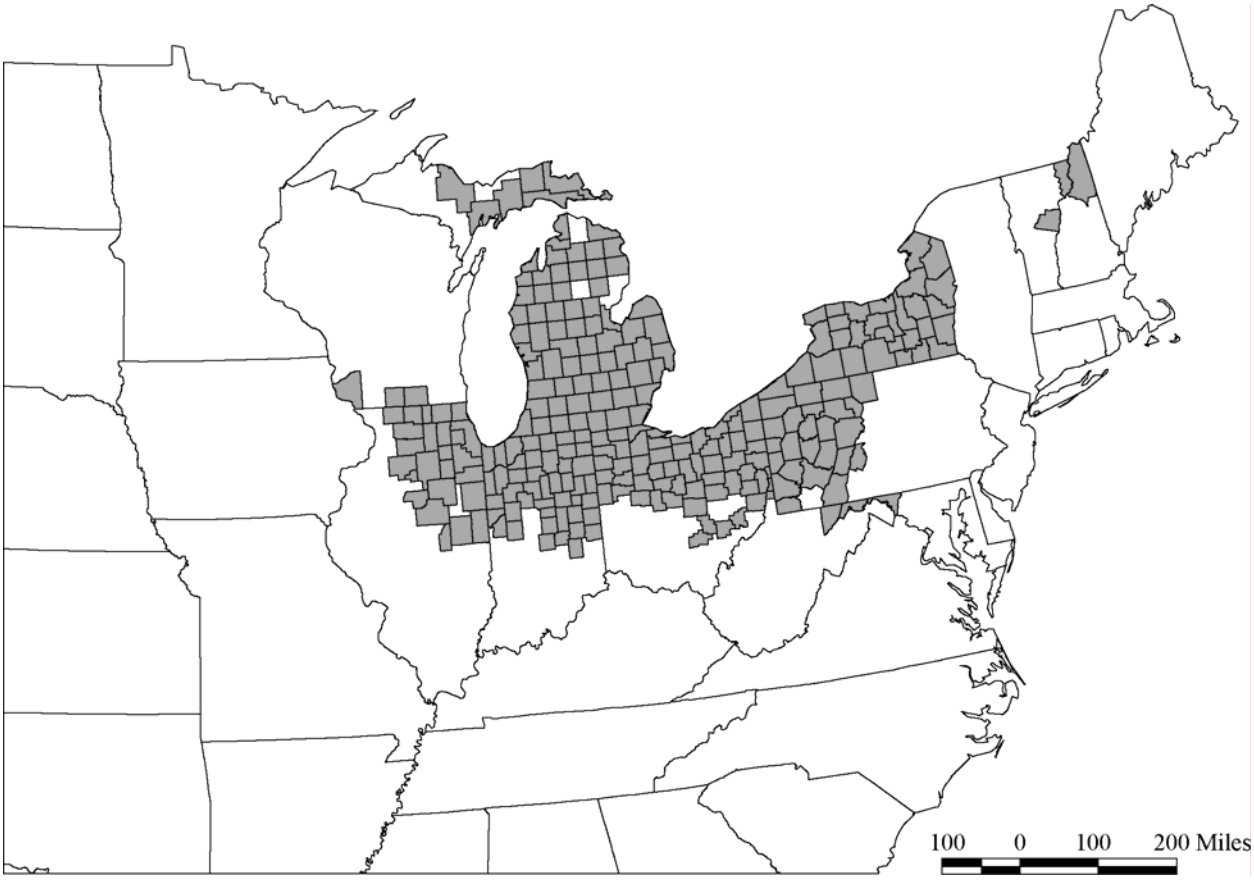


Common European pine shoot beetle

Tomicus piniperda is an introduced insect discovered in a Christmas tree plantation near Cleveland, Ohio, in 1992. The beetle prefers Scotch pine, but feeds on other pines as well. The beetle damages weak and dying trees and feeds in the new growth (shoots) of healthy trees. Thus far, the beetle is a problem mainly to Christmas tree growers. In its native Europe and Siberia, the beetle causes serious damage to trees in burned-over areas and areas experiencing severe drought.

State and Federal quarantines have been imposed to prevent the movement of this beetle, which was found in 6 States in 1993. In 1999, the beetle has been found in 11 northeastern States; New Hampshire and Vermont were added to the list in 1999. Also in 1999, the beetle was found in 18 new counties.

Eastern Counties Where The Common European Pine Shoot Beetle Was Reported, 1999



Spruce beetle

Dendroctonus rufipennis is a native insect that occurs across North America from Maine to Alaska and south in the Rocky Mountains to Arizona. Spruce beetle is the most significant mortality agent of mature spruce. Populations also build up in windthrown trees. Besides killing merchantable trees, infestations affect habitat quality for wildlife and fish, reduce scenic quality, and increase fire hazard.

The infestation in Alaska further declined in 1999 to 253.3 thousand acres from the peak 1.13 million acres in 1996. The 1999 acreage is the lowest in the past 10 years. There are still some spots of heavy activity.

Elsewhere in the West, spruce beetle activity was generally low; however, beetle populations are expected to build in the extensive areas of blowdown in Colorado. In Wyoming, some areas of severe beetle damage were observed. Beetle populations are expected to increase in areas of recent avalanches.

In Maine the beetle infestation remains along the central Maine coast. The infestation is expected to expand following the 1999 drought.

Spruce Beetle Active and Newly Infested Areas in Alaska, 1999

Disease Conditions Highlights

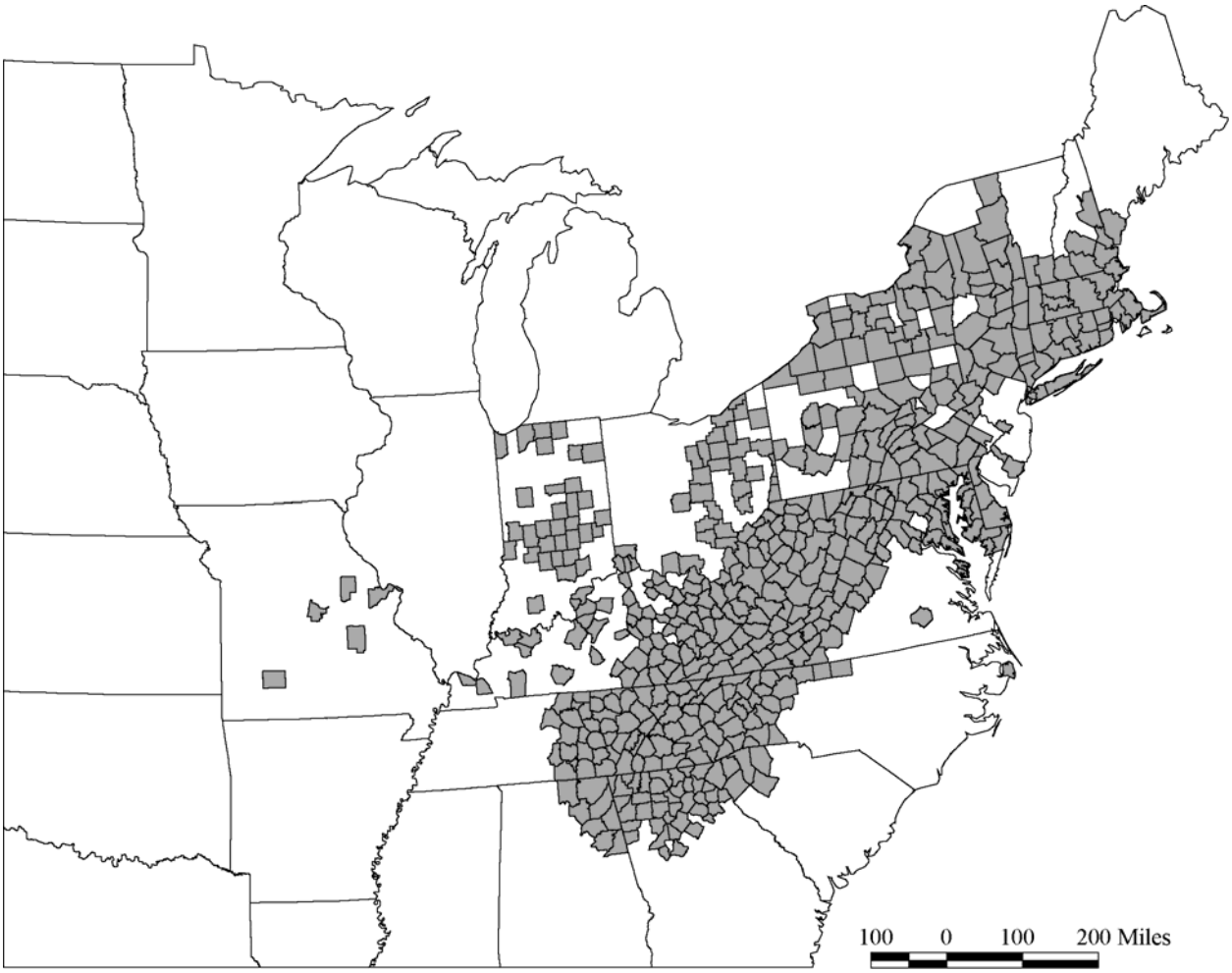
Dogwood anthracnose

Discula destructiva, the fungus that causes dogwood anthracnose, is of unknown origin. First discovered in the Pacific Northwest in 1976, the disease is confirmed in Idaho, Oregon, and Washington. Although the Pacific dogwood is more susceptible to the fungus than the eastern dogwood, drier summers in the West reduce the number of infection cycles. Significant mortality has occurred, but the problem is not as severe as it is in the East.

In the East, the fungus was first found in southeastern New York in 1978. By 1994, this disease was found in 22 States from Maine to Georgia and west to Indiana and Missouri. The range of dogwood extends from southern Maine to Florida and west to Michigan and eastern Texas.

Dogwood anthracnose continues to intensify within the infested counties in the South, but no new infested counties were found. In the Northeast, diseased dogwoods have been found in every county in Maryland, West Virginia, and Delaware. A survey in New York recorded dogwood anthracnose in 18 additional counties.

Eastern Counties Where Dogwood Anthracnose Was Reported, 1999



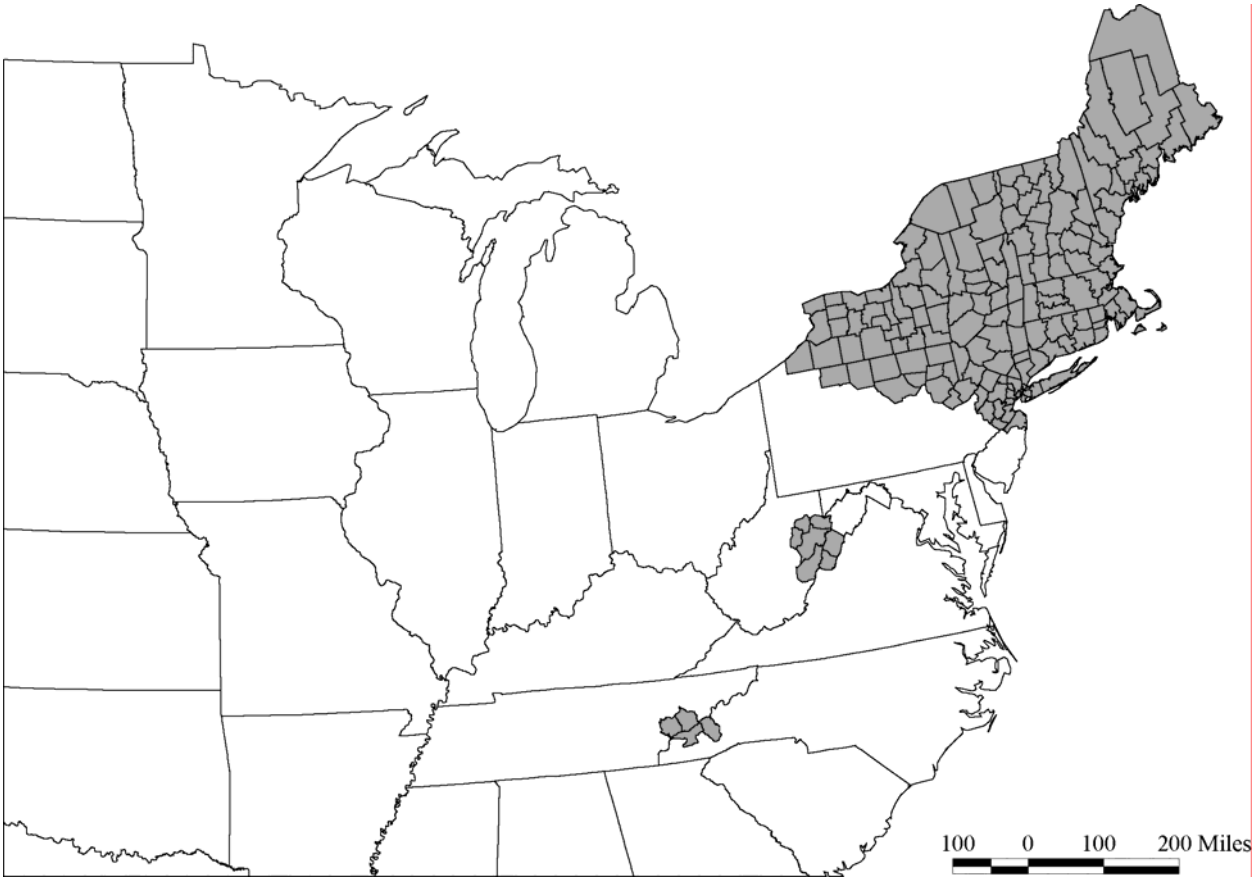
Beech bark disease

Beech disease results when bark--attacked and altered by the beech scale, *Cryptococcus fagisuga*--is invaded and killed by the fungus *Nectria coccinea* var. *faginata*. The scale, and probably the fungus, was accidently brought to Nova Scotia, Canada, about 1890. By 1932, the disease was killing trees in Maine. It continued to advance south and west into northeastern Pennsylvania.

In 1981, a large area of infested American beech was found in West Virginia well ahead of the advancing front of the disease. Beech mortality was reported in northern Virginia by the mid 1980's. In 1994, the disease was affecting approximately 100 acres in three counties on the North Carolina-Tennessee border (within the Great Smoky Mountains National Park). This infestation was about 300 miles southwest of its previously known distribution.

Tree mortality continues to intensify within the affected counties in the South, and at a greater rate than predicted. In New York, 90 percent of the trees surveyed have evidence of the disease. The range of American beech is from Maine to northwest Florida, and west to eastern parts of Wisconsin and Texas.

Eastern Counties Where Beech Bark Disease Was Reported, 1999

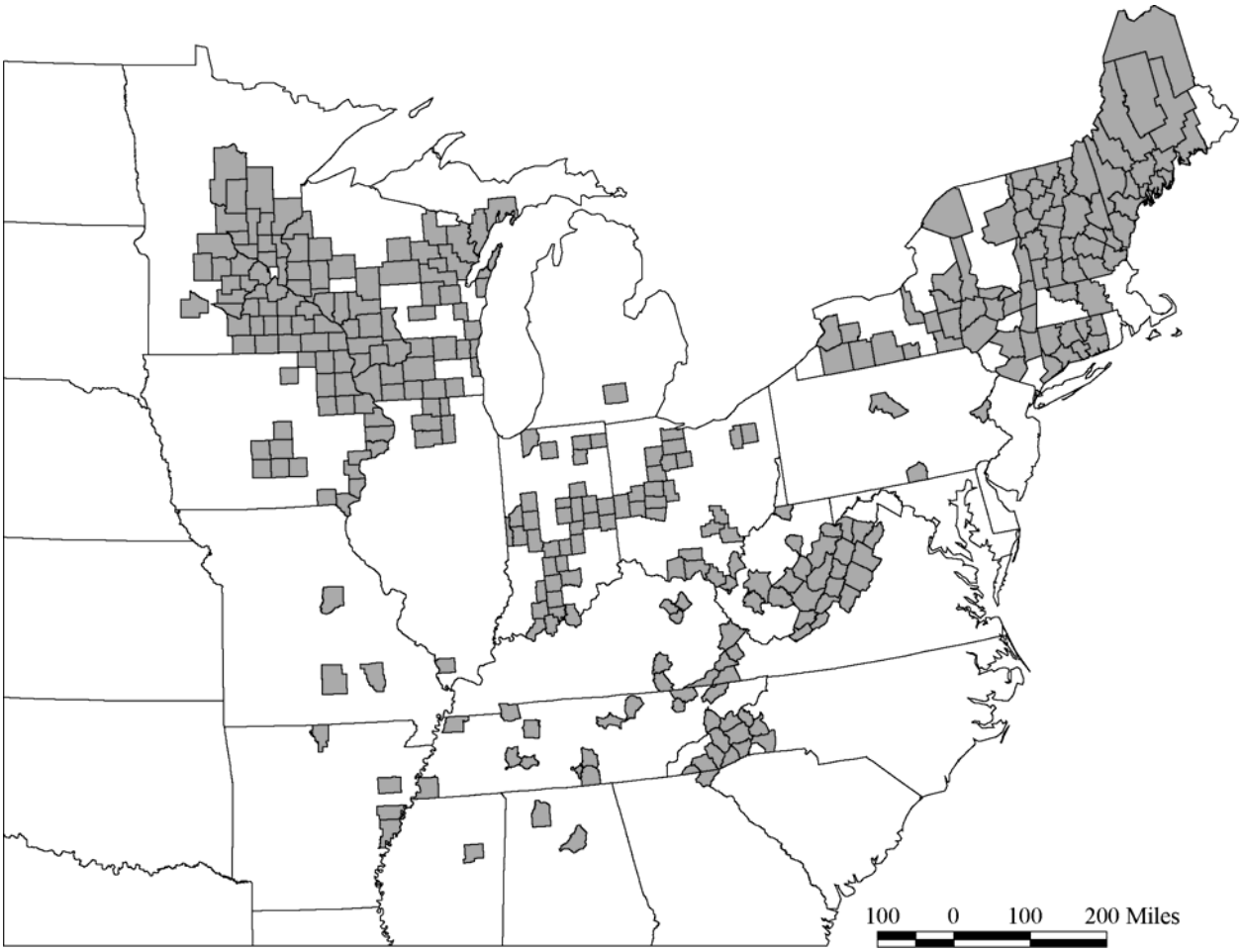


Butternut canker

Sirococcus clavigignenti-juglandacearum is the fungus that causes butternut canker; the origin is unknown. Symptoms of the disease have been recognized since the early 1900's, but the casual fungus was not identified until the late 1970's. The range of butternut is from Maine to Georgia on the east, and west to Minnesota and Arkansas. Butternut is not an abundant tree in any part of its range.

The disease is found throughout most of the range of butternut and is a serious threat to the survival of the species--killing large trees, saplings, and regeneration. It is estimated that 77 percent of the butternut trees in North Carolina and Virginia have been killed. Trees exhibiting resistance to the disease have been found in five States from Virginia to Arkansas. These trees are being propagated for host resistance studies. There are no known control measures.

Eastern Counties Where Butternut Canker Was Reported, 1999



Fusiform rust

Cronartium quercuum f. sp. *fusiforme*, a native fungus, continues to be the most damaging disease agent of loblolly and slash pines in the South. The disease disfigures and kills trees up to pole size and results in much stem breakage. The disease is damaging in both plantations and natural stands.

An estimated 13.9 million acres of pines are affected. Acres are classified as affected if more than 10 percent of the trees have potentially lethal cankers. Georgia is the most seriously affected State, with 4.6 million acres (49 percent) of the host type affected. Genetic selection of resistant planting stock is leading to significant improvement in field survival and stand quality.

Acres (in thousands) Affected by Fusiform Rust, 1999*

State (survey year)	National Forest System	Other Federal	State and Private	Total
Alabama (90)	7.1	0.0	1,704.2	1,711.3
Arkansas (95)	4.9	0.0	280.5	285.4
Florida (95)	35.3	6.8	1,426.3	1,468.4
Georgia (89)	38.0	102.8	4,452.9	4,593.7
Louisiana (91)	85.0	18.4	1,554.9	1,658.3
Mississippi (94)	118.0	60.0	1,043.0	1,221.0
North Carolina (90)	4.9	7.8	956.2	968.9
Oklahoma (93)	0.0	0.0	33.9	33.9
South Carolina (95)	46.0	59.0	1,332.2	1,437.2
Texas (92)	21.8	0.0	397.3	419.1
Virginia (92)	0.0	0.0	59.3	59.3
Total	361.0	254.8	13,240.7	13,856.5

* Acres with greater than 10 percent infection.

Dwarf mistletoes

Arceuthobium spp. are parasitic plants that invade the branches of host trees. These pest species are associated with much of the tree mortality in the West. Conifers on about 29.0 million acres of western forests are infested. Dwarf mistletoe infection reduces tree growth and seed crops and kills tops, branches, and entire trees. Growth loss totals about 164 million cubic feet of wood annually. Most of the volume loss is caused by 7 of the 19 dwarf mistletoe species. These species occur on Douglas-fir, lodgepole pine, true fir, western hemlock, western larch, and two species on ponderosa pine.

In the past, fire helped reduce the incidence of dwarf mistletoes. Fire control has had the inadvertent effect of allowing dwarf mistletoes to increase in severity.

Acres (in thousands) in the West Affected by Dwarf Mistletoes, 1998

State (survey year)	National Forest System	Other Federal	State and Private	Total
Alaska*	3,060.0	0.0	340.0	3,400.0
Arizona (85-89)	1,040.0	674.0	25.0	1,739.0
California (80-90)	2,283.0	69.0	1,911.0	4,263.0
Colorado (96)	638.0			638.0
Idaho - North (70-80)**	478.0	10.0	224.0	712.0
Idaho - South (94)**	2,813.2			2,813.2
Montana (70-80)	1,694.0	123.0	602.0	2,419.0
New Mexico (97)	1,440.0	348.0	581.0	2,369.0
Nevada (94)	52.1			52.1
Oregon (67)	1,137.0	43.0	2,760.0	3,940.0
Utah (94)	416.7			416.7
Washington (97)	2,703.3	505.0	2,470.0	5,678.3
Wyoming (97)	582.7			582.7
Total	18,338.0	1,772.0	8.913.0	29,023.0

* Commercial acreage only in Alaska.
** Idaho-North is in Region 1, and Idaho-South is in Region 4.

Part 2 Conditions by Damage Agent by Region

Insects: Native

Balsam gall midge,
Paradiplosis tumifex

Region 9/Northeastern Area: New Hampshire, Maine, Vermont

Host(s): Balsam fir

Populations exploded in 1999 and were moderate to high in many areas in Maine. Estimates of the area affected exceed 10,000 acres and it was difficult to find suitable balsam fir brush for wreaths. This created a problem when hundreds of shipped wreaths were rejected by States such as California. Scattered populations occurred in New Hampshire and Vermont.

Balsam twig aphid,
Mindarus abietinus

Region 5: California

Host(s): White fir

This aphid caused needle stunting and twig distortion of white fir over 5,000 to 10,000 acres on the Hume Lake District, Sequoia National Forest, and the Sequoia-Kings Canyon National Parks. Much of the area affected coincided with areas that had received moderate to heavy defoliation by the Douglas-fir tussock moth between 1997 and 1999. Twisted needles on new growth of white fir were also widespread on the Modoc and Lassen National Forests.

Buck moth,
Hemileuca maia

Region 8: Louisiana

Host(s): Live oak and other hardwoods

Buck moth defoliation of live oak has been a problem in New Orleans for a number of years. It continues to be locally abundant in the city and of particular concern in the Federal Historic Districts. Pheromone trapping of adult moths is being utilized to identify hot spots for further evaluation.

Cedar bark beetles,
***Phleosinus* spp.**

Region 5: Northwestern California

Host(s): Incense-cedar

Cedar bark beetles were involved in mortality of Port-Orford-cedar along the Trinity River north of Trinity Lake and along Castle Creek above Castle Crags State Park; and in a spot of mortality along Clear Creek in the Siskiyou Wilderness. Silting during flooding and debris-flow damage were involved in the first two locations. Port-Orford-cedar root disease was not involved in any of the situations.

Cypress looper,
Anacamptodes pergracilis

Region 8: Florida

Host(s): Baldcypress and pond cypress

The serious 1998 cypress looper outbreak in Florida did not reappear in 1999.

Douglas-fir beetle,
Dendroctonus pseudotsugae

Region 1: Idaho, Montana

Host(s): Douglas-fir

As expected, Douglas-fir beetle (DFB)-caused tree mortality increased dramatically in 1999. These trees were actually attacked by the beetle in 1998, but most crowns didn't fade until 1999. On the three northern Idaho National Forests (Idaho Panhandle, Clearwater, and Nez Perce) and adjacent State, private, and other Federal lands, infested acres increased from about 47,000 in 1998 to over 136,000 in 1999. Most of the increase occurred on the Idaho Panhandle National Forests and adjacent lands, which went from just over 5,000 acres infested, as detected in 1998 aerial surveys, to over 108,000 acres detected in 1999. Western Montana forests also experienced increases. Over 47,000 acres were infested on the Kootenai, Flathead, Lolo, and Bitterroot National Forests, up from about 8,300 acres in 1998. Regionwide, over 508,000 trees were killed by DFB's on over 187,295 acres. This is the highest level of tree mortality caused by DFB's in the region since the early 1950's. This outbreak was linked to unusually high amounts of wind-thrown and winter damaged trees available to the beetles in the spring of 1997. Ground surveys conducted in the fall of 1999 indicate that 1998 (detected by 1999 aerial survey) was probably the peak of the outbreak. Other than a few areas with still building populations, we anticipate an overall declining trend for the next few years.

Region 2: Wyoming, Colorado

Host(s): Douglas-fir

State lands, primarily in Fremont county, saw an increase in Douglas-fir beetles (DFB's) from 1998 to 1999. There are roughly 5,000 acres (mostly on steep slopes) that are considered susceptible to DFB's. DFB's killed 1,680 trees on 2,383 acres along the North Fork of the Shoshone River in the Shoshone National Forest in 1998. This increased to 14,449 trees on 5,791 acres in 1999. Spots (50 trees or more) were observed along the side drainages of the North Fork of the Shoshone River. The DFB continues to remain at endemic levels in the Bighorn National Forest in Wyoming. In Colorado, DFB's killed an estimated 8,900 trees on 5,800 acres. Mortality has increased by 32 percent from the 1998 estimates. Almost three quarters of the total DFB mortality occurred in the lower South Platte River watershed. The DFB also continues to kill trees that survived the 1996 Buffalo Creek Fire. Recent DFB activity is evident on the Saguache Ranger District of the Rio Grand National Forest, where Douglas-fir forests have been repeatedly defoliated by western spruce budworm, *Choristoneura occidentalis*, for the past 13 years.

Region 3: Arizona, New Mexico

Host(s): Douglas-fir

Douglas-fir beetle-caused tree mortality in the Southwest increased from 1,555 acres in 1998 to 3,315 acres in 1999. In Arizona, Douglas-fir beetle-caused tree mortality occurred on the Apache-Sitgreaves (360 acres), Coconino (2,680 acres), Kaibab (60 acres), Prescott (5 acres), and Tonto (15 acres) National

Forests; Grand Canyon National Park (15 acres); Fort Apache Indian Reservation (175 acres); and 5 acres of private lands. No Douglas-fir beetle activity was detected in New Mexico in 1999.

Region 4: Idaho, Utah, Wyoming

Host(s): Douglas-fir

Increasing mortality was observed in Idaho and Wyoming and static mortality levels in Utah. In 1998, 31,300 trees were killed compared to 52,500 trees in 1999. Outbreaks were located on the Sawtooth, Boise, Salmon-Challis, Caribou, Targhee and Payette National Forests in southern Idaho. In Utah outbreaks were located on the Manti-LaSal, Ashley, Dixie, Fishlake, Uinta, and Wasatch-Cache National Forests. Mortality on the Bridger-Teton National Forest in western Wyoming increased from 3,600 trees in 1998 to 5,900 trees in 1999.

Region 5: Northern California

Host(s): Douglas-fir

Douglas-fir beetles killed a small number of Douglas-firs near Hotelling Ridge, southwestern Siskiyou County. The attacking population apparently developed in trees damaged during storms in December 1995.

Region 6: Oregon, Washington

Host(s): Douglas-fir

Douglas-fir beetle activity, as expected, was detected on more acres, at somewhat greater intensities. Activity was reported on 151,120 acres with an average of 1.4 trees per acre in 1999 as compared to 33,600 acres averaging 1.1 trees per acre in 1998. Increased levels of activity were detected on virtually all reporting areas within the region. Northeastern Washington, the Blue Mountains of Oregon, and westside forests in the Oregon Cascades were most heavily affected. Predisposing tree stresses caused by repeated years of defoliation by western spruce budworm, drought, and overstocking may result in relatively high levels of DFB activity in the next few years. Increased activity in northeastern Oregon and in other parts of the region is associated with either recent fires or with windstorm breakage or blowdown that has occurred the past couple of years. Another year of increased DFB-caused mortality is expected for the summer of 2000 and likely into the year 2001. Heavy blowndown associated with winter 2000 storms will probably exacerbate the problem.

Douglas-fir tussock moth, *Orgyia pseudotsugata*

Region 1: Idaho, Montana

Host(s): Douglas-fir, spruce, true firs

Trap catches of the Douglas-fir tussock moth (DFTM) suggest that populations may have doubled in 1999 in northern Idaho, but are still at relatively low levels across most of Montana. No aerially visible defoliation was detected; however, larvae were found at most sites sampled in northern Idaho. At approximately 95 trapping sites in northern Idaho, about 12,000 moths were caught in 1999, compared to 6,500 moths in 1998. The Montana trap catch, from 33 sites, totaled 371 moths in 1999; up from 17 in 1998. However, 86 percent of these moths were found at one site near St. Ignatius, Montana. Some minor defoliation was observed on ornamental trees in residential areas, but none was noted in forest stands. Trap catches, some larval sampling, and observations suggest populations should continue to increase, and

defoliation is expected in northern Idaho and in a few isolated spots in Montana in 2000. This trend may be part of a larger population outbreak pattern/cycle that is occurring in other parts of the northwest.

Region 2: Colorado

Host(s): Douglas-fir, true firs

The DFTM outbreak in the South Platte River watershed, Pike National Forest, collapsed in 1999. No defoliation was detected nor were moths captured in the early warning system's traps throughout the region.

Region 4: Idaho, Nevada, Utah

Host(s): Douglas-fir, true firs

Approximately 17,000 acres of defoliation from DFTM were observed in the Owyhee Mountains in southwest Idaho and 100 acres of defoliation were observed on the Fishlake National Forest in central Utah. Pheromone bait trap catches indicated increasing populations in the Weiser and Council Ranger Districts on the Payette National Forest.

Region 5: California

Host(s): White fir

In northeastern California, about 2,200 acres of defoliation were detected by aerial survey in 1999. About half was on private lands and half on the Big Valley District, Modoc National Forest. Egg mass surveys completed in November by State and Federal entomologists found that populations have collapsed and little defoliation should be evident in 2000. Populations on the Sequoia National Forest and Sequoia-Kings Canyon National Parks declined in 1999 due to natural factors without causing significant additional damage.

Region 6: Oregon, Washington

Host(s): Douglas fir, true firs

The DFTM early warning system was established to monitor DFTM population trends throughout its range. There are over 350 plots in the system scattered throughout eastern Washington and Oregon. Since 1995, traps have indicated a trend for increasing populations; in 1998, the number of moths trapped per plot, for all plots, averaged over 10 moths. This was the highest average number of moths trapped for the region since the trapping program began in 1979. In 1999, average number of moths trapped decreased slightly, although the numbers of plots with traps catching moths remained approximately the same. This decrease in trap catches could be expected as natural populations increase. Early larval sampling in the spring, and later a more intensive cocoon and egg mass sampling in the fall was done over much of the potentially infested area. These samples confirmed that in some areas, DFTM populations are either at sub-outbreak or outbreak levels. Specific areas of concern are on the Pine Ranger District of the Wallowa-Whitman National Forest and the northern part of the Umatilla National Forest. Other Forests with plots indicating sub-outbreak or outbreak populations on some of the sample plots include the Malheur, Ochoco, Okanogan, and Wenatchee National Forests.

During the 1999 aerial detection survey, approximately 21,000 acres of visible defoliation was mapped on the Wallowa-Whitman National Forest for the first time in this potential outbreak. The majority was in the moderate defoliation category. It is anticipated that DFTM populations will continue to increase. In 1999, the Forest Service initiated preparation of a site-specific Environmental Impact Statement over nine national forests for potential suppression activities over the next several years.

Fall cankerworm,
Alsophila pometaria

Region 4: Idaho, Utah

Host(s): Gamble oak

In Utah, approximately 17,700 acres of gamble oak (*Quercus gambellii*) were defoliated in 1999 compared to 34,200 acres in 1998. In 1998, most defoliation occurred along the Wasatch Front in northern Utah, while in 1999, most defoliation occurred on the Dixie National Forest in southern Utah. This is the sixth consecutive year of this defoliation. In southeastern Idaho, approximately 2,000 acres of maple defoliation were reported and attributed to the fall cankerworm.

Region 8: North Carolina, Tennessee, Texas, Virginia

Host(s): Oaks

In North Carolina, the 1998 outbreak in the Charlotte area has subsided. No control other than burlap banding was undertaken, and pheromone trapping surveys show populations to be so low that no treatments are planned for 2000. Virginia sustained heavy fall cankerworm defoliation in Fairfax and Chesterfield counties. Meanwhile, Tennessee reported the lowest levels of fall cankerworm ever recorded in the northeast quadrant of the State.

Region 9/Northeastern Area: Maine, Maryland, Massachusetts, West Virginia

Host(s): Maples, oaks, other hardwoods

In Maine, populations continued to decline, with light to moderate defoliation in Aroostook County. Scattered defoliation was reported in Charles and Prince Georges counties, Maryland. In 1999, in Massachusetts, the fall cankerworm caused 2,457 acres of defoliation in Plymouth and Norfolk counties. Based on reports of heavy male moth flight in these two counties, an increase in defoliation is expected in 2000. The 1998 populations in Pocahontas, Preston, and Monongahela counties, West Virginia, apparently crashed in 1999. Defoliation was too light to record damage.

Fall webworm,
Hyphantria cunea

Region 5: California

Host(s): Pacific madrone

The fall webworm fed heavily on madrone for the past 2 years in a number of locations in the Klamath Mountains. Some trees were completely stripped of foliage. The combination of feeding from fall webworm, several madrone leaf spot diseases that were abundant during the past two wet springs, and madrone canker has raised concerns about possible mortality of individual ornamental madrones.

Region 9/Northeastern Area: Maine, Vermont

Host(s): Apple, ash, beech, birch, cherry, elm, oak

Populations and damage by this species were extremely high in 1999, especially in southwestern Maine (Cumberland, York, and southern Oxford counties). More than 10,000 acres were affected. Many trees were totally stripped and webbed by mid-August. Populations were high throughout Vermont.

Fir engraver beetle,
Scolytus ventralis
Dryocoetes confusus

Region 1: Idaho, Montana

Host(s): Grand fir, subalpine fir

Fir engraver beetle-caused mortality continued to decline in 1999 after reaching a high in 1997. An estimated 10,500 trees were killed on 9,400 acres according to the 1999 aerial survey (1998 beetle activity). Fir engraver beetle-caused mortality was most evident in northern Idaho, where on the Coeur d'Alene Reporting Area (Coeur d'Alene River Ranger District of the Idaho Panhandle National Forest and adjacent lands) over 5,000 red trees were mapped on over 5,000 acres. The St. Joe reporting area, just south of the Coeur d'Alene reporting area, had over 2,000 red trees on about 2,000 acres. The Nez Perce reporting area, just north of the Salmon River in Idaho, had approximately 1,200 red trees mapped on 1,100 acres. All other reporting areas had far fewer acres and trees affected.

Region 3: Arizona, New Mexico

Host(s): White fir, subalpine fir

Fir engraver beetle activity decreased regionwide from 4,835 acres in 1998 to 3,770 acres in 1999. Tree mortality on Federal lands in Arizona was detected on the Apache-Sitgreaves (835 acres), Coconino (885 acres), Coronado (125 acres), Kaibab (550 acres), Prescott (5 acres), and Tonto (70 acres) National Forests; Grand Canyon National Park (15 acres); Fort Apache (140 acres) and Navajo (45 acres) Indian Reservations; and 10 acres of private lands. In New Mexico, fir engraver beetle-related mortality occurred on the Carson (135 acres), Gila (835 acres) and Santa Fe (120 acres) National Forests.

Region 4: California, Idaho, Nevada, Utah

Host(s): Grand fir, Red fir, Subalpine fir, White fir

Approximately 26,300 dead trees were observed during aerial surveys in 1999. Virtually all of this mortality occurred on the Humboldt division of the Toiyabe-Humboldt National Forest in Nevada in areas that had not been aerially surveyed in recent years. Mortality was particularly heavy on the Ely Ranger District. Mortality remained low in Utah with 500 trees killed on the Dixie and Fishlake National Forests. No significant mortality was observed in southern Idaho.

Region 5: California

Host(s): White fir, red fir

Fir mortality was light in northern California, at background rates in the southern Sierra Nevada Mountains, and continued scattered and light in Southern California.

Region 6: Oregon, Washington

Host(s): True firs

A threefold increase in fir engraver beetle activity was mapped in 1999, which followed three straight years of decline. Approximately 34,800 acres in 1999 (2.45 trees per acre) were mapped compared to 11,400 acres in 1998 (0.74 tree per acre). Increased levels of activity were reported on Forest Service lands within the Fremont and Wallowa-Whitman reporting areas and on the Yakama Indian Reservation. Following 4 years of approximately normal precipitation, mortality levels remain highest in areas that have experienced

drought, defoliation, or are infected with root disease. Many of the most heavily infested areas are pine sites that, due to selective logging and fire exclusion, now have a large component of true fir.

Forest tent caterpillar,
Malacosoma disstria

Region 8: Louisiana, North Carolina

Host(s): Tupelo gum, upland hardwoods

Defoliation occurred on 79,000 acres of forested wetlands in southeastern Louisiana. In North Carolina, 93,000 acres along the Roanoke River were defoliated, with 30,400 acres classified as severe. In Texas, local infestations of the forest tent caterpillar occurred in the Dallas/Ft. Worth area.

Region 9/Northeastern Area: Illinois, Maine, Minnesota, Michigan, Vermont, Wisconsin

Host(s): Aspen, basswood, pin oak, sweetgum, other hardwoods

Over 7,000 acres were defoliated in Illinois on the Shawnee National Forest. In Maine, low and endemic populations were present in 1999 and no defoliation was observed. Defoliation occurred in Minnesota on nearly 500,000 acres in 1999, up from 11,217 acres in 1998. This year Michigan sustained defoliation on 163,000 acres, and in Wisconsin 47,000 acres were affected. Populations in Vermont remained low with no defoliation in 1999.

Fruittree leafroller,
Archips argyrospilus

Region 5: California

Host(s): California black oak

The end of the millennium marked the heaviest defoliation of black oak in Southern California in the 1990's. Defoliation was heavy near Heaps Peak Arboretum in the San Bernardino Mountains, moderate to heavy around Lake Gregory and along the Rim of the World Drive, moderate in Angelus Oaks and on portions of the north slope of the San Bernardino Mountains, and light on ridge tops and at higher elevations.

Region 8: Louisiana

Host(s): Baldcypress

Defoliation occurred on nearly 300,000 acres of forested wetlands in southeastern Louisiana. It is estimated that almost half of the defoliated acreage (approximately 140,000 acres) is serious enough to cause significant growth loss. Repeated defoliation has caused dieback and mortality on sapling and pole-sized cypress in permanently flooded areas. The outbreak now borders the City of New Orleans.

Jack pine budworm,
Choristoneura pinus

Region 9/Northeastern Area: Maine, Michigan, Wisconsin

Host(s): Jack pine, red pine, white pine

In Maine, moth activity of this species seemed to increase in light traps in Mt. Vernon (Kennebec County) and Steuben (Washington County) in 1999, however no defoliation was observed. Primarily, white pine occurs near the Mt. Vernon trap site and Jack, red, and white pine occur at the Steuben site. In 1999, 10,500 acres of defoliation were observed in Michigan. This was the third outbreak year for Jack pine budworm in Michigan. In Wisconsin, no defoliation was reported this year.

Jeffrey pine beetle,
Dendroctonus jeffreyi

Region 4: California, Nevada

Host(s): Jeffrey pine

Jeffrey pine beetle activity increased on the Toiyabe National Forest and Tahoe Basin Management Area with 700 trees killed in 1999 compared to 400 trees killed in 1998.

Region 5: California

Host(s): Jeffrey pine

Jeffrey pine beetle activity peaked about 3 years ago in northeastern California and declined each year thereafter. Light mortality continues in Lassen Volcanic National Park and along trails into the Thousand Lakes Wilderness. Mortality associated with Jeffrey pine beetle remained low in Southern California and throughout most of the southern Sierra Nevada Mountains. Small pockets of mortality were located east of June Lake on the Inyo National Forest, at a few scattered locations in the Lake Tahoe Basin, and in the southeastern quadrant of the intersection of Highway 89 and Interstate 80 on the Tahoe National Forest.

Jumping oak gall,
Neuroterus saltatorius

Region 9/Northeastern Area: Indiana, Missouri

Host(s): Bur oak, white oak

About 1 million acres were affected in Indiana, mostly in the northern third of the State. Heavy damage from this gall-producing wasp was reported on trees in eastern and southeastern Missouri encompassing 612,000 acres. In addition, light damage was reported on 5 million acres extending from St. Louis to the Arkansas border. This was up from 1,883,900 acres in 1998. When galls become numerous they cause leaf discoloration or premature leaf drop.

Large aspen tortrix,
Choristoneura conflictana

Region 9/Northeastern Area: Maine, Michigan, Minnesota, New Hampshire, Vermont, Wisconsin
Host(s): Aspen

Scattered defoliation occurred across northern Maine in 1999, but most was light with localized moderate defoliation noted only around open farmland in eastern Aroostook County, with less than 100 acres affected. Moth numbers were down noticeably. The large aspen tortrix defoliated 382,382 acres in the Upper Peninsula of Michigan in 1999, down from 592,121 acres in 1998. Defoliation caused by this insect also occurred on 340,000 acres in St. Louis County in Minnesota, up from 3,078 acres in 1998. In New Hampshire, there was light scattered defoliation. Populations in Vermont increased; however, no defoliation was detected. In Wisconsin, 1,738 acres were defoliated.

Lodgepole pine needleminer,
Coleotechnites milleri

Region 5: California
Host(s): Lodgepole pine

Lodgepole needleminer populations continued to increase in several areas of Yosemite National Park. High populations were present at Tenaya Lake Basin, Cathedral Lake, Delaney Creek, Olmstead, and May Lake. Populations were high at Budd Creek, but this area also showed high rates of parasitism by *Copidosoma* sp. Defoliation was very evident at May Lake, Tenaya Gap, the Cathedral Lake Basin, and the upper Budd Creek area. Population densities remained low around the high-use areas of Tuolumne Meadows, but there are extensive areas of visible defoliation to lodgepole pine both north and south of Tuolumne Meadows and along the Pacific Crest, John Muir, and High Sierra Loop trails.

Mountain pine beetle,
Dendroctonus ponderosae

Region 1: Idaho, Montana
Host(s): Lodgepole, ponderosa, and other pines

Mountain pine beetle (MPB) populations increased significantly in 1999. In 1998, nearly 115,000 acres were infested (up from 72,000 acres infested in 1997), on which an estimated 303,000 trees were killed. In 1999, more than 641,000 trees were killed on approximately 144,000 acres--including all host species, found on lands of all ownerships. More than 95 percent of those beetle-killed trees were lodgepole pine. The most expansive, as well as the most intense, outbreak in the region exists on the Lolo National Forest in western Montana, where slightly more than 49,000 acres were affected, mostly in lodgepole pine stands. In 1998, an average 10 trees per acre were killed (mapped as faders in 1999). Next most seriously affected stands were on the Nez Perce National Forest, in northern Idaho, where 27,000 acres were infested to some extent. There, an average of only two trees per acre were killed, but populations appeared to be intensifying. An additional 37,100 acres were infested in north Idaho, most on the Idaho Panhandle National Forest. Beetle populations continued to increase in older lodgepole pine stands on parts of the Flathead National Forest, in Montana, as well. There, almost 4,000 acres were infested. Overall, populations are quite active in lodgepole pine stands in several areas and are likely to increase on the Lolo and Flathead National Forests in Montana, and parts of the Idaho Panhandle and Nez Perce National Forests in northern Idaho. Beetle-caused mortality in ponderosa pine stands, regionwide, is not extreme, but is of concern in some areas on the Bitterroot, Lolo, and Lewis & Clark National Forests and the Flathead, Rocky Boys, Fort Belknap, and Crow Indian Reservations, in Montana.

Insects: Native

Region 2: Colorado, South Dakota, Wyoming

Host(s): Limber pine, lodgepole pine, ponderosa pine

In Colorado, over 150,000 trees on 120,000 acres were killed by the MPB in 1999. The single largest area of mortality is located in ponderosa pine in the upper Arkansas Valley, between Salida and Buena Vista along the eastern foothills of the Sawatch Range. Also in the Arkansas Valley, lodgepole pines are being infested in the Twin Lakes and Fooses Creek areas. Chaffee, Grand, Eagle, Saguache, and Jackson counties as well as the Front Range have the highest MPB attributed mortality in Colorado. The MPB population in the Black Hills of South Dakota is expanding rapidly and moving distances of at least ¼ mile to infest new locations. Tree mortality caused by the MPB has risen from 5,219 trees killed in 1997, to 11,383 trees killed in 1999. This increasing trend will continue in 2000. The majority of the infestation is confined to national forest lands but greater impacts to private and State lands are anticipated in 2000. The Sturgis watershed area is hard hit with the beetle and water quality could be threatened. In Wyoming, the eastern edge of the Bighorn National Forest recorded relatively high levels of MPB. In 1998, there were 1,793 trees killed by MPB, which increased to 2,241 trees killed over 1,281 acres in 1999. Approximately 1,187 limber pine over 377 acres were killed in 1999. Some of these limber pine were thought to be infected by white pine blister rust. Endemic levels of MPB were found in lodgepole pine. There were low levels of tree mortality in lodgepole pine in the Shoshone National Forest. Roughly 634 whitebark or limber pines were reported killed by MPB.

Region 3: Arizona, New Mexico

Host(s): Ponderosa pine

Mountain pine beetle-caused tree mortality decreased from 7,500 acres in 1998 to 195acres in 1999. In Arizona, MPB's attacked and killed ponderosa pines in the Grand Canyon National Park (25 acres), and on 30 acres of State lands. In New Mexico, MPB-caused tree mortality was detected on 140 acres of the Santa Fe National Forest.

Region 4: Idaho, Nevada, Utah, Wyoming

Host(s): Limber, Lodgepole, Jeffrey, Ponderosa, Whitebark pines

Mountain pine beetle-caused mortality increased from 11,000 trees in 1998 to 23,700 trees in 1999. Increasing mortality levels were observed in Idaho and Wyoming, while mortality levels in Utah were static. The largest outbreaks in the region were located on the Sawtooth, Payette, and Salmon-Challis National Forests in southern Idaho in lodgepole pine with a combined total of 13,600 trees killed and on the Dixie National Forest in southern Utah in ponderosa pine with 2,000 trees killed. On the Bridger-Teton National Forest in western Wyoming 1,600 lodgepole pine were killed. Elsewhere in the region smaller MPB outbreaks were located on all national forests except the Toiyabe National Forest.

Mortality of whitebark and limber pine attributed to MPB attack increased from 3,200 trees killed in 1998 to 12,100 trees killed in 1999. While mortality was observed throughout the host type, greatest mortality was located on the Payette National Forest in southern Idaho with 4,800 trees killed and on the Humboldt and Toiyabe National Forests in Nevada with 1,300 and 500 trees killed, respectively.

Region 5: California

Host(s): Limber, lodgepole, ponderosa, sugar, western white, and whitebark pines

Mortality associated with MPB remained low in Southern California and throughout most of the southern Sierra Nevada Mountains and foothills. Pockets of lodgepole pine mortality were reported near the town of Mammoth Lakes, Mono County, and in the Lake Tahoe Basin in the Washoe Meadows area and along Pioneer Trail east of the airport. Chronic areas of lodgepole mortality continued in 1999 along Highway 89 north and south of Truckee.

Mountain pine beetle killed scattered lodgepole pine on the Lassen National Forest near the north side of Lassen Volcanic National Park. Within the park, scattered lodgepole pine and western white pine continue to be attacked and about 10 percent of the lodgepole pines are now dead in an area northeast of Emigrant Lake. Several areas of high lodgepole pine mortality continue to be evident northwest of Lassen Park in the Thousand Lake Wilderness, and pockets of mortality occur east of the wilderness.

Region 6: Oregon, Washington

Host(s): Jeffrey pine, lodgepole pine, ponderosa pine, sugar pine, western white pine, whitebark pine

Three straight years of decreases in the number of acres affected by MPB have ended. Activity was reported on 111,148 acres with on average of 3.63 trees per acre in 1999 compared with 95,963 acres with an average of 3.31 trees per acre in 1998. Increased activity was detected in all host types with the exception of ponderosa pine. Areas most heavily affected by MPB in lodgepole pine include Federal lands within the Deschutes and Okanogan reporting areas. Federal lands within the Fremont reporting area showed the most dramatic decrease in acres affected by MPB in lodgepole pine. In contrast to last year, most heavily affected areas in the ponderosa pine type shifted from private lands to Forest Service lands within the Malheur, Umatilla, and Okanogan reporting areas. The most significant decrease in acres affected in the ponderosa pine host type occurred on private lands in central Oregon and Northeast Washington. In the whitebark pine host type, the most heavily affected areas were in the Pasayten, Goat Rocks, and Alpine Lakes wilderness areas. Approximately 3,400 acres in the western white pine host type were mapped on Federal lands within the Kaniksu reporting area. Dense stand conditions continue to predispose areas to MPB infestations.

Nantucket pine tip moth,
Rhyacionia frustrana

Region 8: Regionwide

Host(s): Loblolly pine, shortleaf pine

In Texas, tip moth infestations increased from 50 percent of pine tips in 1998 to about 75 percent in 1999, but some areas completely escaped infestation for unknown reasons. Mississippi reported sharp increases in tip moth infestations. In Georgia, tip moth was most troublesome along the coastal plain where, in combination with drought, the insect has been particularly damaging. Florida recorded especially high levels of tip moth, probably due to the compounding impact of summer drought. South Carolina noted that damage was most pronounced in old fields, with the August generation causing the most damage. Nevertheless, in Tennessee, the spectacular 1998 outbreak subsided, with 1999 classified as an average pine tip moth year.

Oak leaftier,
Croesia semipurpurana

Region 9/Northeastern Area: Maine, Pennsylvania, West Virginia

Hosts: Black oak, red oak, scarlet oak

Defoliation by a complex of the oak leaftier and oak skeletonizer, *Bucculatrix ainsliella,* was fairly widespread over 8,000 to 10,000 acres across southern Maine in 1999. Most defoliation fell in the light to moderate category with about 500 acres of very spotty moderate to heavy. The defoliation occurred in Hancock, Knox, Lincoln, and Waldo counties. In Potter and Tioga counties in Pennsylvania, 3,786 acres were defoliated by oak leaftier. This was a twofold increase of defoliation from last year. Treatments of the most severely affected areas were conducted to prevent defoliation and mortality. In West Virginia, egg

surveys were conducted in Barbour, Pendleton, Pocahontas, Randolph, and Tucker counties but no eggs were found. Light populations were reported in Randolph, Pocahontas, Tucker, and Pendleton counties and defoliation was light and spotty.

Periodical cicada,
Magicicada septendecim, M. septendecula, M. cassini

Region 9/Northeastern Area: Maryland, Ohio, Pennsylvania, West Virginia

Host(s): Hardwoods

Three separate species of periodical cicadas appeared this spring over large portions of Ohio and West Virginia during the scheduled Brood V emergence. This brood is the largest that occurs in either State and was last seen in 1982. It also emerged in the southwest corner of Pennsylvania and the western most county of Maryland. In West Virginia, over 5 million acres were mapped during emergence where flagging was visible.

Pine engraver beetles,
Ips spp.

Region 1: Idaho, Montana, Wyoming

Host(s): Lodgepole pine, ponderosa pine

The most significant pine engraver activity noted in the 1999 aerial survey (1998 attacks) occurred on the Coeur d'Alene and Kaniksu reporting areas in the Idaho Panhandle. In the Coeur d'Alene reporting area pine engraver was the credited mortality agent for 1,200 ponderosa pines across 750 acres; the regional totals for pine engraver in ponderosa pine was 3,062 dead trees on 1,184 acres. Pine engraver activity in lodgepole pine was also highest, regionwide, in the Coeur d'Alene reporting area with 4,575 dead trees mapped across 1,058 acres and the Kaniksu reporting area with 1,005 dead trees mapped across 165 acres. Regional totals for the pine engraver in lodgepole pine were 6,260 dead trees across 1,421 acres. There was no obvious trigger for the increased pine engraver mortality mapped in 1999 in northern Idaho. Above average precipitation during the winter of 1998-99 throughout typically dry and often susceptible ponderosa pine stands in western Montana and northern Idaho, should result in a reduction of engraver beetle-caused damage detected in the 2000 aerial survey. In Montana, pine engraver is credited with the death of 854 ponderosa pines across 144 acres, a slight increase from 1998, and 80 lodgepole pine trees on 70 acres, a decrease from 1998. These mortality levels are considered endemic. Land managers are becoming increasingly aware of the need for proper slash management during late winter and early spring logging in ponderosa pine stands, which should help reduce losses to engraver beetles.

Region 2: South Dakota

Host(s): Ponderosa pine

No significant activity was detected in 1999.

Region 3: Arizona, New Mexico

Host(s): Ponderosa pine, pinyon pine

Ips-killed ponderosa pines in the Southwest decreased significantly from 18,165 acres in 1998 to 2,505 acres in 1999. In Arizona, *Ips*-killed trees were detected on the Apache-Sitgreaves (95 acres), Coconino

(75 acres), Coronado (15 acres), Kaibab (45 acres), Prescott (55 acres), and Tonto (985 acres) National Forests; Grand Canyon National Park (10 acres); Fort Apache (85 acres), Haulapai (5 acres), Navajo (35 acres), and San Carlos (900 acres) Indian Reservations; and 15 acres, each, on State and private lands, respectively. In New Mexico, *Ips* beetle-killed trees were detected on 185 acres of the Carson National Forest.

Region 4: Idaho, Nevada, Utah

Host(s): Lodgepole, Ponderosa pine

Mortality due to pine engraver beetle remained low throughout the region. Activity is often associated with western pine beetle. In Utah, populations were found in slash of ponderosa and lodgepole pine.

Region 5: California

Host(s): Lodgepole pine, pinyon pines, ponderosa pine

Pine engraver activity was at background rates throughout northern California. The pinyon ips, *I. confusus*, continued to kill singleleaf pinyon infected with black stain root disease in the eastern San Bernardino Mountains.

Region 6: Oregon, Washington

Host(s): Ponderosa pine

Pine engraver activity increased over 1998 levels. The majority of activity was detected on the Colville and Spokane Indian Reservations and on private lands in northeastern Washington.

Region 8: Regionwide

Host(s): Loblolly pine, shortleaf pine, slash pine

Drought conditions during the growing season across much of the South led to another year of higher-than-normal levels of *Ips* pine engraver beetle activity. Small groups of *Ips*-killed trees were scattered throughout the forest stands, consequently losses are difficult to quantify. In the Gulf Coast States, activity increased into late summer and early fall. Louisiana surveys showed 120 multiple-tree infestations. Texas also reported unusually heavy *Ips* activity for a second straight year. In the Carolinas, the situation was much the same, with high levels of *Ips* losses. South Carolina foresters noted that *Ips* were common on the edges of southern pine beetle spots. In Georgia, *Ips* are estimated to have killed almost 690,000 trees over about 2,300 acres. As with South Carolina, many pine engraver spots were associated with southern pine beetle. In Tennessee, losses were on the increase statewide, particularly in west Tennessee. Nevertheless, Florida *Ips* activity declined in 1999, apparently due to continuing recovery from the 1998 wildfires.

Pine reproduction weevil, *Cylindrocopturus eatoni*

Region 5: California

Host(s): Ponderosa pine

Mortality from pine reproduction weevil continued in pine plantations on the Groveland District, Stanislaus National Forest, and the Mariposa District, Sierra National Forest, but at reduced rates compared to 1997 and 1998. About half of the 3,343 acres surveyed on both districts had mortality related to the pine

reproduction weevil. Suppression was conducted on 577 acres on the Groveland District and 954 acres on the Mariposa District.

Pine sawflies, *Neodiprion* spp. *Diprion* spp.

Region 4: Idaho

Host(s): Ponderosa pine

Defoliation of ponderosa pine caused by a sawfly was detected on 500 acres of private land near Lakefork, Idaho. Scattered pockets of defoliation were observed on ornamental trees along the Wasatch Front in Utah.

Region 8: Florida, Louisiana, North Carolina, Tennessee, Texas, Virginia

Host(s): Southern pines

Several species of the pine sawfly were active across the South in 1999. Infestations of the blackheaded pine sawfly (*Neodiprion excitans*) were present in October and November in seven east Texas counties. Some areas were completely defoliated. In Louisiana, the loblolly pine sawfly (*N. taedae linearis)* defoliated several thousand acres of loblolly pine reaching maturity in the north central part of the State, prompting private industry to treat 600 acres from the air. This same species also defoliated scattered urban pine plantings in northwest and middle Tennessee. In Florida, the redheaded pine sawfly, *N. lecontei*, defoliated young stands of longleaf pine in Citrus, Flagler, and Lake counties. Virginia foresters recorded Hetrick's sawfly (*N. hetricki*) defoliating loblolly pine in the southeastern piedmont and nearby coastal plain areas. In North Carolina, redheaded, Virginia (*N. pratti pratti*), and introduced pine sawflies (*Diprion similis*) stripped pines of their needles at various locations across the western part of the State.

Ponderosa pine needle miner, *Coleotechnites moreonella*

Region 6: Oregon

Host(s): Ponderosa pine

In 1999, about 2,800 acres were reported to be infested. This is down from the approximately 24,700 acres of needle miner in ponderosa pine reported in central and eastern Oregon in 1998, which was the first aerially detected outbreak of ponderosa pine needle miner since 1992. A species determination was not made, but the causal insect is believed to be *Coleotechnites moreonella.* The crown symptoms of yellowing caused by larval mining seemed to be more pronounced along the edges of meadows and the surrounding lowland forests. Parasitoids are expected to increase in number and eventually bring the needle miner population back in check. The majority of the area affected was once again mapped on the Ochoco National Forest, although a new area was mapped on private lands within the Northeast Washington Reporting Area.

Red oak borer,
Enaphalodes rufulus

Region 8: Arkansas

Host(s): Northern red oak, black oak

Red oak borer attacks increased dramatically in 1999 in north central Arkansas in association with severe drought (for the second consecutive year). Damage was evident and contributed to drought-related mortality in red oaks. Degradation in lumber from attacked trees can lower product values.

Red turpentine beetle,
Dendroctonus valens

Region 5: California

Host(s): Jeffrey pine, ponderosa pine

Activity of the red turpentine beetle was associated with prescribed burns and wildfires. In general, populations were not high. However, mortality was found in the Lost Creek area, south of Highway 44 and north Lassen Volcanic National Park, and the beetle was abundant in a ponderosa pine plantation near the Everett Memorial Highway on Mt. Shasta, which had been scorched in a prescribed burn in the spring of 1999.

Reproduction weevils,
Hylobius pales
Pachylobius picivorous

Region 8: Georgia, Mississippi, Texas

Host(s): Southern pines

Weevil activity declined significantly from 1998 in Texas. This is probably because most plantings in 1999 were actually replantings of trees killed during the 1998 drought (the delay for replanting ameliorated the risk of weevil damage). However, Mississippi reported an increase in reproduction weevil damage. In Georgia, pine reproduction weevils caused light to moderate damage statewide, with heaviest damage on tracts smaller than 10 acres. Many States now pretreat some seedlings with an insecticide as protection against weevil attack.

Roundheaded pine beetle,
Dendroctonus adjunctus

Region 3: Arizona, New Mexico

Host(s): Ponderosa pine

Roundheaded pine beetle-caused tree mortality regionwide decreased significantly from 6,730 acres in 1998 to 1,700 acres in 1999. In Arizona, roundheaded pine beetle-killed trees were detected on the Apache-Sitgreaves (280 acres) and Coronado (30 acres) National Forests and the Fort Apache Indian Reservation (20 acres). In New Mexico, roundheaded pine beetle-caused tree mortality decreased from 6,575 acres in 1998 to 730 acres in 1999 on the Lincoln National Forest and from 5,210 acres to 640 acres

on the Mescalero Apache Indian Reservation. This dramatic decrease in roundheaded pine beetle-killed trees on the Lincoln National Forest and Mescalero Apache Indian Reservation may indicate these bark beetles are decreasing to endemic levels in the Sacramento Mountains.

Region 4: Utah

Host(s): Ponderosa pine

Ponderosa pine mortality attributed to this beetle continues to occur in scattered areas of the Dixie and Manti-LaSal National Forests in southern Utah.

Southern pine beetle,
Dendroctonus frontalis

Region 8: Regionwide

Host(s): Loblolly pine, shortleaf pine, slash pine, longleaf pine, Virginia pine

During 1999, most southern pine beetle (SPB) activity in the South was concentrated in the central part of the South. Alabama, Tennessee, South Carolina, and North Carolina reported significant losses. Meanwhile, Arkansas, Louisiana, Oklahoma, and Texas reported no confirmed SPB spots on State or private lands. For Texas, this was the second straight year of no SPB activity -- a most unusual occurrence.

Alabama had the highest levels of SPB activity across the South. Forty-one of their 67 counties were in outbreak status. Losses were also high on the Bankhead National Forest in the northwest section of the State. In North Carolina, outbreaks in the southern coastal area have abated, and now have shifted to the western mountain and piedmont counties. Similarly, east Tennessee foothills and mountain counties showed some of the heaviest losses, but the southwestern area of the State also showed some activity. South Carolina's nine outbreak counties were western and upstate counties in the western piedmont, foothills, and mountains, but an extremely hot 1999 summer caused many spots to collapse. In Virginia, the 1998 mountain counties epidemic collapsed, with widely scattered spots in the piedmont and coastal areas showing an upward trend at year's end. Florida reported a late summer buildup of SPB in Hernando County (just north of Tampa). This activity was unanticipated given the relatively small and disjunct acreage of loblolly pine occurring at the southern end of the species range. It is also the farthest south in the State that SPB has ever been reported. Most of the infestations are occurring in residential areas and wildland/urban interface around the city of Brooksville.

Region 9/Northeastern Area: Maryland

Host(s): Loblolly pine

Ground surveys detected a few spots of southern pine beetle activity on 19 acres in a State park located in Somerset County, Maryland.

Spruce beetle,
Dendroctonus rufipennis

Region 1: Idaho, Montana

Host(s): Engelmann spruce

Spruce beetle (SB) populations remained low throughout the region in 1999, decreasing slightly in infested area in western Montana, but making small advances in north Idaho. In northern Idaho, less than 200 infested acres were recorded. Most occurred as small and scattered groups of beetle-killed Engelmann spruce on the Idaho Panhandle National Forest (St. Joe and Kaniksu). In western Montana, the infested area decreased from about 2,000 acres in 1998 to just over 800 acres in 1999. Those infested acres were more commonly found on the Gallatin, Flathead, and Kootenai National Forests, and in Glacier National Park; however, the Lolo and Lewis & Clark National Forests also reported small outbreaks. Slightly more than 1,500 trees were killed throughout the region. Just over 300 acres were infested on the Flathead National Forest, but are not associated with the area successfully treated in 1996-97 to reduce beetle populations following the Little Wolf Fire.

Region 2: Colorado, Wyoming

Host(s): Engelmann spruce

In Colorado, SB populations are building in Conejos, Garfield, and Eagle counties. It is expected that SB population will be more noticeable in 2000 due to the emergence of beetles from extensive areas of blowdown on the Routt, White River (Baylor and Triangle Park areas), Grand Mesa (Lands End) and Rio Grand (Grouse Creek, Twister, and Cliff areas) National Forests. In Wyoming, SB damage was severe in many side drainages of the North and South Forks of the Shoshone River. An estimated 15,000 trees were killed on 5,523 acres. Many recent avalanches were observed in these areas and SB population buildups are expected. Minor occurrences of SB have been noted near blowdown areas on the Bighorn National Forest. A buildup of SB populations is expected for the Snowy Range of south-central Wyoming in 2000. This area has experienced recent windthrow (1998) in the spruce cover type.

Region 3: Arizona, New Mexico

Host(s): Spruce

Spruce beetle-caused tree mortality in the Southwest increased nearly twofold from 2,690 acres in 1998 to 5,015 acres in 1999. In Arizona, spruce beetle-killed trees were detected on the Apache-Sitgreaves (35 acres), Coconino (5 acres), and Kaibab (5 acres) National Forests; and the Fort Apache (15 acres) and Navajo (2,170 acres) Indian Reservations. In New Mexico, SB-caused tree mortality occurred on the Carson (1,235 acres), Santa Fe (1,420 acres), and Gila (90 acres) National Forests; and the Mescalero Apache Indian Reservation (40 acres).

Region 4: Idaho, Utah, Wyoming

Host(s): Spruce

Spruce beetle mortality decreased from 1998 levels with 66,200 trees killed in 1999 compared to 105,500 in 1998. The largest infestations were located in Utah where 32,500 trees were killed on the Dixie National Forest and 29,000 trees were killed on the Manti-LaSal National Forest. Mortality was also observed on the Fishlake, Uinta, and Wasatch-Cache National Forests. On the Bridger-Teton National Forest, in western Wyoming, 100 trees were killed. No significant mortality was observed in southern Idaho national forests.

Insects: Native

Region 6: Oregon, Washington

Host(s): Engelmann spruce

All reported mortality in Oregon and Washington in 1999 was in Engelmann spruce. Reported trees killed decreased from approximately 2,900 trees in 1998 to fewer than 1,800 in 1999. The majority of mortality occurred on Forest Service lands within the Okanogan and Wallowa-Whitman reporting areas. In other areas, SB activity was lightly scattered in the host type. Low levels of SB activity are due, in part, to the gradual removal of preferred host trees by previous infestations.

Region 10: Alaska

Host(s): Lutz, Sitka, and White Spruce

Since 1996, when the total area impacted by SB's peaked at 1.1 million acres, populations across Alaska have fallen by 77 percent to 253,265 acres. This is the lowest figure in the past 10 years. Basically, the beetles "ate themselves" out of host type, especially in the nearly pure spruce stands on the Kenai Peninsula and Copper River Basin. Despite the overall decline, aerial surveys still located spots of heavy activity.

Region 9/Northeastern Area: Maine

Host(s): Red spruce, white spruce

The condition of many of Maine's coastal spruce stands continued to gradually decline in 1999. The current SB infestation remains confined predominantly to the central Maine coast, especially Penobscot Bay. The area infested by SB increased slightly, but the intensity of attack in infested stands appeared to decline. Several Penobscot Bay stands had lost more than 50 percent of all their red and white spruce over 15 inches in diameter. Four newly attacked stands were found in 1999 in the Cape Rosier area, Seal Harbor, Bass Harbor, and on islands near Vinalhaven. About 2,760 acres of 30 to 50 percent mortality and 465 acres of greater than 50 percent mortality were mapped. Drought conditions in 1999 are likely to add more stress to coastal spruce stands and may result in expansion of the SB infestation as was seen following the 1995 drought.

Spruce budworm, *Choristoneura fumiferana*

Region 10: Alaska

Host(s): Lutz, Sitka, and White Spruce

It appears that after more than 5 consecutive years, the budworm outbreak has declined, likely due to the increasing affects of parasites and predators. We expect little defoliation next year. A ground survey, conducted in late summer of 1999 by Tanana Chief Council crews, noted little or no mortality associated with the budworm outbreak, although top-kill was prevalent. Only 708 acres of light to moderately defoliated spruce were noted in 1999 vs. 87,800 acres noted in 1998. Little *Ips* beetle activity was noted in previously defoliated spruce stands.

Region 9/Northeastern Area: Maine, Michigan, Minnesota, Vermont

Hosts: Balsam fir, white spruce

In Maine, spruce budworm moth catch in both pheromone and light traps was the lowest since 1995. Lower catch in 1999 ended a 3 year trend toward increased moth catch and more widespread distribution of the locations where budworm moths were trapped. No larvae were found and no defoliation was detected. There was no defoliation in Michigan in 1999. Significant defoliation occurred on forestlands in northeast

Minnesota encompassing an area of 70,000 acres, down from 256,400 acres in 1998. This is the 46th consecutive year of spruce budworm defoliation in Minnesota. Populations remained low in Vermont and there was no defoliation in 1999.

Western balsam bark beetle,
Dryocoetes confusus

See Subalpine fir mortality complex.

Western pine beetle,
Dendroctonus brevicomis

Region 1: Idaho, Montana

Host(s): Ponderosa Pine

Tree mortality attributed to western pine beetle declined to about 7,400 trees on 7,200 acres regionwide. This is down from nearly 18,000 acres in 1998. More than half (nearly 5,000 acres) was located in northern Idaho on private and Forest Service land in the Idaho Panhandle National Forest reporting area. Elsewhere in the region mortality was widely scattered in fairly small groups throughout the ponderosa pine type.

Region 3: Arizona, New Mexico

Host(s): Ponderosa pine

Western pine beetle-caused tree mortality increased slightly regionwide from 2,340 acres in 1998 to 2,605 acres in 1999. Mortality in Arizona occurred on the Apache-Sitgreaves (165 acres), Coconino (55 acres), Coronado (20 acres), Kaibab (310 acres), Prescott (10 acres), and Tonto (5 acres) National Forests; Fort Apache (135 acres), Navajo (45 acres) and San Carlos (50 acres) Indian Reservations; Bureau of Land Management lands (5 acres); Grand Canyon National Park (5 acres); 5 acres in Walnut Canyon; and 30 acres of private lands. In New Mexico, western pine beetle-caused tree mortality was detected on 1,765 acres of the Gila National Forest.

Region 4: Idaho

Host(s): Ponderosa pine

Only small isolated infestations of western pine beetle were recorded in 1999. Pine engraver beetle activity was frequently associated with western pine beetle infestation.

Region 5: California

Host(s): Coulter pine, ponderosa pine

Tree mortality caused by western pine beetle was generally light after 5 consecutive years of ample winter precipitation. Mortality was confined to scattered individual trees or small groups of trees.

Insects: Native

Region 6: Oregon, Washington

Host(s): Ponderosa pine

Acres affected by western pine beetle activity decreased in both large and pole-sized ponderosa pines throughout much of the region, although intensity increased over fewer mapped acres in the pole-sized stands. Over 5,700 large trees were killed in 1999 compared to about 13,300 in 1998. Mortality in smaller, pole-sized trees increased from 7,800 trees in 1998 to 12,000 trees killed in 1999. Areas most heavily affected included Forest Service lands on the Malheur, Wallowa-Whitman, and Wenatchee National Forests. Other areas with notable levels of mortality include: private lands within the Northeast Washington reporting area and Indian reservation lands within the Colville and Yakima reporting areas.

Western spruce budworm, *Choristoneura occidentalis*

Region 1: Idaho, Montana

Host(s): Douglas-fir, Engelmann spruce, true firs

Defoliation from western spruce budworm on permanent plots increased in 1999 on the Deerlodge National Forest in Montana but remained the same on forests in Idaho. No budworm defoliation was observed from the air anywhere in the region. Pheromone trap counts were up significantly in some areas in 1999, but remained the same or decreased in others. Trap catches on permanent plots on the Helena National Forest and Lubrecht Experimental Station increased to 107 moths in 1999, up from 58 moths in 1998. Populations appear to be rebuilding slowly, but remain low. Increased defoliation may be expected in a few scattered areas where trap counts were above 4 or 5 moths per trap in 1999, such as the Deerlodge and Helena National Forests. Large population increases are weather-dependent and will likely take several more years A major population increase is not expected in 2000.

Region 2: Colorado

Host(s): Douglas-fir, Engelmann spruce, blue spruce, true fir

An estimated 41,000 acres of forest were defoliated by western spruce budworm in southwestern Colorado in 1999. This is approximately double the number of acres defoliated in 1998. Most of the western spruce budworm activity occurred throughout the Sangre de Cristo and Wet Mountains in Costilla, Custer, Fremont, Las Animas, and Saguache counties. Defoliation of Douglas-fir in Hinsdale County, adjacent to Lake City, Colorado, was less severe than that observed in 1998. There was no noticeable defoliation in Wyoming in 1999.

Region 3: Arizona, New Mexico

Host(s): True firs, Douglas-fir, and spruce

Western spruce budworm decreased slightly regionwide from 320,665 acres in 1998 to 292,925 acres in 1999. In Arizona, western spruce budworm defoliation was detected on the Apache-Sitgreaves National Forest (250 acres) and Navajo (10,145 acres) and San Carlos (60 acres) Indian Reservations. In New Mexico, western spruce budworm defoliation continued to occur on the Carson (130,000 acres), Cibola (5,270 acres) and Santa Fe (82,480 acres) National Forests; Picuris (190 acres), Santa Clara (1,215 acres) and Taos (13,150 acres) Pueblo Indian Reservations; and 50,165 acres of State and private lands in northern New Mexico.

Region 4: Idaho, Utah, Wyoming

Host(s): Douglas-fir, True firs

On the Dixie National Forest in southern Utah defoliation decreased from 19,500 acres in 1998 to 900 acres of light defoliation in 1999. In Idaho, approximately 2,500 acres of mostly light defoliation were mapped on the Targhee National Forest. This is the first western spruce budworm defoliation observed since 1988 in Idaho.

Region 6: Oregon, Washington

Host(s): Douglas fir, true firs, Engelmann spruce, western larch

Areas of aerially visible defoliation decreased from approximately 486,000 acres in 1998 to 189,700 acres in 1999. Ground surveys conducted by field crews during the summer of 1998 indicated that the extent and severity of budworm that year was actually less than indicated by aerial surveys. Over 76 percent of the area reported with visible defoliation caused by western spruce budworm in 1999 occurred on Yakama Indian Reservation lands. Over 13,000 acres of defoliation was detected on the Gifford-Pinchot National Forest. Approximately 28,500 acres of adjoining State and private lands were also affected.

Approximately 37,000 acres were treated with Bacillus thuringiensis (Bt) on the Yakima Indian Reservation, an additional 5,000 acres has been identified for a suppression project in 2000. Approximately 400 acres is planned for treatment on the Gifford Pinchot National Forest to protect northern spotted owl nesting sites.

Yellowheaded spruce sawfly, *Pikonema alaskensis*

Region 9/Northeastern Area: Maine

Host(s): Black spruce, white spruce

Yellowheaded spruce sawfly required control measures on 400 acres in western Maine in 1999. Scattered pockets of damage can still be found in western and northern Maine in Franklin, Somerset, Penobscot, and Aroostook counties.

Insects: Nonnative

Asian longhorned beetle,
Anoplophora glabripennis

Region 2: Colorado, Kansas

Host(s):

Colorado has yet to officially record its first Asian longhorned beetle, although unsubstantiated reports continue to surface.

Surveys were conducted by Kansas Department of Agriculture for evidence of this pest since dead larvae were found in pallets from China last year. Surveys were conducted at businesses that deal in pallets and at any other locations where pallets could be found. Also, trees around areas with pallets were surveyed for signs of infestation. No indication of Asian longhorned beetles were found.

Region 9/Northeastern Area: Illinois, New York

Host(s): Ash, birches, black locust, elm, horse chestnut, maples, poplar, willow

This insect, a serious pest of hardwoods in China, has been discovered in Chicago and New York City. There are currently three separate infested areas within the Chicago metropolitan area, along with other spot infestations. A new quarantine area was established in Chicago in 1999 called the "All Saints" infestation. Since the initial discovery, 1,243 trees have been cut, including 357 in 1999. In 1999, 1,498 trees were replanted in the infested areas. From 1996 to 1998, infestations in New York were found in Brooklyn (Greenpoint), Queens (Bayside), and the Amityville area of Long Island. Over 4,300 trees have been found infested and 3,966 trees have been removed. About 2,000 trees have been replanted. Three new infestations were discovered in 1999: Bayside (669 trees have been removed), Manhattan, close to Central Park (23 trees have been removed), and Islip (7 trees removed). Intensive surveys for infested trees will be continued. Other States have also actively been surveying for the pest. Connecticut has been continually surveying around the harbors in Bridgeport, Groton, New Haven, and New London and all surveys were negative. Maryland initiated a survey of industrial and port areas statewide and no beetles were found. In New Jersey, 326 plots were surveyed and no beetles were found. The insect has been detected in wood packing material at warehouses in various other locations across the country.

Balsam woolly adelgid,
Adelges piceae

Region 1: Idaho

Host(s): Grand fir, subalpine fir

Aerial survey data estimated nearly 96,070 acres infested by the balsam woolly adelgid (BWA) in 1999, a significant increase from the 53,400 acres infested in 1998. Actual infested acres is higher as some infested areas are not yet displaying crown symptoms. Areas with the heaviest infestations occur on the Idaho Panhandle, Clearwater, and Nez Perce National Forests and adjacent State, private, and Bureau of Land Management land. Subalpine fir of all ages and size classes are killed. Extensive gouting and bole infestations occur on grand fir, but only regeneration in the grand fir type has suffered mortality. Regeneration mortality of both subalpine and grand fir is high, resulting in forest type conversions in some areas. Surveys to help delimit the distribution and assess damage caused by BWA were begun in 1998. Additional damage assessment surveys were conducted in 1999 and results of this work should be available

in the form of a distribution survey to be published in the Western Journal of Applied Forestry. In a few low elevation sites, where adelgid populations became established in the early 1980's, subalpine firs have virtually been eliminated.

Region 6: Oregon, Washington

Host(s): True firs

Balsam woolly adelgid activity was observed on 6,900 acres in 1999, an increase of approximately 4,400 acres from 1998 reported levels. The majority of activity occurred in Oregon on the Umatilla and Wallowa-Whitman National Forests.

In 1998, a Forest Health Monitoring ground survey was initiated to confirm its occurrence and distribution in the host type throughout Washington and Oregon; and determine effects on host species and changes in local ecosystems. To date, the the ground survey has focused primarily on the coasts of Oregon and Washington, the Olympic National Park, and the Cascade Range in Oregon. The permanent plots indicate that environment plays a significant role in the fluctuations of BWA populations; this is true, for instance, at higher elevations. Once the BWA has infested an area, it does not disappear; however, on higher elevation areas such as the Olympic National Park, there may be occasional population increases, followed by a decline to less damaging levels. The BWA survey will continue along the Puget trough and Cascades in Washington and in northeastern Oregon in 2000.

Region 8: North Carolina, Tennessee, Virginia

Host(s): Fraser fir

Fraser fir has a very limited range in the southern Appalachian Mountains and appears almost exclusively in pure stands on the highest mountain peaks or in combination with red spruce at somewhat lower elevations. Since the first introduction of the BWA, approximately 64,700 acres of Fraser fir have been affected. The insect attacks trees of all age classes, but prefers the older fir trees. Adelgid populations were again high in 1999.

Region 9/Northeastern Area: Maine

Host(s): Balsam fir

This introduced species is a perennial problem in Maine but has been a concern primarily of homeowners and landscapers. It continued to kill and deform fir in coastal areas from Brunswick to Calais. Infestations also plagued some Christmas tree growers and may become more serious if mild winters continue. In 1999, infestations of woodland fir were reported across southern Piscataquis and central Penobscot counties. In at least two areas totaling 500 acres, these infestations were accompanied by bark beetle attack and mortality after only a couple of years.

Browntail moth,
Euproctis chrysorrhoea

Region 9/Northeastern Area: Maine, Massachusetts

Host(s): Red oak

The browntail moth, first recorded in Somerville, Massachusetts, in 1897, was located in 58 towns in Maine in 1999 during the annual winter survey, this is a slight reduction from 1998. Twenty-seven of these towns had sufficient population levels to represent a hazard to individual landowners; the hairs cause a severe rash on exposed skin. In the Casco Bay area, populations of this pest were again high enough to

warrant control. Municipal spray programs were done on 5,120 acres in five towns. There was a shift in population from southern portions (Portland) to more northern sites (Freeport and Harpswell). The trend in year 2000 appears to be a continuance of damaging populations in the Casco Bay area and a depression of populations in outlying areas. Scattered populations continued on Cape Cod in Massachusetts.

Common European pine shoot beetle,
Tomicus piniperda

Region 2: Kansas

Host(s):

No pine shoot beetles were found in traps or surveys by Kansas Department of Agriculture.

Region 9/Northeastern Area: Indiana, Illinois, Maryland, Michigan, New Hampshire, New York, Ohio, Pennsylvania, Vermont, Wisconsin, West Virginia

Host(s): Scotch pine, white pine, pines

The pine shoot beetle, a pest of pine trees, causes damage in weak and dying trees, and in the new growth of healthy trees. The beetle has been found in a variety of pine species in the United States and was first discovered in this country in a Christmas tree farm in Ohio in 1992. In 1999, one county was added to the list of infested counties in Illinois (Woodford), and five new counties in Indiana (Hamilton, Henry, Rush, Marion, Montgomery). Eleven counties were surveyed in Maryland for pine shoot beetle and beetles were trapped in two counties, Garrett and Allegany. In 1999, The insect was trapped for the first time in New Hampshire in Coos County, however no trees were found infested. In New York in 1999, the common pine shoot beetle was found in seven new counties: Jefferson, Lewis, Oneida, Madison, Chenango, Broome, and Tioga. No new counties were added to the quarantine area of Ohio, where the quarantine remains at 54 counties. The beetle was found in Vermont in 1999, with nine beetles trapped in Essex County and one in Orleans County near the Canadian border. Other States have surveyed for the beetle. In Connecticut, Christmas tree plantations, along with cut trees, were examined and no beetles were discovered.

Gypsy moth (European),
Lymantria dispar

Region 1: Idaho, Montana, North Dakota, Wyoming

Host(s): Hardwoods

Cooperative detection monitoring for the gypsy moth with APHIS and State Departments of Agriculture, Forestry, and Lands continued in 1999. A network of strategically located pheromone baited traps were placed throughout all States in Region 1. There were no moths trapped in Region 1 or the States of Montana and Idaho in 1999. The trapping program will continue as usual in Region 1 next year. In the spring of 1999, the Idaho Department of Lands conducted an eradication project on 30 acres surrounding a trap site that had 5 moths in 1998. No moths were caught in 1999 so the effort is thought to have been successful.

Region 2: Colorado, Kansas, South Dakota, Wyoming

Host(s): Hardwood species

In addition to trapping efforts by Region 2 Forest Health Management, the Colorado State Forest Service put out a total of 972 detection traps. A total of 11 moths (all singles) were caught during the 1999 trapping effort in Colorado. The 1999 catches were in Rocky Mountain National Park (in a delimitation trap near the 1998 catch), Castle Rock (south of the Denver Metro Area), and nine scattered about the Denver Metro Area in Jefferson and Arapahoe counties. All these sites will be delimited at the rate of 25 traps per square mile around the catch sites in 2000.

In Kansas, Several dozen traps were placed at locations across the State as a cooperative effort by State and Federal agencies. No moths were caught in traps this year. However, Kansas Department of Agriculture found three egg masses on Christmas trees imported from Michigan. None of the egg masses were viable. Trapping throughout South Dakota resulted in catching four male moths. One moth was on the eastern border and three were in private campgrounds in the Black Hills camping areas. The catches are attributed to movement of tourists from infested areas. Six adult-male gypsy moths were captured in Wyoming during 1999. One moth was captured in both Park and Lincoln counties and four moths were captured in Washakie county. Delimiting trapping will be deployed in these particular areas in 2000. F.E. Warren Air Force Base in Cheyenne had multiple catches in 1996, 1997, and 1998. No moths were found in 1999.

Region 3: Arizona, New Mexico

Host(s): Hardwoods

No adult male gypsy moths were captured in Arizona or New Mexico in 1999.

Region 4: Nevada, Utah

Host(s): Hardwoods

The gypsy moth was first detected in Utah in 1988. Between 1989 and 1993 approximately 72,000 acres of Federal, State, and private lands were treated with Bacillus thuringiensis (Bt). In 1995, after 2 years of intensive trapping resulting in no moth captures, the gypsy moth was declared eradicated. In 1997, 46 moths were captured in Salt Lake City and one moth on the Wasatch-Cache National Forest. In 1998, the Utah Department of Agriculture, in cooperation with the USDA Forest Service, treated 801 acres.

In 1999, 764 acres in Salt Lake County were aerially treated using Bt. Three applications were made at 5-7 day intervals. Treatment was 95 percent effective with only one gypsy moth caught in the treatment area. In 2000, a 10-acre mass trapping grid will be installed around each positive catch using nine pheromone traps per acre. Statewide detection trapping will continue at current levels.

Region 5: California

Host(s): Hardwoods

Thirteen male moths were trapped in 1999 by personnel of the California Department of Food and Agriculture - by county: Contra Costa 1, Los Angeles 2, Nevada 3, San Diego 2, San Mateo 5. There were no reported properties with egg masses or pupal cases.

Region 6: Oregon, Washington

Host(s): Oaks, apple, sweetgum, other hardwoods

While no defoliation has been observed in either State, pheromone traps continue to catch moths. These catches represent either new introductions or populations not completely eradicated by previous treatments. In Washington, two eradication projects totaling 27 acres were conducted using ground applications of

Insects: Nonnative

Bacillus thuringiensis (Bt). The gypsy moth survey in 1999 resulted in trap catches of 42 individuals. Of those, 41 were identified as the European strain. One moth from the Ballard area of Seattle was identified as Asian gypsy moth. Eradication projects are planned for 2000 at three sites totaling an estimated 726 acres.

In Oregon, one eradication project was conducted using two ground applications of Bt on 19 acres. Thirteen moths were trapped in 1999 in Oregon, and all have been identified as the European strain. One site in Ashland, encompassing an estimated 10 acres is proposed for eradication in 2000 using two ground applications of Bt followed by mass trapping. New introductions are expected to continue as long as moth populations in the eastern United States persist and people move from the generally infested area to the Pacific Northwest.

Region 8: Arkansas, North Carolina, Tennessee, Virginia

Host(s): Hardwoods, especially oak species

In 1999, aerial surveys in early July failed to detect any noticeable defoliation by gypsy moth in Virginia. This is a continuing effect of an *Entomophaga maimaiga* fungal outbreak that caused gypsy moth populations to collapse throughout its eastern range. However, ground surveys located apparently healthy local populations in several mountain and piedmont counties. Consequently, the potential for limited local area defoliation in Virginia is greater for next year than it was for 1999.

In Tennessee, two infestations in Overton and White counties were eradicated. Over 1,900 acres in Scott County were sprayed with *Bacillus thuringiensis* where 224 moths were captured in 1998 and 11 in 1999. Two ground treatments are planned for Sevier and Cumberland counties in 2000.

In Georgia, gypsy moth infestations were eradicated in the City of Conyers. No new infestations were discovered during the fiscal year.

In North Carolina and Georgia, 23,000 acres in and around the town of Highlands, North Carolina, were treated as part of a gypsy moth eradication project. Follow-up trapping showed very few moths and no treatment is planned there in 2000.

The Gypsy Moth Slow-the-Spread Pilot Project moved toward operational status in 1999. Trapping and treatments were carried out in 8 States from North Carolina to Wisconsin. Within the boundaries of the Southern Region, 9,090 acres were treated in eastern North Carolina and 24,640 acres in eastern and western Virginia. Additional monitoring and treatment activities will be carried out in 2000.

In Arkansas, delimiting trapping continues in Carroll, Marion, and Newton counties in the aftermath of an eradication treatment carried out from 1993-95. Only three moths were caught in Newton County in 1999, with none caught in Carroll or Marion counties. Trapping will continue within an expanded area in Newton County, but no eradication treatments are planned for 2000.

Region 9/Northeastern Area: Connecticut, Indiana, Maine, Maryland, Massachusetts, Michigan, New Jersey, New York, Ohio, Pennsylvania, Vermont, Wisconsin

Host(s): Apple, aspen, basswood, black walnut, northern red oak, pin oak, red oak, white oak.

During the aerial survey of 1.8 million acres of urban/suburban forest in all eight Connecticut counties, no gypsy moth defoliation was found. No defoliation occurred in Indiana where treatments in 1999 reduced moth catches from 81,000 in 1998 to 13,500 in 1999. Gypsy moth has been very scarce in recent years in Maine presumably due to mortality from the fungus *Entomophaga maimaiga*. No defoliation was found during a summer aerial survey and egg mass levels have continued to be very low throughout the southern half of the State. No significant increase in the population level of this pest is expected in 2000 in Maine. In Maryland, scattered defoliation was reported in Baltimore, Cecil, Dorchester, Frederick, and Washington counties on 1,197 acres. Gypsy moths defoliated slightly over 9,800 acres this past season in Massachusetts; this figure is up slightly from 1998, possibly a result of the inactivity of the fungal pathogen, *Entomophaga maimaiga.* Gypsy moth populations decreased in Michigan, where defoliated acres

went from 301,780 acres in 1998 to about 176,625 acres in 1999. In New Jersey, gypsy moths defoliated 1,380 acres in Burlington, Camden, and Salem counties. In New York in 1999, 4,000 acres in the town of Rochester, Ulster County, were defoliated and 2,000 acres in Warren, Washington, and Saratoga counties had moderate-heavy defoliation. Gypsy moth populations increased most dramatically in Ohio, where defoliation soared from 1,261 acres in 1998 to 48,162 acres in 1999. Gypsy moth is also on the increase in Pennsylvania with 281,605 acres of defoliation reported statewide. Defoliation on Federal lands included 496 acres at Raystown Lake, Pennsylvania; one acre at Berlin Lake, Ohio; and 244 acres at Mosquito Creek Lake, Ohio. Cuyahoga Valley National Recreation Area, Ohio, reported moderate to heavy defoliation on 4,372 acres. Populations remained low in Vermont, with no defoliation detected. Wisconsin treated over 54,000 acres, but moth catches continued to increase to over 125,000, a new record for the State.

Hemlock woolly adelgid,
Adelges tsugae

Region 8: North Carolina and Virginia

Host(s): Eastern hemlock, Carolina hemlock

This insect threatens the entire range of eastern hemlock, and is found throughout Virginia wherever hemlock is abundant, as well as in five North Carolina counties. No new infested counties were added to the list in 1999. The USDA Forest Service and North Carolina State University cooperated in the evaluation of a release of predaceous beetles in Hanging Rock State Park in Stokes County.

Region 9/Northeastern Area: Connecticut, Delaware, Maryland, Massachusetts, New Jersey, New York, Pennsylvania, Rhode Island, West Virginia

Host(s): Eastern hemlock

The hemlock woolly adelgid occurs in 164 of 169 towns in Connecticut, where all 8 counties are infested. The hemlock woolly adelgid infestation expanded to one additional county (Allegheny) in Maryland and infestations are found in 50 percent of the counties in the State. Twenty-one new townships were identified as having infestations in Massachusetts in 1999, but no new counties were found to be infested. This brings the number of townships known to be infested to 88. Delaware Water Gap National Recreation Area, bordering Pennsylvania and New Jersey, reported 24 acres of hemlock mortality and 40 acres of discoloration and decline. Picatinny Arsenal, New Jersey, reported hemlock discoloration and decline on 148 acres. The spread of hemlock woolly adelgid throughout the 26,000 acres of hemlocks in northern New Jersey continues unchecked. Hemlock stands that just a year ago did not have any hemlock wooly adelgid are now heavily infested. In New York, the adelgid has been infesting hemlocks in the southeastern portion of the State, with a new county record in Greene County in 1999, indicating that the infestation is spreading north. Hemlock woolly adelgid continued to spread in Pennsylvania and 31 counties have confirmed infestations affecting both ornamental and forest hemlocks. In West Virginia, the 1999 survey located additional areas of infestation in Monroe, Pocahontas, and Greenbriar counties. Defoliation and needle discoloration from hemlock woolly adelgid was particularly noticeable this year due to the additional stress the trees were under from the severe drought conditions experienced over most of the growing season. To date, 11 counties are infested with hemlock woolly adelgid in West Virginia. Release and evaluation of the hemlock woolly adelgid insect predator, *Pseudoscymnus tsugae*, were initiated in Connecticut, Massachusetts, Maryland, New Jersey, New York, Pennsylvania, Rhode Island, and West Virginia in May of 1999. Evaluations of predator impacts at the release sites are currently being conducted.

Larch casebearer,
Coleophora laricella

Region 1: Idaho, Montana

Host(s): Western larch

In 1999, visible defoliation caused by larch casebearer increased significantly in many western larch stands throughout northern Idaho and western Montana. Though a few areas in which defoliation had been recorded in 1998 decreased in intensity, in other areas, defoliation was recorded for the first time. Defoliation heavy enough to be detected during aerial surveys was found in several areas; in others, increasing defoliation was noted through ground observations. In total, more than 14,000 acres showed some level of observable defoliation in 1999. Most noticeably affected areas were on the Kaniksu National Forest in northern Idaho (5,600 acres) and the Kootenai and Lolo National Forests (3,500 acres and 3,400 acres, respectively) in western Montana. Ground collections made during 1997, 1998, and 1999 showed low parasitism rates in casebearer populations, compared to similar surveys conducted during the 1970's, the last time populations were unusually high. Parasitism levels that were generally less than 15-20 percent in the past 3 years compared with rates of 40-65 percent -- rates common in the early 1980's when casebearer populations began to decline. Surveys indicated that some areas will again experience moderate to heavy defoliation in 2000. Monitoring of population levels and parasitism rates will continue.

Region 6: Eastern Oregon, Washington

Host(s): Western larch

After years of negligible damage, larch casebearer-caused defoliation of western larch has slowly increased in the late 1990's to 15,836 acres in 1999. The vast majority of the observed damage was mapped within the Mt. Hood and Wallowa-Whitman reporting areas.

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

Larch sawfly,
Pristiphora erichsonii

Region 10: Alaska

Host(s): Eastern larch (Tamarack), Siberian larch (ornamental)

The larch sawfly was first recorded in North America in 1880. In 1999, larch sawfly affected 189,246 acres; a significant reduction from the more than 450,000 acres of defoliated larch observed in 1998. However, after 7 years of heavy defoliation, larch mortality is occurring either due to the direct effects of the sawfly or by larch beetle attacking stressed, defoliated trees. The concern still exists that larch beetle may begin to build up in these heavily defoliated stands which could result in further mortality. The Alaska Cooperative Extension Service noted localized defoliation of Siberian larch in and around Anchorage. This is the first time the sawfly has been recorded south of the Alaska Range and could represent an accidental introduction. Efforts are being undertaken to eradicate this pest from these areas as Siberian larch is widely used as an ornamental in urban settings.

Pear thrips,
Taeniothrips inconsequens

Region 9/Northeastern Area: Maine, Massachusetts, Vermont

Host(s): Red maple, sugar maple

In Maine, populations remained low and spotty in 1999. Leaf tattering and defoliation caused by pear thrips was documented on 40,700 acres of Berkshire, western Franklin, Hampshire, and Hampden counties in Massachusetts. Damage in Vermont was down from 1998, but heavy defoliation did occur. Refoliation was limited and browning increased over the course of the summer, in combination with anthracnose infection.

Pink hibiscus mealybug,
Maconellicoccus hirsutus

IITF: Puerto Rico, Virgin Islands

Host(s): Hibiscus and many other species

The pink hibiscus mealybug continued to spread in 1999, and has now reached over 25 Caribbean Islands. It was detected in Puerto Rico in 1997, but thus far has not spread to Florida. The USDA Forest Service and Animal and Plant Health Inspection Service, Plant Protection and Quarantine staffs are working together to rear parasites in Puerto Rico to control this pest. Surveys show that population reductions of 85-90 percent have been achieved at the parasite release sites.

Red pine scale,
Matsucoccus resinosae

Region 9/Northeastern Area: Massachusetts

Host(s): Red pine

The annual aerial survey identified 150 acres of red pine plantation mortality in Hampden and Berkshire counties in Massachusetts. The follow-up ground surveys identified the presence of the fungal pathogens *Diplodia* and *Fusarium* as well as red pine scale. The sudden death of these red pine stands is thought to have been caused by a combination of the above factors, coupled with the 1999 season drought. This is the first time that red pine scale has been documented in Massachusetts.

Redgum lerp psyllid,
Glycaspis brimblecombei

Region 5: California

Host(s): *Eucalyptus camaldulensis* and *E. radis, E. globulus, E. diversicolor, E. sideroxylon*

This insect has become widespread in California since its discovery at two locations in 1998; it has spread to 37 of California's 58 counties. Heavily infested trees are partially defoliated. In addition, the insect is a nuisance because of the honeydew it secretes and the fallen leaf litter. Potential natural enemies were collected in Australia in 1999 and are under study at the University of California, Berkeley.

Smaller Japanese cedar longhorn beetle
Callidiellum rufipenne

Region 9/northeastern Area: Connecticut, New York

Host(s): Arborvitae, eastern red cedar

In the fall of 1998, this exotic beetle was found infesting arborvitae in Milford in New Haven County, Connecticut. This is only the second report of the beetle in the United States outside a port of entry. The first report was in North Carolina in 1997. This is also the first time in this country that the insect had completed its life cycle in a live, healthy plant. The pest has now been recorded in many locations in southwestern Connecticut and a few sites in southeastern New York. This finding has posed an immediate threat to the nursery industry in Connecticut.

Spruce aphid,
Elatobium abietinum

Region 3: Arizona, New Mexico

Host(s): Spruce

No spruce aphid infestations were aerially detected in 1999; declining from 27,950 acres in 1997 and 170 acres in 1998.

Region 10: Alaska

Host(s): Spruce

In 1999, spruce needle aphid occurred on 4,253 acres in southeast Alaska from the southern end of Prince of Wales Island to Chichagof Island. This was a 90 percent reduction from 1998 acres. Sitka spruce along the beach fringe was most affected. Defoliation by aphids causes reduced tree growth, mortality, or can predispose the host to other mortality agents. Approximately 1,000 acres of spruce mortality was noted in 1999 as a result of the severe defoliation in 1998.

Two-spotted leafhopper,
Sophonia rufofascia

Region 5: Hawaii

Host(s): More than 300 plant species

For the last 3 years, rainfall in Hawaii has been below normal in most areas of the State. Some areas of Maui had 28 to 40 percent of normal in 1999 and on Oahu it was 41 to 83 percent of normal at selected sites. The drought has caused the leafhopper to become a more pronounced problem.

Diseases: Native

Annosus root disease,
Heterobasidion annosum

Region 1: Idaho, Montana

Host(s): Douglas-fir, grand fir, ponderosa pine, subalpine fir, western hemlock

Annosus root disease is common in ponderosa pine stands in western Montana. Most damage is concentrated in lower elevations where ponderosa pine is the dominant tree species and past harvesting of large trees has been common. Presence of annosus root disease in ponderosa pine stands greatly decreases the potential for managing ponderosa pine. These sites are usually too dry to effectively grow alternative tree species, so preventing the introduction and subsequent increase of annosus root disease is crucial for managing ponderosa pine. Annosus root disease is widespread at low levels on Douglas-fir and true firs in mixed conifer stands throughout western Montana and northern Idaho. It is frequently found in association with other root diseases.

Region 2: Colorado, Nebraska

Host(s): Eastern redcedar, jack pine, ponderosa pine, white fir

Annosus root disease has scattered distribution in white fir in the mixed conifer cover type throughout southern Colorado. In campgrounds, the disease creates hazardous conditions by increasing the probability of tree failure. In Nebraska, the disease is affecting jack pine, ponderosa pine, and redcedar plantings.

Region 3: Arizona, New Mexico

Host(s): True firs, ponderosa pine

Root diseases and their associated pests may be responsible for about one-third of the conifer mortality in the region. Annosus root disease accounts for roughly 20 percent of this mortality.

Region 4: California, Idaho, Nevada, Utah, Wyoming

Host(s): Bitterbush, chokecherry, Douglas-fir, Jeffrey pine, lodgepole pine, ponderosa pine, spruce, true firs

This root disease fungus can be found throughout the region, but mostly as a decay organism. The fungus is occasionally damaging to young, planted stands of ponderosa pine on droughty soils.

Region 5: California

Host(s): Conifers, some hardwoods

Annosus root disease causes losses in Eastside ponderosa pine in northern California, true firs throughout the Sierra Nevada Mountains and in many conifers in southern California. The pathogen is common in areas that have been partially cut where large stumps provide habitat for the fungus. Mortality is high when annosus root disease interacts with fir engraver in pest complexes.

Diseases: Native

Region 6: Oregon, Washington

Host(s): True firs, ponderosa pine, western hemlock

Annosus root disease causes losses in many partially-cut white and grand fir stands in southern and eastern Oregon and eastern Washington. Damage is often especially severe in subalpine fir, and is associated with smaller stumps than other true fir species. Mortality is high where annosus root disease and fir engravers operate as a complex. The Region 6 Current Vegetation Survey requires examination of cut stumps. This has led to increased reporting and awareness of annosus root disease on many national forests. In eastern portions of the region, where many stands were cut 10-20 years ago, trees surrounding cut stumps are dying. Disease severity is expected to increase with time. Annosus root disease was observed with increasing frequency in stands that are predominantly ponderosa pine on drier sites in eastern Washington and Oregon, and in true fir species in mixed conifer and true fir stands throughout southwest Oregon.

Reports of the disease in mountain hemlock and Pacific silver fir in high-elevation stands in the Cascade Range are also increasing. Annosus root disease in low-elevation western hemlock stands primarily causes butt rot. Impacts are considered low unless stands are managed at rotations greater than 120 years.

Region 8: Regionwide

Host(s): Southern pines

Localized mortality and growth loss occurred throughout the South in 1999 due to annosus root disease. Alabama and Texas reported losses, with the Texas infections occurring mostly in the northeast corner of the State. In South Carolina, annosus root disease combined with drought to caused increased mortality in infected stands.

In North Carolina, annosus root disease killed yellow pine in localized areas and was also reported on coastal red cedar. Mountain sites in North Carolina saw small pockets of white pine mortality.

Armillaria root disease, *Armillaria* spp.

Region 1: Idaho, Montana

Host(s): Douglas-fir, other conifers

This pathogen is the most broadly distributed of the root pathogens and the most important disease agent, overall. It usually occurs in conjunction with annosus root disease, laminated root rot, or brown cubical root and butt rot. Conifers of all species can be killed by *Armillaria* when they are young, but only Douglas-fir, subalpine fir, and grand fir remain highly susceptible throughout their lives. Consequently, the damage is much greater in the latter species where severe disease often renders formerly forested sites to long-term shrub fields.

Region 2: Colorado, South Dakota, Wyoming

Host(s): Engelmann spruce, Colorado blue spruce, Douglas-fir, ponderosa pine, lodgepole pine, subalpine fir, white fir

Armillaria is the most common root disease in the region. Its impacts continue to be especially evident in the mixed conifer and spruce-fir cover types. *Armillaria* is among the key causal agents contributing to subalpine fir decline, which accounts for the most tree mortality in the Rocky Mountain Region. *Armillaria* incidence in developed recreation sites in Colorado has resulted in heightened awareness among resource managers and numerous tree removal projects. Although no acreages are available, *Armillaria* is building up in State sections in northeast Wyoming (Crook and Weston counties). Permanent plots have been established to assess the role of this and other root diseases.

Region 3: Arizona, New Mexico

Host(s): Douglas-fir, ponderosa pine, true firs, spruce, aspen

Armillaria spp. account for about 80 percent of the root disease mortality in the region. The disease is more common in mixed-conifer and spruce-fir forests than in ponderosa pine forests. Region 3 is tracking the long-term spread and effects of this and other root diseases on several sites using a series of permanent plots.

Region 4: Idaho, Nevada, Utah, Wyoming

Host(s): Douglas-fir, grand fir, pines, spruce, subalpine fir

Evidence of *Armillaria* root disease can be found throughout the region functioning primarily as a weak pathogen or saprophyte causing little direct mortality. In southern Utah, it may act as a primary pathogen, killing mature and immature ponderosa pine and mature fir and spruce.

Region 5: California

Host(s): Conifers and hardwoods

Armillaria root disease is common throughout California, typically functioning as a weak pathogen or saprophyte. The disease can be very damaging to trees and shrubs in landscapes and recreation areas that are watered in the summer.

Region 6: Oregon, Washington

Host(s): Conifers

The most serious losses from this disease have occurred east of the Cascade Range in mixed conifer stands. Mortality continues in both disturbed and undisturbed stands. True firs and Douglas-fir sustain the most losses. However, in localized areas, ponderosa pine mortality is significant. In the Blue Mountains of Oregon, there is a several-thousand-acre armillaria-infected area. In mid- to high-elevation stands in the Cascades of southwestern Oregon, armillaria root disease causes mortality of several conifer species. Mortality on lower slopes west of the Cascades and in the Coast Range is usually confined to younger, stressed trees. Assessing species resistance on a site-by-site basis and discriminating for the more resistant species during stand management activities are considered the most effective means of controlling spread and mortality. Studies are currently being made on the genetic characteristics of especially large concentrations of Armillaria on the northeastern portion of the Malheur National Forest.

Black stain root disease,
Leptographium wageneri
Ophiostoma wageneri

Region 3: New Mexico

Host(s): Pinyon pine, Douglas-fir

Both *Leptographium wageneri* var. *wageneri*, affecting pinyon, and. *L wageneri* var. *pseudotsugae*, affecting Douglas-fir, are rare in the Southwestern Region. The former has only been confirmed in two isolated areas in northern New Mexico, while the latter has been observed on a single site in southern New Mexico.

Diseases: Native

Region 4: Idaho, Nevada, Utah

Host(s): Pinyon pine

This fungus caused mortality of pinyon pine on the Bureau of Land Management Burley District in Idaho, on the Humbolt and Toiyabe National Forests in Nevada, and on the Dixie and Manti-LaSal National Forests in Utah.

Region 5: California

Host(s): Douglas-fir, Jeffrey pine, Pinyon pines, Ponderosa pine

In northwestern California, black stain is killing trees in Douglas-fir plantations, particularly in areas where soil is compacted or trees are otherwise stressed. Black stain is also killing trees in pockets in ponderosa pine in northeastern California and pinyon pine in southern California.

In 1999, incidence of black stain root disease was found to have decreased dramatically in thinned ponderosa pine stands at several areas of McCloud Flats, Shasta-Trinity National Forest. Seven black stain root disease centers were identified in Douglas-fir north of Lyonsville, Tehama County. Hundreds of trees have died over many years.

Region 6: Oregon, Washington

Host(s): Douglas-fir, ponderosa pine

In southwestern Oregon, black stain root disease is the most commonly encountered disease in Douglas-fir plantations. High-risk areas are those where disturbances, such as road building or soil compaction, have occurred or where road maintenance equipment injured roadside Douglas-firs. Infected larger individuals are found scattered in previously entered forest stands. Black stain root disease continues to be observed on ponderosa pine east of the Cascades. Best management practices, especially related to prescribed fire and reducing vectoring insect effectiveness, are currently being investigated.

Brown cubical root and butt rot,
Phaeolus schweinitzii

Region 1: Idaho, Montana

Host(s): Douglas-fir, other conifers

Brown cubical root and butt rot is common on mature Douglas-fir throughout its range. Damage is mainly due to defect and growth loss, rather than mortality, although it is often associated with endemic levels of Douglas-fir bark beetle.

Brown root disease,
Phellinus noxious

Region 5: Commonwealth of the Northern Mariana Islands

Host(s): At least 20 native or introduced forest and agroforest species.

The disease varies from localized to widespread on Rota or Saipan, depending upon the host. The last systematic survey for the signs and symptoms of the disease was in 1994.

Cytospora canker, *Cytospora abietis*

Region 5: California

Host(s): Red and white fir

In 1999, the disease was widespread and sometimes severe on the Shasta-Trinity, Six Rivers, and Klamath National Forests. Cytospora canker also caused conspicuous branch flagging in white fir north of the Kaiser Wilderness on the Sierra National Forest. In most cases the branch flagging accounted for 10 percent of the live crown.

Diplodia blight of pines, *Sphaeropsis sapinea* (*Diplodia pinea*)

Region 5: California

Host(s): Gray pine and ponderosa pine

Diplodia blight was widespread in low elevation (1,000 to 2,500 feet) ponderosa pine stands at numerous locations in northern California. Wet spring weather during shoot elongation caused an increase in infections and shoot dieback.

Such weather conditions might also account for the disease appearing suddenly in several southern Sierra Nevada locations. Elevation of locations varied from 900 feet to 3,500 feet. Ponderosa pine was the host at all locations observed except for Lake Don Pedro, where gray pine was infected. Severity of infection varied tremendously, from only one or two branches to 90 percent of the live crown killed in 1 year. None of these trees had died when last examined.

Dwarf mistletoes, *Arceuthobium* spp.

Region 1: Idaho, Montana

Host(s): Douglas-fir; lodgepole, ponderosa, limber, and whitebark pines, western larch

Lodgepole pine dwarf mistletoe infests approximately 2 million acres (28 percent) of the lodgepole pine type in Region 1 and causes about 18 million cubic feet of growth reduction annually. Douglas-fir dwarf mistletoe infests about .6 million acres (13 percent) of Douglas-fir, reducing growth by approximately 13 million cubic feet annually. Western larch dwarf mistletoe occurs on about .8 million acres (38 percent) of western larch stands, and reduces annual growth by over 15 million cubic feet. Dwarf mistletoe is locally heavy in ponderosa pine stands around Coeur d'Alene, Idaho, and along the Spokane River drainage in northern Idaho. Limber pine and whitebark pine are heavily infected in localized areas in Montana, with infection being most prevalent east of the Continental Divide.

Region 2: Colorado, Wyoming

Host(s): Douglas-fir, lodgepole pine, ponderosa pine

Dwarf mistletoes cause the greatest amount of disease losses in the Rocky Mountain Region. Program emphasis continues for landscape-scale surveys and resulting suppression projects where dwarf mistletoe impacts are unacceptable (e.g., developed recreation sites and wood fiber production areas).

Diseases: Native

Dwarf mistletoe infests approximately 20 percent of the ponderosa pine stands along Colorado's Front Range. Mountain pine beetle populations are currently expanding in many parts of Colorado and together with the presence of dwarf mistletoes, are complicating manager's abilities to meet certain resource management goals.

Lodgepole pine dwarf mistletoe is common in the Shoshone National Forest with the majority located at the southern end of the Wind River and Washakie Ranger Districts. This continues to be a problem on State lands in the Green Mountains of Fremont County. There are roughly 5,000 acres of lodgepole pine infested with dwarf mistletoe in the Green Mountains. Lodgepole pine dwarf mistletoe is widespread and is a concern throughout the Bighorn National Forest.

Region 3: Arizona, New Mexico

Host(s): Pines, Douglas-fir, spruce, true firs

Dwarf mistletoes are the most significant pathogens in the Southwestern Region. Over 1 million acres of national forest commercial timberland in each State have some level of infection. The disease also affects several hundred thousand acres of noncommercial and reserved areas, woodlands, and other public and private forest lands. Region 3 is monitoring the disease on several sites, including recently prescribed burned areas, using permanent plots. The region has been active in developing new management approaches for this disease.

Region 4: Idaho, Nevada, Utah, Wyoming

Host(s): Douglas-fir, lodgepole pine, ponderosa pine, western larch

Suppresion projects continue to remove infected overstory trees; however, this forest disease remains the most widespread and frequently observed disease within the Intermountain Region. Regional incidence by major host species is estimated as follows: lodgepole pine, 50 percent; ponderosa pine, 20 percent; Douglas-fir, 20 percent; and western larch, 10 percent infected. These numbers represent the percentage of host stands having some level of infection.

Region 5: California

Host(s): Douglas-fir, pines, true firs

Dwarf mistletoes are infesting conifers on about 25 percent of the forested lands in California with over 4 million acres of forest lands affected. The distribution of dwarf mistletoe has not changed significantly over the past 30 years.

Region 6: Oregon, Washington

Host(s): Conifers

Dwarf mistletoes are present on approximately 9.5 million acres of forested lands in the Pacific Northwest region. Their status changes little from year to year. However, long-term impacts, including reduced growth, mortality, deformity, and top-kill, are significant, particularly in unmanaged stands. Most conifer species are affected to some degree. Douglas-fir dwarf mistletoe is abundant east of the Cascades and in southwestern Oregon. Western larch dwarf mistletoe causes significant effects in northeastern Oregon and eastern Washington. The intensity of dwarf mistletoes in eastern Oregon and Washington and in southwestern Oregon is closely related to fire ecology. Lack of frequent, periodic fire in the last century has allowed infection levels to increase on many sites, especially those where mistletoe was not culturally controlled.

Region 9/Northeastern Area: Maine, Minnesota, New Hampshire, New York, Vermont, Wisconsin

Host(s): Black spruce, red spruce, white spruce

Endemic levels of infection persisted in all these northern States.

Region 10: Alaska

Host(s): Western Hemlock

Hemlock dwarf mistletoe is an important disease of western hemlock in unmanaged, old-growth stands throughout southeast Alaska as far north as Haines. Hemlock dwarf mistletoe continues to cause growth loss, top-kill, and mortality in old-growth forests; its impact in managed stands depends on the abundance of large infected trees remaining on site after harvesting. The incidence of dwarf mistletoe varies in old-growth hemlock stands in southeast Alaska from stands in which every mature western hemlock tree is severely infected to other stands in which the parasite is absent. The dominant small-scale (canopy gap) disturbance pattern in the old forests of coastal Alaska favors the short-range dispersal mechanism of hemlock dwarf mistletoe and may explain the common occurrence of the disease here. Infection of Sitka spruce is uncommon and infection of mountain hemlock is rare. The disease is uncommon on any host above elevations of approximately 1,000 feet. We have found the aggressive heart rot fungus *Phellinus hartigii* associated with large mistletoe brooms on western hemlock.

Elytroderma needle blight, *Elytroderma deformans*

Region 1: Idaho, Montana

Host(s): Ponderosa pine, lodgepole pine

Localized areas of heavy infection from Elytroderma needle blight were seen in Montana in 1999. Elytroderma has been heavy in several areas of western Montana for a number of years, but several new heavily infected areas were reported in 1998 and 1999. This apparent increase in Elytroderma indicates that favorable weather conditions for infection must have occurred during the summer of 1997 and 1998.

Region 5: Northern California

Host(s): Ponderosa pine, Jeffrey pine

Elytroderma disease from recent *wave-year* infections continues to damage ponderosa and Jeffrey pines near the west shore of Lake Almanor. The heaviest infestations in the area were found in 30- to 40-year-old pine. Up to 75 percent of the branches have been killed and mortality in the lower crown has left some pines with live crown ratios of 10 percent or less. Ponderosa pines of all ages were infected at 4,000 to 5,000 foot elevation on the west and northwest sides of Snow Mountain, Shasta County. As at Lake Almanor, infections appeared recent, i.e., few trees showed evidence of chronic infection. In southern California, elytroderma was widespread on Jeffrey pines in the Laguna Mountain area, Cleveland National Forest.

Fusiform rust,
Cronartium quercuum f. sp. *fusiforme*

Region 8: Regionwide

Host(s): Southern pines, especially loblolly pine, slash pine

Fusiform rust is the most damaging disease of loblolly and slash pine in the South. Other pine species may also be infected, but little damage or mortality occurs. An estimated 13.8 million acres of loblolly and slash pine have at least 10 percent of the trees infected. Georgia is the most heavily impacted State, with 4.6 million acres (49 percent of host type) affected. Texas surveys showed that the disease is on the decline over the past few years. Because of the exceptionally dry weather throughout much of 1999, rust incidence across the region was relatively low for the year (the fungus depends on wet weather for spread and distribution).

Laminated root rot,
Phellinus weirii

Region 1: Idaho, Montana

Host(s): Douglas-fir, grand fir

This disease is most severe on sites that historically may have supported mostly western white pine and western larch. These tree species have been replaced by highly susceptible Douglas-fir, grand fir, and subalpine fir with consequent increases in this pathogen. Like *Armillaria*, and usually in conjunction with armillaria and/or annosus root disease, this pathogen often converts formerly forested sites to long-term shrub fields.

Region 6: Oregon, Washington

Host(s): Conifers

Laminated root rot is the most serious forest tree disease west of the Cascade Mountains in Washington and Oregon. Overall, an estimated 8 percent of the area with susceptible host species is affected in this portion of the region. Locally, 15 to 20 percent of an area may be affected. East of the Cascades, laminated root rot affects mixed conifer stands north of the Crooked River in central and northeastern Oregon and throughout eastern Washington. Effects of the disease include significant changes in species composition, size, and structure. Regeneration of susceptible species in root disease centers may not grow beyond sapling and pole size. Hardwood trees and shrubs, which are immune to the fungus, often increase their site occupancy.

Littleleaf disease,
Phytopthora cinnamomi

Region 8: Alabama, Georgia, Kentucky, North Carolina, South Carolina, Tennessee, and Virginia

Host(s): Loblolly and shortleaf pines

Littleleaf disease continues to cause growth loss and mortality across the Piedmont areas of the affected States. Shortleaf pine is highly susceptible while loblolly pine is affected, but at a later age. Many of the stands that were converted from shortleaf to loblolly pine to reduce the impact of this disease are now reaching their age of susceptibility. These stands are often attacked by bark beetles once weakened by the root infection.

Oak wilt,
Ceratocystis fagacearum

Region 2: Nebraska, Kansas

Host(s): Red oak, bur oak

Oak wilt continues to be a problem in forests along the eastern edge of the State of Nebraska. Only a few cases were reported in extreme northeast Kansas.

Region 8: North Carolina, South Carolina, Texas

Host(s): Live and red oaks

Oak wilt continues to be a devastating tree killer in 60 counties in central Texas. Urban, suburban, and rural oaks are affected. Live oak is a premier shade tree species in the region and is highly valued for beauty, shade, and wildlife benefits. The Texas Forest Service completed the 12th year of a cooperative suppression project. Since the project's inception, more than 2.4 million feet (more than 450 miles) of barrier trenches have been installed around 1,600 oak wilt infection centers in 34 counties. In the last several years, the Army Corps of Engineers has implemented suppression efforts on four central Texas reservoirs. The U.S. Fish and Wildlife Service has initiated suppression efforts at the Balcones Canyons National Wildlife Refuge near Austin, Texas.

Region 9/Northeastern Area: Iowa, West Virginia, Wisconsin

Host(s): Black oak, bur oak, red oak, scarlet oak

Tree mortality caused by oak wilt continued to occur across Iowa, affecting an area of 1,719 acres. In West Virginia, aerial oak wilt surveys were conducted in 14 counties. Oak wilt diseased trees were only found in Grant County, which is historically known to have active oak wilt centers. Drought during the summer may have contributed to tree decline and the number of oak wilt centers detected. In Wisconsin, three separate infection centers were found in Florence County in 1999. In Minnesota, control work begun in 1990 continues.

Stem decay,
Basidiomycetes (many)

Region 10: Alaska

Host(s): All tree species

In southeast Alaska, approximately one-third of the gross volume of forests is defective due to stem and butt rot fungi. These extraordinary effects occur where long-lived tree species predominate in old-growth forests in southeast Alaska. The great longevity of individual trees allows ample time for the slow-growing fungi to cause significant amounts of decay. Wood decay fungi play an important role in the structure and function of coastal old-growth forests where fire and other forms of catastrophic disturbance are uncommon. By predisposing large old trees to bole breakage, these fungi serve as important disturbance factors that cause small-scale canopy gaps. A study has been concluded that investigated how frequently fungi enter wounds of different sizes and the rate of subsequent decay in these wounded trees. Generally, larger, deeper wounds and larger diameter breaks in tops result in a faster rate of decay. Results indicate that heart rot development is much slower in southeast Alaska than the Pacific Northwest.

Stem decay is the most important cause of volume loss and reduced wood quality in boreal Alaskan hardwood species and is considered a limitation on the availability and cost of harvesting timber. In south-central and interior Alaska, incidence of stem decay fungi increases as stands age and is generally high in

stands over 100 years old. Stem decay fungi will limit harvest rotation age of forests that are managed for wood production purposes. Studies are currently underway in paper birch forests to identify the most important stem decay fungi and assess the relationships among decay, stand age, presence of decay indicators, and site factors.

Swiss needle cast,
Phaeocryptopus gaumannii

Region 6: Western Oregon, Washington

Host(s): Douglas-fir

Swiss needle cast, a fungus disease of Douglas-fir foliage, is endemic in Douglas-fir west of the Cascade Mountain crest. Over the last 15 years, distinctive yellowing, needle loss, and growth reduction have been observed in coastal Douglas-fir plantations. A combination of favorable climate, plantation age, and genetics may be the cause of severe disease symptoms seen in recent years. In the spring of 1999, 295,000 acres of discolored Douglas-fir along the Oregon coast were mapped by a special aerial survey. Surveys were also conducted during the spring of 1996, 1997, and 1998. An overall increase in affected acreage and intensification of the affected areas have been detected. Estimates of affected acreage for all years, however, are conservative since mapped acres represent only those areas with obvious symptoms; ground surveys indicated that Swiss needle was present in all Douglas-fir stands throughout the survey area. The 1997 survey showed more discoloration in mature trees than was seen in previous surveys.

Washington Department of Natural Resources conducted their first aerial survey for Swiss needle cast in the spring of 1998 and mapped in 44,000 acres. Over 200,000 acres were mapped during the 1999 survey. A survey is scheduled for the spring of 2000 in Oregon and Washington.

Tomentosus root disease,
Inonotus tomentosus (Fr.) Teng.

Region 10: Alaska

Host(s): Lutz, Sitka, and White Spruce

In south-central and interior Alaska, tomentosus root rot causes growth loss and mortality of white and Lutz spruce in all age classes. Root disease fungi are capable of spreading from tree to tree through root contacts. Infected trees are prone to uprooting, bole breakage, and outright mortality due to the extensive decay of root systems and the lower tree bole. Volume loss due to root diseases can be substantial, up to one-third of the gross volume. In managed stands, root rot fungi are considered long-term site problems because the fungi can remain alive and active in large roots and stumps for decades, impacting the growth and survival of susceptible host species on infected sites. The disease appears to be widespread across the native range of spruce in south-central and interior Alaska**,** but to date, has not been found in southeast Alaska.

True mistletoes, *Phoradendron* spp.

Region 4: Nevada, Utah

Host(s): Junipers

Occurring throughout the pinyon-juniper forest type in Nevada and Utah, this disease spreads and intensifies slowly and is therefore more common in older stands.

Region 5: California

Host(s): Hardwoods, incense-cedar, white fir

True (leafy) mistletoes continue to cause dieback and decline in both hardwoods and conifers in developed recreation sites on all national forests in Southern California. Minor amounts of incense-cedar true mistletoe were noted at Juanita Lake Campground, Klamath National Forest.

Diseases: Nonnative

Beech bark disease,
Nectria coccinea var. faginata

Region 8: North Carolina, Tennessee, Virginia

Host(s): American beech

Beech bark disease was not found in any additional counties in 1999, but the disease continues to intensify within the currently affected areas. Beech bark disease was first reported in the Great Smoky Mountains National Park in 1994. However, the first mortality in the South was reported as early as the mid-1980's in northern Virginia. This is well outside the previously known distribution. Tree mortality continues to intensify in Tennessee along the Appalachian Trail in Blount, Cocke, and Sevier counties within the Great Smoky Mountains National Park. The disease has intensified at a greater rate than predicted, and is spreading downslope toward the Cherokee National Forest.

Region 9/Northeastern Area: Connecticut, Maine, Massachusetts, New Hampshire, New Jersey, New York, Rhode Island, Pennsylvania, Vermont, West Virginia

Host(s): American beech

This disease, which was introduced into Maine in the early 1930's, continued to kill or reduce the quality of beech stems Statewide. But beech bark disease does not threaten to eliminate beech from the Maine forest because some trees are resistant, and even susceptible trees sprout profusely from roots when trees are damaged, killed, or harvested. Decline of American beech caused by beech bark disease was documented on 850 acres in Berkshire County in Massachusetts. Beech bark disease continued to be prevalent in New York, with over 90 percent of the trees surveyed having evidence of the disease. In Vermont, dry conditions led to an increase in chlorosis, dieback, and mortality on infected trees. The disease is also present in Pennsylvania and in West Virginia on the Virginia border.

Dutch elm disease,
Ophiostoma (=Ceratocystis) ulmi

Region 1: Idaho, Montana, North Dakota

Host(s): American elm

Dutch elm disease continued to spread in urban areas in North Dakota and Montana. Montana's highest losses are occurring in the cities of Billings and Great Falls. In North Dakota, heavy losses have occurred in both urban areas and in naturally occurring American elms in riparian zones. In Idaho, this disease is common in many communities along the Snake River in southern Idaho, and is slowly working its way into northern Idaho communities. It was discovered in Moscow, Idaho, in 1990, but an aggressive treatment program has limited losses to only a few trees per year for the past several years. It has also been discovered in several communities nearby--Genesee, in Idaho; Palouse and Pullman, in Washington.

Region 2: Colorado, Nebraska, Kansas

Host(s): American elm

In Colorado, the disease did not cause major problems anywhere in the State, although losses are taken seriously by towns or private citizens who own elm trees. Systematic surveys continue to be conducted by Colorado State Forest Service Districts.

Dutch elm disease continues to be a problem in riparian areas and cities throughout Nebraska. Kansas had numerous reports of Dutch elm disease across much of the State, which is normal.

Region 8: Regionwide

Host(s): American elm

Scattered, localized mortality continues to occur at low severity levels in urban and wild populations of elm. In Georgia, Dutch elm disease killed hundreds of elms during the 1999 summer drought. Most reports came from larger cities including Atlanta, Augusta, Macon, and Rome.

Region 9/Northeastern Area: Areawide

Host(s): American elm

Symptoms of Dutch elm disease were conspicuous throughout Maine during 1999. Many old elms, which escaped the initial wave of infection, now succumb each year, at least partially the result of the development of more aggressive strains of the disease organism. Mortality of younger elm trees (4 to 8 inches diameter-breast-height (DBH) and 20 to 30 feet tall) is also occurring. Numerous diseased elms were reported in Wilmington, Delaware, in 1999. In the District of Columbia, infected American elms were either removed or pruned in order to help minimize the spread of the disease. Dutch elm disease surveys were conducted for the first time in Mount Ranier, Maryland; trees infected with Dutch elm disease were found. While conducting elm yellow surveys across Ohio, 50 counties were found infected with Dutch elm disease. In Vermont, the disease remained common.

European larch canker, *Lachnellula willkommii*

Region 9/Northeastern Area: Maine

Host(s): Larch

European larch canker is a fungal disease that originated in Europe and was first found on native larch (tamarack) in southeastern Maine in 1981. The disease is under State and Federal quarantine. Surveys in 1999 of previously uninfested areas proved negative. Commercial larch seed orchards in the towns of Unity and Howland were also checked for evidence of larch canker; no disease was found. The trend for this disease is static.

White pine blister rust,
Cronartium ribicola

Region 1: Idaho, Montana

Host(s): Limber pine, western white pine, whitebark pine

White pine blister rust causes extensive tree mortality throughout the range of western white pine. Mortality of naturally occurring regeneration has virtually eliminated western white pine from many forests. This has resulted in major changes in historical transitions in forest types over broad areas. In moist habitat types, where white pine was historically the dominant species, it has been replaced by climax species such as grand fir, hemlock, and western redcedar. Efforts to restore white pine are concentrated on planting genetically improved stock. We are currently intensifying monitoring efforts to gain a better understanding of how well the improved stock is holding up in the field. In addition, pruning lower branches from natural regeneration is being conducted on a large scale because it can greatly improve survival in some areas.

Blister rust is also causing extensive mortality in high-elevation five-needle pines. Recent surveys in northern Idaho and western Montana high-elevation forests have found infection rates in whitebark pine regeneration of up to 90 percent. There is a growing concern that severe losses of large diameter whitebark pine due to insects coupled with regeneration losses due to blister rust may have significant impacts on water and wildlife in these fragile ecosystems.

Region 2: Wyoming

Host(s): Limber pine, whitebark pine

This disease was found for the first time in Colorado in 1998. The rust is causing branch and main stem cankers on scattered limber pines in several locations north of Redfeather Lakes, which is approximately 40 miles northwest of Fort Collins, Colorado. Incidence appeared low. Additional surveys are planned to determine the extent of the infestation in Colorado in the near future.

Roughly 6,260 acres of the Shoshone National Forest are severely impacted by white pine blister rust. White pine blister rust impacted 428 acres in the Bighorn National Forest.

Region 3: New Mexico

Host(s): Southwestern white pine

Blister rust occurs throughout most of the range of southwestern white pine in the Sacramento Mountains, adjoining White Mountains, and nearby Capitan Mountains of southern New Mexico. This area includes two Districts of the Lincoln National Forest and the Mescalero-Apache Indian Reservation. In 1999, two infected white pines were found on Gallinas Peak, about 50 miles north of the Capitans. This is the first confirmed siting of the disease on the Cibola National Forest.

Region 4: Idaho, Nevada, Utah

Host(s): Limber pine, whitebark pine, bristle cone pine, western white pine, sugar pine

This introduced disease is common throughout its host ranges in southern Idaho and western Wyoming. It is present in the western portion of Nevada. No infection has been reported in Utah.

Region 5: California

Host(s): Sugar pine, western white pine, whitebark pine

White pine blister rust was not found during surveys of the Tehachapi Mountains, the Los Padres National Forest, or the Angeles National Forest. The known southern extent of the disease remains at Breckenridge Mountain on the Sequoia National Forest. On the adjacent Sierra National Forest, blister rust was prominent on sugar pine seedlings and saplings between Wishon Reservoir and the Kings River. Most of the rust was found between 6,000 and 7,000 foot elevation. Tree and branch mortality were common from infections dating to the early 1990's. Branch mortality and topkill on sugar pine were observed north of the Kaiser Wilderness. Affected trees were widely scattered at elevations between 5,500 and 7,000 feet.

In northern California, minor amounts of white pine blister rust were observed in western white pine at Kangaroo Lake Campground, Klamath National Forest.

Region 6: Oregon, Washington

Host(s): Western white pine, sugar pine, whitebark pine

Cronartium ribicola was introduced to the west coast in 1910. Its impacts include top-kill, branch flagging, and tree mortality. While much of the mortality associated with this disease occurred earlier in the century, its impacts are still great in wild populations of five-needled pines throughout their range. Locally, this disease, in combination with mountain pine beetle, still kills many host trees. Of particular concern are the effects of blister rust in whitebark pine at high elevations in the Cascades and in the Blue and Wallowa Mountains and in sugar pine in southwest Oregon where survey and impact data are not available.

An attempt was made to aerially identify areas symptomatic of blister rust beginning in 1994. Although blister rust is known to occur extensively throughout the range of susceptible host type, observers mapped only 3,139 acres in 1999. Blister rust symptoms are difficult to distinguish from the more easily observed effects of mountain pine beetle. With the exception of blister rust in whitebark pine (which grows at higher elevations and in more open conditions), blister rust is very difficult to detect from the air. The bulk of the reported 3,139 acres mapped in 1999 fell within the Yakama Indian Reservation, the Wenatchee National Forest, and State and Forest Service lands within the Okanogan reporting area. An on-going study of whitebark pine stands in eastern Washington has found that 81 percent of the trees are alive, most mortality is more than 10 years old, and in trees greater than 9 inches DBH. Thirty-four percent of the mortality is attributed to blister rust. The Colville National Forest is pruning western white pine plantations to reduce the incidence of lethal blister rust infections. Ground surveys indicate that blister rust is common in whitebark pine communities in the Seven Devils (Idaho), Elkhorn, and Wallowa Mountains, but scarce in the Strawberry Mountains, and all of northeastern Oregon.

A recent survey of whitebark pine along the Pacific Crest National Scenic Trail on the Umpqua National Forest estimated that 50 percent of the whitebark pine were infected by white pine blister rust. Ninety percent of the infected trees had potentially lethal cankers. Topkill caused by blister rust was common.

Region 9/Northeastern Area: Areawide

Host(s): White pine

In Maine limited control efforts continued to manage this disease in certain high value pine stands each year. In 1999, a total of 4,319 acres of high quality pine timber was scouted for *Ribes* spp. plants in the Androscoggin County town of Auburn. A total of 2,782 *Ribes* spp. were destroyed. In Vermont, topkill and mortality were more common due to dry conditions. Wet weather the previous spring may have led to higher infection levels. Infection levels in affected areas averaged 20 percent in Christmas tree plantations and 32 percent in pole-size stands.

Diseases: Origin Unknown

Butternut canker,
Sirococcus clavigignenti-juglandacearum

Region 8: Regionwide

Host(s): Butternut

This disease has been in the South for at least 40 years and is believed to have killed 3 of every 4 butternuts in North Carolina and Virginia. The fungus kills trees of all ages. Butternut canker is expected to spread and kill most of the resource, including regeneration. The species will be replaced by other species on these sites (e.g., black walnut). It is too early to project the benefits of selection and breeding. However, trees exhibiting resistance have been found in Arkansas, North Carolina, Tennessee, Kentucky, and Virginia.

Region 9/Northeastern Area: Areawide

Host(s): Butternut

In Connecticut, of 704 tagged butternut trees surveyed yearly for Sirococcus cankers, only 141 remain canker free and 22 have died. In Maine, butternut canker was first found in 1993 when the disease was located in Kennebec County. Surveys for this disease in succeeding years indicate that the canker is now located in all Maine counties except Washington County.

Dogwood anthracnose,
Discula destructiva

Region 8: Alabama, Georgia, Kentucky, North Carolina, South Carolina, Tennessee, Virginia

Host(s): Flowering dogwood

Dogwood anthracnose continues to intensify within its range, although late season dry weather reduced its impact. No new dogwood anthracnose infected counties were added to the list in 1999.

Region 9/Northeastern Area: Connecticut, Delaware, Indiana, Maine, Maryland, Massachusetts, Missouri, New Hampshire, New Jersey, New York, Ohio, Pennsylvania, Rhode Island, Vermont, West Virginia

Host(s): Flowering dogwood, dogwood

The incidence of dogwood anthracnose continued to be prevalent in all three Delaware counties. Dead and dying dogwood trees were quite noticeable in many areas of the State. Dogwood anthracnose is now found in all counties in Maryland. Visual symptoms of this disease were reported in Franklin, Essex, and Bristol counties in Massachusetts; however, no samples were collected for positive diagnoses in the laboratory. In New York, a survey for dogwood anthracnose was performed to determine if the disease has spread to areas in which it was not previously recorded. As a result of this survey, new records of the disease were found in 18 counties. In West Virginia, diseased and dying trees were found in every county. Over the 10 year period in which this survey has been conducted, mortality increased from 8.8 percent in the first survey to 44.1 percent in the 1999 survey. During the same time period, there was a dramatic change in the number of healthy dogwoods from 49 percent healthy dogwoods in the first survey to 0.4 percent in the

1999 survey. This shows a general trend where the native dogwood population is moving from a healthy State to one of decline and mortality.

Pitch canker,
Fusarium circinatum

Region 5: California

Host(s): Bishop pine, Douglas-fir, Monterey pine, Monterey pine x Knobcone pine

The total number of California counties infested with pitch canker increased to 19 with the addition of Napa County. It was not found by survey in Del Norte, Humboldt, Mendocino, Yolo, and Sacramento counties. Other northern California counties will be surveyed in 2000.

The isolated infestation of pitch canker at a Christmas tree farm near Dixon, California, has persisted in spite of the removal of all visibly infected trees. Ground level infections and contaminated soil are typical at other Christmas tree farms; at Dixon the infections are in the tree tops.

Concern about the spread of pitch canker heightened when it was discovered that bales of pine needles contaminated with *Fusarium circinatum* were imported to Truckee, California, from Georgia. The bales were being used for erosion control and landscaping at a resort development. The discovery was made while checking the shipment for red imported fire ant.

In August, the California Native Plant Society submitted a petition to the California Fish and Game Commission to list Monterey pine as a State threatened plant species. The petition discusses pitch canker as a major threat to the native stands along the Central California Coast. The Commission will make a ruling on the completeness of the petition and then has a year to evaluate the request and make a decision.

Region 8: Regionwide

Host(s): Southern pines

Only scattered trees across the region are infected, but impacts can be locally significant. In Georgia, pitch canker continues to be associated with pine plantations near chicken houses. The ammonia released from the brood houses creates conditions on the trees conducive to infection. The damage is usually confined to the area within the plantation nearest exhaust fans. All species of pine (slash, longleaf, shortleaf, and loblolly) are affected. Chicken houses are becoming a common sight throughout the coastal plain of Georgia. Thus, problems with pitch canker are expected to increase there, especially during droughts. Similar problems have been noted in North Carolina when chicken waste has been used as fertilizer in pine plantations.

Port-Orford-cedar root disease,
Phytophthora lateralis

Region 5: California

Host(s): Pacific yew, Port-Orford-cedar

Fish Lake Creek was resurveyed from Blue Lake to below Fish Lake, Orleans District, Six Rivers National Forest. Although the incidence and impact of the disease have increased markedly since the last survey in 1997, indicators of infection have not appeared below the outlet of Fish Lake.

Diseases: Origin unknown

New areas of infestation were confirmed at Alder Conservation Camp and Golden Bear RV Park near Klamath, California, at Shasta Retreat in Dunsmuir, and at three new locations near the river bank along the Sacramento River south of Dunsmuir, California.

Region 6: Oregon

Host(s): Port-Orford-cedar

The annual aerial survey reported evidence of the disease on over 4,300 acres (1.48 trees per acre) in 1999. Within these areas, mortality was distributed in scattered pockets or individual trees. On National Forest System lands, slightly less than 10 percent of all Port-Orford-cedar is infected.

Sudden oak death,
Unknown

Region 5: California

Host(s): Tanoak, coast live oak

Thousands of tanoak and neighboring oaks have died throughout coastal California from the Oregon border south to San Luis Obispo. The symptoms vary; typically the first symptom is branch wilt at the tip, followed by branch dieback. The branch resprouts but the sprouts also die. The necrotic area spreads into the stem and then the foliage turns brown, but remains attached to the branches.

In 1999, dieback of tanoak was observed at Mt. Tamalpais and Muir Woods National Monument, Marin County; in Santa Cruz County; on the Orleans and Lower Trinity Districts, Six Rivers National Forest, and in Redwood National Park.

Declines and Complexes

Aspen decline

Region 5: California

Host(s): Aspen

Quaking aspen on the Warner Mountain District, Modoc National Forest, are exhibiting symptoms of insect and disease activity. Small stands affected by defoliation are distributed across the district and some clones appear to have considerable amounts of defoliation from insect feeding. Many stands also exhibit chronic infections of the false tinder fungus.

Aspen defoliator complex

Region 3: New Mexico

Host(s): Aspen

In New Mexico, aspen defoliation caused by a complex of insects, diseases, and abiotic factors decreased from 27,355 acres in 1998 to 22,545 acres in 1999. Defoliation was observed on the Carson (4,700 acres), Cibola (1,560 acres), Lincoln (260 acres), Santa Fe (4,785 acres) and Gila (245 acres) National Forests; Taos Pueblo Indian Reservation (805 acres); and 10,190 acres of State lands in central and northern New Mexico.

Chaparral decline

Region 5: California

Host(s): Chaparral

Chaparral dieback is extensive in areas on the Mountaintop District, San Bernardino National Forest, and on private lands in the San Jacinto Mountains, Riverside County. Reports have also been received from the Santa Ana Mountains and the San Gabriel Mountains.

Elm yellows

Region 9/Northeastern Area: Maryland, Ohio, Pennsylvania, West Virginia

Host(s): American elm, slippery elm

A multi-State survey detected disease symptoms and mortality due to elm yellows. Areas affected are presently contained within a large area extending north into Pennsylvania, south past Winchester, Virginia, and east and west bounded approximately by Martinsburg, West Virginia, and Frederick, Maryland. In Pennsylvania alone, 3,180 acres, in 45 counties, are infested with elm yellows, but a few counties appear to have a limited distribution of the disease. Based on ground surveys, elm yellows occurs scattered in 31 counties across the State in Ohio. In West Virginia, elm yellows surveys were conducted in the Eastern Panhandle as well as Brooke and Hancock counties. Diseased and dying trees were detected in Brooke,

Jefferson, Berkeley, and Morgan counties. A major outbreak of elm yellows disease is still occurring in Jefferson, Berkeley, and Morgan counties.

Hackberry decline

Region 5: California

Host(s): Hackberry

For the past 8 to 10 years, hackberry in Davis, California, have been declining and dying. Typically the declining trees are about 45 years old, surrounded by lawn, and irrigated frequently. Examination of tree tops, root crowns, and roots show evidence of tree failure only in the roots and root crown. Wood at the soil line is very dark, almost black, in an irregular pattern corresponding to affected roots below. There is a strong, distinct anchovy odor. The cambium is killed in areas with discoloration. Some roots are affected while others appear to be healthy. The stain does not extend higher than the root crown and fine roots are not visibly affected. As roots are girdled and die, living roots can no longer support the tree's physiological needs and it declines and dies.

Koa tree quick decline,
Cause undetermined

Region 5: Hawaii

Host(s):

Tree mortality continues to occur, but is reported less frequently. Trees die off suddenly after a period of branch dieback. A causal agent has not been determined, but *Fusarium oxysporum* fungus and scolytid beetles have been found.

Larch stressors

Eastern larch beetle
Dendroctonus simplex
Larch casebearer
Coleophora laricella
Larch sawfly
Pristiphora erichsonii
Variable water levels

Region 9/Northeastern Area: Maine

Host(s): Larch

Native eastern larch and some larch hybrids have been under serious stress from several pests and significantly fluctuating water levels in the recent past and especially during 1999. During 1999, combinations of these agents resulted in significant larch mortality in pockets and to individual trees throughout eastern Maine. Approximately 10,800 acres of seriously defoliated, discolored, and dead larch were mapped. In addition to this mapped acreage, scattered individual larch and small clusters of stressed or dead trees were seen throughout eastern and northeastern Maine (over 1.2 million acres). Larch sawfly has caused near complete defoliation on scattered larch stands since 1997. Defoliated regions have varied from year to year but the hardest hit areas include central Penobscot, eastern Piscatiquis, southeastern

Aroostook, and southern Washington counties. Near complete defoliation of larch for two successive seasons have caused branch, top, and whole tree mortality in several areas.

Limber pine decline

Region 1: Montana

Host(s): Limber pine

Limber pine mortality is continuing across scattered locations in central and eastern Montana. In some stands on the Lewis and Clark National Forest, nearly 100 percent mortality has been observed. Data from permanent plots indicate that the mortality is strongly associated with severe defoliation from Dothistroma needle blight (caused by *Dothistroma septospora*). Defoliation from *Dothistroma* was severe at many locations again in 1999, marking the fifth consecutive year of severe damage. Continued mortality is expected. Other factors thought to be contributing to this decline are winter damage, drought, and competition-related stress.

Lodgepole pine decline

Region 5: California

Host(s): Lodgepole pine

Lodgepole pine north of Cone Lake, around McCoy Flat Reservoir, and along Road A21 north of Westwood, California, are showing signs of decline. Short needles, thin crowns, and lower branch mortality are common on overstory lodgepole pines over 100 years of age. Some of the pines are infected with dwarf mistletoe, but old age and competition from understory trees are suspected as major causes of the decline. No pathogen has been identified thus far.

Northern hardwood decline

Region 8: Virginia

Host(s): Eastern hardwoods

Although a small area of upland hardwoods in extreme southern Virginia continues to show decline, research by the Southern Research Station showed in 1999 that claims of widespread decline of northern hardwoods in the Southern Appalachians are highly exaggerated. The report also dispelled the myth that air pollution is a significant causal agent for hardwood declines in the Appalachians. A summary of the report (written by Dr. Jim Steinman of the USDA Forest Service) in news release format is available on the worldwide web at: www.hcs.ohio-state.edu/ODNR/Publications/082399nr/082399nr.htm

Oak decline

Region 8: Regionwide

Host(s): Oaks, other hardwoods

The severe summer drought of 1998 continued into 1999, with both the Ozark and Appalachian mountain areas taking the brunt of the moisture deficit. Oaks were particularly hard hit, with North Carolina and

Virginia incurring heavy losses on south-facing slopes. Similarly, Tennessee noted increased losses of both red and white oak, with white oak especially hard hit in the Appalachians. Arkansas reported widespread red oak mortality in the north-central part of the State. In Georgia, oak mortality was heaviest on rocky ridges and side slopes in the mountains. Drought is just one component of oak decline, a syndrome resulting in dieback and mortality of dominant and co-dominant mature oaks. Other causal factors that are stressors include frost, defoliation by insects (including the gypsy moth) and secondary pests such as Armillaria root disease and two-lined chestnut borer (*Agrillus bilineatus*), and hypoxylon canker. Oak decline and gypsy moth have been shown to interact: severe defoliation by gypsy moth can induce oak decline in previously unaffected areas, and in areas of pre-existing oak decline, gypsy moth defoliation causes increased mortality. Host, age, and site conditions also play a role.

Subalpine fir decline

Region 2: Colorado, Wyoming

Host(s): Subalpine fir

Subalpine fir (SAF) decline was the most widespread damage agent detected in Colorado in 1999. Nearly 400,000 acres were affected by this decline. It is poorly understood, but it is thought that a combination of insect (western balsam bark beetle, *Dryocoetes confusus*) and disease (*Armillaria* or other root diseases) plays a role in tree decline and mortality. In Wyoming, roughly 2,951 SAF located on 1,685 acres within the Bighorn National Forest are affected by SAF decline. A total of 4,602 trees on 2,805 acres were affected by SAF decline in the Shoshone National Forest. In both the Bighorn and Shoshone National Forests, fir decline is increasing and has become a significant management concern. An increase of 600 acres of SAF decline was observed on State lands in southwest Wyoming.

Subalpine fir mortality complex

Region 1: Idaho, Montana

Host(s): Subalpine fir

Once again in 1999, the area of SAF "decline" increased in the Northern Region. Several agents, notably root diseases and secondary bark beetles, are often found to be involved in the complex of pests causing this decline. Western balsam bark beetle *(Dryocoetes confusus)* appears to be the most commonly observed organism in the "complex." Subalpine fir mortality was recorded on almost 81,000 acres in 1999, compared to 64,500 acres in 1998. This figure does not include the Beaverhead National Forest, typically one of the more severely affected forests in the region, which was not flown in 1999. Had that forest been flown, the infested area would likely have been close to 100,000 acres. While the number of infested acres increased, in at least some areas intensity of tree killing appeared to decline. Regionwide, just over one tree per acre was killed. Of the infested area recorded, approximately 37,300 acres were in northern Idaho, principally on the Idaho Panhandle and Nez Perce National Forests. The remaining 43,400 acres were found rn Montana, located on the Gallatin, Lolo, Lewis and Clark, and Kootenai National Forests. Regionwide an estimated 90,200 SAF's were killed in 1998 and recorded as faders in 1999.

Region 4: Idaho, Nevada, Utah, Wyoming

Host(s): Subalpine fir

Subalpine fir decline and mortality complex continues to occur throughout the host type in the region. Ground examinations suggest a complex of factors are involved in this mortality. These factors include: twig beetles, secondary bark beetles, wood borers, engraver beetles, root diseases, cankers, rusts, and environmental conditions.

Significant increase in mortality was observed in 1999 with 58,000 trees killed compared to 13,200 trees killed in 1998. Mortality was located on all national forests in Utah. The largest area of mortality in the region is located on the Bridger-Teton National Forest in western Wyoming where 20,100 trees were killed. In Idaho, 1,100 trees were killed on the Caribou National Forest.

Yellow-cedar decline

Region 10: Alaska

Host(s): Yellow-cedar

Decline and mortality of yellow-cedar persists as one of the most spectacular forest problems in Alaska. Approximately 494,000 acres of yellow-cedar decline have been mapped across an extensive portion of southeast Alaska. Ground surveys show that 65 percent of the basal area of yellow-cedar is dead on this acreage. Research suggests that the total acreage of yellow-cedar decline has been increasing very gradually; the slow increase in area has been a result of the expansion of existing decline (less than 3 feet per year) into adjacent stands. Most stands contain trees that died up to 100 years ago (snags still standing), as well as recently-killed cedars, dying cedars (with yellow, red, or thinning crowns), healthy cedars, and other tree species. Snags of yellow-cedar accumulate on affected sites and forest composition is substantially altered as yellow-cedar trees die, giving way to other tree species. Regionwide, this excessive mortality of yellow-cedar may lead to diminishing populations (but not extinction) of yellow-cedar, particularly when the poor regeneration of the species is considered.

All research suggests that contagious organisms are not the primary cause for this extensive mortality. Some site factor, probably associated with poorly-drained anaerobic soils, appears to be responsible for initiating and continuing cedar decline. Two hypotheses have been proposed to explain the primary cause of death in yellow-cedar decline: 1) Toxins are produced by decomposition in the wet, organic soils, or 2) Shallow fine roots are damaged from freezing, associated with climatic warming and reduced insulating snowpack in the last century.

Seed Orchard Insects and Diseases

Coneworms,
Dioryctria amatella
Dioryctria clarioralis
Dioryctria disclusa
Dioryctria merkeli

Region 8: Regionwide

Host(s): Southern pines

Coneworms caused a 25-percent cone loss in untreated areas of a pine seed orchard in the Texas State Seed Orchard in 1999. Elsewhere in the South, coneworm levels were relatively normal, except in Florida, where a prevalence of cone rust continues to contribute to unusually high coneworm populations in the Withlachoochee Seed Orchard in Brooksville, Florida.

Pitch canker,
***Fusarium subglutinans* f. sp. *pini (=F. circinatum* Nirenberg & O'Donnell)**

Region 8: Regionwide

Host(s): Southern pines

About 5 percent of the cone crop in the Texas State Seed Orchard was affected by pitch canker. In North Carolina, pitch canker-caused losses in seed orchards are described as being at normal levels.

Seed bugs,
Leptoglossus corculus
Tetyra bipustata

Region 8: Regionwide

Host(s): Southern pines

Seedbugs were abundant in untreated pine seed orchards in Texas in 1999. In other States, seedbug losses were typical.

Southern cone rust,
Cronartium strobilinum

Region 8: Florida

Host(s): Slash pine

In Florida, abnormally high levels of cone rust in slash pine seed orchards continue a problem prevalent over the last several years.

Western conifer seed bug,
Leptoglossus occidentalis
Coneworm,
Dioryctria abietivorella
Cone beetle,
Conophthorus ponderosae

Region 1: Idaho, Montana

Host(s): Western White Pine and other conifers

Cone and seed insects can cause considerable damage to the seeds of western conifers, significantly reducing seed crops. Though insects are found feeding on a variety of tree species in wild stands, they are especially of concern in blister-rust-resistant western white pine seed orchards. Seeds collected in these orchards are used to regenerate areas where white pine, once the dominant tree species, has nearly disappeared due to white pine blister rust. The insects that cause the most damage in western white pine are western conifer seed bug, *Leptoglossus occidentalis*, cone beetle, *Conophthorus ponderosae*, and coneworm, *Dioryctria abietivorella*. One or more of these insects are often so abundant in northern Idaho white pine seed orchards to warrant an insecticidal spray treatment. These insects have also been found destroying whitebark pine seeds in high elevation stands. Whitebark pine is an important tree species for watersheds, wildlife, recreation, and aesthetics. This tree species has significantly declined in recent years due to blister rust, periodic outbreaks of mountain pine beetle, natural forest succession and fire suppression. Its seeds are extremely valuable for wildlife and regeneration and may need to be protected from insect predation in the future.

White pine cone beetle,
Conophthorus coniperda

Region 8: North Carolina, Virginia

Host(s): Eastern white pine

Overwintering white pine cone beetle populations did not increase over 1998 levels in Virginia. In North Carolina, beetle populations were low.

Nursery Insects and Diseases

Cranberry girdler moth,
Chrysoteuchia topiaria

Region 6: Oregon

Host(s): Conifers

Cranberry girdler caused minor losses in some lots of Douglas-fir; however, there were significant amounts of damage in some lots of true fir (10-20 percent). Adult moths were detected at low levels in pheromone traps. Late in the growing seasson girdler damage was noted at the ground line in Douglas-fir, but not in the true fir. Douglas-fir was treated with one application of chlorpyrifos.

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

Region 6: Oregon

Host(s): Conifers

The nursery experienced less than 5 percent mortality to damping-off. Fumigation, early sowing, deep watering, and delayed fertilization helped control damping-off.

Region 8: Regionwide

Host(s): Southern pines

Damping off is the most common disease problem facing southern nurseries. Loss of seedlings to damping-off varies greatly from year to year owing to the interaction of pathogenic fungi (species of *Fusarium, Pythium, Rhizoctonia,* and *Phytopthora*) and environmental conditions. Seedling losses can be severe when germination is slow due to cold, wet weather. Losses in 1999 were lower than normal due to the very dry weather, which inhibits fungus development. Nevertheless, North Carolina reported scattered damping off in southern yellow pine and white pine seedbeds.

Fusarium root disease,
Fusarium spp.

Region 1: Idaho, Montana

Host(s): Conifers

The major disease problems occurring in forest nurseries are caused by *Fusarium* spp. *Fusarium oxysporum* is the major cause of damping-off and root diseases of bareroot seedlings; *F. proliferatum* is the most important *Fusarium* spp. on container-grown conifer seedlings. Most damage occurs on Douglas-fir, western larch, western white pine, and Engelmann spruces, although all conifer species are susceptible.

Region 6: Oregon

Host(s): Conifers

The nursery experienced less than 5 percent mortality due to root and shoot Fusarium infections during the 1-0 year. Cooling by irrigation helped to limit losses.

Gray mold,
Botrytis cinerea

Region 6: Oregon

Host(s): Conifers

Botrytis gray mold caused losses of 2-3 percent in rooted cuttings and seedlings of Port-Orford-cedar in a greenhouse at the tree improvement center.

Phomopsis needle blight,
Phomopsis spp.

Region 2: Kansas, Nebraska

Host(s): Eastern redcedar, Rocky Mountian juniper

Kansas nurseries had fewer disease problems than in recent years due to a very dry summer. The Bessey Nursery in Nebraska has suffered at least 2 years of devastating *Phomopsis juniperova* outbreaks, killing approximately 75 percent of the growing stock with stems less than 1/3 inch in diameter. Older stock suffered branch dieback and foliage discoloration, making them nonsellable.

Region 8: North Carolina

Host(s): Fraser fir

This disease was scattered in a North Carolina Fraser fir nursery in 1999.

Phytopthora root rot,
Phytophthora spp.

Region 6: Oregon

Host(s): Douglas-fir

At the nursery, Phytophthora damage was not notable this growing season. At the tree improvement center, there were no new Phytophthora infections this year.

Pythium root disease,
Pythium spp.

Region 1: Idaho, Montana

Host(s): Conifers

Pythium spp. and *Phytophthora* spp. occurred at most bareroot nurseries and in some container seedlings. Efforts have been underway for the past several years to develop alternatives to preplant soil fumigation with methyl bromide for production of bareroot forest seedlings. Thus far, fallowing fields at least 1 year prior to sowing a conifer crop and using an alternative soil fumigant (dazomet) has shown promise in some nurseries. However, these alternatives have not been satisfactory in other nurseries and continuing investigations of other alternatives are underway. In particular, supplementing presowing soil treatments with applications of selected biological control agents appears promising. The major goal of this work is to develop alternatives to synthetic chemicals for control of important nursery diseases.

Rhizoctonia needle blight,
***Rhizoctonia* spp.**

Region 8: Regionwide

Host(s): Southern pine seedlings

Thanks to improved fungicide treatments, less than 10,000 seedlings were lost to this blight at the Taylor State Nursery in South Carolina in 1999. This compares to 60,000 seedlings lost in 1998.

Storage molds

Region 6: Oregon

Host(s): Conifers

There were no significant storage mold incidences noted during the past season. Freezer storage is recommended for most of our clients.

Tip dieback,
Sirococcus strobilinus
Sphaeropsis sapinea
Phoma eupyrena

Region 1: Idaho, Montana

Host(s): Conifers

Tip dieback, caused by *Sirrococcus strobilinus, Sphaeropsis sapinea,* and *Phoma eupyrena,* occurs at some level on bareroot seedlings at several nurseries. Ponderosa pine and lodgepole pine are the most commonly affected species.

White grubs,
***Phyllophaga* spp.**

Region 8: Florida

Host(s): Southern pine and baldcypress seedlings

Abnormally high populations of white grubs necessitated remedial control actions in Florida. Three separate forest tree nurseries reported significant, although scattered, mortality.

Abiotic Damage

Air pollution

Region 5: California

Host(s): Jeffrey pine, ponderosa pine

Forest Pest Management, Pacific Southwest Region, established 26 ozone monitoring plots on the Sierra National Forest in 1977. All of the plots are located between 4,000 and 8,000 feet in elevation and have been visited biennially over the past 22 years. Compared to 1997 when these sites were last visited and rated for chlorotic mottle in needles of ponderosa and Jeffrey pine, 10 sites showed no change in injury, 15 sites showed increased injury, and one site had less injury in 1999. Although some of the changes in plot ratings from 2 years ago were small, it is unusual for so many plots to experience an increase in foliar symptoms.

The general trend in ozone injury over the past two decades has been that plots at the lower elevations (4,000 to 5,000 feet) show the greatest amount of chlorotic mottle, which has gradually become worse over time. Plots at the higher elevations (7,000 to 8,000 feet) show the least amount of injury and have changed very little since 1977.

Drought effects

Region 8: Regionwide

Host(s): All species

Drought conditions prevailed over much of the South in 1999. Arkansas, Florida, Georgia, Kentucky, Louisiana, Mississippi, North Carolina, Oklahoma, South Carolina, and Tennessee had severe to extreme drought conditions in portions of each State and Texas has had drought in 3 of the last 4 years. At the end of 1999, over 60 percent of the Southern Region was below normal in percipitation with 20 percent having a deficit from 3 to 6 inches and 16 percent having a deficit of 6 to 9 inches. Drought contributed to early defoliation, growth loss, and general stress on trees. Many pine plantations planted since the mid-1990's have failed due to drought and been replanted more than once. It is estimated that 35 percent of the seedlings planted regionwide died from drought in 1999 with up to 60 percent loss in the extreme drought areas. Overall it is estimated that 25 percent of the 1999 plantations will require replanting. In particular, the drought has led to higher than normal populations of *Ips* pine engraver beetles and increased oak decline and dieback.

Region 9/Northeastern Area: Delaware, Massachusetts, Missouri, New Jersey, New York, Ohio, Pennsylvania, Rhode Island, Vermont, West Virginia

Host(s): Red oak, hardwoods, conifers

In Delaware, a severe drought was experienced and has the potential to cause significant forest health problems in 2000. Decline attributed to drought was recorded on 4,885 acres in Massachusetts, with most of the symptoms recorded on south and southwest slopes and those areas with shallow soils and ledge outcrops. Foliage discoloration of hardwoods by August and browning of needles on white pine, was reported statewide in Missouri. New Jersey also experienced a severe drought with deciduous trees on ridge tops in the northern part of the State experiencing drought symptoms. Drought surveys focused on southeastern New York, including New York City and Long Island. The lower Hudson Valley was most affected by the drought, with over 70 percent of the trees surveyed showing some affects. The most prevalent type of damage was discoloration of the foliage with few trees showing defoliation or general

decline due to the drought. One beneficial effect of the drought on the forest trees was the decreased incidence of tar spot on maples. Conditions in Ohio were hotter and drier than average. As of September, Ohio precipitation levels were 5 to 6 inches below normal. The drought of 1999 was one of the most severe droughts on record throughout most of Pennsylvania. Drought stress appeared most severe along ridge tops. The symptoms of drought stress have been observed on many forest tree species including hemlock, sugar and red maple, red oak, birch, black cherry, white pine, and chestnut oak. Symptoms of drought injury included leaf scorch, premature leaf drop, twig and branch dieback, foliage wilt, and abnormal foliage coloration. Some tree mortality has been observed throughout the drought affected region, but mortality is not widespread at this time. Drought caused major stress to the forests of Rhode Island. In Vermont, the drought led to widepspread browning and yellowing on hardwoods by late summer, especially on roadside trees and ledgy sites. In West Virginia, the summer of 1999 was a record drought season and the State was declared a drought disaster by USDA. Drought impact was most noticeable on ridge tops and south-facing slopes. Large numbers of trees showed signs of dieback and mortality.

Fire

Region 8: Florida

Host(s): All species

The massive wildfires throughout Florida in the summer of 1998 caused mortality, but also predisposed trees to a variety of opportunistic pathogens and insects. While related tree mortality declined dramatically in 1999, Florida resource managers are still alert for secondary insects and disease damage in fire-stressed stands.

Region 9/Northeastern Area: West Virginia

Host(s): Various hardwoods and conifers

In 1999 in West Virginia, 1,875 fires burned over 84,000 acres in the State, causing an estimated $25 million in damage.

Frost

Region 3: Arizona

Host(s): Aspen

In Arizona, 147,975 acres of aspen defoliation was caused by frost damage and occurred on the Apache-Sitgraves (3,285 acres), Coconino (6,045 acres), and Kaibab (77,560 acres) National Forests; Fort Apache (3,180 acres) and Navajo (20,755 acres) Indian Reservations; and Grand Canyon National Park (37,150 acres).

Region 5: Southern California

Host(s): California black oaks

Growing tips of California black oaks were killed by an early June frost in several areas in Southern California, including cold spots in organizational campgrounds above Cuddy Valley on the Los Padres National Forest, and Barton Flat and Banning Canyon on the San Bernardino National Forest.

Hail

Region 8: Mississippi, South Carolina

Host(s):

Three spring hail storms were particularly destructive to forests in Mississippi and South Carolina in 1999. In Mississippi, the hail storm defoliated hardwoods and pines in portions of Greene, Jones, Perry, and Wayne counties in the southeastern area of the State. Because most hardwoods had not leafed out, defoliation was confined largely to conifers, although bark damage occurred to twigs and branches of both pine and hardwood trees. Field surveys found that most stands refoliated adequately, and there was little mortality. Some dieback might be expected in the future due to branch canker organisms exploiting damaged bark.

In South Carolina, two separate hail storms in late April and early May caused defoliation in Aiken, Saluda, and Newberry counties in the western part of the State, and Marlboro County in the east. As in Mississippi, both hardwoods and conifers were impacted, but defoliation was worse among pines. The South Carolina Forestry Commission estimates that some 47,700 acres were affected by a minimum of 50 percent defoliation. The commission continues to monitor the affected areas for opportunistic insects and diseases exploiting weakened trees.

Ice/snow damage

Region 9/Northeastern Area: Maine, New Hampshire, New York, Pennsylvania, Vermont

Host(s): Various hardwoods and conifers

Four acres of red pine at Fort Necessity, Pennsylvania, were damaged due to an ice storm. In Vermont, a snowstorm in late September caused crown breakage in several sugarbushes in Franklin County. Recovery continued from the extensive 1998 ice storm in Maine, New Hampshire, New York, and Vermont, with smaller than normal leaves and epicormic branching occurring on many of the affected trees. Severe branch and stem breakage is still evident within impacted areas.

Salt damage

Region 9/Northeastern Area: Maryland

Host(s): Pines

Following Hurricane Dennis in September, salt spray affected trees near the towns of Ocean City and Berlin, Maryland.

Water

Region 5: Northern California

Host(s): Lodgepole pine

Flooding continues to cause lodgepole pine mortality around Hog Flat and McCoy Reservoirs along Highway 44 on the Eagle Lake District, Lassen National Forest. Red turpentine beetles are associated with the mortality.

Weather

Region 2: Colorado

Host(s): Lodgepole pine, ponderosa pine

By early summer, ponderosa pines throughout much of the San Juan National Forest (from 6,500 to 9,000 feet in elevation) experienced discolored needles. Discoloration was not always limited to older needles. No biotic cause was identified and the widespread occurrence of the discoloration appears to be of abiotic (e.g., weather) origin.

Wind

Region 2: Colorado, Wyoming

Host(s): Engelmann spruce

Approximately 3,000 acres of wind damage occurred in the higher elevations of the White River National Forest in Colorado. This blowdown will contribute to the increase of spruce beetle populations in the area. Other areas of concern include the San Juan and Routt National Forests where past blowdown events have created suitable breeding habitat for spruce beetle. There are isolated patches of downed Engelmann spruce in the Snowy Range of the Medicine Bow National Forest in Wyoming. These areas of spruce beetle infestation are suspected to be the result of severe winds and will undoubtedly be rated for spruce beetle potential during the 2000 field season.

Region 5: Northern California

Host(s): lodgepole pine, red fir, white fir

About 700 acres of breakage and blowdown were reported on the Doublehead District, Modoc National Forest. The blowdown is in the Medicine Lake highlands between the Glass Mountain Geologic Area and Burnt Lava Flow Geologic Area. About 25 to 50 percent of the trees over the 700 acres were affected.

Region 8: Arkansas, North Carolina, Tennessee

Host(s): Southern pines and hardwoods

The year 1999 was a terrible one from a natural destruction perspective in North Carolina. Hurricanes Dennis and Floyd dropped a massive amount of water throughout the whole of eastern North Carolina. Although blowdown damage was not nearly as destructive as other recent hurricanes (e.g., Hurricane Hugo), the consequences of the devastating flooding are yet to be fully realized. For example, the North Carolina Division of Forest Resources lost a nursery/seed orchard facility valued at $1.5 million, and the ramifications of not providing the citizenry with seedlings is yet to be calculated. The division estimates that 71 million cubic feet of timber were lost to blowdown, with another 80 million lost to flooding. Almost 15,000 acres of reforestation projects were destroyed. Total direct cost of trees and timber lost exceeds $89 million. The full impact of these hurricanes will not be felt for years to come. History shows that southern pine beetle populations often build to epidemic levels following flooding, and other insects and disease are also likely to flourish in the storm-stressed forests of the piedmont and coastal plain.

In other incidents, a tornado touched down in west Tennessee, damaging trees along a 20-mile path. Another tornado damaged timber across a 600-acre swath in Handeman County, Tennessee. A severe windstorm in Hot Springs, Arkansas, during the summer damaged 3,000 acres of timber. Approximately 500 board feet per acre was damaged.

Abiotic Damage

Region 9/Northeastern Area: Minnesota, New Hampshire, Vermont, Wisconsin

Host(s): Various hardwoods and conifers

This is the second consecutive year of severe wind damage to forests in Minnesota and Wisconsin. On July 4, 1999, in Minnesota, straight-line winds blew down and damaged trees on 465,000 acres, 380,000 of which were in the Boundary Waters Canoe Area. That same storm, and another one a couple of weeks later, resulted in blowdown and damaged trees in northern Wisconsin over a widespread area encompassing 50,000 acres. Also on July 4, storms blew down trees in Orleans and Essex counties in Vermont. In southern Vermont, severe damage was caused by a storm on July 6 and winds associated with Hurricane Floyd in mid-September blew down trees in scattered locations. In New Hampshire, on August 13, 1999, a tornado caused an 8-mile swath of damage, affecting 200 acres in Sullivan and Grafton counties.

Appendixes

Appendix A

Forested Areas*

About one-third of the Nation's land area, 736.7 million acres, is forested -- 380.3 million acres (52 percent) in the East, 227.3 million acres (31 percent) in the continental West, and 129.1 million acres (17 percent) in Alaska. By ownership nationwide, 42 percent of the acreage is in public ownership and 58 percent is in private ownership. Of the public ownership, 20 percent is in the East, 48 percent in the continental West, and 32 percent in Alaska. In contrast, 75 percent of the private ownership is in the East, 18 percent in the continental West, and 7 percent in Alaska.

Eastern hardwood forests make up 74 percent of all the forested acreage in the East. The largest component of the eastern hardwood forest type is oak-hickory, which occupies 130 million acres, or 34 percent, of the eastern forested acreage and is found in the South and the southern half of the North.

The beech-birch-maple forests occur on 51 million acres, or 13 percent, of the eastern forests and are located in the North.

The oak-pine forests occupy 32 million acres, or 8 percent, of the eastern forested acreage and are located in the South, as are the oak-gum-cypress forests, which occur on 29 million acres, or 8 percent, of the eastern forested acreage.

The aspen-birch forests occupy 17 million acres, or 4 percent, of the eastern forested acreage and are located in the North. The elm-ash-cottonwood forests on 15 million acres, or 4 percent, of the forested acreage are bottom land forests in both the North and South. Other forest types occupy 13 million acres, or 3 percent, of the forested acreage in the East.

Eastern softwood forests make up the remaining 26 percent of the eastern forested acreage. The loblolly-shortleaf pine forests occupy 50 million acres, or 13 percent, of the eastern forested acreage and occur in the South. Also in the South are the longleaf-slash pine forests, which cover 14 million acres, or 4 percent, of the forested lands.

The spruce-fir forests are on 20 million acres, or 5 percent, of the forested lands and the white-red-jack pine forest on 15 million acres, or 4 percent, of the forest lands; both are in the North.

Western hardwood forests occupy 49 million acres, or 14 percent, of the western forested acreage, including that in Alaska. The primary species are oaks in California, aspen in the Intermountain Region, and red alder in the Pacific Northwest.

Western softwood forests make up 86 percent of all the western forests. Douglas-fir forests occupy 43 million acres, or 12 percent, of the western forest lands. Douglas-fir is found throughout much of the West except Alaska.

Ponderosa pine forests occupy 31 million acres, or 9 percent, of the forested acreage; the species is present through much of the West. Lodgepole pine is also found throughout much of the West. It is most abundant in the Intermountain Region, occupying 18 million acres, or 5 percent, of the forested acreage.

Hemlock-Sitka spruce forests are found on the Pacific Slope in Oregon and Washington and along coastal Alaska. These forests occupy 16 million acres, or 5 percent, of the forested lands. The fir-spruce forests occupy 60 million acres, or 17 percent, of the acreage and are mid-to-high elevation forests throughout the West.

The other softwoods group is made up primarily of black spruce stands in interior Alaska and occupies 70 million acres, or 20 percent, of the forested land in the West.

The pinyon juniper type occupies 48 million acres, or 14 percent, of the forested acreage.

Other western types (western white pine, larch, redwood, chaparral, and nonstocked areas) occupy 17 million acres, or 5 percent, of the western forested acreage.

* Data may not add to totals because of rounding

From: Powell, Douglas S.; Faulkner, Joanne L.; Darr, David R.; Zhu, Zhiliang; MacCleery, Douglas W. 1993. Forest resources of the United States, 1992. General Technical Report RM-234. Fort Collins, CO: U.S. Department of Agriculture, Forest Service, Rocky Mountain Forest and Range Experiment Station. 132p.+map. [Revised, June 1994]

Appendix B

Reporting Area

Reporting area is defined as an area of land designated by the name of the Federal or tribal land (in most cases) included in the area, but also contains intermingled and adjacent lands of all ownerships. Reporting areas border on each other to include all lands. The name of the reporting area defines its location; for example, the Mount Hood reporting area includes the Mount Hood National Forest and vicinity.