United States
Department of
Agriculture

Forest Service

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January 2012

Major Forest Insect and Disease Conditions in the United States: 2010 Update

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Compiled by Gary Man
Forest Health Protection

Cover photo: *Spruce beetle-killed trees beside the Swanson River in Colorado. USDA Forest Service photo.*

Preface

This report represents the 60th annual report of the major insect and disease conditions of the Nation's forests prepared by the Forest Service, U.S. Department of Agriculture (USDA). The report focuses on the 20 major insects and diseases that annually cause defoliation and mortality in forests of the United States. The 2007 report, *Major Forest Insect and Disease Conditions in the United States 2007* (http://www.fs.fed.us/foresthealth/publications.shtml#reports) provides background information on the 20 insects and diseases described in this report and should be referenced if more detailed information is desired. This 2010 update provides a national summary of the major changes and status of these 20 forest pests with updated charts, tables, and maps. Additional information on these and other pests can be found at http://foresthealth.info/.

The information in this report comes from the Forest Health Protection program of the Forest Service and its State partners. This program serves all Federal lands, including the National Forest System, the lands administered by the U.S. Departments of Defense and the Interior, and tribal lands. The program also provides assistance to private landowners through the State foresters and other State agencies. A key element of the program is detecting and reporting insect and disease epidemics. State and Forest Service program specialists regularly conduct detection and monitoring surveys.

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

United States Department of Agriculture

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Pacific Northwest Region (R6)
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UPR Experiment Station Grounds
P.O. Box 25000
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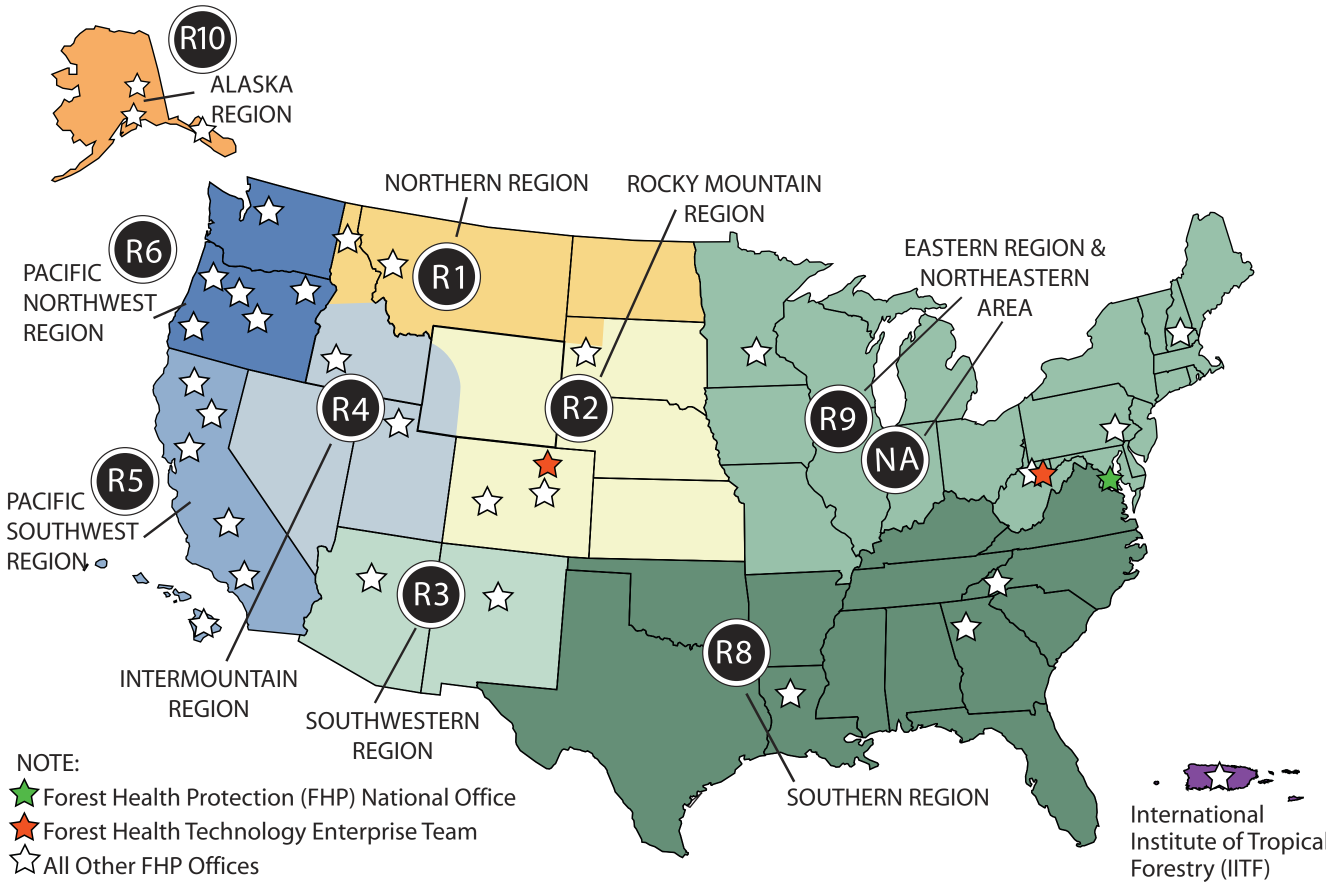
787–766–5335

Forest Service Regions and Area



Copies of this report are available from:

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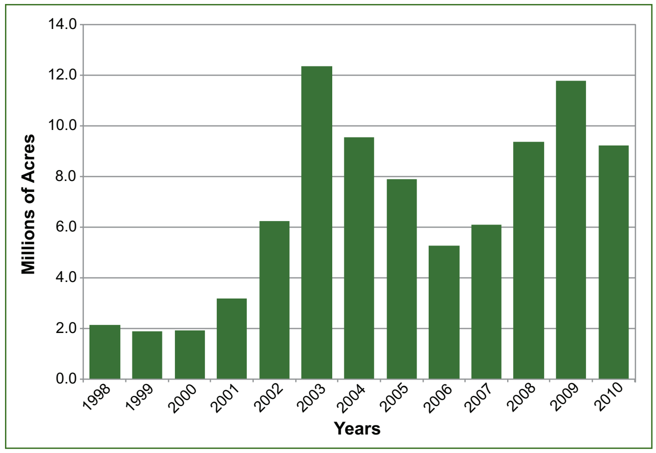
This report is also available on the Internet at http://www.fs.fed.us/foresthealth/current_conditions.shtml and at http://www.fs.fed.us/foresthealth/publications.shtml#reports.

Contents

Executive Summary/Introduction

America is fortunate to have forests that cover nearly one-third of the country, providing a wide array of services and commodities such as timber and other forest products, recreation, wildlife, clean water, carbon sequestration, and jobs. Healthy forests, regardless of ownership, are important to providing these goods and services on a sustainable basis. One aspect of maintaining and even enhancing a healthy forest is to protect and restore forests from native and nonnative insects and diseases, which can cause significant damage. Surveys describing the forest insect and disease conditions are important tools to help prioritize actions by Federal agencies, States, and other stakeholders. As with most biological systems, the overall mortality that insects and diseases cause varies from year to year and pest to pest. The following chart (fig. 1) illustrates how mortality has varied over the past 13 years.

Figure 1.—*Surveyed acres with mortality from 1998 to 2010.*



Acres of Tree Mortality Caused by Insects and Diseases

In 2010, nearly 9.2 million acres with mortality caused by insects and diseases were reported nationally, a 2.6-million-acre decrease from 2009, when 11.8 million acres of mortality were reported. Nearly 74 percent of the mortality is attributed to one pest, the mountain pine beetle, a native insect found in forests in the Western United States. Although only mortality is represented in the chart, defoliation also can significantly affect our forests. The western spruce budworm caused more than 2.4 million acres of defoliation damage in 2010. Reports of European gypsy moth defoliation increased more than 37 percent from last year; the moth defoliated more than 1.2 million acres. A single defoliation event usually does not cause tree mortality; however, taken together with continued attacks or severe abiotic factors such as weather and drought, trees can succumb to these defoliating insects.

Readers should use caution in interpreting the maps in this document, because they are displayed at the county scale. If damage was reported at just one location in the county, the whole county is noted as affected. The reason for this protocol is that, for some pests, data are collected only at the county level. Also, if damage was reported at a finer pixel level, many areas would not show up at the scale used in this publication. For instance, numerous counties reported southern pine beetle mortality in 2010, but most spots are small and, when added together, affect a little more than 14,000 of the 9.2 million acres of mortality. In addition, the maps represent only what is reported as mortality or defoliation and not necessarily the total infestation of a pest. In any given year, some areas are not surveyed because of physical limitations, such as forest fires, weather events, or limited resources.

Every year, hundreds of native and nonnative insects and diseases damage our Nation's forests. In the following pages, we describe 20 of the major insects and diseases that contribute annually to mortality and defoliation. In addition, we have added a section for pests that have the potential to become major threats and that we are monitoring.

Mountain Pine Beetle

Dendroctonus ponderosae Hopkins

In 2010, surveys detected more than 6.8 million acres with mountain pine beetle (MPB) mortality across the Western States, down from slightly more than 8.8 million acres in 2009 (figs. 1 and 2). The decrease in acres reported is likely due to a combination of declining beetle populations in some areas (because of weather conditions and lack of host material) and a lack of aerial surveying over some wilderness areas last year (fig. 3).

In Colorado, MPB affects lodgepole, ponderosa, and three different five-needle pines (whitebark, limber, and bristlecone pines). The MPB epidemic that began in northern Colorado in the late 1990s continued to expand to new areas in 2010. This epidemic, which has been most severe in lodgepole pine forests north of Aspen to Fairplay, has also severely affected limber and ponderosa pine stands adjacent to and mixed with

Figure 1.—*Mountain pine beetle activity has risen dramatically since 2000 in much of the Western United States.*

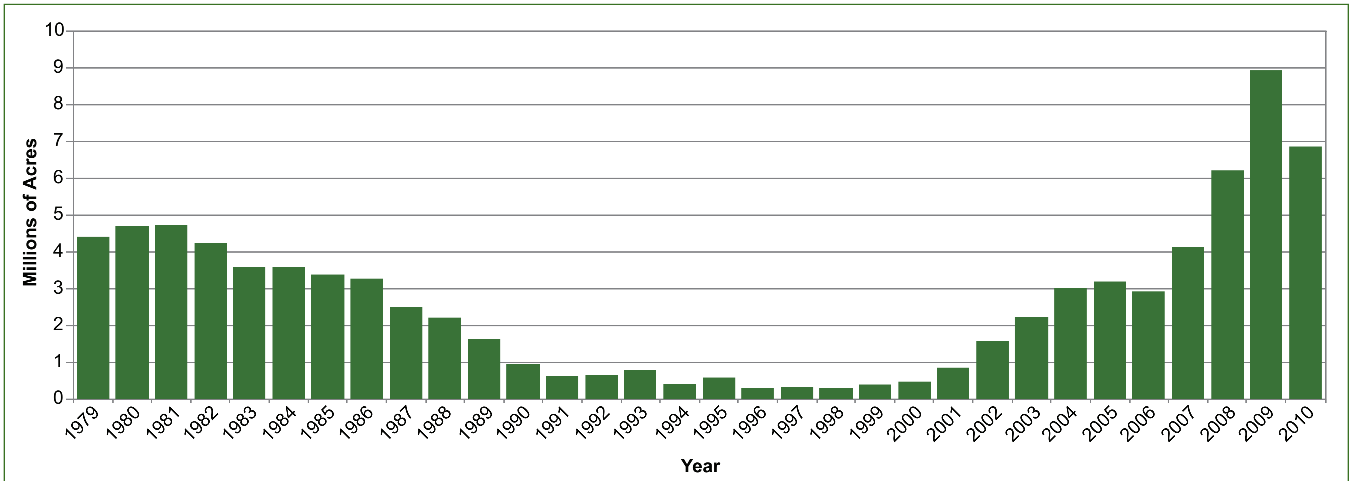


Figure 2.—*Mountain pine beetle mortality in 2010 by State.*

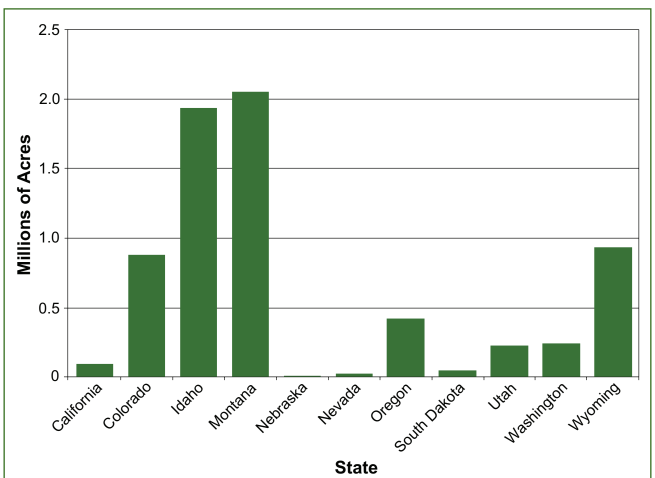
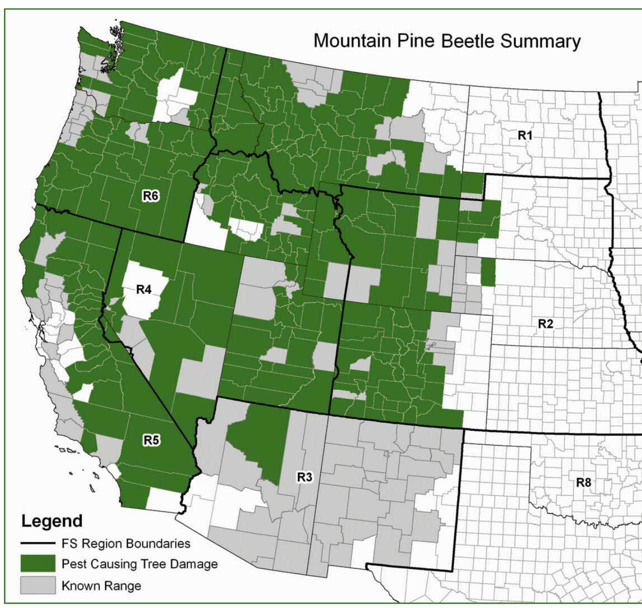


Figure 3.—*Counties where mountain pine beetle was reported in 2010.*



lodgepole pine in many areas. Along the Colorado Front Range, MPB activity continues in high-elevation lodgepole pine, and beetles moved into lower elevation ponderosa pine stands in Colorado and southern Wyoming.

In western Nebraska, MPB caused scattered mortality in ponderosa pine in the Pine Ridge area (fig. 4). The beetle also killed Scotch pines in communities and windbreaks of the Wildcat Hills. Pine mortality caused by MPB was reported in western Nebraska in Banner, Cheyenne, Kimball, Scott's Bluff, and Sioux Counties.

Mountain pine beetle activity continues at epidemic levels on all ownerships in the Black Hills in South Dakota and in northeast Wyoming (fig. 5). The MPB epidemic also continues in northwest Wyoming on the Shoshone National Forest just east of Yellowstone National Park. MPB is particularly active in the Wind River Range of the Shoshone National Forest, often affecting five-needle pines.

MPB-caused tree mortality remained extremely high across the intermountain region, increasing slightly in 2010. Most of the mortality in the intermountain region continues to occur in three areas: central Idaho, northern Utah, and western Wyoming.

In California, MPB caused higher pine mortality during 2010 than any other tree-killing agent. The continued activity of MPB over multiple years, particularly in whitebark pine—which have fairly limited distribution in California—has increased the level of concern for this species.

Figure 4.—*Mountain pine beetle mortality. USDA Forest Service photo.*

In the Pacific Northwest, MPB activity was locally very intense in areas such as the Warner Mountains, southern Cascades, and the eastern Sierra Range. A significant outbreak in Washington State is occurring in Chelan County in the Shady Pass area just south of Lake Chelan. Kittitas, Chelan, and Okanogan Counties continue to have active MPB populations. In the western part of Yakima County, near Mount Adams, populations appear to be increasing, with significant mortality in lodgepole pine on the north slopes of the mountain.

In the northern Rockies, acres infested and trees killed by MPB in the northern Rockies dropped to between two-thirds and one-half of 2009 levels. The regionwide drop in activity may be in part because of the lack of remaining good-quality hosts in many previously active areas. Other possible factors include the surveying of around 10 percent fewer acres and delayed tree fading in some areas, making the red-crown signature less apparent from the air. While northern Idaho exhibited increased infested areas in 2010, western Montana recorded fewer infested acres, but still the highest of all States surveyed.

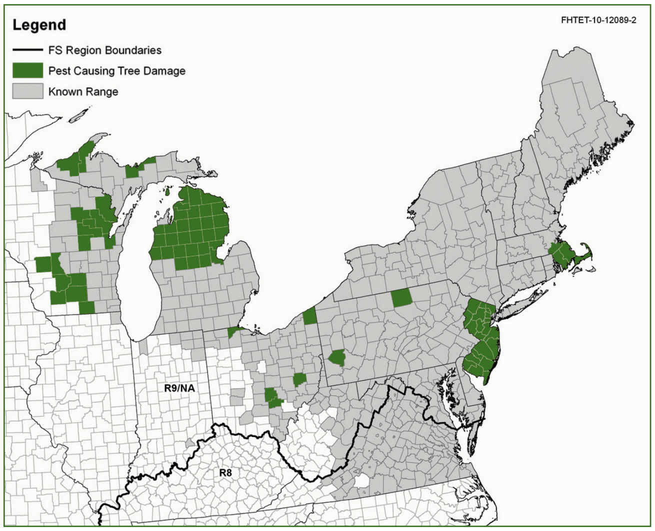
Figure 5.—*Pitch tubes on lodgepole pine, Medicine Bow Mountains in southeast Wyoming. Photo by Steven Katovich, USDA Forest Service.*

Gypsy Moth

Lymantria dispar Linnaeus

Across most of the generally infested area, gypsy moth populations continue to remain at low levels. Although defoliation increased nationally from more than 450,000 acres in 2009 to 1.2 million acres in 2010, more than 940,000 acres of the total were reported from Michigan (fig. 1, fig. 2, and table 1).

Figure 1.—*Counties where gypsy moth damage was reported in 2010.*



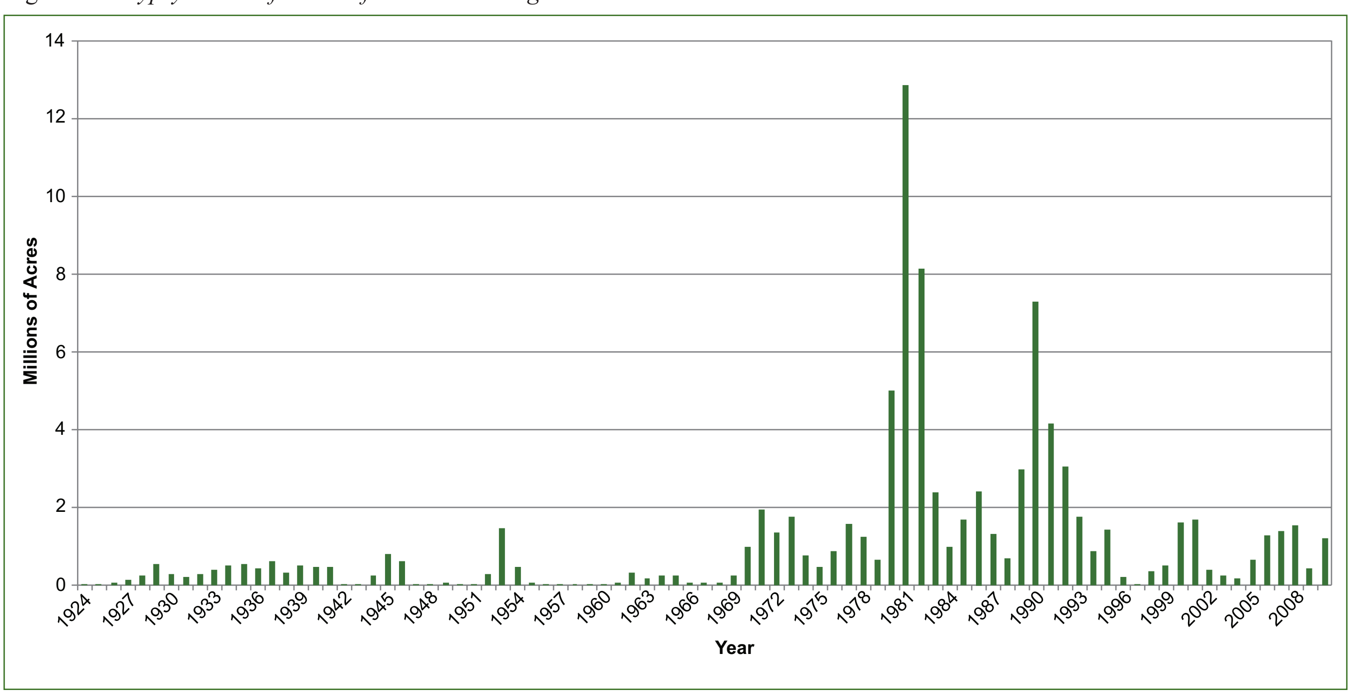
Gypsy moth populations in Michigan increased dramatically from 2009 levels across the northern Lower Peninsula and across scattered areas of the western Upper Peninsula. Oak and aspen were the primary hosts. Mortality of poor-quality oak was occurring in the north-central part of the Lower Peninsula in combination with nutrient-poor glacial outwash soils and the past 2 to 3 years of droughty conditions.

Gypsy moth activity decreased substantially in 2009 and 2010 in New Jersey. All counties, except for Hudson County, were observed to have less than 1 percent associated defoliation damage (fig. 3).

Table 1.—*Gypsy moth defoliation by State in 2010.*

Massachusetts	5,295
Michigan	941,981
New Jersey	3,809
Ohio	330
Wisconsin	255,890
Total	1,207,305

Figure 2.—*Gypsy moth defoliation from 1924 through 2010.*



Ground surveys for gypsy moth in Ohio determined low levels of infestation. Damage in Ashtabula and Lucas Counties currently accounts for most of the acres recorded as damaged in the State. Guernsey and Hocking Counties reported isolated areas where gypsy moths caused defoliation this year, after reporting no damage in 2009.

Gypsy moth populations significantly decreased across Pennsylvania following 2010 epizootics of the fungal pathogen *Entomophaga maimaiga* and nuclear polyhedral virus. Only 429 acres of damage in the State were reported in 2010 compared with 246,010 acres of damage in 2009. Sizable populations were observed only in Allegheny and Tioga Counties.

Virginia did not detect any defoliation from gypsy moth infestations; the last time that happened was 6 years ago. The wet spring of 2009 and the resultant impact of *E. maimaiga* decimated gypsy moth populations. Gypsy moths laid few egg masses in 2009, and emerging populations were undetectable in 2010.

No defoliation from gypsy moth was recorded in Connecticut, although the insect was present in all counties in the State. No defoliation of hardwoods resulting from gypsy moth larval feeding was recorded in Maine. Massachusetts reported about 4,700 acres of defoliation in the southeastern part of the State (fig. 4). In addition, about 236 acres of mortality were associated with previous infestations of gypsy moth, forest tent caterpillar, and winter moth in Bristol, Barnstable, and Norfolk Counties. In New Hampshire, gypsy moth populations were stable with very low levels statewide. Gypsy moth activity was not reported in New York, and no damage was observed by aerial survey. No defoliation was reported in Rhode Island, although mortality continued to occur in areas of previous defoliation by a complex of gypsy moth, forest tent caterpillar, and orange-striped oakworm. Vermont reported little damage in the northwestern part of the State, with no defoliation mapped.

Figure 3.—*Heavy defoliation by larvae. Photo by Tim Tigner, Virginia Department of Forestry.*

Figure 4.—*Gypsy moth on oak. Photo by USDA Animal and Plant Health Inspection Service.*

Southern Pine Beetle

Dendroctonus frontalis Zimmermann

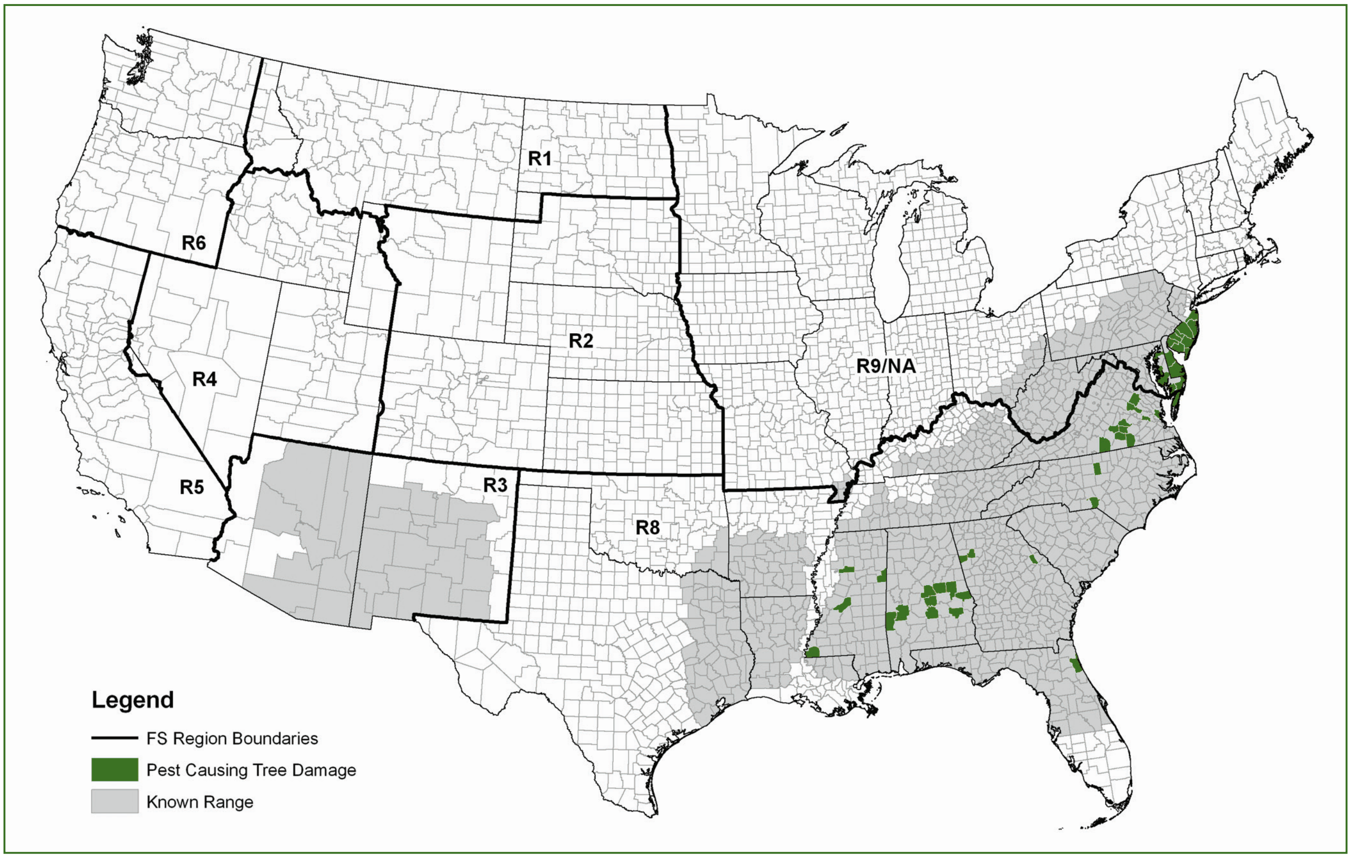
Southern pine beetle (SPB) populations remained at historically low levels across the South in 2010, but populations in New Jersey continued to build (fig. 1, fig. 2, and table 1).

Southern pine beetle populations and damage have been very low across much of the South for years, especially in the western Gulf of Mexico where SPB has been virtually absent for 12 or more years. A total of 67 SPB spots were detected and mapped during 2010 in 6 Southern States and 29 counties.

Southern pine beetle has affected 3 percent (more than 14,100 acres) of the pine component in southern sections of New Jersey. Ground surveys verified the presence of SPB for the first time in Monmouth County. Nine counties in New Jersey are now established as having SPB (figs. 3 and 4).

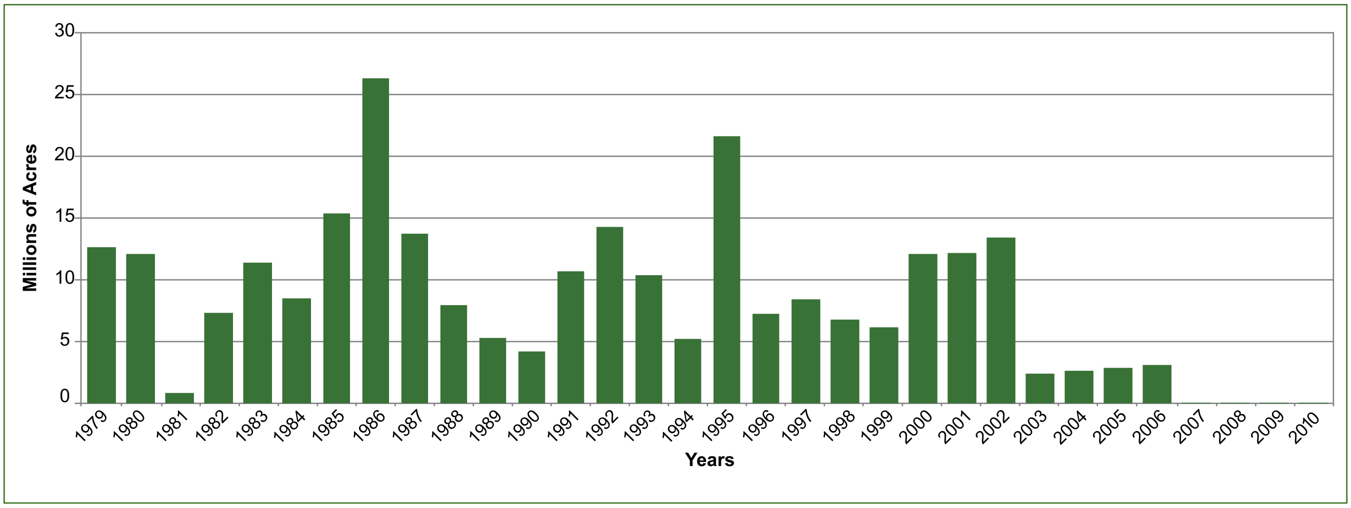
Ground surveys and trapping indicate SPB populations in Delaware and Maryland are currently static and low, with only 34 acres reported in Maryland. Observers found damage for the first time at two sites in Kent County in northeastern Maryland.

Figure 1.—*Counties with southern pine beetle infestations reported in 2010.*



NA = Northeastern Area.

Figure 2.—*Southern pine beetle outbreaks, 1979 to 2010.*



Note: The surveys after 2007 counted outbreak acres differently than in earlier years. Previously, all acres in the county were counted if a single spot was positive for southern pine beetles. The surveys after 2007 reflect only the estimated actual areas affected by southern pine beetles.

Table 1.—*Southern pine beetle activity by State in 2010.*

State	Acres Infested	Number of Spots[1]
Alabama	14.5	160
Florida	4	1
Georgia	3	4
Maryland[2]	34	—
Mississippi	4	10
New Jersey[3]	14,154	—
North Carolina	0.3	5
Virginia	79	25

[1] Spot size and density vary, so the number of spots does not directly correlate to the number of acres infested.

[2] No spot information is available for Maryland.

[3] Acres infested include mostly lightly scattered mortality. No spot information is available for New Jersey.

Figure 3.—*Southern pine beetle mortality at Clark's Landing, NJ. Photo by Ronald E. Billings, Texas Forest Service.*

Figure 4.—*Southern pine beetle mortality. Photo by William A. Carothers, USDA Forest Service.*

Emerald Ash Borer

Agrilus planipennis Fairmaire

As of 2010, emerald ash borer (EAB) is known to occur in 15 States. The USDA Animal and Plant Health Inspection Service coordinated surveys in 2010 that found EAB in Iowa and Tennessee for the first time (fig. 1).

In Iowa, surveyors detected EAB larvae in an ash tree growing on an island in the Mississippi River in Allamakee County, close to the EAB sites in Victory, WI, and Houston County, MN.

Surveys discovered emerald ash borer infesting declining and dying ornamental ash trees at a truck stop along Interstate 40 outside Knoxville, TN. EAB are also infesting trees in Loudoun County, VA.

Based on trap survey data, EAB currently infests six counties in West Virginia, each of which shows increasing damage and mortality of ash species. Fayette, Morgan, and Roane Counties have new developing infestations.

Increasing levels of damage by EAB occurred in Prince George's and Charles Counties, MD, in 2010.

Trap surveys indicate that EAB has increased in most Ohio counties in 2010. Surveyors have now found EAB in 53 out of 88 Ohio counties, and, in 2010, the Ohio Department of Agriculture quarantined the entire State.

In Pennsylvania, Bedford County reported sizeable infestations, but other counties showed only spot infestations. Bedford, Centre, Clarion, Cumberland, Fulton, Somerset, and Union Counties observed new infestations. Ground surveys found a total of 30 acres of EAB damage in the State in 2010.

Damage varies in the 14 Kentucky counties where the beetle has been confirmed, including three new counties in 2010: Boone, Boyd, and Woodford. A quarantine of 20 counties is in place.

In Virginia, trap catches detected EAB in two new counties in 2010: Frederick and Prince William. This new information brings the number of infested counties to four. Seven Virginia counties are under Federal quarantine, which includes three adjacent counties where EAB has not been found yet.

Six new counties (Genesee, Greene, Livingston, Monroe, Steuben, and Ulster) in New York had confirmed EAB infestations in 2010. Champaign, Kendall, and Vermilion Counties in Illinois and Carroll, Cass, Hendricks, LaPorte, Madison, Marshall, Tippecanoe, and Washington Counties in Indiana also confirmed new infestations (fig. 2).

Figure 1.—*Counties quarantined as a result of the emerald ash borer infestation as of 2010.*

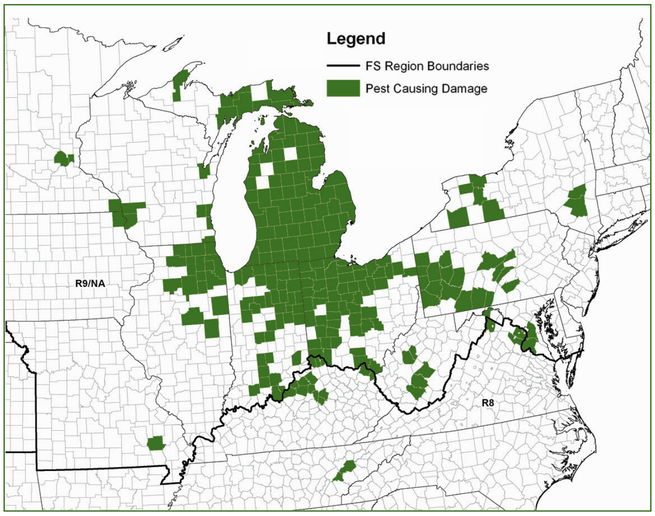


Figure 2.—*Crown symptoms in ash following emerald ash borer attack. Photo by Joseph O'Brien, USDA Forest Service.*

Sudden Oak Death

Phytophthora ramorum Werres et al.

Phytophthora ramorum, commonly known as Sudden Oak Death (SOD), is a quarantine pathogen of unknown origin, alien to its known endemic range in forest landscapes of central coastal California and southwestern Oregon. Since SOD was first reported in 1995 along the central coast of California, this disease has killed millions of tanoaks, coast live oaks, and California black oaks (fig. 1). The pathogen has spread to 14 coastal counties in California and to Curry County in southwestern Oregon (fig. 2).

Figure 1.—*Coast live oak mortality at China Camp State Park in California. Photo by Joseph O'Brien, USDA Forest Service.*

SOD mortality in tanoak and coast live oak on the northern coast of California decreased from last year, both in terms of intensity and extent, to about 2,700 trees over approximately 1,500 acres. This figure is the lowest amount of mortality attributed to SOD since aerial surveys began in 2001. Despite the decline in acreage, aerial surveys verified mortality in oaks in two new locations in Humboldt County in 2010 (fig. 3). One new location is in the Mattole River watershed, extending the distribution farther north and the second in the Redwood Creek watershed that runs through Redwood National Park, draining into the Pacific Ocean near Orick, CA, to the north.

Figure 2.—*Counties where Sudden Oak Death was reported in 2010.*

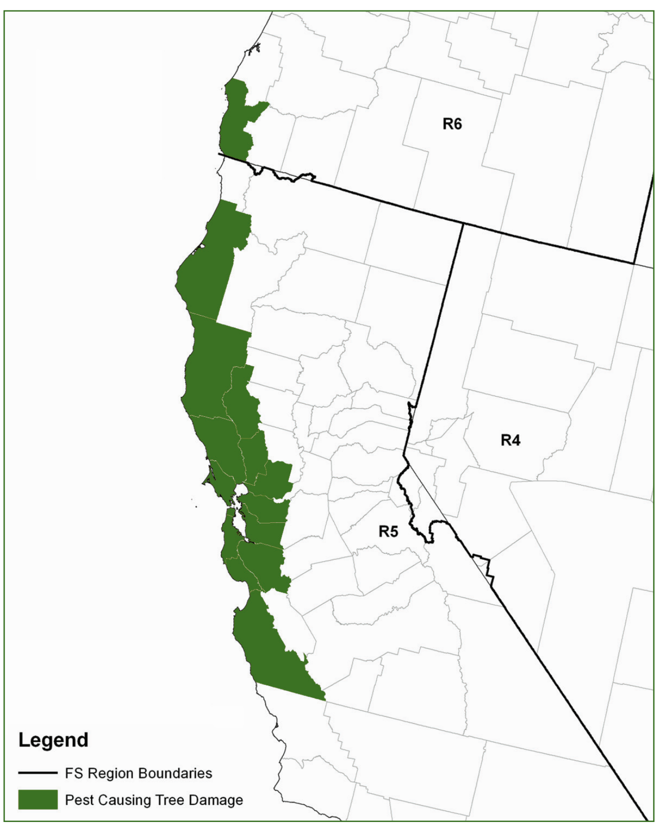


Figure 3.—*Symptoms of* Phytophthora ramorum *on main bole of California live oak in California. Photo by Bruce Moltzan, USDA Forest Service.*

Spruce Beetle

Dendroctonus rufipennis Kirby

During the past 14 years, a number of significant wind events have resulted in thousands of acres of fallen trees in Colorado and Wyoming. This has led to an increase in spruce beetle activity in this area. In 2010, aerial detection surveys recorded more than 409,000 acres of spruce beetle mortality (fig. 1).

In 2010, aerial surveys detected approximately 208,000 acres of spruce beetle-caused mortality in Colorado and 79,000 acres in Wyoming (Shoshone, Big Horn, and Medicine Bow National Forests). This total is an increase of 150,000 acres from 2009. These numbers are probably low, because the signature of active spruce beetle infestation is often difficult to detect during aerial surveys.

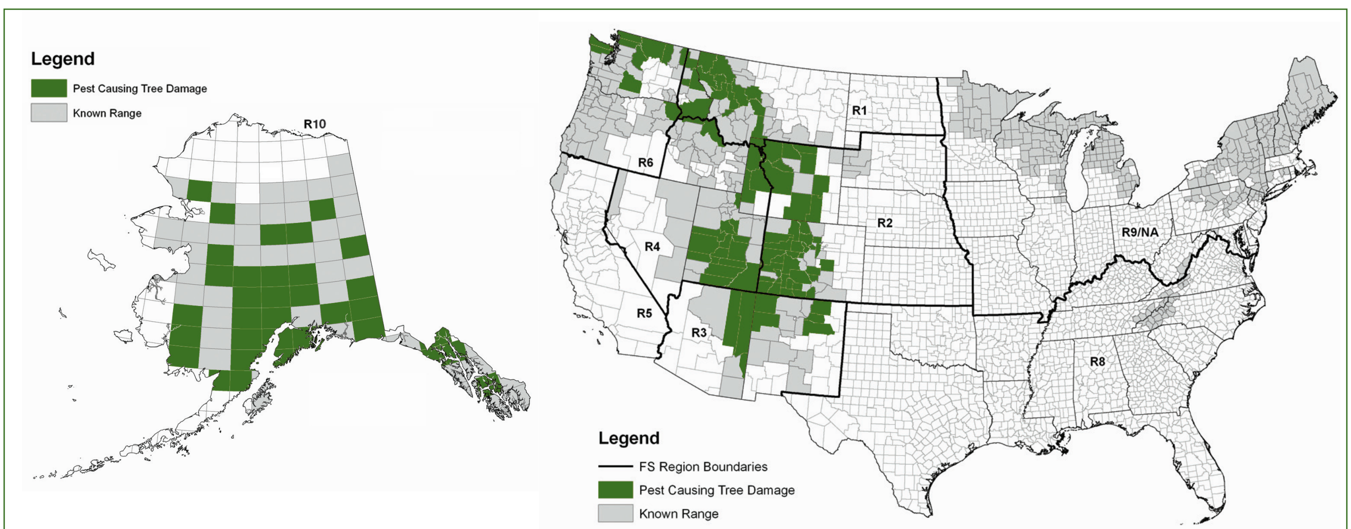
The most active spruce beetle epidemics are occurring in southern Colorado. The largest outbreak is spreading from the Weminuche Wilderness on both the San Juan and Rio Grande National Forests and on adjacent lands (fig. 2). Some spruce beetle activity is occurring at 12,000 feet in elevation at timberline. In 2010, surveys detected new mortality on 135,000 acres, up from 94,000 acres in 2009. Notable infestations are also growing on the Grand Mesa, Uncompahgre, and Gunnison National Forests (39,000 acres), the White River National Forest (18,000 acres), the Arapaho and Roosevelt National Forests (21,000 acres), the Medicine Bow–Routt National Forests (21,000 acres), and the Shoshone National Forest (53,000 acres). Spruce beetle infestations were also spreading in Rocky Mountain National Park.

In the Intermountain Region, spruce beetle-caused mortality affecting primarily Engelmann spruce and, to a much lesser extent, blue spruce decreased slightly to approximately 23,100 acres in 2010 compared with 25,000 acres in 2009. Most spruce mortality was in Utah, where it was detected at some level on all national forests. Surveyors also mapped spruce mortality on the Bridger-Teton National Forest in western Wyoming and scattered and isolated spruce mortality in Nevada.

In Washington, spruce beetle damage occurred primarily near the Cascade Crest in Okanogan County. In 2010, the number of acres with spruce beetle damage dropped by three-fourths from the 2009 total. Most of the infected areas are in, or adjacent to, recently burned areas.

Area estimates for spruce beetle-caused mortality in the northern Rockies increased from 60 to 5,845 acres between 2009 and 2010. Beetle populations remained endemic throughout most of northern Idaho and Montana, except for two areas in south-central Montana. Spruce beetle outbreak populations in Montana occurred primarily on federally managed lands in the

Figure 1.—*Spruce beetle-caused tree mortality detected in 2010 by aerial detection surveys.*



Gravelly Mountains, on the Beaverhead-Deerlodge National Forest, and within the Rock Creek drainage on the Custer National Forest. Groups of beetle-caused mortality typically consisted of three to five trees in Montana (fig. 3).

Figure 2.—*Spruce beetle mortality on the Rio Grande National Forest in Colorado. Photo by Steve Munson, USDA Forest Service.*

Figure 3.—*Spruce beetle mortality. Photo by Steve Munson, USDA Forest Service.*

Western Bark Beetles

Numerous species

Over the past decade, western bark beetle outbreaks have spread throughout the Western United States, from the low-elevation pinyon woodlands to the high-elevation spruce-fir forests. Mountain pine beetle is the beetle in this complex causing the most mortality. In 2010, surveyors observed tree mortality caused by the mountain pine beetle on approximately 6.8 million acres of the total 8.6 million acres affected by all western bark beetle species combined (fig. 1). Other western bark beetles, however, continue to cause significant tree mortality (figs. 2 and 3).

The fir engraver showed increased activity in California, particularly in the Sierra Range, where mortality nearly doubled from 2009 to 2010. Western pine beetle mortality also nearly doubled in 2010, with the beetle causing 231,600 acres of mortality compared with 103,800 acres of mortality in 2009. Table 1 shows the 2010 status of selected western bark beetles that have caused significant tree mortality to their respective hosts in recent years.

Figure 1.—*Western bark beetle outbreaks from 1997 to 2010.*

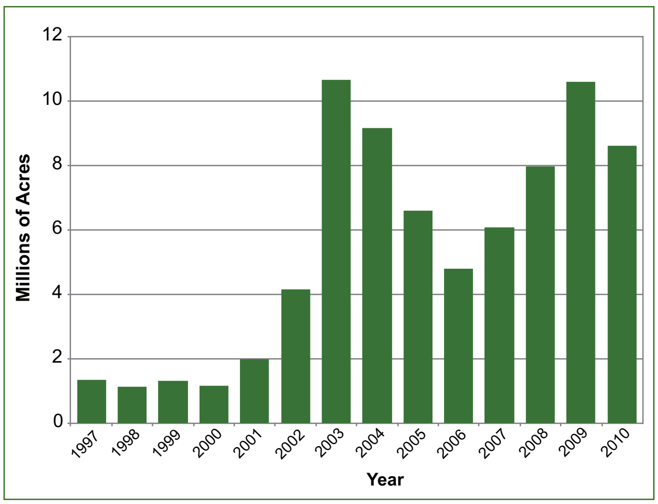


Figure 2.—*Douglas-fir beetle mortality in Indian Canyon, Manti-La Sal National Forest, UT. Photo by Steve Munson, USDA Forest Service.*

Figure 3.—*Small group of fir killed by beetle in Little Bald Mountain area, Walla Walla Ranger District, Umatilla National Forest, WA. Photo by Dave Powell, USDA Forest Service.*

Table 1.—*Trends for selected western bark beetles and infested acres detected in aerial surveys during 2010.*

Bark Beetle(s)	Host(s)	Acres Detected With Bark Beetle Activity in 2009*	Trend
Mountain pine beetle, *Dendroctonus ponderosae* Hopkins	Ponderosa pine (*Pinus ponderosa* C. Lawson), lodgepole pine (*P. contorta* Douglas ex Louden), white pines, and others (*Pinus spp.*)	6,743,437	Decreasing across much of the West. The cause for the decline is probably due to a combination of weather, lack of host material, and some areas not surveyed.
Spruce beetle, *Dendroctonus rufipennis* (Kirby)	Engelmann spruce (*Picea engelmannii* Parry ex Engelm.), white spruce (*P. glauca* [Moench] Voss), Sitka spruce (*P. sitchensis* [Bong.] Carr.)	409,229	Alaska and southern Colorado reported large active spruce beetle outbreaks. Spruce beetle activity in the Cascades of Washington declined by more than 70 percent.
Douglas-fir beetle, *Dendroctonus pseudotsugae* Hopkins	Douglas-fir (*Pseudotsuga menziesii*)	174,275	Overall, the trend is decreasing, especially in the Rockies. Some areas in Colorado, Idaho, Utah, and Wyoming are increasing.
Jeffrey pine beetle, *Dendroctonus jeffreyi* Hopkins	Jeffrey pine (*Pinus jeffreyi* Balf.)	14,830	Populations declining across the range with continued local areas increasing.
Western pine beetle, *Dendroctonus brevicomis* LeConte	Ponderosa pine, Coulter pine (*Pinus coulteri* D. Don)	231,630	Total acres of mortality increasing from 2009 and decreasing in some areas.
Western balsam bark beetle, *Dryocoetes confusus* Swaine	Subalpine fir (*Abies lasiocarpa* (Hook. Nutt.)	31,163	Significantly declining in most areas.
Fir engraver beetle, *Scolytus ventralis* LeConte	True firs (*Abies* spp.)	708,336	Significant increase in California, particularly in the Sierra Range mid-elevation forests. Most other areas show significant decline.
Pine engraver, *Ips pini* (Say), Arizona five spined ips, *Ips lecontei* Swaine	Ponderosa pine	8,231	With improved moisture, acres affected have declined dramatically since 2003 peak.
Pinyon ips, *Ips confusus* (LeConte)	Pinyon pine (*Pinus edulis* Engelm.), singleleaf pinyon (*P. monophylla* Torr. & Fen.)	10,056	With improved moisture, acres affected have declined dramatically since 2003 peak.

** The number of dead trees per acre varies.*

Western Spruce Budworm

Choristoneura occidentalis Freeman

Surveys recorded slightly more than 2.3 million acres of western spruce budworm defoliation in 2010, one-half of the defoliation recorded in 2009 (figs. 1 and 2). Idaho, Montana, New Mexico, and Washington continued to report relatively large areas of western spruce budworm defoliation, although all States reported significantly less defoliation than in 2009 (table 1).

Defoliation by western spruce budworm continues to be widespread throughout northern New Mexico. The number of acres with defoliation mapped dropped considerably from 2009 but, overall, remains elevated. In addition, the outbreak in the Sacramento Mountains in southern New Mexico continued in 2010, affecting a substantial portion of the mixed conifer type on the Sacramento Ranger District and the Mescalero Apache Indian Reservation (fig. 3).

Figure 1.—*Acres of western spruce budworm defoliation in 2010.*

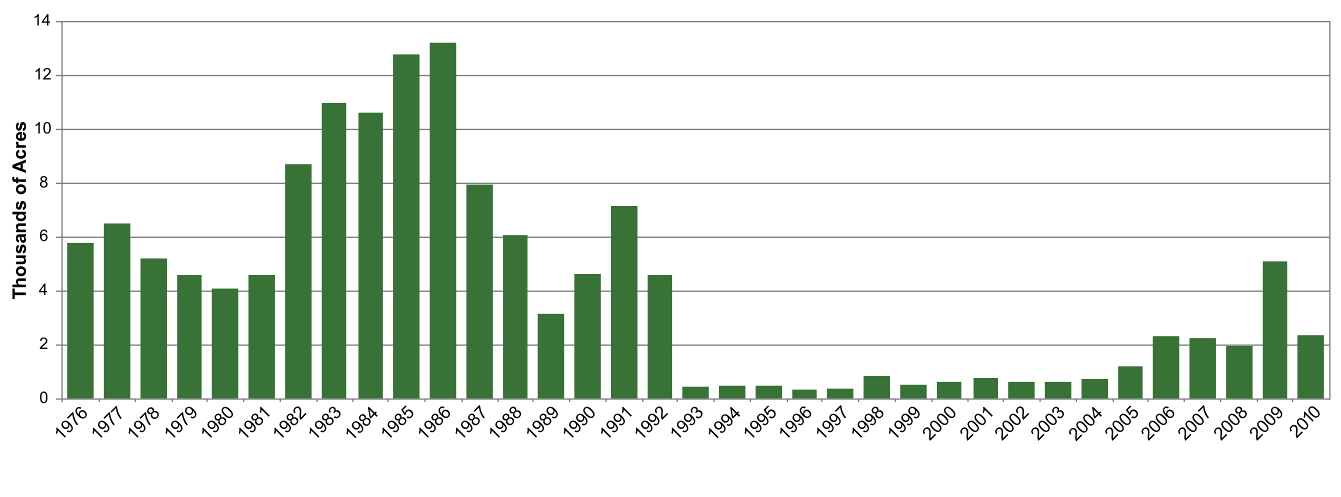
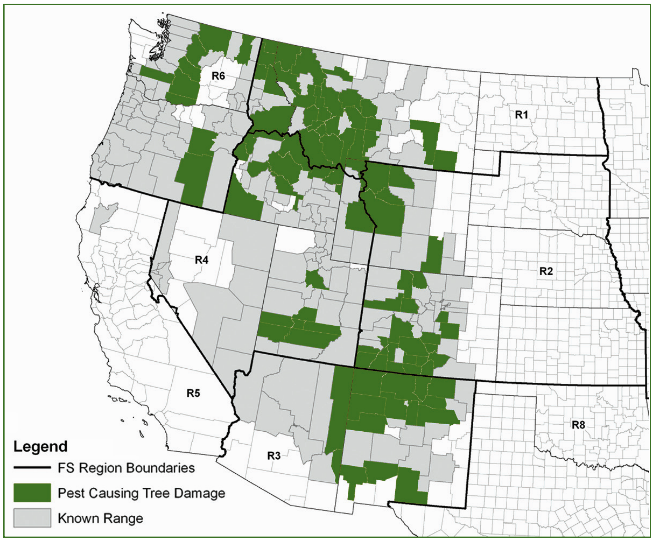


Figure 2.—*Counties where western spruce budworm was reported in 2010.*



In 2010, Colorado and Wyoming exhibited slight decreases in forest acres affected by western spruce budworm. In southern Colorado, western spruce budworm continued to defoliate Douglas-fir, white fir, subalpine fir, and Engelmann spruce forests. Also in Colorado, western spruce budworm affected portions of the Culebra, Flat Top, and Rampart mountain ranges and the San Juan and Sangre de Cristo Mountains. The year 2010 is the first since this outbreak began in 1998 that an infestation was detected in the Wet Mountains. Most of these outbreaks started from blow-down events.

In south-central Idaho, surveyors reported defoliation across most land ownerships, with the highest amount occurring on the Boise National Forest (182,500 acres), the Salmon-Challis National Forest (116,200 acres), the Caribou-Targhee National Forest (78,300 acres, up from 15,600 acres in 2009), and the

Table 1.—*Acres (in thousands) with western spruce budworm defoliation by State, 2002 to 2010.*

State	2002	2003	2004	2005	2006	2007	2008	2009	2010
Arizona	11.30	24.00	10.70	11.20	2.50	4.80	1.70	1.27	393.00
California	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Colorado	131.10	20.00	20.00	71.40	93.70	390.20	153.40	382.37	212,834.00
Idaho	22.60	204.10	64.10	75.30	254.30	360.50	366.20	1,030.56	865,991.00
Montana	52.40	66.00	177.30	453.70	1,142.20	497.20	577.80	2,576.15	326,340.00
Nevada	0.00	0.00	0.00	0.00	0.00	0.70	0.00	0.00	0.00
New Mexico	198.80	143.20	238.20	183.80	142.50	452.20	360.40	559.29	317,424.00
Oregon	1.90	5.50	6.60	0.30	38.00	98.10	10.00	40.80	108,135.00
Utah	7.00	14.70	20.00	40.50	88.60	51.40	7.70	69.71	142,044.00
Washington	57.50	139.90	193.20	363.10	555.70	355.80	455.10	414.50	373,081.00
Wyoming	134.60	13.30	4.50	6.40	4.40	29.00	34.90	30.32	20,851.00
Total	**617.20**	**630.70**	**734.60**	**1,205.70**	**2,321.90**	**2,239.90**	**1,967.20**	**5,104.97**	**2,367,093.00**

Sawtooth National Forest (52,400 acres, up from 27,200 acres in 2009). In Utah, large areas of heavy defoliation occurred on the Dixie (98,800 acres, up from 47,500 acres in 2009) and Fishlake (38,500 acres, up from 19,700 acres in 2009) National Forests. Nevada reported no western spruce budworm activity, and Wyoming reported minimal acres of defoliation in 2010.

Aerial surveys reported that the Kootenai National Forest was the most heavily impacted area in Montana, with 73,347 acres affected compared with 267,770 acres in 2009. Significant defoliation from budworm is historically rare on the Kootenai. The Helena (57,640 acres) and Gallatin (49,364 acres) National Forests in Montana and the Coeur d'Alene (216,894 acres) National Forest in Idaho also exhibited significant budworm defoliation. These figures include national forests and surrounding lands of other ownerships.

The Pacific Northwest saw a decline of almost 10 percent in acres mapped with western spruce budworm damage from 2009 to 2010 (fig. 4). The eastern slope of the Cascade Mountains continues to experience large areas of budworm damage, and surveyors have found significant areas of damage east of Okanogan, WA, in the Mt. Bonaparte area of the Okanogan National Forest and the Confederated Tribes of the Colville Reservation.

Figure 3.—*Western spruce budworm, late instar larva. USDA Forest Service photo.*

Figure 4.—*Western spruce budworm mortality in the Starr Ridge area, Bear Valley Ranger District, Malheur National Forest, OR. Photo by Dave Powell, USDA Forest Service.*

Hemlock Woolly Adelgid

Adelges tsugae Annand

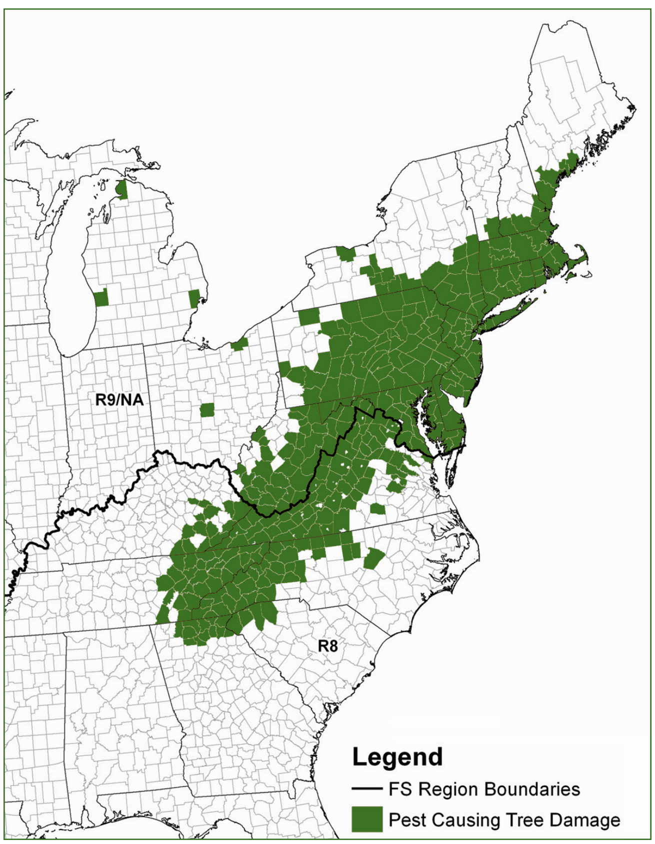
The range of hemlock wooly adelgid (HWA) continues to infest 17 States from southern Maine to northeastern Georgia and west to eastern Kentucky and Tennessee (fig. 1).

In West Virginia, HWA is found in 37 counties and damage is generally increasing throughout the State. In some areas, especially those with previously high HWA infestation levels, however, damage appears to be decreasing. Lewis, Taylor, and Wirt Counties reported damage for the first time in 2010.

HWA now affects all Maryland counties. Infestation incidence increased substantially in 2010 in Garrett County.

HWA affects nearly all areas with hemlock in New Jersey, with ground surveys reporting 25,000 acres of associated damage. Trees older than 80 years seem to be the most affected with discernible crown dieback and increased transparency. Observers found adelgid populations to be decreasing in numerous areas in New Jersey in 2010 and 2009, possibly because of severe winter conditions.

Figure 1.—*Counties where hemlock wooly adelgid damage was reported in 2010.*



In 2010, surveys found two new infestations on single landscape trees in Cuyahoga and Franklin Counties, OH. One eastern hemlock in Cuyahoga County is being treated, and the tree in Franklin County was removed. Future surveys are planned by the State to determine any spread of the adelgid in Ohio.

In Pennsylvania, HWA started to recover after the 2009 winter population decrease. Surveys found significant increase of this pest in Bedford, Franklin, and Fulton Counties, with more than 6,000 acres of damage in each county. Blair, Carbon, and Lycoming Counties also showed noticeable increases in HWA population. Ground surveys reported a total of 21,171 acres of damage in 41 counties throughout the State.

Decline and mortality of eastern and Carolina hemlock continue in infested areas of northeastern Georgia, now on both sides of the Appalachian Mountains. HWA infested two new counties, Murray and Pickens, in 2010, bringing the total number of infested counties in Georgia to 12.

Four new counties in Kentucky reported infestation in 2010: Breathitt, Floyd, Owsley, and Wolfe, bringing the total number of infested counties in Kentucky to 14. The find in Floyd County represents an urban environment. A newly discovered infestation at the Big South Fork National River and Recreation Area in McCreary County now represents the westernmost site in Kentucky.

Surveyors determined two new counties in North Carolina, Iredell and Wake, to be infested. Those counties bring the total number of infested counties to 34. Infestations continue to intensify and spread in affected counties. Most of the native range of hemlock in North Carolina is now infested. Decline and mortality are common in infested areas (fig. 2).

Almost the entire range of hemlock in Virginia is now generally infested. The mortality level for southwestern Virginia counties is an estimated 16 percent.

Figure 2.—*Ovisacs on underside of hemlock branch. Photo by Michael Montgomery, USDA Forest Service.*

Hemlock woolly adelgid continues to cause damage to hemlocks in the mountainous eastern counties of Tennessee. Surveys determined Cumberland and McMinn Counties to be infested in 2010, bringing the total number of infested counties in Tennessee to 29.

Present in Connecticut for many years, HWA continued to cause patchy damage and decline in the remaining populations of hemlocks. The insect was detected in York County, ME, in 2003 but was not found outside that county in Maine until 2010. In May 2010, surveys reported and confirmed the insect in Cumberland, Lincoln, and Sagadahoc Counties. Infestations occurred in two new communities in Massachusetts but in no new counties. New Hampshire reported populations increasing and detected infestations in five new towns in Cheshire County for the first time. The infestation remained present in all five counties in Rhode Island. In Vermont, one new town was infested, but no new counties were infested. No tree mortality was observed.

Hemlock woolly adelgid continued to cause damage and mortality to native forest and ornamental eastern hemlock trees in New York. Some new towns were found infested in the Finger Lakes region and Broome, Chemung, and Tioga Counties reported infestations for the first time. Damage was most severe in the Catskill region and southern part of the State, areas that have had the infestation for several years.

HWA has been detected in three counties in Michigan: Macomb, Ottawa, and Emmet. In 2010, Michigan Department of Natural Resources staff surveyed 39 high-risk forested and recreation sites within a 50-mile radius of the newly discovered HWA-positive landscape trees in Emmet County (Walloon Lake area), and all surveys were negative for HWA.

Laurel Wilt Disease/Redbay Ambrosia Beetle

Raffaelea lauricola T.C. Harr., Fraedrich and Aghayeva • *Xyleborus glabratus* Eichhoff

Surveys documented infestations by laurel wilt disease and the redbay ambrosia beetle in 68 counties as of 2010, an increase of 9 counties from 2009 (fig. 1). Georgia reported 4 new counties affected by the insect/disease complex in 2010: Bacon, Davis, Lanier, and Lowndes, bringing the number of infested counties in the State to 29 (fig. 2). The disease is now 95 miles inland from the Atlantic coast and continues to kill redbay and sassafras trees.

Laurel wilt in Mississippi is still confined to Jackson County. Trapping for the redbay ambrosia beetle continues, with followup ground survey and sampling of dying or dead redbay trees and other hosts. The beetle has also been trapped in neighboring Harrison County, MS, and Mobile County, AL, but, to date, neither county has detected the laurel wilt fungus.

Five new counties were confirmed to harbor laurel wilt in Florida in 2010—Bay, Levy, Orange, Polk, and Seminole—bringing the total affected county count to 27 within 5 years. The detection in Bay County (Panama City) is more than 150 miles west of the nearest known infested area.

Figure 1.—*Counties where laurel wilt disease has been detected, as of 2009.*

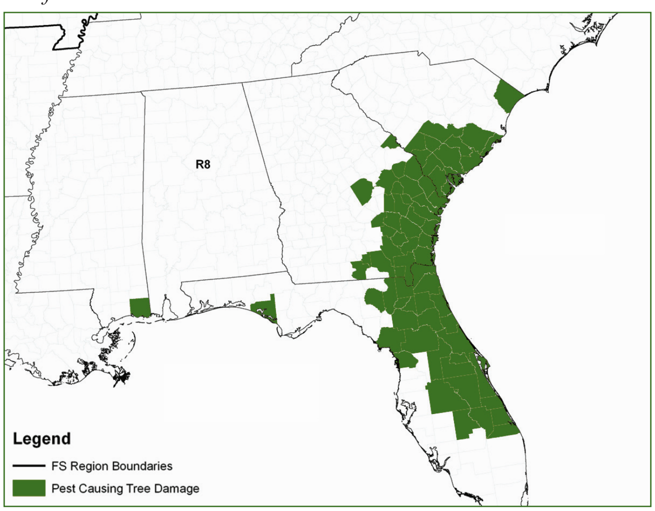


Figure 2.—*Widespread mortality of red bay in Liberty County, GA. Photo by James Johnson, Georgia Forestry Commission.*

Spruce Budworm

Choristoneura fumiferana Clemens

In 2010, eastern spruce budworm populations remained low in Maine, which reported no defoliation.

Michigan reported more than 178,000 acres of spruce budworm damage mapped by aerial survey. The number of acres of defoliation of white spruce and balsam fir greatly increased in the Upper Peninsula in 2010.

Minnesota reported more than 121,000 acres of budworm defoliation in 2010, which was double the number of acres reported in 2009. The defoliation extended from the western edge of Lake Vermilion in St. Louis County east to the city of Ely and into Lake County in the northeastern part of the State (figs. 1, 2, and 3).

Aerial survey mapped almost 5,000 acres of spruce budworm damage in Wisconsin.

Figure 2.—*Counties where spruce budworm was reported in 2010.*

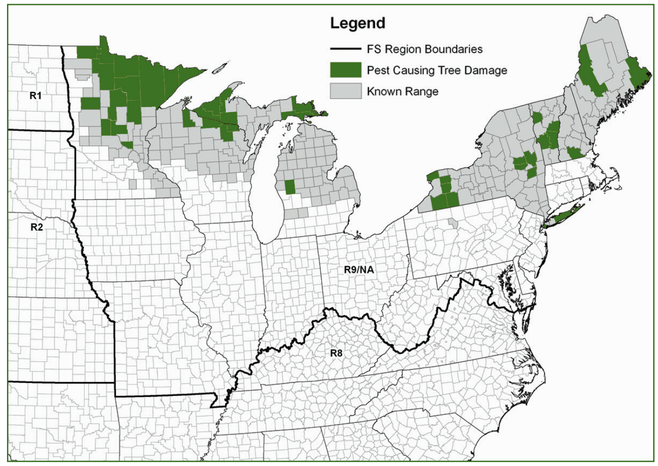


Figure 1.—*Spruce budworm defoliation. Photo by Joseph O'Brien, USDA Forest Service.*

Figure 3.—*Closeup view of spruce budworm defoliation. Photo by Joseph O'Brien, USDA Forest Service.*

Sirex Woodwasp

Sirex noctilio Fabricius

The sirex woodwasp is known to occur in Michigan, New York, Ohio, Pennsylvania, and Vermont, and now has been detected in Connecticut (fig. 1). The first find of sirex in Connecticut occurred in Fairfield County.

In Michigan, sirex woodwasp populations are spreading along the shoreline of Lake Huron, where Saginaw County reported the wasp for the first time. In Pennsylvania, sirex woodwasp was found for the first time in Forest County.

Figure 1.—*Sirex woodwasp in New York. Photo by Dave Lance, USDA Animal and Plant Health Inspection Service.*

Dwarf Mistletoes

Arceuthobium spp.

Although dwarf mistletoes continue to cause tree growth loss and some mortality, no comprehensive dwarf mistletoe surveys have been conducted for more than 25 years, in part because of the slow spread of this pest (figs. 1 and 2).

Figure 1.—*Witches brooms often indicate dwarf mistletoe infection, which tends to be most severe in the lower portions of the crowns. Photo by Jane Taylor, USDA Forest Service.*

Figure 2.—*Dwarf mistletoe infections cause spindle-shaped swellings on branches and small stems. USDA Forest Service photo.*

Asian Longhorned Beetle

Anoplophora glabripennis Motschulsky

The Asian longhorned beetle was first detected in Massachusetts in 2008 in Worcester County, where, in 2010, the quarantine area increased to 94 acres (figs. 1 and 2). In July 2010, surveys discovered an infestation in Suffolk County, a suburb of Boston. Infested trees were removed and a 10-mile quarantine area was established in Norfolk and Suffolk Counties (fig. 3).

In New York, cooperative efforts are ongoing to eradicate the beetle from the quarantined areas of New York City and Long Island. No new infestations were found in 2010.

Figure 1.—*Counties where Asian longhorned beetle was reported in 2010.*

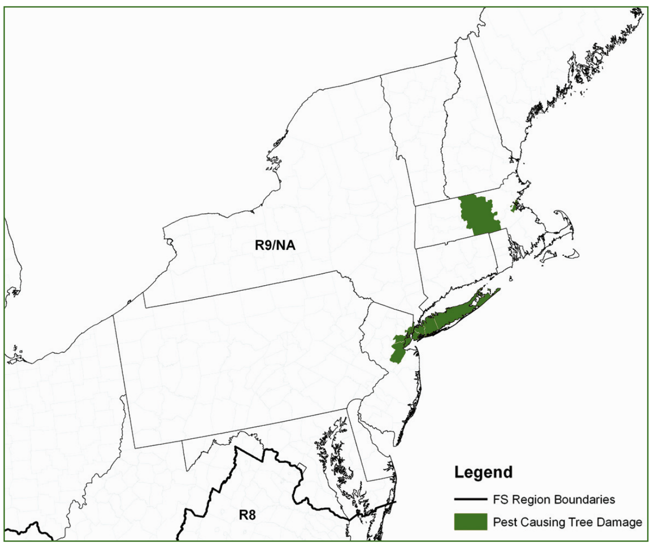


Figure 2.—*Infested tree with exit holes in Worcester, MA. Photo by Mike Bohne, USDA Forest Service.*

Figure 3.—*Infested trees beginning to die. Photo by Mike Bohne, USDA Forest Service.*

White Pine Blister Rust

Cronartium ribicola J.C. Fisch. ex Rabenh

White pine blister rust infests five-needle pines in 39 States. This slowly spreading disease is causing significant damage and mortality on eight of the nine native five-needle pine species in the United States. In general, the disease has remained static, but locally significant cankering and mortality are occurring. Ecologically, concern exists for the vulnerable high-elevation five-needle pines, which are susceptible to this disease and mountain pine beetle (fig. 1).

Figure 1.—*Basal canker caused by white pine blister rust on five-needle pines. Photo by Susan K. Hagle, USDA Forest Service.*

In the Northeastern Area, white pine blister rust continued to cause concern in Maine, and active control of the species of the *Ribes* genus, the alternate host of the disease, took place. Dieback and mortality from white pine blister rust decreased statewide in New Hampshire and Vermont.

In the Northern Region, white pine blister rust has spread throughout the range of western white pine in the inland northwest. More than 5 million acres that were once considered western white pine forest types are affected. Although western white pine can still be found at low densities on much of its original range, western white pine still dominate only about 10 percent of acreage in that range, a dramatic decrease.

White pine blister rust has also spread throughout the range of whitebark and limber pine in the Northern and Rocky Mountain Regions, including approximately 500,000 acres above 5,000 feet on mountaintops in Idaho and Montana, from the Canadian border south to Glacier and Yellowstone National Parks. A recent study in northern Idaho found that whitebark pine is the dominant species on only 2 percent of its original potential habitat. White pine blister rust and mountain pine beetle have combined to kill most limber pine across the entire expanse of the Rattlesnake Hills, Crooks Mountain, Green Mountain, and Ferris Mountains in central Wyoming. Whitebark pines on the Shoshone National Forest weakened by this rust disease are succumbing to mountain pine beetle attacks.

In the Intermountain Region, white pine blister rust has spread throughout the range of many western five-needle pines. White pine blister rust is most frequently found on whitebark and limber pines. To date, surveys have not detected white pine blister rust on Great Basin bristlecone pine despite high susceptibility in greenhouse tests. Observers have established plots to survey and monitor white pine blister rust spread and intensification on limber, whitebark, Great Basin bristlecone, and western white pines. Increased survey efforts continue to find more infected southwestern white pine on the White Mountain Apache tribal lands and Apache-Sitgreaves National Forest.

Oak Wilt

Ceratocystis fagacearum Bretz

Oak wilt continues to be the most destructive wilt disease in the Upper Midwest and Texas. In the South, oak wilt infection centers remain active in widely scattered locations at low incidence in five affected counties in North Carolina. Oak wilt continues to cause mortality on scattered red and live oaks stretching across central South Carolina. In Texas, oak wilt remains at epidemic levels in 73 central Texas counties, primarily affecting live oak and Texas red oak (fig. 1). No new counties reported the disease in 2010.

Oak wilt has been confirmed in Arkansas, Kentucky, Mississippi, and Oklahoma. Although damage continues as a result of the disease, no formal surveys were conducted in 2010. Tennessee has positively detected oak wilt in the past but documented no infected trees or infection centers in 2010. Along the mountains of Virginia, 23 counties have positively detected oak wilt in the past but currently document no infected trees or infection centers and conduct no formal annual surveys for oak wilt.

In the Northeastern Area, aerial survey mapped oak wilt damage in Indiana, Michigan, and Minnesota. Oak wilt surveys yielded no new infestations in New York in 2010. Iron County, MI, Morgan County, MO, and Oneida County, WI, reported records for oak wilt for the first time in 2010.

Figure 1.—*Oak wilt symptoms on live oak tree, Kerrville, TX. Photo by Paul A. Mistretta, USDA Forest Service.*

Fusiform Rust

Cronartium quercuum f. sp. *fusiforme* Hedg. and Hunt ex Cumm.

Fusiform rust (fig. 1) is sometimes a significant disease problem in loblolly and slash pine plantings throughout the South (fig. 2), primarily in stands that are less than 5 to 7 years old. Rust infection varies in severity from year to year, depending on weather patterns, local site conditions, and the susceptibility of host genetic sources. There were no new significant reports of fusiform infestations in 2010.

Figure 1.—*Fusiform rust; stand showing many cankers. USDA Forest Service photo.*

Figure 2.—*Fusiform rust; fruiting aecial stage. USDA Forest Service photo.*

Dogwood Anthracnose

Discula destructiva Redlin

Dogwood anthracnose has had a tremendous impact on eastern flowering dogwood throughout the Eastern United States; no formal surveys have been conducted recently. In the South, however, the disease continues to cause dieback and mortality in the generally infested areas in the western part of North Carolina (figs. 1 and 2). Dogwood anthracnose remains confined to six counties in South Carolina, where much of the dogwood resource has been lost. The disease is known to occur in the higher elevations of northwestern Alabama, Georgia, and Kentucky. Surveys have detected dogwood anthracnose over the entire eastern half of Tennessee, with dieback and mortality more common and severe at higher elevations. Similarly, dogwood anthracnose is active in most counties in western Virginia, where dieback and mortality are common.

In the Northeast, dogwood anthracnose continued to affect flowering dogwood throughout its range across the New England States. The disease still plagues understory and ornamental flowering dogwood across New York but did not spread to any new counties in the State in 2010. The disease is present throughout Indiana, wherever flowering dogwood is present, especially in southern forests. St. Louis County, MO, had a new report in 2010, bringing the total of known infected counties to six for the State.

Figure 1.—*Dogwood anthracnose decline. Photo by Robert L. Anderson, USDA Forest Service.*

Figure 2.—*Dogwood anthracnose symptoms on leaves at Bent Creek, NC. Photo by Robert L. Anderson, USDA Forest Service.*

Beech Bark Disease

Cryptococcus fagisuga Lindinger • *Neonectria ditissima* Tul. & C. Tul. Samuels & Rossman • *N. faginata* Lohman

In the Northeast, beech bark disease (BBD) continued to affect beech throughout New England and New York. In Maine, surveys identified a small number of trees that were likely immune or highly resistant. Infestation remained stable statewide in New Hampshire, whereas, in Vermont, surveys recorded almost 15,000 acres of dieback and new mortality in 2010. West Virginia had a total of 1,705,820 acres with varying degrees of damage and mortality in 2010, including a recorded increase of 304,032 acres of damage across counties in the Potomac Highlands. In Maryland, the disease causes extensive mortality and decline in isolated areas throughout the State. Future surveys are planned to examine the disease spread and mortality in more eastern Maryland counties.

In New Jersey, 14 counties have varying degrees of decline and mortality associated with BBD. The killing front occurs in more northern New Jersey counties, but the scale component is observed only in the central part of the State. Surveyors are currently investigating the spread of fungus to central New Jersey and scale southward. Scale populations are light to moderate in Ashtabula, Cuyahoga, Geauga, Lake, and Portage Counties, OH, but both the insect and fungus are known to occur only in Geauga County. Future surveys will delimit the presence and spread of BBD within and outward from Geauga County.

In Michigan, the BBD front continues to advance east and westward in the Upper Peninsula and to new areas in the northern Lower Peninsula (fig. 1). Isolated satellite populations occur well ahead of the advancing front in both the west-central Upper Peninsula and the northern Lower Peninsula (fig. 2). In 2010, seven Wisconsin counties confirmed BBD for the first time.

In the South, BBD is scattered and widespread in 14 counties of western North Carolina, with decline and mortality occurring in affected stands. The disease is particularly troubling in and around Great Smoky Mountains National Park. Beech bark disease is now known to exist in a number of eastern tier counties in Tennessee and in 6 counties in western Virginia. No formal surveys have been conducted recently in either Tennessee or Virginia.

Figure 1.—*"Beech snap," commonly associated with beech bark disease, Michigan. Photo by Joseph O'Brien, USDA Forest Service.*

Figure 2.—*Tarry spots and beech scale on American beech in Michigan. Photo by Joseph O'Brien, USDA Forest Service.*

Butternut Canker

Sirococcus clavigignenti-juglandacearum Nair, V.M.G: Chuck Kostichka and J.E. Kuntz

Butternut canker continues to have a damaging impact throughout the entire range of butternut (fig 1). In the Northeast, butternut canker caused scattered dieback and mortality, especially throughout New England. In New York, no new counties reported butternut canker in 2010, but mortality continues to advance in areas where the disease is present (fig. 2).

Figure 1.—*Crown dieback from butternut* (Juglans cinerea) *canker. Photo by Robert L. Anderson, USDA Forest Service.*

Figure 2.—*Butternut canker bole damage. Photo by Joseph O'Brien, USDA Forest Service.*

Pests To Watch

Ips

Ips avulsus • Ips calligraphus • Ips grandicollis

In the South, *Ips* bark beetles—commonly known as engraver beetles—generally cause widespread but scattered mortality and only occasionally kill trees in large groups, similar to southern pine beetle (fig. 1). *Ips* is most likely to attack and kill trees hit by lightning or stressed by drought or other factors. Three species of *Ips* are common in the South—*Ips avulsus* (the small southern pine engraver), *I. calligraphus* (the eastern six-spined engraver), and *I. grandicollis* (the eastern five-spined engraver). *Ips* bark beetle damage increased dramatically in the South during the summer of 2010, particularly in late summer in the western gulf coast area, where drought was long lasting and extreme. Surveys documented several very large areas of scattered but fairly intense mortality in Louisiana and detected and documented several hundred small spots from a number of States in the South.

In the South, surveys detected and reported a total of 465 spots of mortality from 61 counties in 8 States. *Ips* affected about 191 acres, with an estimated volume loss of 353,000 cubic feet. In addition to these spots, surveyors documented two very large areas of scattered but heavy *Ips* mortality in Louisiana—in Franklin Parish (about 11,000 acres) and in Evangeline Parish (about 80 acres)—in stands of various ages and size classes. Those two outbreaks brought total damage in 2010 to about 11,300 acres in 8 States and 62 counties (fig. 2).

Ips damage is rarely quantified adequately because of its scattered nature. In 2010, much more damage probably occurred than was reported, and many late-season detections were not tallied in time to be included in this report. *Ips* damage in 2010 far exceeds that of southern pine beetle. *Ips* mortality is likely to remain high into 2011 as the drought situation is predicted to persist for some time.

Figure 1.—*Stand mortality from* Ips. *USDA Forest Service photo.*

Figure 2.—*Individual tree mortality from* Ips. *USDA Forest Service photo.*

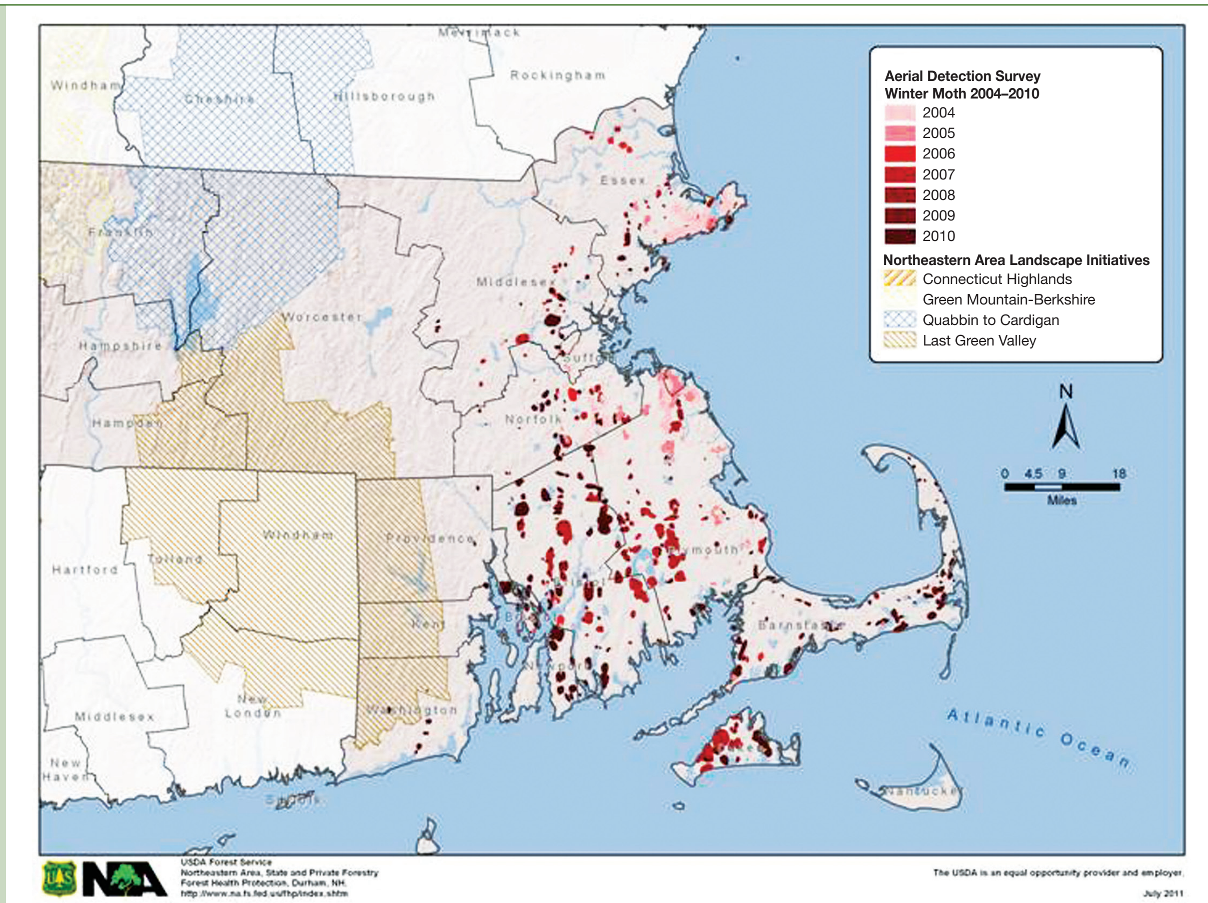
Winter Moth

Operophtera brumata (Lepidoptera: Geometridae)

The winter moth, *Operophtera brumata* (Lepidoptera: Geometridae), is an nonnative defoliator of trees that was first identified in Massachusetts in 2003 and is believed by scientists to have been present since the late 1990s. This European species has established populations in North America two other times, once in Nova Scotia, Canada, and once in the Pacific Northwest. In the United States, the current known range of winter moth, based on adult trapping surveys, is from southern Maine to Long Island, NY. Future surveys are likely to confirm the presence of the insect elsewhere. Studies have implicated winter moth as the causal agent of early season forest defoliation in portions of Massachusetts and Rhode Island over the past 7 years (fig. 1).

As with European gypsy moth, winter moth females (fig. 2) are flightless and found on tree trunks or other surfaces. They lay

Figure 1.—*Between 2004 and 2010, winter moth caused defoliation on more than 186,000 acres in Massachusetts and Rhode Island. USDA Forest Service map.*



eggs on host trees and larvae hatch as early as March. Early instar larvae enter a bud to feed from within and, once that bud is destroyed, move on to others. Later instar larvae feed on foliage. In late May or early June, the larvae cease feeding, drop to the ground, and pupate in the soil at the bases of trees. Winter moth adults begin to emerge and mate in November. The females may lay upwards of 150 eggs on the trunk and branches of host trees. Adults are active over a period of several weeks in November and December.

The winter moth feeds on a wide variety of deciduous plants, making this insect a concern for many North American forest types (fig. 3). The species feeds on dominant forest trees of the Northeast (for example, oak and maple), fruit trees, and ornamentals. The winter moth is an early spring defoliator that feeds on the expanding buds and leaves of its hardwood host. The insect dominates the complex of spring defoliators in Massachusetts and Rhode Island that includes fall cankerworm (*Alsophila pometaria* [Lepidoptera: Geometridae]) and Bruce spanworm (*O. bruceata* [Lepidoptera: Geometridae]).

Winter moths have defoliated hardwood stands in parts of Massachusetts and Rhode Island. Defoliation was quite severe and extensive in Massachusetts between 2004 and 2010. Surveys observed overstory tree mortality in some places in Massachusetts and Rhode Island, especially in red oaks. The winter moth is feeding on many of the hardwood trees present in infested stands infested by other insects, and the cumulative effects of this insect and other native and nonnative defoliators will lead to further tree mortality (fig. 4).

The application of insecticides may reduce or prevent damage to trees from winter moth outbreaks in the short term. Long-term control of the insect has been successful in North America; however, in the past the use of biological control agents has controlled the insect long term. Use of the tachinid

Figure 2.—*The adult female winter moth is wingless and may lay upwards of 150 eggs on the branches and trunks of trees in November and December. USDA Forest Service photo.*

Figure 3.—*The winter moth can cause extensive defoliation on trees early in the spring. USDA Forest Service photo.*

Figure 4.—*Defoliation by winter moth larvae. USDA Forest Service photo.*

fly, *Cyzenis albicans*, successfully managed winter moth populations in Nova Scotia and the Pacific Northwest. The introduction of this European fly permanently reduced winter moth populations in those areas. *C. albicans* is very specific to winter moth and does not attack other spring defoliators. *C. albicans* eggs are deposited on leaves and ingested by feeding winter moth larvae. *C. albicans* larvae then feed on winter moth larvae from within and kill them during pupation. Scientists at the University of Massachusetts, in cooperation with the Forest Service, have successfully established *C. albicans* in the Northeast. Plans are under way to expand this biological control program and establish *C. albicans* across a wider area over the next few years to manage winter moth populations.