United States
Department
of Agriculture

Forest Service

Forest Health Protection

June 2007

Forest Insect and Disease Conditions in the United States 2006

Healthy Forests Make A World of Difference

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PREFACE

This is the 56th annual report prepared by the U.S. Department of Agriculture 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 2006. The first section of this report highlights emerging insect and disease issues. Regional and temporal trends in selected insect and disease conditions are highlighted in the second section of the report. Distribution maps are provided for some pests. Graphs depict acreage trends over the last several years for some pests. Tables show acreages affected for selected pests by state by year for the last 5 years.

The third section of the report brings together insect, disease, and abiotic agent damage reports from each affected USDA Forest Service 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.

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 Department of Defense and the Department of the Interior. Service is also provided to tribal lands. The program provides assistance to private landowners through the State Foresters. A key part of the program is detecting and reporting insect and disease epidemics and the effects of wind, air pollution, floods, droughts, and other agents. Detection surveys are conducted on a regular basis by state and USDA Forest Service program specialists.

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

United States Department Of Agriculture
Forest Service
Forest Health Protection Offices

Forest Service, USDA
Northern Region (R-1)
P.O. Box 7669
Missoula, MT 59807
(406) 329-3308

Forest Service, USDA
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Forest Service, USDA
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Forest Service, USDA
Pacific Northwest Region (R-6)
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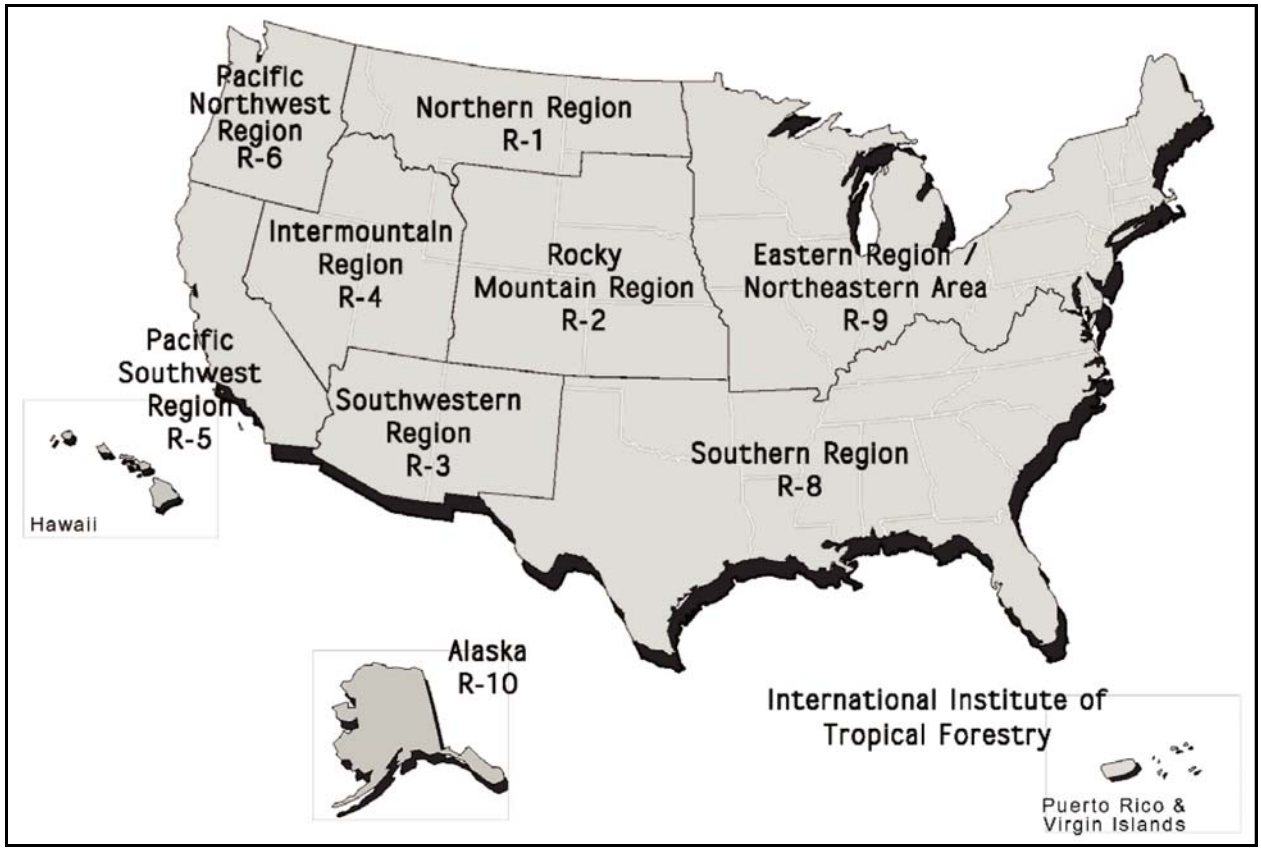
Forest Service, USDA
International Institute of Tropical Forestry
UPR Experiment Station Grounds
P.O. Box 25000
Rio Piedras, PR 00928-5000
(787) 766-5335

USDA Forest Service Regions and Area



Copies of this report are available from:

USDA Forest Service
Attn: Forest Health Protection
Stop Code 1110
1400 Independence Avenue, SW
Washington, DC 20250-1110
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This report is also available on the Internet at:

http://www.fs.fed.us/foresthealth/current_conditions.shtml

CONTENTS

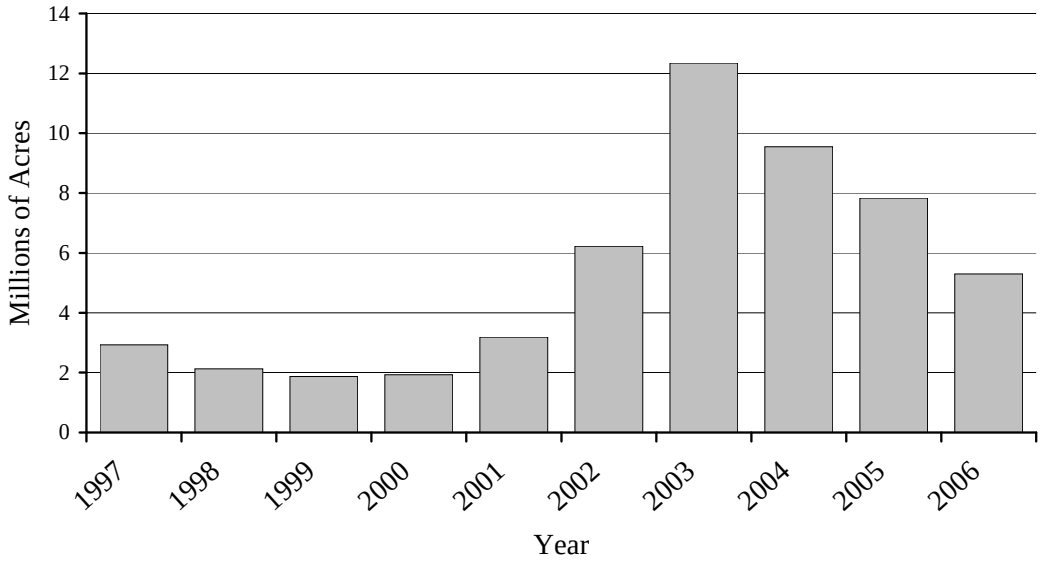
Executive Summary

INTRODUCTION

There are approximately 750 million acres of forested land in the United States, about one-third of the total land area (including Alaska and Hawaii). Nationwide, these forests provide numerous economic, social, and environmental benefits to residents of the United States and visitors from abroad.

Native and nonnative (exotic) insects and diseases and abiotic influences cause significant damage that affects the health and productivity of our forests. In 2006, approximantely 5.3 million acres of tree mortality was reported due to insects and diseases. The chart below shows the amount of insect- and disease-caused tree mortality over the past 10 years.

Acres with Insect- and Disease-Caused Tree Mortality



Highlighted below are some of the major insect pests and diseases of concern in the United States. These pests either are causing serious damage or have the potential to do so.

Insects: Native

Southern pine beetle – The extent of the current southern pine beetle outbreak rose in 2006 after declining over the past three years. About 3.1 million acres were affected in 2006, nearly an 11 percent increase from 2005. Outbreak counties were reported in Alabama and South Carolina.

Mountain pine beetle – Nationally, mountain pine beetle outbreaks decreased by about 8 percent to almost 2.9 million acres in 2006, but the per-state differences varied widely, from a 288,000 acre decrease in Washington to an increase of 161,000 acres in Colorado.

Spruce budworm – The acreage of spruce budworm defoliation rose dramatically by nearly 168 percent to about 372,000 acres in 2006, due in large part to a large increase in affected acres in Minnesota. Even with the significant increase in 2006, spruce budworm remains at historically low levels.

Western spruce budworm – Overall, defoliation by western spruce budworm increased by 93 percent, from about 1,206,000 acres in 2005 to 2,322,000 acres in 2006. Montana alone added over 688,500 acres, while Idaho and Washington also experienced significant increases.

Spruce beetle – Outbreaks were present in Wyoming, Colorado, and Alaska. In Alaska, spruce beetle activity increased from almost 70,000 acres in 2005 to about 120,000 acres in 2006.

Insects: Nonnative

Asian longhorned beetle – No new infestations were found in Chicago during 2006. About 1,400 acres of newly infested trees were discovered in New Jersey during 2005, and nearly 24,000 susceptible trees have since been removed. In New York, eradication efforts continue. Since an Asian longhorned beetle was found in Sacramento, CA on June 16, 2005, no new beetles have been found

Gypsy moth (European) – Overall, reported gypsy moth defoliation increased dramatically, from about 670,000 acres in 2005 to almost 1,290,000 acres in 2006. By far, the biggest contributing state was Pennsylvania, with over 701,000 acres, followed by Connecuticut, at almost 257,000 acres.

Common European pine shoot beetle – The beetle continued to spread from its original introduction site in Ohio. Fifteen states are currently infested.

Hemlock woolly adelgid – This insect continued its rapid spread in 2006. Natural predators are being reared and released on a limited basis. Nineteen eastern states are now affected.

***Sirex noctilio* woodwasp** – The first North American sightings of the woodwasp *Sirex noctilio*, native to Europe, Asia, and north Africa, were reported in 2005. The woodwasp was found in a trap in Fulton, NY, and subsequent surveys found infested trees around Oswego, NY, and woodwasps in traps in five counties in central New York State. This insect has caused significant losses of North American species of pines planted in several countries in the Southern Hemisphere and can potentially impact native pines across North America. In 2006, the U.S. Department of Agriculture Forest Service and USDA Animal and Plant Health Inspection Service supported surveys in New York, Pennsylvania, and Vermont and found an additional 19 counties in New York and two in Pennsylvania infested with *S. noctillo*.

Diseases: Native

Fusiform rust – Despite some declines in infection levels, fusiform rust continues to be the most significant disease of loblolly and slash pine in the South. The Resistance Screening Center in Asheville, NC, continues to test seed lots for fusiform rust resistance, and the Florida Division of Forestry has confirmed that its "rust-resistant" slash pine has significantly lower infection levels.

Dwarf mistletoes – These are native plants that parasitize western conifers and larch. They have increased as a result of fire suppression, and the witches' brooms they cause provide fuel ladders that increase fire severity. Drought exacerbates the impact of mistletoe on tree growth and survival. An estimated 29.3 million acres have some level of infestation.

Root diseases – Stress from root disease is frequently an underlying cause of mortality attributed to drought, bark beetles, and defoliators. Different pathogens cause root disease based on regional conditions and host types present.

Diseases: Nonnative

Beech bark disease – Introduced in North America about 1890, this disease continues to spread, killing beech trees from Maine to Michigan and as far south as North Carolina and Tennessee. The disease is caused by an interaction of fungal pathogens and scale insects with sucking mouthparts that pierce the tree bark. The disease is killing trees and spreading faster than predicted.

White pine blister rust – Introduced around the turn of the 20th Century, this disease now occurs throughout most of the ranges of white pines and has caused extensive tree mortality. It affects commercially important white pine as well as ecologically sensitive, high-elevation species such as whitebark, limber, and bristlecone pine.

Diseases: Origin Unknown

Butternut canker – The fungus that causes this disease was identified in the late 1970s and can be found throughout most of the natural range of butternut. The pathogen produces multiple cankers under the bark that merge and kill large trees, saplings, and regeneration. This disease is a serious threat to the survival of the butternut species.

Sudden Oak Death – Caused by *Phytophthora ramorum*, this recently recognized disease is killing oaks and other plant species in California and a small portion of southwestern Oregon. First reported in 1995, the disease has been confirmed in 14 coastal counties north and south of San Francisco and in one county in southwestern Oregon. The outbreak in Oregon is the focus of an eradication program. Dissemination of the pathogen via nursery stock, greenery, and wood chips is a major concern.

PART 1: EMERGING INSECT AND DISEASE ISSUES

Part 1 contains information on current emerging insect and disease issues.

PART 2: HISTORICAL HIGHLIGHTS

Part 2 contains information on selected insects and diseases on a national scale, including distribution maps, tables, and graphs of occurrence over time.

PART 3: CONDITIONS BY DAMAGE AGENT REGION

Part 3 provides detailed information about the insects and diseases by the USDA Forest Service Region and states where they occur. 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: Emerging Insect and Disease Issues

Emerald ash borer

The emerald ash borer, *Agrilus planipennis* Fairmaire, is a nonnative insect originally from Japan, Korea, Taiwan, northeast China, and adjacent parts of Russia. It was unknown on the North American continent until its discovery in the Detroit, MI, area in July of 2002. Subsequent surveys showed that a large area of infestation was present, covering at least six counties surrounding Detroit. This 'core' area was put under quarantine in the fall of 2002. Infestations were also discovered across the border in Windsor, Ontario, Canada. Following further surveys in 2003, the quarantine was expanded to 13 counties, and by fall of 2004, the quarantine area included 20 counties in Michigan and Lucas County in northwest Ohio. A number of scattered isolated infestations outside of the quarantine area occur in the lower peninsula of Michigan, northern Ohio, and northeastern Indiana. In 2006, emerald ash borer was found in 13 additional counties in Ohio and one new county in Indiana. Infestations found for the first time in Illinois in Kane and Cook Counties. Surveys in Maryland found infested ash just outside the area of a 2004 eradication associated with a nursery that received infested nursery stock from Michigan. Eradication plans for a 11,000-acre area in Prince George's County was initatiated in 2006. It appears that many of these sites have been infested for several years and probably represent human-aided introductions, primarily through infested ash firewood, logs, or nursery material.

Emerald ash borer infests ash, walnut, and elm species in its native habitat. In North America, emerald ash borer is found (so far) only on ash (*Fraxinu*s spp.), an abundant tree species in urban areas, rural woodlots, and riparian areas.

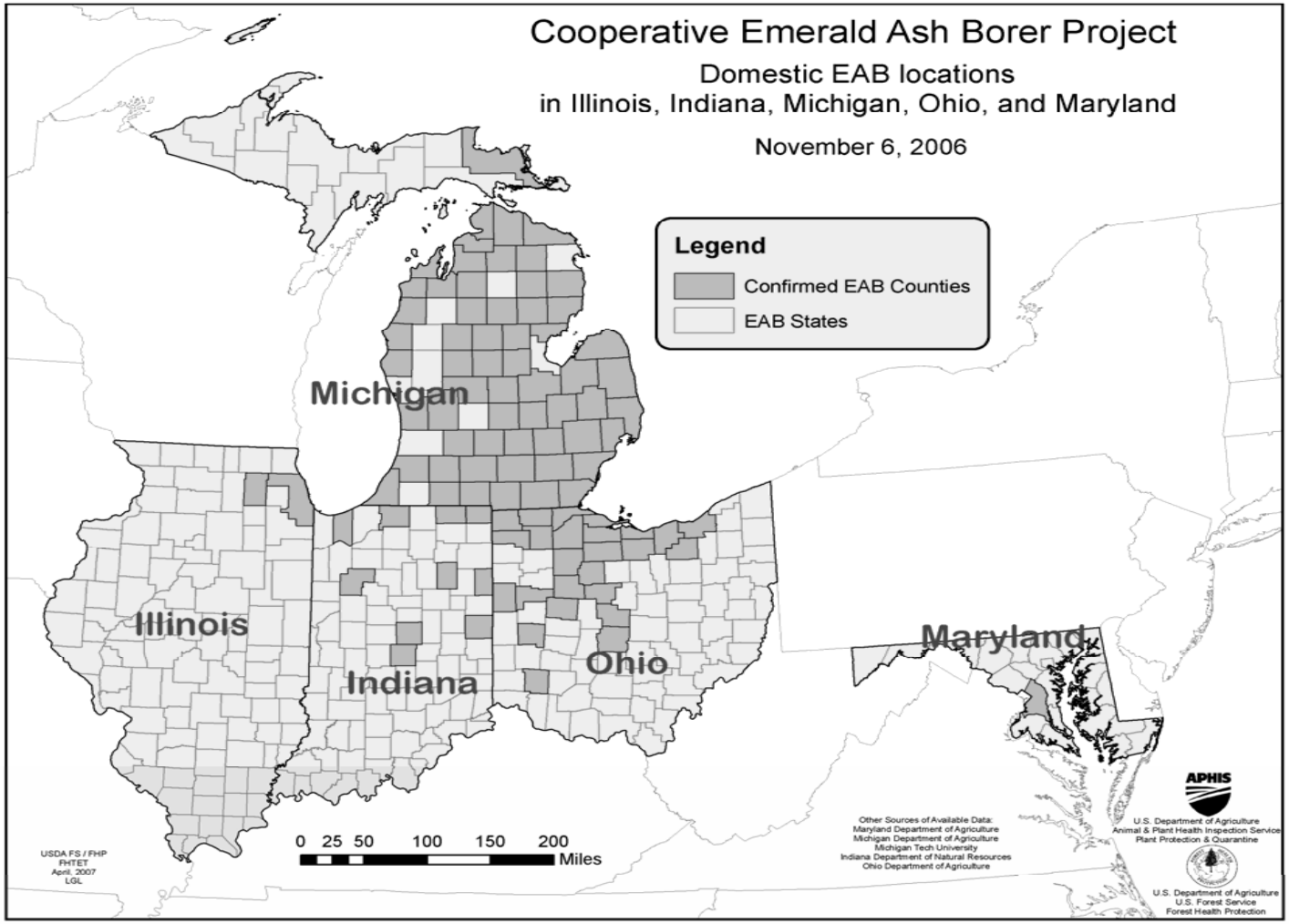
Our understanding of emerald ash borer is improving, but still limited. Control options are also limited; wood boring insects are notoriously difficult to kill with insecticides once they bore under the bark or into the wood of trees.

The USDA Forest Service is a partner with the USDA Animal and Plant Health Inspection Service and State authorities in the emerald ash borer containment and eradication effort, providing scientific and technical expertise, including survey, restoration, and public outreach and communications assistance. In 2004 and 2005, the USDA Forest Service implemented emerald ash borer surveys on federal and State forestlands in Michigan and on public and private forest lands in more than 20 eastern states. Special emphasis was placed on areas of known ash decline, around nurseries, and in areas where firewood introductions were likely. The USDA Forest Service also supports and conducts critical technology development activities with university and research cooperators to advance its understanding of emerald ash borer biology and dispersal habits, chemical control tactics, management strategies, survey techniques, and monitoring, among others.

Scientists estimate that emerald ash borer has been in the United States for perhaps 5 to 10 years prior to its detection in 2002. Emerald ash borer was previously unknown outside of Asia and was neither on any exotic pest "watch list" nor the subject of any pest risk assessments.

Ash trees throughout southern Michigan have exhibited decline and dieback symptoms for years, delaying identification of emerald ash borer effects. "Ash yellows," a condition caused by a mycoplasma-like organism (MLO), was prevalent in the area and was one of the presumed causes. Ash yellows and another malady, referred to as "ash decline," were so prevalent that dying ash trees did not draw close scrutiny.

Emerald ash borer has killed millions of ash trees so far and has the potential to decimate the more than 800 million ash trees in Michigan forests. Ash species are common across the Great Lakes region and the northeastern United States and is a common roadside, shade, and yard tree. No ash species appear to be resistant to emerald ash borer infestation and mortality. Emerald ash borer appears capable of infesting and killing ash trees across North America.


Cooperative Emerald Ash Borer Project
Domestic EAB locations
in Illinois, Indiana, Michigan, Ohio, and Maryland
November 6, 2006
Legend
Confirmed EAB Counties
EAB States
Michigan
Illinois
Indiana
Ohio
Maryland
0 25 50 100 150 200
Miles
USDA FS / FHP
FHTET
April, 2007
LGL
Other Sources of Available Data:
Maryland Department of Agriculture
Michigan Department of Agriculture
Michigan Tech University
Indiana Department of Natural Resources
Ohio Department of Agriculture
APHIS
U.S. Department of Agriculture
Animal & Plant Health Inspection Service
Plant Protection & Quarantine
U.S. Department of Agriculture
U.S. Forest Service
Forest Health Protection

Western bark beetles

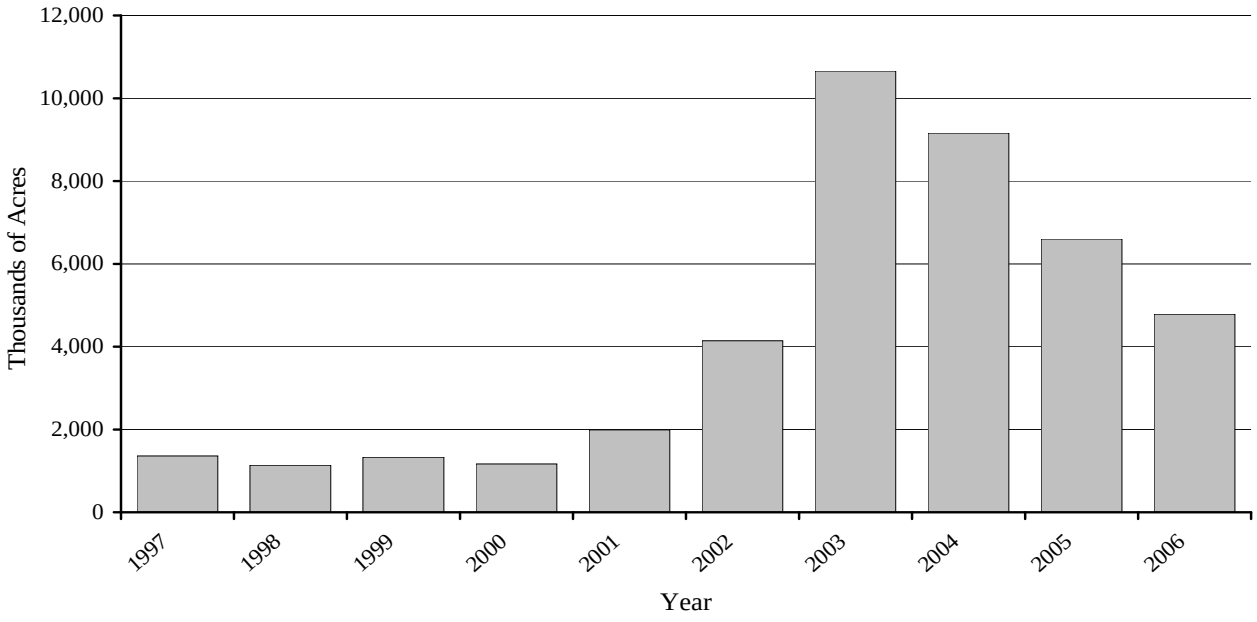
Tree mortality from bark beetles increased substantially in many parts of the West in 2003, particularly in forests severely stressed by widespread and prolonged drought and overstocking. Mortality in the piñon-juniper woodlands of the Southwest declined in 2006, in part due to a reduction in tree stress from a return to more normal weather patterns. Mountain pine beetle, Douglas-fir beetle, and spruce beetle were the direct cause of much of the mortality in the West in 2006, affecting over 4 million acres. However, less commonly seen insects (such as fir engravers, pine engravers, western pine beetle, Jeffery pine beetle, and western balsam bark beetle) caused substantial damage. In total, nearly 4.8 million acres were affected.

Outbreak Areas of All Bark Beetles in the Western United States, 2006

Acres (in thousands) with Aerially Detected Bark Beetle Mortality in the Western United States, 2002-2006

Region	2002	2003	2004	2005	2006
1	919.6	910.6	1,278.7	1,514.9	1,109.3
2	573.3	2,301.7	1,956.6	1,746.9	1,546.3
3	716.0	2,596.8	439.6	218.8	211.6
4	279.3	918.2	2,066.2	872.5	553.6
5	846.6	2,560.2	1,717.0	623.1	318.1
6	750.5	1,255.6	1,545.7	1,510.6	911.8
10	58.5	115.3	157.0	114.3	134.4
Total	4,143.8	10,658.4	9,160.8	6,601.1	4,785.1

Acres (in thousands) with Aerially Detected Bark Beetle Mortality in the Western United States, 1997-2006



Sudden Oak Death

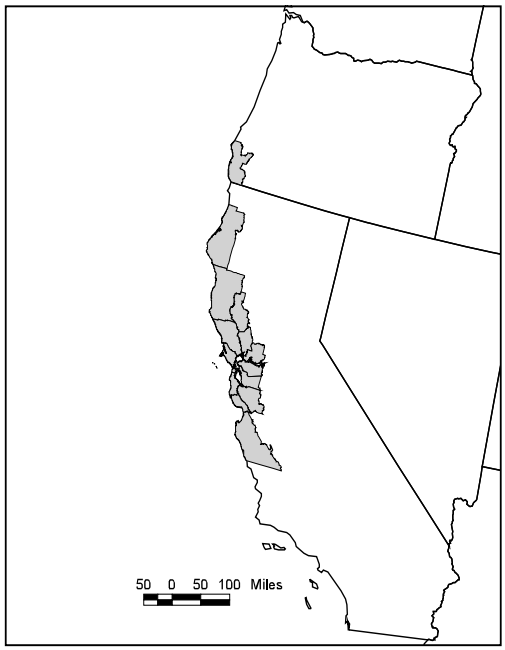
Sudden Oak Death is a recently recognized disease that is killing oaks and other plant species in California and a small portion of southwestern Oregon. First reported in 1995, the disease has been confirmed in the coastal areas north and south of San Francisco and in southwestern Oregon. The pathogen responsible for the disease, a fungus-like organism called *Phytophthora ramorum*, is also found in Europe, where it is causing nursery problems on rhododendron and viburnum, and was recently was discovered attacking landscape trees in affected gardens.

On oaks, *P. ramorum* is a bark pathogen: it causes necrotic, often girdling cankers that can lead to mortality on tanoak, coast and canyon live oak, California black oak, and shreve oak. The pathogen also causes leaf spots and/or twig dieback on California bay laurel, rhododendron, big leaf maple, Pacific madrone, huckleberry, California buckeye, manzanita, toyon, California honeysuckle, wood rose, and California coffeeberry. Under moist conditions, the pathogen sporulates profusely on tanoak, bay, rhododendron, and other species, so these "foliar" hosts serve as important reservoirs of inoculum.

The disease is widespread in coastal California and is found commonly in two forest types: in the understory of coast redwood (*Sequoia sempervirens*) forests on tanoak and in coastal evergreen forests on oaks, madrone, California bay laurel, and other species. In California, Sudden Oak Death has been confirmed in scattered locations along the Pacific Coast from Monterey County north into Humboldt County. All confirmations are within 50 miles of the Pacific Coast. Marin and Santa Cruz Counties are heavily infested, and dead and dying trees are common in the wildland/urban interface in backyards, parks, and open space greenbelts. During 2006, *P. ramorum*- related mortality was at the highest level observed since 2000. Recent estimates suggest that more than a million overstory trees have been killed thus far in California, with at least another million currently infected. The increased mortality is associated with above-average rainfall and late spring rains in 2005 and 2006, followed by an exceptionally hot summer in 2006, promoting enhanced innoculum spread and growth. Special aerial and ground surveys conducted by the USDA Forest Service and Oregon Department of Forestry in July 2001 detected the pathogen on approximately 40 acres in coastal southern Oregon just north of the California border. Since the initial survey, additional infested acres have been found, for a total of 128 acres. A cooperative program involving State and federal agencies, as well as private landowners, is underway to eradicate *P. ramorum* from the known infested sites in Oregon. Because Sudden Oak Death is still a rather new forest disease, there remains much to learn about its host preferences and behavior in new environments.

Twenty new hosts were confirmed and added to the USDA Animal and Plant Health Inspection Service *P. ramorum* regulated list in 2006. While many of these new hosts were detected in nursery settings outside of the U.S., new additions of particular importance for California forests were *Abies magnifica* (red fir), *Ceanothus thyrsiflorus* (blueblossom), and *Eucalyptus haemastoma* Sm. (Myrtaceae – Myrtle family). The current list of hosts, including over 100 plant species and in more than 60 genera, can be found on the COMTF website, *www.suddenoakdeath.org*. Additional information on this disease can be found at *http://www.na.fs.fed.us/SOD*.

Counties Where Sudden Oak Death Was Reported, 2006



Oak decline

The oak resource forms a major comonent in hardwood forests that comprise 75 percent of all forested acreage in the Eastern United States. While oak decline has been reported for over 130 years, it is a disease complex that occurs mostly in natural stands, which now predominate in much of the country. This syndrome results from interacting factors, such as climate, site quality, and tree age.

Drought and insect defoliation escalate the condition by putting trees under additional stress. Pests such as Armillaria root disease and the two-lined chestnut borer, which are ordinarily nonaggressive pests on vigorous trees, severely affect stressed oaks. Decline is characterized by a gradual but progressive dieback of the crown. Mortality typically results after several years, with mature overstory trees the most heavily affected. Oak decline was abundant throughout the eastern states in 2006, mostly in the South.

Red bay wilt or laurel wilt

Extensive mortality of red bay (*Persea borbonia* (L.) Spreng) has been observed in the coastal plains of South Carolina and Georgia since 2003 and around Jacksonville, FL, since the spring of 2005. Dead and dying trees exhibit wilt-like symptoms, and trees often decline very rapidly with the wilt affecting the entire crown uniformly. A fungus has been consistently isolated from the discolored xylem of symptomatic trees throughout the range of the problem. This fungus has been identified as an *Ophiostoma* sp. based on sequences of the ribosomal DNA and its tolerance of cycloheximide. The anamorph of the fungus is similar to species of the genus of ambrosia beetle symbionts, *Raffaelea*. This fungus is vectored by an ambrosia beetle, *Xyleborus glabratus (*Eichhoff). This nonnative beetle was first trapped in the United States in 2002 at a port facility near Savannah, GA, during the Early Detection Rapid Response Pilot Project. The recovery of the beetle from dead and dying red bay on Hilton Head Island, SC, in November 2004 was the first indication that the beetle was established in southeastern U.S. forests. The beetle is native to Asia (e.g., India and Japan) where it is associated with plant species in the family Lauraceae (e.g., *Lindera latifolia* and *Litsea elongata).*

During the spring and summer of 2005, sassafras mortality was also observed at several locations in coastal counties of Georgia. An examination of the trees found sapwood discoloration similar to that observed in red bay. *Xyleborus glabratus* and the *Ophiostoma* sp. were also associated with the wilted sassafras.

Extensive surveys were conducted in 2006 in South Carolina, Georgia, and Florida. The current range in the southeastern U.S. includes most of the coastal and adjacent inland counties from Charleston County, SC, to St. Johns County, FL. This range is expected to continue to expand at 20 miles per year.

USDA Forest Service Research has conducted host range studies for both the beetle and fungus. Based on the results of these studies, and the association of *X. glabratus* with species in the family Lauraceae, there is reason to be concerned that the wilt associated with red bay could affect other Lauraceae species, such as endangered or threatened pondberry (*Lindera melissaefolium*) and pondspice (*Litsea aestivalis*), sassafrass (*Sassafras albidum*) and avacado (*Persea americana*). Various plant species in the Lauraceae are common components of forests in other regions of the United States and other countries in the Western Hemisphere.

Sirex noctilio woodwasp

A female woodwasp collected in fall, 2004, in a New York survey trap was identified in February 2005 as *Sirex noctilio*. Infested red and Scots pines were subsequently found in nearby Oswego, NY, later that spring. Delimitation trapping surveys conducted in summer and fall 2005 recovered *S. noctilio* specimens in five counties around Oswego, NY. In late fall of 2005, it was announced that *S. noctilio* was recovered from two locations in Ontario, Canada, approximately 100 miles from the New York infestation. These collections represent the first known establishment of *S. noctilio* in North America.

In 2006, USDA Animal and Plant Inspection Service, the USDA Forest Service, New York, Pennsylvania, and Vermont conducted an extensive trapping survey. *Sirex noctilio* was found in an additional 19 counties in New York and two counties in Pennsylvania.

Sirex noctilio is native to Europe, Asia, and northern Africa, and has been inadvertently introduced into a number of countries in the Southern Hemisphere, including New Zealand, Australia, Uruguay, Argentina, Brazil, Chile, and South Africa. In its native range, where it is generally considered to be a secondary pest, it attacks pines almost exclusively—e.g., Scots (*Pinus sylvestris*), Austrian (*P. nigra*), and maritime (*P. pinaster*) pines. In the Southern Hemisphere, the insect has caused upwards of 80-percent mortality in plantations of North American pines, especially Monterey pine (*P. radiata*) and loblolly pine (*P. taeda*). Other known susceptible pines include slash (*P. elliottii*), shortleaf (*P. echinata*), ponderosa (*P. ponderosa*), lodgepole (*P. contorta*), and jack (*P. banksiana*) pines.

Interceptions of *S. noctilio* have occurred in the past. The insect is the most common species of exotic woodwasp associated with solid wood packing materials detected at U.S. ports of entry. In November 2003, USDA Animal and Plant Health Inspection Service added *S. noctilio* to their Regulated Plant Pest List.

Forest Health Protection conducted an economic analysis of the potential impacts if the Sirex infestation in New York is allowed to spread. The analysis assumed a conservative 25-mile-per-year spread from New York, no human-aided movement, current sawtimber and pulpwood prices, a 4-percent discount rate, and a 10-percent mortality rate. Sirex is expected to reach the loblolly pine growing areas of central Virginia in about 10 years; within 20 years, as it spreads throughout most of North Carolina, Sirex is expected to have caused $275 million in losses to southern pines. By the time Sirex spreads throughout the southern pine-growing region (55 years), it is projected to have caused nearly $2 billion in losses.

USDA Forest Service and USDA Animal and Plant Health Inspection Service are members of a Sirex Science Advisory Panel and a Sirex Management Team. The first phase of the management plan is to delimit the infestation, implement regulatory controls, and evaluate biological control. The USDA Forest Service has also developed a Pest Alert and identification guide to aid in detection and a series of risk maps to identify forests that are susceptible to Sirex infestation.

Part 2: Historical Highlights

Gypsy moth

Lymantria dispar was intentionally brought into the Boston, MA, area from France in 1869 to start a silk industry. The moth escaped and continues to spread south and west. In 2002, all or parts of 15 states and the District of Columbia were considered infested. The infested states now extend from Maine to West Virginia, Indiana, and Wisconsin, although Indiana's and Wisconsin's defoliated areas are less than 100 acres, each.

Defoliation in the East has risen from 669,300 acres in 2005 to 1,289,700 acres in 2006. This is primarily attributable to dramatic defoliation acreage increases in Connecticut, Massachusetts, New Jersey and Pennsylvania.

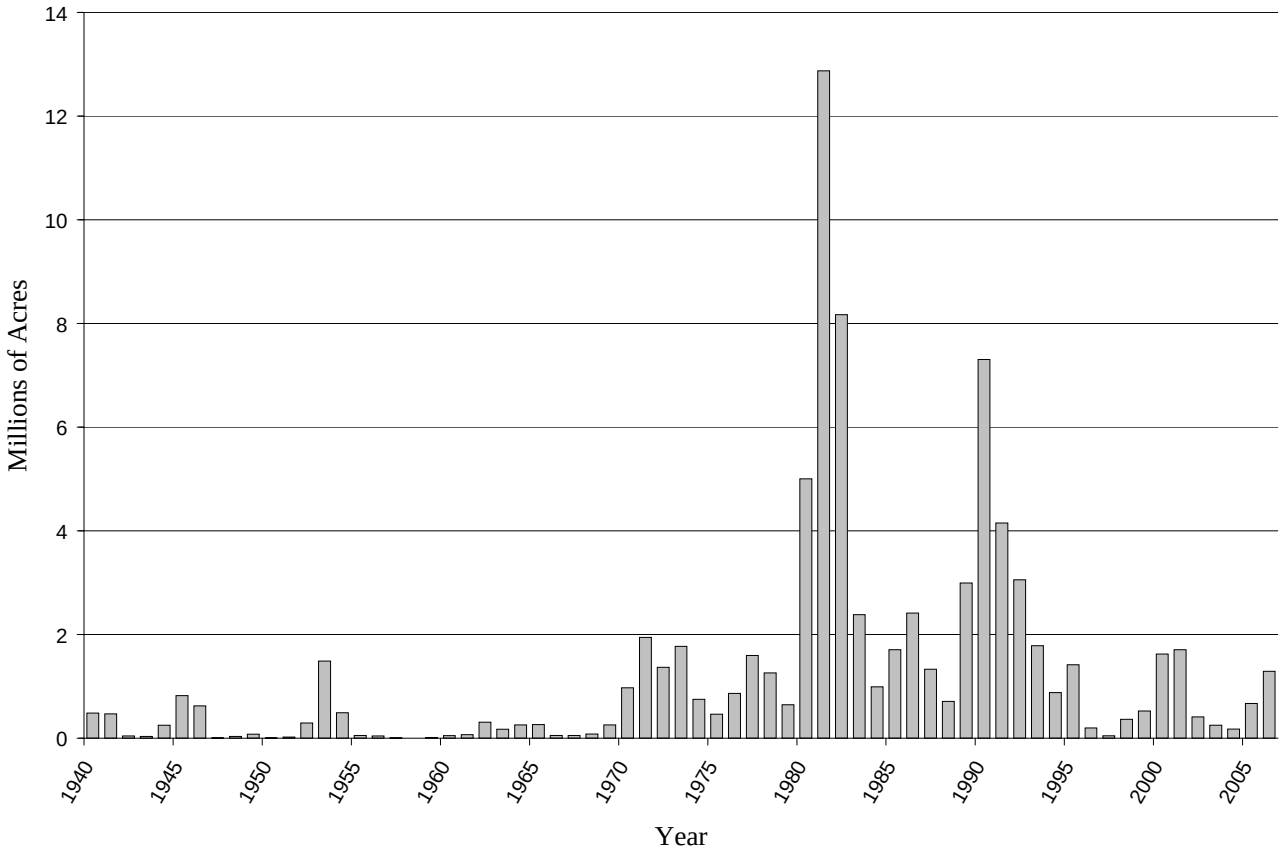
Slow-the-Spread and other suppression/eradication projects continue to show success. Four northeastern states (Delaware, Maine, and Wisconsin, and Washington, DC) and all southern states except Virginia reported no defoliation. Gypsy moth activity continued to decline in Ohio, with only 800 acres reported in 2006, while in New York, defoliation continued to decline substantially, from 21,200 acres in 2005 to 8,800 acres in 2006.

Eastern Counties Where Gypsy Moth (European) Defoliation Was Reported, 2006

Acres with Gypsy Moth (European) Defoliation, 2002-2006

State	2002	2003	2004	2005	2006
Connecticut	0	0	600	64,300	257,900
Delaware	0	0	0	0	0
Maine	51,500	0	0	0	0
Maryland	14,000	100	0	0	15,800
Massachusetts	4,700	0	34,800	36,800	123,000
Michigan	0	46,800	45,200	148,500	32,000
New Hampshire	11,800	0	5,000	6,400	100
New Jersey	41,900	5,100	8,000	45,400	102,900
New York	7,100	200	60,000	21,200	8,800
Ohio	2,500	4,100	5,900	7,700	800
Pennsylvania	55,800	1,800	16,800	333,300	701,300
Rhode Island	0	0	0	3,100	4,500
Vermont	0	0	0	0	1,200
Virginia	51,900	79,900	0	0	14,333
Washington, DC	0	0	0	0	0
West Virginia	132,100	13,900	0	2,600	17,300
Wisconsin	37,400	99,000	500	0	24,100
Total	410,700	250,900	176,800	669,300	1,304,033

Gypsy Moth (European) Defoliation, 1940-2006



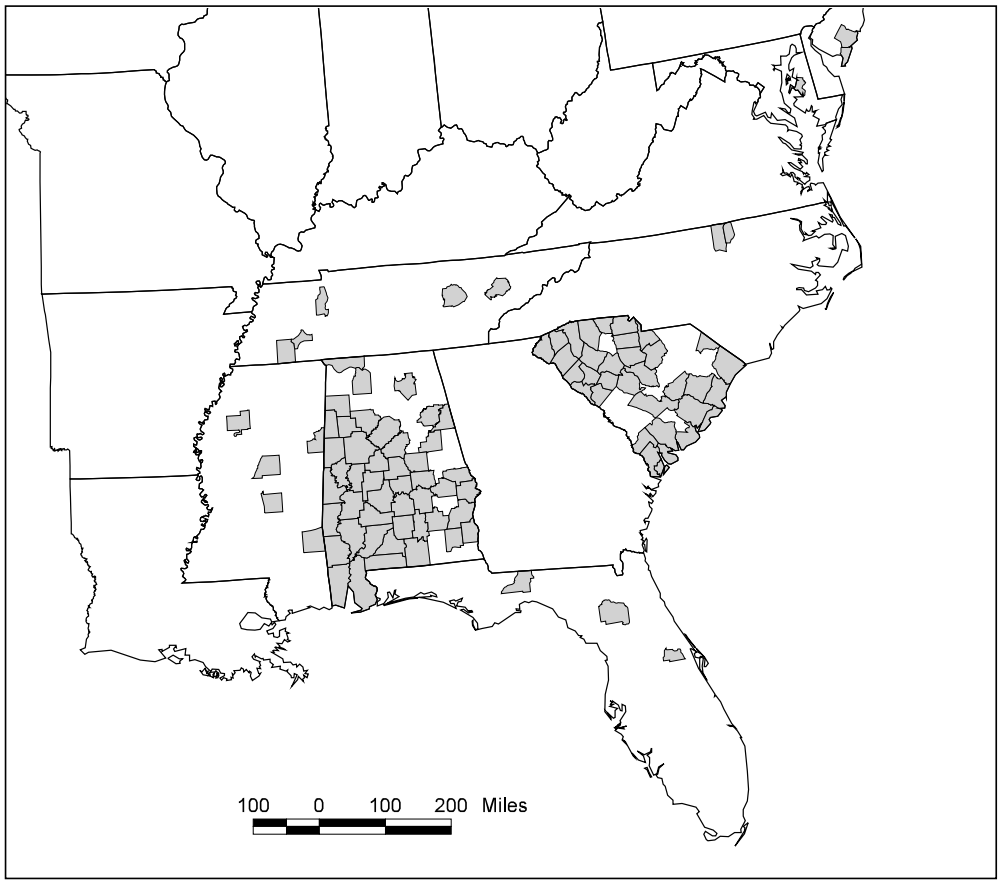
Southern pine beetle

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 every year. Infestations usually start in trees weakened by disease, lightning strikes, excessive age, storm damage, or other stress factors. Populations can build quickly as there are three to seven generations per year. Shortleaf, loblolly, Virginia, and pitch pines are preferred hosts.

Southern pine beetle activity remained at historic lows over much of the South in 2006, although the affected acreage increased from 2,846,000 in 2005 to nearly 3,114,000 acres in 2006. Beetle activity continued in South Carolina and Alabama. South Carolina reported four counties still in outbreak status, up from two in 2005. Alabama reported 18 counties in outbreak status in 2006, the same as in 2005.

New Jersey was the only northeastern state to report pine mortality from southern pine beetle: 1000 acres in the two southern-most counties.

Counties Where Southern Pine Beetle Spots Were Reported, 2006*



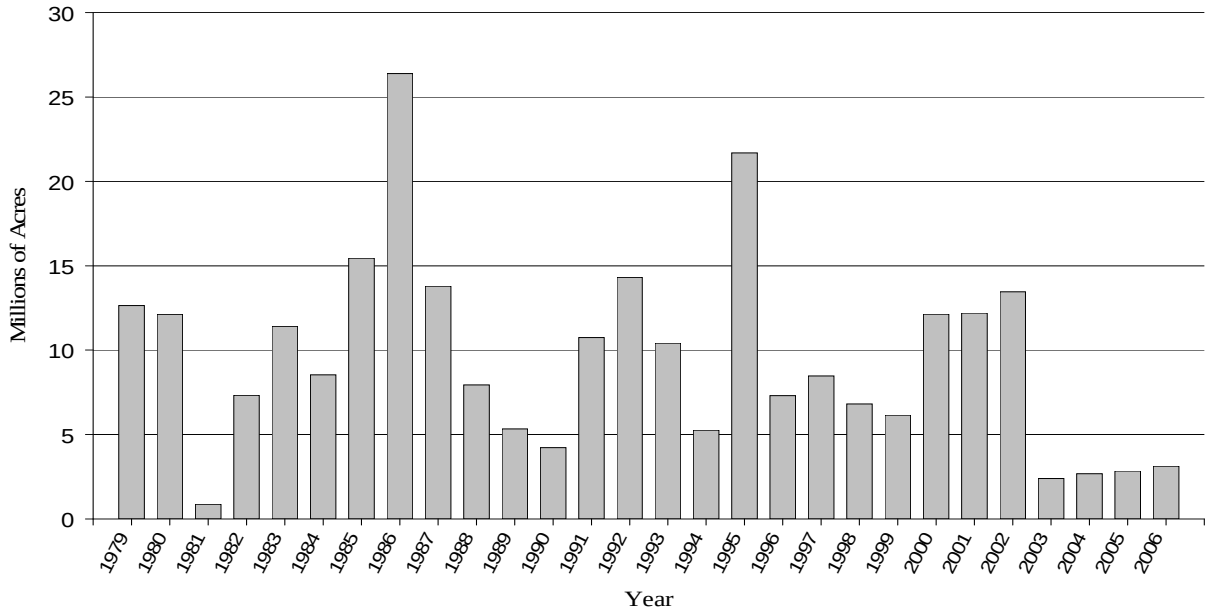
*A spot is defined as finding evidence of southern pine beetle not necessarily an outbreak. When a spot is indicated, the whole county is identified.

Acres (in thousands) with Southern Pine Beetle Outbreaks, 2002-2006*

State	2002	2003	2004	2005	2006
Alabama	5,077.0	0.0	2,182.9	2604.0	2641.1
Arizona	0.0	0.0	0.0	0.0	0.0
Arkansas	0.0	0.0	0.0	0.0	0.0
Florida	916.0	0.0	0.0	0.0	0.0
Georgia	2,424.0	85.8	0.0	0.0	0.0
Kentucky	0.0	0.0	0.0	0.0	0.0
Louisiana	0.0	0.0	0.0	0.0	0.0
Mississippi	265.0	0.0	0.0	0.0	0.0
New Jersey	1.9	2.5	0.0	0.6	1.0
North Carolina	935.0	9.2	0.0	0.0	0.0
Oklahoma	0.0	0.0	0.0	0.0	0.0
South Carolina	2,574.0	1,789.0	500.6	241.0	471.7
Tennessee	1,197.0	516.9	0.0	0.0	0.0
Texas	0.0	0.0	0.0	0.0	0.0
Virginia	66.0	0.0	0.0	0.0	0.0
Total	13,455.9	2,403.4	2,683.5	2845.6	3113.8

* Acres of outbreak are acres of host type having one or more multitree spots per 1,000 acres.

Southern Pine Beetle Outbreaks, 1979-2006



Mountain pine beetle

Dendroctonus ponderosae is a native bark beetle that attacks lodgepole, ponderosa, sugar, western white, whitebark, and limber pines. The beetle ranges throughout western pine forests from Canada into Mexico. Beetles infest mature, dense stands of pines.

Mountain pine beetle populations decreased by about 8 percent over 2005 levels. Beetles were found in all western states, except Arizona and New Mexico, with lodgepole pine being the hardest hit tree species.

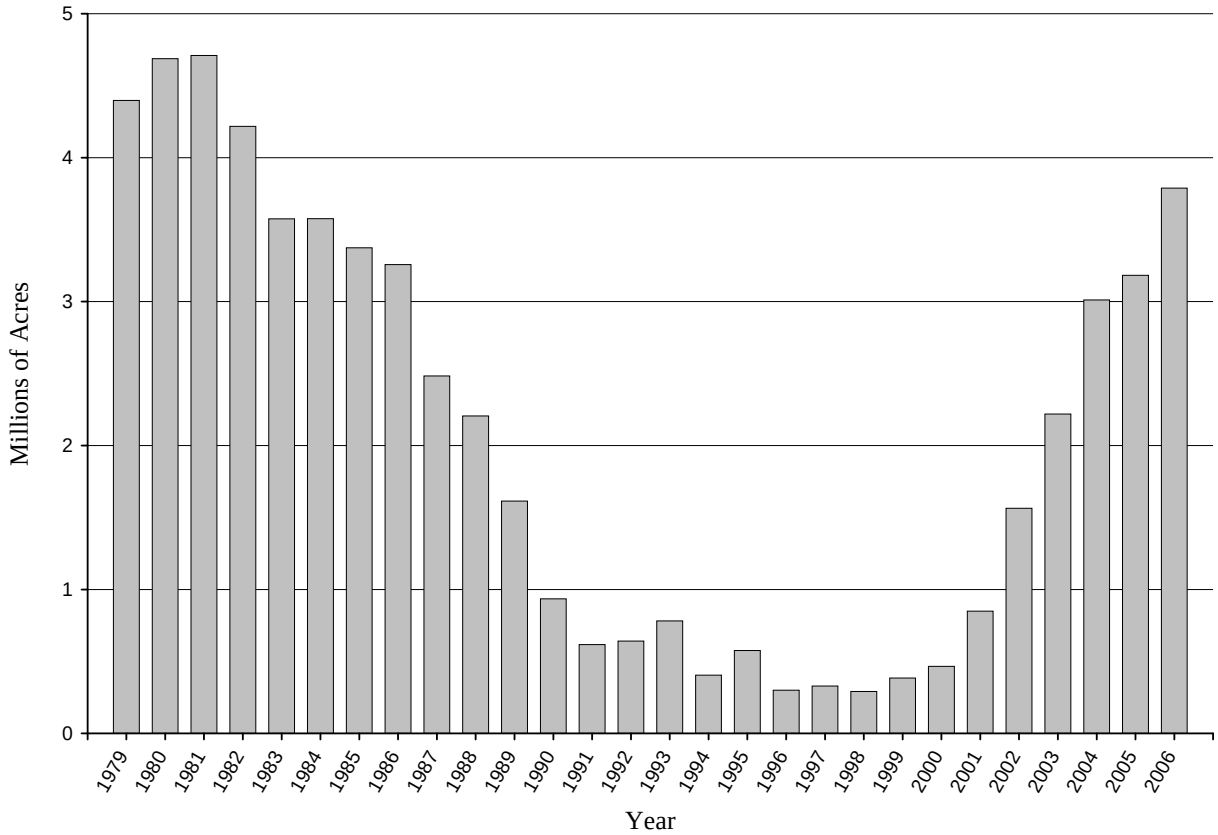
Mountain pine beetle activity decreased substantially in some states: a 59-percent decrease in Washington and a 42-percent decrease in Idaho. However, these decreases were more than offset by continuing epidemics in Colorado and Oregon, with acreage increases of 32 percent and 45 percent, respectively. The states with highest 2006 acreage in outbreak status are Montana (899,000), and Colorado (665,000).

Mountain Pine Beetle Outbreak Areas, 2006

Acres (in thousands) with Aerially Detected Mountain Pine Beetle Outbreak, 2001-2006

State	2001	2002	2003	2004	2005	2006
Arizona	0.0	0.0	0.0	0.0	0.0	0.0
California	29.6	186.8	614.8	438.4	110.2	118.3
Colorado	151.2	209.6	227.1	438.4	502.7	664.5
Idaho	170.0	339.3	341.9	553.1	528.8	307.1
Montana	111.7	249.5	291.2	453.2	749.0	805.4
Nevada	1.2	2.6	2.4	4.0	2.7	4.1
New Mexico	0.0	3.8	0.0	0.0	0.0	0.0
Oregon	76.3	182.3	186.0	244.5	265.4	383.3
South Dakota	102.2	102.9	189.6	57.6	19.5	40.0
Utah	17.3	26.7	53.4	143.9	116.2	83.3
Washington	134.8	173.1	223.8	289.9	492.6	204.2
Wyoming	55.0	88.0	88.9	389.2	395.9	302.1
Total	849.3	1,564.6	2,219.1	3,012.2	3,183.0	2,912.3

Mountain Pine Beetle Outbreaks, 1979-2006



Spruce budworm

Choristoneura fumiferana is a native insect currently found in the Great Lakes Region and Alaska. In the past, spruce budworm was also found in northern New England, New York, and Pennsylvania. 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.

Populations of spruce budworm in 2006 increased significantly from 2005, but still remained historically low. The Lake States still have noticable defoliation. In Minnesota, defoliation increased from 92,600 acres in 2005 to 293,000 acres in 2006; in Michigan, the acres of defoliation increased from 9,500 acres to 24,200; and in Wisconsin, defoliation decreased from 21,000 acres in 2005 to 2,500 in 2006.

In Alaska, acres of defoliation increased substantially, from the 16,000 acres observed in 2005 to 53,000 acres in 2006. However, observation problems during the 2005 survey kept reported acreage artifically low.

Eastern Counties Where Spruce Budworm Defoliation Was Reported, 2006

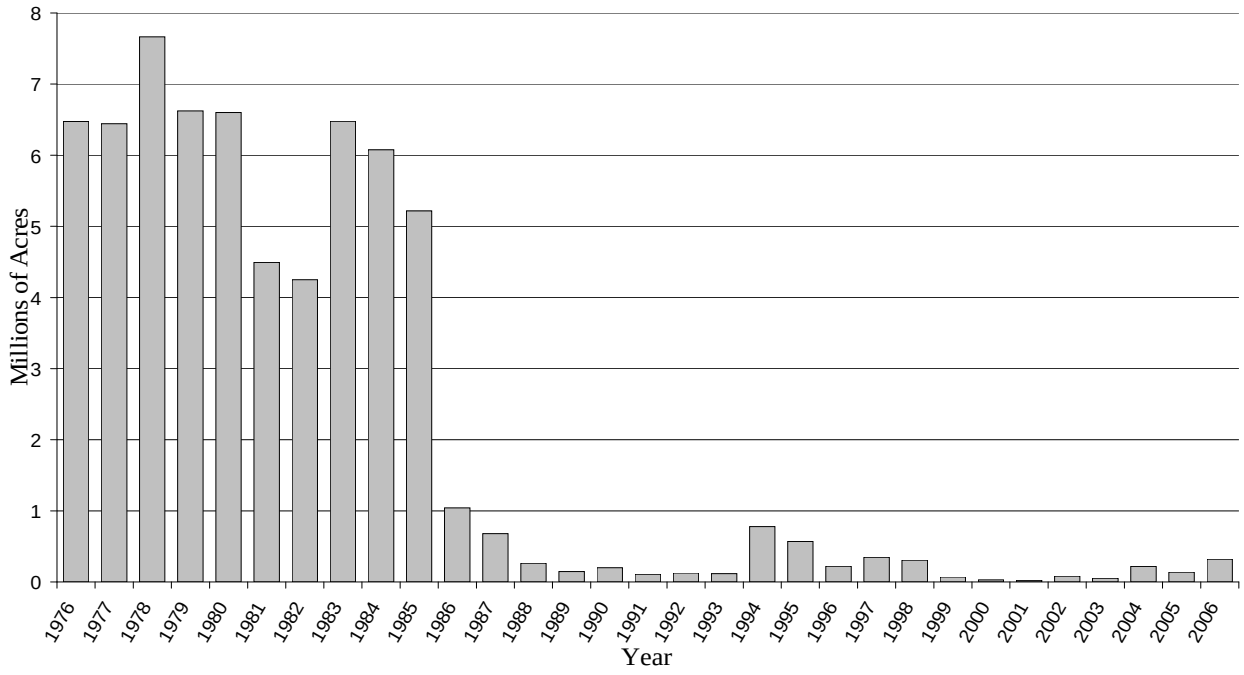
Acres (in thousands) with Spruce Budworm Defoliation in the Eastern United States, 2002-2006

State	2002	2003	2004	2005	2006
Maine	0.0	0.0	0.0	0.0	0.0
Michigan	0.5	11.8	26.0	9.5	24.2
Minnesota	80.3	34.9	83.0	92.6	292.6
New Hampshire	0.0	0.0	0.0	0.0	0.0
New York	0.0	0.0	0.0	0.0	0.0
Pennsylvania	0.0	0.0	0.0	0.0	0.0
Vermont	0.0	0.0	0.0	0.0	0.0
Wisconsin	0.4	4.0	26.0	21.0	2.5
Total	81.2	50.7	135.0	123.1	319.3

Acres (in thousands) with Spruce Budworm Defoliation in Alaska, 2002-2006

State	2002	2003	2004	2005	2006
Alaska	0.0	0.0	84.0	16.0	53.0

Acres (in thousands) with Spruce Budworm Defoliation in the Eastern United States, 1976-2006



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 west to Washington and Oregon. The insect causes topkill, growth loss, and some tree mortality. The budworm feeds primarily on Douglas-fir and true firs.

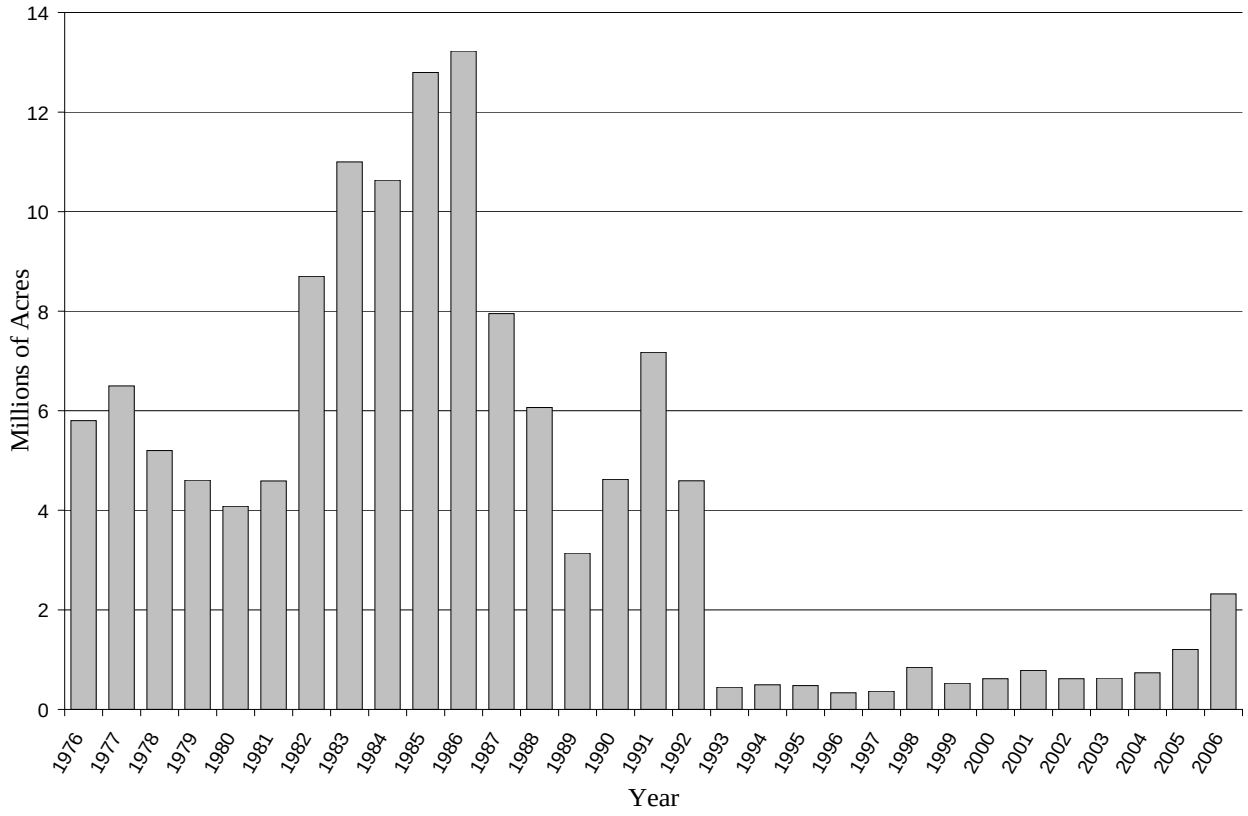
Populations of western spruce budworm remain at historic lows in many of the western states. Despite the relatively low level of activity, acres of western spruce budworm defoliation jumped by 93 percent, from 1,205,700 acres in 2005 to 2,321,900 acres in 2006. Other than a slight decline in New Mexico, Arizona, and Wyoming, defoliation acreage in other western states increased dramatically, with three states seeing increases greater than 100 percent between 2005 and 2006: 238 percent (179,000 acres) in Idaho, 152 percent (688,500 acres) in Montana, and 119 percent (48,100 acres) in Utah, where the budworm defoliation increased not only in extent, but also in intensity. With much of the West experiencing warmer and drier weather conditions, western spruce budworm populations are expected to continue to increase.

Western Spruce Budworm Defoliation Areas, 2006

Acres (in thousands) with Western Spruce Budworm Defoliation, 2002-2006

State	2002	2003	2004	2005	2006
Arizona	11.3	24.0	10.7	11.2	2.5
California	0.0	0.0	0.0	0.0	0.0
Colorado	131.1	20.0	20.0	71.4	93.7
Idaho	22.6	204.1	64.1	75.3	254.3
Montana	52.4	66.0	177.3	453.7	1,142.2
New Mexico	198.8	143.2	238.2	183.8	142.5
Oregon	1.9	5.5	6.6	0.3	38.0
Utah	7.0	14.7	20.0	40.5	88.6
Washington	57.5	139.9	193.2	363.1	555.7
Wyoming	134.6	13.3	4.5	6.4	4.4
Total	617.2	630.7	734.6	1,205.7	2,321.9

Aerially Detected Western Spruce Budworm Defoliation, 1976-2006



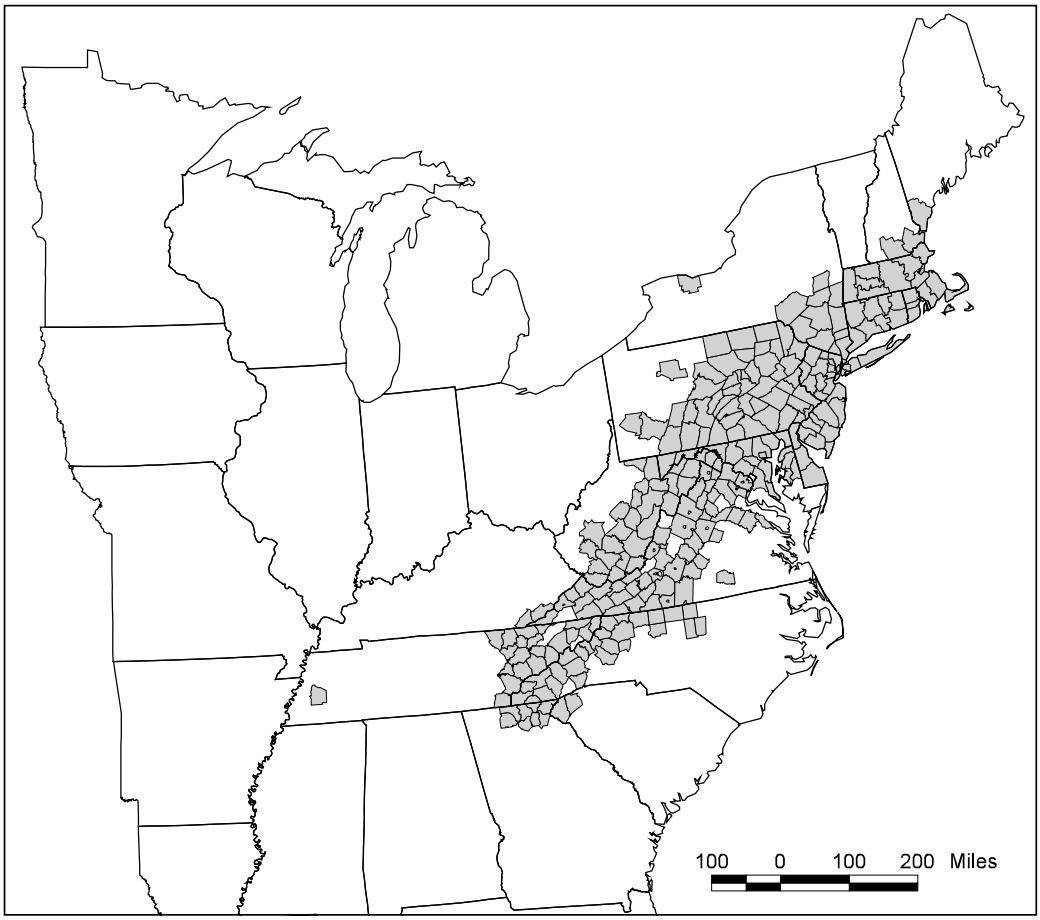
Hemlock woolly adelgid

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

In 2006, infestations of hemlock woolly adelgid continued to intensify dramatically in the Southern Appalachians. Despite some success, the adelgid continues to outpace control efforts in many areas. The influence of migrating songbirds helps in the spread of this insect to new sites in the Southeast. Shipments of infested hemlocks can be linked to other infestations in the northeastern states.

The adelgid was found on the west coast in 1924 and occurs in British Columbia, Washington, Oregon, and California. The adelgid appears to be innocuous in the West, as little damage is reported.

Eastern Counties Where Hemlock Woolly Adelgid Was Reported, 2006

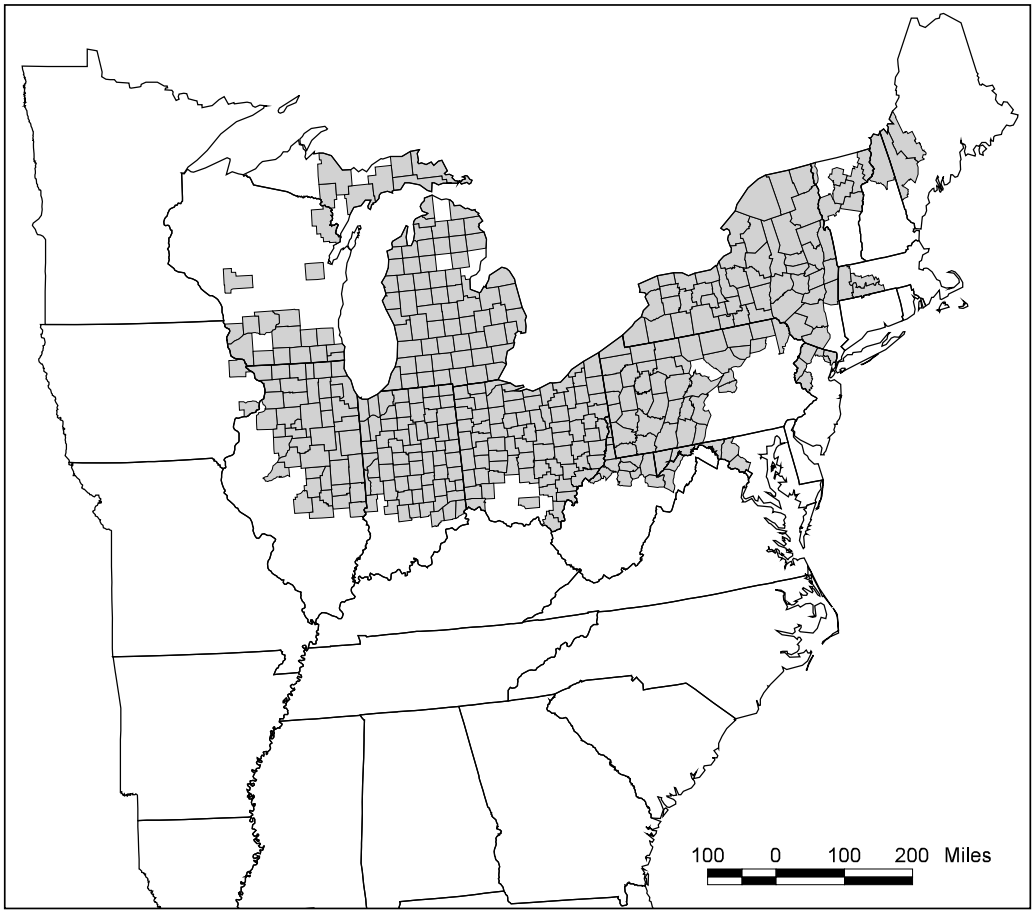


Common European pine shoot beetle

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

State and federal quarantines have been imposed to reduce the movement of this beetle, which was found in 13 states during 2006.

Eastern Counties Where Common European Pine Shoot Beetle Was Reported, 2006



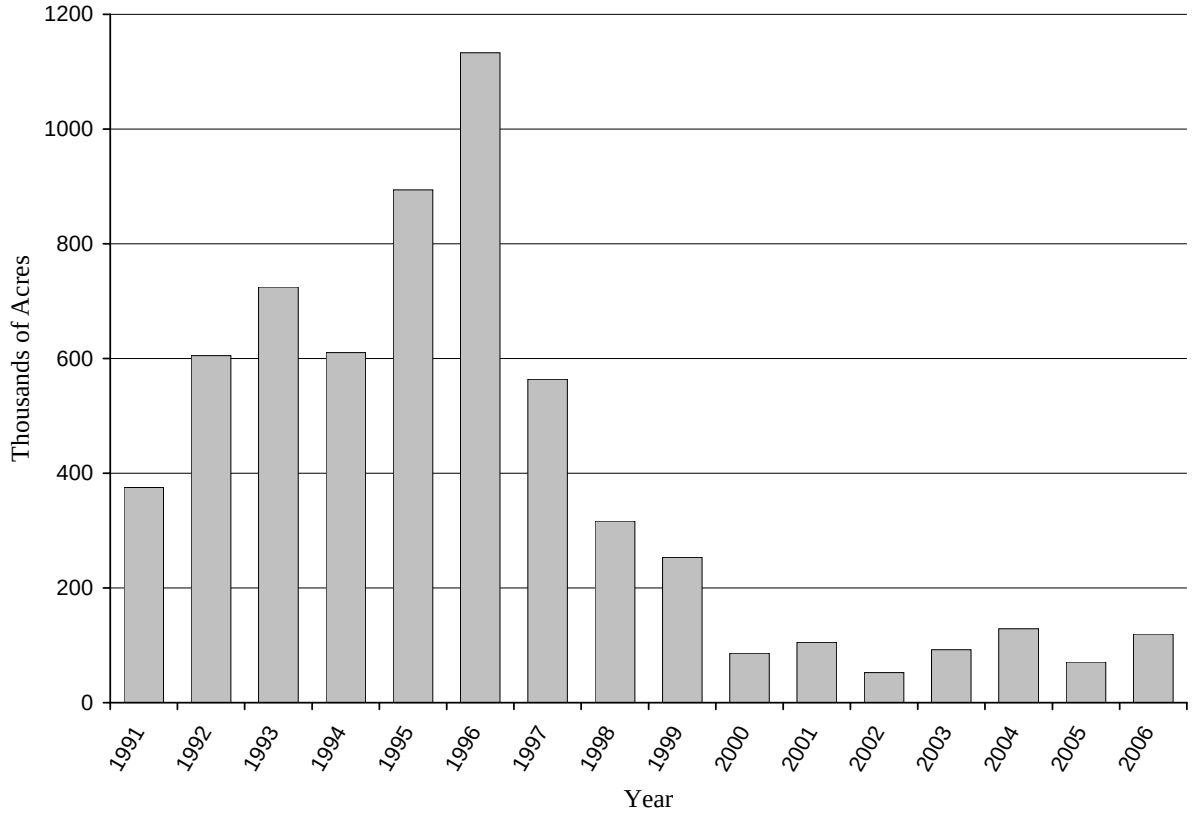
Spruce beetle

Dendroctonus rufipennis is a native insect that occurs across North America from Maine to Alaska and, in the Rocky Mountains, south to Arizona. Spruce beetle is the most significant mortality agent of mature spruce. Populations usually build up in windthrown trees.

Spruce beetle activity has increased 68 percent in Alaska from 71,000 acres in 2005 to 120,000 acres in 2006. These are still considered endemic levels. In the 1990s, Alaska's spruce beetle epidemic saw rapid acceleration from an endemic level (approximately 150,000 acres) of active beetle-caused mortality to a peak of 1.1 million acres in 1996 and then rapidly declined due to lack of suitable host material. This intensive epidemic resulted in mortality exceeding 90 percent of all trees in many drainages, and the resulting fuel hazard and fire risk is requiring continued efforts to mitigate.

Outbreaks continue in a few forests in Arizona, Montana, Utah, and Washington. Throughout much of the West, weather conditions were conducive to increases in spruce beetle populations. Mild winters and warm dry summers have created a situation that has allowed the various populations to significantly increase.

Acres (in thousands) with Spruce Beetle Active and Newly Infested Areas in Alaska, 1991-2006



Dogwood anthracnose

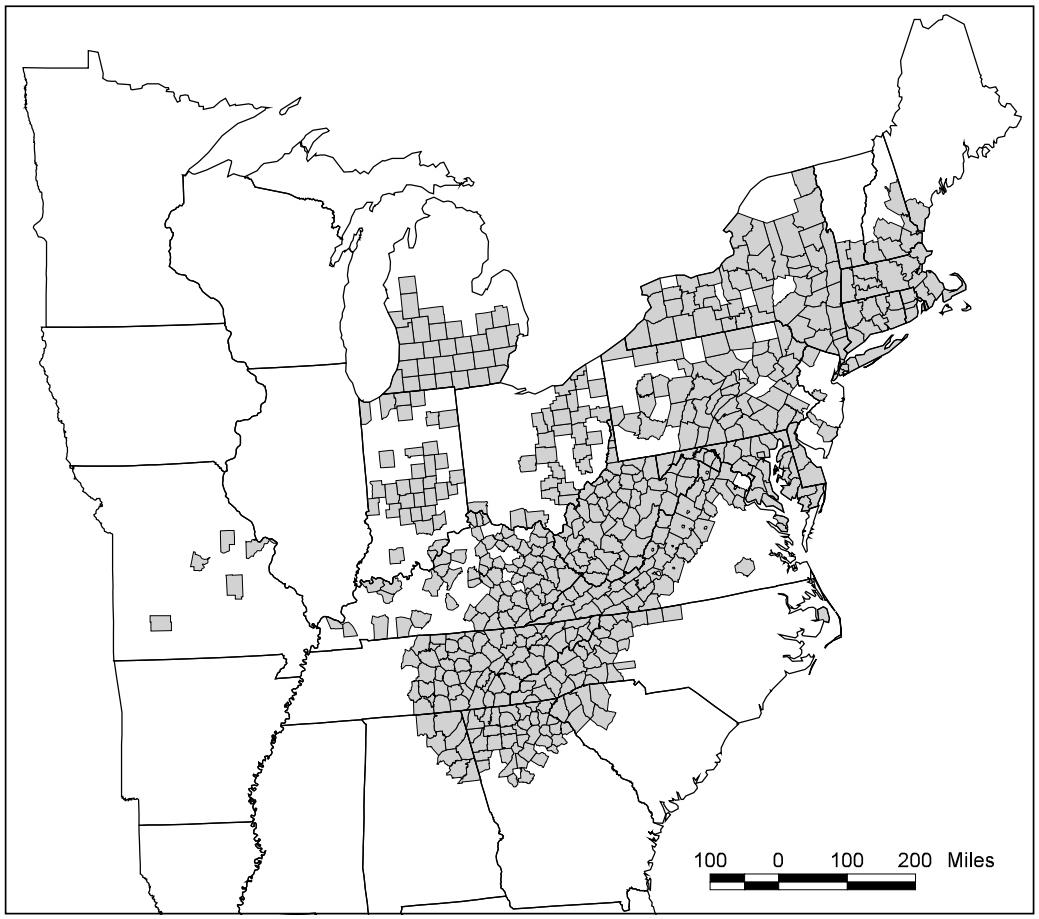
Discula destructiva, the fungus that causes dogwood anthracnose, is of unknown origin. First discovered in the Pacific Northwest in 1976, the disease is confirmed in Idaho, Oregon, and Washington. Although the Pacific dogwood is more susceptible to the fungus than the eastern dogwood, drier summers in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

In the East, the fungus was first found in southeastern New York in 1978. By 2005, this disease was found in 22 states from Maine to Georgia and west to Indiana and Missouri. The range of dogwood extends from southern Maine to Florida and west to Michigan and eastern Texas.

Dogwood anthracnose continues to intensify at the disease front within the infested counties in the South, although in areas long-infested, mortality has declined with the decrease in susceptible host.

In the Northeast, diseased dogwoods have been found in every county in Delaware, Maryland, Massachusetts, Rhode Island, West Virginia, and Connecticut.

Eastern Counties Where Dogwood Anthracnose Was Reported, 2006



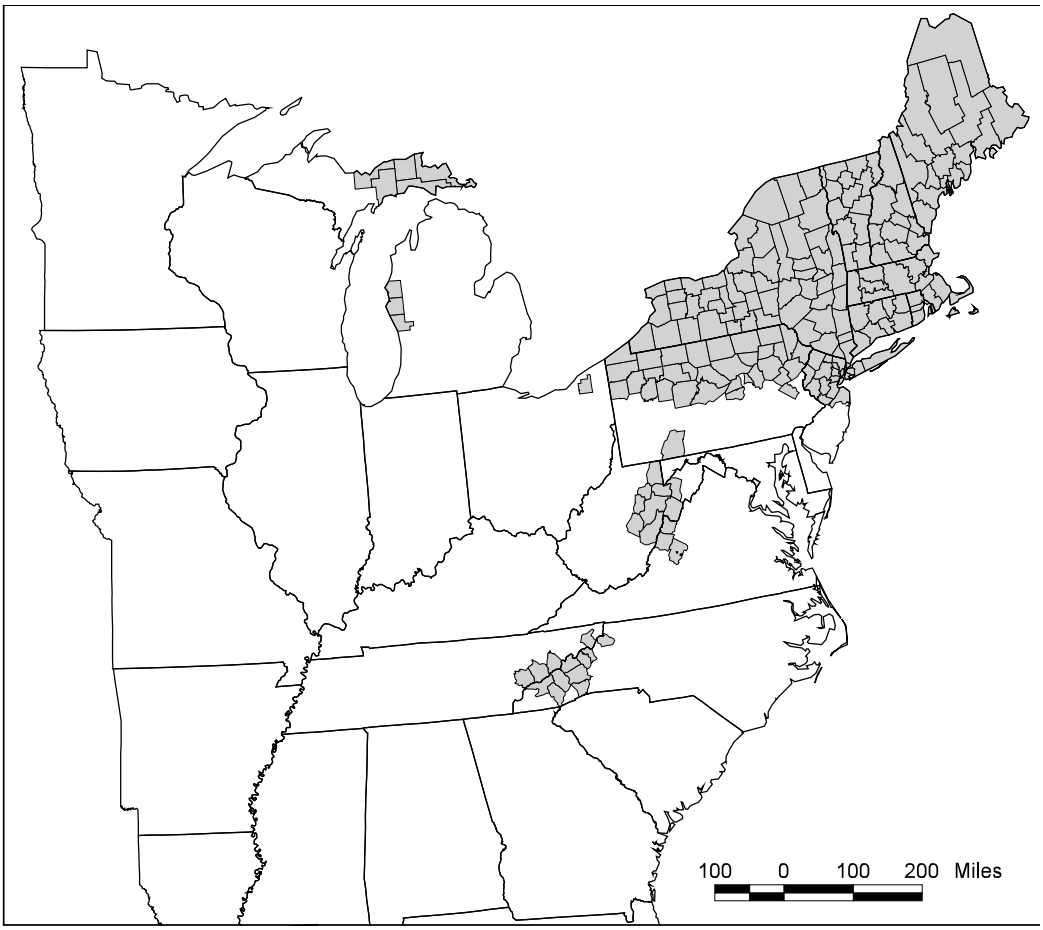
Beech bark disease

Beech bark disease is caused by the interaction of the beech scale, *Cryptococcus fagisuga*, and one or more fungi in the genus *Neonectria*. The scale insect creates wounds in the tree that are colonized by fungi, such as *Neonectria coccinea* var. *faginata*. The scale, and probably the fungus, were accidentally brought to Nova Scotia, Canada, circa 1890. Native fungi, *Neonectria galligena* and *Neonectria ochroleuca*, can also invade wounds caused by the scale, inciting the disease. By 1932, the disease was killing trees in Maine. It continued to advance south and west into northeastern Pennsylvania.

In 1981, a large area of infested American beech was found in West Virginia, well ahead of the advancing front of the disease. In 1994, the disease was found 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. Mortality continued to intensify and was spreading downslope toward the Cherokee and Pisgah National Forests at a rate faster than predicted. In 2006, surveys were completed in West Virginia along the advancing front. Three new infestated counties were found increasing the total infected area to more than 3.6 million acres. Beech bark disease continued to expand westward in the Upper Peninsula of Michigan. The annual spread rate in Lower Michigan averaged 1 mile per year from 2005 to 2006.

Tree mortality continues within affected areas at a greater rate than predicted, although some beech trees appear to be resistant. The range of American beech extends from Maine to northwest Florida and west to eastern parts of Wisconsin and Texas.

Eastern Counties Where Beech Bark Disease Was Reported, 2006



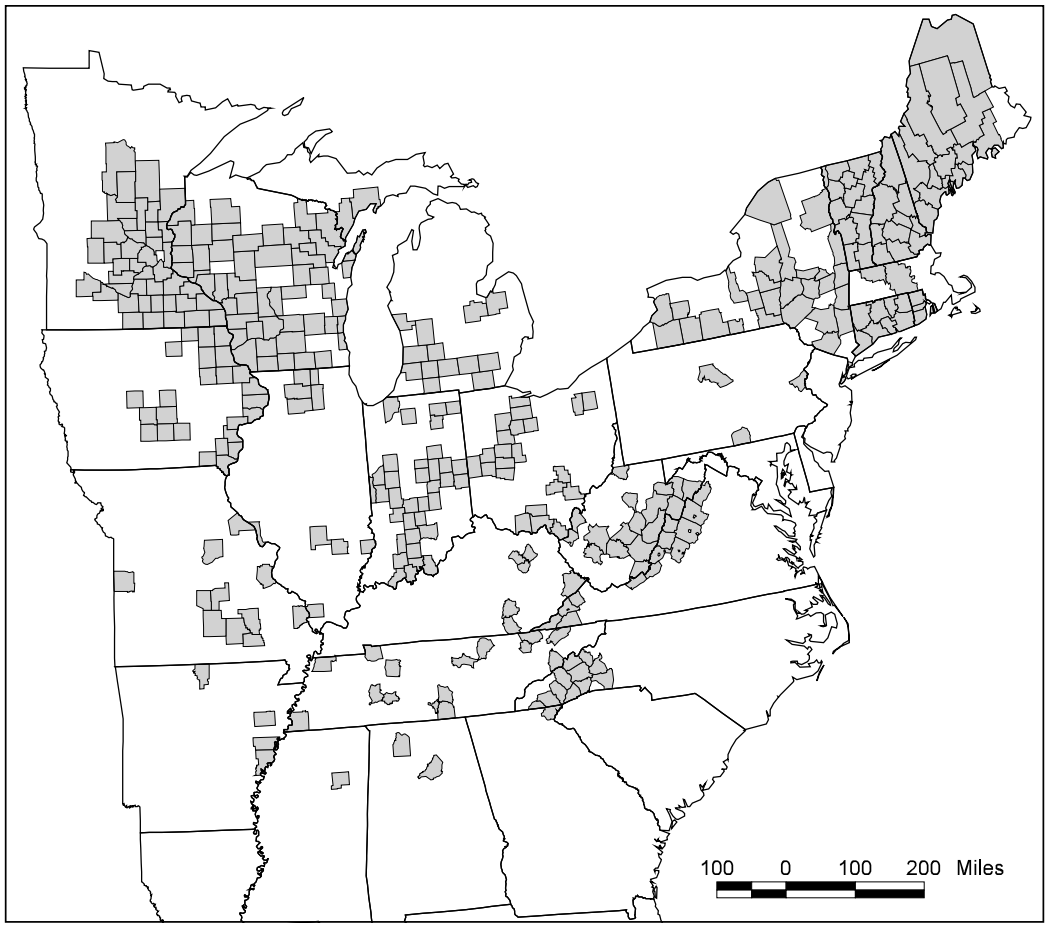
Butternut canker

Butternut canker is caused by the fungal pathogen *Sirococcus clavigignenti-juglandacearum.* The origin of the pathogen is unknown, but because of its severe impact on butternut, it is likely that it was introduced into North America. Symptoms of the disease were recognized and reported in 1967 in Wisconsin, but the causal fungus was not identified until the late 1970s. The native range of butternut extends from Maine to Georgia and west to Minnesota and Arkansas. Butternut is usually found scattered in a variety of cover types and is not abundant in any part of its range.

The disease is found throughout the range of butternut and is a serious threat to the survival of the species. The pathogen causes multiple cankers under the bark that merge and girdle the trees, killing large trees, saplings, and regeneration. It is estimated that 77 percent of the butternut trees in North Carolina and Virginia have been killed, and in the northeastern area, most of the monitored trees are infected. Trees that appear to exhibit resistance to the disease have been found in most states where butternut grows. Many of these trees are being propagated for host resistance studies.

Several states have implemented harvesting guidelines or moratoriums in an attempt to preserve genetic variability in the species and to ensure that potentially resistant trees are not removed. There are no viable control measures for this disease, but no new affected counties have been added to the map (below) in 2006.

Eastern Counties Where Butternut Canker Was Reported, 2006



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 has the greatest amount of the disease, 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, 2006*

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 (93)	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 infect the aerial portions of host trees. They affect most conifer species in the West and spruces in the Northeast, causing branch distortions, reduced stem growth, and decreased longevity.

Commercial trees most affected include Douglas-fir, lodgepole pine, true fir, western hemlock, western larch, and ponderosa pine. Dwarf mistletoes are usually host-specific and have patchy distributions within stands and across larger landscapes. Over 29 million acres of western forests (including Alaska) have some level of infection. Losses are estimated at around 164 million cubic feet of wood annually.

Dwarf mistletoes are amenable to cultural treatments, although infected areas are often more difficult to manage than uninfected areas. The overall incidence and severity of this disease are thought to have increased over the past century due to fire suppression.

Acres (in thousands) in the West Affected by Dwarf Mistletoes, 2006

State (survey year)	National Forest System	Other Federal	State and Private	Total
Alaska*				3,400.0
Arizona (85-89)	1,174.0	674.0	25.0	1,873.0
California (05)	2,536.4	76.7	2,123.1	4,736.2
Colorado (06)				815.9
Idaho - North (70-80)**	478.0	10.0	244.0	732.0
Idaho - South (94)**				2,600.0
Montana (70-80)	1,694.0	123.0	600.0	2,417.0
New Mexico (97)	1,144.0	348.0	581.0	2,073.0
Nevada (94)				49.0
Oregon (67)				3,940.0
Utah (94)				410.0
Washington (97)				5,678.3
Wyoming (06)				637.3
Total	7,026.4	1,231.7	3,573.1	29,361.7

* Commercial acreage only in Alaska.

** Idaho-North is in Region 1, and Idaho-South is in Region 4.

Part 3: Conditions by Damage Agent by Region

INSECTS: NATIVE

Amethyst cedar borer
Semanotus amethystinus

Region 5: California

Host(s): Cedar

The amethyst cedar borer infested mature Port-Orford cedars that died along the Sacramento River in the town of Dunsmuir and along Clear Creek in the Siskiyou Wilderness, Siskiyou County.

Arborvitae leaf miners
A complex of four species

Region 9/Northeastern Area: Vermont

Host(s): Northern white-cedar

No significant activity was reported in Maine or New Hampshire in 2006. Light damage was observed in Vermont, a decrease from the previous year.

Ash defoliator
Palpita magniferalis

Region 9/Northeastern Area: Maine

Host: ash

Defoliation in Maine was much reduced in 2006 as compared with the previous three years. Islesboro had some light to moderate defoliation, and there was only a trace amount of defoliation on the mainland in the mid-coast area.

Aspen leaf miner
Phyllocnistis populiella

Region 10: Alaska

Host(s): Aspen, balsam poplar, black cottonwood, birch, and alder

Aspen leaf miner infestations appear to have topped out in 2005 after five consecutive years of increases. In 2006, 457,882 acres were mapped by aerial surveys, the lowest acreage in two years. However, because much of the aspen covered by aerial survey was also damaged by large aspen tortrix and other defoliators, it is thought that actual acreage remained close to the 2005 figure of 659,536, the apparent peak of the outbreak. With the exception of a few localized outbreaks found in south-central Alaska and those spread sporadically across the west of the state, the majority of the outbreak is bounded by the Alaska Range to the south and the Brooks Range to the north. This year, the Fairbanks area remained heavily infested, as did the area between Delta and Tok and between Glennallen and Chitina. The area between Delta and Tok has been heavily infested for about 10 years and remain so this year. The area between Glennallen and Chitina has been previously infested, but the infestation appeared to intensify in 2006.

Observers noticed that the intensity varied within aspen patches, with intensity highest on the edges and light in the center of each patch. This would indicate a disease outbreak in the leaf miner population as opposed to a "catch-up" of parasitoid or predator populations in response to the high leaf miner populations. The cause of outbreak crashes has often been attributed to disease or parasitoid/predator loading.

Bagworm moth
Thyridopteryx ephemeraeformis

Region 2: Nebraska

Host(s): Eastern redcedar

Populations continue to be high on eastern redcedar in some areas of eastern Nebraska and are causing some tree mortality.

Region 9/Northeastern Area: Connecticut, Delaware, Illinois, New Jersey, and West Virginia

Host(s): Arborvitae, black locust, boxelder, conifers, juniper, Northern white-cedar, spruce, white pine

In Connecticut, heavy populations occurred on arborvitae.

Delaware reported light to moderate infestations on spruces and pines throughout the state in 2006. In New Jersey, approximately 250 acres of eastern redcedar were affected by this pest at various locations throughout Atlantic, Burlington, Cumberland, Cape May, Ocean, and Salem Counties. In West Virginia, as in 2004 and 2005, light populations of this moth were reported statewide in 2006.

High populations were reported in scattered locations in the northern half of Illinois. Complete defoliation and death of spruce trees used as windbreaks occurred in some areas. In past years, this pest was limited in range to the southern two-thirds of Illinois, but with milder winters over the last ten years, it was now found in the northern part of the state.

Baldcypress leaf roller
Archips goyerana

Region 8: Louisiana

Host(s): Baldcypress

In 2006, 101,736 acres of mixed baldcypress stands in southern and southeastern Louisiana were defoliated by the baldcypress leafroller (in Ascension, Assumption, Iberia, Iberville, LaFourche, Livingston, St. James, St. John the Baptist, and St. Martin parishes). Approximately 70,049 acres were severely defoliated ($\geq$50 percent foliage damaged). The primary impact of this defoliation is loss of radial growth, producing an estimated volume loss of 0.1 MBF/acre. Dieback and scattered mortality occurred in some areas. Permanently flooded areas were most severely impacted.

Insects: Native

Balsam gall midge
Paradiplosis tumifex

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

Host(s): Balsam fir

In Maine, this pest caused very significant damage to the Christmas tree and wreath industries in the past, but currently, population levels were very low throughout the state. No control projects were necessary in 2006, and no reports of damage in commercial Christmas tree farms or in wild balsam stands were received. Expectations that population levels would increase in 2006 did not materialize. An increase in gall midge was seen throughout the northern region of New Hampshire. There was very little defoliation reported in Vermont.

Balsam twig aphid
Mindarus abietinus

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

Host(s): Balsam fir

Although the Maine Forest Service conducted no specific surveys for this pest in 2006, because this pest has caused significant damage to the Christmas tree and wreath industries of Maine in the past, most Christmas tree producers monitored its presence closely. Based on their reports, population levels were very low throughout Maine, with only scattered reports of noticeable damage on individual Christmas trees and no reports of damage in forest stands. Statewide populations were rising in New Hampshire, with most reports from northern part of the state. There was an increase in this pest in Vermont, with widely scattered light to moderate damage on Christmas trees.

Barklice or psocids
***Archipsocus* spp.**

Region 8: Texas

Host(s): Hardwoods, mostly oaks

During the summer of 2006, higher than normal populations of barklice in southeastern Georgia caused many people to inquire about the cause of webbing covering the trunks and branches of their trees. No permanent damage was caused.

Beech blight aphid
Grylloprociphilus imbricator

Region 9/Northeastern Area: Ohio

Host(s): American beech

In Ohio, no report of this aphid was received for 2006, and populations were reported decreasing in 2005.

Birch skeletonizer
Bucculatrix canadensisella

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

Host(s): Birch species

In Maine, there was scattered defoliation over much of the state, but it was a minor part of a complex of many defoliation causal agents. The expected birch skeletonizer problem did not reappear in eastern Maine in 2006. This insect was present throughout the range of birch in New Hampshire at endemic levels. There was light defoliation reported in central and northern Vermont.

Black pineleaf scale
Nuculaspis californica

Region 5: California

Host(s): Various conifers

Black pineleaf scale was observed infesting ponderosa pine plantations and mature stands on and adjacent to Timber Mountain, Doublehead Ranger District, Modoc National Forest. This is the same general area where one of California's largest outbreaks of black pineleaf scale occurred in 1992. In 2006, plantations on Timber Mountain had many pockets with severe defoliation and stunted growth due to chronic and heavy scale infestations. Healthier plantation trees, with good leader growth and needle retention, have chlorotic foliage from lighter infestations. Several larger trees within and adjacent to the plantations are also infested and exhibited poor needle retention. One natural stand of ponderosa pine (~20 acres), surrounding a nearby pumice plant, is severely infested with scales. Approximately 50 percent of the trees in this stand have died over the past few years and the surviving trees have very little foliage. In this stand, dust from the pumice plant is likely playing a role in reducing the ability of the predators and parasites to find the scales.

Scales were also abundant on the foliage of several large ponderosa pines growing near a dirt surfaced residential road near Janesville, CA, Lassen County.

Sugar pine suffering from an outbreak of black pineleaf scale north of Dead Horse Summit, Siskiyou County, had healthier foliage this year. Trees within the infested area (roughly 1500-to-2000 acres) had greener and fuller crowns than were seen in 2005.

Black turpentine beetle
Dendroctonus terebrans

Region 8: Regionwide

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

Much like pine engraver beetles, the black turpentine beetle prefers to attack stressed, weakened trees. Stands stressed by multiple factors such as drought and logging injury, compacted soil, or wildfires are especially vulnerable. Black turpentine beetle are active in the lower six to eight feet of the tree's bole. Although generally present at low population levels, when black turpentine beetle numbers increase significantly, they are capable of attaining primary pest status, attacking trees with no overt damage or other evidence of susceptibility.

Black turpentine beetle activity increased in southern Alabama in 2006, probably in combination with summer drought and the lingering effects of hurricane Katrina. A drastic increase in pine mortality following hurricane Katrina occurred in SE Louisiana parishes (St. Tammany, Tangipahoa, and

Washington) in 2006 due to the storm, summer drought, black turpentine beetle, and *Ips* engraver beetle activity. Mortality was very abundant, but widely scattered. Mortality also occurred farther west and into SW Louisiana parishes affected by hurricanes Katrina and Rita. Activity increased to moderate levels in Texas in 2006, with damage very localized; the summer drought probably increased tree susceptibility. Georgia reported intense activity in the lower Piedmont and upper Coastal Plain, often associated with *Ips* beetles. Mississippi reported continuing black turpentine beetle activity in longleaf pine stands in the southern part of the state where both prescribed burning and harvest treatments had been carried out. South Carolina reported increases in black turpentine beetle activity in areas previously thinned to control Southern pine beetle, in scattered commercial thinnings, and in areas of hot prescribed fires. North Carolina noted scattered and moderate black turpentine beetle activity in the mountains and reduced activity in Sandhills longleaf stands being managed for pine straw production. Tennessee reported small spot infestations, often in association with *Ips* beetles.

Bruce spanworm
Operophtera bruceata

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

Host(s): Sugar maple and beech

No significant activity was reported in Maine or New Hampshire. Populations of this defoliator in New York declined in the Adirondacks. In Vermont, there was a decrease in populations and very light defoliation reported.

In Pennsylvania, there were 2,606 acres of combined damage from Bruce spanworm along with other geometrid defoliators, including the halfwing geometer (*Phigalia titea*) and fall cankerworm (*Alsophila pometaria*).

Buck moth
Hemileuca maia

Region 8: Louisiana

Host(s): Live oak and other hardwoods

Buck moth defoliation of live oak has been a problem in New Orleans for many years. The moth continues to be locally abundant in the city and of particular concern in the Federal Historic Districts. The insect population in Louisiana declined in 2006, with little obvious defoliation occurring. Adult moth catches and infested tree numbers declined. The effects of flooding from hurricane Katrina may have had a negative effect on diapausing pupae.

California flatheaded borer
Melanophila californica

Region 5: Southern California

Host(s): Various pines

A flatheaded borer that appears identical to *Melanophila drummondi* caused mortality and top-kill of mountain hemlock on the ridge between Little Duck Lake and High Lake in the Russian Wilderness.

Cedar bark beetle
Phloeosinus spp.

Region 3: Arizona and New Mexico

Host(s): Cypress, juniper

Cedar bark beetle tree mortality was not recorded in the Southwest in 2005. In 2006, 11,120 acres of mortality were recorded. In Arizona, cedar bark beetle mortality was recorded on the Apache-Sitgreaves National Forest (710 acres); and Fort Apache (35 acres), Hualapai (2,130 acres), Navajo (4,615 acres) and San Carlos (2,020 acres) Indian Reservations. In New Mexico, mortality was recorded on the Gila National Forest (1,570 acres); and 40 acres of State and private land.

Region 5: California

Host(s): Incense-cedar, cypress

Branch and stem dieback of ornamental cypress was caused by cypress bark beetles at Oak Run, Shasta County.

Cherry scallop shell moth
Hydria prunivorata

Region 8: Alabama and Tennessee

Hosts: Black cherry and other native cherries

A small infestation was detected in Lauderdale County, Alabama, in the spring of 2006. No serious damage occurred and refoliation was present by late summer. Tennessee reported scattered heavy defoliation in Monroe, McMinn, and Polk Counties.

Common oak moth
Phoberia atomaris

Region 9/Northeastern Area: Ohio and West Virginia

Host(s): White oak

In Ohio, populations of the common oak moth and the half-winged geometer were reported to decrease or collapse in 2005, and surveys were not done in 2006. In West Virginia, surveys were done in conjunction with several miscellaneous loopers that caused damage at similar times. Damage had decreased dramatically in 2005, and in 2006 defoliation was light and was not mapped.

Cypress looper
Anacamptodes pergracilis

Region 8: Florida

Host(s): Baldcypress

No reports were received in 2006

Douglas-fir beetle
Dendroctonus pseudotsugae

Region 1: Idaho and Montana

Host(s): Douglas-fir

Douglas-fir beetle populations returned to, or remained at, nearly endemic levels in most parts of northern Idaho. Not all of the potentially infested areas were surveyed; but we believed most areas in that part of the Region harbored few active beetle populations. While the Coeur d'Alene, Clearwater, and St. Joe National Forests showed the most significant reductions in infested area, most of those National Forests were not surveyed. The Nez Perce National Forest showed less-significant decreases. Few currently infested trees were observed in areas surveyed in northern Idaho, and we believe populations are at near-normal levels in most Douglas-fir and mixed-species stands.

In western Montana, every area surveyed showed a marked decline in infested stands. In a few areas, especially the Bitterroot, Beaverhead, Flathead, Helena, and Lolo National Forests, beetle populations and resultant beetle-killed trees remain at higher-than-normal levels. But on every one of those national forests, infested area declined in 2006. In many areas, beetle-killed trees were still noticeable; but seldom did we find higher numbers of new attacks in 2006. Stands surveyed in and around areas affected by 2000 and 2003 fires on parts of Bitterroot and Helena National Forests showed populations declining dramatically. Few areas had more new attacks in 2006 than in 2005. Infested acreage recorded on aerial detection surveys declined on the Helena National Forest from 5,550 acres in 2005 to slightly less than 5,300 acres in 2006. On the Bitterroot National Forest, where beetles have infested stands not affected by fire, infested area decreased from 69,300 acres in 2005 to just over 27,000 acres in 2006. That was still the most heavily impacted reporting area in the Region. Ground surveys and observations on the national forest showed fewer areas with currently infested trees, so we believe the infestation has declined markedly. Surveys conducted elsewhere in the state had similar results. We may begin to see more beetle activity in western spruce budworm-affected areas; but that has not been manifest as yet.

Region-wide, the mapped infested area decreased to just less than 62,800 acres; down from more than 177,000 acres in 2005. Approximately 121,800 beetle-killed Douglas-fir were recorded on those infested acres. In most areas, we believe populations are still declining. In some areas, still-high populations may be more perceived than real, as it is often difficult to determine the year of kill from the air.

More than 2 million acres of Douglas-fir older than 100 years exist in the Region. Weather and stand disturbances—fire, defoliation, or windthrow—increase the likelihood of Douglas-fir beetle outbreaks in susceptible stands. Preventive management is the key to reducing outbreak potential.

Region 2: Colorado and Wyoming

Host(s): Douglas-fir

In Colorado, Douglas-fir beetle declined from about 35,000 acres in 2005 to about 13,000 acres in 2006. Some Douglas-fir beetle activity was in direct association with prior prescribed burns and wildfires, while some had no association with fire/tree scorch. Douglas-fir beetle activity was observed on the Gunnison, Rio Grande, San Isabel, San Juan, and White River National Forests and surrounding lands of mixed ownership. Chronic Douglas-fir beetle activity continues in some stands previously defoliated by western spruce budworm of the Rio Grande National Forest. In 2006, the anti-aggregation pheromone MCH was successfully deployed to protect specific Douglas-fir stands on the Rio Grande, White River, and Pike-San Isabel National Forests.

In Wyoming, large pockets of Douglas-fir beetle mortality were observed along the North Platte River. Drainages of the North Platte River have considerable Douglas-fir mortality. Douglas-fir beetle continues to cause high levels of mortality throughout the national forests in northern Wyoming. On the Bighorn National Forest, Douglas-fir on the west side of the forest showed high levels of beetle activity. Shell Canyon, which was largely Douglas-fir, has seen well over 80 percent mortality caused by the beetle. Management activities are now occurring in this area to reduce the amount of fuels left by the beetles and

to provide some level of protection for any remaining stands. Other parts of the western Bighorn Mountains have not reached this level of mortality, but mortality is increasing. Areas such as Battle Park and Ten Sleep Canyon have experienced increased beetle outbreaks the past few years.

On the Shoshone National Forest, Douglas-fir beetle continues to kill large numbers of trees in the North Fork corridor of the Yellowstone River. This outbreak has been going strong for at least eight years now, and much of the mature overstory has been killed. This past year, beetles were noted attacking small (3- to 4-inch-diameter) trees along the North Fork, indicating how many beetles still remain and their reduced food source. Douglas-fir beetle activity has also picked up in intensity in the Sunlight Basin area of the northern Shoshone National Forest over the past two years. There are large expanses of almost pure Douglas-fir type forestland in this area, and so it seems that this outbreak has considerable room to expand over the coming years. In the southern part of the Shoshone National Forest, Douglas-fir in the Wind River area is being attacked and killed. Many of the larger stands have experienced almost complete mortality over the past few years. On the Shoshone National Forest in general, much of the Douglas-fir resource is rapidly being depleted.

Region 3: Arizona and New Mexico

Host(s): Douglas-fir

Douglas-fir beetle mortality decreased in the Southwest from 77,255 in 2005 to 15,360 acres in 2006. In Arizona, Douglas-fir beetle tree mortality was recorded on the Apache-Sitgreaves (300 acres), Coconino (1,785 acres), Coronado (150 acres), Kaibab (845 acres), Prescott (15 acres), and Tonto (65 acres) National Forests; Grand Canyon National Park (35 acres); Fort Apache (15 acres), and Navajo (5 acres) Indian Reservations; and 105 acres of State and private land. In New Mexico, Douglas-fir beetle-caused tree mortality was detected on the Carson (4,600 acres), Cibola (290 acres), Gila (60 acres), and Santa Fe (3,540 acres) National Forests; Valles Caldera National Preserve (80 acres), Bandelier National Monument (20 acres); 1,340 acres of USDI Bureau of Land Management land; Jicarilla Apache (1,310 acres), and Santa Clara Pueblo (320 acres) tribal lands; and 480 acres of State and private lands.

Region 4: Idaho, Utah, and Wyoming

Host(s): Douglas-fir

Douglas-fir beetle-caused tree mortality decreased significantly across Region 4. In 2006, over 19,100 acres were affected, compared to 140,800 acres in 2005. Most of the Douglas-fir mortality for 2006 was scattered across southern Idaho, with the majority mapped on the Salmon-Challis National Forest. However, with 6,200 acres affected on the Salmon-Challis National Forest in 2006, the amount of acres was half of the acreage mapped on the Salmon-Challis National Forest in 2005. Both the Ashley National Forest in Utah and the Bridger-Teton National Forest in Wyoming saw significant reductions in affected acres, from 33,100 and 19,100 acres, respectively, in 2005 to 1,400 and 1,300 acres, respectively, mapped in 2006. Increased precipitation in 2005 may have contributed to the decline in tree mortality as residual trees recovered from the effects of the prior drought.

Region 5: California

Host(s): Douglas-fir

Individual trees that were heavily infested with Douglas-fir dwarf mistletoe were killed by the Douglas-fir beetle in the Castle Creek, Scott Camp Creek, and Upper Sacramento River drainages in Siskiyou County.

Insects: Native

Region 6: Oregon and Washington

Host(s): Douglas-fir

Douglas-fir beetles occur throughout the range of Douglas-fir and are considered the most common bark beetles to cause mortality in Douglas fir. We observed fewer acres affected by Douglas-fir beetles in 2006, but at elevated intensities. Mortality affected 76,968 acres at 1.72 trees per acre in 2005: in 2006, mortality was noted on 52,555 acres at 2.56 trees per acre.

Within the Colville Reporting Area in northeast Washington, Douglas-fir mortality was mapped on 5,288 acres (7.74 trees per acre). Other Reporting Areas with significant mortality include: Wenatchee RA (6,633 acres, 3.39 trees per acre), Mt. Baker-Snoqualmie (5,089 acres, 1.62 trees per acre), and Olympic National Park (3,806 acres, .56 trees per acre).

Douglas-fir tussock moth
Orgyia pseudotsugata

Region 1: Idaho and Montana

Host(s): Douglas-fir and true firs

Defoliation from Douglas-fir tussock moth in northern Idaho dropped from 5,400 acres in 2002 to zero in 2003-2006. In Montana, noticeable defoliation from tussock moth dropped from 312 acres in 2005 to zero in 2006. However, pheromone trap catches slightly increased in Idaho in 2006. Twenty six moths were caught on the 26 USDA Forest Service-monitored sites south of Lewiston, Idaho. The total average per site was 0.2 moths. In 2006, pheromone traps were not deployed in Montana at historical sites because of low tussock moth activity.

Region 2: Colorado

Host(s): Douglas-fir

Defoliation in Douglas-fir due to Douglas-fir tussock moth continued to increase in Jefferson County on private forested lands, west of Denver, Colorado. The Douglas-fir tussock moth early-warning traps caught a total of 29 moths in 2005; trap catches in 2006 increased to 211 moths.

Region 3: Arizona and New Mexico

Host(s): Douglas-fir and true firs

Douglas-fir tussock moth defoliation in the Southwest increased from 870 acres in 2005 to 1,230 acres in 2006. No defoliation by this insect was recorded in Arizona in 2006. Douglas-fir tussock moth defoliation was recorded on 1,230 acres of the Cibola National Forest in New Mexico.

Region 4: Idaho, Nevada, and Utah

Host(s): Douglas-fir, tue firs

Defoliation of Douglas-fir and subalpine fir attributed to Douglas-fir tussock moth continued to decrease in 2006. Approximately 2,700 acres of defoliation were reported in 2006, compared to 10,500 acres mapped in 2005. Over 1,000 acres of Douglas-fir tussock moth defoliation occurred on USDI Bureau of Land Management lands in Idaho. Douglas-fir tussock moth defoliation was confirmed in the Ketchum/Sun

Valley area. The last time Douglas-fir tussock moth occurred in this area was in 1992 during a state-wide Douglas-fir tussock moth outbreak.

Region 5: California

Host(s): White fir (other conifers during outbreaks)

During 2006, defoliation from Douglas-fir tussock moth was detected by aerial surveys in Yosemite National Park and on the Sierra and Stanislaus National Forests on over 20,605 acres; much more than that observed in 2005 (12,711 acres). The Sierra National Forest had 10,005 acres of defoliation, Yosemite National Park had 7,157 acres of defoliation, and the Stanislaus National Forest recorded 2,275 acres of defoliation. Whole tree mortality may be observed in the defoliated areas, though topkill may be more common. No Douglas-fir tussock moth egg masses were found during preliminary surveys (used to predict populations trends) conducted in the fall of 2006, indicating that the Douglas-fir tussock moth populations in these areas appear to be collapsing.

Douglas-fir tussock moth-defoliated areas were detected in a few new locations in 2006. There were about 40 acres of white fir defoliated on the Eldorado National Forest near Panther Creek. Douglas-fir tussock moth feeding on white fir and Douglas-fir was also detected further north on the Shasta-Trinity National Forest (1,783 acres) and on private land near Burney, California (57 acres). Egg mass counts in the northern Douglas-fir tussock moth outbreak area indicate that some noticeable defoliation should be expected in 2007.

Region 6: Oregon and Washington

Host(s): Douglas-fir and true firs

There were no areas of visible defoliation caused by tussock moth recorded in 2006. The Douglas-fir tussock moth Early Warning System traps showed a slight increase in trap catches in some areas.

Douglas-fir twig weevil
Cylindrocopturus furnissi

Region 5: California

Host(s): Douglas-fir

No reports were received in 2006.

Eastern larch beetle
Dendroctonus simplex

Region 9/Northeastern Area: Maine, Michigan, Minnesota, New Hampshire, and Vermont

Host(s): Eastern larch

Pockets of dead and dying larch infested with this species continued to be a common sight throughout the range of larch in Maine. Stands of larch in southern and central portions (including Downeast) of the state exhibited the highest mortality rates. Populations were found throughout the range of larch in New Hampshire. This beetle was found associated with other tree stressors causing mortality in north and central portions of the state. This insect was found statewide in Vermont associated with larch decline, especially in the northeastern part of the state. About 1,400 acres of dieback and mortality was mapped.

Insects: Native

Populations declined in Michigan in 2006. In Minnesota, eastern larch beetle continued to kill larch trees. Although only 8,927 acres of mortality were mapped by aerial survey in 2006, mortality due to eastern larch beetle continued to be very common and widespread. From 2001 through 2006, larch mortality was mapped by aerial survey on 53,734 acres in 911 stands. No consistent stress factor contributing to the current mortality by eastern larch beetle was found. Trees from 40 to 160 years and older were killed by the beetle. Mortality occurred on upland as well as lowland sites and in pure as well as mixed stands.

Eastern tent caterpillar
Malacosoma americanum

Region 8: Regionwide

Host(s): Cherry

Infestations were reported from urban areas in northern Kentucky. Tennessee reported average to declining infestations in middle and eastern portions of the state, with scattered areas experiencing defoliation as high as 50 percent. Defoliation by this pest rarely causes serious or permanent damage.

Region 9/Northeastern Area: Delaware, Illinois, Maine, Massachusetts, New Hampshire, New Jersey, New York, Pennsylvania, Vermont, and West Virginia

Hosts(s): Black Cherry, pin cherry, crabapple

Eastern tent caterpillar was noticeably absent from the landscape in Maine in 2006. This may be due in part to the cool, wet spring in 2005, which allowed fungal pathogens to take hold in the populations of early season defoliators, reducing the numbers for 2006. In Massachusetts, approximately 217 acres of defoliation was documented in Berkshire County. Several stands of black cherry were completely defoliated. Observed populations remain higher than the 10 year average in New Hampshire. There was no reported activity from New York. There was heavy defoliation throughout Vermont.

In Delaware, black cherry throughout the state was moderately infested in 2006. Damage was not serious in New Jersey, and most visible infestations were noticed on black cherry trees along highways and in open fields. Pennsylvania reported eastern tent caterpillar damage scattered throughout the state, with two new counties (Lancaster and Wayne) reporting total damage from this pest at 613 acres. In West Virginia, light to moderate defoliation was observed over most of the state.

Moderate to heavy infestations were found in the southern half of Illinois and very light infestations in the northern half of the state. This was in contrast to very heavy infestations in the southern third of Illinois in 2005.

Fall cankerworm
Alsophila pometaria

Region 8: Regionwide

Host(s): Various oak species

Minimal, localized activity is reported almost every spring in post oak forests in central Texas; little serious damage occurs. North Carolina reported a very heavy infestation and defoliation in Mecklenburg County, centered around Charlotte. Tennessee experienced defoliation levels below 30 percent statewide, except in Claiborne and Union Counties, where damage was somewhat heavier. Virginia reported 790 acres of light to moderate defoliation in an isolated infestation in Shenandoah County.

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

Host(s): Maples, oaks, other hardwoods

Connecticut reported about 28 acres of damage mapped in aerial survey in the southeastern-most county of New London. In Maine, defoliation from an early season defoliator was reported in the Wells area after the insects were gone. Additional light, spotty defoliation was detected in other coastal towns in York County. Winter moth was iniatially suspected, but after further inspection and pheromone trapping, the causal agent was identified as fall cankerworm. Approximately 900 acres of moderate defoliation was documented in Hampshire County, Massachusetts. About 28,000 acres of defoliation occurred in southern New Hampshire: the host was red oak and the major damage occurred in May and June. This insect was associated with some light to heavy defoliation in the Catskills region of New York; however its impacts were secondary in comparison to the forest tent caterpillar, which was often observed in the same stands and seemed to be the cause of the majority of damage. Populations collapsed in Vermont and no damage was observed.

In New Jersey, defoliation attributable to the fall cankerworm was noticeable throughout the state on hardwood trees and did not appear to be static, but affected the same acreage as in past years. Maryland reported two areas of defoliation from the fall cankerworm. In Anne Arundal County, the damage area expanded to 6,082 acres, almost four times the 1,608 acres defoliated in the same area in 2005. A small part of this area had only light to moderate damage in 2004 (which was not reported). In addition, severe defoliation was seen on 1,187 acres in Cecil County in 2006, much of this overlapping a gypsy moth treatment block. Pennsylvania continued to survey for fall cankerworm and other geometrid defoliators, including the halfwing geometer (*Phigalia titea*) and the Bruce spanworm (*Operophtera bruceata*). Combined damage from the larvae of these moths occurred on 2,606 acres in 2006, and new damage was listed in the counties of Bradford, Columbia, Lycoming and Sullivan. Increasing damage also was reported for Montour County, which was resurveyed in 2006. This was the fourth consecutive year of defoliation in some areas of Pennsylvania. West Virginia described fall cankerworm damage in terms of damage caused by several coexisting geometrid defoliators. Looper defoliation was light and was not mapped.

Fall webworm
Hyphantria cunea

Region 5: California

Host(s): Pacific madrone

Infestations of fall webworm were noted in Tuolumne, Amador, Calavaras, and Eldorado Counties. Light defoliation was noted along the Highway 49 corridor and south on Highway 108. Most of the affected trees occurred in groups along streambeds or by roadsides.

Region 8: Regionwide

Host(s): Hardwoods

North Carolina reported heavy infestations in the mountains, with partial to total defoliation. Scattered infested landscape trees were observed statewide. Tennessee reported average to low infestation levels statewide.

Insects: Native

Region 9/Northeastern Area: Delaware, Maine, Maryland, New Hampshire, New Jersey, New York, Vermont, and West Virginia

Host(s): Maple, beech, birch, hickory, walnut, apple, ash, black cherry, cherry, elm, persimmon, oak, other hardwoods

Fall webworm populations were at high levels in Maine in 2006 with many trees festooned with webs from top to bottom. Webs were found throughout the state and were in noticeable numbers further north than was usual. Populations continued to be high throughout New Hampshire, with localized populations in the central region of the state. There was no report from New York in 2006. The norther part of Vermont, experienced the heaviest damage seen in many years.

In Delaware, light defoliation was observed on black cherry and black walnut throughout the state. Numerous webs were noted in trees throughout central and southern Maryland, but only light damage in any area. There were very scattered and low infestation levels in New Jersey, with minor webbing and subsequent defoliation affecting counties bordering the Delaware River. Light to moderate defoliation occurred over most of West Virginia in 2006.

Fir engraver beetle
Scolytus ventralis and Scolytus spp.

Region 1: Idaho and Montana

Host(s): Grand fir and, rarely, other fir species

According to 2006 aerial surveys, the number of acres with fir engraver-caused mortality in grand fir stands and the number of visible red trees decreased from 2005 levels across western Montana and northern Idaho.

Regionally, total infested area exceeded 15,000 acres, down from 91,000 plus acres reported in 2005. On the 15,000 infested acres, nearly 18,000 trees were killed in 2005 (recorded as faders in 2006). Some of this reduction may be attributed to less area surveyed during aerial detection survey flights in 2006; however, ground surveys support the conclusion that fir engraver populations declined across the Region, resulting in fewer red trees across the landscape in 2006.

We believe the reduction in the number of acres with fir engraver-caused tree mortality is related to a return to near normal moisture conditions. Should we continue this nearly normal precipitation trend, fir engraver populations should continue to decline in 2007.

Region 2: Colorado

Host(s): Douglas-fir, white fir

Scolytus ventralis populations have expanded for the third consecutive year in dense white fir stands on the Pagosa Ranger District, San Juan National Forest, and on the San Carlos Ranger District, Pike-San Isabel National Forest. On the southern portions of the San Juan National Forest, corkbark fir (*Abies lasiocarpa arizonica*) has also been a preferred host of the fir engraver.

Fir engraver beetle caused tree mortality markedly diminished from 2004 in the Wet Mountains of southern Colorado. Fir engraver outbreaks, however, persist to the southwest in the Rio Grande and San Juan National Forests.

Region 3: Arizona and New Mexico

Host(s): White fir and subalpine fir

Tree mortality in the Region due to fir engraver beetles increased slightly from 64,915 acres in 2005 to 72,530 acres in 2006. In Arizona, fir mortality was recorded on the Apache-Sitgreaves (295 acres), Coconino (745 acres), Coronado (25 acres), Kaibab (105 acres) and Tonto (5 acres) National Forests; Grand Canyon National Park (5 acres); and Fort Apache Indian Reservation (20 acres). In New Mexico, fir mortality was reported on the Carson (8,250 acres), Cibola (3,710 acres), Gila (17,750 acres), Lincoln (8,810 acres), and Santa Fe (4,320 acres) National Forests; Bandelier National Monument (60 acres); 20 acres of USDI Bureau of Land Management land; Jemez Pueblo (30 acres) Jicarilla Apache (1,090 acres), Mescalero Apache (10,350 acres), and Santa Clara Pueblo (1,330 acres) tribal lands; and 15,610 acres of State and private lands.

Region 4: California, Idaho, Nevada, and Utah

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

Fir engraver beetle-caused tree mortality continues to decrease region-wide in 2006. Aerial surveyors recorded over 21,000 acres with fir mortality in 2006, compared to 65,800 acres reported in 2005. On the Humboldt-Toiyabe National Forest in Nevada, fir mortality increased slightly, from 12,400 acres in 2005 to 16,000 acres in 2006. Most of this mortality occurred on the Ely and Jarbidge Ranger Districts. Additionally, Great Basin National Park in Nevada had 2,200 acres mapped with fir mortality. In Utah, the Fishlake National Forest had 1,400 acres with mortality.

Region 5: California

Host(s): White fir and red fir

Most of northeastern California experienced low to moderate levels of fir engraver beetle activity in 2006. However, fir engraver beetle-caused mortality continued at the same elevated levels as 2005 in a few areas, in conjunction with overstocking, dwarf mistletoe, Cytospora canker and annosus root disease.

Elevated fir mortality levels continued on the Warner Mountain, Big Valley, and Doublehead Ranger Districts in the Modoc National Forest. High levels of activity were observed in the Warner Mountains near Cedar Pass, Mount Bidwell, Mount Vida to Buck Mountain, northwest of Boot Lake, and in an area between Pepperdine and Squaw Peak. The Big Valley Ranger District had notable areas of mortality east of Adin near Deer Spring Ridge and also southeast of Adin near Hunsinger Flat. Mortality also occurred in red and white fir near Medicine Lake on the Doublehead Ranger District.

Fir engraver activity was minor throughout most of the Plumas and Lassen National Forests. Areas of elevated activity were southwest of Lake Davis and northeast of Frenchman Lake, Beckwourth District, Plumas National Forest, and in extremely dense stands on Harvey Mountain and Campbell Mountain, Eagle Lake Ranger District, and Black Mountain, Hat Creek Ranger District, in the Lassen National Forest.

Elevated mortality levels continued throughout the entire red fir belt on the Tahoe National Forest. Red fir infected with dwarf mistletoe and/or annosus root disease were attacked and killed throughout the Alpine Meadows Ski Area, Truckee Ranger District. Fir engraver-caused mortality was also observed on Babbit Peak, Sierraville Ranger District, and near Leviathon Mine in Alpine County. Mortality of red and white fir continued this year on drier, high elevation sites in the vicinity of Interstate 80 from Monumental Ridge north to Yuba Pass and east to the Nevada border, in Placer and Nevada Counties.

Mortality caused by the fir engraver continued at low levels throughout most of the southern Sierra Nevada range. Elevated fir mortality was noted at higher elevations on the Eldorado National Forest. Fir engraver was also found attacking red fir of all size classes in much of the older, decadent stands that are being heavily encroached by lodgepole pine. Most of the high elevation fir mortality in the Eldorado and Stanislaus National Forests was caused by a combination of true fir dwarf mistletoe, fir roundheaded borer,

and fir engraver. Elevated fir mortality on the Stanislaus National Forest was largely aggregated in the northern section: east of the Emigrant Wilderness along the Summit Level Ridge and large areas in the Mokelumne and Carson-Iceberg Wilderness. Fir engraver activity in the Sequoia National Forest has subsided to background levels, with scattered red fir mortality confined to higher elevations.

The amount of mortality caused by the fir engraver beetle continues to decrease in southern California. Some damage occurred in the San Bernardino Mountains, but appears to be approaching the background levels found prior to the recent outbreaks.

Region 6: Oregon and Washington

Host(s): True firs

Acres reported affected by fir engraver decreased for the third straight year, from 540,630 acres with 1.72 trees per acre in 2005, to 197,348 acres, with 1.32 trees per acre in 2006.

The most significant fir engraver activity occurred in Washington. The following Reporting Areas were mapped with high mortality: Colville National Forest 12,652 acres, 1.71 trees per acre, Colville Indian Reservation 4,572 acres, 2.27 trees per acre, Gifford Pinchot National Forest 7,234 acres, 1.45 trees per acre, Mt Baker-Snoqualmie National Forest, 32,575 acres, 1.10 trees per acre, Okanogan National Forest, 4.283 acres, 3.13 trees per acre, Olympic National Park, 17,477 acres, .91 trees per acre, Wenatchee National Forest, 17,692 acres, 3.34 trees per acre, and Yakama Indian Reservation, 6,351 acres, 3.27 trees per acre. In Oregon, the most significant fir engraver was on the Umatilla National Forest, 12,655 acres with .83 trees per acre, and the Wallowa-Whitman National Forest, 10,918 acres with .73 trees per acre.

Fir roundheaded borer
Tetropium abietis

Region 5: California

Host(s): Various fir

No reports were received in 2006.

Flatheaded fir borers
Melanophila drummondi

Region 5: California

Host(s): Douglas-fir

During 2006, Douglas-fir mortality in interior portions of Santa Cruz, Mendocino, and southern Humboldt Counties increased slightly from levels detected in previous years. Mortality from this beetle was noted on Douglas-fir infected with *Phaeolus schweinitzii* in Santa Cruz County.

Douglas-fir growing on private property near Cedar Creek, west of Round Mountain in Shasta County exhibited varying degrees of resin streaming and branch and top dieback: symptoms that are typical of chronic activity by the flatheaded fir borer on stressed trees.

Flatheaded wood borer
Agrilus spp.

Region 2: South Dakota

Host(s): Gambel oak, English oak, and Eastern redcedar

Two-lined chestnut borer (*A. bilineatus*) was associated with dying bur oaks located in native stands in western South Dakota. These infestations appeared to be concentrated along the White River, though they occur in oak stands in the northwest part of the state. Bronze birch borer (*A. anxius*) infested trees are becoming more common in the central part of the state, even within communities that had experienced few problems with birch dieback until now. The increase in activity and tree decline may be related to the high summer temperatures which are a stress to birches. The hackberry borer (*A. celti*) has also been found infested hackberries throughout the central part of the state and this increased activity is probably also related to the lack of host vitality due to the drought and high summer temperatures.

Forest tent caterpillar
Malacosoma disstria

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

Host(s): Aspen and cottonwood

In 2006, forest tent caterpillar defoliation was not detected during aerial surveys. However, isolated pockets of forest tent caterpillar and fall webworm defoliation were noted throughout the Region based on ground observations.

Region 8: Kentucky, Louisiana, North Carolina, South Carolina, and Texas

Host(s): Tupelo gum and upland hardwoods

In Louisiana, defoliation occurred on 218,069 acres of forested wetlands in Ascention, Assumption, Iberville, Lafourche, Livingston, St. James, St. John the Baptist, and St. Mary Parishes in 2006. This defoliation was severe (>50 percent foliage damage) on 110,570 acres.

Kentucky reported a decline in populations in previously infested counties along the Ohio River due to natural parasitism, but the infestation has moved into urban areas in Boone, Kenton, and Campbell Counties, causing high levels of defoliation in concert with Eastern tent caterpillar.

In Texas, light, scattered defoliation was noted along the Angelina River in Angelina and Nacogdoches Counties; this is almost an annual occurrence.

North Carolina reported light defoliation along the Roanoke River in Bertie, Halifax, Martin, and Northhampton Counties.

South Carolina reported severe defoliation on 371,700 acres in 13 counties (Bamberg, Beaufort, Berkeley, Charleston, Colleton, Dillon, Dorchester, Georgetown, Horry, Jasper, Marion, Orangeburg, and Williamsburg).

Insects: Native

Region 9/Northeastern Area: Connecticut, Illinois, Indiana, Maine, Massachusetts, Michigan, Minnesota, New Hampshire, New York, Pennsylvania, Rhode Island, Vermont, and West Virginia

Host(s): Aspen, basswood, pin oak, red oak, white oak, sweetgum, sugar maple, other hardwoods

Connecticut reported more damage noted than in previous years, with about 15,500 acres defoliated. Populations in Maine remained at endemic levels with no defoliation from the insect seen in 2006. In Massachusetts, severe defoliation was reported on 438,148 acres, more than double the acres reported in 2005. This widespread defoliation occurred in Plymouth, Bristol, Norfolk, Barnstable, Hampshire, Franklin and Berkshire Counties. The presence of both an Entomophaga fungus and a virus were confirmed by the USDA Forest Service lab in Hamden, CT and populations were expected to collapse. In June, large numbers of the native biological control "friendly fly", *Sarcophaga aldrichi*, were observed. A total of 450 acres of managed sugar bushes received aerial treatment. New Hampshire aerial survey detected about 28,000 acres of defoliation in 2006, a decline from the 66,000 acres recorded in 2005. The host was generally red oak and some sugar maple. Pheromone trap catches had risen sharply and were moderate to high in northern New Hampshire where little defoliation occurred, which suggested the outbreak could move to that area in 2007.

This insect was again the most significant defoliator in New York in 2006 with an estimated damage of about 1.2 million acres. Damage was mapped by aerial survey on 34,297 acres. Heavy defoliation occurred in a band from east of the Finger Lakes to the Adirondack and Catskill mountains. Preliminary egg mass surveys indicated that there will likely be significant defoliation again in 2007, despite the fact that a large number of caterpillars were killed by disease. However, egg mass counts were generally lower than 2005 numbers. Rhode Island reported about 4,340 acres of defoliation throughout the northern, central, and eastern parts of the state. Most of the defoliated areas were a combination of forest tent caterpillar and gypsy moth. In Vermont, defoliation was mapped on 343,000 acres, mostly in the southern and western part of the state. Large numbers of caterpillars died from disease and parasites that were common in the early summer. However, the outbreak was expected to continue in 2007. A total of 5,488 acres, in 168 blocks, were aerially sprayed in late May.

The forest tent caterpillar was reported defoliating 41,976 acres in Pennsylvania during 2006, up from 30,759 in 2005. Sugar maple was most severely affected. West Virginia reported no damage in 2006.

Populations remained very low in Illinois. The epidemic in Southeast Indiana continued in 2006. It was the fourth consecutive year of noticeable defoliation in Jefferson and Switzerland Counties and the infestation expanded into Ohio, Dearborn, and Ripley Counties. Defoliation ranged from light to severe but most was in the severe class and mortality increased in 2006. In Minnesota, even though natural controls had caused the disappearance of forest tent caterpillars in most northern areas of the state, the insect was found in rather large numbers in 2006 in northeastern Grant and northeastern Stearns Counties. These populations usually inhabited oak and basswood forests along lakeshores in the west-central counties. The population of forest tent caterpillars last peaked in Northern Minnesota in 2002 but had a fairly constant presence every year in the western lake country. No defoliation was reported in Michigan in 2006.

Fruittree leaf roller
Archips argyrospilus

Region 5: California

Host(s): California black oak

Fruit tree leafroller, *Archips argyrospilus*. Black oaks had some feeding by fruit tree leafroller in early June near Cedar Camp on the Mendocino National Forest.

Hemlock looper (fall flying)
Lambdina fiscellaria

Region 9/Northeastern Area: Maine, and Michigan

Host(s): Eastern hemlock, balsam fir, white spruce

No significant hemlock looper populations were found in Maine in 2006. However, small pockets of defoliation were found in several townships in Kennebec and Cumberland County. Loopers were also found feeding on oak and maple in areas infested by the saddled prominent complex.

Loopers have been epidemic in isolated areas of Michigan in the last few years. This resulted in thin crowns, top kill and tree mortality. The eastern Upper Peninsula in Luce and Alger Counties were especially hard hit. Populations moved to areas of Northern Lower Michigan and the central Upper Peninsula in 2006. Because loopers first feed on lower branches, it was impossible to detect feeding damage with aerial surveys until trees were heavily damaged.

Horned oak gall wasp
Callirhytis cornigera

Region 8: Alabama

Hosts: Oaks and other hardwoods

A small infestation was detected in Satsuma, Alabama, where about 90 percent of the water oaks were infested and the gall wasp may have contributed to the mortality of over 50 trees in the area. The infestation appeared to be several years old.

Jack pine budworm
Choristoneura pinus

Region 9/Northeastern Area: Michigan, Minnesota, and Wisconsin

Host(s): Jack pine

Jack pine budworm defoliated almost 159,000 acres in Michigan in 2006. Heavily damaged stands are being prepared for a 2007 harvest.

In Minnesota, the primary infestation occurred in 2005 in the north-central part of the state in the area of Hubbard County and the counties surrounding it. In 2006, defoliation in that area decreased four-fold to 19,400 acres, but the infestation increased in the northern and northeastern counties, from Roseau east to Cook County on Lake Superior. Defoliation was mapped on 51,390 acres in those counties, where a portion of the outbreak was probably associated with the spruce budworm outbreak in adjacent Canada. The total area affected in the state in 2006 was 70,790 acres. In 2005, there was an unusual infestation recorded of about 6,000 acres of jack pine budworm defoliation of red pine. In 2006, the defoliation of red pine dropped to about 500 acres and occurred in Hubbard County.

The population of jack pine budworm dropped significantly in northwestern Wisconsin in 2006, but was on the rise in west-central Wisconsin. There was a total of about 115,000 acres of defoliation in the state.

Insects: Native

Jeffrey pine beetle
Dendroctonus jeffreyi

Region 4: California and Nevada

Host(s): Jeffrey pine

Jeffrey pine beetle-caused mortality nearly doubled in 2006. Approximately 900 trees were killed over 450 acres. Most of the mortality occurred on the Carson Ranger District of the Humboldt-Toiyabe National Forest, affecting nearly 700 trees over 330 acres.

Region 5: California

Host(s): Jeffrey pine

Jeffrey pine beetle activity increased on the east side of the Sierra Nevada range in 2006. Scattered mortality was noted from the northern end of the Carson range down to Coleville, Carson Ranger District, Toiyabe National Forest, and from Tahoe City to Sierraville, Sierraville and Truckee Ranger Districts, Tahoe National Forest. Notable areas of Jeffrey pine mortality are Wolf Creek Meadows, the Markleeville area, and south of Chilcoot, California, on the Toiyabe National Forest. Most mortality is in the larger diameter classes. Jeffrey pine beetle-caused mortality was also noted in large mature trees near Emerald Bay on the south edge of Lake Tahoe. Jeffrey pine beetle activity is expected to increase in these areas in 2007.

Jeffrey pine beetle was associated with chronic Jeffrey pine mortality in a stand of pine mixed with white and red fir south of Swain Mountain, Plumas County. The pines show considerable evidence of snow-caused injury, including broken, bent, and uprooted trees; nearby fir trees were not injured.

Jeffrey pine needleminer
Coleotechnites sp., near *milleri*

Region 5: California

Host(s): Jeffrey pine

The Jeffrey pine needleminer infestation continued this year near Truckee, Placer County, but at a lower intensity than in the past. Approximately 200 acres were affected, which is about the same as last year. The affected area is still entirely to the south of Interstate 80.

Jumping oak gall wasp
Neuroterus saltatorius

Region 8: Tennessee

Host(s): Oaks

Infestations were at generally low levels across Tennessee.

Lace bugs
Corythucha spp.

Region 9/Northeastern Area: New Jersey and West Virginia

Host(s): Black cherry, sycamore, and oaks

There were no observations in New Jersey in 2006. No reports were received from West Virginia in 2006.

Lecanium scale
Lecanium spp.

Region 8: Virginia

Host: Oaks, hickories, redbud, blackgum

A small infestation (5-10 acres) was reported in Shenandoah County.

Loblolly pine sawfly
Neodiprion taedae linearis

Region 9/Northeastern Area: Missouri

Host(s): Shortleaf pine and loblolly pine

No activity was reported from Missouri in 2006.

Locust leaf miner
Odontota dorsalis

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

Host(s): Black locust

Locust leafminer activity was heavy in Virginia, western North Carolina, and upper eastern Tennessee in 2006.

Region 9/Northeastern Area: Deleware, Maine, Massachusetts, New Hampshire, New York, Ohio, Pennsylvania, Vermont, and West Virginia

Host(s): Black locust

Populations remained low in Maine in 2006. There was no significant activity reported in Massachusetts. In New Hampshire, hundreds of acres of damage were mapped by aerial survey in the past decade. Mortality in those areas increased, but not significantly. In New York, this insect caused some mild to moderate discoloration and defoliation on black locust over eastern portions of the state. About 8,000 acres of damage was mapped in Dutchess County. There was widely scattered light defoliation and discoloration in Vermont.

An estimated forty percent of the black locust stands in New Castle and Kent Counties in Delaware were moderately defoliated in 2006, an increase from 2005. In New Jersey, this insect was active at low to

moderate levels and appeared to be diminishing in central counties. No significant activity was reported in Ohio or Pennsylvania. West Virginia reported moderate to severe damage across most of that state, with bronzing most obvious by late June.

Lodgepole pine needleminer
Coleotechnites milleri

Region 5: California

Host(s): Lodgepole pine

Lodgepole needleminer defoliated nearly 14,000 acres of lodgepole pine on the eastside of Yosemite National Park. This is considerably lower than previous years. Over 30,000 acres of defoliation have been detected annually since 2003. Most of the defoliation was concentrated between Tenaya Lake and Cathedral Ridge in Tuolumne Meadows. Feeding appears to have tapered off in currently infested areas, and no lodgepole pine mortality was identified.

Longhorned beetle
Lagocheirus aranaeformis stroheckeri

Region 8; Florida

Host: Gumbo limbo

A notable infestation was reported from Little Torch Key and some other Florida Keys, probably resulting from flooding stress during 2004-2005 hurricanes.

Looper complex – Linden looper and half-winged geometer
Erannis tiliaria
Phigalia titea

Region 9/Northeastern Area: Indiana

Host(s): Various oak species

There was no significant activity reported in 2006 in Indiana.

Maple leafcutter
Paraclemensia acerifoliella

Region 9/Northeastern Area: New Hampshire and Vermont

Host(s): Sugar maple

Populations remained level throughout the maple region of New Hampshire, with no significant damage. There was occasional moderate defoliation and discoloration in northern Vermont.

Maple trumpet skeletonizer
Epinotia aceriella

Region 9/Northeastern Area: Pennsylvania and Vermont

Host(s): Sugar maple, red maple

In Vermont, there was light to moderate defoliation reported statewide.

There was no significant activity reported in Pennsylvania.

Maple webworm
Tetralopha asperatella

Region 9/Northeastern Area: Massachusetts, and Vermont

Host(s): Sugar maple

Massachusetts reported heavy defoliation of sugar maple in Berkshire, Franklin, Hampden, and Hampshire Counties. In Vermont, there was widely scattered light defoliation.

Mites
***Olygonychus* spp.**

Region 8: Tennessee

Hosts: Red oak, spruce

Damage from mites feeding on oaks was generally low across Tennessee, although scattered damage to spruce was noted in high elevation stands in the northeastern part of the state.

Mountain pine beetle
Dendroctonus ponderosae

Region 1: Idaho and Montana

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

The area infested by mountain pine beetles, mapped in 2006, decreased significantly in most of the Region. Infested acreage was reduced, from 1,277,800 in 2005 to 880,900 acres for 2006. Both the Kaniksu and Clearwater National Forests showed significant decreases; however, the greatest part of those national forests were not surveyed. Most of the rest of northern Idaho exhibited verified decreases in infested area—particularly on the Nez Perce National Forest, where the infested area declined by more than two-thirds. Several formerly heavily infested areas have experienced severe amounts of host depletion.

In western Montana, with only a few exceptions, most areas also showed a decrease in infested acres. The Lolo National Forest showed a slight increase as infestations moved into previously uninfested areas. On the Deerlodge National Forest, the infested area increased significantly as beetle populations infested previously unaffected stands. However, beetle populations declined in some of the most severely impacted areas, and some of the apparent increase could be the result of mapping trees actually killed in 2004. Acres on which beetle-caused mortality was recorded, in all species and on all ownerships, increased to 804,400 in 2006, compared to 749,000 in 2005. Total infested area is still higher than the 675,000 acres that had been recorded in 2004. On those infested acres, more than 2.4 million trees were killed in 2005—recorded

as faders in 2006. A bit more than 83 percent of those were lodgepole pine. Although beetle populations declined in some host stands, populations continued to expand in a few areas. In some infested areas for which ground-collected data were obtained, as many as 295 trees (lodgepole pines) per acre have been killed within the past two to three years.

A substantial decrease in beetle-caused mortality was noted in whitebark pine stands, but mortality is still quite high—especially on the Gallatin, Helena, and Beaverhead National Forests and in Yellowstone National Park. In the Park, aerial surveys did not record as much beetle activity as in past years; however, the Park was not completely surveyed. Ground surveys in some of those stands showed 96 percent of the whitebark pine has been killed within the past few years. Infestations in some whitebark pine stands continued to expand.

Many susceptible lodgepole, whitebark, and ponderosa pine stands remain in the Region. Unless weather patterns change that favor hosts and are less conducive to beetle survival and population expansion, or management activities reduce availability of susceptible hosts, mountain pine beetle populations and resultant tree mortality will continue until few susceptible hosts remain in many stands.

Region 2: Colorado, South Dakota, and Wyoming

Host(s): Bristlecone pine, limber pine, lodgepole pine, ponderosa pine, and whitebark pine

Mountain pine beetle again was the most damaging agent in the Region in 2006. Large outbreaks continue to devastate pines in the Region from Colorado's San Luis Valley north to the Absaroka Mountains in northwest Wyoming and east into the Black Hills in South Dakota.

Mountain pine beetle populations remained at epidemic levels in lodgepole pine stands throughout northern Colorado. The following counties were severely impacted: Eagle, Grand, Jackson, Routt, and Summit. Large amounts of dead and dying lodgepole pines adjacent to towns prompted efforts by federal, state, and local homeowners to manage beetle impacts and fire risk in the wildland-urban interface. These communities included Breckenridge, Silverthorn, Dillon, Frisco, Grand Lake, Granby, Winter Park, Steamboat Springs, Avon, and Vail.

As lodgepole pine trees have been depleted from an area, mountain pine beetles have concentrating on the few pines remaining that are intermingled with Engelmann spruce in riparian areas. Along these riparian areas, the mountain pine beetle is attacking and infesting Engelmann spruce trees along with lodgepole pine trees. Mountain pine beetle larvae are developing in these trees and are reaching late larval instars. Whether these mountain pine beetles will survive to emerge as adults has not been determined.

In an unusual twist, mountain pine beetle-infested Engelmann spruce are being attacked at their base by the spruce beetle, *Dendroctonus rufipennis*. This interaction between these two *Dendroctonus* species may lead to an increasing problem as spruce beetle populations build while mountain pine beetle populations collapse due to a depletion of the lodgepole pine resource.

In Colorado, mountain pine beetles successfully completed their lifecycle in a single year at elevations in excess of 9,500 feet, where they were expected to take two years to complete development. As a result, we saw unprecedented high levels of lodgepole pine mortality in these high elevation forests.

Beetle activity in lodgepole pine continued to intensify in proximity to Vail, Colorado. Mountain pine beetle populations in ponderosa pine were at epidemic levels surrounding the Woodland Park community in El Paso and Teller Counties. The beetles also caused high levels of tree mortality in stands of ponderosa pine in the South Park area, near Fairplay, in Park County, Colorado.

A massive outbreak of mountain pine beetle in ponderosa pine on the Pike National Forest continued in 2006. In some areas much of the susceptible host type has been depleted. The outbreak of mountain pine beetle along the eastern slopes of the Sangre de Cristo Range continued during 2006.

Infestations in lodgepole, limber, and bristlecone pines were detected in a number of areas along the Front Range. Mountain pine beetle is at epidemic levels in lodgepole and limber pine forests throughout the Colorado State Forest and adjoining portions of the Routt National Forest, in the northeastern part of Jackson County. The present level of infestation averages 10 new faders per acre throughout, with some large spots of up to 1,000 infested trees.

Single trees and small groups of fading lodgepole pines, indicative of mountain pine beetle attacks, were detected throughout high-elevation forests near Rocky Mountain National Park. This suggests that a major outbreak may be imminent in this area within the next three to five years.

Mountain pine beetle epidemics continued to intensify and expand in the Black Hills of South Dakota and eastern Wyoming, where a high level of impact was detected, totaling an estimated 111,000 trees killed across 41,400 acres. Pine mortality due to this beetle was widespread in localized areas of the northern areas and across the central Black Hills. A multi-stand, landscape-level episode of beetle-caused mortality continued across the Deerfield Reservoir area.

The areas surrounding Deerfield Reservoir continue to suffer the largest outbreak of mountain pine beetle in the Black Hills. This episode has been going for about four years now and is still producing widespread and intense tree mortality. Efforts continue to treat this area to reduce beetle spread: in this past year, over 200,000 infested trees were removed to help reduce beetle populations. The outbreak around Harney Peak, including the Black Elk Wilderness, has intensified greatly over the past two years. Widespread mortality is now evident throughout the wilderness area, and this trend is expected to continue.

Mountain pine beetle populations increased to outbreak levels around the northern Hills, central Hills, and in the Norbeck-Mt Rushmore area.

Although these areas had the highest concentration of beetle-caused mortality, activity again appeared to be elevated across much of the Black Hills. In some locations, what were a few, small, widely separated spots of mountain pine beetle-killed pines in 2005 appeared in 2006 to be more numerous, larger spots closer together—potential signs of a developing beetle epidemic.

In Wyoming, limber pine mortality attributed to mountain pine beetle in concert with other stressors such as white pine blister rust was mapped within the Snowy Mountain and Sierra Madre mountain ranges of the Medicine Bow National Forest in 2006. An estimated 14,387 limber pine trees on 6,533 acres in the Medicine Bow National Forest were killed in the Carbon County area.

Lodgepole pine mortality due to mountain pine beetle was the most damaging forest agent observed during the 2006 survey of the Medicine Bow National Forest. Lodgepole pine forests across both the Sierra Madre and Snowy Range mountains were attacked by mountain pine beetle. Some of the larger infestations occurred near the Wyoming-Colorado border. Overall observations from aerial survey showed that mountain pine beetle killed roughly 780,000 lodgepole pine trees over an area of 75,453 acres on the Medicine Bow National Forest. In a separate survey within the southern Medicine Bow Mountains, 119 lodgepole pine trees per acre were infested—a 10-fold increase in the number of beetle-infested trees in 2005 surveys.

On the Shoshone National Forest, there is a large and increasing outbreak of mountain pine beetle in the Wind River area. Whitebark and limber pines were being killed in large numbers, and now landscape-level mortality is occurring throughout the lodgepole pine in the area. In whitebark pine, mortality has exceeded 50 percent in some stands, and the outbreak is only growing larger. In lodgepole pine, whole hillsides and river drainages are being killed in a relatively short amount of time. On the northern end of the Shoshone National Forest, there are rapidly increasing levels of mountain pine beetle in lodgepole pine stands. Throughout the Clarks Fork basin, small groups of beetle-killed lodgepole are appearing at regular intervals. This certainly could be the precursor to a larger-scale outbreak in this area. Along the North Fork corridor, numbers of beetle-killed lodgepole pine are also increasing. In some areas, most or all the larger-diameter pine trees are already dead, and many of the remaining ones were attacked this past summer.

In the Bighorn National Forest, there continues to be an elevated level of beetle activity in the ponderosa pine along the east slope of the Bighorn Mountains. Much of this activity occurs on lands that are difficult to treat in any way due to topography. It is expected that this trend will continue over the next few years. There is significant beetle mortality occurring in the limber pine throughout the Bighorns, especially on the western side of the mountains. Many of the limber pine stands have been heavily impacted, with the larger-diameter trees killed.

Insects: Native

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

Host(s): Bristlecone, limber, lodgepole, Jeffrey, ponderosa, western white, and whitebark pines

Mountain pine beetle-caused tree mortality decreased from 2.4 million trees killed over 615,700 acres in 2005 to 1.7 million trees killed over 510,500 acres in 2006. Most of the mortality occurred in three distinct areas. In central Idaho on the Salmon-Challis National Forest and Sawtooth National Recreation Area, a total of 827,200 lodgepole, whitebark, and limber pine trees were killed over 205,500 acres in 2006, compared to 863,700 lodgepole and whitebark pine trees killed over 246,000 acres in 2005. Bark beetle-caused tree mortality began in this area in 1998. This mountain pine beetle outbreak is currently the largest recorded in the Region. The mountain pine beetle infestation appears to be moving west onto the Boise National Forest, where an additional 125,200 lodgepole and whitebark pine trees were killed over 21,000 acres. The second outbreak area is located in western Wyoming on the Bridger-Teton National Forest. Tree mortality decreased from approximately 818,300 lodgepole and whitebark pine trees killed over 201,100 acres in 2005 to 469,500 trees killed over 165,500 acres in 2006. The third outbreak area is in northern Utah on the Wasatch-Cache and Ashley National Forests. This outbreak, in its fourth consecutive year, decreased from 504,000 lodgepole and ponderosa pine trees killed over 101,200 acres in 2005 to 169,700 lodgepole and ponderosa pine trees killed over 74,200 acres in 2006.

Region 5: California

Host(s): Various pines

Mountain pine beetle activity increased in lodgepole pine, western white pine, and whitebark pine stands in 2006. The highest mortality levels were again observed on the Modoc National Forest, where mountain pine beetle continued to cause mortality of ponderosa pine, lodgepole pine, and whitebark pine. The north end of the Warner Mountain range has some of the highest mortality levels in the Region, especially on Mount Bidwell, where approximately 75 trees per acre have been killed. Other notable areas of mortality in the north Warners include Mount Vida, Fandango Valley, and Buck Mountain. The lodgepole and whitebark pine mortality is also occurring in the south end of the range near Pepperdine, Squaw Peak, and Warren Peak to Eagle Peak. In addition, high mortality of lodgepole pine is occurring on the southeast side of the Warner Mountains near Sworinger Reservoir and Red Rock Mountain, Warner Mountain District, and near Medicine Lake, Doublehead District, Modoc National Forest.

The Tahoe National Forest had some elevated lodgepole pine mortality along Prosser Creek, near Boreal Ridge and Interstate 80, along the Truckee River, and southeast of Independence Lake, Truckee Ranger District. Also observed on the Truckee Ranger District was elevated mortality of large-diameter western white pine near Alpine Meadows. Mountain pine beetle activity associated with white pine blister rust was also noted in old growth sugar pine in the Lake Tahoe Basin.

Mountain pine beetle-caused mortality of sugar pine infected with white pine blister rust was observed near La Porte, Feather River District, and mortality of lodgepole pine was observed southwest of Lake Davis, Beckwourth District, Plumas National Forest.

Other areas of mountain pine beetle-caused mortality include lodgepole pine in the Thousand Lakes Wilderness, Hat Creek District, Lassen National Forest, and western white pine and whitebark pine east of Sonora Pass, Bridgeport District, Toiyabe National Forest.

Mountain pine beetle was involved in the death of western white pines near the Young's Valley trailhead to the Siskiyou Wilderness and above Mill Creek Lake in the Trinity Alps Wilderness. Mountain pine beetle was responsible for the death of widely scattered individual lodgepole pines on the Whaleback, Siskiyou County. The level of mortality was the lowest seen there in the past four years.

Mountain pine beetles continue to kill a number of pines in the southern California mountains, though the amount of damage has steadily decreased from previous outbreak years. Levels of mortality appear to be reaching general background levels. Concerns exist about future *Annosus* root disease in southern California resulting from inconsistent stump treatment following tree removal.

Region 6: Oregon and Washington

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

Mountain pine beetles occur throughout the range of the pine type in the Pacific Northwest. In 2006, 587,610 acres were affected, at average mortality of 6.73 trees per acre, compared to 757,969 acres affected, at an average of 8.01 trees per acre killed, in 2005. Overall, decreases in mortality were reported in all host types except sugar pine.

Lodgepole Pine

Tree mortality in lodgepole pine decreased in both acreage and intensity. A true comparison of 2005 and 2006 is difficult due to the severe fire season in the Pacific Northwest. Many of the fire areas were in lodgepole pine-dominated stands. Nevertheless, total reported affected acres decreased from 606,023 acres, at 9.31 trees per acre, in 2005, to 431,177 acres, at 8.44 trees per acre, in 2006.

Areas mapped with significant levels of mortality were in north-central Washington on acres administered by the USDA Forest Service on the Okanogan National Forest (51,038 acres), the North Cascades National Park (9,031 acres, 16.14 trees per acre), and the Colville Indian Reservation (15,217 acres, 4.31 trees per acre); and in central Washington on the Wenatchee National Forest (30,439 acres) and the Yakama Indian Reservation (27,543 acres, 14.57 trees per acre). In Oregon, significant levels of mortality were in central and south-central Oregon on the Deschutes National Forest (71,448 acres) and the Fremont National Forest (96,551 acres).

Ponderosa Pine

More affected acres were mapped in the ponderosa pine type in 2006, but at a slightly lower intensity than 2005. In 2005, 98,620 acres at 1.58 trees per acre were mapped, compared with 108,714 acres at 1.34 trees per acre mapped in 2006.

The most significantly affected areas included lands administered by the USDA Forest Service on the Fremont National Forest (39,661 acres at 1.06 trees per acre), the Deschutes National Forest (21,160 acres at .67 trees per acre) in Oregon, and the Wenatchee National Forest (5,769 acres at 2.72 trees per acre) in Washington. Affected acres on the Glenwood Reporting Area in Washington decreased significantly from 2005 with 10,889 acres at 1.45 trees per acre, to 2006 1,124 acres at 1.29 trees per acre; the Yakama Indian Reservation also showed a decrease in acres from 2005, with 10,501 acres averaging 1.26 trees per acre, to 1.300 acres, 2.06 trees per acre, in 2006.

Sugar Pine

Activity in sugar pine increased, from 796 acres 2005 to 2,835 acres in 2006. Due to the ecological importance of this rapidly disappearing species, observers attempt to record individual tree mortality to better assist land managers in maintaining the remaining resource.

In 2006, the highest recorded sugar pine mortality was 1,766 acres at .57 trees per acre on the Warm Springs Indian Reservation.

Western White Pine

Mountain pine beetle activity in western white pine decreased, from 11,117 acres (0.87 trees per acre) in 2005 to 9,726 acres (0.98 trees per acre) in 2006. Significant areas of mapped mortality include the Fremont Reporting Area (3,966 acres, .69 trees per acre) and the Mt. Hood Reporting Area (2,151 acres, .76 trees per acre).

Aerial identification of western white pine mortality is difficult because the species is often found as a minor component in mixed conifer stands and foliage has a color signature very similar to that of Douglas-fir.

Whitebark Pine

Affected acres in the whitebark pine type decreased, from 41,413 acres (5.98 trees per acre) in 2005 to 35,202 acres (4.50 trees per acre) in 2006. Between 1997 and 2006, an estimated 835,000 mature

whitebark pine trees have killed. This is a significant increasse from the previous ten-year period, when only 15,000 trees were reported killed.

Dense stand conditions continue to predispose areas to mountain pine beetle infestations. The highest levels of mortality were reported on lands administered by the USDA Forest Service on the Fremont National Forest (8,797 acres, 2.45 trees per acre), the Okanogan National Forest (13, 457 acres, 6.64 trees per acre), and the Wenatchee National Forest (6,425 acres, 6.44 trees per acre). High mortality was also noted on the Yakama Indian Reservation (1,276 acres, 8.11 trees per acre).

Nantucket pine tip moth
Rhyacionia frustrana

Region 8: Regionwide

Host(s): Loblolly pine, shortleaf pine

Texas reported a dramatic increase in tip moth activity in late summer 2006, probably related to widespread summer drought conditions. North Carolina reported scattered tip moth activity across the Coastal Plain, often in association with pitch canker. Tennessee experienced light infestations with no significant damage.

Region 9/Northeastern Area: Massachusetts

Host(s): Pitch pine

Light to moderate damage was observed on approximately 30,000 acres of pitch pine in Plymouth and Barnstable Counties in Massachusetts.

Oak leaf roller
Archips semiferana

Region 8: Texas

Host(s): Various oak species

High, localized populations of oak leaf rollers occurred over scattered portions of central Texas again in the spring of 2006. No significant damage occurred.

Oak leaftier
Croesia semipurpurana

Region 8: Tennessee

Host(s): Various oak species

High, localized populations of oak leaf rollers occurred over scattered portions of central Texas again in the spring of 2006. No significant damage occurred.

Region 9/Northeastern Area: Maine, West Virginia

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

No defoliation resulting from this pest was recorded in Maine in 2006. West Virginia again surveyed for oak leaftier eggs in 2006 and found no eggs on sample twigs.

Oakworms

Orange-striped oakworm
Anisota senatoria

Spiny oakworm
Anisota stigma

Pinkstriped oakworm
Anisota virginiensis

Yellownecked caterpillar
Datana ministra

Region 8: South Carolina, Tennessee, and Texas

Host(s): Various oak species

In east Texas, oakworm infestations diminished to very light. South Carolina reported scattered defoliation in the Piedmont. Tennessee reported late-season damage to landscape pin oaks in northeastern portions of the state and generally low levels of activity in other areas.

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

Host(s): Black oak, red oak

Connecticut reported more damage than in previous years, with an estimated 31,000 acres infested. There was no significant defoliation reported in New York. Rhode Island reported 9,351 acres of defoliation, mostly in Kent and Providence Counties.

No significant activity was reported in Maryland. In New Jersey, defoliations associated with this insect were surveyed and observed in Atlantic, Burlington and Ocean Counties. Due to overlap with gypsy moth and cynipid wasp, *Callirhytis punctata*, infestation injury status could not be specifically attributed. No significant activity was reported in Pennsylvania or West Virginia.

Oystershell scale
Lepidosaphes ulmi

Region 9/Northeastern Area: Maine and Vermont

Host(s): Beech

There was no significant activity in Maine. Vermont reported scattered light dieback and a noticeable increase in the northern part of the state.

Insects: Native

Pandora moth
Coloradia pandora

Region 5: California

Host(s): Jeffrey pine and lodgepole pine

Populations of the pandora moth appear to be increasing in El Dorado County in the Lake Tahoe Basin Management Area. At present, very little defoliation has occurred.

Region 6: Oregon

Host(s): Ponderosa pine, Jeffrey pine, and lodgepole pine

In the Pacific Northwest Region, pandora moths occur in central and southern Oregon, preferring the pumice soils. A special survey is conducted in even years to coincide with the insect's life cycle. In 2006, pandora moth defoliation was detected on 11,058 acres. Of this, only 1,124 acres were mapped in the 'moderate' defoliation category, the remaining acres were mapped as "light." The bulk of the defoliation occurred within a short distance of Highway 97 between Sand Creek to the north and Calimus to the south. The affected lands were a mix of federal (Winema National Forest) and private lands. A 794-acre polygon of defoliation, isolated from the majority of the other defoliated areas, was detected west of Bear Butte Lookout, mostly on private lands.

Peach bark beetle
Phloetribus liminaris

Region 9/Northeastern Area: New York

Host(s): Black cherry

There was no evidence of new significant damage by peach bark beetle in New York in 2006.

Periodical cicada
Magicicada septendecim

Region 8: Kentucky

Hosts: Hardwoods

A localized outbreak was reported in Kentucky just outside Cincinnati, Ohio.

Region 9/Northeastern Area: Delaware, New Jersey, New York, Ohio, Pennsylvania, West Virginia

Host(s): Hardwoods

Only very light damage on white oaks was observed in Delaware in 2006. No reports of cicadas were received from New Jersey or Ohio for the second year. There was no significant activity reported in Pennsylvania or West Virginia.

Pine bark adelgid
Pineus strobi

Region 8: Virginia and North Carolina

Host(s): White pine

Numerous reports of this pest occurred from sites throughout the range of white pine in 2006, including Madison, Green, Goochland, Albemarle, Franklin, Nelson, Carroll, Rockbridge, Grayson, and Washington Counties. It is likely that drought stress and overstocking were common causes, with the adelgid populations expanding as a result of the number of trees in a weakened condition. Light infestations were noted in western North Carolina.

Pine colaspis beetle
Colaspis pini

Region 8: Arkansas and Louisiana

Host(s): Southern pines and ornamental cypress

As in previous years, this beetle caused localized, minor defoliation of pine plantations in eastern and central Louisiana. In Arkansas, scattered trees were affected in west and northwest White County.

Pine engraver beetles
***Ips* spp.**

Region 1: Idaho and Montana

Host(s): Ponderosa, lodgepole, other pine species

Pine engraver beetle populations and associated tree mortality decreased substantially once again in ponderosa pine stands in the Region. At least some of those decreases resulted from beetle-killed trees in the eastern part of Montana that were attributed to mountain pine beetles rather than engraver beetles. Likely, some of those trees were killed by both—either alone or in combination. Whereas about 13,000 acres of mortality were recorded in 2005, less that 1,600 acres were mapped in 2006. We believe that, throughout the Region, pine engraver beetle populations were static or have declined significantly within the past couple of years in response to increased moisture conditions. Only about 3,000 ponderosa pines were killed by engraver beetle in the Region in 2006.

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

Host(s): Colorado blue spruce, Englemann spruce, jack pine, lodgepole pine, pinyon pine, and ponderosa pine

Ips activity in pinyon pine has subsided along with the drought in southern Colorado. The final tally from a 2003-2005 comprehensive pinyon *Ips* aerial survey was over 5.5 million pinyon trees killed across 1.5 million acres throughout the state

While pinyon *Ips* and pinyon twig beetle activity were much reduced from the large mortality event that occurred in 2003 and 2005, there were still some areas of notable mortality: specifically, throughout the southern portion of the Uncompahgre Plateau.

In virtually all affected pinyon *Ips* areas from prior years, remnant populations of the bark beetles have survived; this, coupled with low moisture levels recorded during the winter of 2006, may cause these

populations to rebound, which may result in increased mortality. The close correlation between beetle activity and moisture availability make additional large mortality events possible. While many stands of pinyon were virtually wiped out during the last mortality event, there are still many areas containing mature, susceptible pinyon.

Ips activity in jack and ponderosa pine continued at elevated levels on the Nebraska National Forest in central Nebraska. There is an increased level of concern over *Ips* activity around Chadron, where a number of large wildfires burned and scorched large acreages of ponderosa pine. Forest areas affected by these fires are now highly susceptible to attack by increasing *Ips* populations.

Ips activity in ponderosa pine continued to be a problem in South Dakota. Far less pine engraver activity was detected as compared with 2005. This is the second consecutive year of large reductions in killed trees and affected acres attributed to pine engraver. Note that pine engravers can and do act in concert with mountain pine beetle, at times attacking the same trees, so that significant pine engraver populations may exist in the mountain pine beetle epidemic areas.

Ips infestations continued to decline in the Black Hills from their historically high levels in 2000-2003. There are still some areas with drought-stressed trees in the wildland-urban interface and/or fire-damaged trees, which were becoming infested and killed by the pine engraver beetle.

In contrast to mountain pine beetle in the central and northern Black Hills, activity by pine engraver beetles was concentrated around the periphery of the Black Hills and, to a much lesser degree, associated with recent fires. Another significant source of tree mortality by *Ips* was attacks on pines weakened by *Sphaeropsis* blight and hail damage.

Ips activity appeared to be reduced this past year in much of Wyoming. As the drought continues, we would expect these beetles to be a continuing concern. They are also a concern in areas being infested by *Dendroctonus* beetles, which are killing much of the larger-diameter stems. The smaller-diameter material that is left could become hosts for an *Ips* population that has built up in *Dendroctonus* attacked trees or other nearby trees stressed by occurrences such as fire.

Region 3: Arizona and New Mexico

Host(s): Ponderosa pine, pinyon pine

Ponderosa pine mortality caused by *Ips* beetles increased from 6,950 acres in 2005 to 18,460 acres in 2006. In Arizona, ponderosa pine mortality due to *Ips* spp. beetles was reported on the Apache-Sitgreaves (855 acres), Coconino (1,300 acres), Coronado (115 acres), Kaibab (6,850 acres), Prescott (170 acres), and Tonto (515 acres) National Forests; Grand Canyon National Park (245 acres), Saguaro National Monument (55 acres), and USDI Bureau of Land Management lands (945 acres); Fort Apache (385 acres), Hualapai (160 acres), Navajo (100 acres), and San Carlos (145 acres) Indian Reservations; and 320 acres of State and private lands. In New Mexico, *Ips*-caused ponderosa pine mortality was detected on the Cibola (1,130 acres), Gila (1,320 acres), Lincoln (100 acres), and Santa Fe (230 acres) National Forests; Mescalero Apache tribal lands (2,330 acres); and 1,190 acres of State and private land.

Region 4: Idaho and Utah

Host(s): Lodgepole pine and ponderosa pine

Approximately 150 trees on USDI Bureau of Land Management and National Forest System lands in Idaho were killed in 2006. Tree mortality caused by pine engraver beetle remained at endemic levels throughout the region. An increase in top-killed ponderosa pine was noted on the Boise National Forest, Idaho USDI Bureau of Land Management, State of Idaho, and private lands in 2006.

Region 5: California

Host(s): Coulter, Jeffrey, knobcone, lodgepole, pinyon, and ponderosa pines

Engraver beetles continue to cause scattered mortality of shore pine and Bishop pine along the Mendocino coast from Fort Bragg northward to Cleone, California.

Region 6: Oregon and Washington

Host(s): Ponderosa pine

Acres affected by pine engraver beetles decreased for the third straight year, from 27,601 acres with 2.25 trees per acre in 2004 to only 5,357 acres with 1.95 trees per acre in 2006. The Wenatchee Reporting Area was the only area that retained consistent damage, with 2,362 acres, 2.21 trees per acre, in 2005, and now 2,416 acres, 2.39 trees per acre, in 2006.

Ips calligraphus
I. grandicollis
I. avulsus

Region 8: Regionwide

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

Alabama reported a sharp increase in *Ips* activity in all but the northeastern part of the state. Mortality is significant but scattered. The summer drought was largely responsible plus the lingering effects of Hurricane Katrina. A drastic increase in pine mortality following Hurricane Katrina occurred in southeast Louisiana parishes (St. Tammany, Tangipahoa, and Washington) in 2006 due to the storm, summer drought, black turpentine beetle activity, and *Ips* engraver beetle activity. Mortality was abundant, but widely scattered. Mortality also occurred farther west and into southwest Louisiana parishes affected by both hurricanes Katrina and Rita. Mississippi also experienced greatly increased pine mortality in the southern part of the state due to the effects of Hurricane Katrina, summer drought, and *Ips* engraver beetle activity. Mortality was widely scattered, but as many as 56 concentrated spots of mortality were detected during aerial surveys.

Georgia reported intense *Ips* activity in the lower Piedmont and upper Coastal Plain due to seasonal drought. The activity was often associated with thinning and *Annosum* root disease; many *Annosum*-infected stands suffered severe losses. Pine mortality due to *Ips* and summer drought was high in southeastern Oklahoma in 2006, but was widely scattered. Pine engraver beetle activity increased across east Texas. The summer drought combined with lingering effects of hurricane Rita probably contributed to this situation. Generally, the highest activity was in an area north of Livingston and Polk Counties, particularly on the edge of the natural pine range in Houston and Anderson Counties. Tennessee experienced scattered small spots statewide, while Virginia reported only scattered activity in the Coastal Plain and in south-central Piedmont sites affected by earlier storms.

Pine engraver
Ips pini

Region 5: California

Host(s): various pines

Small outbreaks of *Ips pini* killed ponderosa pines of various ages in the Camino area of El Dorado County. Trees were growing on poor sites and in overly dense stands.

Insects: Native

Pine needle miner
Exoteleia pinifoliella

Region 9/Northeastern Area: Massachusetts

Host(s): Pitch pine

In Massachusetts, damage was observed on pitch pine in Plymouth and Barnstable Counties. The aerial survey identified 5,469 acres of damage, a decrease from the 22,624 acres reported in 2005.

Pine needle scales
Chionaspis pinifoliae
Matsucoccus acalyptus

Region 2: Colorado

Host(s): Piñon pine and Scots pine

No reports were received in 2006.

Region 5: California

Host(s): Various pines

About five acres of ponderosa and sugar pines in a mixed conifer stand (Groveland Ranger District, Stanislaus National Forest) were experiencing a chronic infestation of pine needle scale. Mature pines had been suffering slow needle loss for a number of years, but no mortality was associated directly to the scale.

Pine needle sheathminer
Zelleria haimbachi

Region 5: California

Host(s): Various pines

A thinning operation in the Ponderosa Burn plantation, Siskiyou County, provided the opportunity to inspect the tops of cut, 22-year-old ponderosa pine for infestation by the pine needle sheathminer in an area that had experienced sheathminer outbreaks during the 1990s. No appreciable injury was present, but 59 percent of shoots from top whorls and terminals were infested with one or more sheathminer larvae. In contrast, 30 percent of shoots from the lower crowns of nearby uncut trees were infested with one or more larvae. Regardless of position within the tree, the majority of shoots had one larva, but occasionally two or three were found. These results translate in to an average of less than one larva per shoot. Infestation levels this low go unnoticed as each larvae destroys only six to ten needle fascicles before pupating.

Plantations of ponderosa pine were heavily infested by the pine needle sheathminer in China Flat, Groveland Ranger District, Stanislaus National Forest. The infestation was scattered over 15 acres. Some trees had nearly 50 percent loss of current and older foliage. Trees less than 10 feet tall displayed stunted terminal growth or “bottlebrush” shorter leaders; however, no mortality was detected.

Pine sawflies
Neodiprion spp.
Diprion spp.

Region 2: South Dakota

Host(s): Ponderosa pine

No reports were received in 2006.

Region 5: California

Host(s): Ponderosa pine

Understory ponderosa pine trees were defoliated by sawflies during the spring in Yreka, Siskiyou County.

Neodiprion lecontei

Region 9/Northeastern Area: Michigan

Host(s): Red pine, jack pine

In Michigan, sawfly populations were active in the eastern Upper Peninsula and the northern Lower Peninsula since 2002. This insect is an important defoliator of ornamental, natural-growing, and plantation pines and there were treatments on 636 acres of infested red pine in 2006.

Diprion spp.

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

Host(s): Southern pines

Infestations of pine sawflies in Georgia were limited to one- to two-year-old plantations, with only light to moderate damage. Scattered sawfly damage was reported in Louisiana in 2006. Redheaded pine sawfly damage was reported in east Texas. Virginia reported light, scattered defoliation, with pockets of heavy defoliation in Westmoreland and Northumberland Counties. Tennessee reported only light damage from red-headed pine sawflies, but noted increasing populations of black-headed sawflies in Jefferson and Polk Counties, with rising populations of loblolly pine sawflies in Wilson, Smith, Putnam, Davidson, Robertson, Coffee, and Rutherford Counties. Surveys indicated approximately 1,400 trees with greater than 50 percent defoliation.

Pine tip moth
Rhyacionia spp.
Dioryctria spp.

Region 2: Nebraska and South Dakota

Host(s): Austrian pine, ponderosa pine, and Scots pine

Not surveyed in 2006.

Insects: Native

Pine tussock moth
Dasychira grisefacta

Region 2: Nebraska

Host(s): Ponderosa pine

An area of a few hundred acres of ponderosa pine on private land near Kimball, Nebraska had an outbreak in 2006. This was near, but separate from, an area that had an outbreak in 2003 and 2004. Heavy defoliation of old needles occurred locally.

Pinyon ips
Ips confusus

Region 3: Arizona and New Mexico

Host(s): Pinyon pine

Pinyon ips caused tree mortality decreased slightly in 2006, with 5,805 acres impacted as compared to 6,080 acres in 2005. Pinyon ips-caused tree mortality in Arizona was recorded on the Apache-Sitgreaves (20 acres), and Kaibab (15 acres) National Forests; and Fort Apache (15 acres), Hualapai (1,860 acres), Hopi (5 acres), Navajo (1,320 acres), and San Carlos (5 acres) Indian Reservations; and 5 acres of State and private land. Pinyon ips-caused tree mortality in New Mexico was recorded on the Cibola (400 acres) and Gila (500 acres) National Forests; USDI Bureau of Land Management lands (30 acres); Alamo Navajo (30 acres), Mescalero Apache (50 acres), and Zuni Pueblo (1,420 acres) tribal lands; and 130 acres of State and private lands.

Region 4: California, Nevada, and Utah

Host(s): Pinyon pine

Historically in the Intermountain Region, pinyon-juniper forests have not been aerially surveyed. However, the dramatic increase in pinyon mortality during 2001 and 2002, which resulted from an extended drought and increased pinyon ips populations, necessitated documenting this widespread mortality. By 2005, the pinyon ips outbreak had collapsed. Therefore, much of the pinyon/juniper forest type was not surveyed in 2005 or 2006. Of the pinyon forest type surveyed in 2006, approximately 12,800 pinyon pines were mapped across 9,200 acres. Most of the tree mortality was reported in Utah (7,300 trees across 5,100 acres). The remainder occurred in Nevada (5,500 trees across 4,000 acres). In Utah, most of the mortality occurred on the Dixie National Forest. In Nevada, most of the mortality occurred on private and USDI Bureau of Land Management lands.

Redheaded ash borer
Neoclytus acuminatus

Region 2: South Dakota

Host(s): Ash trees

The redheaded ash borer has been found in ash injuried by the ice and wind storms that swept across the eastern part of the state. Drought conditions have further weakened trees, and the combination of these stresses has allowed this insect to become a secondary stressor on living trees rather than being associated only with down or dead trees.

Red oak borer
Enaphalodes rufulus

Region 8: Arkansas, Oklahoma, and Virginia

Host(s): Northern red oak, southern red oak, black oak and other red oaks

Virginia reported widespread but locally heavy damage in 2006, evidently resulting from latent effects of past storms, particularly in the Coastal Plain. Alabama reported red oak borer associated with an increase in oak decline in bottomland stands in the southwestern part of the state. These are probably effects in conjunction with effects of Hurricane Katrina and the 2006 summer drought. In Arkansas and Oklahoma, populations of the red oak borer have substantially diminished (see also **Oak decline and Abiotic and Biotic Influences** under **Declines/Complexes**).

Red turpentine beetle
Dendroctonus valens

Region 5: California

Host(s): Various pines

Red turpentine beetle activity was observed in sugar pine, ponderosa pine, and Jeffrey pine in nearly every prescribed burn and wildfire visited in northeastern California in 2006. In a spring 2004 prescribed burn near Prattville, Almanor Ranger District, Lassen National Forest, most large-diameter ponderosa and sugar pine that had over 50 red turpentine beetle attacks are still alive. These trees received very little crown scorch during the burn. Monitoring will continue for the next three years.

Red turpentine beetle-caused scattered mortality in a 20-year-old ponderosa pine plantation north of Lake Almanor, Plumas County. The plantation was thinned in the spring of 2004 and most of the attacks appeared to have occurred in 2005, suggesting that a build-up of red turpentine beetle in cut stumps contributed to the mortality.

Reproduction weevils
Hylobius pales
Pachylobius picivorus

Region 8: Regionwide

Host(s): Southern pines

North Carolina and Tennessee reported only scattered activity; South Carolina also reported scattered activity in the Coastal Plain.

Roundheaded pine beetle
Dendroctonus adjunctus

Region 3: Arizona and New Mexico

Host(s): Ponderosa pine

Roundheaded pine beetle-caused tree mortality in the Region increased from 120 acres in 2005 to 380 acres in 2006. In Arizona, roundheaded pine beetle mortality was recorded on the Apache-Sitgreaves (20 acres)

and Coronado (230 acres) National Forests; Fort Apache (20 acres) and San Carlos (10 acres) Indian Reservations; and 100 acres of State and private lands. In New Mexico no mortality due to roundheaded pine beetle was detected.

Saddled prominent
Heterocampa guttivitta

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

Host(s): Oak, maple, beech, birch

In Maine, saddled prominent occurred in a complex with variable oakleaf caterpillar and green-striped mapleworm on about 10,500 acres. Observations in New Hampshire rose dramatically throughout the central part of the state. Approximately 60,000 acres of damage was reported in the White Mountain National Forest. There was widespread light defoliation reported in northern Vermont by saddled prominent in conjunction with green-striped mapleworm and hemlock looper on sugar maple. About 1,340 acres of moderate to heavy defoliation was mapped by aerial survey, the first mapped from the air since 1981.

Scarlet oak sawfly
Caliroa quercuscoccineae

Region 9/Northeastern Area: Pennsylvania and West Virginia

Host(s): Black oak, pin oak, red oak

Pennsylvania reported light damage in Mifflin, Snyder, and Union Counties, and levels of damage appeared to be decreasing. No significant activity was reported in West Virginia.

Southern pine beetle
Dendroctonus frontalis

Region 8: Regionwide

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

Southern pine beetle activity decreased in Alabama, from 4,444 spots detected in 2005 to over 1,100 spots detected in 2006. A total of 18 counties were considered in epidemic status. Mississippi reported only nine spots, and activity continues to be non-existent in Arkansas, Louisiana, Oklahoma, and Texas. South Carolina reported a total of 3,090 spots in 32 counties, four of these in epidemic status. Florida reported only three spots totaling less than one acre. North Carolina reported only very low levels of southern pine beetle activity. Tennessee noted low, static populations except in a few western counties, where aerial surveys indicated rising southern pine beetle mortality.

Region 9/Northeastern Area: Delaware, Maryland, New Jersey, Ohio, and West Virginia

Host(s): Austrian pine, loblolly pine, pitch pine, Scotch pine, and Virginia pine

In Delaware, southern pine beetle populations were at low or declining levels. In Maryland, populations continued to remain low, similar to 2005. New Jersey reported infestations again found only in Cape May, Cumberland, and Atlantic Counties, with conditions described as decreasing to static for most of this area.

The exception was southeastern sections of Atlantic and Cape May Counties, where high populations of this beetle were observed. Ohio reported no southern pine beetle activity in 2006. Due to very low numbers in past years' surveys, West Virginia did not survey for the southern pine beetle in 2006.

Spruce beetle
Dendroctonus rufipennis

Region 1: Idaho and Montana

Host(s): Engelmann spruce

Spruce beetle populations remained at endemic levels throughout both northern Idaho, Montana, and in Yellowstone National Park. Only the Lolo National Forest had as many as 50 acres infested by spruce beetle in 2006. The outbreak recorded east of Yellowstone Lake in Yellowstone National Park, mapped at more than 8,700 acres in 2003, was not surveyed in 2006, but we believe that outbreak has declined to endemic levels. Total infested area recorded in the Region in 2006 was only 127 acres, on which an estimated 154 trees were killed.

Region 2: Colorado and Wyoming

Host(s): Colorado blue spruce, Engelmann spruce, and white spruce

Spruce beetle activity intensified on the Grand Mesa-Uncompahgre-Gunnison, Rio Grande, San Juan, and White River National Forests. Of particular management concern were three expanding outbreaks: one on the White River National Forest in proximity to Baylor Park, one near the Colorado-New Mexico state line on the Rio Grande National Forest, and a a massive outbreak throughout high-elevation spruce trees from Wolf Creek Pass to west of Telluride (Rio Grande, San Juan, and Uncompahgre National Forests). Recreational values are currently at grave risk as spruce beetles impact stands near the Wolf Creek and Telluride ski areas. Over 1,000,000 trees across 90,000 acres were killed within the San Juan Mountains in 2006.

Spruce beetle populations in northern Colorado remained at epidemic levels in Jackson and Routt Counties in the general vicinity of Steamboat Springs on the Routt National Forest. Spruce beetle populations were reaching epidemic levels adjacent to Rocky Mountain National Park and north to the Wyoming state line, in Grand, Jackson, and Larimer Counties. These epidemics occurred on Colorado State Forest lands, and on the Roosevelt and Routt National Forests.

In Wyoming, spruce beetle continues to expand through the spruce type on the northern end of the Shoshone National Forest. Almost all spruce from pole-size and up were killed in the Carter Mountain area. Now, the beetle is causing similar widespread mortality in spruce stands in Sunlight Basin. At this point, it appears that much of the spruce type on the northern end of the Shoshone National Forest will be affected before this major landscape-level event subsides. Anywhere spruce is found along the North Fork corridor, most of the larger trees have been killed and many of the smaller ones also attacked.

Spruce beetle has been at relatively low levels on the Bighorn National Forest; however, there have been a few spots of elevated activity. There continues to be a large number of spruce killed along Highway 14A, a main highway in Bighorn Mountain area.

In southern Wyoming, spruce beetle populations were at epidemic levels along the main drainages of North Platte Creek and Savage Run Creek, on the Medicine Bow National Forest. Much of this spruce mortality occurs within mixed lodgepole pine forests decimated by mountain pine beetle. Spruce beetle is prominent south of Snowy Range Pass. Spruce mortality due to spruce beetle is also common within lodgepole pine stands destroyed by mountain pine beetle in Carbon County. Spruce beetle is also rampant along the Roaring Fork of the Little Snake River and the West Branch of the Little Snake River. Within the Snowy Range and Sierra Madre Ranges, spruce beetle killed 126,226 trees over 37,212 acres.

Insects: Native

Region 3: Arizona and New Mexico

Host(s): Spruce

Spruce beetle-caused tree mortality decreased from 19,935 acres in 2005 to 7,025 acres in 2006. In Arizona, spruce beetle mortality occurred on Fort Apache (5 acres) and Navajo (70 acres) Indian Reservations. In New Mexico, spruce beetle related tree mortality occurred on the Carson (2,220 acres), Cibola (40 acres), Lincoln (80 acres), and Santa Fe (1,870 acres) National Forests; Mescalero Apache (80 acres) tribal lands; and 2,660 acres of State and private lands.

Region 4: Idaho, Utah, and Wyoming

Host(s): Spruce

In 2006, Engelmann spruce beetle mortality decreased to 20,700 trees killed over 12,800 acres compared to 83,200 trees killed over 35,400 acres in 2005. Nearly all of the mortality occurred in Utah, where each National Forest experienced some level of spruce mortality. Forests where heavier mortality was mapped included the Loa and Beaver Ranger Districts on the Fishlake National Forest (2,500 acres and 1,100 acres, respectively), the Price Ranger District on the Manti-La Sal National Forest (2,700 acres) and the Heber Ranger District on the Uinta National Forest (1,200 acres). Spruce mortality was also mapped on private lands from central to southern Utah affecting 1,000 acres.

Region 6: Oregon and Washington

Host(s): Engelmann spruce

All reported mortality in Oregon and Washington in 2006 was in Engelmann spruce. Reported acres affected decreased from 39,802 acres, 18.2 trees per acre, in 2005 to 30,852 acres, 20.90 trees per acre, in 2006. The majority of mortality occurred on lands administered by the Forest Service within the Okanogan Reporting Area. This area experienced numerous large wildfires in the spruce/fir/lodgepole forest types.

On the Okanogan Reporting Area, acres with mortality decreased from 38,235 acres, 18.72 trees per acre, in 2005, to 25,735 acres, 23.46 trees per acre, in 2006.

Region 10: Alaska

Host(s): White, Lutz, Sitka, and black spruce

Spruce beetle activity in Alaska has increased. A total of 119,610 acres were mapped in 2006, an increase of 68 percent since 2005. Light to moderate activity persists in some areas of south-central Alaska and the Copper and Kuskokwim river valleys. Although only 2,100 acres of beetle activity were identified in the Lake Clark area, this relatively small figure belies its potential significance. Intense beetle activity has occurred over the past 10 years in the Iliamna area to the south and the Lake Clark Pass area to the east. Throughout this period, beetle populations in the vast, mature, susceptible spruce stands around Lake Clark have remained at endemic levels. If conditions become favorable for an outbreak of spruce beetle, the forests around Lake Clark are capable of sustaining widespread activity for a number of years to come. Aerial surveys will continue in this area in 2007 to assess the progress of this activity. Katmai National Park has the most intense spruce beetle outbreak in the state. Populations at Katmai increased 300 percent since last year. Nearly 70,000 acres of mature spruce, primarily at the west end of Naknek Lake and Lake Brooks, are currently under attack. On the Kenai Peninsula, spruce beetle activity has doubled over the last year, increasing to over10,000 acres. In addition to beetles moving into previously uninfested stands, trees previously too young and too small to suffer attack in stands infested earlier are now mature and large enough to be susceptible. Spruce beetle populations in the Mat-Su Valley doubled to 14,200 acres during the past year due largely to increasing beetle activity in the Skwentna and Yentna river valleys. The large

volume of beetle-killed spruce in past-affected areas across the interior and south-central regions continues to pose a threat to forests and forest managers as potential for catastrophic wildfires.

Spruce budworm
Choristoneura fumiferana

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

Host(s): Balsam fir, hemlock, white spruce, red spruce, black spruce, larch

Monitoring of low level spruce budworm populations continued in Maine in 2006. The population remained static at very low levels. The numbers of moths caught in pheromone traps were slightly up or down at individual locations, but the average was about the same as it was in 2005. Light trap catches reflected this same low-level population. No larval activity or defoliation was observed during field surveys. The Maine Forest Service will continue to monitor this serious pest. In New Hampshire, no defoliation was found, and trap catches remained low. No significant defoliation was observed in New York in 2006, and trap counts were generally low to moderate. No defoliation was observed in Vermont.

There were about 29,700 acres defoliated by spruce budworm in Michigan, all in the Upper Peninsula. Areas of light defoliation were visible for the last few years. The 2006 survey was complicated by a very heavy spruce cone crop: the cones thinned the crowns and turned upper canopies brown, making aerial detection of light to moderate defoliation difficult.

In Minnesota, spruce budworms defoliated trees on 287,220 acres in 2006. This was a large increase from the 92,500 acres defoliated in 2005. Budworm activity continued to be centered in northern St. Louis County, with some defoliation also occurring in southeastern Koochiching County, northeastern Itasca County, and central Lake County, as well as a number of scattered locations in other parts of the state. In addition to white spruce and balsam fir, budworm defoliation occurred on black spruce and tamarack on the west end of Lake Vermillion in northern St. Louis County. In northeastern Minnesota, budworm defoliation has been noticeable and mapped continuously since 1954. There was an average of 220,000 acres of defoliation mapped each year over this 53-year period.

There was 2,438 acres of defoliation mapped in Wisconsin in 2006.

Region 10: Alaska

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

In 2004, indications were that a spruce budworm outbreak had begun as over 83,000 acres of spruce in interior Alaska were defoliated. Fires and smoke in 2004 and 2005 curtailed the area surveyed and may also have contributed to a decrease in the severity of the outbreak. In 2006, just over 53,000 acres of defoliation were mapped by aerial surveys. Damage was concentrated along the hills and ridges around Fairbanks (Nenana Ridge, Parks Ridge, and Chena Ridge), west along the Tanana River, north to the vicinity of Livengood, and along the northern foothills of the Alaska Range.

Ground surveys indicate that populations of spruce budworm are still expanding and that the outbreak will continue to intensify along the ridges. Defoliation of white spruce tops was observed on as much 5-10 feet, resulting in some top kill.

Insects: Native

Spruce needleminer
Endothenia albolineana

Region 2: South Dakota

Host(s): Black Hills white spruce, Colorado blue spruce, Englemann spruce

The number of spruce found infested by this insect continues to grow. The needleminer was confined to only a few counties in the state in the 1980s, but now can be found defoliating spruce throughout eastern South Dakota and the Black Hills. The defoliation is usually confined to the lower branches but this premature loss of foliage reduces the value of the trees in windbreaks and urban plantings.

Texas leaf-cutting ant
Atta texana

Region 8: Louisiana and Texas

Host(s): Southern pines and hardwoods

Localized defoliation of recently planted pine plantations occurs annually in east Texas and west-central Louisiana on sites with deep, sandy soil. Populations of these ants remain relatively stable from year to year.

Twig beetles
***Pityophthorus* spp.**
***Pityogenes* spp.**

Region 2: Colorado

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

No reports were received in 2006.

Variable oakleaf caterpillar/saddled prominent/green-striped mapleworm complex
Lochmaeus manteo/Heterocampa guttivitta/Dryocampa rubicunda

Region 8: Arkansas and Tennessee

Hosts: Oaks

Defoliation was noted in 2006 for the first time in several years in north-central Arkansas, in Conway, Faulkner, and Van Buren Counties. Tennessee reported defoliation along the southwestern Highland Rim during late spring affecting mostly intermediate crown classes of oak.

Region 9/Northeastern Area: Maine

Host(s): Oak, maple, beech, birch

In 2006, moderate defoliation of red oak, maple, beech and birch caused primarily by saddled prominent was detected in western Maine as well as in a small pocket in Cumberland County. The green striped mapleworm, *Dryocampa rubicunda*, was found in collections and at light trap stations. Moderate to heavy defoliation was noticeable from the air on approximately 10,360 acres. The Cumberland County infestation was smaller than in 2005, but the western Maine area had expanded and was overlapped by birch leaf spot damage, making delineation of the infestation difficult.

Walnut caterpillar
Datana integerrima

Region 8: Florida and Tennessee

Host(s): Walnut and hickories

Only low levels of damage were noted.

Web-spinning sawflies
Neurotoma fasciata

Region 2: South Dakota

Host(s): Cherry and plum trees

The feeding by this sawfly resulted in the defoliation of plums and cherries throughout the south-central part of the state. The sawfly had left most plum thickets completely defoliated by early summer, resulting in a poor fruit crop this year.

Western balsam bark beetle
Dryocoetes confusus

Region 1: Idaho and Montana

Host(s): Subalpine fir

Western balsam bark beetle mortality is a significant component of the subalpine fir mortality complex described in the Decline and Complexes portion of this report.

Aerial detection surveys in 2006 showed a decrease in acres infested and in red (dead) subalpine fir trees from 2005 levels. In 2005, aerial detection surveys in western Montana and northern Idaho mapped over 308,000 acres, with over 392,000 red trees detected. In 2006, 158,000 acres with over 185,000 red subalpine fir trees were recorded.

In 2006, aerial detection surveys were not conducted over portions of some forests that were heavily impacted by western balsam bark beetle in 2005, including the Beaverhead National Forest, Gallatin National Forest, and Kaniksu National Forest. The Beaverhead National Forest in southwestern Montana was not surveyed in its entirety, but was still found to harbor the most widespread outbreaks with more than 54,000 infested acres reported in 2006. If nearly normal precipitation trends continue, western balsam bark beetle populations should continue to decline in 2007.

Insects: Native

Western black-headed budworm
Acleris gloverana

Region 10: Alaska

Host(s): Western and mountain hemlock; Sitka, Lutz, and white spruce

Western black-headed budworm populations are currently at endemic levels, with approximately 1,400 acres of defoliation mapped in Prince William Sound and southeast Alaska for the past three years.

Western hemlock looper
Lambdina athasaria

Region 6: Oregon and Washington

Host(s): Western hemlock and associated conifers

Western hemlock looper has caused more mortality of western hemlock than has any other defoliator. Acres defoliated in Washington State increased slightly, from 1,207 acres in 2005 to 1,771 acres in 2006. Almost all the affected acres this year were in the Mt. Baker-Snoqualmie Reporting Area.

Western pine beetle
Dendroctonus brevicomis

Region 1: Idaho and Montana

Host(s): Ponderosa pine

Ponderosa pine mortality attributed to western pine beetle continued to decline from about 3,600 acres in 2005 to slightly under 1,000 acres in 2006. Almost 1,350 trees were killed. About one-third of the infested acres occurred on the Lolo National Forest in Montana. Most of the other mortality occurred on the Nez Perce Reporting Area and the Nez Perce Indian Reservation in northern Idaho. As moisture levels continue to maintain normal or above normal conditions, western pine beetle populations are expected to remain at low levels in 2007.

Region 3: Arizona and New Mexico

Host(s): Ponderosa pine

Tree mortality attributed to this insect more than doubled, from 25,445 acres in 2005 to 80,270 acres in 2006. In Arizona, western pine beetle mortality was detected on the Apache-Sitgreaves (145 acres) and Kaibab (410 acres) National Forests; USDI Bureau of Land Management lands (130 acres); Fort Apache (75 acres), Hualapai (115 acres), Navajo (30 acres) and San Carlos (10 acres) Indian Reservations; and 105 acres of State and private lands. In New Mexico, significant activity was detected on the Carson (240 acres), Cibola (2,400 acres), Gila (56,600 acres), Lincoln (1,860 acres), and Santa Fe (1,830 acres) National Forests; USDI Bureau of Land Management lands (20 acres); Mescalero Apache (360 acres) tribal lands; and 15,940 acres of State and private lands.

Region 4: Idaho

Host(s): Ponderosa pine

In 2006, the number of ponderosa pine trees killed by western pine beetle attacks remained at endemic levels. Most of the mortality occurred on national forests and private lands in Idaho. Approximately 1,000 trees were killed, affecting 500 acres in 2006, compared to 1,500 trees killed over 600 acres in 2005.

Region 5: California

Host(s): Coulter pine and ponderosa pine

Western pine beetle-caused mortality increased slightly in northeastern California in 2006. Western pine beetle-caused mortality of ponderosa pine was most prevalent in the Warner Mountains, Warner Mountain Ranger District, Modoc National Forest. Specific areas of mortality include Mount Bidwell, from Mount Vida to Buck Mountain, Fandango Valley, and Joseph Creek. The Wildhorse Reservoir and Weed Valley areas west of Goose Lake, Devils Garden Ranger District, Modoc National Forest, had elevated levels of western pine beetle-caused ponderosa pine mortality, and Ash Creek had scattered activity on the Big Valley Ranger District, Modoc National Forest.

Elevated ponderosa pine mortality continued on the Eagle Lake District, Lassen National Forest, on the lower northeast side of Campbell Mountain, between Upper and Lower Gooch Valleys, and between Hog Flat Reservoir and the Susan River. Pockets of mortality were also found in the area of the Straylor Fire, Hat Creek Ranger District, Lassen National Forest.

Scattered ponderosa pine mortality continued in and around Hobo Camp on USDI Bureau of Land Management land near Susanville, Lassen County.

The Plumas National Forest had one area of elevated ponderosa pine mortality, near Frenchman Lake on the Beckwourth Ranger District, and the Tahoe National Forest had activity near Camp Pendola on the Yuba River Ranger District.

Western pine beetle activity was generally low for the remainder of California. An exception was in chronic black stain root disease areas near the eastern end of McCloud Flats. Scattered mortality of ponderosa pine caused by the western pine beetle was also noted near Black Butte, Shasta County. The site has well-drained, droughty soils and is at the edge of the natural range of ponderosa pine. Western pine beetle was also responsible for the death of scattered ponderosa pine that had been heavily scarred by the Campbellville Fire nearly 20 years ago.

Region 6: Oregon and Washington

Host(s): Ponderosa pine

Western pine beetles periodically kill large numbers of ponderosa pine in the Pacific Northwest. Acres affected and mortality intensities were reported at slightly higher levels in 2006, compared with 2005. Aerial determination of ponderosa pine affected by western pine beetle versus mountain pine beetle is challenging. Observers attempted to identify large-tree (greater than 20 inches diameter at breast height—dbh) mortality by western pine beetle, using ground-based information to assist in making the distinction in smaller-sized trees. Total acres affected increased from 70,137 acres, 1.10 trees per acre, in 2005 to 72,316 acres, .86 trees per acre, in 2006. Large-tree mortality was estimated to have occurred on 25,616 acres at a rate of 1.21 trees per acre.

Highest levels of mortality occurred within the following Reporting Areas in Washington: Glenwood Reporting Area (15,124 acres, 2.16 trees per acre), Wenatchee Reporting Area (15,980 acres, 2.07 trees per acre), and Yakama Indian Reservation (14,815 acres, 2.01 trees per acre). In Oregon, the highest levels occurred on the Ochoco Reporting Area (4,512 acres, .65 trees per acre).

Insects: Native

Western pineshoot borer
Eucosma sonomana

Region 5: California

Host(s): Ponderosa pine

The western pineshoot borer continues to damage plantation ponderosa pine near Pondosa, California, in Siskiyou and Shasta Counties and north of Lookout, Modoc County. Damage, in the form of stunted terminals, varies widely across the plantations. Some stands are receiving pheromone-based treatments to reduce damage.

Western spruce budworm
Choristoneura occidentalis

Region 1: Idaho and Montana

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

In Montana, defoliation by western spruce budworm increased significantly between 2005 and 2006. In 2006, a total of 1,169,000 acres were mapped in as defoliated by budworm, while 453,739 acres were recorded in 2005.

The most heavily impacted reporting areas were Beaverhead (150,199 acres), Gallatin (208,787 acres), Deerlodge (174,852 acres), Helena (413,384 acres), and Lewis & Clark (106,751 acres). Many other areas in Montana retain small, endemic western spruce budworm populations.

Number of acres defoliated by budworm in 2006 not only increased in extent, but, also in intensity. In 2005 and 2006, we recorded very heavy defoliation on Douglas-fir on the Helena and Gallatin National Forests. We are monitoring tree mortality from budworm in these areas via ground surveys. We also recorded areas of defoliation from budworm at locations that had never been recorded via aerial survey.

In the Kanisku National Forest and nearby areas of northern Idaho, budworm has been continually feeding on western hemlock for the past four years. Some defoliation is still present, but has noticeably decreased at most locations. In 2006, western hemlock defoliation occurred over 1,414 acres and was visible along the north fork of the Coeur d'Alene River on the Coeur d'Alene River Ranger District of the Idaho Panhandle National Forests. Ground surveys and subsequent taxonomic work identified a complex of *Choristoneura* species associated with the defoliated areas, the most prevalent of which was the western spruce budworm.

Region 2: Colorado and Wyoming

Host(s): Douglas-fir, Engelmann spruce, subalpine fir, and white fir

Defoliation by western spruce budworm was detected in pockets of pure Douglas-fir along the North Platte River on the Routt National Forest in Colorado near the Wyoming border. Another infestation detected in 2005 in the vicinity of the Eldorado Mountains southwest of Boulder continued in 2006, but at much lower levels.

Western spruce budworm damage was seen in spruce-fir stands of the southern Uncompahgre Plateau and within the area around the Cimarron Ridge. Several consecutive years of defoliation have decimated understory spruce and firs, and top-kill was readily evident in overstory and mid-story trees. Budworm activity continued in another high elevation spruce-fir forest on the Rio Grande National Forest. Significant impact was evident in understory spruce and fir. Both sites are noteworthy because the western spruce budworm are attacking both spruce and subalpine fir in the affected stands.

In Wyoming, there has been some light budworm defoliation noted both in the northern and southern end of the Shoshone National Forest. This is certainly an increase from what has been seen over the past few years. There has been some heavy budworm activity occurring in Yellowstone National Park. At this point, it is hard to say where the budworm population is going. Also chronic populations of the budworm continue in the Medicine Bow National Forest.

Region 3: Arizona and New Mexico

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

Western spruce budworm defoliation decreased, from 194,970 acres in 2005 to 145,055 acres in 2006. In Arizona, western spruce budworm defoliation was recorded on the Navajo Indian Reservation (2,535 acres). In New Mexico, western spruce budworm defoliation was detected on the Carson (53,430 acres), Cibola (530 acres), Gila (1,070 acres), Lincoln (690 acres), and Santa Fe (42,710 acres) National Forests; Valles Caldera National Preserve (2,480 acres), and USDI Bureau of Land Management (20 acres) lands; Jicarilla Apache (2,370 acres), Mescalero Apache (760 acres) Santa Clara Pueblo (60 acres) and Taos Pueblo (1,840 acres) tribal lands; and on approximately 36,560 acres of State and private lands.

Region 4: Idaho, Utah, and Wyoming

Host(s): Douglas-fir and true firs

Western spruce budworm-caused tree defoliation tripled in 2006, affecting 342,900 acres compared to 103,600 acres of defoliation mapped in 2005. Defoliation was reported on nearly all ownerships in south-central Idaho and the southern part of Utah. In Idaho, for the second consecutive year, most of the defoliation occurred on the Boise National Forest (102,600 acres). Moderate to heavy defoliation was also reported on the Salmon-Challis (81,500 acres) and Sawtooth (34,500 acres) National Forests; USDI Bureau of Land Management lands (11,900 acres), State of Idaho lands (8,500 acres), and private lands (3,300 acres). In Utah, the Fishlake and Dixie National Forests had moderate to heavy budworm defoliation, with 51,200 and 33,200 acres affected, respectively. Private land in Utah had 3,300 acres of moderate to heavy defoliation.

Region 6: Oregon and Washington

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

Western spruce budworm is a common defoliator of conifers in the Pacific Northwest. Areas of visible defoliation increased from approximately 352,210 acres in 2005 to 593,726 acres in 2006. Oregon increased from 254 acres to nearly 38,000 acres, and Washington State went from approximately 352,000 acres to 555,748 acres in 2006. In addition to the increase in areas of detectable defoliation, there was a significant intensification of the defoliation throughout the affected area (over twice as many acres in the heavy category, and nearly 1.5 times as much in both the light and moderate categories.

Reporting Area Highlights include:

Reporting Area	Survey Year	Acres Affected
Gifford-Pinchot	2005	696
	2006	13,137
Malheur	2005	254
	2006	33,778

Insects: Native

North Cascades National Park	2005	10,320.00
	2006	18,142
Okanogan	2005	64,133
	2006	91,820
Wenatchee	2005	259,725
	2006	410,194
Yakama Indian Reservation	2005	6,186
	2006	18,096

Western tent caterpillar
Malacosoma californicum

Region 2: Colorado

Host(s): Aspen

In 2006, this defoliator was detected primarily in the southern and western parts of the state. Defoliation has increased from 2005, as approximately 800 acres of noticeable defoliation by western tent caterpillar on USDA Forest Service and private lands. Populations of western tent caterpillar were high within the town of Telluride.

Western tent caterpillar damaged aspens on 265 acres during 2005 along the northwestern rim above Colorado's San Luis Valley. An outbreak continued in the area near LaVeta. This outbreak has been ongoing for approximately four years, and mortality of a few repeated defoliated aspen was evident in late summer, 2006.

White oak borer
Goes tigrinus

Region 8: Virginia

Host: White oak

Widespread but locally heavy infestations were reported from the Virginia Coastal Plain, aided by the latent effects of past storms.

White pine weevil
Pissodes strobi

Region 8: Tennessee

Host: White pine

Tennessee experienced only average to low levels of defoliation in the northeastern part of the state.

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

Host(s): White pine and spruce

Connecticut continued to observe white pine weevil on pines and spruces.

While this perennial problem continued to impact the growth of white pine, Colorado blue spruce, and Norway spruce in Maine, the situation appeared to be static in 2006. New Hampshire reported the insect remained common throughout the pine regions of the state. White pine weevil remained endemic statewide in New York. Populations of this insect were reported to be common but stable throughout Vermont.

Zimmerman pine moth
Dioryctria spp.

Region 2: South Dakota

Host(s): Austrian pine, ponderosa pine, Scotch pine, and Colorado blue spruce

Zimmerman pine moth continued to be a problem in windbreaks and ornamental plantings of South Dakota. Austrian pine is the primary species affected, though ponderosa pine windbreaks in drought-stricken areas were also experiencing significant branch injury.

INSECTS: NONNATIVE

Ambermarked birch leafminer
Profenusa thomsoni

Region 10: Alaska

Host(s): Birch

Three species of birch leaf mining sawflies occur in Alaska: *Profenusa. thomsoni*, *Fenusa pusilla*, and *Heterarthrus nemoratus*. While *F. pumila* is still apparently rare in occurrence and *H. nemoratus* is becoming increasingly more common than in previous years, the ambermarked birch leafminer, *P. thomsoni*, has become the most important exotic invasive insect in Alaska.

Damage was not visible from the air at the time of the 2006 surveys. However, special ground surveys were conducted along all major contiguous highways and many secondary roads south of the Yukon Flats. These ground surveys show the extent of the current populations to be similar to that of the past two years, about 140,000 acres, with new populations found in the Fairbanks area and the Kenai Peninsula. Surveys also indicate that this insect is most likely being spread via movement of nursery/landscape stock and by "hitchhiking" on or in vehicles along road corridors. In fact, over 20 percent of the roadways surveyed had evidence of ambermarked birch leafminer present, primarily in or near major urban centers or recreation areas.

Impacts to urban trees include decreased aesthetic values and the high cost of applying pesticides. Thousands of dollars each year are spent on pesticides to control *P. thomsoni*. The larvae of this insect eat the inside of leaves between the epidermal layers, causing leaves to die and entire urban landscapes to turn brown. Affected trees are obvious, and our stakeholders commonly inquire about the damage. Mortality of affected trees after several years of continuous infestation may be possible, but has not yet been proven.

In 2003, a cooperative birch leafminer biological control program was started in Anchorage. This biological control program entails the release of the parasitoid, *Lathrolestes luteolator* Gravenhorst (Hymenoptera: Ichneumonidae), collected in Canada. Participating agencies include: USDA Forest Service, Canadian Forestry Service, University of Alberta, University of Massachusetts, USDA Animal and Plant Health Inspection Service, State of Alaska Division of Forestry, and the Municipality of Anchorage.

Parasitoid specimens, either reared locally from larvae imported from Canada or imported as adult wasps, have been released: 53 individuals in 2004, 158 in 2005, and 458 in 2006. Monitoring efforts have been unable to show that the parasitoid has yet established populations at the release sites. However, dissections of leafminer larvae within the release areas show widespread parasitism. This indicates that native parasitoids have the ability to parasitize the ambermarked birch leafminer.

Birch leafminers will probably continue to spread along roads throughout Alaska's South-central and Interior birch forests and access natural forests away from the road corridors.

Ambrosia beetle
Xyleborus similis
Xylosandrus crassiusculus
Xylosandrus mutilatus
Xylosandrus germanus

Region 8: *X. crassiusculus*: Region-wide; *X. mutilatus*: Mississippi, Florida, and Texas; *X. compactus* and *X. glabratus*: Florida, Georgia and South Carolina; *X. similis* has only been detected in the Houston, Texas area

Hosts: Hardwoods

Xyleborus crassiusculus was introduced into the port of Charleston, South Carolina, in the 1970s and has spread throughout the South. It is known to attack a wide variety of trees and shrubs, including pecan, peach, plum, cherry, persimmon, oak, elm, sweet gum, magnolia, fig, buckeye, crape myrtle, and sweet potato. It is mainly a problem in oaks, cherries, and crape myrtles in nursery and landscape settings. It probably will attack other plants on which it has yet to be found.

Xyleborus mutilatus was first detected in Mississippi in 2002. Subsequent, South-wide detection surveys found it to be present in Texas (2005, in Houston) and Florida. It is not known to attack live trees, but infests a wide variety of dead hardwood material. *Xyleborus similis* was first detected in Houston, Texas, in 2002. Additional surveys in Texas and other states have not found more specimens of this species; however, it is assumed to be established in Texas, where its effects are unknown, but in all likelihood it is not attacking living trees. Scattered ambrosia beetle infestations have been reported throughout the North Carolina Coastal Plain and Piedmont, mostly in urban areas.

Tennessee reported damage to oaks and redbud from unspecified *Xylosandrus* spp. in the area around Knoxville.

(See **Redbay wilt** under **Diseases: Non-native** for information on *X. compactus* and *X. glabratus*.)

Region 9/Northeastern Area: Indiana and Missouri

Host(s): Black walnut, other hardwoods

Asian ambrosia beetle was a new landscape and nursery pest in Indiana in 2006. It appeared to be an opportunistic organism attacking trees under stress in Indiana forests. In Missouri, there were no reported outbreaks of the granulate ambrosia beetle (*Xylosandrus crassiusculus*, also known as the Asian ambrosia beetle) and the black stem borer (*X. germanus*) in 2006.

Asian cycad scale
Aulacaspis yasumatsui

Region 5: Guam

Host(s): *Cycas circinalis* and *C. micronesica*

Over the last three years, the rapid spread of the Asian cycad scale by wind and human transport of infested plants and plant debris has resulted in the drastic reduction in the the native cycad (*Cycas micronesica*). Once a dominant component of Guam's limestone and ravine forests, *Cycas micronesica* is currently listed as endangered by the World Conservation Union (IUCN). Recent surveys in northwest Guam by the USDI Fish and Wildlife Service and the University of Guam documented a 64-percent decline in the cycad population in less than 12 months following invasion by the scale. Most of the mortality occurred in the seedling and juvenile stages of growth, but large, mature individuals are also dying. Further reduction in the cycad's reproductive potential may be caused by the scale's interference with plant-pollinator

interactions, particularly that of the cone borer moth, *Anatrachyntis* sp. (Cosmopterygidae). Chemical treatment is costly and logistically difficult. A biological control program is underway with limited success. The U.S. Navy is establishing an *ex situ* germplasm collection on the nearby island of Tinian. Within the western Pacific, the scale appears to be limited to Guam, but cycads on Rota, Yap, and Palau are at risk if the scale spreads.

Asian longhorned beetle
Anoplophora glabripennis

Region 5: California

Host(s): Hardwoods

Survey and preventative treatments for the Asian longhorned beetle continued in Sacramento County in 2006. The invasive insect has not been found since the discovery of three adult beetles on the grounds of a warehouse on McClellan Air Force Base, in Sacramento, California, on June 16, 2005.

Region 9/Northeastern Area: Illinois, New York, and New Jersey

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

Cooperative efforts to eradicate the beetle from the quarantined areas in New York City and Long Island were ongoing, but progress was slow. Meanwhile, no new infestations outside of the quarantine areas were detected.

The Asian longhorned beetle was found in New Jersey for the first time in 2002. Since then, multi-agency efforts to manage potential infestations have been conducted. In 2006, approximately 24,000 susceptible trees were removed from seven quarantined communities in Essex, Hudson, and Union Counties.

Through the excellent cooperative efforts of the Illinois Department of Agriculture, Chicago Forestry Department, and USDA Animal and Plant Health Inspection Service, Plant Protection and Quarantine in conducting tree surveys, felling infested trees, and conducting insecticide treatments, the last infested tree was found in November 2003 within the Chicago area.

Balsam woolly adelgid
Adelges piceae

Region 1: Idaho

Host(s): Grand fir, subalpine fir

Aerial detection estimated a total of 42,250 acres infested by the balsam woolly adelgid in northern Idaho in 2006. This is a considerable increase over the estimated 28,000 acres detected in 2005. The yearly fluctuation of acres infested by balsam woolly adelgid is likely due to aerial survey methodology and the visibility of balsam woolly adelgid symptoms from year to year. In actuality, the number of acres infested likely exceeds the recent "high" level of 85,000 acres mapped in 2002 as some infested areas may not yet be displaying crown symptoms. The heaviest infestations in 2006 occurred within the Clearwater and St. Joe Reporting Areas. Because these areas weren't surveyed in their entirety, it is assumed the reported infested acreage is an underestimation. Aerial surveyors mapping the Clearwater Reporting Area observed an estimated 23,650 acres around the vicinity of Headquarters, Clearwater County. Observations on the St. Joe showed nearly 17,500 acres of balsam woolly adelgid infestation along areas of the Marble Creek drainage, northeast of Clarkia, in Shoshone County.

Subalpine fir mortality occurred in all ages and size classes. Extensive gouting and bole infestations occur on grand fir, but to date, no grand fir over 5 inches in diameter has been documented as being killed by balsam woolly adelgid. Regeneration mortality of both subalpine and grand fir is high, resulting in forest type conversions in some areas. Surveys to delimit the current distribution of balsam woolly adelgid and assess tree damage were initiated in 2006 and will be completed in 2007.

Region 4: Idaho

Host(s): Subalpine and grand firs

While this introduced forest insect has been present in northern Idaho (Region 1) since 1983, its presence in southern Idaho (Region 4) was not verified until 2001, when it was found killing subalpine fir trees in residential areas of Cascade and McCall. In 2006, delimitation surveys were conducted by personnel from Idaho Department of Lands and Intermountain Region Forest Health Protection to determine the distribution of balsam woolly adelgid south of the Salmon River. From these surveys, we have identified the presence of balsam woolly adelgid on State, private, and national forest lands as far south as Smith's Ferry, as far west as Sturgill Peak, and as far east as Johnson Creek. Continuing delimitation surveys and the establishment of long-term evaluation plots are planned for 2007.

Region 6: Oregon and Washington

Host(s): True firs

The balsam woolly adelgid is an introduced insect that has had significant impact on grand fir, silver fir, and subalpine fir in Washington and Oregon. In 2006, balsam woolly adelgid activity was detected on fewer acres in Region 6, but at somewhat higher intensities. Over 108,000 acres of balsam woolly adelgid damage were detected in 2005, and a total of 91,350 acres were affected in 2006. Better detection methods for balsam woolley adelgid have resulted in a steady increase in areas mapped. Data would indicate an eastward trend of spread and intensification.

Acres affected by balsam woolly adelgid fluctuated throughout Region 6. The Gifford-Pinchot Reporting Area reported decreased damage, from 8,358 acres in 2005 to 4,316 acres in 2006. The Malheur Reporting Area reported an increase in affected area, from 2,474 acres in 2005 to 6,386 acres in 2006. Mt. Rainier National Park reported fairly constant affected acreage, with 4,656 acres in 2005 and 4,583 acres in 2006. The Olympic National Park Reporting Area damage decreased, from 10,069 acres in 2005, to 8,039 acres in 2006. The Umatilla Reporting Area damage decreased, from 22,873 acres in 2005 to 9,790 acres in 2006. The Wallowa-Whitman Reporting Area damage decreased, from 36,037 acres in 2005 to 22,918 acres in 2006. The Wenatchee Reporting Area damage increased, from 3,712 acres in 2005 to 6,269 acres in 2006. And finally, the Willamette Reporting Area damage decreased, from 6,259 in 2005 to 4,119 acres in 2006. Once the insect infests an area, changes in acres of infestation may be a result of weather factors or decrease in host type.

Region 8: North Carolina, Tennessee, and 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 introduction of the balsam woolly adelgid, approximately 64,700 acres of Fraser fir have been affected. The insect attacks all age classes, but prefers older trees. The summer of 2003 witnessed high adelgid populations in all infested areas, and scattered mortality has been observed since 2004. It is expected that most wild fir populations will undergo another mortality and regeneration cycle within the next five to ten years.

Insects: Nonnative

Region 9/Northeastern Area: Connecticut, Maine, New Hampshire, Vermont, and West Virginia

Host(s): Balsam fir

In Connecticut, there was no sign of adelgid resurgence at a predator release and study site. Balsam woolly adelgid populations continued at low levels in Maine in 2006. While mortality from past years was striking, the consistent rainfall of 2004 through 2006, coupled with low population levels of the adelgid, allowed a number of the lightly to moderately damaged trees to recover. Trunk phase was reported on scattered trees in northern reaches of the adelgid's distribution, perhaps related to the mild winter and spring temperatures. Mortality of heavily damaged fir continued to occur, but it became less obvious as old stands were salvaged or fell to the ground. This pest has infested most fir stands in New Hampshire below 2000 feet in elevation. Mortality was severe throughout central regions of the state, covering 11,760 acres. In Vermont, mortality decreased from 5,900 to 2,700 acres, but an increase in population levels was noticeable in northeastern Vermont following the mild winter.

In West Virginia, balsam wooly adegid continued to cause mortality in Randolph, Pocahontas, and Tucker Counties.

Banded elm bark beetle
Scolytus schevyrewi

Region 2: Colorado, Nebraska, and South Dakota

Host(s): American elm, rock elm, and Siberian elm

Banded elm bark beetle is found nearly everywhere elms are found in the region. It has been associated with declining Siberian elms in communities across South Dakota; however, the infestations appeared to be concentrated in many of the western communities where Siberian elm was a dominant tree species and a long-term drought has been occurring. The insect also appears in dying American elms within many of the riparian stands in the western and central part of the state. The population appears high, based upon the number of emergence holes found on these trees, and the expanding elm mortality may be due to the possibility of the banded elm bark beetle serving as a vector for Dutch elm disease.

Region 5: California

Host(s): Elm

No reports were received in 2006

Region 9/Northeastern Area: Illinois, Indiana, Maryland, Michigan, Missouri, and New Jersey

Host(s): Elm

No new states reported this Asian bark beetle in 2006. No reports were received from Maryland or New Jersey since its first discovery in 2004.

The insect was widespread and aggressively colonizing dying elm trees in Illinois and Indiana. There was no activity reported in Michigan in 2006, being overshadowed by the extensive damage to ash trees by the emerald ash borer. The banded elm bark beetle was previously found in several locations in Missouri. In 2006 surveys, it was found for the first time in Boone and Gasconade Counties in central Missouri.

Birch leaf miner
Fenusa pusilla

Region 9/Northeastern Area: Massachusetts, New Hampshire, and Vermont

Host(s): Birch

There was no significant activity reported in Massachusetts. In New Hampshire, defoliation was light and scattered in Carroll, Grafton, and Sullivan Counties. Populations decreased in Vermont where defoliation and discoloration of birch was common but most of the damage was caused by a foliar disease.

Black twig borer
Xylosandrus compactus

Region 5: Hawaii

Host(s): Numerous, both native and exotic

The introduced black twig borer and its associated pathogens continue to be serious pests of native and alien shrubs and trees, affecting more than 200 species. The borer was first reported in 1961. Several species affected by this ambrosia beetle are rare and/or endangered, and the black twig borer continues to hinder forestry plantings (especially koa) and native ecosystem restoration efforts in the state.

Browntail moth
Euproctis chrysorrhoea

Region 9/Northeastern Area: Maine and Massachusetts

Host(s): Red oak and beach plum

The browntail moth population in Maine continued to decline in 2006. Only 693 acres of defoliation was mapped in Freeport and Brunswick. Late-instar larvae again showed signs of disease and/or parasitism. Populations continued to be monitored. In Massachusetts, defoliation continued to be limited to the Provincetown and Truro areas of Cape Cod. The aerial survey detected 103 acres of defoliation, approximately twice of that reported in 2005.

Common European pine shoot beetle
Tomicus piniperda

Region 9/Northeastern Area: Illinois, Indiana, Iowa, Maine, Massachusetts, Maryland, New Hampshire, New Jersey, New York, Ohio, Pennsylvania, Vermont, and West Virginia

Host(s): Scotch pine, red pine, and white pine

The Maine Forest Service has trapped for pine shoot beetle, *Tomicus piniperda*, in Maine since 1999. Oxford and Franklin Counties continued to be under a state and federal quarantine. During 2006, trapping was conducted at 44 sites (22 pine processing sites, three log yards, and 19 plantations/natural stands with hard pines) in 11 counties. No pine shoot beetle adults were recovered from any of the traps in Maine in 2006. This beetle was trapped for the first time in Massachusetts and confirmed in Berkshire, Hampden, and Hampshire Counties. The beetle was found at two small isolated locations in northern New Hampshire, and the populations did not increase or move in five years. No new counties were found to be infested in New York in 2006. There was very light damage observed in northeastern Vermont.

Insects: Nonnative

In Maryland, pine shoot beetle was surveyed in 10 Maryland counties in 2006, as in 2005. This beetle was present in all five western Maryland counties (Allegany, Frederick, Montgomery, Garrett, and Washington). No additional counties were added after 2003. Significantly more beetles were trapped in 2005 than in previous years, and trap yields increased in 2006, continuing a trend begun in 2004. Most of the increase was in Garrett, the westernmost county. Consequently, a federal quarantine restricted pine material moving from these counties. In New Jersey, this exotic species was not resurveyed in 2006. No reports were received from Ohio, Pennsylvania, or West Virginia in 2006.

Populations continued to remain at low levels in Illinois. In Indiana, pine shoot beetle is now found in 61 of the 92 counties in the state. In May, 2006, pine shoot beetle was identified in Dubuque and Scott Counties, in Iowa. There was no new activity or infested counties reported from Minnesota.

Cycad blue butterfly
Chilades pandava

Region 5, Guam

Host(s): Cycadacae

The cycad blue butterfly is native to Asia and was discovered in the Ritidian area of Guam in July of 2005. It was first noted from Saipan in 1996, but was not considered a threat as few native cycads remain on Saipan. The butterfly continues to infest *Cycas micronesica* on Guam. Larvae feed on young cycad leaves, resulting in damaged leaves with greatly reduced leaf area. Severe infestations can result in complete defoliation of new leaves, and repeated defoliation can result in plant death. This feeding also reduces the cycad's ability to recover from defoliation by the Asian cycad scale, causing increased mortality. While the total extent of the distribution of the cycad blue is not known, the insect has been reported from sites throughout the island of Guam. Pesticide trails are underway by the University of Guam. Egg parasitism occurs at very low, and ineffective, levels.

Elongate hemlock scale
Fiorinia externa

Region 9/Northeastern Area: Connecticut, Massachusetts, New Hampshire, New Jersey, New York, and Pennsylvania

Host(s): Eastern hemlock

Heavy scale populations were reported throughout Connecticut causing some damage in infested areas. Populations appeared to be increasing in Massachusetts. Hemlocks were showing signs of stress in areas where the insect was first observed, and there was a small pocket of mortality in the town of Sheffield. One landscape tree was found infested in southern New Hampshire. This insect was common in approximately the same range as hemlock woolly adelgid in New York, and was often found in the same stands. Damage from the scale was hard to separate from damage by the adelgid, but it was likely that both caused significant decline and mortality of hemlocks, independently and in tandem.

A New Jersey Department of Agriculture survey recorded moderate to heavy scale infestations throughout the hemlock range in New Jersey except in Warren County along the Delaware Water Gap National Recreation Area. In Pennsylvania, data for this insect were reported during other hemlock ground and aerial surveys. New counties affected were Adams, Bradford, Centre, Mifflin, Potter, Susquehanna, Wyoming, and York Counties. A total of 16 counties reported scale populations, and four reported increasing infestations rates.

Emerald ash borer
Agrilus planipennis

Region 2: Nebraska

Host(s): Ash

A trap-log survey was conducted in five Nebraska state parks in 2006. No emerald ash borers were found.

Region 8: Virginia

Host: Ash

Trap tree surveys and visual inspections concentrated in Fairfax and Prince William Counties, Virginia, revealed no signs of infestations in 2005. Surveys in a number of other southern states also produced no results. Kentucky has instituted a regular trapping program in northern counties in response to the spreading infestation in Ohio.

Region 9/Northeastern Area: Illinois, Indiana, Maryland, Michigan, and Ohio

Hosts(s): Ash species

In Maryland, detection surveys observed infested trees near the perimeter of a 2004 emerald ash borer eradication effort at a private nursery that received infested trees from Michigan. Eradication was planned for an 11,000-acre area surrounding these positive detection sites. In Ohio, trap tree and visual surveys, conducted since 2003, were used to locate infested areas and continue to address single infestations by removing all ash trees within a half-mile radius of each infested tree. New counties listed with infestations in 2006 were Cuyahoga, Franklin, Hardin, Huron, Logan, Marion, Medina, Mercer, Miami, Paulding, Seneca, Warren, and Wyandot. An all county statewide survey for this pest was planned for 2007.

During the summer of 2006, the first discovery of the emerald ash borer in Illinois occurred in Kane and Cook Counties. It is speculated that the insect was introduced in firewood. A total of 41 infested trees were discovered in Kane County and five infested trees were found in Cook County. In Indiana, emerald ash borer presence was confirmed in DeKalb County (Spencer Township) during November 2006, the last new county confirmation for the year. DeKalb, Allen, Porter, White, St. Joseph, LaGrange, Steuben, Randolph, Huntington, Hamilton, Marion, and Adams Counties all had one or more townships with infestations at the end of 2006. Most of these infestations were not considered “new” introductions; rather, they had been active for probably four to six years. Since the discovery of emerald ash borer in Michigan in 2002, predicting the insect’s distribution and impact on the ash resource continued to be one of the most important and difficult challenges facing forest health professionals. The good news was that the borer was not found in Michigan’s Upper Peninsula in 2006. The Michigan Department of Agriculture and Michigan Technological University deployed survey trap trees throughout the Upper Peninsula ash resource in 2006, and full time staff was deployed at the Mackinac Bridge to enforce the quarantine and educate travelers not to bring restricted materials into the Upper Peninsula region.

Erythrina gall wasp
Quadrastichus erythrinae

Region 5: Hawaii

Host(s): Coral trees (*Erythrina* spp.), wiliwili

The erythrina gall wasp was first detected on Oahu, Hawaii in April of 2005. By October 2005, it was found throughout the Hawaiian Islands, associated with the culturally and biologically important native, dry

forest tree *Erythrina sandwicensis*, or "wiliwili," as well as several ornamental coral trees (*Erythrina* spp.). Many wiliwili are severely infested, with trees showing infestation of all new growth—shoots, leaves, flowers, and fruit. The native range of the gall wasp is unknown, but presumed to be Africa. Since it was first described in 2004 from trees in Singapore, Mauritius, and Reunion, spread of this species has been swift. Spread in Hawaii closely follows the 2004 outbreak in Taiwan, where it spread rapidly throughout the island within a year of detection. Severe infestations in Taiwan have resulted in the death of trees. Its current distribution includes Mauritius, Reunion, Singapore, India, Taiwan, China, Hong Kong, Thailand, Guam, American Samoa, Florida and Hawaii.

In Hawaii, a network of federal, state, and local governments and non-government organizations continue to respond to additional outbreaks of the gall wasp in the state. Monitoring and mapping of infestations continues. Many of the tall windbreak trees that were initially infested have subsequently died. While infestations continue to be periodically heavy, so far, few trees in the wild have died from gall wasp infestations. Pesticide trials by the University of Hawaii, USDA Forest Service–Forest Health Protection, and Hawaii Division of Forestry continue using a variety of injection systems and several insecticides for both wildland and urban applications. Entomologists from the Hawaii Department of Agriculture and the University of Hawaii traveled to Africa in 2006 and returned with several potential wasp enemies, which are currently in quarantine. Studies continue on the basic biology of the wasp. Seeds from the native wiliwili trees have been collected and stored in a certified seed bank for use in future restoration efforts.

European fruit lecanium scale
Parthenolecanium comi

Region 9/Northeastern Area: Massachusetts, New York, Pennsylvania, and Vermont

Host(s): Hardwoods

Populations appeared to be building in Massachusetts in Berkshire, Franklin, and Worcester Counties. Mortality was observed on sugar maple seedlings and saplings. This soft-bodied scale was reported in dense populations on many hardwoods in Northern New York for the second straight year. High populations seemed to be extremely localized and patchy. Most populations collapsed in Vermont; however, there were some heavy populations in scattered locations. Sugar maple recovery appeared to be good in areas that had heavy damage in 2005.

In Pennsylvania, several reports of heavy infestations totaling 9,247 acres were received in 2006 in Adams, Cumberland, Franklin, Jefferson, McKean, and Union Counties, and light scale levels were reported in Elk and Cameron Counties.

Gypsy moth
Lymantria dispar

Region 1: Idaho, Montana, North Dakota, and Wyoming

Host(s): Hardwoods

Cooperative detection monitoring continued for the gypsy moth in Region 1 with USDA Animal and Plant Health Inspection Service and State Departments of Agriculture, Forestry, and Lands in 2006. A network of strategically located pheromone-baited traps was placed throughout all Region 1 states. One European gypsy moth was caught on federal land in Yellowstone National Park. It was identified by park personnel who have experience with previous trap catches, but it was not submitted for further identification. However, it was taken from a trap site located in Fishing Bridge RV Park, which has a history of trapping a moth nearly every year. Delimitation surveys near the Fishing Bridge RV Park and Madison Campground were still in place as a result of previous year catches. Although it is believed that gypsy moths are unlikely to survive Park winters, delimitation trapping will continue, particularly near the RV parks.

A single European gypsy moth was trapped on private land near Enaville in the Idaho panhandle in 2005. Delimitation surveys will continue until 2007 for the area surrounding this catch and will end for the area adjacent to the 2004 Asian gypsy moth catch near Hauser, Idaho. There have been no new Asian gypsy moth catches in the area following an Idaho Department of Lands-led suppression projectin which 600 acres were treated with Btk4a48b. No moths were caught in Montana or North Dakota in 2006. The trapping program will continue as usual in Region 1 next year.

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

Host(s): hardwood species

Annual detection trapping for gypsy moth was again conducted in 2006. Traps were placed among potential hosts stands at popular developed recreation sites throughout the Region.

One gypsy moth was collected from a trap near a Kansas City racetrack. Visitors to the track often bring firewood with them and egg masses travel easily on RVs: both, potential means of introduction. Trapping efforts continue.

In Nebraska, traps were placed in nurseries, among potential hosts stands, and at popular developed recreation sites throughout the state. Gypsy moths were caught in traps at three locations: 24 male moths at one nursery in Omaha, two moths in one trap in Papillion, and one moth in a trap in Gretna. Site inspections were conducted at the Omaha and Papillion sites, and no egg masses believed to be viable in 2006 were found. Delimiting blocks of traps will be put in the three sites in 2007.

There were four moths collected in traps on the eastern edge of South Dakota and another four moths in a trap in the Black Hills area.

Region 3: Arizona

Hosts: various hardwoods and conifers

No male gypsy moths were trapped in Arizona or New Mexico.

Region 4: Idaho, Nevada, and Utah

Host(s): Various deciduous species

Gypsy moth was first detected in Utah in 1988. Since then, male moths have been captured in various locations throughout the region nearly every year. In 2006, no male moths were captured in any delimitation-trapping grids. In 2005, one male moth was captured in Utah and two separate single male moths were captured in Wyoming.

Region 5: California

Host(s): Hardwoods

Over 22,000 traps were deployed and monitored as part of California's program to detect and delimit new Asian or Siberian gypsy moth infestations. Trap density is three traps per square mile in the 19 coastal California counties and two traps per square mile in the remaining 39 counties. Ports receiving shipments from foreign sources are trapped at 25 traps per square mile for Asian and Siberian gypsy moths. Traps are deployed in urban areas and in rural residential areas of 300 or more homes per square mile. This season, a total of seventeen moths were trapped at 11 sites in nine counties, compared to seven moths at seven sites in five counties during 2005.

Region 6: Oregon and Washington

Host(s): Apple, oaks, sweet gum, and 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 2006, traps captured 47 moths in Bend, Oregon. Subsequent ground surveys located larvae, adults, and new egg masses at a residence, and 537 acres were identified for a potential eradication project in 2007. In Kent, Washington, a small reproducing population was found near a strip mall. This area is also proposed for a 2007 eradication project. In addition, one Asian gypsy moth was captured near St. Helens, Oregon; one Asian moth is usually the trigger for an eradication project. A 640-acre eradication project is proposed for 2007 in the St. Helens area.

Region 8: Arkansas, Georgia, Kentucky, North Carolina, Tennessee, and Virginia

Hosts: Hardwoods, especially oak species

Suppression. Virginia conducted suppression on 2,574 acres in 2006: 2,495 on co-op lands and 79 acres on national forest lands. Of these, 567 acres were treated with *Bt* and 2,007 were treated with dimilin. Subsequent to treatment, Virginia reported moderate to heavy defoliation on approximately 14,330 acres in Frederick, Giles, Montgomery, and Roanoke Counties in the western mountains of the state. Of this, 2,950 acres occurred on the George Washington-Jefferson National Forest. The increase of gypsy moth defoliation is consistent with the general trend in defoliation throughout the Northeast.

Slow-The-Spread (STS). In conjunction with the STS program, treatments were conducted on 47,890 acres of non-federal lands in North Carolina. Treatments were also conducted on 73,464 acres of non-federal land, 1,872 acres of National Park Service land, and 10,812 acres of national forest lands in Virginia. The majority of the treatments were specific to the gypsy moth: mating disruption accounted for 90 percent and Gypchek for another 5 percent. Since the inception of this program in the South, spread rates have been reduced from an average of 21 km per year to less than 5 km per year, a reduction of more than 75 percent. Populations in North Carolina were for the most part under control, with only light defoliation in Currituck County.

Eradication. North Carolina conducted four eradication projects in three counties in the western half of the state, totaling 19,142 acres. This area was treated with Foray 76B. Georgia conducted delimiting trapping in six northern counties and detection trapping in counties surrounding the ports of Brunswick and Savannah and the Hartsfield-Jackson Airport in Atlanta. Five male moths were captured in four counties, but no active infestations were detected. Kentucky reported capturing 116 male moths, primarily in the Cincinnati area. In Tennessee, a single small ground spray project using Dimilin was conducted in Cumberland County. Mass trapping efforts were carried out in Cumberland, Campbell, and Claiborne Counties in the northeastern part of the state.

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

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

There was considerable feeding by larvae in Connecticut, however, the population crashed in mid-June, resulting in 257,955 acres with slight to moderate defoliation. In Maine, there was no defoliation of hardwoods from gypsy moth, probably due to *Entomophaga maimaiga*, a virus, and parasites that continued to keep the population at low levels throughout the infested area in southern and central areas of the state. Male moth catches had increased, but not strikingly, in the infested area. The 2006 fall egg mass survey indicated that the population would remain at endemic levels in 2007, although the number of moths caught in pheromone traps was more than double the catch from the previous year. In Massachusetts, Plymouth, Bristol, Norfolk, Hampshire, and Hampden Counties experienced heavy defoliation on approximately 123,000 acres, an increase from 2005. About 10 acres were also mapped in Cape Cod

National Seashore in Barnstable County. In many cases this insect was defoliating the same areas as the forest tent caterpillar. Permanent survey sites indicated the population was collapsing in southeast Massachusetts, whereas a buildup was reported in the western part of the state. Both *Entomophaga maimaiga* and the virus were observed in the infested area. No major defoliation was found in New Hampshire in 2006, and only about 144 acres of defoliation were mapped. Moderate to heavy defoliation from this insect totaling about 8,840 acres occurred in western New York, around the Finger Lakes and Southern Tier areas, and some light to moderate defoliation near the New Jersey and Massachusetts borders. Egg mass surveys in Western New York predicted a decrease in 2007 gypsy moth defoliation. Rhode Island reported about 4,540 acres of defoliation from their aerial survey. Damage occurred in Bristol, Kent, Newport, and Providence Counties, which cover most of the state except for the southern end. About 1,176 acres of defloiation were mapped in Vermont, larvae were occasionally observed feeding in stands that were also defoliated by forest tent caterpillar. Eggs mass counts indicated that populations were expected to remain very low.

In Delaware, following aerial surveys, only eight acres of defoliation, mostly of sweet gum, was observed in southern Sussex County. There has been no major gypsy moth infestation in Delaware since 1997. Gypsy moth defoliation was increasing in Maryland since 2004 and, in 2006, 15,793 acres of defoliation were reported in nine counties. Increased treatments were planned for 2007. After high egg mass counts, New Jersey experienced an increase in statewide defoliation, with 102,909 acres reported, of which about 55,100 acres were on state-owned forestland. A low incidence of the fungus *Entomophaga maimaiga* resulting from very dry conditions in the state was implicated in the increased gypsy moth infestation. Approximately 28,000 acres were treated. Ohio reported only 842 acres of damage this year, but listed Clark, Delaware, Franklin, Green, and Guernsey Counties as infested. Aerial and ground surveys in Pennsylvania recorded an increase in defoliation from 333,335 acres of damage in 2005 to about 698,268 acres in 2006. An additional 3,017 acres of defoliation were mapped on federal lands. Defoliation was noted in ten previously affected counties and in Bedford, Blair, Cambria, Centre, Clearfield, Clinton, Cumberland, Dauphin, Franklin, Fulton, Huntington, Juniata, Lancaster, Lycoming, McKean, Mifflin, Northumberland, Perry, Schuylkill, Snyder, Somerset, Susquehanna, Union, and Wyoming Counties. There was a significant increase in defoliation totaling 17,272 acres in West Virginia in 2006, and there was an increase in the number of gypsy moth egg masses detected in the eastern counties. As a result, West Virginia was planning a suppression program for 2007.

Populations in 2006 remained low and spotty in northeastern Illinois, with little noticeable defoliation. In Indiana, over 17,000 traps were placed on 3-kilometer grids over the entire state. Treatments with *Bacillus thuringiensis* var. *kurstaki* took place on approximately 11,085 acres and pheromone flakes on approximately 26,529 acres. There was no detected defoliation. Gypsy moth populations were down significantly in Michigan in 2006, with 31,995 acres defoliated, compared to 148,525 in 2005. Cool, wet spring weather favorable to development of the fungal pathogen, *Entomophoga maimaiga*, likely contributed to the decline in populations. There were 15,981 acres treated in six counties in the Lower Peninsula. In Minnesota, 2006 was a record-breaking year for gypsy moth treatments after a year of record high numbers of moths trapped in 2005. Approximately 138,000 acres were treated for gypsy moth. This was a drastic increase from the previous five years' average of 760 acres annually. The Missouri Cooperative Gypsy Moth Program continued its annual survey to detect the presence of gypsy moths by placing and monitoring more than 9,600 traps across the state in 2006. Seventeen moths were captured statewide in Jackson, Taney, Franklin, and St. Louis Counties. Gypsy moth populations remained low in Wisconsin due to a population collapse in 2004, but rose since then due to the warm, dry summers of 2005 and 2006. There were about 24,000 acres of defoliation mapped in the Apostle Islands in Lake Superior. South-central Wisconsin was considered likely to be the next region of the state to see widespread outbreaks. The Department of Natural Resources suppression program was very small in 2006, with four participating counties (Brown, Fond du Lac, Manitowoc, and Rock) and approximately 1,500 acres sprayed.

Insects: Nonnative

Region 10: Alaska

Host(s):

Alaska has maintained a detection monitoring system focused on the gypsy moth, a serious defoliator of hardwoods, for several years. A single male gypsy moth was trapped near Fairbanks in 2006. Both the European and Asian gypsy moths are of concern to Alaska. To address this concern, annual gypsy moth trapping has been, and continues to be, done in cooperation with the USDA Animal and Plant Health Inspection Service in several locations across Alaska.

Hemlock woolly adelgid
Adelges tsugae

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

Hosts: Carolina hemlock, Eastern hemlock

Hemlock woolly adelgid populations continue to rapidly expand their range in the Southeast. Kentucky confirmed its first infestations, in Bell and Harlan Counties, and initiated suppression activities. In Virginia, the infested range was extended into Buchanan, Dickerson, Wise, Lee, Loudon, and Fauquier Counties, leaving no southwestern Virginia counties uninfested. Populations spread and intensified in Georgia, North Carolina, South Carolina, and Tennessee; all counties in the western Carolinas with hemlock populations are experiencing significant decline and some mortality. Efforts at chemical control continued on a limited basis on several national forests, in the Great Smoky Mountains National Park, and along the Blue Ridge Parkway. The rearing and release of various adelgid predators was expanded.

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

Host(s): Eastern hemlock

Hemlock woolly adelgid continued to spread throughout the generally infested area, causing hemlock decline and tree mortality.

There was no new activity reported in Connecticut. Hemlock woolly adelgid was detected in native hemlocks for the first time in Maine three years ago and in 2006 occurred in light infestations scattered over approximately 6,500 acres in five towns in the southernmost tip of the state (Kittery, Wells, York, Eliot and South Berwick). Perhaps partly due to the mild winter and spring, populations increased within the previously infested area, and new spot infestations were found scattered in an abutting area of 500 acres in South Berwick and York.

The Maine Forest Service was carrying out an integrated slow-the-spread management program to reduce the spread and impact of established adelgid populations in York County. Gerrish Island, where the insect was first detected in native trees, had light to moderate populations throughout its hemlock stands. A series of predator releases were made on the island and several sites were sprayed with Talstar plus oil. Treated sites were monitored throughout 2005 and 2006 and all showed excellent control in the first year. Site visits in 2006 revealed that some trees treated in 2004 have been reinfested. Additional treatments were implemented in the fall of 2006 on five sites. The Maine Forest Service continued to respond to reports of adelgid on planted nursery stock outside the infested towns.

In Massachusetts, this insect continued to be a major concern. Predator release sites were monitored, but the ladybird beetle was not recovered at 10 of the 11 release sites. A buildup of hemlock woolly adelgid in areas known to be infested was noticeable and was probably the result of the mild winter of 2005.

New infestations were found in eight towns in New Hampshire on 29 different properties in 2006. All infestations outside the quarantine zone and most of the properties inside were treated.

The hemlock woolly adelgid, continued to cause damage and mortality to native forest and ornamental eastern hemlock trees in New York. Damage was most severe in areas that were infested for several years (in the Catskills and in the south). In some areas a majority of the trees were infested and many of those were in declining health or dead. Pockets of hemlock mortality were seen from the air in infested areas. No new counties were found to be infested in 2006, but the adelgid populations were noticeably increased within the infested areas, and two new infested properties were found in Monroe County (Rochester), where a spot infestation had been thought to be eradicated.

Infestation remained present in all five Rhode Island counties. The insect was not established in Vermont; infested hemlocks imported from a New Jersey nursery in May were eradicated from four sites.

Throughout Delaware, eastern hemlocks were commonly infested, and levels appeared to be increasing. In Maryland, several recoveries of *Laricobius nigrinus* were made in 2005 and 2006 in Allegany County following releases begun in 2004. There were trunk injections on 230 trees, and over 2,600 trees were treated by soil injection. Populations were low and static in most hemlock stands throughout New Jersey, possibly due to cold weather and poor tree growth due to past infestations.

The predatory beetle was released within the two state forests. In Ohio, urban ground surveys found 10 infested landscape trees in Geauga County (previously affected) and in Cuyahoga and Lorain Counties (newly affected). In Pennsylvania, this adelgid was found for the first time in Cambria, Susquehanna, and Westmoreland Counties, bringing the total number of counties to 47. Infestation appeared to be static in most resurveyed counties.

New infestations of the adelgid were found in West Virginia include Barbour, Boone, Braxton and Kanawha Counties, bringing the total number of infested counties to 28 within the state. In 2006, due to limited availability of predators, only 450 *Scymnus sinuanodulus* were released in Calvin Price State Forest, and 532 trees were injected with imidacloprid.

Thirty hemlocks were shipped from West Virginia to a local landscaper in Michigan in 2003. Hemlocks in three of four planting sites that received these trees were infested. Michigan Department of Agriculture staff in cooperation with Michigan State University and the Michigan Department of Natural Resources initiated an intensive, rapid response to this detection. All 30 planted hemlock and adjoining native trees were voluntarily removed and destroyed by the landscaper. Perimeters of hemlock on all four sites were treated with a systemic insecticide in November, 2006, to ensure eradication of possible below-detection-level adelgid populations. These sites will be treated again in the spring and fall of 2007. Other hemlock shipments from West Virginia have subsequently been discovered. Surveys and responses necessary to protect Michigan's hemlock resources will continue.

Icosium tomentosum

Region 5: California

Hosts(s): Cupressaceae

Five specimens of the exotic longhorned beetle *Icosium tomentosum* were recovered in Orange County in 2006. A visual survey within one-quarter-mile radius of the initial find site failed to detect any evidence of an established infestation. *Icosium tomentosum* is a circummediterrean species represented by two distinct subspecies: *tomentosum* Lucas, 1854 and *atticum* Ganglbauer, 1881. The subspecies *tomentosum* occurs in southwest Europe and North Africa, whereas subspecies *atticum* occurs mainly in the eastern Medditerranean, including Turkey, the Balkan Pennisula, and west to southern France. Both subspecies develop in various Cupressaceae (*Juniperus, Cupressus, Thuja, Callitrix, Tetraclinus*,etc.). Adults are 8-16 mm in length and appear in June through August. The adults are nocturnal and frequently come to light. Larvae first feed under bark and later enter the wood of recently dead or moribund hosts. The life cycle is two years.

Insects: Nonnative

Larch casebearer
Coleophora laricella

Region 1: Idaho and Montana

Host(s): Western larch

After four years of relative inactivity, appreciable larch casebearer activity was detected on forests in northern Idaho and western Montana. Within the Kaniksu reporting area in northern Idaho, 1,559 acres of defoliation were detected, primarily along the Pack River drainage north of Sandpoint, in Bonner County. In western Montana, 1,020 acres of larch casebearer activity were reported within the Flathead reporting area along the upper Stillwater River and the Spruce Creek drainages in Lincoln County. Observations within the Kootenai reporting area showed 1,228 acres of larch casebearer damage along drainages of Bull River and Rock Creek, Sanders County, just southwest of the Cabinet Mountains Wilderness.

Region 6: Eastern Oregon and Washington

Host(s): Western larch

Ideal timing for a larch casebearer survey in the Pacific Northwest is in June; however, most of the surveys in larch type occur in late July through early September. Poor visibility due to large wildfires delayed the start of our aerial survey season in 2006.

Approximately 337 acres were mapped in 2006, compared to 2,532 acres mapped in 2005. It should be noted, however, that a training flight conducted in June over the Mt. Hood National Forest detected widespread defoliation throughout the host type.

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

Region 9/Northeastern Area: Minnesota, Michigan, Pennsylvania, Vermont, and Wisconsin,

Host(s): Eastern larch

In Vermont, there was only light damage in scattered locations.

In Pennsylvania, damage from the larch casebearer for the first time in Schuylkill County was reported on 25 acres. Counties reporting low damage estimates in 2005 were not resurveyed in 2006.

No activity was reported from Michigan in 2006. In Minnesota, larch casebearer continued to be active, mining tamarack needles and turning trees brown. Larch casebearer was mapped on 6,013 acres in 2006. The duration and extent of the outbreak in 2006 was unusual. Prior to 2000, larch casebearers were seldom seen, but since then, damage has been obvious enough to be mapped annually during the aerial survey. No activity was reported from Wisconsin in 2006.

Larch sawfly
Pristiphora erichsonii Hartig

Region 10: Alaska

Host(s): Eastern larch (tamarack) and ornamental Siberian larch

Larch sawfly defoliation decreased, from 16,771 acres in 2005 to 2,666 acres in 2006. Nearly all of the defoliation occurred on Minto Flats west of Fairbanks. Smaller infestations were also noted east of McGrath, where larch sawfly has been very active for a number of years. Larch sawfly continues to be a problem on ornamental larch in urban areas of south-central Alaska.

Larch sawfly is an invasive defoliator in Alaska. Based on aerial survey data, it is estimated that 600,000-700,000 acres of larch forest in Alaska have been impacted by a larch sawfly infestation that began in 1999. The mortality of larch affected by the larch sawfly has been documented to reach 80 percent. As a result, concern has been expressed that the extent of the larch mortality may necessitate genetic conservation measures.

In September 2006, a special aerial survey was conducted in order to update the mapped distribution of larch in Alaska and document the extent of healthy stands of larch. This survey was conducted while larch were exhibiting their fall foliage, making them easy to distinguish from the black spruce trees that occupy many of the same sites as the larch. Over four days, 2,572 miles were flown, with 6,067,738 acres being surveyed. The land area with healthy larch stands totaled 673,685 acres (11.1 percent of area surveyed). Outside the known range of larch, 10,651 acres of larch were identified. A second fall aerial survey to map healthy larch stands will be conducted during September, 2007.

Lobate lac scale
Paratachardina lobata lobata

Region 8: Florida

Host(s): *Melaleuca*; over 100 other woody species

No reports were received in 2006

Mediterranean pine engraver
Orthotomicus erosus

Region 5: California

Hosts(s): Pines

Orthotomicus erosus, the Mediterranean pine engraver, is a new exotic bark beetle for North America that was found in May 2004 in baited flight traps in Fresno, California, by the California Department of Food and Agriculture. Thus far, California is the only place where Mediterranean pine engraver has been detected in North America. It has since been found abundantly throughout California's southern Central Valley (Fresno, Kern, Madera, Merced, and Tulare Counties) in flight traps or feeding in the phloem of cut logs of Aleppo and Italian stone pines. A few beetles have also been captured in traps in Monterey, Sacramento, and Salinas Counties, but breeding populations have not been found in these counties yet. Observations in California indicate that this species overwinters as larvae, pupae, and adults beneath the bark surface. In the Central Valley, Mediterranean pine engraver has perhaps three to four generations per year, initiates flight in late February, and continues to fly until October-November. In 2006, several dead ornamental pines were removed from the Valley Oaks Golf Course in Visalia, and galleries and numerous adult *O. erosus* were found throughout the stems.

Pear thrips
Taeniothrips inconsequens

Region 9/Northeastern Area: Vermont

Host(s): Red maple and sugar maple

This insect was reported widely scattered in Vermont, but at light levels.

Red pine scale
Matsucoccus resinosae

Region 9/Northeastern Area: Connecticut, Massachusetts, and Rhode Island

Host(s): Red pine

There was no significant activity reported in Connecticut, Massachusetts, or Rhode Island in 2006.

Red-haired pine bark beetle
Hylurgus ligniperda

Region 5: California

Host(s): Various pines

Established populations of the red-haired bark beetle, *Hylurgus ligniperda*, were first found in North America in New York in 2000. In California, red-haired bark beetle was first detected by the California Department of Agriculture in July 2003 at two locations in Los Angeles County: Bear Divide Guard Station, Angeles National Forest, and Frank G. Bonelli Regional County Park. These locations are near heavily urbanized areas. In 2005, red-haired bark beetle was collected in flight traps in urban and more remote forest lands in Los Angeles, Orange, and San Bernardino Counties. In 2006, red-haired bark beetle was detected in three more adjacent counties: Riverside, San Diego, and Ventura. In August 2006, red-haired bark beetle was found at Canyon Crest Country Club in Riverside, which is the first time it was collected in urban areas of Riverside County.

Adult *H. ligniperda* are attracted to fresh stumps, slash, and logging debris for breeding. In unhealthy *Pinus* spp., the beetle usually breeds in thick bark near the base of the stem or in large exposed roots. Newly emerged adults may attack seedlings and stressed, pole-sized trees. Adult beetles carry *Leptographium* fungi, which have been implicated in pine root decline diseases. A March 2005 survey in California revealed that red-haired bark beetle feeds and reproduces in the phloem of large-dimension cut logs of Aleppo and Canary Island pines. Mating pairs of red-haired bark beetle were also collected at this time from a stump of an Aleppo pine that had broken during a major storm on 27 December 2004. The 2006 trap catch of red-haired bark beetle in urban Riverside coincided with the dumping of freshly cut pine logs at the site.

Satin moth
Leucoma salicis

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

Host(s): Aspen

No significant activity was reported in Maine or New Hampshire in 2006. No defoliation was observed in Vermont, a decrease from 2005.

Sirex wood wasp
Sirex noctilio

Region 9/Northeastern Area: New York, and Pennsylvania

Host(s): Pines

This new invasive pest of pines was the subject of an intensive large-scale delimitation trapping survey in New York, Pennsylvania, and Vermont in 2006. In New York, results confirmed the insect to be present in 25 counties, from the western part of the state as far east as Hamilton County in the Adirondack area. In Pennsylvania, positive finds were confirmed in two counties. No positive confirmation of *S. noctilio* was found in Vermont. While efforts in the three states delimited the population in New York and Pennsylvania, it was likely that the actual *S. noctilio* population covered a larger geographic area. In 2007, further efforts will be made to determine the extent of the infestation.

Spruce aphid
Elatobium abietinum

Region 3: Arizona

Host(s): Engelmann spruce and blue spruce

No spruce aphid defoliation was recorded in Arizona or New Mexico in 2006.

Region 10: Alaska

Host(s): Feed on most species of spruce, but are most damaging to Sitka spruce

Only 9,120 acres of spruce aphid defoliation were mapped in 2006, down 60 percent from 2005. Defoliation occurred in small pockets along the beach fringe from Lincoln Island in the Lynn Canal, across from Berners Bay, to the north end of Kupreanof Island, and along the mainland from Juneau to Thomas Bay. In the southwest area of the panhandle, small spots were mapped between Edna Bay, Kosciusko Island, Naukati, Prince of Wales Island, and on Long and Dall Islands. Defoliation also occurred around the towns of Craig, Juneau, Ketchikan, and Sitka. The current outbreak started in 1998, but the worst year was in 2003, when defoliation occurred on 30,627 acres distributed over more of the area surveyed than in the previous five years.

In 2006, four low-temperature events of approximately 20 hours total occurred in southeast Alaska, from March 14 through March 17. These combined low-temperature periods are thought to have killed a large number of aphids.

Twospotted leafhopper
Sophonia rufofascia

Region 5: Hawaii

Host(s): Numerous, both native and exotic

Since its first report in 1987 on Oahu, the twospotted leafhopper has been recorded on over 300 host plants on all major Hawaiian islands. Of major concern are its impacts on ohia lehua (*Metrosideros polymorpha*), a dominant tree in native Hawaiian forests, and uluhe (*Dicranopteris linearis*), a common native fern that provides cover on steep slopes. The leafhopper continues to kill the invasive firetree (*Morella faya*) on the island of Hawaii.

Uglynest caterpillar
Archips cerasivorana

Region 10: Alaska

Host(s): Cotoneaster, crabapple, and mountain ash

Populations of this introduced pest remains a problem in west Anchorage on plantings of cotoneaster and mountain ash. It can also be found along roadsides near and around Anchorage on *Prunus*, *Malus*, and *Salix* species. This insect is especially a problem for nurseries and owners of ornamental plantings because of the unsightly appearance of the larval nests.

Winter moth
Operophtera brumata

Region 9/Northeastern Area: Connecticut, Massachusetts, and Rhode Island

Host(s): American elm, apple, basswood, northern red oak, red maple, poplar, and willow

There were moths trapped in the southeastern corner of Connecticut; the extent of feeding and infestation was unknown. Pheromone trapping in 2005 indicated a possible winter moth population in southern-most Maine. Defoliation from an early season defoliator was reported in the Wells area in 2006 after the insects were gone, but winter moth was strongly suspected. Additional light, spotty defoliation was detected in other coastal towns in York County. Work is currently underway to positively identify the causal agent. In Massachusetts, a total of 6,208 acres of defoliation were documented in Middlesex and Essex Counties. It was likely that the southeastern part of the state also experienced considerable defoliation, but this could not be differentiated from the forest tent caterpillar and gypsy moth defoliation in the same areas. Rhode Island reported about 233 acres of defoliation in the eastern part of the state near the Massachusetts border.

Woolly alder sawfly
Eriocampa ovata

Region 10: Alaska

Host(s): Sitka, red, and thin-leaf alder

Defoliation by woolly alder sawfly remained moderate to heavy on thin-leaf alder, *Alnus tenuifolia* Nutt., from Palmer to Seward in south-central Alaska. Based on roadside observations, many acres additional to the 7,000 in the previous section were affected by this insect on the Kenai Peninsula. This species

skeletonizes alder leaves, consuming all leaf tissue except major veins. Thin-leaf alder is the preferred host of this insect; Sitka alder, *A. sinuata* (Regel) Rydb., and green alder, *A. crispa* (Ait.) Pursh, are seldom defoliated.

Xyleborus bark beetle
Xyleborus seriatus

Region 9/Northeastern Area: Massachusetts

Host(s): Conifers

No significant activity was reported in Massachusetts in 2006.

Yellow Phoracantha
Phoracantha recurva

Region 5: California

Host(s): Eucalyptus

No reports were received in 2006.

DISEASES: NATIVE

Alder canker
Valsa melanodiscus

Region 10: Alaska

Host(s): Thin-leaf alder

For the fourth consecutive year, cankers caused by *Valsa melanodiscus* were girdling and killing branches, stems, and genets of alder in 2006, causing widespread dieback and mortality. This pathogen is the primary agent associated with riparian thin-leaf alder, *Alnus tenuifolia*, dieback and mortality across thousands of acres in south-central and interior Alaska. While the primary host affected is thin-leaf alder, dieback and mortality is occurring and intensifying on Sitka alder, *A. sinuata*, and to a lesser degree on green alder, *A. crispa*.

Road surveys in 2006 in south-central and interior Alaska detected the canker at over 100 locations, primarily at low levels with 15 to 30 percent of stems affected. An outbreak of alder canker near Council on the Seward Peninsula in 2004 appeared closely tied to sudden intense spring freeze/thaw events, indicating that stress factors play a role in reducing host defenses and/or favoring the pathogen's infection process. Monitoring of 16 sites in 2006 revealed that dieback and mortality is intensifying within affected sites and is expected to continue in the near future. Recovery of the alder is not certain as less than half of the dead genets appear to be recovering, with live sprouts at the base. As alder is a keystone successional species, alder mortality may have important long-term ecological consequences. Researchers from the University of Alaska Fairbanks are assessing the impact of dieback and mortality on nitrogen fixation.

Annosus root disease
Heterobasidion annosum

Region 1: Idaho and Montana

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

There are two types of annosus root disease found in the Northern Region. The p-type is found causing disease in ponderosa pine, and the s-type causes disease in Douglas-fir, grand fir, subalpine fir, western hemlock, and Engelmann spruce, and occasionally other conifer species in these moister habitats. Most damage from annosus root disease is concentrated in lower elevations where ponderosa pine is the dominant tree species and past harvesting of large trees has been common. Presence of p-type annosus root disease in ponderosa pine stands greatly decreases the potential for managing ponderosa pine. These sites are usually too dry to effectively grow alternative tree species, so preventing the introduction and subsequent increase of annosus root disease is crucial for managing ponderosa pine. S-type annosus root disease is widespread at low levels on Douglas-fir and true firs in mixed conifer stands throughout western Montana and north Idaho. It is frequently found in association with other root diseases and appears to be involved in a decline of subalpine fir in high elevations.

Region 2: Nebraska

Host(s): Jack pine, Ponderosa pine, and eastern redcedar

Annosum root disease was recently discovered on ponderosa pine and eastern redcedar in the Bessey Ranger District of the Nebraska National Forest. This root disease has previously been identified there on jack pine. At present, the incidence levels are low. Heterobasidion occurred on both jack pine and eastern red cedar in the same stand. In another stand, this root disease appeared to be killing the ponderosa pine.

Region 3: Arizona and New Mexico

Host(s): True firs and ponderosa pine

This root disease fungus is common in the region, functioning as both a pathogen and a saprophyte. It causes scattered mortality in spruce-fir, mixed conifer, and ponderosa pine forests throughout Region 3. Mortality rates are typically highest in young regeneration.

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

Host(s): Bitterbrush, chokecherry, Douglas-fir, true firs, spruce; and Jeffrey, lodgepole, and ponderosa pines

This disease can be found throughout the region, but mostly as a saprophyte on dead trees, stumps, roots, and cull logs or fallen stems. The fungus occasionally kills young ponderosa pine, especially in plantations on droughty soils.

Region 5: California

Host(s): Conifers and some hardwoods

Annonus root disease is a growing concern in southern California after the cutting of numerous bark beetle-killed trees. The potential for spread of annosus root disease will be a possibility for decades to come where freshly cut stumps were not properly treated. Specifically, there is concern in the mountains of southern California where dead tree removal projects have been underway since the extreme conifer mortality events between 2002-2004.

Annosus root disease continues to cause scattered pockets of mortality in ponderosa pine on McCloud Flats on the Shasta-Trinity National Forest. Mortality is impacting management in the Pilgrim Sale Area.

Annosus root disease was identified from laminated decay and the presence of fruiting bodies in scattered white fir stumps near Little Grass Valley Reservoir on the Plumas National Forest. Based on stunted growth and crown dieback, many young and old white fir trees in the area appear to be infected with root disease.

Region 6: Oregon and Washington

Host(s): True firs, pines, and hemlocks

In southern and eastern Oregon and eastern Washington, annosus root disease causes damage primarily in partially harvested white and grand fir stands. Damage from root and stem decay also occurs in subalpine fir, red fir, noble fir, pacific silver fir, and mountain hemlock, especially in partially harvested stands and in wounded trees. Mortality is high where annosus root disease and fir engravers occur together. Despite high infection levels in true fir stumps cut 20-25 years ago, mortality of surrounding conifer regeneration is low in northeastern Oregon, but infection levels are high especially in sapling grand fir, subalpine fir, Engelmann spruce, and Douglas-fir. Annosus root disease in low-elevation western hemlock occurs primarily as a butt rot in wounded trees. Efforts are underway to artificially inoculate unwanted western juniper with *H. annosum* to create mortality centers in eastern Oregon. Ponderosa pine and associated western juniper are frequently infected and often killed on drier sites east of the Cascades.

Diseases: Native

Region 8: Regionwide

Host(s): Southern pines

Localized, scattered annosum mortality occurs annually throughout the range of southern pines. Alabama reported no significant change, but the disease remains a prevalent problem statewide, especially in Conservation Reserve Program plantations damaged by storms. North Carolina also reported scattered problems statewide. Georgia reported extremely high levels of *Annosum* due to the large acreage of young pine plantations that have been thinned in recent years; *Annosum* caused the greatest amount of disease-related mortality of pines in Georgia in 2006. In South Carolina, surveys indicated damage in 34 counties, with an estimated 50,890 acres affected and financial losses totaling $1,832,040.

Region 9/Northeastern Area: Connecticut, Vermont, and Wisconsin

Host(s): Red and white pine

Annosus root disease is present in Connecticut, but is not a notable problem in 2006. The disease was scattered throughout southern Vermont. No new infections centers were reported.

In Wisconsin, annosum root rot was found in a red pine stand in Columbia County. This brings the total number of counties with this disease to fifteen (Adams, Buffalo, Columbia, Dunn, Green, Iowa, Jefferson, LaCrosse, Marquette, Richland, Sauk, Trempealeau, Walworth, Waukesha, and Waushara).

.Region 10: Alaska

Host(s): Western hemlock and Sitka spruce

Annosus commonly causes root and butt-rot in old-growth western hemlock and Sitka spruce forests in southeast Alaska. The form present in Alaska is the 'S' type, which causes internal wood decay, but is not typically a tree killer. *Heterobasidium annosum* has not yet been documented in south-central or interior Alaska.

Anthracnose
Apiognomonia veneta
Discula fraxinosa
***Gnomonia* spp.**
Mycosphaerella fraxinicola
Septoria leaf blight

Region 8: Tennessee

Host: Ash

Light infection levels were reported statewide in Tennessee in 2006.

Region 9/Northeastern Area: Regionwide

Host(s): American sycamore, ash, beech, birch, maples, oaks, and miscellaneous hardwoods

Damage was widespread and severe throughout Connecticut on many hardwoods in 2006; hosts included sycamore, oak, ash, beech, elm, and maples. Maples were particularly hard-hit and had extensive browning and premature leaf drop; there were about 25,200 acres recorded defoliated.

In Maine, unusually wet weather conditions that persisted throughout the spring, summer, and fall resulted in a number of widespread foliar diseases of hardwood trees. Oaks, ashes, maples, and birches were all affected to some degree statewide. Most notable were *Mycosphaerella fraxinicola* on ashes in central and mid-coastal regions of Maine and *Septoria betulae* on paper birch. This Septoria disease appeared statewide and resulted in considerable early leaf shedding of paper birch, especially in the western regions of Maine. Heavy infections were also noted in the mid-coast region. There were 89,000 acres of damage reported from aerial survey.

In Massachusetts, anthracnose was severe in isolated locations statewide. Anthracnose was widespread and severe in New Hampshire. Over 200,000 acres of damage to birch were mapped in the White Mountain National Forest; a result of a combination of anthracnose and other fungal diseases, birch leafminer, and birch decline. In Vermont, there was heavy damage on sugar maple, white ash, and red oak statewide by late summer. Over 46,000 acres of defoliation and discoloration from anthracnose and fungal diseases, especially Septoria, on birch were mapped. High levels of infection were caused by seasonal wet weather.

Light defoliation was seen throughout Delaware on oak, maple, and sycamore and damage was less than 2005 due to drier spring conditions that diminish disease development. For a second year, Pennsylvania reported mostly light anthracnose conditions throughout the state, with only 1,030 acres of damage. Most likely dry spring conditions not conducive for fungus development were responsible for the lack of fungal development. A district-wide report for the southeastern part of the state did report moderate anthracnose on sycamore and other reports of light activity on sugar maple and oak in the north-central part of the state. New counties reporting anthracnose incidence in Pennsylvania were Berks, Bradford, Chester, Delaware, Lancaster, Lehigh, Montgomery, Philadelphia, Sullivan, and Tioga. West Virginia aerial surveys found moderate to severe anthracnose infections in Pendleton County and moderate levels in Hardy County in 2005 despite prevailing dryer conditions. Stressed induced fungal infection by Hypoxylon and Armillaria were present at many investigated sites. In 2006, anthracnose was light to moderate statewide.

Anthracnose was very common on trees in the northern half of Illinois in 2006. Many trees did not foliate until mid-June.

Armillaria root disease
Armillariella spp.

Region 1: Idaho and Montana

Host(s): Douglas-fir and other conifers

Armillaria root disease is the most damaging and widespread disease in the Northern Region. It exceeds all other insects and diseases in annual mortality. At least 3.3 million acres in the Region have moderate to severe root disease, and up to 60 percent of this impact is due to Armillaria root disease. Armillaria kills conifers of all species when they are young, but is especially damaging on Douglas-fir, subalpine fir, and grand fir because these species remain highly susceptible throughout their lives. About 3 percent of forest lands in Idaho and Montana are devoid of forest cover and have become essentially permanent shrub fields as a result of severe root disease. The disease carries over in roots from one generation to the next on a site, surviving forest fires and tree harvest.

In most cases, the species composition of forests has been altered by human activity. The natural pine and larch forests have accumulated increasing proportions of Douglas-fir and true firs. The only practical control for this disease is restoring a more natural species composition to afflicted forests. This would result in replacement of highly susceptible Douglas-fir and true firs with disease-resistant pines and larch.

Diseases: Native

Region 2: Colorado, South Dakota, and Wyoming

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

Armillaria root disease is the most common root disease in the region and occurs on many different tree species. Often this disease contributes to beetle-caused pine mortality.

Armillaria root disease was seen in oaks along floodplains and in grazed areas in South Dakota and Wyoming. The combination of stresses between flooding in the 1990s and drought in more recent years promoted its growth in these areas.

Region 3: Arizona and New Mexico

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

Armillaria is the most common (and the most easily recognized) root disease in the region, functioning as both a pathogen and a saprophyte. It causes scattered mortality in spruce-fir and mixed conifer forests throughout the Region. Some ponderosa pine sites, especially those on volcanic soils, sustain significant mortality. Mortality rates are typically highest in young regeneration. Permanent plots have been established to assess the role of this and other root diseases.

Region 4: Idaho, Nevada, Utah, and Wyoming

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

Evidence of Armillaria root disease can be found throughout the region, but the fungus functions 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 on cool sites at high elevation.

Region 5: California

Host(s): Conifers, some hardwoods

Armillaria root disease has become a problem on medium pole-size incense-cedar in the central Sierra Nevada. Trees have been killed in small groups in Butte, Placer, and Fresno Counties. Most areas affected are severely overstocked.

Region 6: Oregon and Washington

Host(s): All conifer species

Armillaria root disease causes serious mortality losses east of the Cascade Range in mixed-conifer stands. It is the most commonly encountered root disease in Oregon and Washington. True firs sustain the most losses; however, in localized areas, Douglas-fir and ponderosa pine mortality can be significant. Several large Armillaria clones exist throughout the Region. Thinning of young conifers has been shown to significantly increase tree growth rates and reduce mortality caused by Armillaria root disease in the Cascade Range of Oregon and Washington. Permanent plots on the Winema National Forest were examined in 2005. Ten years after commercial thinning, shelterwood harvesting, and group selection cuts, crop-tree mortality caused by Armillaria root disease is, at least, not exacerbated by harvesting, and at most, reduced by the silvicultural methods tested. 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 reducing disease spread and tree mortality. Infected trees are often attacked by bark beetles. Efforts continue to validate the Western Root Disease Model in Armillaria-affected forests.

Region 9/Northeastern Area: Regionwide

Host(s): All species

Armillaria root disease was present throughout the Northeast Region. Dieback and mortality occurred on many hosts throughout the area with various degrees of damage. Massachusetts reported an increase in Armillaria in conifer stands where harvest had occurred. A total of 95 acres were documented.

Region 10: Alaska

Host(s): Red alder and mixed hardwoods

Several species of Armillaria root disease occur in the coastal forests of southeast Alaska, but in general, these species are less aggressive saprophytic decomposers that only kill trees that are under some form of stress. A few red alder trees were found apparently killed by Armillaria root disease in 45-year old mixed hardwood-conifer forests in the Maybeso Valley of Prince of Wales Island. Many more affected red alders were found in a 100+ year-old mixed forests on Baranof Island and Chichagof Island, indicating that the disease may be important in the senescence of alder as these stands age.

Several species of Armillaria root disease occur in south-central and interior Alaska, where some invade conifers and others invade hardwoods. Most species appear to be weak pathogens invading trees under stress. Mature stands of paper birch and trembling aspen are particularly susceptible to attack by Armillaria root disease.

Ash leaf and twig rust
Puccinia sparganoides

Region 9/Northeastern Area: Delaware and Maine

Host(s): Ash species

In Maine, the expectation that 2006 would be a severe year for this disease did not develop. It most commonly occurred in the mid-coast region, but infections were very low. The extent to which the unusually wet weather conditions affected this disease was unknown.

In Delaware, defoliation from this disease approached ninety percent in some county areas, and tree mortality of five percent was observed.

Black stain root disease
Leptographium wageneri
Ophiostoma wageneri

Region 1: Idaho and Montana

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

Black stain root disease occurs somewhat infrequently in the Northern Region. It has been identified most commonly on Douglas-fir, but has also been found on ponderosa pine and lodgepole pine. It is primarily

found west of the Continental Divide, but in 2003 it was first identified on Douglas-fir east of the Divide near Bozeman, Montana.

Region 3: Arizona and New Mexico

Host(s): Piñon pine and Douglas-fir

Both *Leptographium wageneri* var. *wageneri* (affecting piñon) and *L. wageneri* var. *pseudotsugae* (affecting Douglas-fir) occur, but are rare, in the Region. The former has 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, and Utah

Host(s): Piñon pine

Aerial detection and follow-up ground surveys have discovered about 24 root disease centers in pinyon pine stands in the Intermountain Region. Perennial infections caused mortality of individual pinyon pine over 50 acres of the USDI Bureau of Land Management Burley District in southern Idaho. In Utah and Nevada, the host is more prevalent and so is the occurrence of black stain root disease. Nevertheless, fewer than 1,500 acres of pinyon pine in each state have been found infected with the root disease.

Region 5: California

Host(s): Douglas-fir, Jeffrey pine, and ponderosa pine

Because precipitation levels were again near normal in most of northwestern California during the winter of 2005-2006, ponderosa pine mortality due to a combination of drought, high stocking, black stain root disease and western pine beetle at McCloud Flats (McCloud Ranger District, Shasta-Trinity National Forest) has decreased. However, conspicuous concentrations of mortality around black stain root disease centers were evident at the Mud Flow Research Natural Area, Elk Flat, Ash Creek Sink, Algoma, and Harris Mountain.

Scattered Douglas-fir trees are dying due to black stain root disease throughout Butte and Plumas Counties. The trees are primarily large older trees in stands that have been repeatedly thinned.

A root disease with characteristics similar to *L. wageneri* was detected on bristlecone pines in the Ancient Bristlecone Pine Forest, Inyo National Forest. Identification of the pathogen is in progress. Black stain root disease has been killing pinyon pines at the lower elevations of the White Mountains for a number of years. Monitoring the extent and severity of the root disease in bristlecone pine will initiate in 2007

Region 6: Oregon and Washington

Host(s): Douglas-fir and 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 thinning, 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; it is widespread on the southeastern portion of the Malheur National Forest. Some smaller localized infestations are known in the Deschutes National Forest and in portions of the Blue Mountains. Black stain root disease is seen infrequently in eastern Washington. Pacific Northwest Research Station scientists are investigating relationships with natural and prescribed fire, vector insects, and management strategies.

Botryosphaeria canker
***Botryosphaeria* spp.**

Region 9/Northeastern Area: Connecticut, Pennsylvania, and Vermont

Host(s): Beech, dogwood, chestnut oak, Leyland cypress, maple, and red oak

This disease was widespread on many species in Connecticut, including Leyland cypress, maple, dogwood, beech, peach, and oak, but was not as severe in 2006 as in 2005. There was no significant activity in Vermont.

In Pennsylvania, no twig damage or defoliation was observed in 2006.

Brown cubical root and butt rot
Phaeolus schweinitzii

Region 3: Arizona and New Mexico

Host(s): Douglas-fir and other conifers

This disease is common on old Douglas-fir in many parts of the Region. It causes growth defects and can contribute to windthrow.

Region 5: California

Host(s): Douglas-fir

In 2006, brown cubical butt rot was observed affecting scattered Douglas-fir in Hayden Flat Campground on the Trinity Resourse Management Unit of the Shasta-Trinity National Forest.

Brown cubical butt rot infected large Douglas-firs on Soquel Demonstration State Forest (SDSF) and along Highland Dr. south of Santa Cruz. Sporophores were visible in mid-September. Infected standing trees were killed by the flatheaded fir borer. Several sporophores and one large, windthrown Douglas-fir were also noted near camp sites closed to the public at Hendy Woods State Park in Mendocino County. Sporophores were apparent in early October.

Cankers
***Botryosphaeria* spp.**
Ceratocystis fimbriata
Criptosphaeria populina
***Cytospora* spp.**
Hypoxylon mammatum

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

Host(s): Thinleaf alder, English oak, Gambel oak, and aspen

A survey in 2004 showed that about one third of the standing alder (*Alnus incana* ssp. *tenuifolia*) in Region 2 is dead and another third has at least minor dieback, both associated with cankers caused by *Valsa melanodiscus* (*Cytospora umbrina*). Photographs and reports that have recently come to light suggest that unusual levels of mortality may have already begun before 1995. The cankers expand very rapidly during the growing season. Althought no formal survey has been conducted since 2004, cankers are still a causing mortality in the Region.

Diseases: Native

Aspen bark beetle, *Procryphalus mucronatus*, generally attacks aspen also affected by *Cytospora* canker, and the combination of the two agents often results in the death of the host tree. Areas of the southern Uncompahgre National Forest and northern San Juan National Forests have been particularly hard hit, with some stands experiencing as much as 30 percent mortality over a two-year period.

Hypoxylon and *Botryosphaeria* cankers were observed on oaks under stress (grazed or flooded woodlands) in eastern Kansas.

Cytospora canker of true fir
Cytospora abietis

Region 5: California

Host(s): Red fir and white fir

Cytospora canker is severe on red fir along the Pacific Crest Trail west of Scott Mountain summit and along the Clear Creek Trail in the Siskiyou Wilderness Area near the Young's Valley trailhead. Branch dieback was also noted on true firs at Ward's Fork Gap, Siskiyou County.

Cytospora canker continues to infect red fir branches near Robinson Flat Campground and in scattered areas of the American River Ranger District, Tahoe National Forest. *Cytospora abietis* was identified in red fir in the Alpine Meadows Ski Area on the Truckee River Ranger District, Tahoe National Forest.

Cytospora canker of poplars and willows
Cytospora chrysosperma

Region 5: California

Host(s): Poplars and willows

Cytospora canker was detected in willow species this year at lower elevations on the east side of the northern Sierra Nevada and southern Cascades. Scattered willow dieback could be detected in nearly all stands.

Cytospora tip blight
Cytospora luecostigma

Region 9/Northeastern Area: Pennsylvania

Host(s): Black cherry

This pathogen was described for the first time in Pennsylvania in 2006, with 1,297 acres of damage reported in McKean and Potter Counties.

Cercospora needle blight
Cercospora spp.

Region 8: South Carolina

Host(s): Leyland cypress

Cercospora needle blight continued to be a problem in South Carolina in 2006. Fungicidal control has been suggested for growers experiencing problems with this disease. Georgia and North Carolina also reported scattered problems in landscape trees. The lack of genetic variation in Leyland cypress due to asexual propagation is believed to contribute to disease problems in this species.

Chinkapin canker
Cause unknown

Region 5: California

Host(s): Chinkapin

No reports were received in 2006.

Diplodia blight
Sphaeropsis sapinea (Diplodia pinea)

Region 1: Idaho, Montana, and North Dakota

Host(s): Ponderosa pine

Diplodia shoot blight mostly occurs sporadically at low levels in North Dakota, Montana, and Idaho. In North Dakota, the Towner State Nursery is currently managing the disease in surrounding windbreaks through species conversion of windbreak trees, fungicides, alteration of irrigation schedules, and relocation of pine seedling fields. In Idaho and Montana, where the disease predominantly infects ponderosa pine, high levels of Diplodia shoot blight can be found mostly along river bottoms and major drainages. Considerable variability in infection levels is often seen between trees in a given stand. The disease has been especially severe on ridges and dry slopes of the Southfork and Clearwater Rivers between Grangeville and Orofino, Idaho, but poses little threat to the watershed because mortality rates have been low.

Region 2: Kansas, Nebraska, and South Dakota

Host(s): Ponderosa, Austrian, and Scotch pines

Sphaeropsis blight seemed to increase in importance in the Great Plains and was one of the most important diseases affecting pines in this area. There were few reports of this disease in the 1900s. This shoot blight pathogen is considered a non-native, invasive, forest pathogen in Nebraska and South Dakota.

In 2006, stress from drought allowed the disease to cause greater damage in planted areas and native forests. Sphaeropsis seems to continue to be a problem, and might be getting worse. *Ips* beetle mortality was associated with *Sphaeropsis* infected trees in 2006.

In South Dakota, *Sphaeropsis* caused higher than normal amounts of damage in 2006 because of added stress on the trees from the drought.

Diseases: Native

Region 5: California

Host(s): Ponderosa pine

Shoot dieback caused by Diplodia blight was observed again in 2006 on ponderosa pines in the Sacramento River Canyon, principally between Shasta Lake and Dunsmuir, Shasta, and Siskiyou Counties. Repeated infections on some trees are leading to crown dieback and occasionally mortality. Diseased ponderosa pines were also noted in the upper Trinity River drainage, Trinity County, and in Whitmore, Shasta County. Although the yearly percentage of diseased pines is relatively small, some areas have experienced a chronic occurrence of Diplodia blight since the mid-1990s.

Diplodia blight continued to kill ponderosa pine branches along the North Yuba River in the Goodyears Bar and Downieville area of Sierra County. Some of the infected trees have died since 2005, probably as a result of moisture stress in combination with Diplodia blight. Branch dieback was also noted on ponderosa pine in the Nevada City and Grass Valley area in Nevada County.

Region 8: Georgia

Host: Loblolly pine

Tip blight was detected in eight counties in lower central Georgia during the winter of 2005-06, producing isolated mortality in five-to-ten-year-old loblolly pine plantations.

Region 9/Northeastern Area: Minnesota, Vermont, and Wisconsin

Host(s): Fir, red pine, and white spruce

There was scattered light dieback observed in Vermont affecting Christmas tree plantations.

Minnesota nursery managers reinstituted fungicide spray regimes, regularly rogued seedbeds, and pre-cooled seedlings to reduce the chances of shipping seedlings with latent infections. Assays showed latent infections were down to 1.25 percent. Windbreak removals also reduced incidence of the disease.

Over the last few years, the Wisconsin Department of Natural Resources state nurseries implemented an aggressive management plan to monitor and control Diplodia shoot blight and canker. In 2006, the State nurseries began an intensive sampling and testing protocol to monitor for Diplodia spores on red pine seedlings. The results of this testing allowed the State nurseries to improve management of the disease to ensure that only the highest-quality seedlings were shipped. On June 25, 2006, a severe thunderstorm hit a site in Columbia County (south-central Wisconsin) with golf-ball-size hail; by early August, red pine plantations in the affected area exhibited severe branch dieback. Laboratory examinations revealed branch cankers caused by the fungus, *Diplodia pinea*, starting from wounds inflicted by hail. In severely affected areas, damage reached 80-100 percent of the crown, and the entire crown appeared reddish-brown. Approximately 117 acres of pole-size red pine plantations suffered damage, and more than 6,000 cords of red pine were salvage-harvested. Although branches of nearby white pine were also injured by hail, they sustained only minor branch tip mortality.

Dwarf mistletoes
Arceuthobium spp.

Region 1: Idaho and Montana

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

Lodgepole pine dwarf mistletoe occurs on approximately 1.7 million acres (28 percent) of the lodgepole pine type in Region 1. Douglas-fir dwarf mistletoe occurs on about 0.6 million acres (13 percent) of

Douglas-fir, while Western larch dwarf mistletoe occurs on about 0.8 million acres (38 percent) of western larch stands. Dwarf mistletoes are locally severe within ponderosa pine stands around Coeur d'Alene, Idaho, and along the Spokane River drainage in northern Idaho. Limber pine and whitebark pine are heavily infected in localized areas in Montana, with higher infection levels east of the Continental Divide.

Region 2: Colorado and Wyoming

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

In the Front Range of Colorado, the number of infested pines with dwarf mistletoes has increased since 2005. This could be due to the lack of fires, which leads to dense forests in the area, and thus greater seed dispersal.

Region 3: Arizona and New Mexico

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

Dwarf mistletoes continue to be the most widespread and damaging pathogens in Region 3. Three species—those affecting ponderosa pine, pinyon pine, and Douglas-fir—occur throughout most of the ranges of their hosts, while five other dwarf mistletoe species have more limited distributions. Roughly 2.2 million acres of commercial ponderosa pine forest are infested, resulting in an estimated growth loss of 25 million cubic feet annually.

Region 4: Idaho, Nevada, Utah, and Wyoming

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

These plant parasites remain the most widespread and frequently observed disease within the Intermountain Region. Regional incidence by major host species is declining due to landscape-level wildfires. Although it has been 25 years since the last dwarf mistletoe survey, Forest Health Specialists estimate occurrence is as follows: lodgepole pine, 40 percent; ponderosa pine, 15 percent; and Douglas-fir, 15 percent. These percentages by host type represent stands having some level of infection.

Region 6: Oregon and 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 reducing growth, mortality, deformity, and top-kill, are significant, particularly in unmanaged stands. Most conifer species are affected to some degree. Douglas-fir dwarf mistletoe is abundant east of the Cascades and in southwestern Oregon. Western larch dwarf mistletoe causes significant effects in northeastern Oregon and eastern Washington. The intensity of dwarf mistletoes in eastern Oregon and Washington and in 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. New management policies, including green tree retention requirements and restrictions on silvicultural treatment of certain sensitive areas and large-diameter trees, will reduce sanitation opportunities and allow mistletoe intensification in the future. New information about wildlife use of dwarf mistletoe is leading to retention of infected trees in some locations.

Douglas-fir dwarf mistletoe
Arceuthobium douglasii

Region 5: California

Douglas-fir dwarf mistletoe is slowly killing Douglas-fir on Black Butte (southwest of Mount Shasta), along Castle Crags Creek, and in the upper Sacramento River drainages.

Gray pine dwarf mistletoe
Arceuthobium occidentale

Region 5: California

Gray pine dwarf mistletoe was observed causing branch dieback and some whole tree mortality of mature gray pines off of Highway 89 near the Hat Creek Work Center, Hat Creek District, Lassen National Forest.

Limber pine dwarf mistletoe
Arceuthobium cyanocarpum

Region 5: California

Limber pine dwarf mistletoe is causing flagging on whitebark pine on the ridge between Little Duck Lake and High Lake.

Lodgepole pine dwarf mistletoe
Arceuthobium americanum

Region 5: California

Lodgepole pine dwarf mistletoe was observed on lodgepole pine near Little Grass Valley Reservoir on the Plumas National Forest.

Mountain hemlock dwarf mistletoe
Arceuthobium tsugense subsp. *mertensianae*

Region 5: California

An infestation of mountain hemlock dwarf mistletoe severe enough to cause mortality is present on the ridge between Little Duck Lake and High Lake in the Russian Wilderness Area.

Mountain hemlock dwarf mistletoe was observed on western white pine in the Alpine Meadows Ski Area on the Truckee River District, Tahoe National Forest.

Red fir dwarf mistletoe
Arceuthobium abietinum f.sp. *magnificae*

Region 5: California

Incidence and impact of red fir dwarf mistletoe continues to be heavy at South Fork Mountain on the Hayfork Ranger District, Shasta-Trinity National Forest.

White fir dwarf mistletoe
Arceuthobium abietinum f.sp. *concoloris*

Region 5: California

Incidence and impact of white fir dwarf mistletoe continues to be heavy at South Fork Mountain on the Hayfork Ranger District, Shasta-Trinity National Forest.

Eastern dwarf mistletoe
Arceuthobium pusillum

Region 9/Northeastern Area: Maine, Michigan, Minnesota, Wisconsin, New Hampshire, New York, and Vermont
Host(s): Black spruce, red spruce, white spruce

In Maine, this disease continued to be prevalent; especially in stands of white spruce in coastal areas, conditions remained largely unchanged, as in past years. The disease remained at endemic levels in New Hampshire and in New York. In Vermont, there was scattered damage statewide.

The disease remained at endemic levels in Michigan, Minnesota, and Wisconsin.

Mountain hemlock dwarf mistletoe
Arceuthobium tsugense

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. Although the range of western hemlock extends to the northwest along the Gulf of Alaska, dwarf mistletoe is absent from Cross Sound to Prince William Sound.

It is difficult to detect dwarf mistletoe during aerial surveys, but new estimates of occurrence are available from Pacific Northwest Research Station, Forest Inventory and Analysis (FIA) plots. Approximately 12 percent of forest land in southeast Alaska is infested with hemlock dwarf mistletoe. Ignoring the inaccessible wilderness not sampled, hemlock dwarf mistletoe occurs on an estimated 830,000 acres. Including wilderness areas would increase this estimate to more than one million acres of forest infested with hemlock dwarf mistletoe in southeast Alaska. Most of this occurrence is in the old sawtimber classes, and both the young and old sawtimber classes have a higher proportion of dwarf mistletoe occurrence (19.8 and 13.5 percent, respectively) than in the smaller size classes. These values are likely conservative estimates because dwarf mistletoe may not have been recorded when other damage agents were present. Also, it is important to note that scattered larger trees may have been present in the plots designated as smaller and younger classes. This could explain, in part, the higher level of hemlock dwarf mistletoe in the young sawtimber class.

Diseases: Native

Hemlock dwarf mistletoe is concentrated at low elevations in southeast Alaska. Productive forest land represents most of the affected area. There is an apparent threshold at approximately 500 feet elevation on both productive and unproductive forest lands above which the parasite can occur but is less common. The principle host, western hemlock, is distributed well above this threshold, suggesting that some climatic factor limits the distribution of hemlock dwarf mistletoe at higher elevations.

The dominant small-scale (canopy gap) disturbance pattern in the old forests of coastal Alaska favors the short-range dispersal mechanism of hemlock dwarf mistletoe and may explain the common occurrence of the disease here. Infection of Sitka spruce is uncommon, and infection of mountain hemlock is rare. Heavily infected western hemlock trees have branch proliferations or "witches' brooms," bole deformities, reduced height and radial growth, less desirable wood characteristics, and a greater likelihood of heart rot, top-kill, and death. The aggressive heart rot fungus, *Phellinus hartigii*, is associated with large mistletoe brooms on western hemlock.

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 for birds or small mammals, although this topic has not been adequately researched in Alaska. The inner bark of swellings and the seeds and shoots of the parasitic plants are nutritious and often consumed by small mammals (e.g., flying squirrels). Stand composition is altered when mixed-species stands are heavily infected; growth of resistant species such as Sitka spruce and cedar is enhanced.

Spread of the parasite into young-growth stands that regenerate following clearcutting is typically by: 1) infected non-merchantable hemlock trees (residuals) that are sometimes left standing in cutover areas, 2) infected old-growth hemlocks on the perimeter of cutover areas, and 3) infected advanced reproduction. Residual trees may play the most important role in the initial spread and long-term mistletoe development in young stands. Managers using alternative harvest techniques (e.g., large residuals left standing in clearcuts, small harvest units, or partial harvests) should recognize the potential reduction in timber volume and value resulting from hemlock dwarf mistletoe infection under some of these silvicultural scenarios. Substantial reductions to timber are only associated with very high disease levels, however. High levels of hemlock dwarf mistletoe will only result if numerous large, intensely infected hemlocks are well distributed after harvest. Selective harvesting techniques will be the silvicultural method for maintaining desirable levels of this disease if management intends to emphasize structural and biological diversity as well as timber production.

Elytroderma needle blight
Elytroderma deformans

Region 1: Idaho and Montana

Host(s): Ponderosa pine and lodgepole pine

Elytroderma needle blight has been heavy in several areas of western Montana for a number of years in the Jette Lake area north of Polson and the Bitterroot Valley south of Missoula. This disease has been credited with mortality in mature ponderosa pine and is a threat to the viability of ponderosa pine on several local sites in western Montana. In 2005, it was found causing significant mortality on a local scale in an 80-year old off-site plantation of ponderosa pine in northwest Montana on the Kootenai National Forest. It is widespread but at generally low levels throughout northern Idaho. Although lodgepole pine is considered a host to Elytroderma needle blight, it has been reported only on ponderosa pine in the Northern Region.

Region 5: California

Host(s): Ponderosa pine and Jeffrey pine

No reports were received in 2006.

Fir-fern rust
Uredinopsis mirabilis

Region 9/Northeastern Area: Maine

Host(s): Balsam fir

Fir-fern rust infection was present at moderate levels statewide in Maine in 2006. Symptoms were conspicuous on Christmas trees in many plantations, but infection was much less severe in 2006 than in 2005.

Fusiform rust
Cronartium quercuum f. sp. *fusiforme*

Region 8: Regionwide

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

Fusiform rust continues to be the most significant disease of loblolly and slash pine in the South. Virginia reported unprecedented levels of fusiform rust in plantations statewide, apparently as a result of uncontrolled infections in nursery stock used for outplanting. Although infection rates ranged from 3 percent to 15 percent, few stands were impacted enough to require replanting. In North Carolina, there were moderate levels of fusiform rust in older stands throughout the state; some reports were also received regarding younger stands that possibly started as infected nursery stock. South Carolina reported scattered rust infections to be a continuing serious problem. In Florida, comparisons of fusiform rust levels in longleaf pine and both "improved" and "rust-resistant" slash pine sold by the Florida Division of Forestry showed that infection levels were significantly lower in "rust-resistant" than in "improved" slash pine, while longleaf pine showed the lowest overall levels of infection. The Resistance Screening Center in Asheville, North Carolina, continues to screen seed lots for fusiform rust resistance. Texas reported moderate levels of rust in scattered locations, but noted that infection levels have declined in recent years.

Hemlock needle cast
Fabrella tsugae

Region 9/Northeastern Area: Pennsylvania

Host(s): Eastern hemlock

In 2006, only scattered areas of low infection were found statewide in Pennsylvania.

Hypoxylon canker
Hypoxylon spp.

Region 8: Regionwide

Host(s): Oaks

Higher than normal levels of hypoxylon canker were reported in eastern Virginia as declining trees impacted by past storms and drought succumb to the disease. The condition was very widespread in the Richmond-Petersburg area of the Coastal Plain. North Carolina also reported scattered infections related to oak decline.

Koa wilt
Fusarium oxysporum f. sp. *koae*

Region 5: Hawaii

Host(s): Koa

Koa wilt disease was first described in 1980 on the island of Hawaii and was attributed to the pathogen *Fusarium oxysporum* f.sp. *koae*. The pathogen infects trees through their roots and causes damage to the vascular system, sometimes leading to crown dieback and tree death. It is not known where the disease originated or how the disease spreads in the environment. Other areas of koa dieback were reported throughout the state thereafter, but little work had been carried out on the disease until the last few years despite the ecological, cultural, and economic importance of koa to the state of Hawaii.

Although wide scale dieback has not been observed in forests, there has been a high incidence of the disease causing high mortality rates in koa plantations, especially on former agricultural lands. A survey for koa wilt was conducted in 2004-2005 by the Hawaii Agriculture Research Center and Department of Forestry, Agriculture and Wildlife with funding from USDA Forest Service–Forest Health Protection. The survey located areas with symptomatic trees and collected root, stem, leaf, and seed samples for isolating *F. oxysporum* in the laboratory. Diseased trees were sampled in both plantations and natural forests throughout the state.

Dead or dying trees testing positive for *F. oxysporum* were found on all of the major islands where koa commonly grows. Trees in both planted and natural forests were found infected with koa wilt disease. *Fusarium oxysporum* was found most commonly on roots and soil near diseased trees. Interestingly other *Fusarium* species were also isolated from sampled tissue, and pathologists are exploring the role of these other species in the disease etiology. Methods of sampling for the disease were refined in this survey, facilitating future survey and monitoring for the disease. Outreach materials on koa wilt were developed by the University of Hawaii and can be found at: http://www.ctahr.hawaii.edu/forestry/index.asp.

Many questions remain unanswered regarding koa wilt. The extent of the disease in natural forests is not known, nor is whether the pathogen exists in healthy forests. Knowing how the disease spreads in the environment is also crucial for management. What appears to be genetic resistance has been observed in koa plantations trials, and efforts to develop genetic resistance for plantations are being pursued. Koa families from each island are being screened for resistance by inoculating seedlings with pathogenic strains of *F. oxysporum*. Resistant families will be planted in seed orchards on respective islands to provide seed for plantings. A nursery survey is also being conducted to determine whether outplantings could be spreading the disease to forestlands.

Laminated root rot
Phellinus weirii

Region 1: Idaho and Montana

Host(s): Douglas-fir and grand fir

This disease is most severe on the Region's most productive sites: those that historically supported high proportions of western white pine and western larch. White pine blister rust (an invasive disease), fire exclusion, and selective harvest practices favoring Douglas-fir and grand fir have drastically altered tree species composition on vast acreages in northern Idaho and western Montana. The natural western white pine and western larch forests were resistant to laminated root rot. They largely have been replaced by highly susceptible stands of Douglas-fir and grand fir, with consequent increases in laminated root rot. Like Armillaria, and usually in conjunction with Armillaria and/or annosus root disease, this pathogen often converts formerly forested sites to long-term shrub fields. It damages an estimated 20 million cubic feet of timber each year. Although laminated root rot occupies a smaller part of the Region than Armillaria, it is highly significant because of the potential productivity and the hydrological sensitivity of affected sites. The only practical control for this disease is altering species composition of forests; replacing highly susceptible Douglas-fir and true firs with disease-resistant pines and larch. Continued development of rust-resistance for the restoration of western white pine is essential to the control of laminated root rot.

Region 6: Oregon and Washington

Host(s): Highly susceptible species: Douglas-fir, mountain hemlock, white, grand, and Pacific silver fir

Laminated root rot is the most serious forest tree disease west of the Cascade Mountains crest in Washington and Oregon. Overall, an estimated 8 percent of the area with susceptible host species is affected in this portion of the Region. Locally, 15 to 20 percent of an area may be affected. East of the Cascade crest, laminated root rot affects mixed-conifer stands north of the Crooked River in central and northeastern Oregon and throughout eastern Washington.

Besides the highly susceptible hosts listed above, the other true firs, spruce, larch, and hemlock are intermediately susceptible; lodgepole, sugar, and western white pine are tolerant; cedars, redwood, and ponderosa pine are resistant; and all hardwoods are immune. 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 trees. Hardwood trees and shrubs often increase their site capacity. Infected conifers are often attacked by bark beetles.

PNW Research Station scientists recently have shown that stump removal and fertilization of *P. weirii*-infested stands affect mortality and growth of planted Douglas-fir even 20 years after treatment.

Larch needle cast, larch needle blight
Meria laricis
Hypodermella laricis

Region 6: Eastern Washington and Oregon

Host(s): Western larch

Larch needle blight and larch needle cast, reported as a complex because of their similar signatures as viewed from the air, increased significantly from 4,011 acres reported in 2005 to 29,650 acres reported in 2006. High concentrations were mapped in the Colville and Wenatchee Reporting Areas, with lighter amounts mapped in the Kaniksu, Okanogan, and Northeast Washington Reporting Areas.

Diseases: Native

Concentrations of infections were quite localized and mainly involved dense thickets of seedlings and saplings. These foliage diseases were most severe in stands of western larch growing in moist grand fir and moist subalpine fir plant associations, as well as in riparian areas.

Littleleaf disease
Phytophthora cinnamomi

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

Hosts: Loblolly pine and shortleaf pine

Littleleaf disease continues to cause growth loss and mortality across the Piedmont areas of the affected states. Shortleaf pine is highly susceptible, while loblolly pine is affected, but at a later age. Many of the stands that were converted from shortleaf to loblolly pine to reduce the impact of this disease are now reaching the age of susceptibility. Bark beetles often attack these stands once they have been weakened by this root disease. Some moderation of littleleaf symptoms over time has been reported. It is believed that root penetration of soil hardpans and gradual increases in soil porosity due to increasing biological activity on previously severely eroded sites will gradually reduce the impact of this disease over a period of a century or more. Alabama reported a slight increase in observations of littleleaf in loblolly pine stands, but it was not considered significant. In North Carolina, reports of the disease are confined to Piedmont stands of shortleaf pine.

Lodgepole pine needle cast
Lophodermella concolor

Region 6: Eastern Oregon and Washington

Host(s): Lodgepole pine

Appearance of this needle disease on lodgepole pine is sporadic and strongly influenced by weather conditions. Infected trees will shed foliage prematurely, and vigor and growth may be reduced with successive years of infection. Trees are affected with heavy discolorations of the lower crowns of lodgepole pine. Areas mapped as affected by lodgepole pine needle cast in 2006 totaled 651 acres, a decrease from the 3,312 acres reported in 2005.

Oak anthracnose
Apiognomonia quercina
Discula umbrinella

Region 5: California

Host(s): Oak

High levels of infection by oak anthracnose occurred throughout the foothills of the Sierra Nevada range and in urban areas of the Sacramento Valley. Some oaks defoliated early due to the disease. The high incidence of the disease was likely due to the late spring and early summer rains, which favor infection by the fungus.

Region 8: Tennessee

Host: White oak

Tennessee reported low levels of this disease statewide.

Oak wilt
Ceratocystis fagacearum

Region 8: North Carolina, South Carolina, Tennessee, Texas, and Virginia

Hosts: Live oak, red oaks

Oak wilt continues to affect more than 60 central Texas counties, mostly between Dallas and San Antonio. Urban, suburban, and rural oaks are affected. Live oak, the premier shade tree species in the region and highly valued for beauty, shade, and wildlife benefits, was severely impacted by the disease. Trenches dug between healthy and diseased trees severed interconnected root systems and helped to halt the spread of the disease. During 2006 (the nineteenth year of the cooperative suppression project), approximately 133,000 feet of trenching was installed around 79 oak wilt centers. Although this problem is also known to be widespread in the mountains of southwestern Virginia, only one report was received from this area. Oak wilt levels have remained essentially unchanged in North Carolina since 1955, with activity in six counties. South Carolina reported a new county record in Lexington County. Tennessee reported scattered single-tree infections in Cocke and Washington Counties.

Region 9/Northeastern Area: Illinois, Indiana, Iowa, Michigan, Minnesota, Missouri, Ohio, West Virginia, and Wisconsin

Host(s): Red oaks

In Ohio, ground surveys in 2006 described landscape pin oaks in Licking and Richard Counties as declining due to the oak wilt pathogen. West Virginia did not report any new incidence of oak wilt in 2006, and no aerial surveys were conducted.

Oak wilt continued to be the single most important disease in the Central States. The disease occurred throughout Illinois, but was more prevalent in the upper one-third of the state, especially where new construction took place in wooded areas. In Indiana, oak wilt was predicted to continue as a minor and localized concern, with the exception of the sand ridge areas in the northwestern part of the state where it was commonly found in black oak stands. The disease occurred in 62 counties in Indiana. In Missouri, oak wilt was isolated in seven counties, including two new counties (Texas and Pike), from pin oak, northern red oak, and shingle oak. In Wisconsin, a four-year study on overland infection of oak during summer and fall began in 2006. The risk of the oak wilt fungus spreading via insect vectors was shown to peak from mid-April through early to mid-July. As a result, pruning and cutting of red oaks in the spring is highly discouraged.

In Michigan, the Upper Peninsula Oak Wilt Suppression Project in Menominee and Dickinson Counties was initiated in 2006. A vibratory plow was used to establish 40, 041 feet of root graft barriers on 53 sites, representing about 234 acres of oak wilt epicenters. State-owned forest comprised 65 percent of this area. Red oak within the epicenters will be removed before the spring, 2007, to prevent pressure pad development which can lead to overland spread of the disease. Landowner and public education to prevention the re-introduction of oak wilt via firewood movement and spring tree injury was achieved via newspaper articles, training sessions, site visits generated via detection efforts and public inquiries, and distribution of educational materials. The project goal was to remove oak wilt from the Upper Peninsula. Important components of this effort is a continued education and outreach effort to prevent overland spread via tree injury from April 15 to July 15 and to stop the reintroduction of oak wilt into the Upper Peninsula via infected firewood. In 2006, oak wilt infections were treated in two state forest campgrounds in Grand Traverse and Missaukee Counties. Over 3,550 feet of root graft barrier lines were installed in October in

several campgrounds with the disease. A vibratory plow with a 6-foot blade was used to create the barriers, which were marked in late summer to allow complete expression of current-year symptoms. Symptomatic trees within the barrier will be cut and burned on-site this winter, and remaining trees will be monitored for the next three growing seasons and destroyed if they become infected.

Pine needle cast
Hypoderma sp.
Lophioderma sp.

Region 8: Georgia, North Carolina, and Tennessee

Host: Loblolly pine

Low levels of needlecast were reported from plantations in both eastern and western Tennessee and in eastern North Carolina. Georgia reported fairly high levels of needle cast from southeastern portions of the state.

Region 9/Northeastern Area: Maine

Host(s): Pines

Pine needle cast continued to be a problem on pitch pine in western Maine. The disease again was most severe in Fryeburg, Brownfield, and Waterboro areas, with a total of 11,064 acres affected. *Lophodermium pinastri* is generally considered a very weak pathogen on senescent needles of host pines. However, with the right environmental factors of weather, epiphytotics can occasionally occur.

Pine needle rust
Coleosporium spp.

Region 8: Texas and Tennessee

Hosts: Pines

Visible symptoms of this disease cause concern to landowners, but produce little significant damage. Tennessee reported light incidence of this rust in the eastern and western ends of the state. Light infestations were reported from western North Carolina

Pine wilt and pinewood nematode
Bursaphelenchus xylophilus

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

Host(s): Austrian pine, ponderosa pine, and Scotch pine

Pine wilt caused by pinewood nematode is an increasing problem in Great Plains windbreaks. About 1,000 trees, mostly Scotch pine, were killed by pine wilt in Nebraska in 2006. Southeastern Nebraska is the area most heavily affected by the disease, but it continues to spread north and west.

Pine wilt caused significant Scotch pine mortality in the southwestern and central South Dakota. Windbreak and ornamental trees were being killed at an alarming rate. Austrian pines, though few in number within this region, were also being killed. These species are no longer recommended due to the

prevalence of the disease. Despite the presences of the nematode in southwestern South Dakota for decades, and occasional exotic pines affected by pine wilt in the early 1980s, the disease was not a serious problem until recently. This may be due to the long-term drought stressing the trees and the warmer winters perhaps increasing nemotode survival. The nematode associated with pine wilt has not been found north of I-90 in South Dakota.

In 2006, pine wilt was detected for the first time in Colorado in Larimer and Weld Counties.

Region 9/Northeastern Area: Delaware

Hosts: Japanese black pine

In Delaware, wood samples from dying Japanese black pine, planted extensively in several towns on the Atlantic coast in the southeastern part of the state, were confirmed positive for this nematode.

Ploioderma needlecast
Ploioderma lethale

Region 8: Virginia

Host(s): Loblolly pine

No reports were received in 2006.

Powdery mildew on oaks
Microsphaaera alni
Sphaerotheca lanestris

Region 5: California

Host(s): blue oaks, coast live oak

Powdery mildew was common on blue oak in foothill areas along the west side of the Sacramento Valley, including Nevada, Yuba, and Placer Counties. Abundant soil moisture late in the season allowed many trees to produce a second flush of leaves, which was particularly susceptible to infection.

Phyllactinia spp.

Region 8: Tennessee

Hosts: Dogwood, oaks

Scattered infections were reported from eastern and central Tennessee counties.

Diseases: Native

Rhizosphaera needlecast
Rhizosphaera kalkhoffii

Region 9/Northeastern Area: Vermont

Hosts(s): White and Blue spruce

There was continued widespread heavy damage on Christmas trees and ornamentals in Vermont in 2006.

Seiridium canker
Seiridium cardinale

Region 5: California

Host(s): Incense-cedar

Seiridium canker was observed on scattered Port-Orford-cedar in 12-year-old Port-Orford-cedar in the Provenance Test Site near the Stuart's Fork Arm of Trinity Lake. It was also found on Port-Orford-cedar at the Provenance Test Site at the Humboldt Nursery in McKinleyville, California. Seiridium canker was also found on one Port-Orford-cedar in the old range-wide planting at the Chico Genetic Resource Center

Stem decay
Basidiomycetes (various)

Region 10: Alaska

Host(s): All tree species

Heart rot decay causes enormous loss of wood volume in all major tree species in Alaskan forests. Approximately one-third of the old-growth timber volume in southeast Alaska is defective largely due to heart rot fungi. These extraordinary effects occur where long-lived tree species predominate, such as in old-growth forests in southeast Alaska where fire is absent, and where stand replacement disturbances are infrequent. The great longevity of individual trees allows ample time for the slow-growing decay fungi to cause significant amounts of decay. By predisposing large old trees to bole breakage, these fungi serve as important disturbance factors that cause small-scale canopy gaps.

Wood decay fungi decompose branches, roots, and boles of dead trees; therefore, they play an essential role in recycling wood in forests. This is particularly the case in southeast Alaska, where fires are rare and thus do not contribute to carbon recycling.

In south-central and interior Alaska, sap rot decay routinely and quickly develops in spruce trees attacked by spruce beetles. Significant volume loss occurs within three to five years after tree death. Thus, large amounts of potentially recoverable timber volume were lost annually following the massive spruce beetle outbreak of the 1980s and '90s that killed over 3.4 million acres of spruce on the Kenai Peninsula. Research indicates that the most common and conspicuous sap rot fungus associated with dead spruce is *Fomitopsis pinicola*, the red belt fungus. However, over 70 taxa have been detected in dead and down beetle-killed trees.

A deterioration study of beetle-killed trees on the Kenai Peninsula assessed the rate at which beetle-killed trees decompose. Results indicate an overall decomposition rate of 1.5 percent per year, which is slow compared to other spruce ecosystems worldwide. Beetle-killed trees are, therefore, likely to influence fire behavior and present a hazard for over 75 years. Estimates indicate it would take over 200 years for beetle killed trees to completely decompose.

Sugar pine needle cast
Lophodermella arcuata

Region 5: California

Host(s): Sugar pine and western white pine

No reports were received in 2006

Swiss needle cast
Phaeocryptopus gaumannii

Region 6: Western Oregon and Washington

Host(s): Douglas-fir

Swiss needle cast, a fungal-caused foliage disease of coastal Douglas-fir, has caused significant volume growth loss estimated at 25 percent throughout coastal Oregon and parts of Washington. A combination of warmer winters, increasing acreages of Douglas-fir, and the presence of two distinctive lineages of the fungus may be the cause of the severe disease symptoms over the past 15 years.

A special survey was conducted in the spring 2006 for Swiss needle cast in the Coast Range of Oregon. The survey determined that there were 324,584 acres affected by Swiss needle cast in Oregon in 2006, an increase from 207,090 acres in 2005. Severe defoliation was mapped on 68,889 acres, mostly in Tillamook County, with the remaining areas mapped as moderate.

In 2006, 59 Douglas fir stands in the northern Oregon Cascade foothills were examined for Swiss needle cast. Over the past five years, needle retention increased by 1.2 years. There were poor correlations between severity of Swiss needle cast and 5-year Douglas fir growth.

The disease is also severe in localized areas in coastal Washington, although no special surveys were conducted in this area.

Thinning of young trees has recently shown improved volume growth of severely affected trees. Research on Swiss needle cast continues at Oregon State University and the PNW Research Station concerning growth impact, infection biology, nutrient imbalances, fungicide testing, and fertilizer and vegetation control.

Sycamore anthracnose
Discula platani

Region 8: Tennessee

Host: Sycamore

Moderate to high infection rates were noted in western North Carolina, with scattered infestations in the eastern half of the state. Low infection rates (1-5 percent leaves infected) were reported from most of Tennessee, with some higher rates (20-30 percent leaves infected) in northeastern counties.

Tanoak tip blight
Discula quercina

Region 5: California

Host(s): Tanoak

In late 2005 and again in 2006, many tanoaks of all sizes had extensive branch tip blight. Blighted trees were observed from southern Mendocino County north through the southern half of Humboldt County. This disease made detection of Sudden Oak Death problematic. Tanoaks in similar areas had *Phytophthora ramorum* infections during new branch growth, yielding additional tip blight. *Phytophthora ramorum*-caused tip blight caused branch tips to droop, while the *Discula*-killed tips did not cause tip droop.

Tarspot of maple
Rhytisma acerinum

Region 9/Northeastern Area: Maine, Michigan, Vermont, and Wisconsin

Hosts(s): Maple

This disease, which caused moderate to severe defoliation of maples in southern Maine several years ago, was not reported causing damage in 2006. It was commonly found on red, sugar, and Norway maples throughout the state, but rarely caused early defoliation or any real damage to tree health. Vermont reported widespread, unusually heavy damage statewide.

In Michigan, tarspot was a common site on Norway maple leaves in 2006. Other maples were also infected. In Wisconsin, tarspot was observed causing severe leaf spotting and defoliation on Norway maple in Waukesha County throughout the Village of Chenequa. It was also observed causing similar problems on Norway maple in a city park in the city of Sturgeon Bay in Door County.

Tomentosus root disease
Inonotus tomentosus (Fr.) Teng.

Region 10: Alaska

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

Inonotus tomentosus causes root and butt-rot of white, Lutz, Sitka, and black spruce. The fungus may also attack lodgepole pine and tamarack, but not hardwood trees. The disease appears to be widespread across the native range of spruce in south-central and interior Alaska. Recently, tomentosus root rot was found for the first time in southeast Alaska, infecting Sitka spruce near Dyea. Surveys in the Dyea area in 2006 indicated a high level of tomentosus root disease, with over 27 percent of surveyed trees infected. Uprooting of root diseased trees at the Dyea site is a concern for public safety.

Spruce trees of all ages are susceptible to infection, primarily through contact with infected roots. Infected trees exhibit growth reduction or mortality, depending on age. Younger trees may be killed outright, while older trees may persist in a deteriorating condition for many years. Trees with extensive root and butt decay are prone to uprooting and bole breakage. Volume loss in the butt log of older infected trees can be substantial: up to one-third of the gross volume. Individual mortality centers (groups of infected trees) are typically small; however, coalescing centers can occupy large areas.

True mistletoes
Phoradendron spp.

Region 3: Arizona and New Mexico

Host(s): Juniper and various hardwoods

True mistletoes are common in pinyon-juniper woodlands throughout Region 3 and are locally abundant in riparian areas. Heavy infection contributes toward tree mortality, especially during periods of drought.

True mistletoe of white fir
Phradendron pauciflorum

Region 5: California

Host(s): White fir

No reports were received in 2006.

Western gall rust
Peridermium harknessii

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

Host(s): Lodgepole pine and ponderosa pine

The Region was not surveyed for gall rust in 2006.

Region 5: California

Host(s): Ponderosa pine and Coulter pine

No reports were received in 2006.

Willow rust
Melampsora sp.

Region 5: California

Host(s): Willow

A new rust is infecting various willow species in the town of Soquel along Soquel Creek in Santa Cruz County. Infection is on the underside of the leaves and does not appear to be causing any significant damage to the willows at this time. Infection is mostly on trees in fields and slopes above the creek, as opposed to those trees growing right along the creek. The rust has been initially identified as a species of *Melampsora*. Molecular work is being conducted to determine the specific species. There will be surveys in 2007 to determine the extent of the infestation and to look for any potential alternate hosts in the area.

DISEASES: NONNATIVE

Beech bark disease (origin: Europe)
Neonectria coccinea var. *faginata*

Region 8: North Carolina, Tennessee, and Virginia

Host(s): American beech

Beech bark disease continues to intensify and spread in eastern Tennessee, western North Carolina, and extreme west-central Virginia. Tree mortality is a continuing problem in and around the Great Smoky Mountains National Park. The disease has intensified at a faster rate than predicted and is moving down-slope into the Cherokee and Pisgah National Forests. Beech is an important species for wildlife, providing both mast and den habitat.

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

Hosts(s): American beech

This disease was endemic throughout Connecticut. Beech bark disease occurred statewide in Maine and continued to cause losses in site productivity and timber values, in addition to resulting in decreased wildlife food for a wide variety of birds and small and large mammals. North central Maine was undergoing significant mortality in beech, believed to be the result of a combination of drought stress and the beech bark disease. There were observations in eastern Washington County of some local areas where the scale populations appeared to be increasing. In Massachusetts, decline and mortality caused by this disease was documented in approximately 513 acres in Berkshire and Franklin Counties. The disease continued to be common throughout the range of beech in New Hampshire. Beech bark disease was readily found throughout New York State. Infestation of beech continued throughout most of Rhode Island. There were over 12,000 acres of damage mapped in Vermont; scale populations were low, while high levels of decline and mortality continued.

Beech scale in Maryland was discovered in 2003 in the southern part of Garrett County. Surveys for the scale were not done in 2005 or 2006. No new activity was reported from New Jersey. Surveys in Ohio continued to find beech scale in many northeastern Ohio counties (Lake, Geauga, Cuyahoga, Portage, and Ashtabula). Only one site, located in Geauga County at the Holden Arboretum, was still confirmed to have the disease fungus. In Pennsylvania, there was no report of beech bark disease conditions in 2006.

In West Virginia, a beech scale survey was conducted in 2006 to determine if beech scale is occurring in isolated pockets away from the advancing front. Light scale was only detected near the known advancing front, adding 374,672 acres to the scale infestation area, for a total of 3,653,958 acres. Taylor, Lewis, and Braxton Counties were added to the advancing front. A total of 17 counties are now infested with beech scale.

Beech scale populations in the Upper Peninsula of Michigan moved westward to Munising in 2006. Scale populations were building rapidly as the advancing and killing fronts expand in the Upper Peninsula.

Since the discovery of the disease in Ludington State Park in 2000, the killing front has expanded very slowly in the west-central Lower Peninsula: only Mason, Oceana, and Muskegon Counties have suffered beech mortality as a result of infection from Neonectria fungi. Five discontinuous scale populations were found in the Lower Peninsula, as well as on three islands in Lakes Michigan and Huron. The annual spread rate in the northern Lower Peninsula in 2005-06 averaged 1.5 km per year. Empirical data from the 2004-06 field work suggested that spread rates can vary greatly from year to year.

Dutch elm disease (origin: Asia)
Ophiostoma (=Ceratocystis) ulmi and *Ophiostoma novo-ulmi*

Region 1: Idaho, Montana, and North Dakota

Host(s): American elm

Duch elm disease continues to spread throughout urban areas of Idaho, North Dakota, and Montana. Montana's highest losses are occurring in the cities of Billings and Great Falls. In North Dakota, Dutch elm disease continues to be the most prominent disease of community forests. The disease has eliminated most native elms in the eastern half of the state and is currently causing considerable mortality in wooded draws and riparian areas to the west. In southern Idaho, this disease is common in many communities along the Snake River, and it is slowly working its way into northern Idaho communities. It was positively identified on American elm in Coeur d'Alene for the first time in 2004 on a large isolated boulevard, which is also colonized by elm bark beetles. The tree was removed, and the few remaining elms will be closely monitored. In the three states, larger cities have had good success with aggressive treatment, but smaller communities do not often have resources available to undertake a successful management program, and as a result may lose many of their native elms.

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

Host(s): American elm

The incidence of Dutch elm disease in Nebraska had not increased beyond the 2005 report, though the mortality was higher than what was experienced during the 1990s. This disease is still a concern, especially in trees that escaped the first wave of the disease and are about 5-6" diameter and about 20 years of age. Some larger trees were succumbing as well. The disease continues to be a problem in riparian areas and cities in Nebraska.

The incidence of Dutch elm disease in South Dakota increased in 2006, continuing a trend that began in the late 1990s. This increase in disease detection may be related to the banded elm bark beetle, which has been increasingly assoicated with the disease in declining native elm stands along many of our western and central riparian areas.

Region 8: Regionwide

Host(s): American elm

Localized mortality due to Dutch elm disease continues to occur at a low level of severity in urban and wild populations of elm throughout the Region. Tennessee reported reduced disease incidence, probably due to dry late summer weather. Georgia reported some problems on winged elm as well as scattered infections of urban and wild American elm.

Region 9/Northeastern Area: Regionwide and Washington, DC

Hosts(s): American elm

The disease was endemic throughout Connecticut, with greater than usual incidence and severity for 2006, possibly associated with several years of drought stress in combination with other weather and site-related stresses. In Maine, the disease continued to take its toll in remnant individuals in forest and landscape settings. It was observed to be quite aggressive in the mid-coast area. In New York, symptoms of this disease were conspicuous statewide.

No major state surveys were conducted for Dutch elm disease in the Mid-Atlantic States in 2005 or 2006. In Washington, DC, where this disease has decimated over 80 percent of American elms within the District proper, surveys did not occur in 2006 but will be continued in 2007.

Dutch elm disease continued to be common in the northern half of Illinois, and there is some speculation that *Scolytus schevyrewi* as well as *Scolytus multistriatus* might be implicated in the transmission of the fungus to healthy elms. The status remained unchanged in the rest of the north-central region. Indiana forests were marked by widespread mortality among pole and sawtimber sized elm, especially of American elms. Recent inventories revealed that nearly 25 percent of mortality volume was due to elm mortality. As Indiana forests continue to age, the incidence of the disease was expected to increase.

European larch canker (origin: Europe)
Lachnellula willkommii

Region 9/Northeastern Area: Maine

Host(s): Larch

In Maine, no unusual activity of the European Larch canker was reported, and conditions appeared to be static. It remained under state and federal quarantines and has been known to be present in Maine since 1981. A commercial larch seed orchard in the town of Unity was surveyed, but no disease was found. The Maine Forest Service continued to monitor patterns of intensification and expansion within infested stands inside the regulated area of Maine.

Guava (`ohi`a) rust (origin: American tropics)
Puccinia psidii

Region 5: Hawaii

Host(s): Numerous, both native and exotic

The rust disease, *Puccinia psidii* Winter or guava rust, was originally described in 1884 from infections on guava in Brazil. Until 2005, this pathogen was unknown outside the neotropics and the state of Florida. It was first detected in Hawaii in the spring of 2005 on ‘ohi’a-lehua (*Metrosideros polymorpha* Gaud) and has since spread from Oahu to all major Hawaiian Islands. *Puccinia psidii* has an unusually broad host range for a rust. Worldwide, the host range currently includes 21 genera and 72 species of Myrtaceae, including such common tropical species as *Eucalyptus* and guava. The host range of the pathogen in Hawaii includes 19 susceptible plant species in the family Myrtaceae, including common and endangered native Hawaiian species and numerous introduced species, some of which are weedy and widespread. Infections of the rust affect leaves and meristems, inhibiting normal growth and development, and are particularly severe on seedlings, cuttings, saplings, and coppice. The existence of numerous races/and or clones of *P. psidii* differing in host pathogenicity and a wide variation in susceptibility within host plants and provenances have been reported.

Spread of *Puccinia psidii* is a serious threat to forests and forestry in Hawaii and the Asia-Pacific region. The pathogen has been a problem in *Eucalyptus* plantations in Brazil and considered a serious threat to Eucalyptus plantations worldwide. The strong selection pressure by *P. psidii* on Myrtaceae in its native range suggests a very significant threat from this pathogen to native species of indigenous Myrtaceae in the Asia-Pacific region. Its presence in Hawaii is particularly troubling because `ohi`a-lehua is the dominant overstory tree in over 80 percent of Hawaii’s native forests, is present over a broad environmental gradient, and represents early to late successional stages. Native plant community function, particularly reproductive capacity, could be seriously affected by the spread of the rust. Its presence in Hawaii increases the chance of spread to Asian and the Pacific regions where host species are important biologically and economically.

Redbay wilt or laurel wilt (origin: Asia)
***Raffaelea* spp.**

vectored by redbay ambrosia beetle
Xyleborus glabratus

Region 8: Florida, Georgia, and South Carolina

Host: Redbay, avocado, pondberry, pond spice, sassafras

Widespread mortality of redbay is occurring in coastal counties in Florida, Georgia, and South Carolina, originating near Savannah and now spreading at a rate of approximately 20 miles per year, with occasional longer "jumps" evidently resulting from human movement of infested plant material. The tiny exotic beetles vector an as-yet unnamed *Raffaelea* fungus that infects redbay, pondberry, pondspice (a federally listed Threatened species), and can also kill avocado, sassafras, and probably many other species in the family *Lauraceae*. Another exotic ambrosia beetle, *Xyleborus compactus*, is spreading along with *X. glabratus* and causes branch tip flagging in redbay by feeding on the pith, but is not known to vector the fungal disease. A working group dealing with this insect/disease complex has been formed and research on its biology and control is being undertaken.

Symptoms of redbay wilt (also proposed to be named "Laurel wilt" because of its potential to infect a wider range of hosts) were first noted on Ossabaw Island in the Wassaw National Wildlife Reserve southeast of Savannah, Georgia, by USDI Fish and Wildlife Service biologists in 1998, but no causal agent was identified. The exotic ambrosia beetle *Xyleborus glabratus*, a native of India, Southeast Asia, and Japan, was trapped at Port Wentworth, Georgia, in 2002 and has been identified as the vector of the *Raffaelea* pathogen causing the disease. The beetles bore into the xylem and do not feed on the cambium, and a single beetle attack is capable of infecting a tree with the pathogen; host treatment with systemic insecticides will thus probably not be effective in arresting the disease. Sanitation cutting and removal of infested trees has been attempted as a suppression tactic, but appears to be ineffective. Because the beetle/pathogen complex can infect sassafras, it has the potential of affecting virtually all U.S. forests east of the Great Plains.

White pine blister rust (origin: Eurasia)
Cronartium ribicola

Region 1: Idaho and Montana

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

Regions 1 and 4 are actively surveying and monitoring white pine blister rust spread and intensification on all five-needle pines in the Region. Surveys of over sixty, F2 western white pine plantations with enhanced natural resistance found infection levels varied from less than 5 percent to over 90 percent, but were always lower than infection levels in adjacent naturally regenerated trees. Special technical development projects are being conducted to look for site factors that might be related to infection levels and also trying to determine girdling rates to help predict future loses. Additional projects are monitoring permanent plots to document changes in infection levels and growth rates of individually tagged cankers on improved stock.

As blister rust has moved into fragile, high-elevation ecosystems, the normal successional pathways of limber pine and whitebark pine have been greatly altered. The recent outbreaks of mountain pine beetle have caused additional widespread mortality in many whitebark pine stands. The combination of the beetle mortality with fire suppression and blister rust are raising concerns about the long-term viability of whitebark pine ecosystems. This has severe implications to watersheds and wildlife, such as the grizzly bear and Clark’s nutcracker.

Permanent plots are being established in several areas to monitor blister rust in whitebark pine. A range-wide database is being developed to compile results of surveys in limber pine as well as whitebark pine.

Diseases: Nonnative

Region 2: Colorado, South Dakota, and Wyoming

Host(s): Limber pine, Rocky Mountain bristlecone pine, and whitebark pine

White pine blister rust continues to spread and intensify in the Rocky Mountain Region and often promotes mountain pine beetle attack of the five-needle, white pines.

In Colorado, the disease front is now approximately 12 miles north of the northern boundary of Rocky Mountain National Park, raising concerns about sustaining white pines in one of our national treasures. The disease was also discovered in isolated locations of the Sangre de Cristo and Wet Mountain Ranges of southern Colorado more than 200 miles from any other known infection zone. The closest outbreak area to the south is on Gallinas Peak in central New Mexico. The Sangre de Cristo outbreak was observed on the San Carlos Ranger District of the San Isabel National Forest, the Great Sand Dunes National Park, and other state and federal lands nearby. In the Wet Mountains, the disease is distributed throughout the eastern side of the range, just west of Rye and Beulah, Colorado. Infections in southern Colorado were found primarily on limber pine, but infected Rocky Mountain bristlecone pines were also observed for the first time in their native range.

White pine blister rust was not found in a 2006 visual survey of limber pine in Kimball County, Nebraska (near the Wyoming border). White pines at a number of locations in southeastern Nebraska have died suddenly in recent years without any clear indication of the cause. Possible poor soil conditions for white pine in combination with root diseases are responsible.

White pine blister rust continued to intensify in limber pine sites in western South Dakota. In the Black Hills of South Dakota, the only existing stand of limber pine is now limited to only a couple of hundred trees. The two primary stressors of this relict stand are white pine blister rust and intense competition with other trees. Ponderosa pines and Black Hills spruces are encroaching into this widely dispersed stand and the relatively competition-intolerant limber pine. While noted for its ability to survive on dry sites, the persisting regional drought may also be a contributing factor in the decline and mortality of the limber pines. Mountain pine beetle has not become a mortality factor despite the outbreak in the Norbeck-Mt. Rushmore. However, the South Dakota Division of Resource Conservation and Forestry has been utilizing anti-aggregation baiting in this stand to protect the trees from the beetle.

White pine blister rust is found on whitebark and limber pines throughout Wyoming. This disease is spreading and intensifying throughout the state. The disease is already causing considerable ecological impacts in some areas of Wyoming.

White pine blister rust was discovered in several new locations in south-central Wyoming, including the Snowy Mountains and the Sierra Madre Mountains, where the incidence is currently low. In the Sierra Madre Mountains, the disease was only observed on several trees on private land along Highway 70 just east of the Medicine Bow National Forest boundary.

Limber pine mortality is widespread throughout the Bighorn Mountains and Crooks, Green, Ferris, and Shirley Mountain Ranges. Virtually the all of the northern Shirley Mountains have declining limber pine populations due to infection by white pine blister rust. Intensities range from four to 15 infected trees per acre.

According to results from a two year limber pine aerial survey (2004-2005), white pine blister rust and mountain pine beetle affected over 1,000,000 trees across 200,000 acres. Most of the mortality was attributed to mountain pine beetle; a recent forest health survey of limber pine in the Bighorn National Forest showed that mountain pine beetle incidence positively correlates with white pine blister rust branch canker severity and stem canker incidence. Mountain pine beetle infested trees had higher incidences of branch cankers and stem cankers than non-infested trees.

Region 3: Arizona and New Mexico

Host(s): Southwestern white pine

Blister rust was detected on the Santa Clara Pueblo (Jemez Mountains) in 2006, the first report of this disease in northern New Mexico. In 2005, it was detected for the first time on the Gila National Forest, on a site only 3 miles from the Arizona border. Blister rust occurs throughout most of the range of southwestern white pine in the Sacramento Mountains, the adjoining White Mountains, and the nearby Capitan Mountains of southern New Mexico. Over 40 percent of the white pines are currently infected within this area based on a set of representative plots. No white pine blister rust has been detected in Arizona.

Region 4: California, Idaho, Nevada, and Wyoming

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

This introduced disease is common throughout its hosts range in southern Idaho and western Wyoming. It is present in the western portion of the Intermountain Region in California and Nevada near Lake Tahoe. No infection has been found or reported in Utah; but the disease has been identified very close to the Utah border in southern Idaho and to the west, in the Jarbidge Mountains of northeastern Nevada. Recent observations of whitepine blister rust in eastern Nevada are cause for concern because they are close to highly sensitive bristlecone pine populations in Great Basin National Park and elsewhere. Overall, five-needled pine trees are of low occurrence and frequency in the Intermountain Region. Often relegated to high alpine areas, these pines grow slowly but provide important ecosystem functions, such as providing shade and stabilization for snow retention to maintain watershed integrity, recreation, aesthetics, and wildlife habitat and usage.

Region 5: California

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

White pine blister rust is the most destructive disease on five-needle pines (such as sugar pine, western white pine, and whitebark pine) in California.

White pine blister rust was present on western white pine along the Pacific Crest Trail west of the intersection with the Soapstone Trail, and along the Pacific Crest Trail west of Scott Mountain Summit. The disease is also present on western white pine on Black Butte (southwest of Mount Shasta) and at Washbasin Lake in the Trinity Alps Wilderness Area. White pine blister rust was found present on western white pine in the Alpine Meadows Ski Area on the Truckee River District, Tahoe National Forest.

Levels of blister rust appear to be increasing in the Lake Tahoe Basin Management Unit. Most of the infected trees are old growth sugar pines, although western white pine trees were also infected. Injury was primarily that of dead branches, although some of the trees are also dying from a combination of white pine blister rust and attack by mountain pine beetles.

2006 White Pine Blister Rust Resistance Screening Program

During 2006, the rust-resistance program screened 799 sugar pine families from new candidate trees thought to carry major gene resistance to blister rust; 49 families proved to be from major gene resistance seed-parent trees. This brings the total number of proven resistant trees to 1,625 in the Pacific Southwest Region, including other federal, State, and private lands. In addition, 378 families had one or more major gene resistance seedlings due to an unknown major gene resistance pollen parent. Most major gene resistance and major gene resistance pollen-parent seedlings were transferred to the Happy Camp field site for slow rust-resistance screening, although some major gene resistance pollen-parent seedlings with northern California parents were retained and planted in the local breeding arboretum near Placerville.

The spring 2006 sowing included seed from 730 sugar pine families, of which many were from the northern (29 percent) and southern California forests (43 percent). The Regional Genetic Resources

Program has been focusing efforts on the northern forests (Klamath, Mendocino, Shasta-Trinity, Six Rivers, Modoc, and Lassen National Forests) due to the difficulty in finding major gene resistance trees in that part of the state. In light of that, the Program has supported cone collections and grown additional seedlings from that area for testing. While some seedlings go through the typical testing process at Placerville and Happy Camp, additional siblings of the same families go directly to Happy Camp, thereby speeding up the rate at which rust-resistant seedlings—i.e., slow rust resistant (SRR; also called partial rust resistance) seedlings—are found for the northern forests. The 300-plus sugar pine families from the southern forests (Los Padres, Angeles, and San Bernardino National Forests) represent the first major operational testing of material from that area by the Genetic Resources Program. Seed from another 570 southern forest trees are being stored for rust-resistance testing in upcoming years. Cone collections from major gene resistance candidate trees in southern California will continue when the next cone crop is large enough to warrant this effort. In the fall of 2006, cone collections are expected to come from about 210 trees from the northern forests and 130 from cooperators. In addition, a small crop of cones (5 bushels) were collected from major gene resistance sugar pine trees at the Foresthill seed orchard on the Tahoe National Forest as some trees are in the initial stages of producing cones. Working together with the Regional Natural Resources and National Forest staffs, efforts are underway to increase the number of proven major gene resistance trees represented in the Regional seed bank. Currently, 38 percent of the sugar pine seed in the bank is highly genetically resistant.

Activities at the Happy Camp outplanting site on the Klamath National Forest included the planting of 1,711 highly rust-resistant sugar pine seedlings, shipped from Placerville, for slow rust resistance testing. Another 7,824 sugar pine seedlings were established for a study that will examine slow rusting heritability and efficacy. Additional activities included the selection of 44 trees with slow rust-resistance traits from 1,959 evaluated, the collection and shipment of scion from these treess for clone bank and seed-orchard establishment, and selection of scion from 29 other trees for North Zone major rust-resistance orchards. As part of a continuing effort to monitor the frequency and spread of the two virulent rust strains in northern California, vCr1 (sugar pine) and vCr2 (western white pine), *Ribes sanguinium* leaves infected with blister rust in the telial stage were collected from seven key locations.

Seed orchards are being developed by the USDA Forest Service and Sierra Pacific Industries to supply rust-resistant sugar pine seed for reforestation and fire restoration. Cuttings from parent trees possessing major gene resistance or both major gene resistance plus slow rust resistance are being collected by these and additional cooperators throughout the state. To date, more than 700 unrelated parents have been established in five separate orchards from Sierra Nevada native forests. Additional sites are being used as "clone banks" to preserve resistant sugar pine grafts from other parts of California where seed needs are not as high or in anticipation of seed orchard development in the future. Last fall, 44 major gene resistance parents were collected from wild stands and an additional 44 with both major gene resistance plus slow rust resistance that represented forests in much of the state. More will be established each year to both conserve and use the genetic diversity of this species.

High-elevation Five-needle Pine Survey

The 2004-2005 survey of white pine blister rust on high-elevation white pines in California continued for a third year with the establishment of a few plots and attention to analyses and reporting on the data. Approximately 120 plots were established and spread out across the species' ranges in California, with about 75 percent of those being in western white pine and whitebark pine. In the Sierra Nevada range, plots were paired west and east of the Pacific crest to capture climatic and landscape differences. The data revealed that white pine blister rust was not present in plots of limber, Great Basin bristlecone, and southern foxtail pine. In contrast, white pine blister rust was found in plots with western white, whitebark , and northern foxtail pines. Mean rust levels were relatively low within species (12-15 percent), but plot-to-plot variation was high (northern foxtail, 0-33 percent; western white, 0-92 percent; whitebark, 0-71 percent). Data indicate that white pine blister rust levels were higher west of the Pacific Crest of the Sierra Nevada range although the crest does not appear to be a strong barrier given the presence of white pine blister rust in Lake Tahoe Basin. Western white pine and whitebark pine were affected by rust in the northern and central portions of their California ranges, but less so in the southern portions. White pine blister rust was found on whitebark pine at about 11,000 feet on the Sierra National Forest, further south than previously reported. Activity of another biotic factor, mountain pine beetle, was found in plots with whitebark pine (62 percent), western white pine (54 percent) or northern foxtail pine (43 percent), but was

not observed in plots with limber, Great Basin bristlecone, or southern foxtail pines. Data analyses are ongoing, and more detailed information is forthcoming

Region 6: Oregon and Washington

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

Cronartium ribicola was introduced to the west coast in 1910. Its impacts include top-kill, branch flagging, and tree mortality. While much of the mortality associated with this disease occurred earlier in the century, its impacts are still great in wild populations of five-needled pines throughout their range. Locally, this disease, in combination with mountain pine beetle, still kills many host trees. Of particular concern are the effects of blister rust in whitebark pine at high elevations in the Cascades and in the Blue and Wallowa Mountains and in sugar pine in southwest Oregon, where about 45 percent of stands with host components are affected.

An attempt was made to identify areas symptomatic of blister rust through aerial survey beginning in 1994. Blister rust is known to occur extensively throughout the range of the susceptible host type. Observers mapped approximately 995 acres in 2006, down from 2,211 acres in 2005. 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.

Region 8: North Carolina

Host(s): Eastern white pine

White pine blister rust continues to be a disease of concern for North Carolina landowners. The northwestern mountains are an area of particularly high hazard. The disease can be especially devastating to growers of ornamentals and Christmas trees, many of whom are centered in this area.

Region 9/Northeastern Area: Connecticut, Maine, Massachusetts, Michigan, Minnesota, New Hampshire, New York, Vermont, West Virginia, and Wisconsin

Host(s): Eastern white pine

The disease was endemic in several parts of Connecticut and more active in 2006 than in previous years. In Maine, white pine blister rust remained static at moderate levels, but was common throughout the state. Division personnel provided on the ground technical assistance to landowners interested in pursuing Ribes suppression, but the state Ribes eradication program was not operational. No significant activity was reported in Massachusetts, New Hampshire, and New York in 2006. Vermont reported flagging and mortality statewide. West Virginia surveys reported white pine blister rust still occurred at moderate levels in Mercer, Monroe, Pocahontas and Summers Counties.

No significant changes were reported in the Lake States in 2006.

Region 10: Alaska

Host(s): White pine

A single ornamental eastern white pine tree was found to be infected by white pine blister rust in Ketchikan several years ago. The rust fungus was also found sporulating on leaves of the alternate host, an ornamental black currant, at the same location. This was the first report of white pine blister rust in Alaska. The fungus is not native to North America and, while causing devastating mortality in native white pines in some areas of the US and Canada, it does not pose a threat in Alaska because no native trees are

susceptible. The ornamental tree is about 20 years old and is being repeatedly reinfected, as evidenced by small young infected branches. Removal of the alternate host may eliminate any new infections. The pathway of the original introduction into Ketchikan is not certain. The tree has received surgical treatment, with infected shoots removed and infected cambial tissue carved away. The health of the tree will be monitored into the future.

DISEASES: ORIGIN UNKNOWN

Bacterial leaf scorch
Xylella fastidiosa

Region 8: Tennessee

Host(s): Sycamore and pin oak

No reports were received in 2006.

Region 9/Northeastern Area: Delaware, Maryland, Missouri, New Jersey, New York, and West Virginia

Host(s): Maples, northern red oak, scarlet oak, and pin oak

A bacterial leaf scorch survey in southern New York resulted in positive finds in Kings County (Brooklyn), Westchester County, and Rockland County.

Surveys this year for bacterial leaf scorch have found this disease to be widespread in urban areas throughout Delaware. As a result of this survey, the Delaware Forest Service has recommended in a press release that pin and northern red oaks, often debilitated and killed by this disease, should not be used in urban plantings. In addition to urban areas, forests, and wooded areas in Delaware have been surveyed for the first time this year. Forest surveys determined an equally alarming incidence of disease present. There was no significant activity reported in Maryland. Surveys continued in New Jersey, where over the past six years, this disease caused substantial losses of oak trees in municipal areas throughout most of the state. Surveys in New Jersey forests in 2006 found oaks declining and dying. In West Virginia, this disease was detected in Jefferson County in a wooded area in 2006.

Bacterial leaf scorch caused was reported on pin oaks in the St. Louis, Missouri, metropolitan area.

Butternut canker
Sirococcus clavigignenti-juglandacearum

Region 8: Regionwide

Host(s): Butternut

This disease has been present in the South for at least 40 years and is believed to have killed more than 75 percent of the butternut across the Region. 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 (e.g., black walnut). It is too early to predict the benefits of selection and breeding on developing resistance to the disease, but trees exhibiting resistance have been found in Arkansas, North Carolina, Tennessee, Kentucky, and Virginia.

Region 9/Northeastern Area: Regionwide

Host(s): Butternut

Butternut canker was found throughout Connecticut. In Maine, it continued to cause damage to the butternut resource. Because this tree species occurs uncommonly and is widely scattered as individuals and not as forest stands of any size, the disease often goes unnoticed or unrecognized. It was found in all counties in Maine except Washington County. New Hampshire reported it common throughout the state. Butternut canker was common in New York wherever butternut was found, and it was uncommon to see a

symptom-free butternut. This disease was not reported from any new counties in 2006. The Department of Environmental conservation began archiving locations of healthy butternut and when it was found or reported. In Rhode Island, butternut canker continued to be present on butternut in Kent, Newport, Providence, and Washington Counties. Butternut canker occurred statewide in Vermont, and uninfected trees were rarely observed.

The disease remained endemic through the range of butternut in the Mid-Atlantic States and the Lake States. No new counties were added to the infection areas in the Lake States.

Dogwood anthracnose
Discula destructiva

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

Host(s): Flowering dogwood

The disease continues to intensify within the generally infested area. North Carolina reports continuing mortality attributable to dogwood anthracnose in mountain counties, while Tennessee experienced increased incidence in some eastern counties. The number of confirmed infected counties in the region is as follows:

State	Counties
AL	8
GA	38
KY	64
NC	30
SC	6
TN	59
VA	48
Total	253

Region 9/Northeastern Area: Regionwide

Host(s): Flowering dogwood

The disease was found throughout Connecticut; in addition, dogwoods also had early and heavy powdery mildew that resulted in leaf discoloration and deformation. In New York, dogwood anthracnose continued to affect understory and ornamental flowering dogwood across the state. The disease was not reported in any new counties in 2006. Dogwoods throughout Rhode Island remained infected with the disease. In Vermont, dieback and mortality occurred on dogwood throughout the state.

Damage form this disease in Delaware stabilized, and many trees on well-drained soils escaped infection. In 2006, West Virginia conducted a dogwood health survey to aid the USDA Forest Service in predicting trends in dogwood populations. Anthracnose was detected at extremely low levels on existing trees. Surviving trees were mostly immature stands with evident decline. In some areas, dogwoods could not be found. Survey sites were located in Mercer, Logan, Wayne, Cabell, Kanawha, Ritchie, Wetzel, Monongalia, Morgan, Berkeley, and Jefferson Counties.

There was no significant change in the Region’s central states.

Phytophthora canker
Phytophthora pseudosyringae

Region 5: California

Host(s): California laurel, coast live oak, and tanoak

No reports were received in 2006.

Phytophthora root rot
Phytophthora cinnamomi

Region 5: California

Host(s): Douglas-fir and true firs

Mortality due to *Phytophthora cinnamomi* continues to affect the endangered Ione manzanita, *Arctostaphylos myrtifolia*, in at least two sections of its limited range in Amador County. Ione manzanita occurs on Ione-formation soils in this area, which are highly acidic. The common whiteleaf manzanita (*A. viscida*) is also killed by *P. cinnamomi* in the infested areas. Both manzanitas are commonly killed in upland sites and along slopes that dry out by late spring. Other species, including scrub oak (*Quercus berberidifolia*) are affected in low-lying areas such as drainages that remain wet later in the season. DNA microsatellite analyses by the Garbelotto lab (University of California–Berkeley) have shown that the larger infected area, located between Ione and Buena Vista, has apparently resulted from several independent introductions of the pathogen into the area, whereas only a single disease genotype has been associated with mortality in the Carbondale Road area. However, *P. cambivora* was also associated with diseased manzanita in one portion of the affected Carbondale Road area.

Phytophthora cinnamomi was also associated with native plant mortality in the Oakland Hills on a steep slope below residences and upslope from the Huckleberry Botanic Regional Preserve. Movement of the pathogen downslope into the Preserve is likely. Affected species included the endangered pallid manzanita (*A. pallida*), brittleleaf manzanita (*A. tomentosa* ssp. *crustacea*), giant chinquapin (*Chrysolepis chrysophylla* var. *chrysophylla*), and huckleberry (*Vaccinium ovatum*). Chinquapin appeared to be the most sensitive of the species present in the affected area.

Phytophthora cinnamomi was also associated with mortality of madrone and California bay on a hill overlooking the Miwok Meadows area of China Camp State Park. This area is also severely affected by Sudden Oak Death (*P. ramorum*) and includes an area containing long-term Sudden Oak Death research plots. Dead madrone and manzanita plants, most likely killed by *P. cinnamomi*, were noted within the area when Sudden Oak Death research plots were established in 2000. Wilting and mortality of mature madrone observed in the 2006 plot evaluations prompted investigation that led to the isolation of *P. cinnamomi.*

Phytophthora cinnamomi has been found killing incense cedar trees in Shasta and El Dorado Counties where streams have flooded the trees during the past rainy season. The pathogen has also killed Douglas-fir Christmas trees in plantations in Sacramento and Placer Counties when irrigated with infested water sources. Shade trees are diseased and dying in many parts of the Central Valley of California. Oaks and sycamores in the Sacramento Valley are especially affected.

All three of these *P. cinnamomi* root disease situations are notable in that they are affecting native vegetation in relatively dry areas on slopes. All of the sites also have relatively poor soils with low levels of organic matter. *Phytophthora cinnamomi* may be more common than previously suspected in sites such as these, in many parts of California.

Pitch canker
Fusarium circinatum

Region 5: California

Host(s): Bishop pine, Douglas-fir, Monterey pine, and Torrey pine

Pitch canker disease was first identified in California on Monterey pine in the Santa Cruz area in 1986. It now exists in the coastal and adjacent areas of the state from San Diego to Mendocino Counties. The disease tends to be most serious on planted Monterey and Bishop pines but is of a major concern in the limited natural ranges of Monterey pine in California. Pitch canker also affects Coulter, Gray, knobcone, shore, Torrey, Aleppo, Canary Island, and Italian stone pines, as well as Douglas-fir in California. Laboratory tests show that most native pines in the state could potentially be infected. The spread of the disease in California is thought to be primarily by insects, mostly bark, twig and cone beetles, that carry the fungus on their bodies and act as vectors. Humans may also spread the disease by moving infested material from one area to another.

Pitch canker disease has increased within the Coastal Pitch Canker Zone of Infestation in California during 2006. It has not spread outside of the previously infected areas but has intensified within the zone. The disease has moved up higher in elevation in areas where infestations have existed for a longer period of time.

Douglas-fir seed orchard trees in the Camino area of El Dorado County in the Sierra Nevada range were found to be infected in the previous years. All of the infected trees were destroyed. Since then, no new infections have been found in the seed orchard, and outbreaks of the disease have not been discovered in extensive surveys of wild land forests, Christmas tree plantations, or landscape plantings in the area.

Recent research on pitch canker disease on Douglas-fir has found that the fungus easily forms spores on Douglas-fir in experiments conducted in coastal areas. However, experiments in the inland areas did not show that spore production could readily occur on Douglas-fir away from the coast.

Aleppo pines in the Legoland area of San Diego County were infested by pitch canker in the past. The affected trees have since died. Spore traps are being monitored in the area to determine whether there continues to be any potential infection pressure in the area. Surveys of the surrounding areas have not uncovered any significant outbreaks of pitch canker in susceptible landscape plantings.

In 2005, infections were found in large, planted Monterey pines in a private campground in Olema and in a mature Monterey pine plantation and adjacent native Bishop pines in the Drakes Estero portion of Point Reyes National Seashore. Recent reports indicate flagging north of those areas in late 2006, with sampling and verification yet to be undertaken.. There infections mark the most northern coastal sites in Marin County wherein symptoms have been reported or sampled.

Region 8: Regionwide

Host(s): Southern pines

Problems with the disease in west-central Louisiana, Mississippi, and east Texas in 2005 seemed to dissipate in 2006, with no new reports coming in. In Alabama, however, pitch canker increased, particularly in the southern part of the state in mid-rotation pine plantations. Top kill and stem dieback was prevalent and may be mixed with damage from *Ips* beetles. Hurricane damage may have provided an abundance of infection courts for the fungus.

Georgia reported widespread damage to slash pine plantations in six southern and southeastern counties initially detected in 2005 continued in 2006, but with relatively few new infection sites. The State of Georgia has undertaken resistance screening of slash pine seedlings for pitch canker in cooperation with the USDA Forest Service, Asheville Field Office. North Carolina reported scattered infections of pitch canker on longleaf and loblolly pines in the Coastal Plain and Piedmont, primarily in "old field" stands. Tennessee reported increasing infection rates from plantations in the eastern part of the state, with 10 percent infection

rates in some stands in Knox and Sevier Counties. Scattered infections were also reported from South Carolina and Virginia.

Port-Orford-cedar root disease
Phytophthora lateralis

Region 5: California

Host(s): Port-Orford-cedar

Port-Orford-cedar is found on approximately 35,000 acres in California; primarily on the Six Rivers, Shasta-Trinity, and Klamath National Forests. The species has a narrow geographic range but a wide ecological amplitude. Port-Orford-cedar is found at elevations from sea level to 6,400 feet among a variety of species with differing ecological requirements, from coast redwood to mountain hemlock.

Phytophthora lateralis, an exotic root pathogen, was introduced to the native range of Port-Orford-cedar in the early 1950s. It is almost always fatal to trees. *Phytophthora lateralis* spores are spread via infested water or soil. A typical long distance spread scenario involves infested soil being transported into an uninfested area from mud on vehicles or equipment or in infested water. The infested soil falls off of the vehicle or spores are delivered via water. The pathogen first infects Port-Orford-cedar near the site of introduction and then is washed downhill in surface water that infects additional hosts. This is especially lethal along drainages and creeks where infested water is channeled and flows near concentrations of healthy Port-Orford-cedar. About 8 percent of the Port-Orford-cedar acres in California are infested with the disease.

Port-Orford-cedar root disease was identified in Port-Orford-cedar and Pacific yew along Clear Creek in the Siskiyou Wilderness Area in 2006. This was the first identification of the exotic root disease in the Wilderness Area and on the Klamath National Forest. Scattered pockets of mortality were identified and confirmed to be caused by *P. lateralis* approximately one mile south of Young's Valley (6.3 miles from the Young's Valley Trailhead) and continuing approximately nine miles further down Clear Creek (to approximately one-half mile above the junction of Clear Creek and the West Fork of Clear Creek). Additional pockets of dead and dying Port-Orford-cedar were observed from that point to the Clear Creek Trailhead, but because they were located well below the Clear Creek Trail, pathogen confirmations were not completed.

Port-Orford-cedar root disease was also present along the main stem of the Sacramento River from Dunsmuir to Shotgun Creek. Monitoring of the Port-Orford-cedar eradication treatments at Scott Camp Creek in the upper part of the Sacramento River drainage revealed no new infestations of Port-Orford-cedar root disease.

Fourteen years after Port-Orford Cedar root disease was eradicated from Cedar Rustic Camp, both the host tree and the disease organism have reinvaded due to a lack of preventive maintenance. All infected and uninfected Port-Orford-cedar have since been removed from the campground in Del Norte County.

The Trinity River drainage continues to be the only major uninfested river drainage within the range of Port-Orford-cedar.

Region 6: Oregon

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

The annual aerial survey reported evidence of Port-Orford-cedar root disease on 10,669 acres, 1.19 trees per acre, in 2006, up from 9,336 acres, 1.16 trees per acre, in 2005. These acres are located in the Coos-Douglas Reporting Area in southwest Oregon.

Mapping of surviving Port-Orford-Cedar inside the Biscuit fire perimeter was completed, and the map posted on the website: *http://fhm.fs.fed.us/posters/posters06/biscuit_fire.pdf*. Biscuit landscape patterns

showed that both Port-Orford-cedar and *Phytophthora lateralis* acres were reduced post-fire. Mapped Port-Orford-cedar acres declined from 89,980 to 23,282 (i.e., to 25.9 percent of pre-fire acres). Mapped *Phytophthora lateralis* acres were reduced from 3,022 to 835 (i.e., to 27.6 percent of pre-fire acres).

Post-fire, Port-Orford-cedar is more strongly associated with riparian areas.

Areas of serpentine soils that still have Port-Orford-cedar tended to burn with greater severity than non-serpentine soils with post-fire Port-Orford-cedar. In the Oregon portion of the Biscuit fire, approximately 34 percent of Port-Orford-cedar acres on serpentine soils (3,958 of 11,824 acres) were characterized by dead trees, with or without needles. This compares to 13 percent of Port-Orford-cedar acres on non-serpentine soils (1,571 of 12,037 acres) characterized by dead trees, with or without needles.

Hosts growing adjacent to streams, in swamps, along drainage ditches, and low-lying areas downhill from roads suffer by far the greatest impacts. Roadside sanitation has been shown to successfully remove 100 percent of Port-Orford-cedar under 7 inches DBH along twenty miles of road on the Illinois Valley Ranger District in southwest Oregon. The roadside sanitation work was accomplished by service contract at a cost of $300 to $400 per acre, or $2,700 to $3,600 per road mile (9 treatment acres/road mile). Removal of Port-Orford-cedar from infested sites reduces the potential for pathogen export. Removal of Port-Orford-cedar from uninfested sites reduces the potential for pathogen establishment.

Sudden Oak Death
Phytophthora ramorum

Region 5: California

Major Host(s): California laurel, California black oak, coast live oak, and tanoak

Significant *Phytophthora ramorum*-related oak and tanoak mortality over the past ten years has resulted in substantial concerns for the forests of California where this exotic pathogen is found. Commonly called "Sudden Oak Death" when affecting oaks and tanoaks, *P. ramorum* also causes a foliar disease known as *ramorum* blight, which affects 100 known plant species. Foliar hosts can be found in infested forests as well as the nursery industry, and while these plants rarely die if infected by *P. ramorum*, many facilitate pathogen spread. *Phytophthora ramorum* is an exotic pest, and recent findings strongly suggest it was introduced inadvertently to California through nursery stock. Regulations to limit the spread of this invasive pest are in place at the federal and state levels, including a federal rule to regulate interstate shipments for all nurseries in California, Oregon, and Washington with host plants on-site.

During 2006, *P. ramorum*-related mortality was at the highest level observed since 2000. Recent estimates suggest that more than a million overstory trees have been killed thus far in California, with at least another million currently infected. The increased mortality is attributed to above-average rainfall and late spring rains in 2005 and 2006, followed by an exceptionally hot summer in 2006. Tanoak mortality was widespread in Sonoma County from Forestville west to Fort Ross. The Russian River area (Guerneville) is of particular concern due to the number of residences in the area. Sudden Oak Death mortality was spotted for the first time north of Cloverdale and was scattered in several locations along the Mendocino/Sonoma County line. In Humboldt County, tanoak mortality was more apparent in the Garberville area. Mortality also flared up in areas infested with the pathogen since the late 1990s, including parts of Marin, Santa Cruz, and Monterey Counties. Maps of *P. ramorum* confirmations and other mortality estimates are available online at the California Oak Mortality Task Force (COMTF) website: www.suddenoakdeath.org.

New hosts. Twenty new hosts were confirmed and added to the USDA Animal and Plant Health Inspection Service *P. ramorum*-regulated list in 2006. While many of these new hosts were detected in nursery settings outside of the U.S., new additions of particular importance for California forests were *Abies magnifica* (red fir), *Ceanothus thyrsiflorus* (blueblossom), and *Eucalyptus haemastoma* Sm. (Myrtaceae – Myrtle family). The current list of hosts, including over 100 plant species and in more than 60 genera, can be found on the COMTF website: www.suddenoakdeath.org.

***Phytophthora ramorum* in nurseries.** To date in 2006, eleven states have had *P. ramorum* nursery detections: Alabama (1), California (26), Connecticut (1), Florida (2), Georgia (1), Indiana (1), Maine (1),

Mississippi (1), Oregon (13), Pennsylvania (1), and Washington (10). Since 2004, when 20 states and more than 170 nursery-related detections were made, the number of such detections has continued to decline each year as a result of implementing the current USDA Animal and Plant Health Inspection Service regulations. In California specifically, there were 26 nursery confirmations as of August 2006, down from the 53 confirmations in the state in July 2005.

New research findings. Until 2006, pathologists had thought that this pathogen infected only aboveground plant parts of forest hosts, but when they collected infected tanoak seedlings from infested forests, they were able to isolate the pathogen from roots, even when the root tissues were asymptomatic. Researchers also found that sapflow and specific conductivity were significantly reduced in infected tanoak trees, suggesting that interference with water conductance may be a factor in tree mortality. Other studies revealed the importance of spore survival in soil and water, especially in nurseries, which has implications for sanitation and spread in these environments. Also within the nursery setting, pathologists discovered a third lineage of *P. ramorum*, distinct from the A1 and A2 lines previously known from North American forests and European gardens and nurseries.

Surveys and monitoring. The USDA Forest Service, California Polytechnic State University, San Luis Obispo, and other cooperators completed their 2006 Sudden Oak Death aerial survey of high-risk forest areas, covering 6,667 miles and 9,000,000 acres in seven counties, with approximately 20,000 acres of tanoak and oak mortality mapped. Watershed monitoring continued in streams outside of known infested areas, with no new finds made outside of the 14 quarantined counties. The California Department of Forestry and Fire Protection (CDF) also conducted the California National *P. ramorum* Survey of Forest Environments in cooperation with the USDA Forest Service and found no new areas of infection.

Big Sur Adaptive Management Project. Started in 2005, the Big Sur project brings together the University of California–Berkeley, UC–Davis, Cal. Poly.–San Luis Obispo, Big Sur Land Trust, Los Padres National Forest, and others to address landscape-level tree mortality. Work already underway includes an estimate of tree mortality in the Region, treatments for high-risk tanoaks, and lowering inoculum levels through selective removal of California bay laurel trees. Future projects will include large stand manipulations and treatments, with the objective of supplying land managers with recommendations for landscape level management.

Tanoak resistance study. This cooperative effort is being carried out by UC–Berkeley, USDA Forest Service, Mid-Peninsula Open Space District, and Pt. Reyes National Seashore. Acorn collections are being made at five locations from Big Sur to southern Oregon for evaluation of tanoak resistance, genetic make-up, genetic variation in growth characteristics, and other traits.

Humboldt County monitoring and management. Between late fall 2005 and mid-summer 2006, tanoak mortality increased dramatically in Humboldt County, primarily in these areas: the Connick Creek canyon and ridgetop separating that area from Briceland; to the north of Redway (at the edges of open stands upslope of Highway 101); along the South Fork of the Eel River between Miranda and Myers Flat; along major riparian corridors to the east of Garberville and Redway, especially Dean Creek and Bear Canyon; a small drainage immediately east of Phillipsville; and near Briceland to the west. Additionally, scattered mortality was visible throughout the Salmon Creek watershed. *Phytophthora ramorum* inoculum was detected for the first time in China Creek near Briceland, in the East Branch of the South Fork of the Eel River near Benbow and in Elk Creek between Miranda and Myers Flat.

Near Miranda, a suppression project currently aims to reduce the spore load of *P. ramorum* in the North Coast and limit pathogen spread. Treatments include the removal of infected tanoak, California bay laurel, and madrone trees in a 50- acre area. Pile burning and underburning are taking place in fall 2006.

Sonoma County treatment and management. Land owners and managers in remote western Sonoma County have voiced concern over Sudden Oak Death for a number of years, but increased mortality in urban corridors around the Russian River in recent years has dramatically raised the concern over the disease in the county. A new county-wide task force has formed to draft a response plan to Sudden Oak Death and increased fire dangers in urban-wildland zones. An educational outreach plan is a large component of the program. Management and research efforts continue with the Kashia Band of Pomo Indians to treat sacred tanoaks trees in an effort to maintain tree health and acorn crop production around Stewart's Point.

Diseases: Unknown Origin

Region 6: Oregon and Washington

Host(s): Oaks

Phytophthora ramorum, the causal agent of Sudden Oak Death, was first discovered in Oregon by aerial survey in July 2001. Since fall of 2001, state and federal agencies have been attempting to eradicate *P. ramorum* from infested sites by cutting and burning all infected host plants and adjacent, apparently uninfected, plants and treating stumps to prevent sprouting. At of the end of 2006, the area under federal and state quarantine is 21.5 square miles near Brookings, Curry County, Oregon. 139 new infected trees in 35 disease centers on approximately 40 acres were discovered in 2006, bringing the cumulative (2001-2006) infested area in Curry County to 128 acres. Two of the new infested sites were found outside of the quarantine zone; one of these sites was discovered using stream baiting techniques. The infested sites occur on lands administered by the USDA Forest Service, USDI Bureau of Land Management, Oregon State Parks, and private industrial and non-industrial forestlands.

During 2006 in Oregon and Washington, nursery, forest environs adjacent to nurseries, and general forest areas were surveyed using the national survey protocol. Streams within the quarantine zone, adjacent to the quarantine zone, and in host-type in other portions of western Oregon were monitored using stream baiting techniques. Oregon had 13 confirmed *P.ramorum*-positive nurseries. In all cases, eradication activities were carried out using the appropriate protocol for the site.

Two aerial surveys were done in Oregon for Sudden Oak Death in 2006. In June, 280,000 acres were surveyed using fixed-wing aircraft. The helicopter survey follow-up encompassed 145,000 acres. In October, 280,000 acres were again surveyed using fixed-wing aircraft followed by a survey of 171,000 acres using helicopter.

Region 8: Not yet known

Hosts: Red and possibly some white oaks, rhododendrons, and numerous other species

Sudden Oak Death is a disease of concern that has been introduced to California, Oregon, and Washington, with potential to be spread into the Southeast through importation of infected nursery stock. A pilot survey to locate the disease if present in the South was initiated in 2003 and continued through 2006. The surveys were expanded in 2006 to include stream baiting in selected watersheds. No Sudden Oak Death-positive specimens have yet been found in native forest vegetation in the South.

Region 9/Northeatestern Area: Regionwide

Host(s): Various oak species

Interest in Sudden Oak Death increased again when the causal agent, *Phytophthora ramorum*, was found on infected nursery stock in Connecticut and in Farmingdale, Maine. It was not established anywhere in the Northeast. While the infected nursery material was destroyed, surveys are planned for 2007 to be sure that the pathogen has not become established.

In New York, the USDA Animal and Plant Health Inspection Service quarantine remained in place at the site of a positive report in 2004. In 2006, there were 30 more locations surveyed for the disease, with all samples testing negative.

Similar to other states, Pennsylvania surveyed for Sudden Oak Death by testing suspect vegetative materials in nursery perimeter and general forested area plots established throughout the state. A single vegetative sample from a Delaware County nursery tested positive for the disease in 2006.

An infected *Viburnum* sp. plant was found at a northern Indiana retailer as part of the USDA Animal and Plant Health Inspection Service nursery survey, and subsequently destroyed.

DECLINES AND COMPLEXES

Ash decline

Region 9/Northeastern Area: Connecticut, Illinois, Indiana, Michigan, New York, Vermont, and Wisconsin

Host(s): Green ash and white ash

Noteworthy incidences of mortality of mature white ash throughout Connecticut for the past two to three years were possibly associated with ash yellows and drought. In New York, 2006 surveys for emerald ash borer resulted in no finds for the insect, but many stands with ash with various symptoms of "decline" were mapped. A few cases of ash yellows were found in these stands. Dieback and mortality occurred statewide in Vermont, and witches brooms were commonly observed.

Ash decline was prevalent throughout Illinois. Typical symptoms were a loss of vigor with a gradual decline in the amount of foliage and loss of the upper canopy branches. Statewide surveys conducted in previous years showed that ash yellows was prevalent throughout the state and was a contributing factor for ash decline. In Indiana, ash decline continued to be found across the state, primarily on white and green ash. Trees in an advanced state of decline had the greatest change with 7 percent dying annually. Cumulative mortality was greatest in trees with advanced decline, about 49 percent. Healthy trees and early declining trees had mortality of 2 percent and 5 percent, respectively. A project in Michigan was initiated to assess decline and contributing diseases, including ash yellows, in white ash stands. Declining ash stands were affected by a variety of agents, including yellows, root and butt rots, and site and cultural factors. In Wisconsin, ash yellows was confirmed in Columbia County, based on the presence of brooms. Ash yellows was confirmed in 17 counties in the state.

Aspen decline
Cause unknown

Region 2: Colorado, South Dakota, and Wyoming

Host(s): Aspen

Declining aspen have been noticed extensively throughout the Rocky Mountain Region. Aerial survey observations indicated that 170,000 acres have dead or severely damaged aspen.

About 90,000 acres of aspen decline and mortality, primarily located in southwest Colorado, were observed from the aerial survey flights in 2006. This more than tripled the number of acres affected since the problem was first reported last year. Despite many site inspections, experts remain baffled about the reason. A systematic investigation by foresters, researchers, and other scientists will attempt to determine specific symptoms and causes. These include: verifying the geographic extent of the dieback; identifying the percentage root systems affected; noting which attacked trees produce new aspen suckers; what percentage of trees are dying; and what factors are contributing to root death. Preliminary assessments have shown many different causal agents, from decay fungi to aspen bark beetles, in different areas. In some cases, the decline is occurring on low-elevation, marginal aspen sites.

Aspen dieback in Southern Colorado is occurring in less than 5 percent of southern Colorado, but is very striking. There is a strong demarcation between areas affected and unaffected, indicating possible dieback of clones. The dieback is more conspicuous at lower elevations, in drier sites near sage brush. At higher elevations, dieback appears to be occurring on the west- and south-facing slopes, again on drier sites. Cytospora cankers, poplar borers, western tent caterpillar, and other damages or stress agents are often associated with aspen dieback. Some affected areas have an abundance of aspen regeneration in the understory, whereas other stands have little or no regeneration.

Marssonina blight (*Marssonina populi*), ink spot (*Ciborina whetzelii*), and Cytospora canker (*Cytospora* spp.) were evident in many places throughout Colorado, primarily in older and dense stands of aspen.

Declines and Complexes

Hypoxylon and Ceratocystis canker diseases were found on many of the trees. Melampsora rust and root diseases caused by Ganoderma and Armillaria are also contributing agents to aspen decline in Colorado, South Dakota, and Wyoming.

Surveys of 30 aspen stands in Wyoming indicated that 83 percent of the aspens are dead or have major damage. Forest Health specialists did closer examination of the dead trees and found that 53 percent had mortality-causing cankers and 47 percent had mortality-causing root diseases. Animal damage, foliage diseases, or insect damage impacted 13 percent of the aspens, and only 17 percent of the trees have no significant damage.

The primary detection signature for declining aspens during aerial survey work is the appearance of significantly more white stems and branches than green canopy color when compared with nearby (healthy) aspen. This "sparse crown look" has the general appearance of defoliation, often intermixed with leafless aspens that appeared to be dead. The moderate size of the aerial survey sketch-map polygons and the aggregated nature of the signature suggest a clonal association with the agent(s) responsible (see Aerial Surveyor W. Schaupp, Service Trip Report RCSC-13-06).

Region 5: California

Host(s): Aspen

Aspen decline was scattered throughout the east side of the northern Sierra Nevada range. Some specific areas are in the Sweetwater Mountains north of Bridgeport, near Twin Lakes, and near Heenan Lake, Alpine County.

Aspen defoliation and dieback

Western tent caterpillar
Malacosoma californicum
Cytospora canker
Cytospora chrysosperma
Weather related damages

Region 3: Arizona and New Mexico

Host(s): Aspen

In Arizona, aspen dieback or defoliation was recorded on the Apache-Stitgreaves (8,990 acres), Coconino (1,035 acres), Kiabab (28,415 acres) and Tonto (15 acres) National Forests; Grand Canyon National Park (17,295 acres); USDI, Bureau of Land Management lands (85 acres); Fort Apache (4,290 acres) and Navajo (6,575 acres) Indian Reservations; and 165 acres of State and private land. In New Mexico, aspen defoliation was observed on the Carson (1,520 acres), Cibola (630 acres), Gila (2,830 acres), Lincoln (90 acres), and Santa Fe (3,010 acres) National Forests; Valles Caldera National Preserve (50 acres), and USDI Bureau of Land Management lands (40 acres); Jicarilla Apache (50 acres), Santa Clara Pueblo (30 acres) and Taos Pueblo (650 acres) tribal lands; and 10,110 acres of State and private lands.

Birch decline

Region 9/Northeastern Area: New Hampshire and Vermont

Host(s): White birch

In New Hampshire, over 200,000 acres of birch showed signs of thin crowns and early defoliation from a combination of fungal diseases and some birch leafminer. There was an increase in dieback and mortality statewide in Vermont, with nearly 15,600 acres mapped in 2006, compared to 7,900acres mapped in 2005. High-elevation trees were most affected; past drought and ice damage were thought to be stress factors.

Black ash/brown ash decline
Fraxinus nigra

Region 9/Northeastern Area: Maine and Minnesota

Host(s): Black ash (brown ash)

In Minnesota, black ash decline continued to be a concern both because of the loss of the trees and because damage from this decline could hide or mask the damage of emerald ash borer once it enters Minnesota. Ash decline and mortality were mapped by aerial survey on 27,000 acres in 2004, on 4,322 more acres in 2005, an on an additional 662 acres in 2006. Site and weather conditions were still considered to be primary factors in stressed or killed trees rather than any particular insects or fungi. The significant drought in 2006 will likely hinder recovery and increase the problem.

Cytospora canker of true firs, dwarf mistletoe, sawfly (unknown species), and fir engraver beetle complex
Cytospora abietis
***Arceuthobium* spp.**
***Neodiprion* sp.**
Scolytus ventralis

Region 6: Oregon and Washington

Hosts: True firs

The various agents of this complex are widely distributed throughout Oregon and Washington wherever true firs occur. Activity levels of each agent typically fluctuate more-or-less independently among locations and over time. *Cytospora a*bietis is a weak, canker-inducing fungus that attacks stressed trees. It commonly infects branches bearing dwarf mistletoe infections, causing branch death. Conifer-feeding sawfly larvae feed on old foliage, temporarily weakening trees and slowing their growth. Outbreaks are usually sporadic and subside quickly. Fir engraver beetle activity is strongly associated with tree stress.

Aerially detected damage increased from 2,916 acres in 2005 to 6,687 acres in 2006. Most of the aerially detected damage occurred within the Rogue River and Siskiyou Reporting Areas.

Aerial observers sometimes mistake the color signature of C*ytospora abietis* with that of balsam woolly adelgid. Incidence was associated with mature noble fir and silver fir stands located near ridgetops and is probably related to drought stress.

Elm yellows

Region 9/Northeastern Area: Pennsylvania and West Virginia

Host(s): American elm and slippery elm

Pennsylvania reported elm yellows widely distributed in northeastern areas of the state, mostly in riparian habitats, fence rows, and along roadways. Elm yellows appeared to affect individual elms and not large groups of elms known as disease "flair-ups". This disease persisted in Bradford, Centre, Clinton, Lycoming, Potter, and Union Counties. West Virginia reported elm yellows in the Charleston/Guthrie areas.

Hickory decline

Region 9/Northeastern Area: Iowa, Minnesota, and Wisconsin

Host(s): Bitternut and shagbark hickories

Dieback and mortality of hickory significant problem in Minnesota, Iowa, and southern and central Wisconsin in 2006. Mortality was seen both on bitternut and shagbark hickories. The symptoms progress from thinning crowns to branch mortality to complete tree mortality. Epicormic branches often sprout from the main stem only to wilt and die later.

Many of the affected bitternut hickories had indications of cankers on the stems. Examinations under the bark of these cankers revealed brown discolored lesions of varying sizes. At the center of most of these lesions is one single entrance hole that appears to be made by a species of ambrosia beetle, yet to be identified. The upper crowns of felled trees have entrance holes and plenty of activity from the hickory bark beetle. On occasion, *Phomopsis* galls were found on branches and main stems.

A species of *Ceratocystis*, *C. carya*, was associated with a "canker-wilt" disease on hickory. It caused wilting and was particularly associated with wounds and may have been brought in by ambrosia beetles. Another species, *C. smalleyi*, may also have played a significant role in hickory mortality as it may have some adaptations related to its association with the bark beetles that are unique.

Incense-cedar decline

Region 5: California

Host(s): Incense-cedar

Symptomatic incense-cedar were found throughout northern California and the Sierra Nevada. Symptoms include foliage dieback and whole tree mortality. Seedlings and saplings appear to be the most affected but some large diameter tree mortality has occurred.

Loblolly pine decline
Abiotic and biotic influences

Region 8: Alabama, Georgia, and South Carolina

Host(s): Loblolly pine

Premature decline of loblolly pines is occurring on many, predominantly upland, sites with history of previous agriculture activity, which are not well suited for long-term management of loblolly pine.

Maple decline

Region 8: Tennessee

Hosts: Sugar maple, boxelder

Symptoms and scattered mortality were noted in eastern and middle Tennessee counties.

Oak decline

Abiotic and biotic influences

Region 2: Kansas and Nebraska

Host(s): Oaks

Oak health faces many challenges in Kansas. Oak decline is a complex problem involving with many biological, environmental, and agricultural factors that combine into situations unfavorable to oaks. *Hypoxylon* and *Botryosphaeria* canker have been noted in decline situations. Incidence of both canker diseases have been recorded in moderate to high levels in select sites. Weather extremes of flooding and drought are important, as are animal husbandry practices such as cattle lots in oak stands and related soil compaction and erosion issues. Oak decline is long-term and appears to be brought on by a combination of weather and man-made stresses that gradually wear down the trees, allowing opportunistic diseases to establish themselves in a stand. Each decline site situation is different, but the combination of these factors is common to all situations and absent when undisturbed native stands were observed. In a 2005 Sudden Oak Death detection survey of forest stands near nurseries receiving planting stock from California, no infected samples were found.

Bur oaks in eastern and north-central Nebraska over the past several years have shown symptoms that have often looked like oak wilt. The symptoms include foliage that dies completely or has large necrotic areas, branch dieback, general tree decline, and occasionally some streaking in the wood. It appears the trees are declining from changes in site conditions from human activities combined with oak wilt along the eastern edge of the state and grazing in the north-central area.

Region 8: Regionwide

Host(s): Oaks and other hardwoods

The oak resource in the southern United States is significant. Approximately two-thirds of the hardwood forest is classified as upland hardwood, where a malady known as “oak decline” is prevalent. Oak decline has been reported in the United States for over 130 years. It is a syndrome that involves the interaction of factors such as climate, site quality, and tree age; drought and insect defoliation escalate the condition by putting trees under additional stress. Pests such as armillaria root disease and the two-lined chestnut borer, which are ordinarily non-aggressive pests on vigorous trees, successfully attack trees stressed by oak decline. Decline is characterized by a gradual but progressive dieback of the crown. Mortality typically results after several years, with mature overstory trees the most heavily affected.

Alabama reported an increase in decline in the southern part of the state, particularly in bottomland stands. These areas are near the Gulf and were probably affected by past hurricanes and the summer drought. Some red oak borer activity was associated with the decline (see also **Red oak borer, *Enaphalodes rufulus,*** under **Native Insects**). Florida reported significant oak decline, especially in laurel and water oaks, in areas previously impacted by hurricanes and drought and in association with secondary infections by root disease fungi, including *Armillaria* and *Ganoderma* spp. There is also continuing interest in the possible role of the bacterial leaf scorch pathogen *Xylella fastidiosa* in oak decline and mortality. Virginia reported continuing widespread oak decline due to past drought and storm events; the problem was most notable in Coastal Plain sites. Mortality has leveled off since 2005. In South Carolina, oak decline

continues to affect substantial acreage of red oak stands, especially those subject to water table fluctuations. Similar damage was reported from scattered sites in North Carolina and Kentucky. Tennessee reported the decline from shallow-soil sites in Davidson and Rutherford Counties and the Nashville Basin. In north central Arkansas and northeastern Oklahoma, widespread oak decline-caused mortality has largely abated, although conditions conducive to decline continue to exist. The red oak borer population has diminished substantially.

Region 9/ Northeastern Area: Connecticut, Indiana, Missouri, Ohio, Vermont, and Wisconsin

Host(s): Oak

There was considerable, unexplained dying of oaks in Connecticut, with many contributing factors, such as drought and armillaria root rot. Vermont reported a decreased incidence of damage attributed to declining impact of drought.

Ohio reported 2,000 acres of dead and declining white oaks observed aerially in Scioto, Ross, Adams, Pike, Vinton, Jackson, Meigs, and Lawrence Counties. Disease contributing agents observed with this decline were armillaria root rot, hypoxylon canker, and two-lined chestnut borer as well as numerous common defoliators.

In Indiana, several reports of dying white oak and chestnut oak groups were received from 2004 to 2006. Examination of two sites in southern Indiana (Orange and Putnam Counties) and one in northern Indiana (Lake County) found that two-lined chestnut borer and armillaria root rot were involved in the decline and death of the white oak. In Missouri, native wood borer activity was at relatively normal levels again in 2006. Oak decline was an ongoing phenomenon in stressed red oak stands across much of the state. Red oak borers were among the complex of agents contributing to oak decline. Their numbers declined after the huge increases of a few years ago, but still may be significant at individual sites. Branch dieback and mortality of white and bur oaks was observed in southern Wisconsin in recent years. It was suspected that affected trees were stressed by one or multiple factors, including frost, oak tatters, anthracnose, tubakia leaf spot (*Tubakia dryina*), mites, and drought. Once the trees were stressed, they were attacked and killed by secondary pests, including the two-lined chestnut borer (*Agrilus bilineatus*) and armillaria root disease.

Red pine decline

Region 9/Northeastern Area: Minnesota and Wisconsin

Host(s): Red pine

No reports were received in 2006

Rhododendron decline

Region 8: Tennessee

Host: Rhododendron

This decline continues to appear in northeastern Tennessee counties.

Subalpine fir decline

Region 1: Idaho and Montana

Host(s): Subalpine fir

Much of the mortality occurring on these high-elevation sites results from varying combinations of root diseases, bark beetles, and possibly other climate-related factors. The most significant factor, however, is thought to be mortality directly or indirectly caused by western balsam bark beetle (*Dryocoetes confusus*). The pathogenic fungus carried by western balsam bark beetle, *Ophiostoma dryocoetidis*, appears to cause tree mortality even when trees are only lightly attacked by the beetles.

According to aerial survey, subalpine fir mortality declined from an estimated 419,000 trees killed on about 250,300 acres in 2005 to just over 185,000 trees killed on nearly 158,500 acres Regionwide in 2006. However, many areas were not surveyed in 2006. Most of the current recorded tree mortality occurred on Beaverhead National Forest in southwestern Montana, where more than 54,000 acres of damage were detected. Other forests with high levels of mortality include the Gallatin and St. Joe National Forests. However, these forests and others were not surveyed in their entirety in 2006. In many areas, populations do appear to be decreasing and should continue to decline in 2007 due to increased levels of precipitation.

Region 2: Colorado and Wyoming

Host(s): Subalpine fir

Subalpine fir decline caused by root disease and western balsam bark beetle is a strong damaging condition in Region 2, affecting over 1.8 million trees across 500,000 acres in 2006. This decline is present everywhere throughout the range of subalpine fir in Region 2, and armillaria root disease was the most common root pathogen found in these sites. Western balsam bark beetle also causes most of the mortality of subalpine fir. In Southern Colorado, mortality levels are lower than those seen during recent years. This mortality may be closely associated with low moisture availability.

In Wyoming, subalpine fir mortality was the second-leading damage agent in the Medicine Bow National Forest after mountain pine beetle. Subalpine fir decline was recorded over 43,994 acres affecting over 200,000 trees.

Subalpine fir mortality continues to increase and cause larger pockets of dead trees throughout the Bighorn National Forest. Much of the mortality is concentrated in the northern half of the forest, where most of the cover type is located, but there also have been some larger areas of mortality occurring in the southern end. There is also concern over the mortality that is occurring at relatively high levels in the krumholtz fir stands in the wilderness areas of the forest.

Region 4: Idaho, Nevada, Wyoming, and Utah

Host(s): Subalpine fir

Decline and die-off of subalpine fir started in the late 1980s in the Intermountain Region, with the peak mortality period occurring during mid-1990 when over a million trees were affected by this complex. Although there are a number of pathogens involved in this complex, the primary insect causing subalpine fir mortality is the western balsam bark beetle; *Dryocoetes confusus.* Drought compounded by overstocked and overmature stand conditions also contribute to subalpine fir mortality. In 2006, approximately 125,300 subalpine fir trees died over 61,700 acres. This is nearly half of the mortality reported in 2005 of approximately 284,200 subalpine fir trees killed over 161,300 acres. The Bridger-Teton National Forest in Wyoming accounted for the majority of subalpine fir mortality for the third consecutive year, with 45,400 trees killed over 25,100 acres, down from 90,200 trees killed over 47,900 acres in 2005. An additional 20,900 trees were killed across 4,500 acres of USDI Bureau of Land Management and 3,900 trees across 900 acres of private lands in Wyoming. Both Idaho and Utah experienced high levels of subalpine fir

mortality. Most of the mortality in both states was scattered across national forest lands. In Idaho, the Salmon-Challis National Forest had the highest amount of mortality (15,700 trees over 8,100 acres). In Utah, most of the mortality occurred on the Uinta (5,100 trees over 2,700 acres) and Wasatch-Cache (5,100 trees over 3,200 acres) National Forests and private lands (4,900 trees over 3,200 acres).

Sugar maple decline

Region 9/Northeastern Area: Connecticut, Michigan, Pennsylvania, and Vermont

Host(s): Sugar maple

Connecticut reported noteworthy incidences of mortality in mature sugar maples, possibly associated with drought, salt (for roadside trees), *Armillaria*, *Verticillium*, and various other factors. In Vermont, dieback and mortality was scattered statewide. Decline of sugar maple increased probably due to drought and insects, such as forest tent caterpillar and lecanium scale.

Surveys were not done in Pennsylvania in 2006.

A serious decline occurred in sugar maple stands growing on rocky knolls in northwest Marquette County and northeast Baraga County in the Upper Peninsula of Michigan. Several factors contributed to significant crown thinning, topkill, and some tree mortality. Factors included shallow soils over bedrock; lighter soils; a series of droughts in the past two decades; south and west exposures on steep slopes that contribute to drought stress; defoliation by late spring frosts and linden loopers in 2006; and possibly logging practices that damaged root systems. This decline was mapped during 2006 aerial surveys and will be evaluated in 2007.

White pine decline
Leptographium procerum
Phytophthora spp.
Pissoides spp.

Region 8: Virginia

Scattered isolated landscape trees and small clusters of planted Christmas trees were reported to display mortality caused by white pine decline in 2006. The decline is often difficult to diagnose, but in some cases the pathogens can be isolated from diseased trees. Feeding by weevils around the root collars of infected trees has also been observed, but it is not known whether the weevils vector the disease. Drought, flooding and poor site conditions may predispose trees to this decline.

Light impacts from this disease were noted in western North Carolina in 2006. Affected stands are typically 5-20 years old, with only small pockets of trees within pure stands usually being injured. Tennessee reported lower incidence of the disease in the middle of the state, but higher incidence in scattered pockets in eastern counties.

Region 9/Northeastern Area: Connecticut, Massachusetts, and Ohio

Host(s): White pine

There were a number of reports of declining white pines in Connecticut (both young and mature trees), but a pathogen was never isolated. Roadside white pine decline was observed at numerous locations across Massachusetts. This decline was attributed to chemicals used to melt snow. Damage appeared to be

impacting the trees in two ways; from the spray created by traffic on treated surfaces and from the pooling of treated runoff around the root of roadside trees.

Aerial observations in Ohio recorded 1,250 acres of damage in Hocking, Ross, Vinton, Pike, Guernsey, Muskingum, Perry, Monroe, and Morgan Counties. Possible factors responsible for this decline observed to date include three successive years of heavy precipitation, pine bark adelgid, and secondary fungi.

White spruce decline

Region 9/Northeastern Area: Michigan, Minnesota, and Wisconsin

Host(s): White spruce

Mortality and decline were observed in a number of white spruce plantations in Michigan on the Ottawa National Forest, throughout Northern Minnesota, and in Wisconsin on the Chequamegon-Nicolet National Forest. Multiple factors seemed to be involved including drought, defoliation, and secondary organisms. Needle loss, due to spruce budworm or *Rhizosphaera* needlecast or a combination of both, reduced growth and vigor. *Rhizosphaera* appeared to have caused as much defoliation in some of the 30 year old and older plantations as spruce budworm had caused in others. Northern spruce engraver beetle, *Ips perturbatus*, was found in dead and declining trees in some plantations and the small spruce weevil, *Pissodes rotundatus*, was found in others. Armillaria root disease was easily found on dead trees and might have played a role as well. These plantations were also affected by droughty weather in 2002 and 2003.

Yellow-cedar decline

Region 10: Alaska

Host(s): Yellow-cedar

Yellow-cedar decline is one of the most prominent forest health issues in Alaska. The principal tree species affected, yellow-cedar, is an economic and culturally important tree. An abnormal rate of mortality to yellow-cedar began in about 1900, accelerated in the mid 1900s, and continues today. These forests generally now have mixtures of old dead, recently dead, dying, and living trees. The extreme decay resistance of yellow-cedar results in trees remaining standing for about a century after death and allowed for the reconstruction of cedar population dynamics through the 1900s.

Approximately 500,000 acres of decline have been mapped during aerial detection surveys. The extensive mortality occurs in a wide band from western Chichagof and Baranof Islands to the Ketchikan area. During the 2006 annual aerial detection survey, actively dying trees were noted in many locations, including Peril Strait, south of Sitka on western Baranof Island, southern Kuiu Island, the mainland near Wrangell Island, and various areas on Kupreanof Island. Several years ago, we discovered that yellow-cedar decline extend approximately 100 miles south into British Columbia, where mapping efforts continued in 2006.

The entire distribution of yellow-cedar decline hints at climate as a trigger for initiating the forest decline. Our current state of knowledge suggests that yellow-cedar decline may by a form of freezing injury. Trees may be predisposed by growing on wet sites where roots are shallow and temperature fluctuations are extreme. Soil warming in these exposed growing conditions may cause premature dehardening and contribute to spring freezing injury. Our collaborative research with experts from Vermont on cold-tolerance testing of cedar supports this hypothesis, as yellow-cedar trees are quite cold hardy in fall and mid winter, but are susceptible to spring freezing. Snow appears to the key environmental factor in yellow-cedar decline: where snow is present in spring, yellow-cedar trees appear to be protected from this presumed freezing injury.

Mapping yellow-cedar decline at three different spatial scales also are consistent with this climate-freezing scenario. At the broadest scale, the distribution of yellow-cedar decline is associated with parts of southeast Alaska that have mild winters with little snowpack. At the mid-scale, we are finding elevation limits to yellow-cedar decline, above which cedar forests appear healthy. This elevation limit is consistent with patterns of snow persistence in spring. For example, the mortality problem is found up to 1,000 feet or slightly higher on some southern aspects, but only to about 500 feet on nearby northern aspects in a study area at Peril Strait and Mount Edgecumbe. Our studies at the fine scale help us define the role of wet soils in creating exposed conditions for trees. Here, we also measure the influence of exposure on soil warming and rapid air temperature fluctuations, as well as snow deposition and persistence.

Throughout most of its natural range, yellow-cedar is restricted to high elevations. We speculate that yellow-cedar trees became competitive at low elevation in southeast Alaska during the Little Ice Age (approximately 1500 to 1850 AD), when there were periods of heavy snow accumulation. Our information on tree ages indicates that most of the trees that died during the 1900s and those that continue to die regenerated during the Little Ice Age. Trees on these low-elevation sites are now susceptible to exposure-freezing injury due to inadequate snowpack during this warmer climate.

The primary ecological effect of yellow-cedar decline is to alter stand structure (i.e., in the addition of numerous snags) and composition (i.e., yellow-cedar diminishing and other tree species becoming more abundant) that leads to eventual succession favoring conifer species such as western hemlock and mountain hemlock (and western red cedar in many areas south of latitude 57). Also, in some stands where cedar decline has been ongoing for up to a century, large increases in understory biomass accumulation of shrubby species is evident. Nutrient cycling may be altered, especially with large releases of calcium as yellow-cedar trees die. The creation of numerous snags is probably not particularly beneficial to cavity-using animals because yellow-cedar wood is less susceptible to decay. Region-wide, this excessive mortality of yellow-cedar may lead to diminishing populations (but not extinction) of yellow-cedar, particularly when the poor regeneration of the species is considered. Planting of yellow-cedar is encouraged in harvested, productive sites where the decline does not occur to make up for these losses in cedar populations.

The large acreage of dead yellow-cedar and the high value of its wood suggest opportunities for salvage. Cooperative studies with the Wrangell Ranger District, the Forest Products Laboratory in Wisconsin, Oregon State University, Pacific Northwest Research Station, and State and Private Forestry are investigating the mill-recovery and wood properties of snags of yellow-cedar that have been dead for varying lengths of time. This work includes wood strength properties, durability (decay resistance), and heartwood chemistry.

We are working with managers to devise a conservation strategy for yellow-cedar in southeast Alaska. The first step in this strategy is partitioning the landscape into areas where yellow-cedar is no longer well adapted (i.e., declining forests), areas where yellow-cedar decline does not now occur but is projected to develop in a warming climate, and areas where decline will not likely occur. Salvage recovery of dead standing yellow-cedar trees in declining forests can help produce valuable wood products and offset harvests in healthy yellow-cedar forests. Yellow-cedar can be promoted through planting and thinning in areas suitable for the long-term survival of yellow-cedar on sites at higher elevation with adequate spring snow or on sites with good drainage that support deeper rooting.

SEED ORCHARD INSECTS AND DISEASES

Cone beetle
Conophthorus species

Region 6: Oregon and Washington

Hosts: Ponderosa pine and western white pine

Minor damage was reported from one western white pine orchard. At one ponderosa pine orchard, the cones were bagged to prevent damage. The treatment was effective but labor-intensive.

Cone midges
Unidentified species

Region 6: Oregon

Host: Douglas-fir

A survey by Forest Health Protection personnel at one seed orchard indicated that cone midges were present on Douglas-fir trees. The trees were treated with esfenvalerate to protect the cone crop.

Coneworms
Dioryctria spp.

Region 6: Oregon

Host(s): Western white pine and sugar pine

No reports received in 2006.

Region 8: Regionwide

Host(s): Southern pines

Informal surveys indicated 20-30 percent loss of second-year cones (2006 cone crop) in untreated trees in slash and loblolly pine seed orchards. This loss does not include first-year flowers and conelets that fall off or disintegrate during the season; therefore, this is a low estimate of the total damage caused by coneworms. Longleaf pine in central Louisiana suffered significant damage from *D. amatella* and *D. merkeli*; this is significant because there was an extremely small first-year crop (2007 cone crop). Surveys in a slash pine orchard in east Texas revealed 11 percent infested cones, an increase from 5 percent in 2005. The increase was probably due to the fact that the orchard was sprayed in 2004 but not 2005.

Cooley spruce gall adelgid
Adelges cooleyi

Region 6: Oregon

Host: Douglas-fir

Adelgids were found infesting rootstock grafts at one orchard. The trees were treated with horticultural oil to prevent further damage and to prevent the adelgid population from building up and spreading to other trees.

Cypress canker
Seiridium cardinale

Region 6: Oregon

Host(s): Port-Orford-cedar

Cypress canker continues to affect a small number of trees in a containerized orchard. Diseased trees are removed and destroyed.

Douglas-fir cone gall midge
Contarinia oregonensis

Region 6: Oregon

Host(s): Douglas-fir

Minor *Contarinia* damage of the 2006 cone crop was noted during longitudinal cut-face counts in early August at one orchard. The cone crop yielded bushel amounts slightly below what would be considered average. Duff vacuuming was conducted on three acres in fall 2005 (which were also treated with imidacloprid in 2006) as a means of removing overwintering habitat. Capsule injection of imidacloprid was applied to 25 acres in late winter 2006. An aerial application of esfenvalerate was applied to 27 orchard acres in early spring 2006 for the primary purpose of reducing Douglas-fir gall midge damage. At another orchard where medium to high levels of damage were observed, two orchard blocks were treated with Asana. The treatment was very effective. Next year, three blocks at this orchard will probably be treated with Asana.

Douglas-fir cone moth
Barbara colfaxiana

Region 6: Washington

Host(s): Douglas-fir

Cone moths caused significant damage in one Douglas-fir seed orchard where no protection was used. Trees with a large proportion of damaged cones were left unharvested.

Douglas-fir seed chalcid
Megastigmus spermotrophus

Region 6: Oregon

Host(s): Douglas-fir

Megastigmus was noted during longitudinal cut-face counts in early August at one of the orchards. Damage was considered very minimal. No chemical control measures were used.

Ensign (Orthezia) scale
Orthezia insignis

Region 8: Tennessee

Host(s): Butternut

An infestation was reported in a butternut progeny test in Polk County, Tennessee.

False chinch bug
***Nysius* spp.**

Region 6: Oregon

Host(s): Port-Orford-cedar

Damage contributed to a reduction in the percentage of filled seed in controlled crosses of containerized stock. The orchard experimented with control treatments, and the staff is assessing the results.

Phytophthora root diseases
Phytophthora cinnamomi

Region 6: Oregon

Host(s): Whitebark pine

In one orchard, *Phytophthora cinnamomi* caused mortality in three-year-old whitebark pine seedlings in test frames used for testing resistance to white pine blister rust. The affected seedlings and soil were removed and destroyed. A new water treatment system and improvements in preventive measures, early detection, and sanitation will be used to reduce damage from this disease in the future.

Phytophthora cryptogea

Region 6: Oregon

Host(s): Sugar pine

During the fall of 2005, researchers from Oregon State University and personnel from USDA Forest Service Forest Health Protection identified root disease caused by *Phytophthora cryptogea* throughout one sugar pine orchard. The disease is by far the largest cause of tree mortality in this orchard. Approximately 300 sugar pine trees died during 2006 due to this root disease.

Phytophthora lateralis

Region 6: Oregon

Host(s): Port-Orford-cedar

Several Port-Orford-cedar in a containerized orchard in a greenhouse were killed by *Phytophthora lateralis*. The affected trees and containers were removed and destroyed. Sanitation and management practices will be used to prevent the spread of inoculum from infected to healthy trees in the future. In addition, the floor of one greenhouse will be paved with concrete this year to make cleaning easier and prevent formation of puddles that harbor inoculum.

Phytophthora pseudotsugae

Region 6: Oregon

Host(s): Bristlecone pine and western white pine

Phytophthora pseudotsugae caused mortality in bristlecone pine and western white pine seedlings in test frames used for testing resistance to white pine blister rust. The affected seedlings and soil were removed and destroyed. The remaining seedlings were treated with metalaxyl. A new water treatment system and improvements in preventive measures, early detection, and sanitation will be used to reduce damage from this disease in the future.

Pitch canker
Fusarium subglutinans f. sp. *pini*

Region 8: Regionwide

Host(s): Southern pines

Damage to second-year cones (2006 cone crop) was reported throughout the South. This damage was particularly severe in both loblolly and slash pine orchards located in the south Coastal Plain of Mississippi and Alabama and the panhandle of Florida. This was associated with tree stress caused by root damage and crown damage caused by hurricanes in 2004 and 2005 followed by severe drought in these areas during most of 2006. Low levels of damage were also reported form the East Tennessee Nursery.

Seed bugs
Leptoglossus corculus
Tetyra bipunctata

Region 8: Regionwide

Host(s): Southern pines

Both species of seedbug were present in pine seed orchards throughout the South. Samples of conelet ovule damage indicated that seedbugs, primarily *L. corculus*, caused about 35 percent seed loss on untreated loblolly in Louisiana.

Seed damage

Western conifer seed bug
Leptoglossus occidentalis

Coneworm
Dioryctria abietivorella

Cone beetle
Conophthorus ponderosae

Region 1: Idaho and Montana

Host(s): Douglas-fir, western white pine, and other conifers

Cone and seed insects can cause considerable damage to the seeds of western conifers, significantly reducing seed crops. Though insects are found feeding on a variety of tree species in wild stands, they are especially of concern in blister rust-resistant western white pine seed orchards. The insects that cause the most damage in western white pine are western conifer seed bug, *Leptoglossus occidentalis*, cone beetle, *Conophthorus ponderosae*, and coneworm, *Dioryctria abietivorella*. One or more of these insects are often abundant enough in northern Idaho white pine seed orchards to warrant an insecticidal spray treatment to protect cones. To assist in timing of insecticide treatments, cone beetles are monitored with pheromone traps. Sanitation of infested cones is routinely done in the orchards. However, their proximity to wild stands makes immigration of pests a continual problem.

Cone beetle populations have been high at white pine seed orchards at the Coeur d'Alene nursery and at Grouse Creek in northern Idaho. At the Coeur d'Alene nursery, integrated pest management activities were conducted to decrease the losses caused by cone beetles. Infested cones that had fallen on the ground were gathered and removed from the orchard in October 2005 and again in March 2006. The orchard was then treated with synthetic pyrethroids shortly after the first beetles were caught in pheromone traps in late April and again in mid-to-late May. As a result of these management activities, seed yield more than doubled that of previous years of no treatment.

At Grouse Creek seed orchard, coneworms continue to infest a young larch seed orchard that is just starting to produce cones.

Tree improvement areas in Montana will be monitored as cones are produced.

Southern cone gall midge
Cedidomyia bisitosa

Region 8: Florida

Host(s): Slash pine

No reports were received in 2006.

Unidentified cone midge

Region 6: Oregon

Host(s): Port-Orford-cedar

Damage contributed to a reduction in the percentage of filled seed in controlled crosses of containerized stock. Orchard management experimented with control treatments and is assessing the results.

Western conifer seed bug
Leptoglossus occidentalis

Region 6: Oregon

Host(s): Sugar pine and western white pine

At one western white pine orchard, seed bugs were observed for the first time. The damage was discovered just before harvest so there was no treatment. The crop was good in spite of the damage. The orchard is considering alternatives for treatment next year; cones may be bagged as a preventive measure. At a sugar pine orchard, a few seed bugs were observed where cotton cone bags had been installed during late winter. Damage to the harvested seed was believed to be minor.

Western red cedar gall midge
Phytophaga thujae

Region 6: Oregon

Host(s): Western red cedar

This insect was observed for the first time at one of the orchards. The insects are probably coming from western red cedars growing in riparian areas near the orchard. Treatment may be needed next year to prevent damage to cones in orchard trees that were treated with gibberillic acid to stimulate cone production.

NURSERY INSECTS AND DISEASES

Aphids
Unidentified species

Region 6: Oregon

Host(s): Oregon ash and red-osier dogwood

Aphid populations built up to damaging levels in containerized ash and dogwood at one nursery. Two separate populations were treated with Safer soap. The soap treatments and sanitation of infested seedlings provided sufficient control.

Black vine weevil
Otiorhynchus sulcatus

Region 6: Oregon

Host(s): Containerized hardwoods, shrubs, and conifers

Monitoring was conducted weekly from April through August. Root weevil activity was observed in mid-June. Two treatments of chlorpyrifos were made. Damage was minimal.

Corky root syndrome
Cylindrocarpon destructans and *Fusarium* spp.

Region 6: Oregon

Host(s): Western white pines and sugar pines

A minor amount of mortality attributed to root disease caused by *Cylindrocarpon destructans* and *Fusarium* species was observed in bareroot sugar pine and western white pine at one nursery during the growing season. Culling due to this problem during lift-and-pack was insignificant.

Cranberry girdler
Chrysoteuchia topiaria

Region 6: Oregon

Host(s): Conifers

Monitoring for the girdler was done with the standard pheromone trap system at one nursery. Routine monitoring of seedlings in the seedbeds during the growing season did not reveal any significant damage. Nursery personnel will continue to monitor seedlings for girdler damage during lift-and-pack. No chemical treatments were used.

Cylindrocarpon root disease
Cylindrocarpon destructans

Region 1: Idaho and Montana

Host(s): Western white pine and whitebark pine

Cylindrocarpon destructans caused root disease of container-grown five-needle pines (western white pine and whitebark pine) at several container nurseries in Region 1. The pathogen caused varying levels of root decay, often without eliciting above-ground disease symptoms on affected seedlings. The disease was best controlled by container sterilization with hot water treatments, seed treatments, and periodic fungicide applications. *Cylindrocarpon destructans* also causes root disease on other conifer hosts grown in both bare root and container nurseries, although damage is usually minor.

Damping-off
Fusarium spp.
Pythium spp.
Phytophthora spp.

Region 1: Idaho and Montana

Host(s): Conifers

Damping-off was fairly common in both bareroot and container nurseries in Region 1. Disease levels varied among nurseries primarily because of seedlot differences and weather conditions during periods of seed germination and seedling establishment. Damage was most often controlled by pre-sowing seed treatments (especially prolonged running water rinses and treatments with aqueous solutions of sodium hypochlorite) and application of post-sowing fungicides when germinants were susceptible and temperature and moisture conditions were conducive.

Region 8: Regionwide

Host(s): Pines and hardwoods

Damping-off continued to be one of the most common disease problems of nurseries in the South. Low levels of post-emergence damping-off were reported in the East Tennessee Nursery.

Fungus gnats
Family: Sciaridae

Region 6: Oregon

Host(s): Containerized conifers and aspen

Fungus gnat populations became a problem in two crops of conifers growing in Q-plugs at one nursery. A fair amount of mortality was caused by feeding damage on young roots. Five applications of Gnatrol (*Bacillus thuringensis)* reduced gnat populations and prevented further damage. At another facility, the fungus gnat population built up in containers of native shrub species. Removal of empty containers, doubles, algae and weeds, and placement of yellow sticky traps across the trays reduced the population to acceptable levels.

Fusarium root disease
Fusarium spp.

Region 1: Idaho and Montana

Host(s): Conifers

Fusarium-associated diseases were the most important and damaging diseases of conifer seedling production in both bareroot and container nurseries in Region 1. These fungi caused several different types of diseases throughout the seedling production cycle. The most damaging *Fusarium* species in bareroot nurseries were members of the *F. oxysporum* species complex, while *F. proliferatum* was the most important pathogen in container operations. Other *Fusarium* species were commonly isolated from both diseased and healthy seedlings; some of these were capable of eliciting diseases, whereas others were more commonly saprophytes, endophytes, or secondary colonizers of seedling root tissues. *Fusarium* diseases were most commonly controlled by pre-plant soil fumigation in bareroot nurseries and seed, container sterilization, and fungicide treatments in container nurseries.

Region 6: Oregon

Host(s): Sugar pine

Fusarium proliferatum was the apparent cause of sugar pine mortality in styroblock containers at two facilities. Sanitation of symptomatic seedlings was sufficient to prevent buildup of inoculum and minimize further losses at one facility. The other facility also reduced humidity by reducing the frequency of irrigation and venting greenhouses after irrigation. In lots with losses greater than one percent, one cause was determined to be germination of more than two seedlings per cell. Once seedlings were thinned to one per cell, the incidence of disease was reduced. In another lot the seed coats did not drop off as quickly as other seedlots, apparently giving the fungus an opportunity to infect the cotyledon needle tips.

Gray mold
Botrytis cinerea

Region 1: Idaho and Montana

Host(s): Western larch, Engelmann spruce, western redcedar, and western white pine

Botrytis cinerea was an important pathogen of container-grown western larch, Engelmann spruce, western red cedar, and western white pine seedlings in container nurseries in Region 1. This disease was best prevented by careful monitoring, sanitation, improved air circulation among seedlings by controlling seedling spacing and manipulating irrigation regimes. Fungicide applications, alternating chemicals with different active ingredients and modes of action, were often necessary to reduce losses. *Botrytis* also caused important damage to cold-stored seedlings after lifting and prior to outplanting. Pathogen development is restricted by storing seedlings at below-freezing temperatures and rapidly thawing them prior to outplanting.

Region 6: Oregon

Host(s): Conifers

Foliage blight caused by gray mold damaged containerized incense cedar, Port-Orford-cedar, western hemlock and western red cedar seedlings at two facilities. Another facility experienced a minor amount of gray mold on containerized western white pine and whitebark pine in a cooled and humidified greenhouse. The nurseries controlled the disease by spacing seedlings to increase air flow, knocking water off foliage

after irrigation in the fall, continuous checks for and removal of infected foliage, and treatments with chlorothalonil, propiconazole or Zerotol.

Leaf spots
Marssonina populi

Region 6: Oregon

Host(s): Black cottonwood

One treatment of Benomyl was used to control black spot in containerized black cottonwood seedlings at one nursery.

Leafroller moths
Family: *Tortricidae*

Region 6: Oregon

Host(s): Western red-cedar

Western red cedar seedlings at one container facility were damaged by feeding by the leafroller moth larvae. The damage was not extensive enough to require treatment.

Lygus
Tropidostepes spp.

Region 6: Oregon

Host(s): Conifers

Monitoring for the lygus bug was done with the yellow sticky trap system at one nursery. Insect levels were low for most of the season and then increased rapidly toward the end of July. Two treatments with Asana were made after high insect numbers were noted. Inspection of seedlings in the seedbeds revealed minor damage on the plants during the growing season. Nursery personnel will continue to monitor seedlings for lygus damage during lift-and-pack.

Needle cast
Unidentified species

Region 6: Oregon

Host(s): Sugar pine

Sugar pine rootstock, grown outdoors, was infected by an unidentified needle cast fungus due to favorable conditions created by heavy fall precipitation. When the trees were taken into a greenhouse for grafting, the infected needles were removed. The grafted trees were treated with chlorothalonil prior to shipment.

Nematodes
Tylenchorhunchus claytoni and *T. ewingi*
Paratrichodorus minor

Region 8: Several nurseries Regionwide

Host(s): Pines

Patches of stunted seedlings occurred in some fields the second year after fumigation.

Pythium root disease
Pythium spp.

Region 1: Idaho and Montana

Host(s): Conifers

No reports were received in 2006.

Phytophthora root rot
Phytophthora cinnamomi

Region 8: North Carolina

Host(s): Fraser fir

Phytophthora root rot affected the end of a field in a North Carolina nursery. Infected seedlings were destroyed; fungicides were used to protect healthy seedlings remaining in the beds.

Pitch canker
Fusarium subglutinans

Region 8: Tennessee and Florida

Host(s): Virginia, white, and slash pines

Low levels of infection were reported at nurseries in the late summer and fall.

Rhizoctonia needle blight
Rhizoctonia spp.

Region 8: Regionwide

Host(s): Longleaf pine seedlings

Little *Rhizoctonia* damage was noted in 2006 due to less bareroot longleaf pine production in the Region and implementation of fungicide spray programs.

Root weevils
Unidentified species

Region 6: Oregon

Host(s): Red alder

Red alder seedlings at a container facility were damaged by feeding root weevil larvae. The damage was not extensive enough to warrant treatment.

A minor amount of mortality attributed to root disease caused by *Cylindrocarpon destructans* and *Fusarium* species was observed in bareroot sugar pine and western white pine at one nursery during the growing season. Culling due to this problem during lift-and-pack was insignificant.

Sirococcus tip blight
Sirococcus conigenus

Region 1: Idaho

Host(s): Conifers, particularly Douglas-fir

No reports were received in 2006.

Unidentified powdery mildew

Region 6: Oregon

Host(s): Bigleaf maple

No reports were received in 2006.

Unidentified shoot blight

Region 6: Oregon

Host(s): Black cottonwood

No reports were received in 2006.

ABIOTIC AND OTHER DAMAGE

Air pollution

Region 5: California

Host(s): Jeffrey pine, ponderosa pine, and hardwoods

Intensified Ozone Monitoring in Southern California

Tropospheric ozone is a phytotoxic gaseous air pollutant formed by photolysis from air pollution generated in large metropolitan areas during transport over long distances to rural areas. Ozone, together with drought and bark beetles, is one of the key stressors affecting forest trees adjacent to urban areas. Recently, passive samplers have been used to measure ambient ozone concentrations. Passive samplers allow O_3 distribution to be characterized at forest stand and landscape scales. An extensive network of 37 passive ozone samplers were established in the southern California mountains, foothills, and desert. Samplers were changed every two weeks between May and September, 2005 and 2006. Several active ozone monitors were installed to provide calibration of passive samplers on-site. In addition, foliar injury was evaluated at 14 monitoring sites established during the 1960s and 1970s. Mortality was also measured at 14 long-term sites in the San Bernardino Mountains.

Mortality and Air Pollution in the San Bernardino Mountains

During the 1960s and 1970s, a series of monitoring sites were established in the southern California Mountains by Paul Miller. Many of these sites have been lost, but 18 sites in the San Bernardino Mountains have been maintained. Mortality was assessed at 14 of these long-term study sites between 2005 and 2006. Preliminary results show a good correspondence between ambient ozone distribution (using 2006 data) and mortality levels. At several sites in the western San Bernardino mountains, all pines in study plots died during the drought of 2001-2004. In contrast, few pines died in low air pollution areas, despite these areas having less precipitation than high air pollution sites.

Foliar Injury and Ambient Ozone Distribution in Southern California Mountains

Foliar injury from ozone was evaluated at 14 sites in southern California mountains in 2006 using a Forest Health Protection protocol developed by John Pronos during the 1970s. This protocol is called the Forest Pest Management (FPM) protocol. Three branches from the lower-third crown of each tree were evaluated then averaged to determine a single tree value.

The results indicate that foliar injury in Southern California is generally 'slight.' The most severe injury was observed in western San Bernardino, San Jacinto, and Laguna Mountains. Equal and more severe injury was observed at long-term sites in the Southern Sierra Nevada range using the same evaluation protocol. These results differ greatly from past work. In past studies, sites in the western San Bernardino Mountains had more severe injury than other sites in California. Many of the most severely impacted sites in the San Bernardino Mountains were not evaluated in 2006 because few or no pines remained at these sites.

Region 8: Tennessee

Host(s): All species

Tennessee reported increasing ozone damage in several northeastern counties.

Drought effects

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

Host(s): All tree species

Moisture conditions improved somewhat in 2006, but parts of the Region are still under severe drought. All tree species have become vulnerable to secondary stressors such as bark beetles and foliar and root diseases.

In Kansas, dessication from hot southern winds caused severe tree damage during this drought cycle.

Drought was still stressing trees in Nebraska and causing many conifers and broadleaf trees to die from secondary and stress-related insect pests and diseases, such as bark beetles, *Sphaeropsis* blight, and root diseases. Reduced growth and poor color were seen in many tree species, especially conifers. Trees particularly stressed from the drought were those in windbreaks and in riparian areas where water tables around them dropped.

In South Dakota, the drought has been responsible for the decline and mortality of spruces that were planted on the western short-grass prairie where the precipitation has been inadequate to support them. Reduced growth and poor color were seen in many tree species, especially conifers. Windbreak trees were particularly stressed by drought conditions in South Dakota.

Region 3: Arizona and New Mexico

Host(s): Ponderosa pine

Discoloration of ponderosa pine attributed to drought occurred on about 18,290 acres in 2005 but only 5,310 in 2006. In Arizona, this occurred on the Apache-Sitgreaves (130 acres), Coconino (4,410 acres), Coronado (100 acres), Kaibab (210 acres) and Tonto (70 acres) National Forests; Fort Apache (55 acres) Indian Reservation; and 335 acres of State and private lands. No discoloration of ponderosa pine due to drought was recorded in New Mexico in 2006.

Region 5: California

Host(s): Oaks and other hardwoods

Information from two sources illustrates meteorological conditions in California over the past few years: the Palmer Drought Indices and data collected by the California Department of Water Resources. The Palmer Drought Index is an indicator of drought or moisture excess and ranges from -6 to +6, with the negative values denoting degree of drought. Wet conditions continued for most of California in 2006. The statewide average snowpack condition in April was 125 percent of averagel. Overall precipitation for the state was at 135 percent of average in 2006; however, dry to slight drought conditions returned to the South Coast and Mojave regions.

Region 8: Alabama, Georgia, Louisiana, Mississippi, Oklahoma, Tennessee, Texas, and Virginia

Host(s): All tree species

Alabama, Louisiana, Mississippi, Oklahoma, Tennessee, and Texas all reported problems with summer drought in 2006. Impacts were primarily related to increases in *Ips* bark beetle-associated pine mortality and somewhat with black turpentine beetle infestations. In Alabama, oak decline in bottomland stands increased with drought conditions and in association with infestations of red oak borer.

Drought conditions prevailed across eastern Texas and Oklahoma through the summer and fall, with only slight and localized relief from Hurricane Rita in Texas. By November, Lufkin, Texas, was 12 inches

below long-term precipitation averages. Much of the Southeast experienced at least moderate and localized drought, with little rain outside of the areas influenced by hurricanes and episodic severe thunderstorms. In Virginia, tree decline due to past drought continued, although overall drought conditions were significantly less severe in 2006 than in 2005. Tennessee reported low survival rates in 1,007 acres of one-year-old loblolly pine plantations in southwestern counties and white pine sapling and poletimber dieback in northern and eastern counties. Georgia reported widespread stress-induced forest injury from the combination of flooding spring rains followed by extreme summer drought.

Region 9/Northeastern Area: Connecticut, Minnesota, Missouri, Pennsylvania, Vermont, and West Virginia

Host(s): Hardwoods and softwoods

Many woody plants were stressed by hot dry conditions in 2005, but drought was not much of an issue in Connecticut in 2006. Drought-related mortality of stressed trees continues in Vermont for some sites and tree species, such as upper-elevation paper birch.

Winter precipitation in Pennsylvania was normal, below normal during the spring, and summer months saw precipitation well above normal, with many areas flooding due to heavy rains. West Virginia reported that, from January through September, conditions were much dryer and warmer than usual, which put the state into a drought status. Drought impact continued to evidence itself through dieing and/or dead trees throughout the state.

A term, "flash drought," was coined by the Minnesota State Climatologic group to refer to a relatively sudden drought onset brought on by the prolonged absence of significant precipitation during the middle of a hot growing season. Such was the case in 2006, when much of Minnesota was in a surplus moisture situation going into the month of May, but by the end of July, many northern and eastern counties declined to the Severe and Extreme Drought categories as a result of the prolonged absence of rainfall combined with very high summer temperatures. This rapid onset of drought over a 2-3 month period was a rare occurrence in Minnesota history, having only occurred at a comparable rate previously in 1896 and 1933. Other severe droughts had taken much longer to establish.

Ongoing drought conditions persisted throughout much of the west-central region and into the southwest corner of Missouri. Samples exhibiting diagnostic scorch symptoms were taken from a variety of tree species such as pin oak, bur oak, maple, dogwood, mulberry, and elm in late July through August 2006. Precipitation was running three inches below average for the northeast, west Ozarks, and southeast portions of the state. West-central Missouri precipitation was roughly seven inches below average. A late-season winter storm may have helped ease the drought situation, as much of the central portion of the state received record snowfalls: the most seen in more than a decade. The eastern Ozarks and the bootheel portions of the state had near normal precipitation reported for the year. Moisture conditions were not expected to reduce further decline of red oaks in susceptible sites throughout the Ozarks.

Flooding

Region 9/Northeastern Area: Connecticut, and Vermont

Host(s): Hardwoods and Softwoods

Frequent, heavy downpours in Connecticut throughout 2006 resulted in flooding and standing water in many areas; root damage from these conditions might not be evident until 2007. Vermont reported some dieback and mortality statewide from flooding.

Hurricane

Region 8: Alabama, Florida, Louisiana, Mississippi, and Texas

Host(s): Southern pines

No direct hurricane damage occurred in the South in 2006. However, damage to southern pine seed orchards that occurred in 2005 as a result of Hurricane Katrina continued in 2006 in the form of tree mortality in pine orchards located in Mississippi and Alabama. The trees received root and crown damage from high winds. Subsequent drought conditions throughout 2006 resulted in severe stress. Trees became susceptible to disease and bark beetle infestations. Loss of large first-generation orchard trees was significant in several orchards.

Ice/snow damage

Region 2: South Dakota

Host(s): All tree species

Ice storms often occur in the Great Plains and cause severe damages to many different species of trees. South-central Kansas had severe ice storms in 2006, with the worst damage occurring in communities and urban areas. An ice storm in late December 2006 caused some limb breakage to trees in central Nebraska. An ice storm that stretched across eastern South Dakota in January 2006 was responsible for damaging thousands of trees. A buildup of ice resulted in branch breakage in silver maples, green ash, and a number of other deciduous species.

Region 8: Regionwide

Host(s): Southern pines and hardwoods

South Carolina experienced an ice storm in late December 2005, generating an estimated $259,193 worth of damage to pine pulpwood stands in five counties that could not be assessed until 2006. Tennessee reported hail damage to 75 percent of the saplings in a 30-acre loblolly pine plantation in McNairy County.

Region 9/Northeastern Area: Connecticut, New York, and Vermont

Host(s): Hardwoods

In Connecticut, there was considerable branch breakage from ice storms, especially in northern areas. An early snow storm felled trees and broke limbs in western New York, with the most serious damage centered on Erie and Niagara Counties. The extent of the damage was not yet fully quantified. Vermont reported only scattered damage.

Wind/tornado/hail

Region 5: California

Host(s): Blue oak, conifers, ponderosa pine, and white fir

On the morning of December 31, 2005, strong winds swept across Humboldt, Del Norte, and Western Trinity Counties. Associated tree damage (2-3 foot diameter trees snapped) was reported from near Cape

Mendocino to north of Trinidad and as far inland as Salyer, with other minor damage reported further north. Resulting widespread power outages affected over 56,000 homes. Wind speeds up to 97 mph were recorded around Humboldt Bay, and tree damage across the area was noted, indicating more widespread winds in excess of 70 mph.

Region 8: Tennessee

Hosts: Southern pines and hardwoods

Spring windstorms damaged poletimber and sawtimber stands in middle Tennessee counties and various eastern counties. Tornadoes on April 2 damaged 1,014 acres of hardwood forest in Gibson County and another 413 acres in Dyer County. On April 7, tornadoes damaged 50 acres in Dickenson County, 40 acres in Cheatham County, and 45 acres on the Natchez Trace State Forest in Carroll County.

Region 9/Northeastern Area: Illinois, Massachusetts, Missouri, Vermont, and Wisconsin

Host(s): Hardwoods and softwoods

In Massachusetts, more than 1,000 acres of damage was caused by a severe windstorm in Chatham, Brewster, Orleans, and Eastham. There was heavy breakage and mortality in scattered locations in Vermont.

Eastern Missouri experienced major damaging weather events on July 19 and Nov 30, 2006. Straight line winds from a significant summer thunderstorm complex produced widespread tree damage from central Illinois across the St. Louis metropolitan area and into the eastern Ozarks. It was estimated that the storm had sustained winds nearing 90 mph. During the late season storm, accumulations of freezing rain and ice in excess of two inches were common across eastern Missouri and western Illinois. The combination of accumulated ice on trees and power lines and gusty northwest winds produced widespread tree breakage, knocking out power to many residents in the area.

During the summer 2006, several storms produced damaging hail in northeastern Wisconsin. Hail as large as 3 inches in diameter was observed, and damage was most severe on young trees. Branches were broken and bark was badly damaged on both young and old trees. Damaged bark dried and split as the summer progressed, creating further damage. Red pine trees in several stands became infected with Diplodia following the hail damage; they were later attacked by bark beetles, and mortality was beginning to occur. Some locations experienced multiple hail storms throughout the summer.

Winter drying

Region 9/Northeastern Area: Missouri

Host(s): Softwoods

In Missouri, winter desiccation left many conifers in poor shape in the spring of 2006, with many white pines exhibiting uniform browning throughout.

Appendix A

Forested Areas*

About one-third of the Nation's land area, 748.9 million acres, is forested—384.3 million acres (51 percent) in the East, 237.8 million acres (32 percent) in the continental West, and 126.9 million acres (17 percent) in Alaska. By ownership nationwide, 43 percent of the acreage is in public ownership and 57 percent is in private ownership. Of the public ownership, 20 percent is in the East, 50 percent in the continental West, and 29 percent in Alaska. In contrast, 74 percent of the private ownership is in the East, 18 percent in the continental West, and 8 percent in Alaska.

Eastern hardwood forests make up 75 percent of all the forested acreage in the East. The largest component of the eastern hardwood forest type is oak-hickory, which occupies 133 million acres, or 35 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 55 million acres, or 14 percent, of the eastern forests and are located in the North.

The oak-pine forests occupy 34 million acres, or 9 percent, of the eastern forested acreage and are located in the South, as are the oak-gum-cypress forests, which occur on 31 million acres, or 8 percent, of the eastern forested acreage.

The aspen-birch forests occupy 18 million acres, or 5 percent, of the eastern forested acreage and are located in the North. The elm-ash-cottonwood forests on 14 million acres, or 4 percent, of the forested acreage are bottom land forests in both the North and South. Other forest types occupy 3 million acres, or 1 percent, of the forested acreage in the East.

Eastern softwood forests make up the remaining 25 percent of the eastern forested acreage. The loblolly-shortleaf pine forests occupy 54 million acres, or 14 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 17 million acres, or 5 percent, of the forested lands and the white-red-jack pine forest on 12 million acres, or 3 percent, of the forest lands; both are in the North.

Western hardwood forests occupy 50 million acres, or 14 percent, of the western forested acreage, including that in Alaska. The primary species are oaks in California, aspen in the Intermountain Region, and red alder in the Pacific Northwest.

Western softwood forests make up 86 percent of all the western forests. Douglas-fir forests occupy 40 million acres, or 11 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 19 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 19 million acres, or 5 percent, of the forested lands. The fir-spruce forests occupy 73 million acres, or 20 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 73 million acres, or 20 percent, of the forested land in the West.

The piñon juniper type occupies 52 million acres, or 14 percent, of the forested acreage.

Other western types (western white pine, larch, redwood, chaparral, and nonstocked areas) occupy 8 million acres, or 2 percent, of the western forested acreage.

*Sum of numbers may not equal totals due to rounding.

From: Smith, W. Brad; Patrick D. Miles, John S. Vissage, and Scott A. Pugh. 2003. Forest resources of the United States, 2002. General Technical Report NC-241. St. Paul, MN: U.S. Department of Agriculture, Forest Service, North Central Research Station. 137 p.

Appendix B

Reporting Area Definition

"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.