

United States
Department of
Agriculture

Forest Service

Forest
Health
Protection

December 1999



Forest Insect and Disease Conditions in the United States 1998



Healthy Forests Make
a World of Difference

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PREFACE

This is the 48th 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 1998. 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 also 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: 1997 Health Update" which highlights major forest health concerns. The report also 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/fhnpc.html

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Pacific Southwest Region (R-5)
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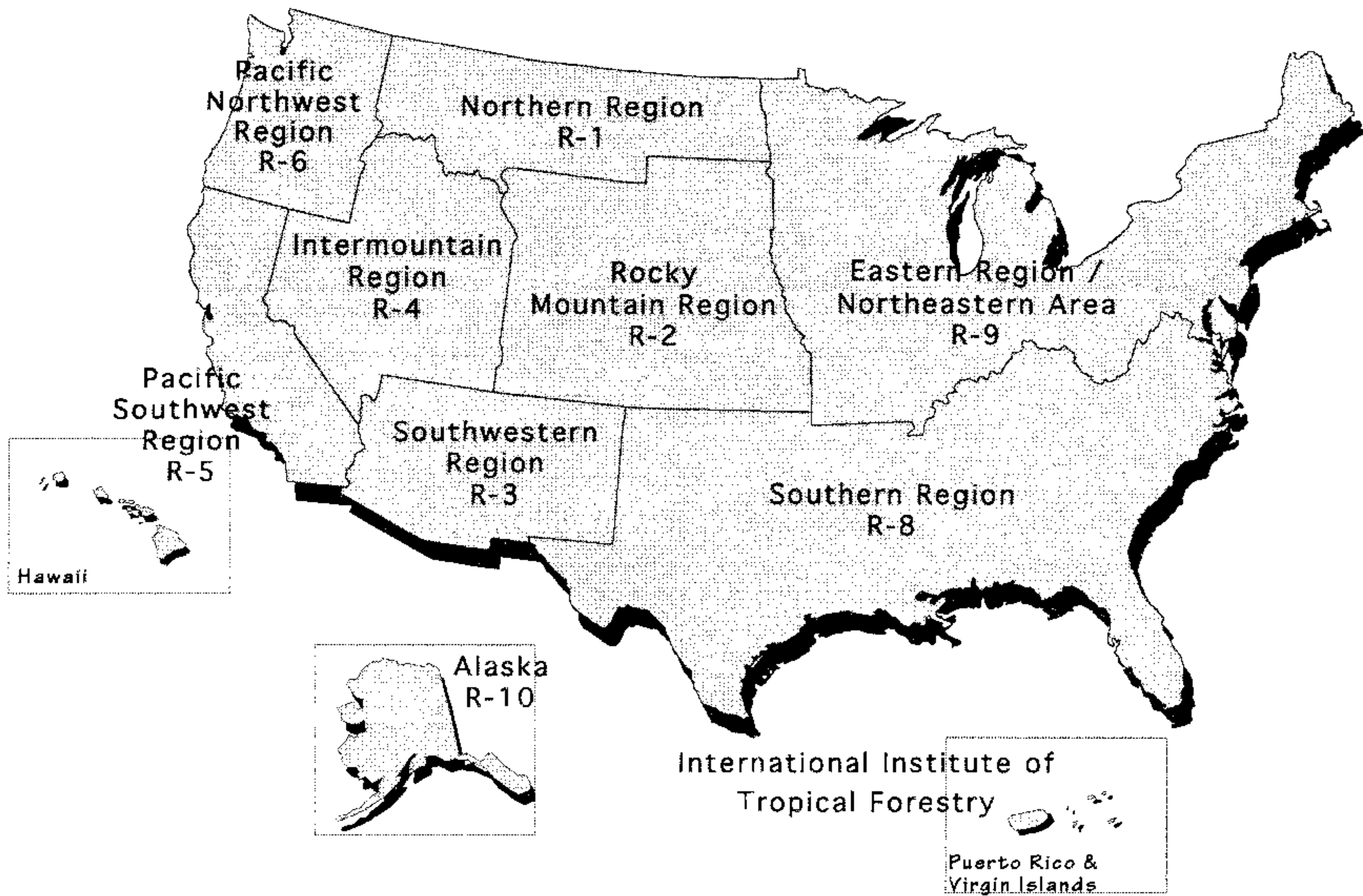
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USDA Forest Service Regions and Area

Copies of this report are available from:
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This report is also available on the Internet at:
www.fs.fed.us/foresthealth/fhnpc.html

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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 8.5 million acres in 1997 to 6.8 million acres in 1998.

Mountain pine beetle - affected acreage decreased from 329,000 acres in 1997 to 291,000 acres in 1998.

Spruce budworm - defoliation in Alaska increased from 38,000 acres in 1997 to 88,000 acres in 1998. In the Great Lakes area, defoliation decreased from 347,000 acres in 1997 to 306,000 acres in 1998.

Western spruce budworm - defoliated acreage increased from 364,000 acres in 1997 to 843,000 acres in 1998.

Spruce beetle - the infestation in Alaska further declined to 317,000 acres in 1998. Spruce beetle activity was generally low in the West.

Insects: Nonnative

Asian longhorned beetle - in 1998 three separate infestations were found in the Chicago metropolitan area; these infestations are in addition to the original two infestations found in Brooklyn and Amityville, New York, in 1996. Eradication measures are underway.

Gypsy moth (European) - defoliated acreage increased from 47,000 acres in 1997 to 363,000 acres in 1998.

Common European pine shoot beetle - found in Ohio in 1992, this beetle is now known to occur in nine States from New York 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 1998, it was discovered on the main island of Puerto Rico.

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 30.6 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, Idaho. The disease kills both woodland and ornamental dogwoods.

Butternut canker - the casual fungus was identified in the late 1970's and occurs throughout most of the range of butternut. 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

European form

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

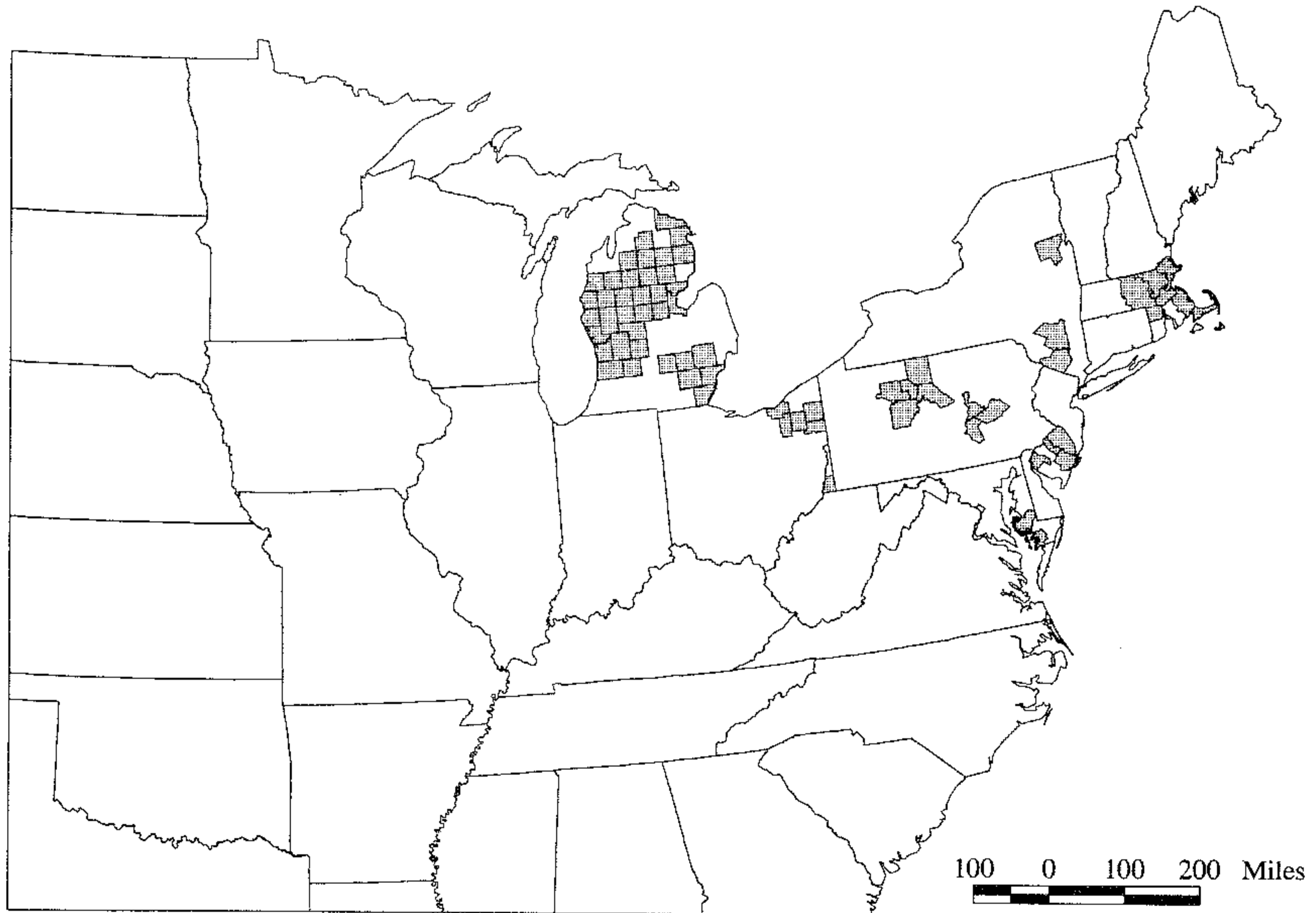
Defoliation in the East increased from 47,300 acres in 1997 to 363,300 in 1998. The fungus *Entomophaga maimaga* is keeping gypsy moth populations low in many areas, but populations

are rebuilding in other areas. Although the fungus occurs in both Michigan and Pennsylvania, both States experienced large gypsy moth population increases in 1998. Gypsy moths continue to be trapped in low numbers in many places across the West. Treatment of 916 acres was required in Salt Lake City, Utah, in 1998.

Asian form

The Asian form of the moth was accidentally introduced into Oregon and Washington on board cargo ships arriving from the Russian Far East in 1991. In 1993, the Asian form was accidentally introduced into North Carolina on board a cargo ship loaded with military equipment returning from Germany. Both infestations have been eradicated.

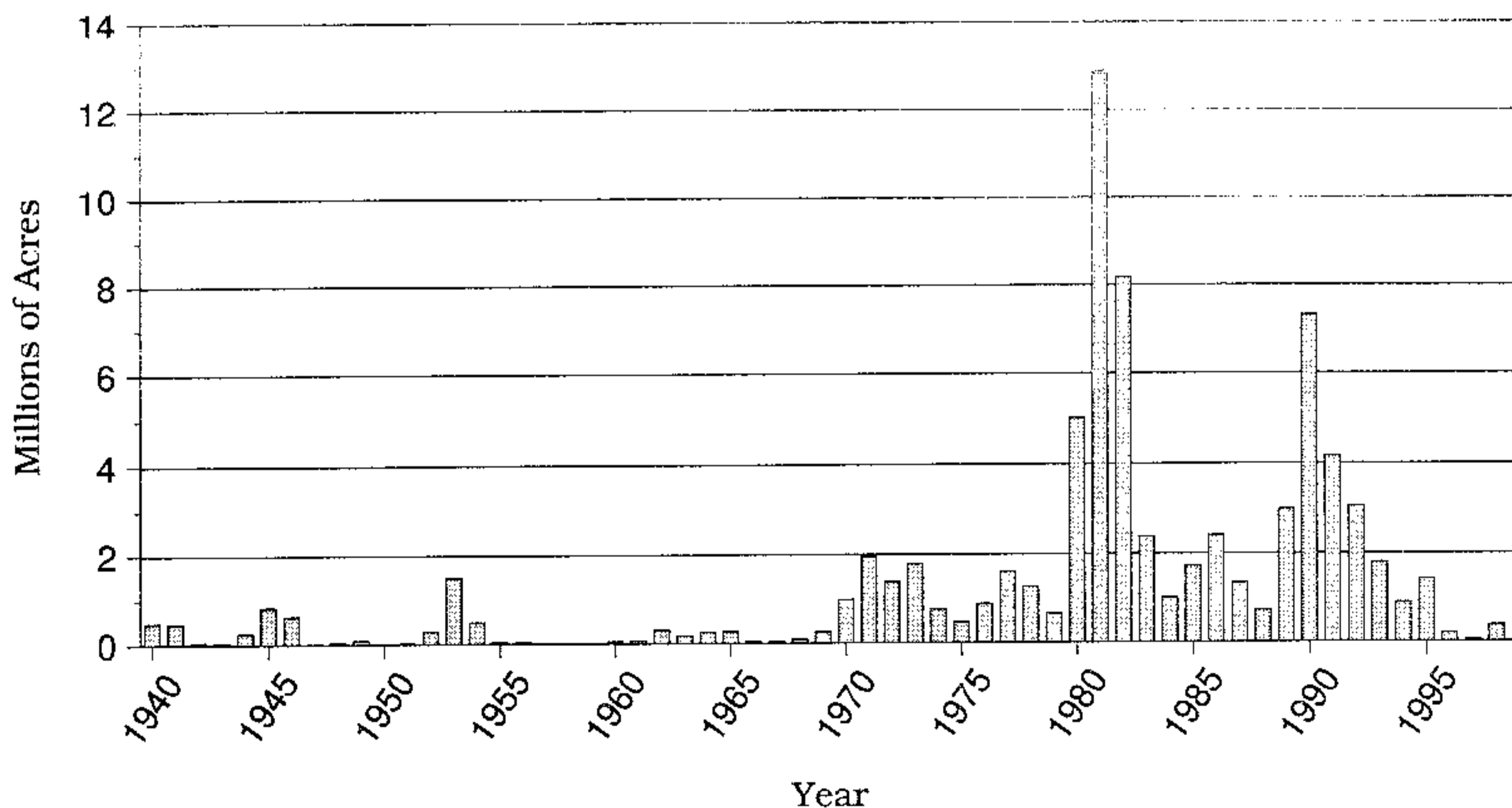
Eastern Counties Where Gypsy Moth (European) Defoliation Was Reported, 1998



Acres of Aerially Detected Gypsy Moth (European) Defoliation, 1994-1998

State	1994	1995	1996	1997	1998
Connecticut	0	2,700	1,400	0	0
Delaware	60,700	65,500	500	0	0
Maine	1,700	0	100	0	0
Maryland	93,200	93,900	11,200	700	500
Massachusetts	76,700	8,700	7,000	100	12,900
Michigan	97,300	85,900	5,000	36,900	301,700
New Hampshire	8,100	1,700	0	0	0
New Jersey	17,800	39,600	27,800	1,900	1,800
New York	500	200	16,300	2,200	9,400
Ohio	100	34,400	49,000	5,000	1,600
Pennsylvania	18,000	132,500	6,700	0	31,600
Rhode Island	400	0	4,000	0	3,000
Vermont	0	0	0	0	0
Virginia	452,500	849,000	0	0	0
Washington, DC	0	0	0	0	0
West Virginia	53,400	103,000	70,700	500	800
Total	880,400	1,417,100	199,700	47,300	363,300

Gypsy Moth (European) Defoliation, 1940-1998



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. Annually, this beetle destroys timber trees worth millions of dollars and affects recreation areas, shade trees, and general aesthetics. Infestations usually start in trees weakened by disease, lightning strikes, excessive age, storm damage, or other stress factors.

The acreage in the South affected by the southern pine beetle decreased by 1.7 million acres. Four States that usually have some level of infestation reported zero infested acres. Populations started high in 1998 and declined only slightly during the

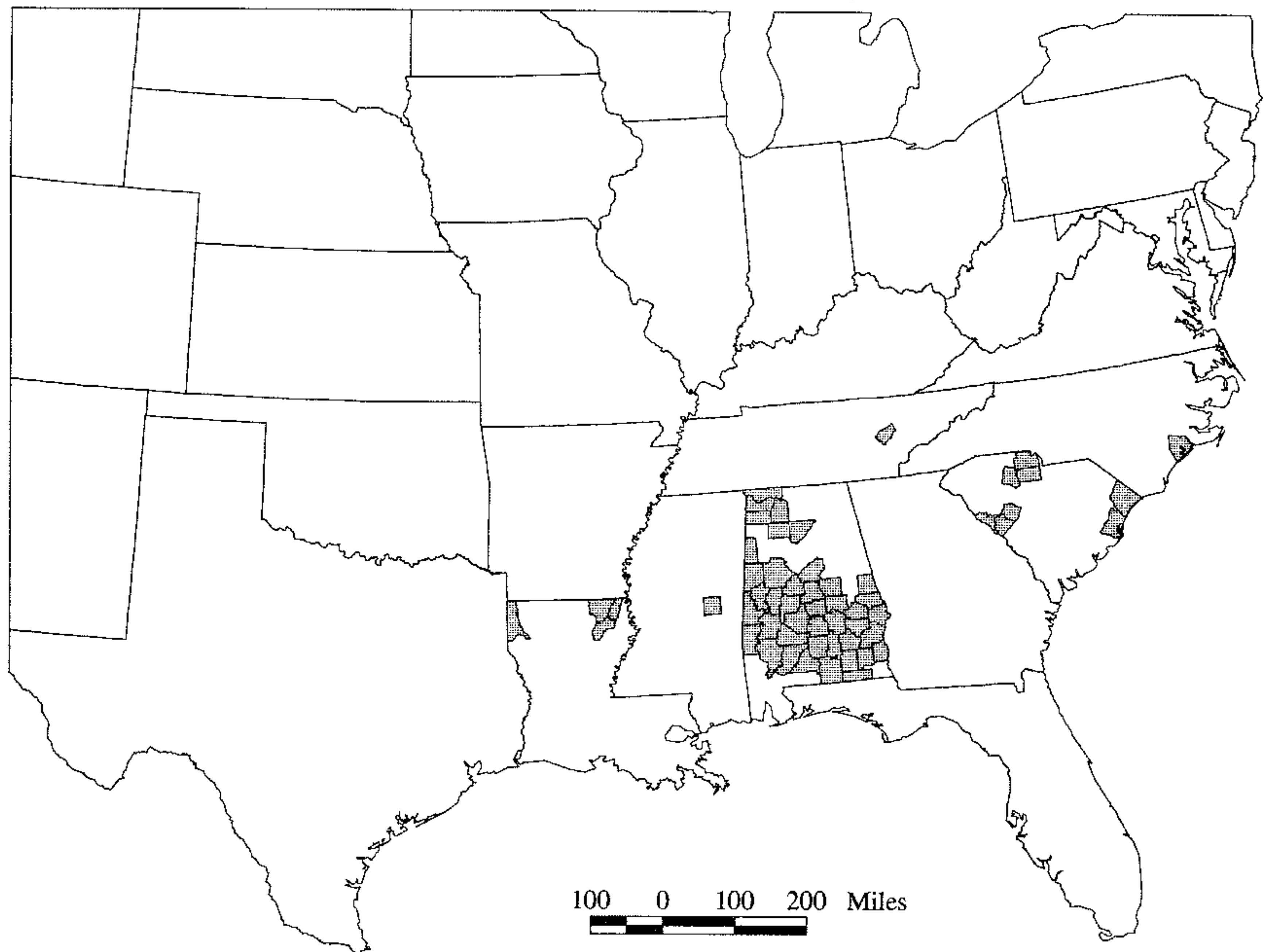
drought. Forty-two of Alabama's 67 counties had outbreak populations at some point during 1998. The infestation was highest along the Piedmont and coastal plain interface.

In North Carolina, the southern pine beetle outbreak area was in the coastal plain affected by Hurricanes Bertha and Fran in 1995. The outbreak continued into early 1998, but subsided.

The 1997 outbreak in the Ocala area of Florida has collapsed. Also in Florida, the expected increase in beetle activity following the severe summer fires of 1998 did not occur.

*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, 1998

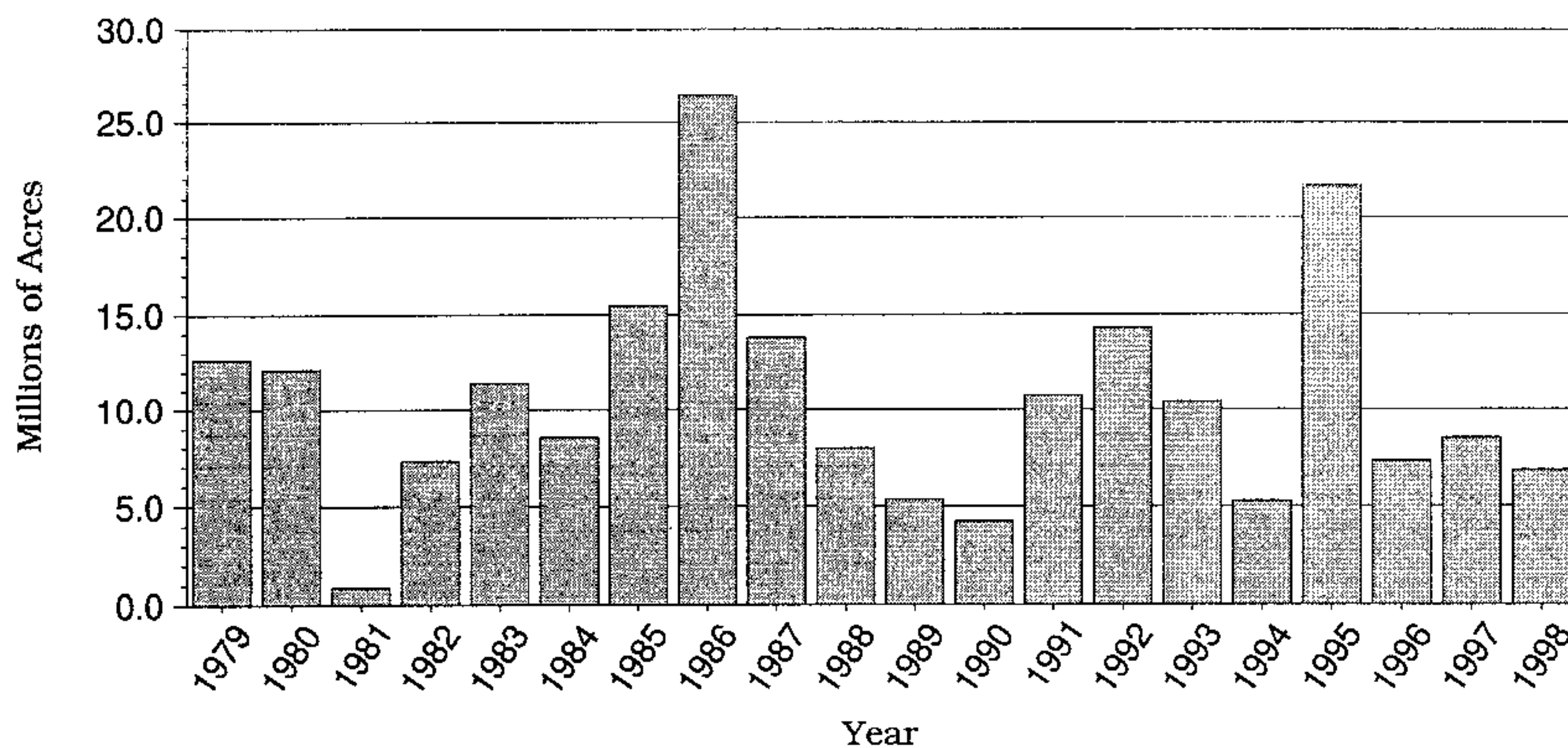


Acres (in thousands) of Southern Pine Beetle Outbreaks in the Southern Region (R-8), 1994-1998*

State	1994	1995	1996	1997	1998
Alabama	2,951.4	6,552.4	1,177.9	4,535.5	5,241.3
Arkansas	429.6	2,112.9	1,420.6	0.0	0.0
Florida	97.1	736.0	0.0	401.1	0.0
Georgia	315.4	1,326.0	101.3	312.9	65.0
Kentucky	0.0	0.0	0.0	0.0	0.0
Louisiana	0.0	2,908.8	165.3	110.0	228.0
Mississippi	689.6	2,714.3	1,150.9	892.1	73.0
North Carolina	47.9	2,755.6	747.1	702.3	234.0
Oklahoma	0.0	0.0	0.0	0.0	0.0
South Carolina	332.8	2,542.9	2,496.6	843.0	944.0
Tennessee	148.6	0.0	41.2	30.3	35.0
Texas	238.3	0.0	0.0	649.6	0.0
Virginia	0.0	27.0	0.0	0.0	0.0
Total	5,250.7	21,675.9	7,300.9	8,476.8	6,820.3

* 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), 1979-1998*



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

Insect Conditions Highlights

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.

In 1998, the affected acreage decreased in Oregon and Washington, but the average number of affected trees per acre increased from 2.2 to 3.3. In Colorado and South Dakota, beetle populations and associated pine mortality increased. Population increases were also recorded in Montana and northern Idaho. Populations generally decreased in the Southwestern States.

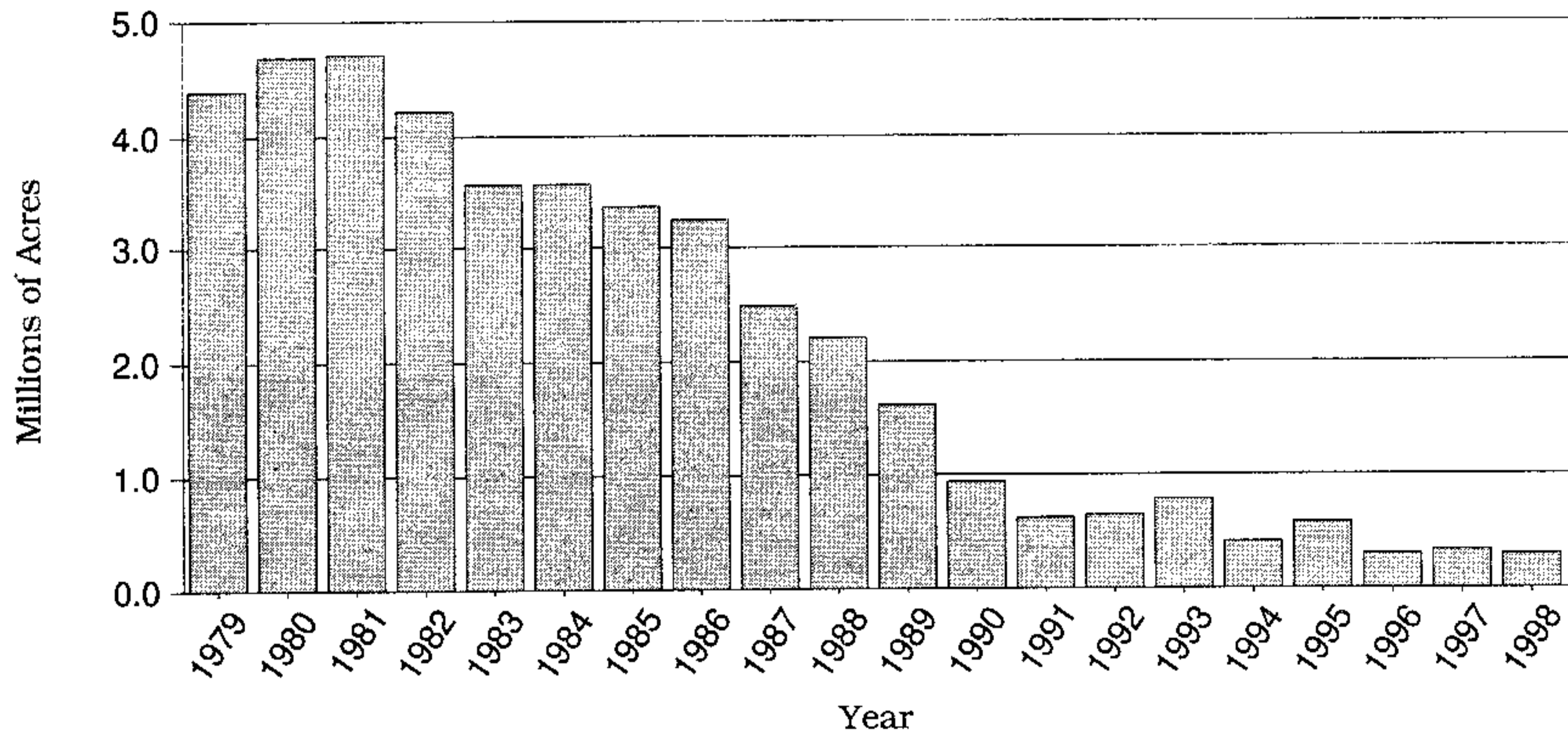
Mountain Pine Beetle Outbreak Areas, 1998



Acres (in thousands) of Mountain Pine Beetle Outbreak, 1994-1998

State	1994	1995	1996	1997	1998
Arizona	0.2	0.2	2.2	10.0	7.4
California	115.0	58.9	25.1	15.2	26.8
Colorado	1.2	4.7	12.8	22.2	23.1
Idaho	7.8	13.9	33.4	54.0	81.6
Montana	19.2	31.3	27.6	33.4	39.2
New Mexico	2.8	0.4	1.1	0.1	0.0
Oregon	161.1	234.4	112.6	82.3	65.5
South Dakota	1.4	2.6	2.2	9.4	10.0
Utah	18.7	20.9	24.6	20.9	4.5
Washington	76.4	205.9	56.7	74.7	30.3
Wyoming	1.6	2.3	1.7	6.7	2.5
Total	405.4	575.5	300.0	328.9	290.9

Mountain Pine Beetle Outbreaks, 1979-1998



Spruce budworm

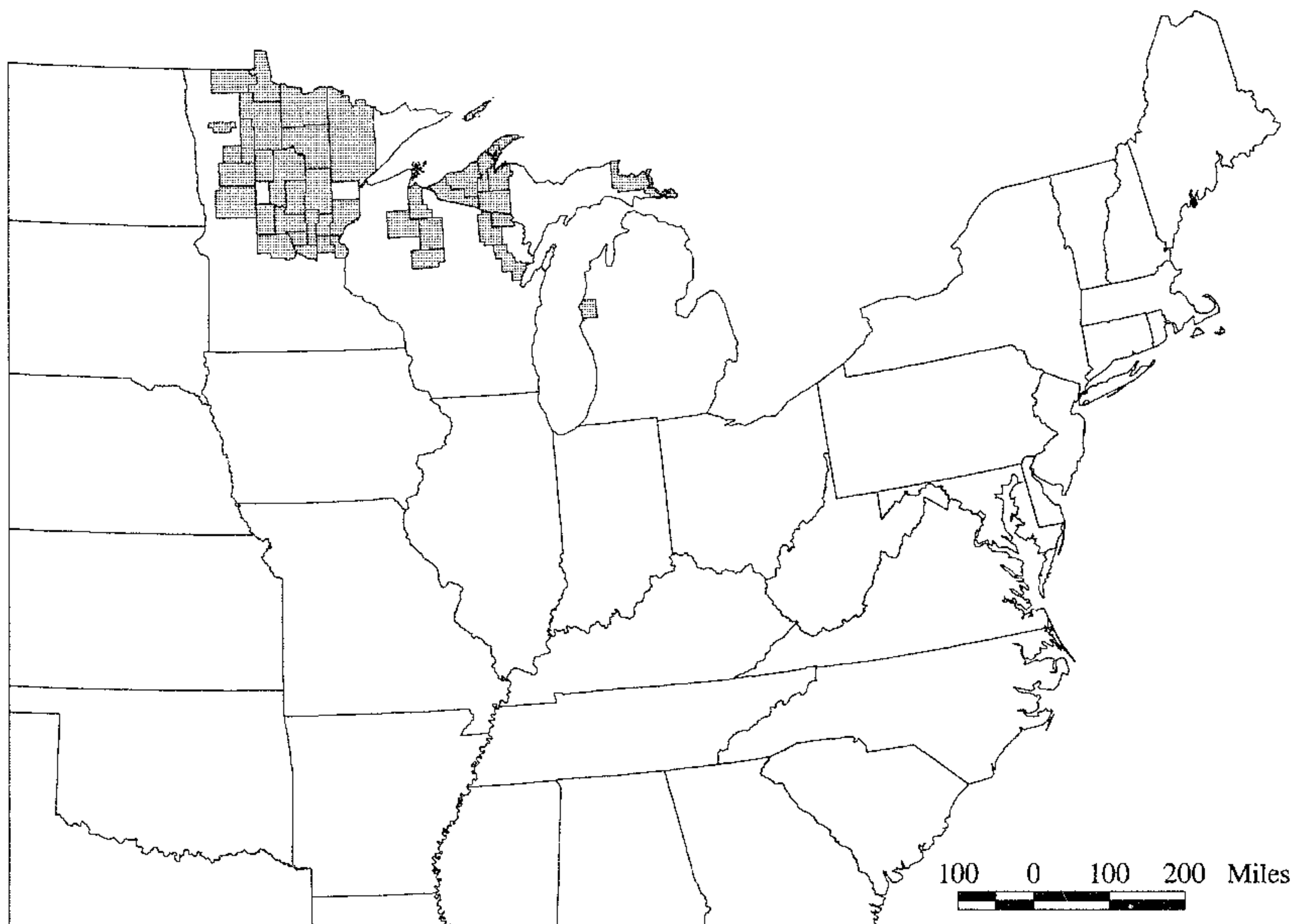
Choristoneura fumiferana is a native insect found in northern New England, New York, Pennsylvania, the Great Lakes area, and Alaska. Balsam fir is the preferred host, but the insect also feeds on white, red, and black spruce. Topkill and tree mortality may result from budworm feeding. Outbreaks generally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

In the East, all of the reported budworm activity was in the Great Lakes area. 87 percent of the activity occurred in Minnesota. Of the 256,400

acres reported for Minnesota, 240,200 (94 percent) are on State and private lands. In Michigan, 12,200 acres of the 33,000 acres (37 percent) are on State and private lands; the rest is on National Forest System lands. In Wisconsin, 16,100 acres of defoliation are on National Forest System lands.

After two years of decline, the Alaska acreage of defoliation increased in the eighth consecutive year of budworm defoliation. All of the 87,800 acres of defoliation occurred along the Yukon River -- 46,200 acres on State and private lands and 41,600 acres of Federal lands. None of the defoliation occurred on National Forest System lands.

Eastern Counties Where Spruce Budworm Defoliation Was Reported, 1998



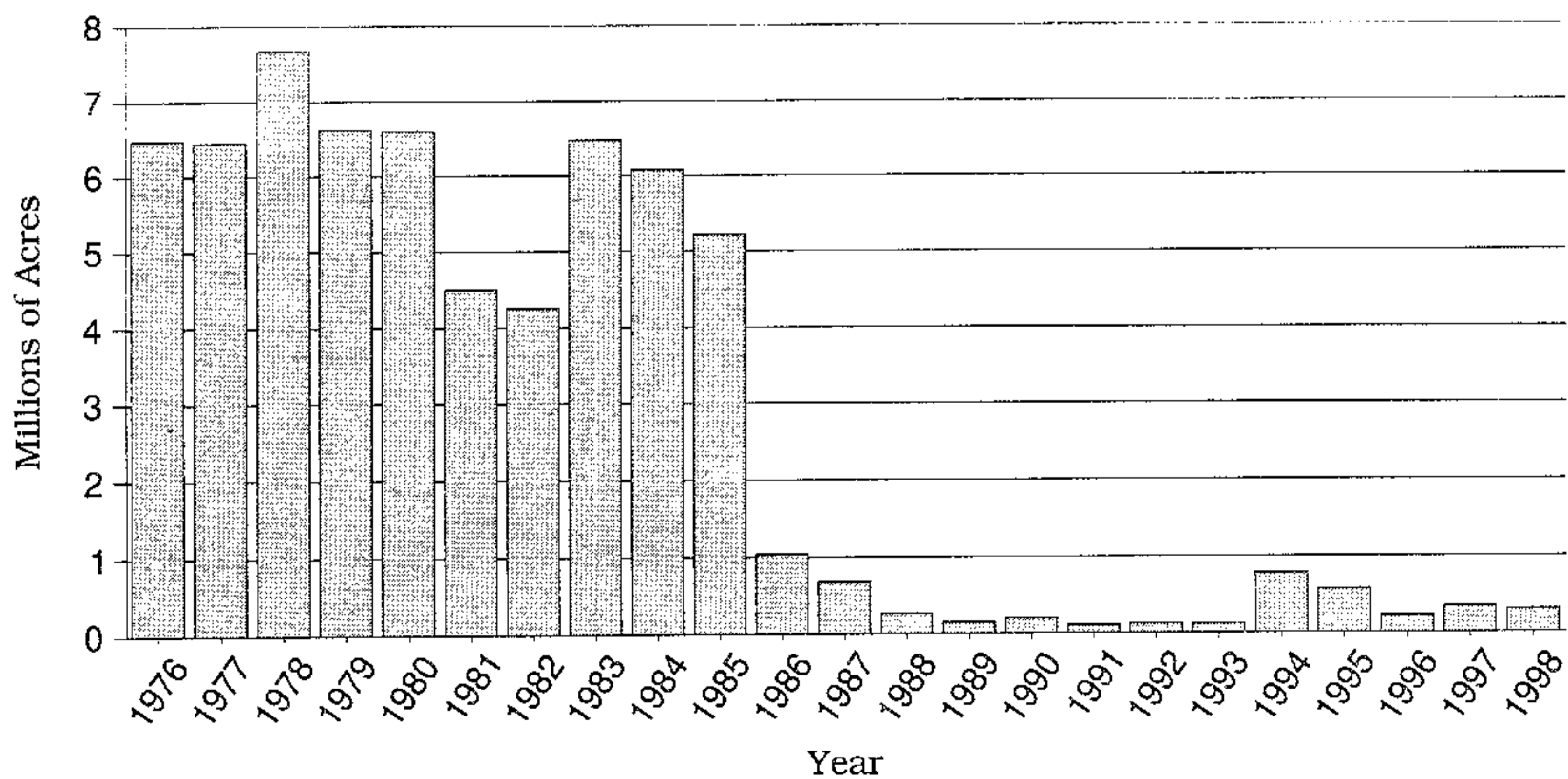
Acres (in thousands) of Aerially Detected Spruce Budworm Defoliation in the Eastern United States, 1994-1998

State	1994	1995	1996	1997	1998
Maine	0.0	0.0	0.0	0.0	0.0
Michigan	6.8	51.2	12.9	61.6	33.0
Minnesota	770.5	505.0	207.6	276.2	256.4
New Hampshire	0.0	0.0	0.0	0.0	0.0
New York	0.1	0.4	0.0	0.0	0.0
Pennsylvania	0.0	0.0	2.0	0.0	0.0
Vermont	0.0	0.0	0.0	0.0	0.0
Wisconsin	1.0	12.5	0.0	9.6	16.1
Total	778.4	569.1	222.5	347.4	305.5

Acres (in thousands) of Aerially Detected Spruce Budworm Defoliation in Alaska, 1994-1998

State	1994	1995	1996	1997	1998
Alaska	232.5	279.1	235.9	38.4	87.8

Spruce Budworm Defoliation in the Eastern United States, 1976-1998



Insect Conditions Highlights

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.

Defoliation increased by 460,000 acres in 1998 to 843,000 acres. About 95 percent of the defoliation occurred in Washington (58 percent) and New

Mexico (37 percent). In New Mexico, 80 percent of the defoliation was on National Forest System lands and 20 percent on State and private lands. In Washington, defoliation increased by 320,900 acres to 487,000 acres. About 380,000 (78 percent) of the defoliation is on the Yakima Indian Reservation. About 27,000 acres of defoliation occurred on the Gifford Pinchot National Forest and 73,000 acres on adjoining State and private lands.

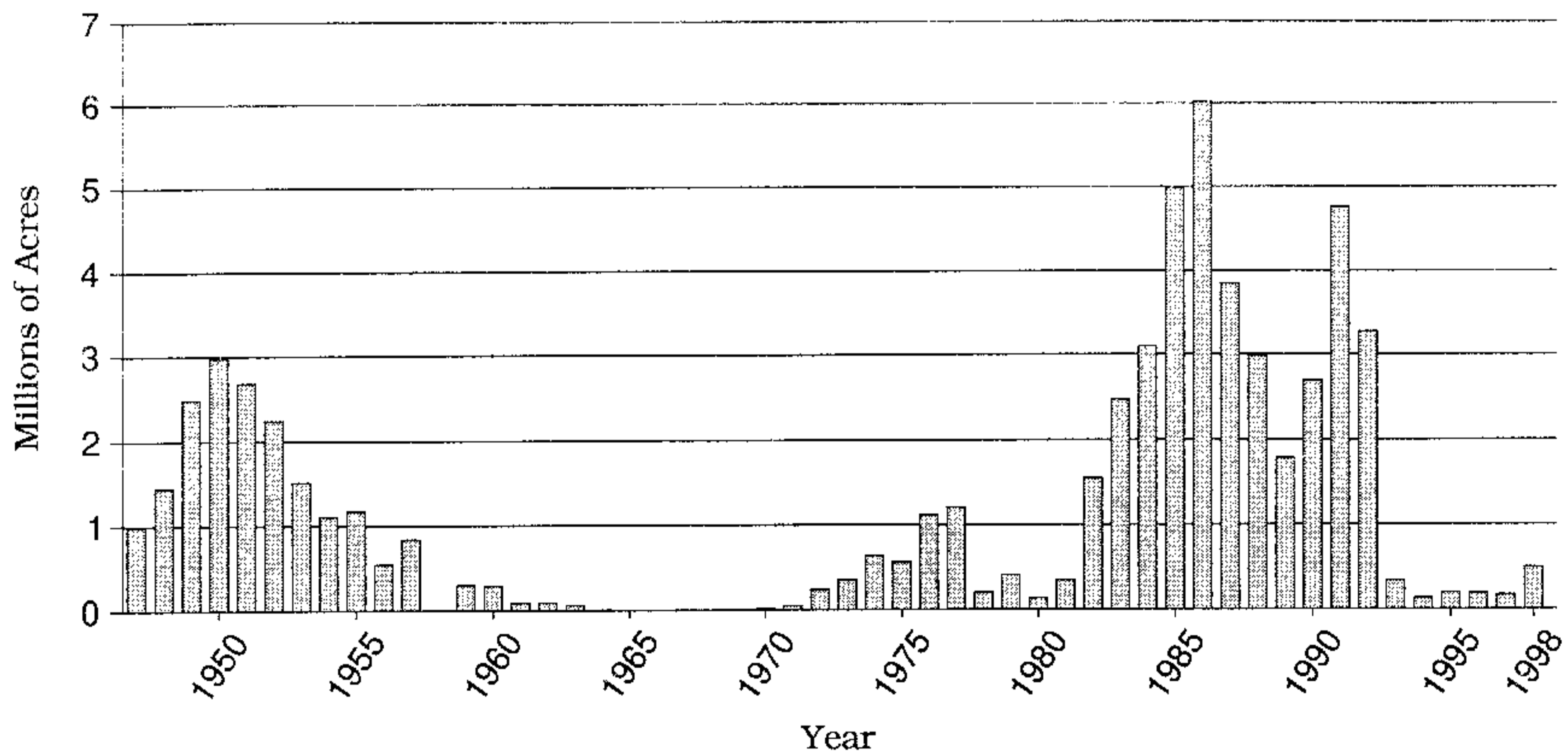
Western Spruce Budworm Defoliation Areas, 1998



Acres (in thousands) of Aerially Detected Western Spruce Budworm Defoliation, 1994-1998

State	1994	1995	1996	1997	1998
Arizona	0.0	7.0	3.0	1.1	10.1
California	0.0	0.0	0.0	0.0	0.0
Colorado	0.0	97.0	21.8	0.0	15.8
Idaho	0.0	0.0	0.0	0.0	0.0
Montana	2.4	0.0	0.0	0.0	0.0
New Mexico	369.2	183.8	123.9	197.1	310.5
Oregon	37.4	14.9	1.0	0.0	0.0
Utah	0.0	0.0	0.0	0.0	19.9
Washington	85.4	175.1	183.2	165.9	486.8
Wyoming	1.1	0.0	0.0	0.0	0.0
Total	495.5	477.8	332.9	364.1	843.1

Western Spruce Budworm Defoliation in the Pacific Northwest Region (R-6), 1947-1998



Hemlock woolly adelgid

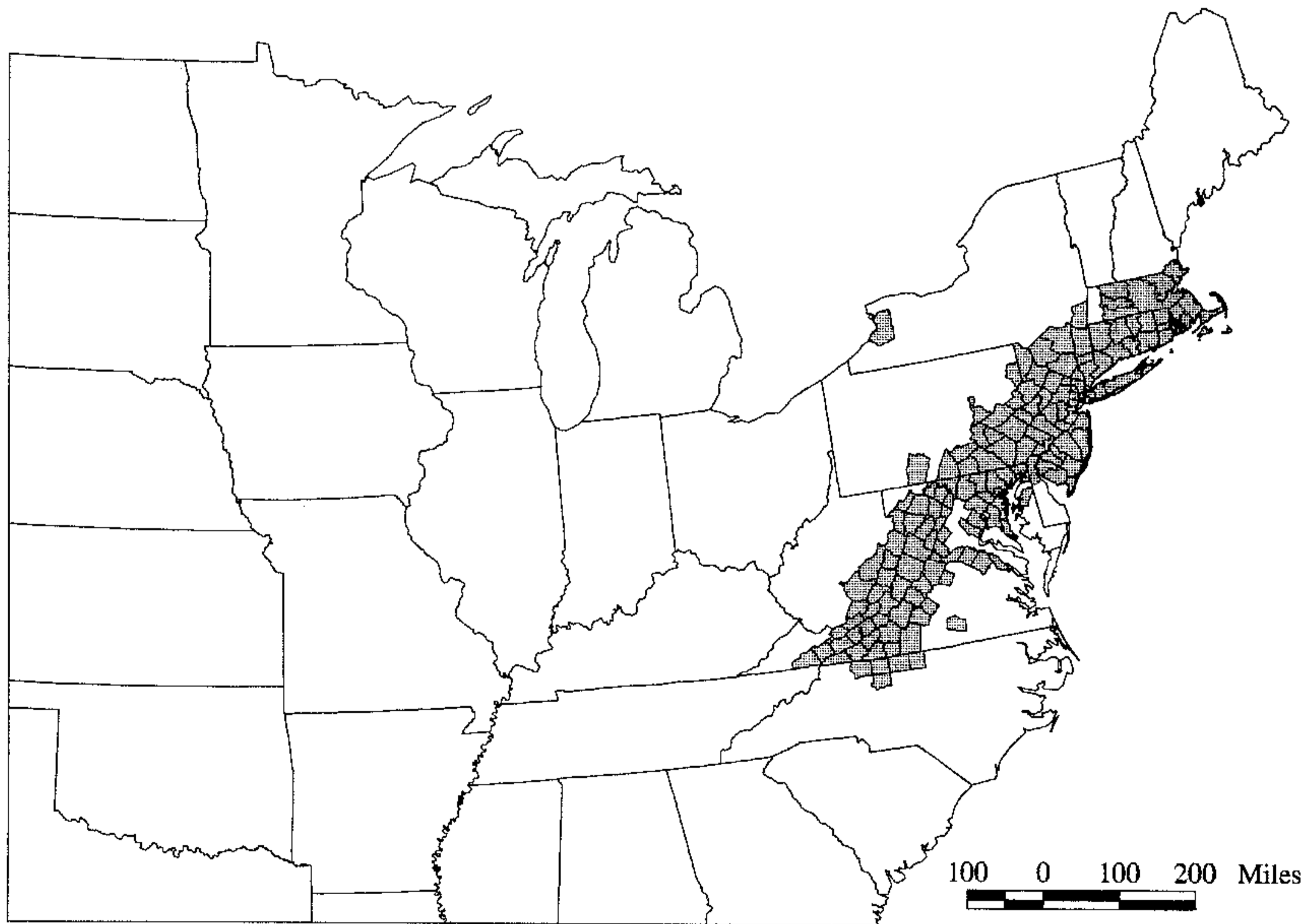
Adelges tsugae was introduced into the West Coast from Asia in 1924 and is now found in British Columbia, Washington, Oregon, and California. The adelgid does very little damage in western forests, but sometimes kills ornamental trees.

In the East, however, the adelgid poses a serious threat to eastern hemlock and Carolina hemlock, killing trees in 3 to 5 years. The insect was introduced into the east coast near Richmond,

Virginia, in 1950. The adelgid became established along the mountainous regions of the Shenandoah Valley and spread south along the Blue Ridge Mountains and north to southern New England.

The adelgid populations continue to spread in the Northeast. New infestations were reported in Massachusetts, New York, and West Virginia. In Pennsylvania, a total of 1,681 newly infested acres were reported. In North Carolina, a fifth county, Cashwell, was added to the infested county list.

Eastern Counties Where Hemlock Woolly Adelgid Was Reported, 1998



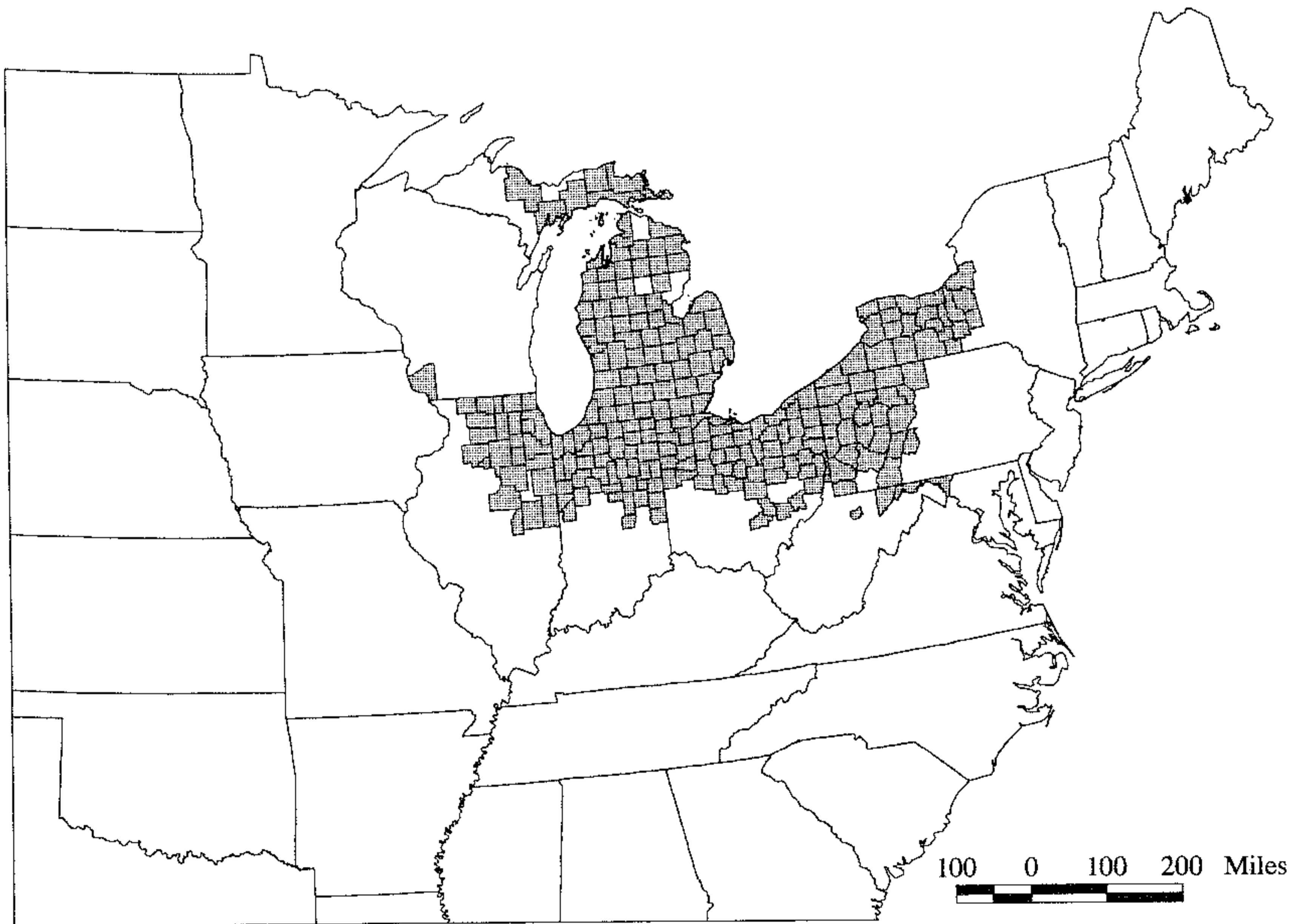
Common European pine shoot beetle

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 of healthy trees. In its native Europe and Siberia, the beetle causes serious damage to trees in burned-over areas and areas experiencing severe drought.

In 1998, the list of affected counties grew to 243, with 19 new counties added to the list. One of those counties is in Wisconsin, adding that State to the list. Six counties in the Upper Peninsula of Michigan were also reported for the first time this year.

Because of the potential damage to trees in the United States, infested counties have been placed under State and Federal quarantines to prevent movement of this beetle to new areas.

Eastern Counties Where The Common European Pine Shoot Beetle Was Reported, 1998



Spruce beetle

Dendroctonus rufipennis is a native insect that occurs across northern North America 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 1998 to 316.8 thousand acres from the peak 1.13

million acres in 1996. About 2.3 million acres have been infested over the last 10 years. Depletion of suitable host material along with a cool, wet summer reduced the beetle to near endemic levels in some areas.

Elsewhere in the West, beetle populations were generally low; previous beetle activity has removed the preferred host trees in some areas. Although beetle densities are low in the Routt Divide Blowdown area (October 1997) in Colorado, beetles were found in nearly every sample.

Spruce Beetle Active and Newly Infested Areas in Alaska, 1998



Disease Conditions Highlights

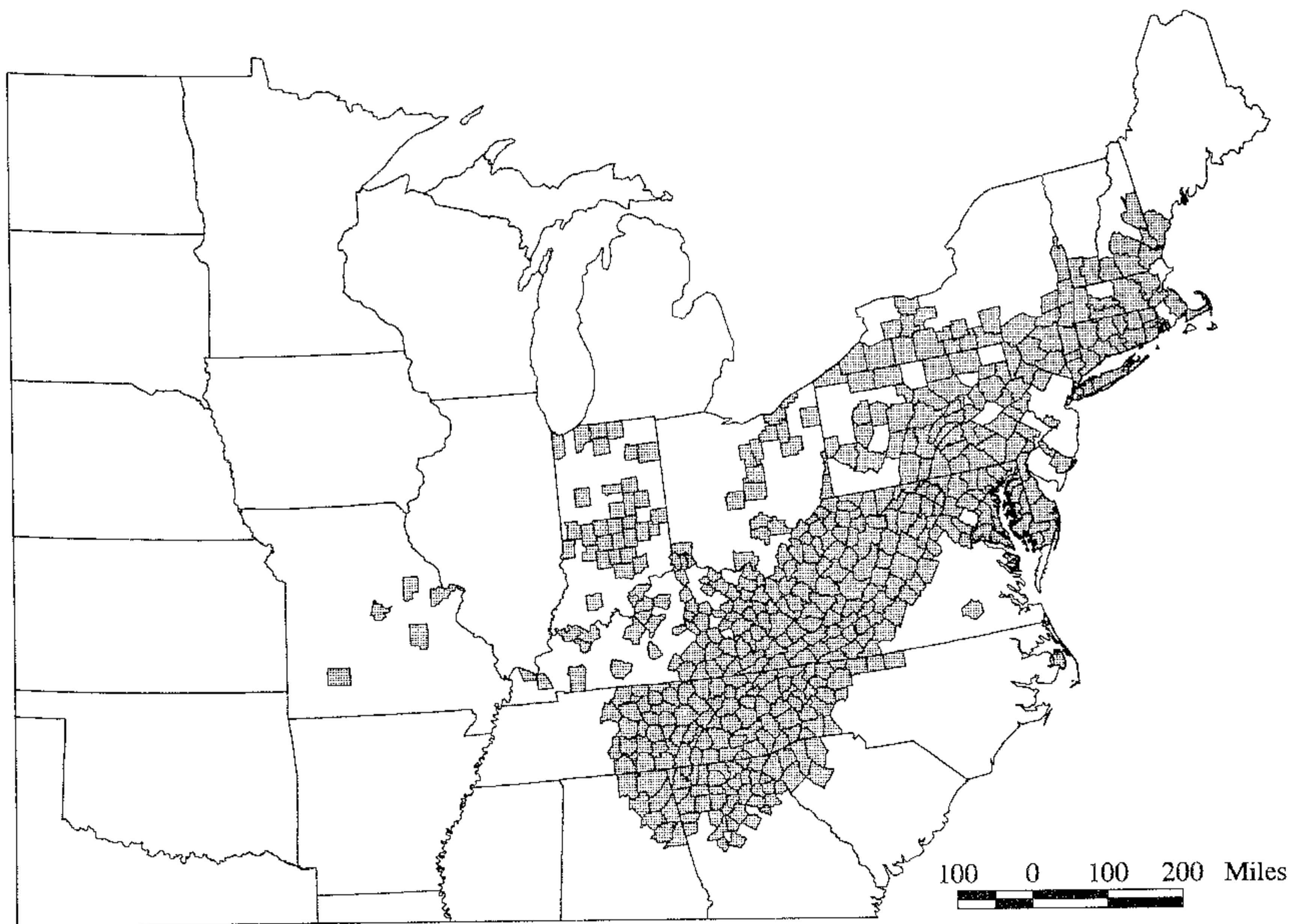
Dogwood anthracnose

Discula destructiva, the fungus that causes dogwood anthracnose, is of unknown origin. First discovered in the Pacific Northwest in 1976, the disease was and 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. Infected nursery stock shipments are implicated in the most recent western spread to Indiana and Missouri. The range of dogwood extends from southern Maine to Florida and west to Michigan and eastern Texas.

In the Southeastern States, most of the dogwood above the 3,000 foot elevation level and in cool, shaded areas below that elevation have been killed. In 1998, anthracnose continued to intensify within its range in the South. In the Northeastern States no new infested counties or changes in disease intensity were reported in 1998.

Eastern Counties Where Dogwood Anthracnose Was Reported, 1998



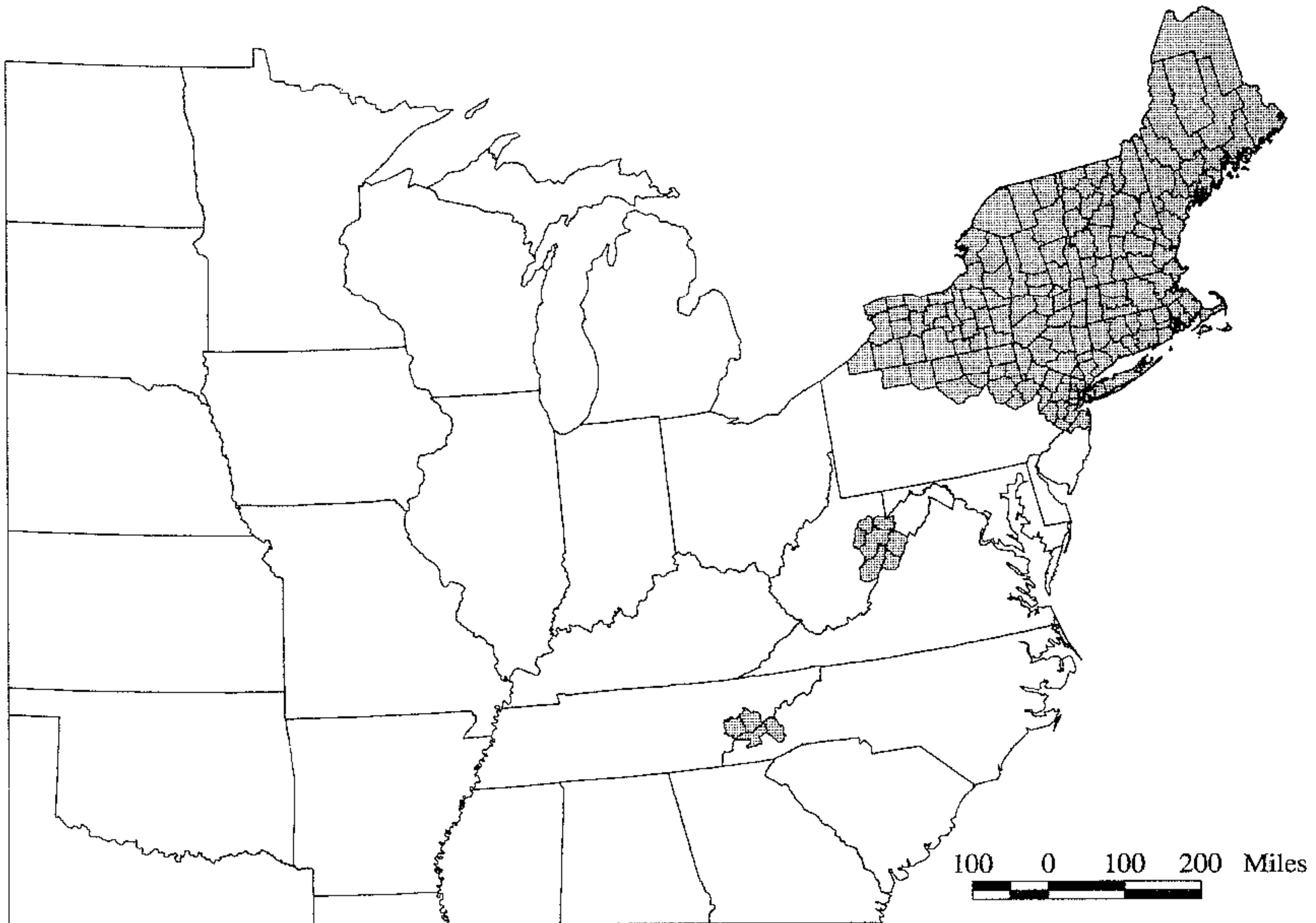
Beech bark disease

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 were accidentally brought to Nova Scotia, Canada, about 1890. By 1932, the disease was killing trees in Maine. It continued to advance into northeastern Pennsylvania.

In 1981, a large infested area 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. Considerable beech mortality has occurred in the Northeast south as northern Pennsylvania. Beech mortality is occurring in West Virginia. The disease continues to intensify within the currently infested areas in North Carolina, Tennessee, and Virginia. The range of American beech is from Maine to northwestern Florida, and west to the eastern parts of Wisconsin and Texas.

Eastern Counties Where Beech Bark Disease Was Reported, 1998

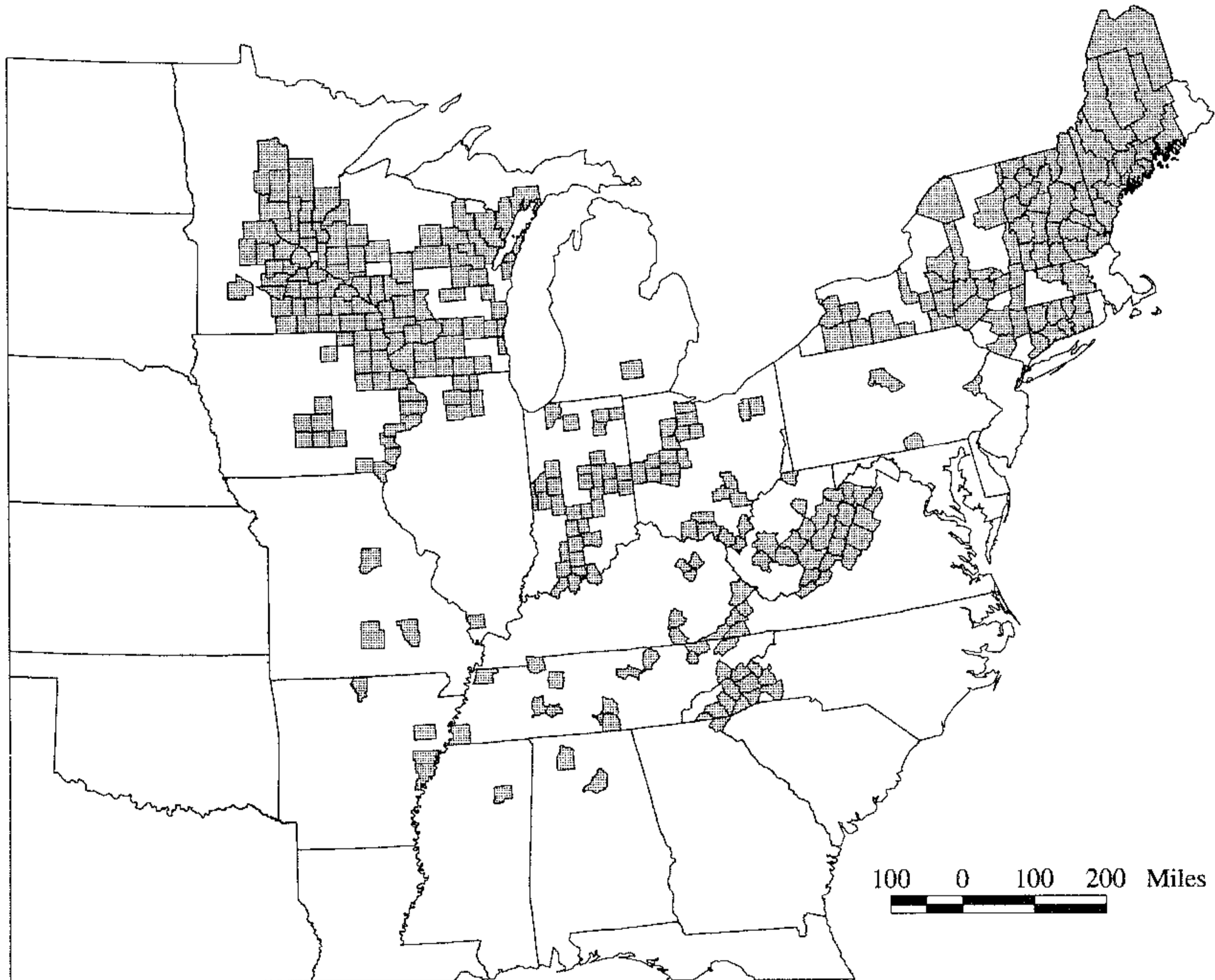


Butternut canker

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, 1998



Disease Conditions Highlights

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, 1998*

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 30.6 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 180 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)	2,276.0	69.0	1,911.0	4,256.0
Colorado (96)	638.0	---	---	638.0
Idaho - North (70-80)**	478.0	10.0	224.0	712.0
Idaho - South (94)**	2,672.5	---	---	2,672.5
Montana (70-80)	1,694.0	123.0	600.0	2,417.0
New Mexico (97)	1,440.0	348.0	581.0	2,369.0
Nevada (94)	49.5	---	---	49.5
Oregon (67)	1,137.0	43.0	2,760.0	3,940.0
Utah (94)	395.9	---	---	395.9
Washington (97)	2,703.3	505.0	4,270.0	7,478.3
Wyoming (97)	553.5	---	---	553.5
Total	18,137.7	1,772.0	10,711.0	30,620.7

* 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

Buck moth, *Hemileuca maia*

Region 8: Louisiana

Host(s): Live oak and other hardwoods

Buck moth defoliation 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.

Cherry scallop shell moth, *Hydria prunivorata*

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

Host(s): Beech, black cherry

Cherry scallop shell moth populations appeared to have collapsed throughout the area in 1998, with no defoliation reported.

Cypress looper, *Anacamptodes pergracilis*

Region 8: Florida

Host(s): Baldcypress, pondcypress

Thousands of acres exhibiting noticeable to severe levels of defoliation caused by the cypress looper were detected during the fall in counties northeast of Lake Okeechobee. Periodic outbreaks of this locally common defoliator have resulted in no known long-term impacts on the health of forested ecosystems.

Douglas-fir beetle, *Dendroctonus pseudotsugae*

Region 1: Idaho, Montana, Wyoming

Host(s): Douglas-fir

Douglas-fir beetle populations have increased dramatically over the past two years throughout many parts of northern Idaho and western Montana. This increase results from the large amounts of windthrown and storm damage to Douglas-fir during the winter of 1996-97. By 1998, more than 78,400 acres had been infested, almost 70,100 acres of which were in northern Idaho. Only 9,500 acres were known to be infested regionwide in 1997. An estimated 145,800 Douglas-fir were actually killed in 1997 and mapped as faders in 1998. Ground surveys indicated that, in most infested areas, four to seven trees were attacked in 1998 for every one killed in 1997. While it appears that 1998 may have been the "peak" year of the infestation in many surveyed areas, additional tree killing will likely continue, at a declining rate, for a few more

Insects: Native

years. The course of those outbreaks are dependent upon availability of susceptible hosts in infested areas, and weather conditions for the next several seasons.

Region 2: Colorado, Wyoming

Host(s): Douglas-fir

A new infestation numbering several hundred trees was detected just west of Oak Creek, Colorado. Two epidemics continued in the South Platte river drainage, one following the Buffalo Creek fire of 1996 and the other following the Douglas-fir tussock moth outbreak of 1993 to 1995. Mortality elsewhere along the Colorado front range continues in small, widely scattered groups. In southwestern Colorado, Douglas-fir beetle continues to impact stands previously defoliated by western spruce budworm. Beetles are also present in large numbers in trees scorched during spring prescribed fire events. Although Douglas-fir beetle populations declined in the Sunlight Basin area of the Shoshone National Forest in Wyoming, there were 645 trees killed along the North Fork of the Shoshone River corridor.

Region 3: Arizona, New Mexico

Host(s): Douglas-fir

Tree mortality caused by the Douglas-fir beetle decreased from 4,455 acres in 1997 to 1,555 acres in 1998. In Arizona, mortality caused by the Douglas-fir beetle occurred on the Apache-Sitgreaves (405 acres), Coconino (425 acres), Coronado (10 acres), Kaibab (25 acres), Prescott (275 acres), and the Tonto (65 acres) National Forests; the Fort Apache (5 acres) and Navajo (30 acres) Indian Reservations; and 40 acres on private land. In New Mexico, mortality caused by the Douglas-fir beetle occurred on the Gila (165 acres) and the Lincoln (110 acres) National Forests.

Region 4: Idaho, Utah, Wyoming

Host(s): Douglas-fir

Mortality increased in Idaho and Wyoming and remained static in Utah. In 1998, 31,300 trees were killed compared to 21,700 trees in 1997. 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 900 trees in 1997 to 3,600 trees in 1998.

Region 5: Northern California

Host(s): Douglas-fir

The only report of activity occurred in Russian Gulch State Park where 18 trees were attacked and killed during the past 2 years.

Region 6: Oregon, Washington

Host(s): Douglas-fir

Douglas-fir beetle activity, as expected, was detected on more acres and at somewhat greater intensities in 1998. Activity was reported on 33,600 acres, averaging 1.1 trees/acre in 1998 as compared to 8,600 acres with an average of 1.0 tree/acre in 1997. Increased levels of activity were detected on National Forest System lands in northcentral and northeastern Washington, as well as the Blue Mountains of Oregon. Predisposing tree stresses caused by repeated years of defoliation by western spruce budworm, drought, and overstocking may result in relatively high levels of Douglas-fir beetle 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 over the past 2 years. Douglas-fir beetle caused mortality is expected to increase during the summer of 1999 and into the year 2000.

Douglas-fir tussock moth,
Orgyia pseudotsugata

Region 1: Idaho, Montana

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

Still at relatively low levels, the Douglas-fir tussock moth populations, confirmed by trap catches, increased in 1998. No aerially visible defoliation was detected. However, larvae were found at two sites sampled in northern Idaho. Moth catches in pheromone traps were at much higher levels in Idaho, but nearly static in Montana. At approximately 95 trapping sites in northern Idaho, approximately 6,500 moths were caught in 1998 as compared to 1,298 in 1997. Trap catches from 33 sites in Montana totaled only 17 moths in 1998, up slightly from 8 in 1997. Some minor defoliation was observed on ornamental trees in residential areas, but none was noted in forest stands. Trap catches and observations suggest that populations should continue to increase and that defoliation may be expected in a few isolated spots in northern Idaho in 1999.

Region 2: Colorado

Host(s): Douglas-fir

The Colorado early warning system using pheromone traps captured very few moths, predicting no population increase. As the 1993 to 1995 Douglas-fir tussock moth outbreak subsided, Douglas-fir beetle populations increased dramatically. Elevated beetle populations continue to kill trees near Deckers and Sprucewood, Colorado.

Region 4: Idaho, Nevada, Utah

Host(s): Douglas-fir, true firs

No visible defoliation from Douglas-fir tussock moth was observed in the Region during 1998. Pheromone trap catches indicated increasing populations in the Owhyee Mountains and on the Weiser and Council Ranger Districts of the Payette National Forest.

Region 5: California

Host(s): White fir

Douglas-fir tussock moth populations reached outbreak on white fir in locations on the Sequoia National Forest and the Sequoia-Kings Canyon National Parks in 1998. About 44,000 acres are affected. Approximately 27,000 acres are in the national parks, 15,500 acres on the Sequoia National Forest, and 1,500 acres on State and private lands. Heavy defoliation has occurred on about 5,800 acres, or 13 percent, of the infested area and is restricted to areas within the national parks and the Hume Lake District of the Sequoia National Forest. Many of the heavily defoliated stands are in high-use recreation areas. Very light feeding injury was observed over about 1,000 acres on the Minarets District of the Sierra National Forest.

Region 6: Oregon, Washington

Host(s): Douglas-fir, true firs

Following 2 years of no reported activity, a small 19 acre pocket of visible defoliation on private lands in northeastern Washington was observed. The Douglas-fir Tussock Moth (DFTM) Early

Insects: Native

Warning Trapping System is a system of over 350 plots scattered throughout Washington and Oregon. The system was established to indicate general population changes. Results of the trapping in 1998 indicate that Douglas-fir tussock moth populations continue to increase throughout the region. Since 1995, traps have indicated a general increase in several areas--primarily on parts of the Pine Ranger District south of Enterprise, in northeastern Oregon, and north central Washington (southwest of Tonasket). Larval sampling and egg mass searches in the area in northeastern Oregon in 1998 indicated that populations were still in suboutbreak stage. Based on the trend of the traps, tussock moth defoliation may begin in some areas in 1999. In 1997, 11 plots had an average of 25 moths or more per trap; in 1998 51 plots had an average of 25 moths or more per trap. In addition to the areas identified in 1997, additional areas with increases include the Methow Valley and the Sanpoil portion of the Colville Indian Reservation in Washington, Bear Valley and portions of the Prairie City Ranger District of the Malheur National Forest, portions of the Heppner and Pomeroy Ranger Districts of the Umatilla National Forest, and State and private land on the Klamath District of the Oregon Department of Forestry. These areas will be monitored closely and additional cocoon and larval sampling will be conducted in 1999.

Eastern pine looper,
Lambdina athasaria pellucidaria

Region 9/Northeastern Area: New Jersey

Hosts: Pitch pine

The eastern pine looper defoliated an area encompassing 400,000 acres within the Pinelands of southern New Jersey. This is the second time during the 1990's that a large outbreak of this insect has occurred within the Pinelands. Unlike the previous outbreak of eastern pine looper in the Pinelands, this one has been made more severe by the occurrence of pine needle miner within the affected area. The combination of looper feeding damage and needle miner caused needle drop has resulted in significant fire danger due to fuel build-up on the forest floor.

Fall cankerworm,
Alsophila pometaria

Region 4: Utah

Host(s): Gamble oak

A significant increase in defoliation of Gamble oak occurred along the Wasatch Front in northern Utah from Spanish Fork to Brigham City. Approximately 34,200 acres were defoliated in 1998 compared to 4,900 acres in 1997. This is the fifth consecutive year of this defoliation.

Region 8: North Carolina, Virginia

Host(s): Oaks

Within the City of Charlotte, high populations of the fall cankerworm have been present since 1987. Natural controls, which regulate outbreaks in uninhabited forests, have not been effective in reducing fall cankerworm populations in this urban environment. Charlotte has a large number of mature willow oaks that provide an almost unbroken canopy over much of the city. In 1998, 5,800 acres of this resource were treated with *Bacillus thuringiensis*, a biological insecticide. A separate North Carolina infestation occurred in the western portion of the State along the Blue Ridge Parkway with 12,000 acres defoliated. There was also defoliation by an oak sawfly, *Periclista* spp., mixed in with the fall cankerworm in this infestation. Amherst County in Virginia incurred a second straight year of noticeable fall cankerworm defoliation along the Appalachian Trail.

Region 9/Northeastern Area: Massachusetts, West Virginia

Host(s): Maples

Defoliation caused by the fall cankerworm occurred on 122,591 acres in Plymouth and Norfolk counties in Massachusetts and on 1,133 acres in Preston and Monongalia counties in West Virginia.

**Fir engraver beetle,
*Scolytus ventralis***

Region 1. Idaho, Montana

Host(s): Grand fir, subalpine fir

Fir engraver populations, and associated mortality in grand fir stands, declined markedly from 1997 levels. In 1997, an estimated 116,400 acres, primarily in northern Idaho, were affected. Populations were abnormally high in 1997 because of unusually high amounts of moisture resulting in stress to host trees. A return to more typical weather conditions in 1998 resulted in more endemic-like beetle populations. Some significant amounts of beetle-killed grand fir were noted widely scattered throughout the host type in northern Idaho: but most beetle-killed groups were small on the Idaho Panhandle National Forest, Nez Perce Indian Reservation, and lands of various other ownerships. In Montana, some minor amounts of fir engraver-killed trees were observed in the westcentral part of the State (Lolo National Forest). Regionwide, an estimated 13,300 acres were infested in Idaho and 500 acres in Montana; 10,600 trees were killed.

Region 3: Arizona, New Mexico

Host(s): White fir

Tree mortality caused by both the fir engraver and western balsam bark beetles (*Dryocoetes confusus*) was detected on 4,835 acres in 1998, compared to 4,345 acres in 1997. Tree mortality on Federal lands in Arizona occurred on the Apache-Sitgreaves (345 acres), Coconino (1,830 acres), Coronado (65 acres), Kaibab (545 acres), and Tonto (5 acres) National Forests; Fort Apache (30 acres) and Navajo (5 acres) Indian Reservations; the Grand Canyon (15 acres) National Park; and 5 acres of private land. In New Mexico, fir engraver beetle-caused mortality occurred on the Carson (20 acres), Cibola (155 acres), Gila (1560 acres), Lincoln (15 acres), and Santa Fe (240 acres) National Forests.

Region 4: California, Idaho, Nevada, Utah

Host(s): Grand fir, red fir, subalpine fir, white fir

Mortality again decreased significantly in 1998 with only 2,600 trees killed compared to 22,600 trees killed in 1997. The largest area of beetle activity continues to be located on the Toiyabe National Forest and on Federal, State, and private lands in the Tahoe Basin Management area with 1,500 trees killed. Approximately 600 dying trees were observed on the Humboldt National Forest in Nevada. No significant mortality was observed in southern Idaho. Mortality remained low in Utah with 500 trees killed on the Dixie and Fishlake National Forests.

Insects: Native

Region 5: California

Host(s): White fir, red fir

Fir mortality continued to decrease across most of the southern Cascades and was at background rates in the Sierra Nevada. Topkill and some mortality were observed in the San Gabriel, San Bernardino, and San Jacinto Mountains in southern California.

Region 6: Oregon, Washington

Host(s): True firs

Fir engraver activity within the region decreased for the third straight year from less than 26,000 acres in 1997 (0.82 tree/acre) to 11,400 acres in 1998 (0.74 tree/acre). Increased levels of activity were reported within the Deschutes and Ochoco reporting areas (see Appendix B for definition of reporting area). Following 3 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 now--as a result of selective logging and fire exclusion--have a large component of true fir.

Forest tent caterpillar, *Malacosoma disstria*

Region 8: Alabama, Florida, Louisiana, North Carolina, South Carolina

Host(s): Tupelo gum, upland hardwoods

Defoliation occurred on 88,000 acres, down from 230,000 acres in 1997, of forested wetlands in Ascension, St. James, and St. John parishes in Louisiana and 11,800 acres, down from 25,000 acres in 1997, in eastern North Carolina along the Roanoke River. The 3-year long outbreak in western Florida collapsed in 1998.

Region 9/Northeastern Area: Massachusetts, Minnesota, Rhode Island

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

Severe defoliation occurred on 11,217 acres in Minnesota, 1,895 acres in Massachusetts, and 1,500 acres in Rhode Island. Populations that caused defoliation in 1997 in Maryland, Illinois, and New Hampshire appear to have collapsed.

Fruittree leafroller, *Archips argyrospilus*

Region 5: California

Host(s): California black oak

The fruittree leafroller causes visible defoliation almost every year in the vicinity of Lake Gregory in the San Bernardino Mountains of southern California. Light defoliation proved 1998 no exception.

Region 8: Louisiana

Host(s): Bald cypress

Defoliation occurred over 616,000 acres, up from 525,000 acres in 1997, of forested wetlands in southeastern and south central Louisiana. Defoliation was severe (greater than sixty percent) on 290,000 acres; a level likely to cause growth loss. Repeated defoliation has caused dieback and mortality on sapling and pole-sized cypress in permanently flooded areas. The outbreak is approaching the outskirts of the City of New Orleans.

**Jack pine budworm,
*Choristoneura pinus***

Region 2: Nebraska

Host(s): Jack pine

An 800 acre outbreak of jack pine budworm on the Nebraska National Forest continued causing extensive defoliation in the jack pine plantations on the forest.

Region 9/Northeastern Area: Michigan, Minnesota, Wisconsin

Host(s): Jack pine

In 1998, 63,221 acres of defoliation were observed in Michigan. This is the second outbreak year for jack pine budworm in Michigan. In Wisconsin, 2,289 acres of jack pine defoliation were reported in Adams and Juneau counties. This is a considerable decrease in activity from what was observed in 1997. No jack pine defoliation was reported in Minnesota in 1998.

**Jeffrey pine beetle,
*Dendroctonus jeffreyi***

Region 4: California, Nevada

Host(s): Jeffrey pine

Jeffrey pine beetle activity remained static on the Toiyabe National Forest and Lake Tahoe Basin Management Unit with 400 trees killed in 1998.

Region 5: California

Host(s): Jeffrey pine

With the exception of one small area with chronic mortality, Jeffrey pine mortality in the southern Cascades has returned to background rate following 3 years of adequate precipitation. The same is true of the central and southern Sierra Nevada. The exceptions are locations on the Truckee Ranger District north of Lake Tahoe, concentrations of mortality around the south shore of Lake Tahoe, and light mortality around Inyo Craters on the Inyo National Forest.

Insects: Native

**Jumping oak gall,
*Neuroterus saltatorius***

Region 9/Northeastern Area: Missouri

Hosts: Bur oak, white oak

Damage from this gall producing wasp was reported on street trees within an area encompassing 1,883,900 acres throughout the State. The galls can become numerous enough to cause leaf discoloration or premature leaf drop.

**Large aspen tortrix ,
*Choristoneura conflictana***

Region 9/Northeastern Area: Michigan, Minnesota, New Hampshire

Hosts: Aspen

The large aspen tortrix defoliated 592,121 acres of aspen in Michigan's Upper Peninsula. Most of the defoliation occurred in Chippewa and Ontonagon counties. Defoliation caused by this insect also occurred on 3,078 acres in St. Louis County in Minnesota and 1,147 acres in New Hampshire. All of the defoliation in New Hampshire occurred in Coos County.

**Mountain pine beetle,
*Dendroctonus ponderosae***

Region 1: Idaho, Montana

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

Mountain pine beetle populations once again increased significantly in 1998. In 1997, just over 72,000 acres had been infested. In 1998, that figure increased to nearly 115,000 acres, on which an estimated 303,000 trees were killed. More than 90 percent of those beetle-killed trees were lodgepole pine. The most expansive outbreak in the region exists on the Nez Perce National Forest in northern Idaho, where 39,000 acres are infested. Although to date an average of just over one tree per acre has been killed, populations appear to be intensifying. An additional 27,500 acres were infested in northern Idaho, including most on the Idaho Panhandle National Forest. The most intense and damaging outbreaks are found on the Lolo National Forest in western Montana, where more than 22,800 acres were infested. A total of 184,000 faded trees were mapped there in 1998; an average of more than 8 trees per acre. Beetle populations appear to be building in older lodgepole pine stands on parts of the Flathead National Forest. 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. Regionwide, beetle-caused mortality in ponderosa pine stands, is not extreme. However, it is of concern in some areas on the Bitterroot and Lewis and Clark National Forests, and the Rocky Boys and Fort Belknap Indian Reservations in Montana.

Region 2: Colorado, South Dakota, Wyoming

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

Mountain pine beetle populations and associated pine mortality increased and expanded in Colorado for the third consecutive year. Areas of significant activity include the Colorado Front Range, especially in the Cache la Poudre and South Platte River drainages, and around Lake Granby, Colorado. On the southeastern edge of southern Wyoming's Sierra Madre Mountains and in the North Park of Colorado, several extensive areas of pine mortality were recorded. Although significant activity was detected in many other locations, it has yet to reach extensive

epidemic proportions. Mountain pine beetle activity in lodgepole pine in Vail Valley declined slightly from the previous year. Populations in ponderosa pine stands in the Upper Arkansas River Valley continued to rapidly expand, impacting large portions of the wildland-urban interface between Buena Vista and Salida. Beetle populations are on the rise throughout much of Colorado's ponderosa pine forests. Populations continued to expand and cause increased damage in the Black Hills and eastern slope of the Bighorns in Wyoming. In the Black Hills, tree mortality has increased from 1,508 trees in 1996 to 5,219 trees in 1997 to 11,383 in 1998. It is expected to increase again in 1999. Suppression activities are occurring in the Black Hills in an attempt to minimize the impact. In the Bighorns, there were 838 ponderosa pine killed in 1997. In 1998, the number of trees killed along the eastern slope of the Bighorns rose to 1,490.

Region 3: Arizona, New Mexico

Host(s): Ponderosa pine

Mountain pine beetle-caused ponderosa pine mortality decreased from 10,080 acres in 1997 to 7,500 acres in 1998. Most of this mortality occurred in the Grand Canyon National Park (7,425 acres). Smaller areas of mountain pine beetle-caused tree mortality occurred on the Kaibab National Forest (10 acres) in Arizona and on the Santa Fe National Forest (65 acres) in northern New Mexico.

Region 4: Idaho, Nevada, Utah, Wyoming

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

Mountain pine beetle-caused mortality decreased from 35,000 trees in 1997 to 11,000 trees in 1998. The largest outbreaks in the region were located on the Sawtooth National Forest in southern Idaho where 2,000 lodgepole pine trees killed, the Dixie National Forest in southern Utah where 2,200 ponderosa pine trees killed, and the Bridger-Teton National Forest in western Wyoming where 2,000 lodgepole pine trees killed. Elsewhere in the region, smaller mountain pine beetle outbreaks were located on all national forests except the Toiyabe National Forest.

Mortality of whitebark and limber pine attributed to mountain pine beetle attack decreased with 3,200 trees killed in 1998 compared to 6,100 trees in 1997. Greatest mortality was located in Utah and Idaho with 900 and 1,200 trees killed respectively.

Region 5: California

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

Mortality of all host species was substantially lower in 1998 than in 1997 in the Klamath Mountains of northern California. Across the southern Cascades and Sierra Nevada ecosections, mortality was largely confined to lodgepole pine and found primarily on the Truckee and Sierraville Ranger Districts north of Lake Tahoe and at the southern end of the Lake Tahoe Basin.

Region 6: Oregon, Washington

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

Acres affected by mountain pine beetle decreased for the third year from 157,089 acres with an average of 2.16 trees per acre in 1997 to 95,963 acres with an average of 3.31 trees per acre in 1998. Decreased activity was detected in all host types with the exception of ponderosa pine. Areas most heavily affected by mountain pine beetle in lodgepole pine include Federal lands within the Deschutes, Fremont, and Okanogan reporting areas (see Appendix B for definition of reporting area). Most heavily affected areas in the ponderosa pine type occurred on private lands within the Ochoco, Umatilla, Central Oregon, and Northeast Washington reporting areas. Dense stand conditions continue to predispose areas to mountain pine beetle infestations.

Insects: Native

**Nantucket pine tip moth,
*Rhyacionia frustrana***

Region 8: Regionwide

Host(s): Loblolly pine, shortleaf pine

From Texas to South Carolina, 1998 was the year of the tip moth. Tip moth levels were much higher than in 1997, probably due to unusual summer drought stress. Damage was most pronounced on open-grown trees. While the insect rarely causes tree mortality, it can cause significant growth loss. More than half of sampled trees, 1 to 5 years old, were infested in east Texas in 1998. Approximately 30 to 40 percent of the tips in the upper branch whorl were attacked. South Carolina experienced heavy damage in August as large areas had 100 percent of terminals and laterals infested. The extended drought allowed development of an unprecedented fourth generation of Nantucket pine tip moths in the central part of Tennessee.

**Oak leaftier,
*Croesia semipurpurana***

Region 9/Northeastern Area: Pennsylvania

Hosts: Northern red oak

The oak leaftier caused 1,666 acres of moderate to heavy defoliation in southcentral Pennsylvania. Some of the oak leaftier activity is coincident with gypsy moth activity. Treatment of the most severely affected areas is planned for 1999 in order to prevent tree mortality.

**Pandora moth,
*Coloradia pandora***

Region 6: Oregon

Host(s): Lodgepole pine, ponderosa pine

The current pandora moth infestation in central Oregon began in 1986 and grew with each successive generation until 1994, when pines on 369,100 acres experienced some level of defoliation. A naturally occurring virus was noted throughout the infested area in 1994. Only 12,300 acres were defoliated in 1996, and we believe that this virus brought about the collapse of the pandora moth population. The defoliation produced by the larvae has caused concern, but trees are only bare for a short time until the current year's growth of needles appears later in the summer. We anticipate the long-term effects of the infestation will be minimal, with very low tree mortality in some areas. Due to greatly diminished larval populations, there was no special aerial survey conducted for the pandora moth in 1998. Defoliation was extremely light and would not have been visible from the air. Some larval feeding was noted near Little Walker Mountain, 10 miles south of Crescent on the Deschutes National Forest.

**Pine engraver beetles,
Ips spp.**

Region 1: Idaho, Montana, Wyoming

Host(s): Lodgepole pine, ponderosa pine

Although pine engraver-infested areas increased in northern Idaho over 1997 levels, they declined throughout Montana. Overall, they remained at nearly endemic levels regionwide in 1998.

In northern Idaho, approximately 5,700 beetle-killed ponderosa pines were recorded on 3,270 acres in 1998, and another 400 acres showed just less than 1,300 lodgepole pines killed as a result of engraver beetle activity. About 650 acres had shown some level of infestation in 1997. In Montana, fewer than 600 ponderosa pines and 250 lodgepole pines were killed on 234 and 464 acres, respectively. In 1997, engraver beetle-caused mortality had been recorded on about 700 acres. The above average precipitation during the 1998-99 winter throughout the typically dry and often susceptible ponderosa pine stands in western Montana and northern Idaho should result in a reduction of engraver beetle-caused damage in 1999. In addition, land managers are becoming increasingly aware of the need for proper slash management during late winter and early spring logging in ponderosa pine stands. That, too, should help reduce losses to engraver beetles.

Region 2: Colorado, Nebraska, South Dakota, Wyoming

Host(s): Ponderosa pine, lodgepole pine, spruce

Ips beetles caused scattered mortality throughout the region. Significant activity was usually correlated with damage to host trees by windthrow or fire. Populations in pine were low, with no real economic damage reported. However, single and small groups of spruce were killed on the Nebraska National Forest and the Pine Ridge and Rosebud Indian Reservations in South Dakota. Activity has increased in spruce trees in the Black Hills, affecting some scenic areas and campgrounds.

Region 3: Arizona, New Mexico

Host(s): Ponderosa pine, pinyon pine

Ips-killed ponderosa pines decreased from 25,085 acres in 1997 to 18,165 acres in 1998. In Arizona, tree mortality was detected on the Apache-Sitgreaves (110 acres), Coconino (820 acres), Coronado (40 acres), Kaibab (820 acres), Prescott (1,655 acres), and Tonto (12,935 acres) National Forests; the Fort Apache (155 acres), Navajo (35), and San Carlos (955 acres) Indian Reservations; and on 500 acres of State and private lands. In New Mexico, *Ips*-caused tree mortality occurred on the Gila (10 acres) and Lincoln (25 acres) National Forests and the Mescalero-Apache Indian Reservation (105 acres). In Arizona, pinyon pine mortality resulting from *Ips* beetle attacks (*Ips confusus*) was detected on the Coconino (35 acres) National Forest, Walnut Canyon National Monument (20 acres), and Hualapai Indian Reservation (10 acres). No pinyon *Ips* activity was detected in New Mexico.

Region 4: Idaho, Nevada, Utah

Host(s): Lodgepole pine, ponderosa pine

Mortality caused by 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*, was more active in southern California. It continued to kill singleleaf pinyon infected with black stain root disease in the eastern San Bernardino Mountains and in the Santa Rosa Mountains. *Pinus californiarum* spp. *californiarum* continued to be killed in the vicinity of the 1994 Palm Fire in the Santa Rosa Mountains in southern California.

Insects: Native

Region 6: Oregon, Washington

Host(s): Ponderosa pine

Pine engraver activity decreased slightly from 1997 levels. The majority of activity was detected on Federal and private lands in northeastern Oregon and northeastern Washington.

Region 8: Regionwide

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

The severe drought conditions during the growing season across the entire South led to 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. Activity was low in Mississippi until early fall when an increase was reported, much of it in young plantations. *Ips* were particularly troublesome in the Carolinas and southwest Tennessee. South Carolina infestations were generally confined to overstocked loblolly pine plantations and rarely exceeded 25 trees. In North Carolina, losses were severe in the Piedmont and also in the mountains where shallow rooted pines were suffering from drought stress. Significant mortality was also experienced in Florida where summer fires predisposed large areas to attack.

Pine reproduction weevil, *Cylindrocopturus eatoni*

Region 5: California

Host(s): Ponderosa pine

The pine reproduction weevil continued to cause damage to pine plantations on the Groveland District of the Stanislaus National Forest in 1998. Mortality ranged from 21 percent to 38 percent of current stocking on about 517 acres and about 846 acres had mortality within the 11 percent to 20 percent range. Suppression was conducted over 567 acres. In addition, the weevil was detected on about 1,000 acres of plantations on the Mariposa District of the Sierra National Forest with mortality rates similar to those on the Groveland District.

Roundheaded pine beetle, *Dendroctonus adjunctus*

Region 3: Arizona, New Mexico

Host(s): Ponderosa pine

Roundheaded pine beetle-caused tree mortality decreased over 50 percent from 18,435 acres in 1997 to 6,730 acres 1998. Mortality from roundheaded pine beetle attacks in Arizona occurred on the Coronado National Forest and totaled 10 acres. In New Mexico, roundheaded pine beetle-killed trees were detected on the Lincoln National Forest (4,020 acres) and Mescalero Apache Indian Reservation (2,700 acres).

Region 4: Utah

Host(s): Ponderosa pine

Ponderosa pine mortality attributed to the roundheaded pine 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: Alabama, Arkansas, Florida, Georgia, Louisiana, Mississippi, North Carolina, South Carolina, Tennessee, Texas, Virginia

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

One of the all time low years for the southern pine beetle populations occurred in 1998. Regionwide, the number of spots in 1998 declined 10 percent from the 1997 level. The number of acres in outbreak status decreased by 25 percent. The only area with any significant numbers of beetle spots was south central Alabama. On State and private land in Texas, there were no reported infestations during the entire year.

In Alabama, southern pine beetle populations started high in 1998 and declined only slightly during the summer drought. Forty-two of Alabama's 67 counties had outbreak population levels at some point during the year. The highest populations were along the interface of the coastal plain and Piedmont. In South Carolina, beetle populations increased in the fall with the highest populations occurring in the Piedmont section. The southern pine beetle outbreak in North Carolina, in the area of the coastal plain affected by Hurricanes Bertha and Fran, continued on in the early part of 1998, but subsided later in the year. The same is true in Florida where the 1997 outbreak in the Ocala area dropped off to nothing. There have been no reports of increased southern pine beetle activity after the severe summer fires in Florida.

Region 9/Northeastern Area: Maryland

Host(s): Loblolly pine

One 19 acre infestation of southern pine beetle was observed in Dorchester County, Maryland.

**Spruce beetle,
*Dendroctonus rufipennis***

Region 1: Idaho, Montana

Host(s): Engelmann spruce

Although there was a slight increase in an infested area in western Montana, spruce beetle populations once again remained low throughout the region in 1998. In northern Idaho, slightly less than 100 infested acres were recorded. Most occurred as small and scattered groups of Engelmann spruce on the Clearwater and Nez Perce National Forests. In western Montana, the infested area increased from 1,500 acres in 1997, to nearly 2,000 acres in 1998. Those infested acres were found on the Gallatin, Flathead, and Kootenai National Forests and in Glacier National Park. Slightly more than 2,500 trees were killed throughout the region. The few spruce beetle-infested trees on the Flathead National Forest are some distance from 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 northcentral Colorado and south-central Wyoming an extensive survey in the Routt Divide Blowdown of October, 1997 detected spruce beetle populations in windthrow at nearly every survey location. Brood sampling and observations showed that spruce beetle densities in windthrow were very low, but that some of the population would mature in only one season. No attacks on standing trees were detected. Intensive monitoring and sampling will continue; it is expected that mortality of standing trees will eventually occur somewhere in the more than 13,000 acres of windthrow. Low numbers of spruce beetles were found in approximately 600 acres of windthrown spruce near Creede, Colorado on the Rio Grande National Forest. Salvage operations are

Insects: Native

ongoing. Windstorms in late 1997 generated large amounts of windthrow scattered throughout the spruce-fir type in the region. Much of this is in inaccessible areas. Single trees or small groups were occasionally found on the Bighorn National Forest.

Region 3: Arizona, New Mexico

Host(s): Spruce

Spruce beetle-caused tree mortality increased from 1,650 acres in 1997 to 2,690 acres in 1998. In Arizona, spruce beetle-killed trees were detected on the Apache-Sitgreaves (50 acres), Coconino (5 acres), and Kaibab (240 acres) National Forests; and the Fort Apache (15 acres) and Navajo (140 acres) Indian Reservations. In New Mexico, spruce beetle-caused tree mortality was detected on the Carson (440 acres), Cibola (145 acres), Gila (10), Lincoln (290 acres,) and Santa Fe (1200 acres) National Forests and the Mescalero-Apache (155 acres) Indian Reservation.

Region 4: Idaho, Utah, Wyoming

Host(s): Spruce

Spruce beetle-caused tree mortality increased with 105,500 trees killed Regionwide compared to 70,700 in 1997. The largest infestations were in Utah where 42,900 trees were killed on the Dixie National Forest and 48,900 trees were killed on the Manti-LaSal National Forest. Mortality was also observed on the Fishlake, Uinta, and Wasatch Cache National Forests. No significant mortality was observed in southern Idaho national forests or on the Bridger-Teton National Forest in western Wyoming.

Region 6: Oregon, Washington

Host(s): Engelmann spruce

All reported mortality in Oregon and Washington in 1998 was in Engelmann spruce. Reported trees killed decreased from approximately 6,500 trees in 1997 to fewer than 2,900 in 1998. Over 92 percent of trees reported killed were on Federal lands. Sixty-eight percent of the reported acreage affected occurred within Wenatchee and Wallowa-Whitman reporting areas (see Appendix B for definition of reporting area). In other areas, spruce beetle activity was lightly scattered in the host type. Low levels of spruce beetle activity are due, in part, to the gradual removal of preferred host trees by previous infestations.

Region 10: Alaska

Host(s): Lutz spruce, Sitka spruce, white spruce

Total acreage affected by the spruce beetle declined by 44 percent in 1998. Since 1996, when the spruce beetle epidemic peaked at 1.13 million acres, levels fell to 563,700 acres in 1997, then to 316,800 acres in 1998. A depletion of suitable host material (substantial mortality in most stands) along with a cool, wet summer most likely accounted for this substantial decline. Although spruce beetle activity has dropped to near endemic levels in some areas, it remains quite active in others. Of the 30 areas tracked annually in southcentral and interior Alaska for spruce beetle activity, 24 experienced declines and none of the areas which increased did so substantially. Total spruce beetle activity in southcentral and interior Alaska covered 312,450 acres with the vast majority occurring on the Kenai Peninsula and the Cook Inlet basin. In southeast Alaska, spruce beetle activity decreased to 4,220 acres in 1998, mostly occurring on State lands in the Haines area. Throughout the State, many ownerships are being affected: 80 percent of the active infestation is occurring on State and private lands, only 1 percent is occurring on national forest lands, and the remaining 18 percent is occurring on other Federal land.

It should be noted, however, that although current levels of infestation have declined, the spruce beetle has impacted 2 to 3 million acres of forested land over the past 10 years. The challenges

stemming from past beetle activity--such as fuel-loading, habitat changes, impacts to wildlife, and hydrologic changes--remain for forest managers and private landowners alike.

Region 9/Northeastern Area: Maine

Host(s): Red spruce, white spruce

Spruce beetle populations in Maine appear to be declining. Only 3,175 acres were affected in 1998.

Spruce budworm,
Choristoneura fumiferana

Region 10: Alaska

Host(s): Lutz spruce, Sitka spruce, white spruce

Acres of defoliation attributed to the spruce budworm rose in 1998 by 129 percent in an eighth consecutive year of budworm defoliation. All of the 87,800 acres of budworm defoliation observed occurred along the Yukon River with 46,240 of those acres on State and private land and 41,640 acres on other Federal land. An outbreak at Tanana is largely responsible for this increase. In 1997, acres of defoliation had declined by 84 percent over 1996 levels. The activity in 1998 is consistent with the general pattern of this outbreak--a general, annual southwestward movement down the Yukon River. Assuming parasites, predators, and adverse weather conditions (the natural control agents of budworm populations) are unable to keep this population in check, there is good reason to believe this pattern will continue because there remain contiguous spruce stands for hundreds of miles downriver.

Region 9/Northeastern Area: Michigan, Minnesota, Wisconsin

Host(s): Balsam fir, white spruce

Significant defoliation occurred on State and private lands in Minnesota encompassing an area of 240,233 acres. In Michigan, 12,157 acres were defoliated on State and private lands and 20,800 acres on National Forest System lands. In Wisconsin, 16,000 acres of defoliation occurred on National Forest System lands.

Western balsam bark beetle,
Dryocoetes confusus

See Subalpine fir mortality complex.

Western pine beetle,
Dendroctonus brevicomis

Region 1: Idaho, Montana

Host(s): Ponderosa pine

In the total area infested, ponderosa pine stands affected by western pine beetle increased significantly in 1998, more than doubling in northern Idaho from 8,400 acres infested in 1997 to 17,900 acres in 1998. Most (8,800 acres) were recorded on lands of mixed ownership within the Coeur d'Alene Indian Reservation reporting area (see Appendix B for definition of reporting area).

Insects: Native

Although the infested area was widespread, intensity of tree mortality in most areas was less than one tree per acre. On privately owned land within the Idaho Panhandle National Forest reporting area, another 5,200 acres were infested. However, tree-per-acre intensity was light there, too. About 2,000 infested acres, in small 5- to 10-tree groups, were infested within the Clearwater National Forest reporting area. Elsewhere in northern Idaho, mortality attributed to western pine beetle was light. Few areas in western Montana were seriously affected by western pine beetle populations in 1998. In total, just over 1,300 acres and less than 1,000 trees were estimated to have been killed. Above average precipitation in late fall 1998, and predicted for winter 1999, suggest declining populations in 1999.

Region 3: Arizona, New Mexico

Host(s): Ponderosa pine

Western pine beetle-caused tree mortality decreased from 12,225 acres in 1997 to 2,340 acres in 1998. Mortality in Arizona occurred on the Apache-Sitgreaves (85 acres), Coconino (35 acres), Coronado (5 acres), Kaibab (105 acres), and Tonto (5 acres) National Forests; the Fort Apache (60 acres), Navajo (125 acres), and San Carlos (45 acres) Indian Reservations; and on 15 acres of state and private lands. In New Mexico, mortality from this beetle was found only on the Gila (1,860 acres) National Forest.

Region 4: Idaho

Host(s): Ponderosa pine

Only small isolated infestations of western pine beetle were recorded in 1998. 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 the western pine beetle returned to or remained at background rates throughout California. Mortality was confined to scattered individual trees or small groups of trees primarily associated with dense stand conditions. There were a few, scattered instances of moderate mortality associated with management activities such as thinning and underburning.

Western spruce budworm, *Choristoneura occidentalis*

Region 1: Idaho, Montana

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

In 1995, for the first time since aerial detection began in 1948, budworm-caused defoliation was not found in the Northern Region. For the next 2 years, no defoliation was detected during aerial survey flights over susceptible stands. As anticipated from increasing moth catches in 1997, a small amount of light defoliation, totaling 534 acres, was observed on the Helena National Forest in 1998. No other budworm defoliation was observed from the air anywhere in the region. There was additional light defoliation observed on some permanent plots in both Montana and Idaho. Pheromone trap counts were up significantly in some areas in 1998, but declined in others. In total, trap catches were virtually the same from 1997 (415 moths) to 1998 (419 moths). Populations appear to be rebuilding slowly, but remain low. Increased defoliation may be expected in a few scattered areas where trap counts were above four or five moths per trap in 1998, such as traps on the Deerlodge and Helena National Forests. Population recovery, to the pre-1994 condition, is weather-dependent and will likely take several more years. A major population increase is not expected in 1999.

Region 2: Colorado, Wyoming

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

Heavy defoliation was evident in Douglas-fir along the Lake Fork of the Gunnison River and immediately surrounding Lake City, Colorado. Budworm populations remain at low to moderate levels throughout portions of the Rio Grande and San Juan National Forests in southern Colorado. No noticeable activity was reported in Wyoming.

Region 3: Arizona, New Mexico

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

Western spruce budworm defoliation increased from 198,165 acres in 1997 to 320,665 acres in 1998. In Arizona, western spruce budworm defoliation was detected on the Apache-Sitgreaves (490 acres) and Kaibab (5,400 acres) National Forests; Grand Canyon National Park (1,440 acres); and the Navajo (2,805 acres) Indian Reservation. In New Mexico, western spruce budworm defoliation was detected on the Carson (174,470 acres), Cibola (1,330 acres), Gila (85 acres), and Santa Fe (72,130 acres) National Forests and on 62,515 acres of mixed State and private lands in northern New Mexico.

Region 4: Idaho, Utah, Wyoming

Host(s): Douglas-fir, true firs

Approximately 19,500 acres of light defoliation was observed on the Cedar City, Escalante, and Teasdale Ranger Districts of the Dixie National Forest in southern Utah. This is the first recorded defoliation in the region since 1987.

Region 6: Oregon, Washington

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

Areas of aerially visible defoliation increased from approximately 166,000 acres in 1997 to over 486,000 acres in 1998. Over 78 percent of the area reported with visible defoliation caused by western spruce budworm occurred on the Yakima Indian Reservation. Over 27,000 acres of defoliation was detected on the Gifford-Pinchot National Forest, compared to less than 7,000 acres reported in 1997. Approximately 73,000 acres of adjoining State and private lands were also affected. In addition to significant increases in affected acres, there was an observable intensification of cumulative damage in areas previously mapped during aerial survey. However, ground surveys indicate that the extent and severity of budworm was actually less than indicated by aerial survey.

Insects: Nonnative

Asian longhorned beetle, *Anoplophora glabripennis*

Region 9/Northeastern Area: New York, Illinois

Host(s): Birch, elm, green ash, horse chestnut, locust, maples, mulberry, poplar, willow

Three separate infestations were found in the Chicago metropolitan area in 1998. The only other known sites of infestation in the United States are in New York City. Eradication efforts began in New York during 1997 where over 2,000 infested trees were removed, chipped, and burned. These trees were located in the boroughs of Brooklyn and Queens and in the Amityville and Lindenhurst areas of Long Island. In 1998, the largest discovery of infested trees in New York occurred in Lindenhurst where approximately 100 infested trees were found. In Chicago, over 400 infested trees have been identified in 1998 and will be removed beginning in February of 1999. Intensive surveys for infested trees will be continued in both Chicago and New York. In New York, planting of replacement trees (for the removed infested ones) will continue in the spring of 1998. More extensive surveys to identify other possible infestations are underway throughout the Northeast.

Australian longhorned borer, *Phoracantha recurva*

Region 5: California

Host(s): Eucalyptus spp.

First found in 1995 in southern California, this longhorned borer may be replacing the eucalyptus longhorned borer in some mutually occupied areas.

Balsam woolly adelgid, *Adelges piceae*

Region 1: Idaho

Host(s): Grand fir, subalpine fir

Balsam woolly adelgid populations in northern Idaho remained high in areas infested, but the affected area remained about the same as recorded in 1997. Aerial survey data estimated nearly 56,300 acres infested in 1997. That figure declined slightly to 53,400 acres in 1998. Actual infested acres may be higher as some infested areas may not yet be displaying crown symptoms. 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 balsam woolly adelgid were begun in 1998. Additional damage assessment surveys will be conducted in 1999. 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 2,500 acres in 1998, a decrease of approximately 7,000 acres from 1997 reported levels. The majority of activity occurred in Mt. Rainier National Park, which experienced a slight increase in the number of acres visibly affected. During the 1950's and 1960's this insect caused extensive mortality primarily along the Cascade Range. Since that initial mortality, balsam woolly adelgid damage has been chronic and subtle and is not often visible from the air.

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 balsam woolly adelgid appeared in the southern Appalachian Mountains in the 1950's, approximately 64,700 acres of Fraser fir have been affected by the adelgid. The insect attacks trees of all age classes, but prefers the older fir trees. Adelgid populations were again high in 1998.

Common European pine shoot beetle, *Tomicus piniperda*

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

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

The pine shoot beetle is a pest of pine trees that causes damage in weak and dying trees and in the new growth of healthy trees. The beetle was first discovered in the United States in a Christmas tree farm in Ohio in 1992. Currently, 243 counties in the States of Indiana, Illinois, Michigan, New York, Ohio, Pennsylvania, Wisconsin, Maryland, and West Virginia have known infested sites. In 1998, 19 counties and the State of Wisconsin were added to the list of areas with known infested sites. These counties are in Michigan, Ohio, West Virginia, New York, Indiana, Pennsylvania, and Wisconsin.

Eucalyptus longhorned borer, *Phoracantha semipunctata*

Region 5: California, Hawaii

Host(s): Eucalyptus spp.

The combined effects of drought and attacks by this longhorn beetle are causing mortality in Hawaii. In California, the insect has spread to most of the areas where eucalyptus has been planted and damage is now occurring in commercial eucalyptus plantations.

Insects: Nonnative

Gypsy moth (European),
Lymantria dispar

Region 1: Idaho, Montana, North Dakota, Wyoming

Host(s): Hardwoods

Cooperative detection monitoring for the gypsy moth with the Animal and Plant Health Inspection Service (APHIS), and State Departments of Agriculture, Forestry, and Lands continued in 1998. A network of strategically located pheromone-baited traps were placed throughout all States in Region 1. On Federal lands in Region 1, one gypsy moth was caught near Lakeside Residence in Yellowstone National Park, Wyoming; one moth was caught in Weitas Campground on the Clearwater National Forest, Idaho; and one was caught at the Cottonwood Campground, Theodore Roosevelt National Park, North Dakota. On private land, 5 moths were caught in a single trap between Coeur d'Alene and Post Falls, Idaho. There were no moths trapped in Montana. The trapping program will continue in Region 1 in 1999. In addition, delimitation surveys will be conducted in Yellowstone and Theodore Roosevelt National Parks and on the Clearwater National Forest. An eradication program is being considered in northern Idaho.

Region 2: Colorado, Kansas, Nebraska, South Dakota, Wyoming

Host(s): Hardwoods

In Colorado, approximately 1,800 detection traps caught six moths in the following counties: Adams, Boulder (two), El Paso (two), and Larimer. Delimitation surveys will be conducted around these capture sites in 1999. Two delimitation surveys around 1997 capture sites were negative. In Kansas, 639 detection traps caught no gypsy moths. In Wyoming, four moths were captured in 1998. Two detection traps captured one moth each in Laramie County, Wyoming, and one moth was captured in Yellowstone National Park. The delimitation effort in Cody was negative. Delimitation traps on F. E. Warren Air Force Base in Cheyenne captured one moth; this is the third consecutive year of delimitation captures on the base. In 1999, an intensive effort will be made on F. E. Warren Air Force Base and delimitation surveys will occur around the three other 1998 capture sites. Four moths were caught in South Dakota: three in the Black Hills area and one near Sioux Falls.

Region 3: Arizona, New Mexico

Host(s): Hardwoods

No adult male gypsy moths were captured in Arizona or New Mexico in 1998.

Region 4: Idaho, Nevada, Utah

Host(s): Various deciduous species

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 of private lands and 115 acres of Federal lands (Little Cottonwood Canyon). No moths were captured in Little Cottonwood Canyon and the moth catches on private lands was reduced to 21 moths. Eleven single moths were caught in other areas along the Wasatch Front.

In 1999, 764 acres will be treated in the Knudsens Corner area of Salt Lake City that borders the Wasatch Range. Trapping will be significantly intensified along the Wasatch Front to further

characterize the nature of the reinfestations. Treatment will be one aspect of the integrated pest management approach along with mass trapping, education, and quarantine, if necessary.

Region 5: California

Host(s): Hardwoods

Six male moths were trapped in 1998 by the California Department of Food and Agriculture. 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, three eradication projects totaling 770 acres were conducted in 1998 using ground and aerial applications of *Bacillus thuringiensis* (Bt). The gypsy moth survey in 1998 resulted in trap catches of 53 individuals. Of those, all were identified as the European strain. Eradication projects are planned for 1999 at two sites with an estimated 57 acres.

In Oregon, two eradication projects were conducted in 1998 using two ground applications of Bt on 30 acres. In 1998, 23 moths were trapped in Oregon and all have been identified as the European strain. One site in Beaverton encompassing an estimated 19 acres is proposed for eradication in 1999 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

No noticeable defoliation occurred in Virginia in 1998. This is the continuing after effect of an *Entomophaga maimaiga* fungus epidemic that caused gypsy moth populations to collapse throughout its eastern range. However, there are some indications that gypsy moth populations have started to rebuild in a few localized areas. There will be one gypsy moth suppression project in Prince William County, Virginia, in 1999.

In North Carolina, the isolated gypsy moth infestation continued around the town of Highlands, near the North Carolina - South Carolina and Georgia borders. An eradication project that will involve treating 23,000 acres that will involve treating areas in both North Carolina and Georgia is planned for 1999.

In Arkansas, delimiting trapping continues in Carroll, Marion, and Newton counties in the aftermath of an eradication treatment of an infestation in 1993-95. Only a limited number of male moths were caught. Trapping will continue, but no treatments are planned for 1999.

Widespread detection trapping also continues in uninfested States with occasional isolated catches reported.

Treatments to slow the rate of spread of the gypsy moth continue to be implemented along the expanding front in the 7-million acre Gypsy Moth Slow-the-Spread Pilot Project area in the States of North Carolina, Virginia, West Virginia, and Michigan. During 1998, a total of 54,687 acres were treated as part of the project -- 14,785 acres of private land in North Carolina, 32,813 acres of private land in Virginia, 6,138 acres of private land in West Virginia, and 953 acres of national forest land in Virginia and West Virginia. About 60 percent of the area was treated with the biological insecticide, *Bacillus thuringiensis*, and 40 percent with a mating disruptant specific to the gypsy moth.

Insects: Nonnative

Region 9/Northeastern Area: Indiana, Maryland, Massachusetts, Michigan, Minnesota, New Jersey, New York, Ohio, Pennsylvania, Rhode Island, West Virginia

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

Gypsy moth defoliated acres increased to 363,300 acres in 1998, up from 49,180 acres in 1997. Gypsy moth populations increased most dramatically in Michigan where defoliated acres increased from 37,000 acres in 1997 to 301,780 acres in 1998. Other areas with increasing gypsy moth populations are south central Pennsylvania, Massachusetts, and Rhode Island. The presence of the fungal pathogen, *Entomophaga maimaiga*, throughout the range of gypsy moth infested areas is a contributing factor in keeping populations at low levels. Though the fungus is present in Michigan, it is not known why the gypsy moth population there continues to increase. In 1998, gypsy moth suppression to minimize damage occurred in Delaware, Maryland, Michigan, New Jersey, and Ohio. In Minnesota, the number of male moths trapped increased by 265 over 1997 numbers to 953 moths. Most of the catches were in the six southeastern counties closest to Wisconsin. In Indiana, 81,995 male gypsy moths were caught in 1998.

Hemlock woolly adelgid, *Adelges tsugae*

Region 8: North Carolina, Virginia

Host(s): Eastern hemlock, Carolina hemlock

This insect threatens the entire range of eastern hemlock and is found throughout Virginia wherever hemlock is found in abundance, as well as five North Carolina counties. Caswell County, North Carolina, was added to the list of infested counties in 1998.

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

Host(s): Eastern hemlock

Hemlock woolly adelgid populations continued to spread throughout the Northeast in 1998. New infestations are reported in Massachusetts, New York, Pennsylvania, and West Virginia. Pennsylvania reported a total of 1,681 forested acres newly affected. In the urban landscape, the adelgid has been the most common ornamental hemlock pest reported. The mild winters over the last 2 years have reduced winter adelgid mortality and populations in previously infested areas are increasing.

Larch casebearer, *Coleophora laricella*

Region 1: Idaho and Montana

Host(s): Western larch

In 1998, visible defoliation caused by larch casebearer occurred in isolated patterns in many western larch stands throughout northern Idaho and western Montana. Heavy defoliation did not occur over areas large enough to be detected during aerial surveys. However, increased defoliation was noted through ground observations. Surveys conducted during 1997 and 1998 showed low parasitism rates in casebearer populations compared to similar surveys conducted during the 1970's, the last time populations were extremely high. Rates of 3 to 13 percent in 1997 and 0.9 to 26.5 percent in 1998 were significantly lower than the 40 to 65 percent parasitism rates common in the early 1980's when casebearer populations began to decline. Surveys indicated that some areas may have moderate to heavy defoliation in 1999. Monitoring of population levels and parasitism rates will continue.

Region 4: Idaho

Host(s): Western larch

Western larch on the Payette National Forest were defoliated by the larvae of this moth. Defoliation also occurred in residential areas of McCall and Cascade, Idaho.

Region 6: Eastern Oregon, Washington

Host(s): Western larch

After years of negligible damage, larch casebearer-caused defoliation of western larch was observed in portions of the Blue Mountains in 1996. Even though the survey timing is not ideal for detecting defoliation caused by this insect, the regionwide aerial survey mapped 166 acres in 1997 and over 4,500 acres in 1998. Approximately 800 acres were mapped on Malheur National Forest, over 2,300 acres on Mt. Hood, and an additional 1,200 acres within the Umatilla Reporting Area (see Appendix B for definition of reporting area).

Introduced parasites released in the Pacific Northwest in the early 1960's and established years ago, along with a couple of 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 makes detection of these infestations less evident to observers late in the season. One of the reasons tree mortality is not expected is the ability of larch to refoliate.

Larch sawfly, *Pristiphora erichsonii*

Region 10: Alaska

Host(s): Eastern larch

This is the sixth consecutive year of major larch sawfly activity. In many of the defoliated areas, patches of larch mortality are beginning to appear. The major area of sawfly activity continues to be from the Alaska Range west to the Kuskokwim River. Total acres of land affected by larch sawfly in 1998 were 461,780 acres. This represents a 58 percent increase over reported levels in 1997 of 268,000 acres. This increase reflects not so much an increase of area affected, but a different way of accounting for the insect activity. Although larch stocking levels are low across much of its distribution, nearly all susceptible larch in a given stand are affected by the larch sawfly. Therefore, in 1998, the total area of land affected was considered to be the area impacted by the larch sawfly.

Pink hibiscus mealybug, *Maconellicoccus hirsutus*

IITF: Puerto Rico, U.S. Virgin Islands

Host(s): Acacia, avocado, citrus, hibiscus, mahoe, sorrel, soursop, sugar apple, teak (This is a non-specific pest, there are over 120 genera of host plants)

The pink hibiscus mealybug has now spread to over 25 Caribbean Islands. It was detected in Puerto Rico in 1997, but has not spread to the mainland of the United States. The USDA Forest Service and APHIS, Plant Protection and Quarantine staffs are working together to rear parasites to control the pink hibiscus mealybug. Pest population reductions of 85 to 90 percent have been achieved at the parasite release sites.

Insects: Nonnative

Spruce aphid,
Elatobium abietinum

Region 3: Arizona

Host(s): Spruce

Spruce aphid defoliation decreased from 27,950 acres in 1997 to 170 acres in 1998. All defoliation was on the Fort Apache Indian Reservation. No spruce aphid defoliation was detected in New Mexico.

Region 10: Alaska

Host(s): Spruce

Defoliation by aphids causes reduced tree growth and predisposes the host to other mortality agents, such as the spruce beetle. Severe cases of defoliation alone may result in tree mortality. Spruce in urban settings and along marine shorelines are most seriously impacted. Spruce aphids feed primarily in the lower, innermost portions of tree crowns, but may impact entire crowns during outbreaks.

An outbreak occurred in 1998 following a mild winter, with 46,300 acres of defoliation. Southeast Alaska accounted for 44,300 acres with 39,100 of those acres on national forest lands. Although spruce needle aphid defoliation occurs primarily along shorelines, in 1998 it extended up the slope in many areas, especially along the outer coast. The affected acres were concentrated on southern and western aspects.

Diseases: Native

Annosus root disease, *Heterobasidion annosum*

Region 1: Idaho, Montana

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

Annosus root disease is common in ponderosa pine stands on the Flathead Indian Reservation and in other western Montana locations. It is widespread on Douglas-fir and true firs on the Clearwater, Nez Perce, and Idaho Panhandle National Forests in Idaho.

Region 2: Colorado, Nebraska

Host(s): Jack pine, ponderosa pine, white fir

Annosus root disease has scattered distribution in white fir in the mixed conifer type throughout southern Colorado. In campgrounds, the disease creates hazardous conditions by increasing the probability of tree failure.

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 about 20 percent of this mortality.

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

Host(s): Bitterbrush, 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 did not receive much attention in 1998. This is probably due to the abundant moisture of the past few years. Moisture stress and the fir engraver are often associated with mortality caused by *H. annosum*, which remains the most widespread and damaging root disease agent in California.

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 new Region 6 vegetation inventory (Current Vegetation Survey) requires examination of cut stumps. This has led to increased

Diseases: Native

reporting and awareness of annosus root disease on many national forests. In eastern portions of the region, where many stands were cut 10 to 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): Loblolly pine, longleaf pine, slash pine, shortleaf pine, eastern white pine

Localized mortality and growth loss occurred throughout the South in 1998. Alabama and Texas reported losses in 1998, while in South Carolina, heavy infection necessitated the clearcutting of 2,000 acres of loblolly and longleaf pine. In several States, pines planted under the Conservation Reserve Program are now being thinned and becoming infected.

Armillaria root disease.

***Armillaria* spp.**

Region 1: Idaho, Montana

Host(s): Douglas-fir, other conifers

Armillaria root disease is widely distributed in northern Idaho and western Montana. The apparent increase of this root disease in parts of Region 1 is attributed, in part, to the increase in Douglas-fir and true firs. The increase in Douglas-fir and true firs is the result of fire control and selective harvesting of high-value, root-disease tolerant pine and western larch early in the 20th century. Armillaria root disease is also a major cause of mortality in young (15 to 25-year-old) ponderosa pine plantations.

Region 2: Colorado, South Dakota, Wyoming

Host(s): Engelmann spruce, hardwoods, lodgepole pine, ponderosa 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.

Region 3: Arizona, New Mexico

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

Armillaria spp. account for about 80 percent of root disease mortality across the region. The disease is more prevalent in mixed conifer and spruce-fir forests than in ponderosa pine forests. Region 3 is tracking the long-term effects and spread of this and other root diseases on a number of 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, some hardwoods

There were limited reports of mortality in Douglas-fir and in California black oak species.

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, indicating one or more especially virulent strains of the fungus. 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.

Aspen leaf blights,

Ciborina whetzellii

Marssonina populi

Region 2: Colorado, South Dakota, Wyoming

Host(s): Aspen

Foliage diseases were rare in 1998 due to a dry spring and summer; down from 20,100 acres in 1997. Presence of *Marssonina* in aspen declined significantly following 2 years of widespread impact in southwestern Colorado.

Black stain root disease,

Leptographium wageneri

Ophiostoma wageneri

Region 2: Colorado

Host(s): Pinyon pine, ponderosa pine

Black stain in combination with other factors has caused widespread pinyon mortality in southwestern Colorado. This area is experiencing unprecedented urban development pressure that

Diseases: Native

may be compounding the problem. A cooperative effort with Colorado State University has been initiated to assess pinyon mortality on a landscape scale.

Region 3: New Mexico

Host(s): Pinyon pine

Both *Leptographium wageneri* var. *wageneri*, which infects pinyon, and *L. wageneri* var. *pseudotsugae*, which infects 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.

Region 4: Idaho, Nevada, Utah

Host(s): Pinyon pine

This fungus causes mortality of pinyon pine on the Bureau of Land Management Burley District in Idaho, on the Humboldt 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 pine, ponderosa pine

A small number of new pockets of black stain root disease were reported in the Klamath Mountains and Southern Cascades ecoregions in northwest and northcentral California respectively.

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.

Dwarf mistletoes, *Arceuthobium* spp.

Region 1: Idaho, Montana

Host(s): Douglas-fir, limber pine, lodgepole pine, ponderosa pine, whitebark pine, 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. Dwarf mistletoe is locally heavy in ponderosa pine stands around Lake Coeur d'Alene and along the Spokane River drainage in northern Idaho. 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. 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): Lodgepole pine, ponderosa pine, Douglas-fir

Dwarf mistletoes cause the greatest disease losses in Region 2. Continuing emphasis is being placed on surveys at landscape scale and on suppression projects in developed recreation sites. As populations of the mountain pine beetle increase along the Colorado Front Range, the health of ponderosa pine stands is a concern. Dwarf mistletoe infests about 20 percent of these stands along the Front Range and may make them more susceptible to beetle attack.

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 one million acres of national forest commercial timberlands in each State have some level of infection. The disease also affects several hundred thousand acres in noncommercial and reserved areas, woodlands, and other public and private forest lands. Region 3 is monitoring the disease on several sites using permanent plots. Over the past few years, the region has been active in developing new management recommendations for this disease.

Region 4: Idaho, Nevada, Utah, Wyoming

Host(s): Douglas-fir, pines, western larch

Suppression 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 is 50 percent infected, ponderosa pine is 20 percent infected, and Douglas-fir is 20 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

About 25 percent of the forested acres in California are at least lightly infected. The infected acres presently receiving the most attention for sustaining tree longevity are high intensity recreational areas.

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 topkill are significant, particularly in unmanaged stands. All 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 central and eastern Washington. The intensity of dwarf mistletoes in eastern Oregon and Washington and in southwest Oregon is closely related to fire ecology. Lack of frequent, periodic fire in the last century has allowed infection levels to increase on many sites, especially those where mistletoe was not culturally controlled.

Diseases: Native

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. 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 disease is uncommon on any host above elevations of approximately 1,000 feet. Heavily infected western hemlock trees have branch proliferations (witches' brooms), bole deformities, reduced height and radial growth, less desirable wood characteristics, greater likelihood of heart rot and topkill. Severely infected trees may die. These symptoms are all potential problems in stands managed for wood production. Growth loss in heavily infested stands can reach 40 percent or more. On the other hand, witches' brooms, wood decay associated with bole infections, and scattered tree mortality can result in greater diversity of forest structure and increased animal habitat.

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. Early spring rains in South Carolina contributed to an increase in rust infection in some localized areas. Genetic selection of resistant planting stock is leading to significant improvement in field survival and stand quality.

Laminated root rot,

Phellinus weirii

Region 1: Idaho, Montana

Host(s): Douglas-fir, grand fir

Laminated root disease is very severe on parts of the Lolo and Kootenai National Forests in Montana, as well as the Idaho Panhandle National Forest. Damage from laminated root disease has increased in recent years. This is attributed, in part, to the loss of root disease-tolerant western white pine to blister rust; an increase in Douglas-fir and true firs as a result of fire control; and selective harvesting of high-value, root disease-tolerant pine and western larch early in the 20th century.

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 eight percent of the area with susceptible host species is affected in this portion of the region. Locally, 15 to 20 percent of an area may be affected. East of the 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.

**Oak wilt,
*Ceratocystis fagacearum***

Region 2: Kansas, Nebraska

Host(s): Oak species

Although oak wilt continues to be a problem in isolated areas in Kansas, numbers of reports are lower.

Region 8: North Carolina, South Carolina, Texas

Host(s): Oaks, especially red oak group and live oak in Texas

Oak wilt continues to be a devastating tree killer in 60 counties in central Texas. Urban, suburban, and rural oaks are affected. Live oaks are the premier tree species in the region and are highly valued for beauty, shade, and wildlife benefits. The Texas Forest Service is in the 11th year of a cooperative suppression project in cities and rural areas of central Texas. In the last 3 years, the Army Corps of Engineers has implemented suppression efforts of four central Texas reservoirs. In South Carolina, oak wilt was confirmed for the first time in Aiken County where it was found on several live oaks. This is also the first known occurrence of the disease on live oak outside of Texas. In North Carolina, 15 new disease centers were detected during 1998 summer aerial surveys, primarily in Haywood and Buncombe counties in the western part of the State.

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

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

Oak wilt caused tree mortality continued to occur across Iowa with trees roughly encompassing an area of 2,607 acres affected. In West Virginia, 35 trees were affected by the disease. In Minnesota, 473 sites in 19 counties were treated in 1998. A total of 5,637 sites have been treated since control work began in 1990.

**Stem decay,
*Basidiomycetes (many)***

Region 10: Alaska

Host(s): All tree species

Stem decay causes enormous loss of wood volume in Alaskan forests. Approximately one-third of the old-growth timber volume in southeast Alaska is defective largely due to heart rot fungi. 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. All major tree species in southeast Alaska have been found killed in this manner.

In southcentral and interior Alaska, stem decay fungi cause considerable volume loss in white spruce forests. Wood recovery studies in mature (120 to 200-year-old) spruce -- where bark beetles have killed large proportions of stands on the Kenai Peninsula -- indicate that volume losses caused by heart rot fungi exceeded defect from sap rot fungi.

Diseases: Native

Stem decay is the most important cause of volume loss in Alaskan hardwood species. In southcentral and interior Alaska, incidence of stem decay fungi is generally high by the time a hardwood stand has reached maturity. These fungi will limit harvest rotation age of forests that are managed for wood production purposes.

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 1998, 173,000 acres of discolored Douglas-fir along the Oregon coast were mapped by a spring, special aerial survey. Surveys were also conducted during the spring of 1996 and 1997. 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 cast 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. A survey is scheduled for the spring of 1999 in Oregon and Washington.

Diseases: Nonnative

Beech bark disease, *Nectria coccinea* var. *faginata*

Region 8: North Carolina, Tennessee, Virginia

Host(s): American beech

Although beech bark disease was not found in any additional counties in 1998, 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 previous 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. In 1998, the disease intensified at a greater rate than predicted and is spreading down slopes toward the Cherokee National Forest.

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

Host(s): American beech

The disease is present in beech stands throughout New England, northwest Pennsylvania, and West Virginia. In West Virginia, the disease is causing beech mortality within an area of approximately 1 million acres in the central portions of the State. Within this million acres of forestland, there are about 18 beech trees (greater than 5 inches) per acre. In Vermont, 759 acres of forest were reported as having beech bark disease caused mortality.

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 at the Knife River Indian Villages National Historic Site. 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. Although it was discovered in Moscow 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, including Genesee, Idaho, and Palouse and Pullman, Washington.

Region 2: Colorado, Kansas, Nebraska, South Dakota

Host(s): Elm species

Dutch elm disease is a serious problem in many Kansas urban areas. Reports of the disease have been on the increase for the past several years.

Diseases: Nonnative

Region 8: Regionwide

Host(s): American elm

Scattered to localized mortality continues to occur at low severity level in urban and wild populations of elm.

Region 9/Northeastern Area: Areawide

Host(s): American elm

Dutch elm disease remains common throughout the region. In the District of Columbia, over 700 infected American elms were removed from city streets in order to help minimize the spread of the disease. Numerous diseased elms were reported in Iowa in 1998.

White pine blister rust, *Cronartium ribicola*

Region 1: Idaho, Montana

Host(s): Western white pine, whitebark pine, limber 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 concentrating on planting genetically improved stock. We are currently intensifying monitoring efforts to gain a better understanding of how well the improved stock is doing 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 have found infection rates in whitebark pine regeneration of up to 90 percent. There is a growing concern that severe losses of whitebark pine may have significant impacts on water and wildlife in these fragile ecosystems.

Region 2: Colorado, Wyoming

Host(s): Limber pine, western white pine

This disease was found for the first time in northern Colorado on limber pine in 1998. The rust was causing branch and main stem cankers. Incidence appeared low. The location is on Sand Creek Pass Road, Arapaho National Forest. White pine blister rust occurs at low to moderate infection levels in whitebark and limber pine stands in South Dakota and Wyoming. A few stands have higher levels with more than 50 percent of the trees infected and causing some mortality.

Region 3: New Mexico

Host(s): Southwestern white pine

White pine blister rust occurs throughout most of the range of southwestern white pine on two Ranger Districts of the Lincoln National Forest and the Mescalero Apache Indian Reservation in southern New Mexico. In 1998, a single gooseberry bush believed to be infected with white pine blister rust was found on Gallinas Peak, Cibola National Forest. This is about 50 miles north of the Capitan Mountains, the previous northern limit in New Mexico.

Region 4: Idaho, Wyoming, Nevada

Host(s): Limber pine, whitebark pine, sugar pine, bristlecone pine, western white 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.

Region 5: California

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

White pine blister rust caused branch and tree mortality in several locations in the southern Sierra Nevada. A site on Greenhorn Summit, Sequoia National Forest, may represent the most southern confirmation of blister rust in the Sierras. It was once thought that white pine blister rust would not migrate this far south in the Sierras.

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 topkill, 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 2,924 acres in 1997. 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 664 acres mapped in 1998 fell within the Yakima Indian Reservation and the Wenatchee National Forest. 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 occurs in trees greater than 9-inches diameter at breast height. Thirty-four percent of the mortality is attributed to blister rust. Some forests are pruning 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 was infected by white pine blister rust. Ninety percent of the infected trees had potentially lethal cankers. Topkill caused by blister rust was common.

Diseases: Origin Unknown

Butternut canker, *Sirococcus clavignenti-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 three of every four 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 (for example, 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. A cove with a large number of canker-free and cankered trees in western North Carolina has been converted to a seed collection area with potentially resistant trees being propagated in an east Tennessee nursery. In 1998, a relatively large cluster of apparently uninfected trees in the North Carolina Piedmont was found on a forest health monitoring plot.

Region 9/Northeastern Area: Indiana, Wisconsin

Host(s): Butternut

Both States continue to collect scion wood from apparently disease resistant trees for grafting on black walnut root stock.

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. Tennessee added seven new counties to the known range of this pest: Lincoln, Macon, Marshall, Moore, Smith, Summer, and Trousdale Counties.

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

Host(s): Flowering dogwood

No newly infested counties or changes in disease intensity were reported in 1998.

Pitch canker,
Fusarium subglutinans

Region 5: California

Host(s): Bishop pine, Douglas-fir, Monterey pine, Monterey X knobcone, other ornamental pines

At a Christmas tree farm, pitch canker was found for the first time in Solano County increasing the number of infested counties by 1 to 18. Since this location is hotter and drier than any other known infected site in California this represents significant environmental flexibility by the pathogen

Since 1987, the California Department of Forestry has monitored 97 trees on study plots in Santa Cruz County. Most of the 56 dead trees were killed by pitch canker and bark beetles or removed because they were heavily damaged. Of the remaining trees, most exhibit little evidence of active disease. This includes a number of trees with substantial crown dieback. Few new infections were found.

Region 8: Regionwide

Host(s): Southern pines

Pitch canker has returned to endemic levels after a major increase in 1995. Scattered trees across the region are infected, and impacts can be locally significant. Pitch canker is increasing in southern Mississippi, particularly Perry County. In North Carolina, pitch canker is becoming especially serious where sewage or animal waste have been applied to forest tracts as fertilizer.

Port-Orford-cedar root disease,
Phytophthora lateralis

Region 5: California

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

No new infected areas were reported in 1998.

Region 6: Oregon

Host(s): Port-Orford-cedar

Port-Orford-cedar root disease causes mortality of Port-Orford-cedar in southwestern Oregon. Where it has been introduced, the disease causes extensive mortality on sites favorable for infection and spread of its waterborne spores -- especially along creeks, in low-lying areas, and below roads where water is channeled.

Evidence of the disease was reported over a total of 21,000 acres in 1994. 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. Over 1,400 killed Port-Orford-cedar on about 1,600 acres were mapped by the 1998 regular aerial survey.

Declines and Complexes

Aspen defoliator complex

Region 3: Arizona, New Mexico

Host(s): Aspen

Aspen defoliation caused by a complex of insects, diseases, and abiotic factors increased from 25,465 acres in 1997 to 85,905 acres in 1998. Defoliation on Federal lands in Arizona occurred on the Apache-Sitgreaves (4,440 acres), Coconino (785 acres), Kaibab (35,905 acres), and Prescott (10 acres) National Forests; Fort Apache (1,510 acres) and Navajo (4,330 acres) Indian Reservations; Grand Canyon (11,590 acres) National Park; and State and private lands (80 acres). In New Mexico, aspen defoliation was detected on the Carson (12,500 acres), Cibola (3,230 acres), Gila (70 acres), Lincoln (235 acres), and Santa Fe (2,175 acres) National Forests and on 9,045 acres of mixed State and private lands in northern New Mexico.

Northern hardwood decline

Region 8: Virginia

Host(s): Eastern hardwoods

In 1997, there were reports of mortality and dieback to the northern hardwood forest type at relatively high elevations along the Appalachian Trail. The Forest Service conducted an aerial survey of this forest type in North Carolina and Tennessee. The conclusion was that while there are small areas of notable northern hardwood decline and tree death in the southern Appalachian Mountains, there is no indication that this condition is widespread or severe or in excess of that expected for forests with similar disturbance history.

Oak decline

Region 8: Regionwide

Host(s): Oaks, other hardwoods

Severe summer drought throughout the region has caused death or decline of oaks and other trees. Arkansas and Virginia were especially hard hit, with oaks dying throughout the States. Oak decline is a syndrome resulting in dieback and mortality of dominant and codominant mature oaks. Causal factors are stressors such as drought, frost, defoliation by insects, including the gypsy moth, and secondary pests such as Armillaria root disease and two-lined chestnut borer (*Agrillus bilineatus*). 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 preexisting oak decline, gypsy moth defoliation causes increased mortality. Host, age, and site conditions also play a role. Analysis of forest inventory data in 12 Southern States shows that 3.9 million acres of upland hardwood forest are affected by oak decline, amounting to approximately 9.9 percent of the susceptible host type. Average annual mortality volume of oaks on affected sites was 45 percent higher than on unaffected areas.

Pacific madrone decline

Region 6: Oregon, Washington

Host(s): Pacific madrone

High levels of pacific madrone leaf spotting and dieback caused by a variety of fungi were reported in southwest Oregon. The greatest impacts appeared on madrones growing in wetter areas of the region, particularly in river valleys and creek bottoms. Although Pacific madrone decline was not detected and mapped from the air in Oregon, approximately 5,000 acres were detected and mapped in Washington. Areas affected include the Olympic Peninsula, the Puget Sound area, and coastlines in northwestern Washington.

Pinyon pine decline

Region 2: Colorado

Host(s): Pinyon pine

Pinyon mortality of undetermined cause continues along the Arkansas River near Buena Vista, Colorado. Unlike extreme southwestern Colorado, neither blackstain root disease nor *Ips* beetles are contributing to the observed mortality. Investigations are ongoing. Also see black stain root disease.

Subalpine fir decline

Region 2: Colorado, Wyoming

Host(s): Subalpine fir

Subalpine fir decline continues to be a condition that occurs throughout this cover type. Although the problem appears to be less intense than in past years, the fact that site specific root disease (*Armillaria* spp.) is involved indicates that the problem does not disappear, but manifests itself from year to year depending upon climatic conditions.

Subalpine fir mortality complex

Region 1: Idaho, Montana

Host(s): Subalpine fir

In 1998, western balsam bark beetle populations once again caused significant amounts of tree mortality in high-elevation subalpine fir stands on several forests in the region. While the infested area increased from 47,500 acres recorded in 1997 to slightly more than 64,500 acres in 1998, intensity of tree killing on those acres appeared to decline. Although it is only one of a complex of pests which likely includes root diseases and other secondary bark beetles responsible for reported mortality, western balsam bark beetle is the most conspicuous and most aggressive of that complex. Because of the virulent fungus (*Ceratocystis dryocoetidis*) this bark beetle carries, it is quite capable of killing its host in the absence of other pests. Of the infested area recorded, approximately 5,300 acres were in northern Idaho, principally on the Idaho Panhandle and Nez Perce National Forests. Of the remaining 59,000 acres, most were in western Montana, on the Beaverhead and Gallatin National Forests. An estimated 89,000 subalpine firs were killed, regionwide, in 1997 and mapped in 1998.

Declines and Complexes

Region 2: Colorado, Wyoming

Host(s): Subalpine fir

Subalpine fir mortality was common in the spruce/fir cover type of Colorado due to a complex of factors that is, as yet, not well understood, but is under investigation. Additional factors include Armillaria root disease and possibly other biotic and abiotic influences that collectively are referred to as 'subalpine fir decline.' Mortality estimates are complicated by the fact that dead subalpine fir retains its needles longer than other conifer species. Subalpine fir decline continues to be the most widespread damage agent detected in Colorado and Wyoming forests. Levels of mortality vary greatly, with some stands losing a significant proportion of the fir component over the course of several years. Western balsam bark beetles continue to cause mortality in subalpine fir throughout the spruce-fir cover type. A major component of subalpine fir decline, western balsam bark beetles often kill trees in conjunction with root disease. When beetle populations are at high levels, noninfected trees are also killed. Beetle activity was high in stands of subalpine fir throughout the Bighorn and Shoshone National Forests. Large areas of "subalpine fir decline" were common.

Region 4: Idaho, Nevada, Utah, Wyoming

Host(s): Subalpine fir

Subalpine fir decline and mortality 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.

A significant decline in mortality was observed throughout host type in 1998 with only 13,200 trees killed compared to 133,000 trees in 1997. During 1997, most mortality was located on national forests in Utah while in 1998 most mortality was located on national forests in Idaho, Nevada, and Wyoming.

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 479,000 acres of decline have been mapped during aerial detection surveys. Concentrated mortality occurs in a wide band from western Chichagof and Baranof Islands to the Ketchikan area on the Tongass National Forest (435,000 acres). Ground surveys show that 65 percent of the basal area of yellow-cedar is dead on this acreage. This 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 yellow-cedar decline. Whatever the primary cause of this mysterious decline, all available information indicates that it is probably a naturally occurring phenomenon. Preliminary investigations were initiated in 1998 to determine the role of soils and hydrology in tree mortality with more detailed research planned for 1999.

Studies were initiated in 1995 to determine the mill-recovery and wood properties of yellow-cedar that have been dead for varying lengths of time. Little is known about wildlife use of yellow-cedar forests. In 1998, a study was initiated to evaluate birds' use of each of the snag classes as nesting or feeding habitat. In a companion study, the insect community on dead cedars is being investigated. Insects on some of the snags may be an important prey source for insectivorous birds.

Seed Orchard Insects and Diseases

Coneworms,

Dioryctria amatella
Dioryctria clarioralis
Dioryctria disclusa
Dioryctria merkeli

Region 8: Regionwide

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

Coneworms caused a 25 percent cone loss in untreated areas of the Texas State seed orchard compared to 5 percent loss in the treated area. Elsewhere in the South, coneworm numbers were relatively static, except for Florida, where a prevalence of cone rust is contributing to unusually high coneworm populations at the Withlachooshee 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.

Seed bugs,

Leptoglossus corculus
Tetyra bipustata

Region 8: Regionwide

Host(s): Southern pines

In the Texas State seed orchard, 13 percent of the seed was lost in untreated areas. In other States, seedbug losses were normal.

Southern cone rust,

Cronartium strobilinum

Region 8: Alabama, Florida, Georgia

Host(s): Slash pine

Heavy cone rust in slash pine seed orchards continues a trend 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): Conifers

Cone and seed insects are significant detriments to the region's blister rust-resistant western white pine seed orchards. They are also a concern in orchards of other tree species and in wild stands where seed of high-quality trees is collected. Cone and seed insects have recently been found having an impact on seeds of whitebark pine, an important high-elevation tree species. The insects causing the most damage are western conifer seed bug (*Leptoglossus occidentalis*), cone beetle (*Conophthorus ponderosae*), and coneworm (*Dioryctria abietivorella*). Cone beetle populations were so high in the Coeur d'Alene white pine seed orchard in 1996 that an insecticidal spray treatment was conducted in April 1997. The need to conduct insecticidal controls is continually assessed. In addition, annual mid-summer spray treatments to control seed bugs are conducted there frequently.

White pine cone beetle,
Conophthorus coniperda

Region 8: Virginia

Host(s): Eastern white pine

Overwintering white pine cone beetle populations increased over 1997 levels in Virginia.

Nursery Insects and Diseases

Cranberry girdler moth, *Chrysoteuchia topiaria*

Region 1: Idaho

Host(s): Conifers

The cranberry girdler moth has been a continuous problem in the Coeur d' Alene bareroot nursery as insect populations immigrate from surrounding grass fields. The larvae damage root crowns of Douglas-fir, western larch, and spruce bareroot seedlings. Insecticide sprays are periodically used to control the moths.

Region 6: Oregon

Host(s): Conifers

Cranberry girdler caused 10 to 15 percent loss in some lots of Douglas-fir and true fir. No adult moths were detected in pheromone traps. Because the growing season was one of unusual weather patterns, the trapping period for adult moths may have missed the time period when they were active.

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

Region 6: Oregon

Host(s): Conifers

The nurseries experienced less than 5 percent mortality to damping-off. Fumigation, 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 *Phytophthora*) and environmental conditions. Seedling losses can be severe when germination is slow due to cold, wet weather. Although the spring of 1998 was conducive to damping-off, warm and dry conditions throughout the rest of the growing season tended to minimize losses to this condition. In 1998, an estimated 2 percent of nursery seedlings were lost to this condition across the South.

**Fusarium root disease,
Fusarium spp.**

Region 1: Idaho, Montana

Host(s): Conifers

The most common and damaging diseases of conifer seedlings in nurseries in the region in 1998 were root diseases caused by *Fusarium* spp. These fungi cause differing levels of damping-off and root diseases on several conifer hosts in bareroot and container nurseries. The most common soil-borne pathogen species in bareroot nurseries is *F. oxysporum*. However, several other potentially pathogenic species are also commonly isolated from infested soil and diseased seedlings. The major pathogens in container nurseries are *F. proliferatum* and *F. oxysporum*. However, several other fusaria may occur at high levels in some nurseries. Although all conifer species are susceptible, most damage occurs on Douglas-fir, western larch, western white pine, and Engelmann spruce.

Region 6: Oregon

Host(s): Conifers

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

**Gray mold,
*Botrytis cinerea***

Region 6: Oregon

Host(s): Conifers

Botrytis cinerea may be prevalent on nursery seedlings. This pathogen often causes extensive damage to container-grown seedlings, especially western redcedar and western larch.

**Lesser cornstalk borer,
*Elasmopalpus lignosellus***

Region 8: North Carolina

Host(s): Eastern white pine

This insect killed 18,000 eastern white pine seedlings at the North Carolina Division of Forest Resources' nursery at Morganton.

Phomopsis needle blight,
Phomopsis spp.

Region 8: Virginia

Host(s): Eastern redcedar

This disease killed 20,000 redcedar seedlings in Virginia.

Phytophthora root rot,
Phytophthora spp.

Region 6: Oregon

Host(s): Douglas-fir

At the nursery, one + one Douglas-fir transplanted into wet spots were culled due to Phytophthora root rot, resulting in 5 to 10 percent losses in Douglas-fir transplants. At the tree improvement center, Phytophthora root rot in the rust runs resulted in partial loss of some replicates.

Pythium root disease,
Pythium spp.

Region 1: Idaho, Montana

Host(s): Conifers

Pythium root disease (caused mostly by *P. irregulare* and *P. ultimum*) occurs at most bareroot nurseries and is also found in container seedlings. Damage is usually minor and mitigated by improving water drainage in soil and container media.

Rhizoctonia needle blight,
Rhizoctonia spp.

Region 8: Regionwide

Host(s): Southern pines

Despite better fungicide treatment regimens, 60,000 seedlings were lost to this blight at the Taylor State Nursery in South Carolina.

**Root disease,
*Cylindrocarpon destructans***

Region 1: Idaho, Montana

Host(s): Western white pine

Root disease caused by *Cylindrocarpon destructans* affects large numbers of container-grow western white pine seedlings at several nurseries. The pathogen usually initiates root decay often without eliciting disease symptoms.

Storage molds

Region 6: Oregon

Host(s): Conifers

One + one Douglas-fir transplants from lots lifted during warm weather in January had 4 percent mortality due to storage molds. Seedlings were lifted when plant moisture stress was high and then were refrigerated for an extended period of time.

**Tip dieback,
Sirococcus strobilinus
Sphaeropsis sapinea
*Phoma eupyrena***

Region 1: Idaho, Montana

Host(s): Conifers

Tip dieback occurs at some level on bareroot seedlings at several nurseries. Ponderosa pine and lodgepole pine are the most commonly affected species.

**Top blight disease,
*Phytophthora spp.***

Region 1: Idaho, Montana

Host(s): Ceanothus

A top blight disease of Ceanothus seedlings caused by *Phytophthora* spp. was detected at high levels at a container facility. Although the disease caused extensive losses, spread was adequately controlled by fungicides.

Abiotic Damage

Air pollution

Region 5: California

Host(s): Jeffrey pine, ponderosa pine

Changes in ozone injury to pines in the southern Sierra Nevada air pollution monitoring plots were minor from 1996 to 1998. Of the 27 plots, 8 showed increased injury, 11 showed less injury, and the remaining eight were unchanged. Trees with air pollution injury can be found at all elevations, but most are concentrated at elevations of 6,000 feet and below.

Chemical Damage

Region 2: Colorado, Kansas, Nebraska, South Dakota, Wyoming

Host(s): Hardwood and softwood species

With increasing population growth and development in Colorado, road maintenance is necessary for public safety. Increased number of inquiries are received concerning damage along roadsides due to the application of deicing salts and dust abatement chemicals and mechanical damage by snow plows. Herbicide damage to windbreaks and other tree plantings continues to be a serious problem in the central portion of Kansas due to pesticide drift off targeted areas in crop weed control programs.

Desiccation injury

Region 5: Northern California

Host(s): Maples

In June, most of the foliage on maples in many parts of northern California exhibited browning from the leaf tips. The change from seasonal green to a bright orange-brown was expected in autumn. The condition was diagnosed as desiccation injury caused by the late cool and wet spring followed by hot, windy weather. The saturated roots were damaged by the length of exposure and then were unable to recover when the weather turned hot and windy. Desiccation injury in these areas was accompanied by a dramatic occurrence of leaf blight on oaks. The color change over large areas raised a considerable amount of public concern. Most trees are expected to recover.

Drought effects

Region 2: Colorado, Kansas, Nebraska, South Dakota, Wyoming

Host(s): All species

Pinyon pine has been declining in the Buena Vista, Colorado, area for about 5 years. No pathogen or insect appears to be related to this damage. Droughty winters and warm, dry summers may be involved.

Abiotic Damage

Region 3: Arizona

Host(s): All species

Drought damage was detected on a total of 2,782 acres in 1998, compared with 957 acres in 1997. Most damage occurred on the Coconino (2,595 acres) National Forest, with little damage occurring on the Kaibab (89 acres) and Tonto (56 acres) National Forests and private (42 acres) lands.

Region 8: Regionwide

Host(s): All species

Despite a wet spring, exceptionally dry weather was the norm throughout the summer and fall across the South. The wet spring stimulated much vegetative growth, which later could not be sustained because of the drought. The drought contributed greatly to the incidence of other pests such as oak decline and Ips pine engraver beetle attacks. Shallow rooted species on rocky mountain sites in Virginia and North Carolina were especially impacted. Hardwood mortality was especially striking throughout Virginia, and secondary impacts to the stressed forest ecosystems are expected for years to come. The drought was also responsible for the seedling mortality in pine regeneration areas covering an estimated 158,000 acres across the South. The estimated cost of replanting these areas is \$20 million.

Region 9/Northeastern Area: Massachusetts, Minnesota, Missouri

Host(s): Various forest and street trees

Lack of sufficient rainfall caused drought stress in several areas of the Northeast in 1998. Foliage discoloration and branch dieback were reported to occur on 673 acres in Minnesota, 378 acres in Massachusetts, and 41,490 acres in Missouri.

Fire

Region 8: Florida

Host(s): All species

Massive wildfires throughout Florida in May, June, and July 1998, caused mortality, but also predisposed trees to a variety of opportunistic pathogens and insects. The long-term effects of the fires will be monitored throughout 1999.

Ice/snow damage

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

Host(s): Northern forests

In January 1998, a devastating ice storm blanketed northern New England and New York with up to 3 inches of ice. Nearly 17 million acres of rural and urban forests were damaged. Federal disaster declarations were made in 37 counties. In Maine, the storm "footprint" covered more than 11 million acres. All 16 of the State's counties were declared Federal disaster areas. In New Hampshire, the storm damaged 900,000 acres, including areas of the White Mountain National Forest. Nine of the State's 10 counties were declared Federal disaster areas. The storm track in New York covered 4.6 million acres and significantly damaged nearly 3 million acres. Six counties were declared Federal disaster areas. The storm left 943,000 acres in Vermont, including portions of the Green Mountain National Forest, damaged. Hardwoods, including poplar, beech,

birch, black cherry, maple, white ash, and oak were most affected. The storm left a substantial amount of woody debris on the ground.

Wind

Region 8: Texas

Host(s): Southern pines and hardwoods

A severe windstorm associated with a strong cold front hit east Texas on February 10, 1998, and caused widespread damage in Angelina, Nacogdoches, Polk, San Augustine, and Shelby counties. The storm affected 103,000 acres of National Forest System lands and 32,000 acres of private land. The storm coupled with the severe summer drought contributed to the high *Ips* beetle populations later in the year.

Region 9/Northeastern Area: Iowa, Maryland, Michigan, Minnesota, New York, Ohio, Pennsylvania, Wisconsin

Host(s): Various hardwoods and conifers

Scattered areas of wind damage occurred throughout the Northeast in 1998. The largest concentration of damage occurred in Wisconsin where 299,796 acres were affected by windstorms. In Iowa, 26,094 acres of forestland were severely damaged, as well as 83,974 acres in New York, and 30,060 acres in Minnesota. In total, 464,531 acres of forestland in the eight States were damaged by wind in 1998.

Appendices

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 forest 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 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 non-stocked 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.