

Missouri Forest Health Highlights - 2011

Invasive Species

Emerald Ash Borer – The emerald ash borer (EAB), *Agrilus planipennis*, is an exotic forest pest that is capable of eliminating ash trees from North American forests. It has been detected in 15 US states and 2 Canadian provinces. The first EAB population detected in Missouri was discovered in 2008 in Wayne County, in the southeastern part of the state. That remains the only known Missouri population as of late 2011. But EAB populations may be present at other locations within the state. With existing detection technology, infestations are typically detected 5 to 10 years after they have been introduced. Missourians are encouraged to be alert for evidence of infestations and visit this web site to learn more and report suspect infestations: <http://eab.missouri.edu>

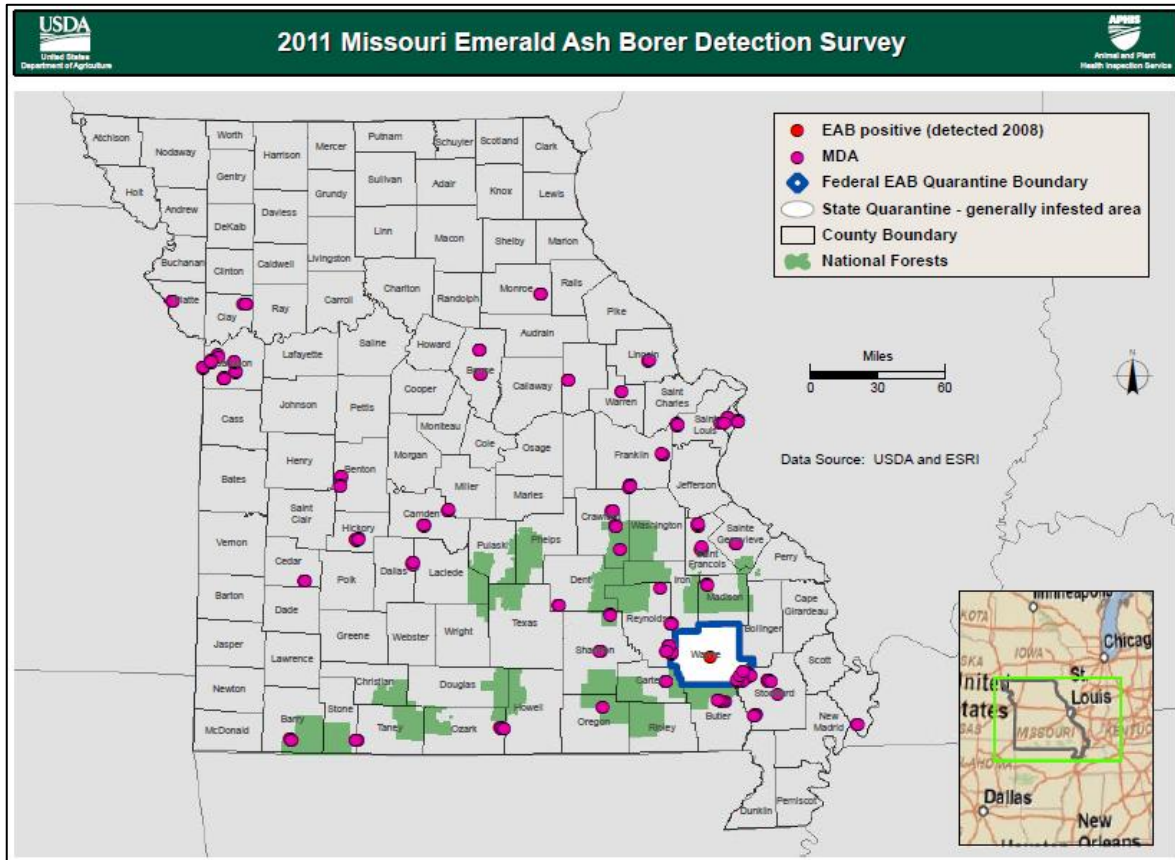


Delimiting surveys of the Wayne County infestation using EAB sticky traps have been conducted annually by U.S. Department of Agriculture (APHIS-PPQ) crews since 2009.

In 2011, a total of 931 traps were monitored within a 10 mile x 8 mile area. Eight adults were found on a total of 7 traps. The newest northern find in the delimit is approximately four miles south of Iron County. The newest southern find in the delimit is approximately six miles north of Butler County. The surveys focus on lowland and riparian areas where ash is more abundant.

The Missouri Department of Agriculture led a statewide survey to detect other EAB populations. A total of 446 traps were monitored at 53 high-risk sites in 31 counties. No new EAB populations were discovered in Missouri in 2011.

The center of the Wayne County infestation is located at the Greenville Recreation Area on land owned and managed by the US Army Corps of Engineers (USACE). The USACE has worked in cooperation with the Missouri Dept. of Agriculture and US Dept. of Agriculture in efforts to slow the spread of the EAB population. During 2008-2011, ash trees (greater than 4-inch dbh) were cut and destroyed on 2,400 acres around the infestation center. Small diameter material was burned on site and larger merchantable wood went to EAB compliance mills. Destruction of larger ash trees removes a large portion of the EAB population and reduces the ash phloem resource available for EAB reproduction.



The Missouri Dept. of Agriculture has led other efforts since 2009 to monitor and slow the spread of the EAB population. Ash trees in areas surrounding the infestation center have been stem-girdled in spring and felled, debarked, and examined in the following fall and winter to serve as detection trees. Clusters of girdled trees have been used as EAB sinks to trap and reduce EAB numbers; these trees were also felled and debarked. In 2011, another lethal trap tree technique was added. Twelve large trees (>10-inch dbh) and seven smaller ones (<10-inch dbh) at the infestation center were injected with TreeAge, a systemic insecticide (emamectin benzoate). Additional trees were scheduled to be treated, but flooding postponed treatments. Branch sampling, a detection survey technique developed by the Canadian Forest Service, was tested but with limited success due to the height of mid-canopy branches. Monitoring efforts with sticky traps and detection trees continue to indicate a low-level population is present.

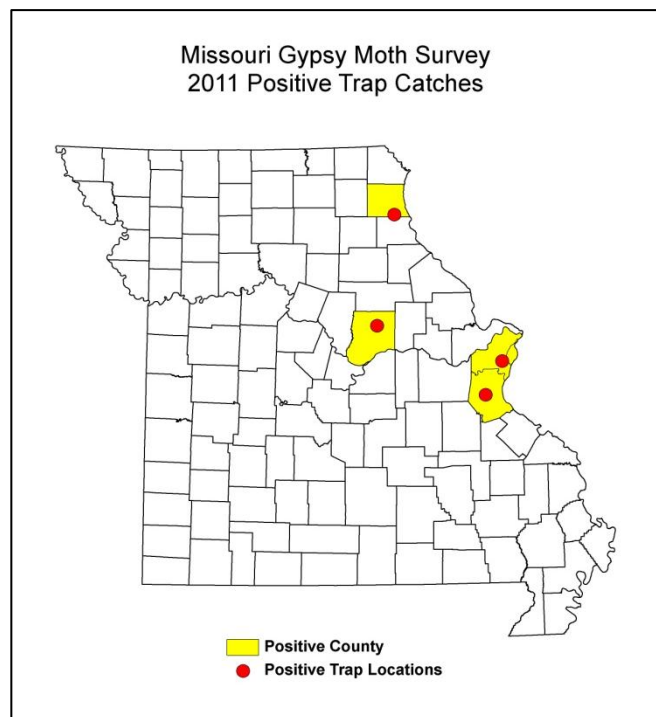


A wide array of outreach efforts was again deployed this year in Missouri to raise awareness about EAB and other invasive pest threats related to firewood movement. Multiple state and federal agencies participate in these

activities led by the state’s EAB Outreach Coordinator. A radio ad campaign operated during summer and fall across the state; also on sports radio stations broadcasting St. Louis Cardinals games. Print ads appeared multiple times in several Missouri-based magazines. Highway billboards and gas pump-top ads were used in many locations. An EAB video was produced and displayed in the State Fair grandstands. A lumberjack show was sponsored at the State Fair that included EAB/firewood information and provided an opportunity to pick up EAB t-shirts at a nearby EAB informational booth. Information was sent to over 400 campground owners across the state and presentations were given to many garden shows, fairs, workshops and a variety of other venues. The “Borer Bite” newsletter continued to inform about the latest news and program efforts regarding EAB. Missouri Dept. of Conservation (MDC) staff continued to respond to questions and reports of suspected EAB infestations submitted by the public via toll-free phone number and web-based reporting form.

Gypsy Moth - The multi-agency Missouri Cooperative Gypsy Moth Program conducted its annual survey to detect the presence of gypsy moths (*Limantria dispar*) by placing and monitoring 6,024 traps in 60 of 114 counties in 2011. Two delimit areas of more intensive trapping were established around sites where gypsy moths were captured in 2010 (in Jasper and Jefferson Counties).

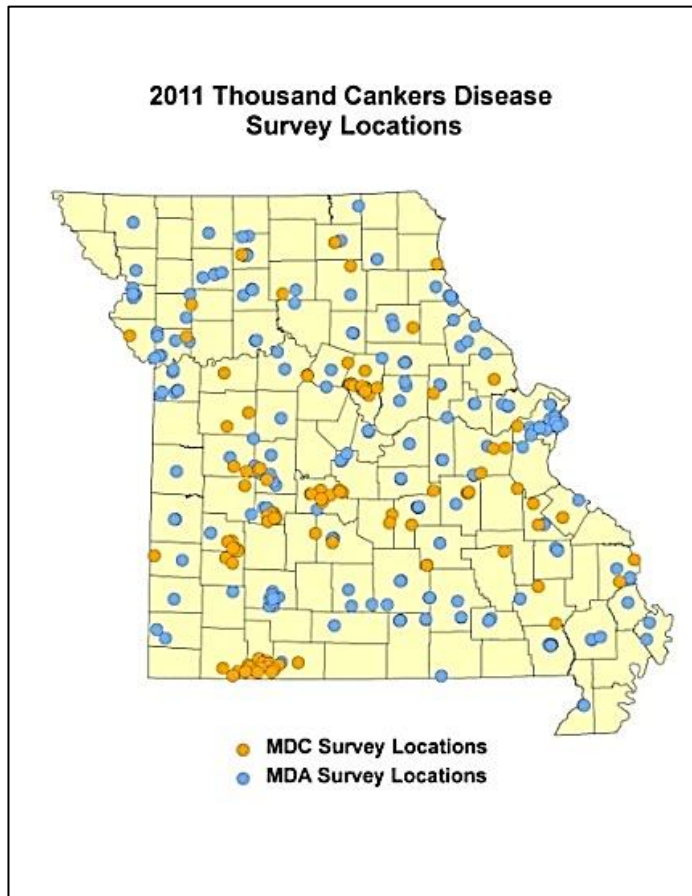
Only four moths were captured statewide in 2011, one each in Lewis, Callaway, St. Louis and Jefferson Counties. No moths were captured in delimit areas. No reproducing populations of gypsy moths have been detected in Missouri as of this time.



Thousand Cankers Disease - Black walnut is ecologically and economically important to Missouri, and thousand cankers disease (TCD) represents a serious threat to this resource. TCD occurs when the walnut twig beetle, *Pityophthorus juglandis*, attacks walnut trees, spreading the *Geosmithia morbida* fungus that causes small cankers in the phloem tissue under the tree bark. TCD has not been detected in Missouri; however there is concern that TCD could spread from western states or Pennsylvania, Tennessee and Virginia where it has been detected. Potential long-distance spread of TCD on infected walnut materials enhances this threat.

A visual survey was conducted in 2011 by MDC with USDA Forest Service funds. MDC staff examined trees at all state park campgrounds and other public and private campgrounds in high-risk areas identified by FIA data. Sixty two public campgrounds, 18 private campgrounds

and 20 additional locations observed by MDC staff and reported by the public were surveyed. Additional survey work was completed by Missouri Department of Agriculture (MDA) with USDA APHIS PPQ funds. MDA staff examined trees near walnut wood processors and 89 municipalities for a total of 215 sites.



During visual survey activities, trees observed with possible symptoms of TCD (dieback in the upper canopy, branches with attached wilted brown leaves, and extensive epicormic sprouting) were evaluated by collecting symptomatic branches 1-2 inches in diameter. Bark was scraped away to look for any evidence of walnut twig beetle and discoloration in the phloem. When suspicious symptoms were observed under the bark, sample branch sections were triple-bagged and placed in a cooler with icepacks for transport to a freezer. Samples were frozen for 48 hours prior to lab analysis and culturing. All suspect trees were photographed and GPS locations were recorded.

Several insect and disease agents, other than TCD, were observed on walnut

samples. Various fungi including *Fusarium* and *Phomopsis* were cultured from discolored phloem tissue. Other problems noted included exposed, elongate *Fusarium* cankers on black walnut trunks, defoliation from anthracnose and walnut caterpillar, site-related decline issues, and infestation by several other wood-boring insects (primarily roundheaded and flatheaded borer larvae).

Outreach efforts were continued this year to raise public awareness about TCD. Messages included the potential impact of this new disease, the threat posed by movement of potentially infected walnut materials, and identification and handling suspect trees. Several state agencies including MDC, MDA, University of Missouri Extension, as well as stakeholder groups were involved in outreach. Efforts have included brochures, poster, website, news releases, presentations, trainings, and displays at a variety of public and green industry meetings. An email address and online reporting form have been publicized as a place to email photos of suspect trees as a first step in determining what trees should be visited by trained personnel.

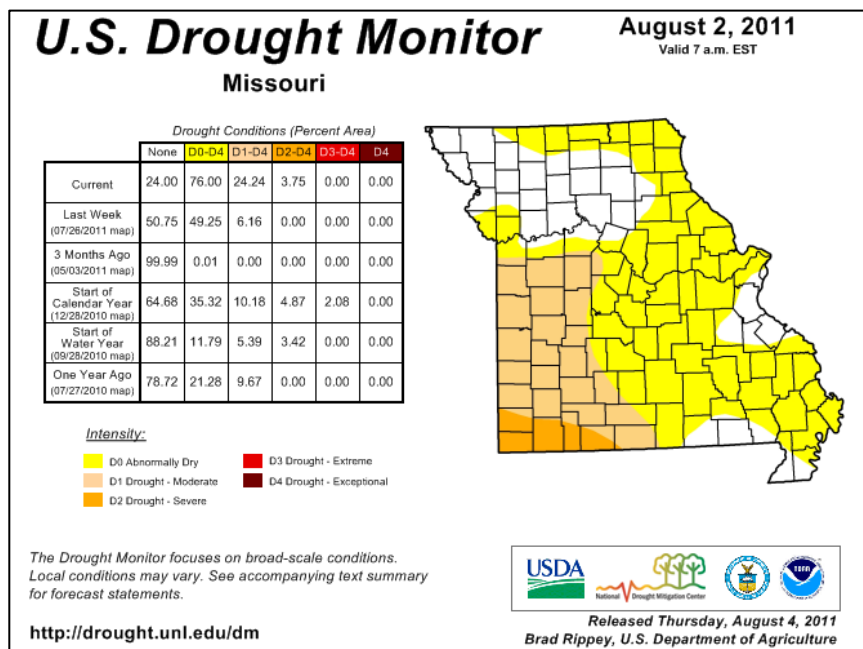
Dogwood Anthracnose, *Discula destructiva*, can be lethal to flowering dogwood, *Cornus florida*, in the eastern states. Lesions develop on the leaves and girdling cankers develop on the twigs,

branches and trunk. Dogwood anthracnose is not common in Missouri and has not been reported in native forested areas. It has been detected in nurseries and landscaped trees, and when traceable, has been traced to out-of-state sources. Previous known infections are believed to have been eradicated. In 2011, the Missouri Department of Agriculture confirmed the presence of *Discula destructiva* associated with flowering dogwood in three adjacent yards in the city of Kirkwood in St Louis County. All positive trees were removed and destroyed. Additional survey work will occur in Kirkwood in spring 2012.

Weather-Related Issues

Highly variable and extreme weather during the past several years continues to be a major source of stress impacting forest health in Missouri. Precipitation was above normal across the state in 2008 and 2009, making that the wettest two-year period on record. In 2010, except for southeast Missouri, rainfall was again above average for much of the state. This year, spring began with above normal precipitation. Many counties in southern Missouri had the wettest April on record, some counties receiving more than 20 inches for the month. Statewide, it was the 5th wettest April on record. However, the wet spring transitioned to very dry conditions, the hottest July in over 30 years and the 8th hottest month ever recorded for Missouri. Some trees subjected to abnormally wet conditions during the past few years may have developed shallow root systems over time, and soft lush growth this spring left them poorly adapted to the sudden onset of hot dry weather this summer.

Drought conditions were especially severe in southwestern Missouri where many reports of drought-scorched tree crowns were received. Many reports included trees on west or south facing slopes in Stone, Barry, McDonald and Newton counties.



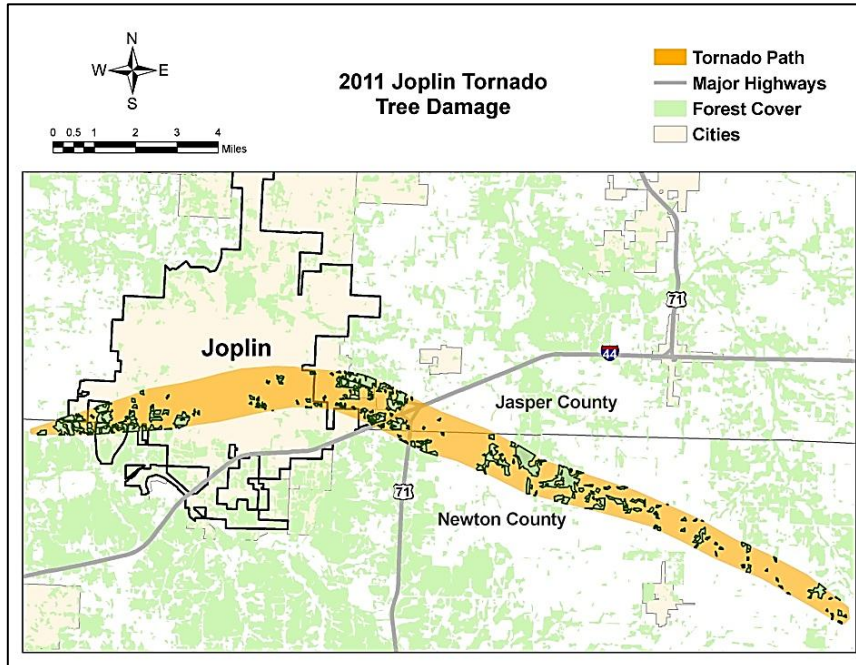
The winter of 2010-2011 was generally cold and snowy. Some record temperatures, a few wide temperature fluctuations, and record snowfall events occurred. December and January temperatures were generally below average. Much above normal monthly snowfall totals were reported over northern and central Missouri in January where snow remained for most of the month. A historic blizzard dropped 15-23 inches of snow over much of southwestern, west central, central, north central and northeastern Missouri at the beginning of February. Bitterly cold temperatures were experienced in early February when temperatures dropped below zero in most locations. Many areas experienced their coldest temperatures in more than a decade. Some of the coldest temperatures were experienced over west central and southwest Missouri where lows dropped to -22°F in some areas. However, unusually warm temperatures were also experienced in mid-February with near record to record high temperatures occurring on a few of these days. The winter conditions resulted in reports of winter desiccation and salt spray injury on pines in the spring.



White pine injured by salt spray along highway

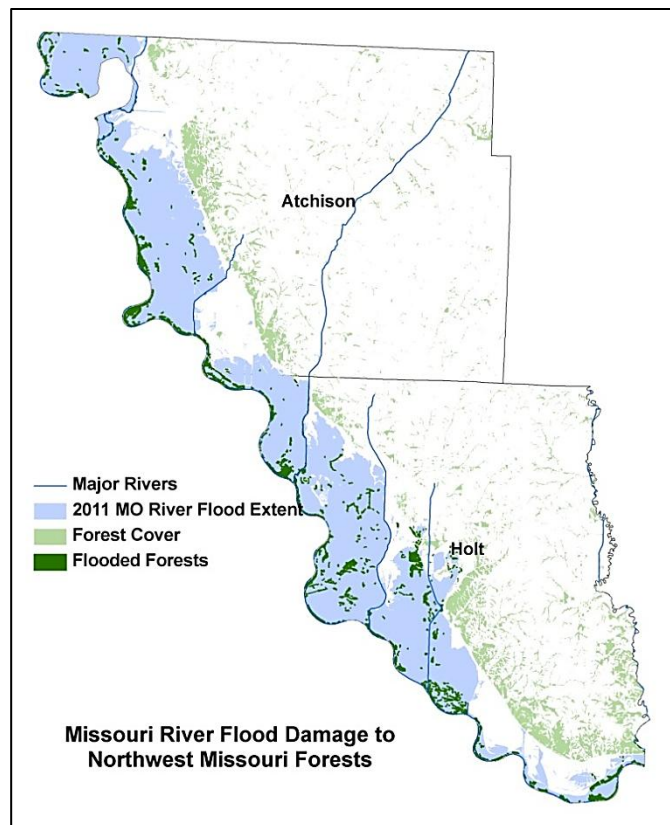
Moisture fluctuations of the past few years and a severe winter are only a part of the tree stress brought about by the weather. A week-long freeze event in April 2007, following an unusually early spring warm-up and early tree development caused tree damage nearly state wide, but also caused more subtle damage that is still becoming apparent as some trees continue to decline. Damage from ice storms, wind storms and tornadoes in recent years has also caused tree damage that continues to become apparent. We anticipate damage from the weather this year and earlier events to continue to show up in the next few years through increased insect and disease damage and decline.

Joplin Tornado - On May 22 a devastating EF5 multi-vortex tornado hit Joplin MO, causing massive destruction along a maximum width greater than 1 mile through the southern portion of the city, continuing eastward into rural Jasper and Newton counties. It ranks as one of Missouri's and America's deadliest tornadoes and caused significant urban and rural forest impacts in the areas shown in figure below, including impacts to urban trees not mapped as forest cover. MDC foresters have been very involved in recovery efforts. Initially, MDC foresters assisted with critical tree cutting and removal efforts. Missouri arborists (MDC foresters and private arborists) met with US Forest Service trainers about responding to federal disasters and received Urban Forest Strike Team (UFST) training to assess tree damage using



Federal Emergency Management Agency (FEMA) and tree risk management standards. MDC foresters have evaluated trees at home sites and public areas within the tornado-affected area and are providing advice and assistance with tree planting efforts, which will continue next year.

Flooding occurred in many areas of Missouri in 2011. Above average amounts of snowmelt and spring rains along the upper Missouri River resulted in major flooding downriver in Missouri. Conditions were most severe, lasting throughout the summer, from the Iowa State line south to St. Joseph, MO. Impacts were particularly severe in Atchison and Holt Counties in the northwest corner of the state (see map). Early fall leaf color and leaf drop were present by late August on larger trees in flooded areas. Many smaller trees were totally brown. Moderate flooding also occurred further downriver from Kansas City to Jefferson City.

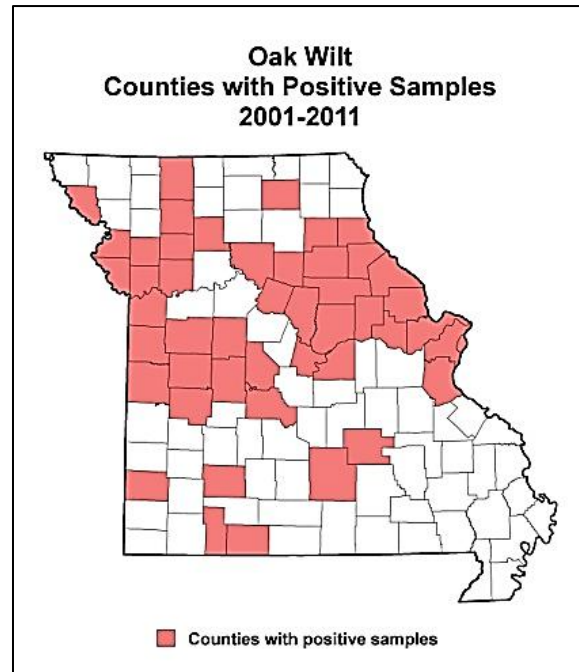


Flooding occurred along many rivers and streams in southeastern Missouri in the spring due to heavy rainfall. About

130,000 acres of primarily farmland in Mississippi County (Birds Point-New Madrid Floodway) were intentionally flooded by the US Army Corps of Engineers by breaching a levee to protect flood-threatened Cairo, Illinois.

Other Forest Health Issues

Oak wilt, *Ceratocystis fagacearum*, is an aggressive fungal disease affecting many oak species and causing oak mortality every year in Missouri. Symptoms vary by species; however red oak species are more severely affected than white oak species, with rapid leaf discoloration, wilting, and leaf drop. Since 2001, the MDC forest health lab has diagnosed oak wilt from 46 counties across the state. In 2011, positive black oak samples were submitted from two counties (St Charles and Warren). Some negative samples were received after several weeks of high temperatures which may have impacted the results. Compared to recent years, fewer samples for oak wilt testing were received. It is possible foresters and arborists are feeling more confident in their abilities to diagnose this disease in the field, or there may be concern that exposure of potentially infected trees to high temperatures prior to sample collection in 2011 might make disease confirmation difficult.



White oak decline and mortality – Beginning in August and continuing into the fall, we received many reports of rapid white oak decline and mortality. Reports were received from across the state, however a majority came from central and northern Missouri. Most reports fit one of two different patterns:

Many affected trees are large, spreading, mature white oaks on upland sites often in lawns and other open areas. Rarely, clusters of up to 3-4 white oaks in natural forested areas, young white oak or other oak species have had similar symptoms. Affected trees often show little evidence of decline prior to browning of large sections of the canopy in early August. Some trees rapidly advanced to browning and death of the entire canopy, while in other cases trees still had some live branches. Brown leaves appear to hang on the tree. Extensive Hypoxylon canker infection is frequently present as bark begins to fall from the trunk and large branches. Preliminary examination of some trees indicates some evidence of decay in the root flare but evidence is not present in many trees. Flatheaded borer larvae have been present in the lower trunk and root flare of some trees. Very few trees have had any evidence of *Armillaria* associated with the root flares or fruiting around the tree.

Other reports have included pockets of white oak on lower slopes and bottomland in natural forested areas with good soils and adequate moisture. These trees also died in late summer, and flatheaded larvae consistent with twolined chestnut borer have been found colonizing some trees.

In 2010 in many parts of the state, white oaks were stressed in late spring by leaf browning caused by jumping oak gall. Recent weather events have also caused tree stress. These white oak issues are being investigated by state Forest Health staffs who hope to have additional information in the future.

Conifer problems – Reports of conifer problems occurred throughout the year. In addition to early reports of desiccation and salt spray injury, some spring reports involved needle diseases, particularly *Dothistroma* needle blight and *Diplodia* tip blight on Austrian and Scotch pines. In



Late summer pine mortality

late spring and early summer several reports involved white pine and spruce samples with damaged shoots due to Imprelis herbicide applications and environmental stress. In late summer and fall, reports continued for a variety of species, particularly spruce, white pine and arborvitae that were dropping needles and/or drying out and turning brown. Many of these trees were stressed by site conditions, excessive spring moisture and drought this year. Multiple agents were detected including pine sawyer beetles and other insects.

Periodical Cicadas – Brood XIX of periodical cicadas (*Magicicada* spp.), a 13-year brood, emerged in Missouri and across a large swath of Midwestern and southern states in 2011. It is the largest of four broods found in Missouri, and this year's emergence did not disappoint. Cicadas came out in huge numbers resulting in much attention by the public and the media. The distribution of cicadas coincided with historical patterns for emergence of this brood. Significant numbers were reported across most of the state, except for the Bootheel, the northwest corner and extreme western edge of the state.

Branch flagging (brown leaves), broken dangling branches, and branches falling to the ground were common on many tree species due to damage caused by cicada oviposition. Females cut a series of slits along the underside of small-diameter twigs into which they insert their eggs.

Kermes Scales – Another commonly observed cause of branch flagging on oaks is Kermes scale damage.

Feeding damage by these sucking insects causes large numbers of leaves and small twigs to drop to the ground.

Kermes scales are tan to reddish brown spheres ranging in size up to 1/4-inch diameter and are attached to feeding sites on twigs.

They're often confused for an insect gall or tree bud. During the summers of 2010 and 2011, branch flagging on post oaks due to Kermes scales

(probably *Nanokermes pubescens*) was common across southwestern Missouri. A few reports of similar damage were also received from the St. Louis area in 2011.



Periodical cicada and oviposition slits on redbud branch

Walnut Caterpillars (*Datana integerrima*) were out in large numbers in many locations in 2011, but most commonly across southwestern Missouri. Similar outbreaks have occurred every few years, particularly in western Missouri. The caterpillars feed on the leaves of black walnut, pecan, butternut, hickories, and a few other hardwood species.

Jumping Oak Galls – Populations of jumping oak gall wasps (*Neuroterus* sp.) generally collapsed in 2011. Unusually high populations in 2010 caused significant leaf damage on white oaks across much of Missouri. The number of galls per leaf was often so high that year that entire tree crowns turned brown in early summer and many leaves dropped prematurely. Only minor jumping oak gall damage was observed this past year.

Shingle Oak Skeletonizers – Leaf damage due to a complex of leaf skeletonizer species (Lepidoptera) occurred again on many shingle oaks in 2011. Large populations in 2010 caused severe leaf damage in many parts of western and southern Missouri. Damage occurred in many of the same areas again this year, as well as parts of eastern and southeastern Missouri. A majority of the damage occurs in July. Populations of this skeletonizer complex typically erupt in outbreak levels every few years and primarily affect only shingle oaks. Skeletonizer populations often collapse after one or two years at outbreak levels.