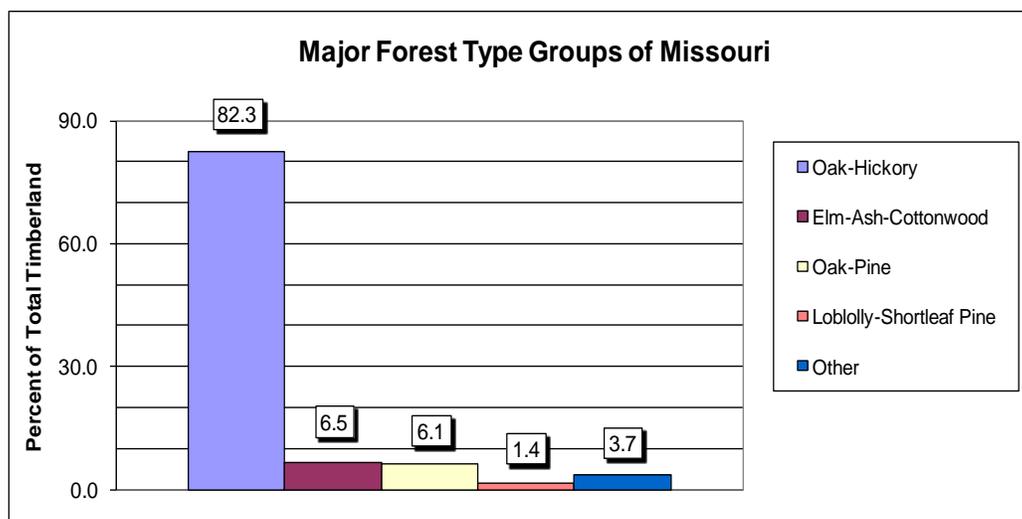


# Missouri Forest Health Highlights - 2009

## The Resource

Missouri is about one-third forested and well-known for its oak-hickory forests. There are 15.4 million acres of forest land based on the 2008 forest inventory, an increase of 10% since 1989. More than four-fifths of the forest land in Missouri is dominated by oaks, hickories and associated species.



In addition to the recreation and wildlife benefits these forests provide, a recent analysis by the Missouri Department of Conservation (MDC) showed that the forest products industry contributed \$5.7 billion annually to the Missouri economy in 2006 dollars. The industry supports about 32,000 jobs at a payroll of about \$1.25 billion and is responsible for over \$465 million in taxes, including \$57 million in state sales tax.

## Invasive Species

**Emerald Ash Borer** – The Wayne County population of emerald ash borers (EAB), *Agrilus planipennis*, in southeastern Missouri remains as the only known EAB infestation in the state as of November 2009. The infestation is centered on the Greenville Recreation Area campground at Wappapello Lake. EAB is assumed to have been introduced by movement of infested firewood by campground visitors. Evidence from trees at the center of the infestation indicates introduction occurred at least 5 to 6 years prior to being discovered in 2008.

A delimiting survey using over 700 sticky traps was conducted in 2009 by a US Department of Agriculture crew within a 16 mile x 16 mile area surrounding the infestation. No EAB adults



Emerald ash borer adult  
*Forestry Images – David Cappaert*

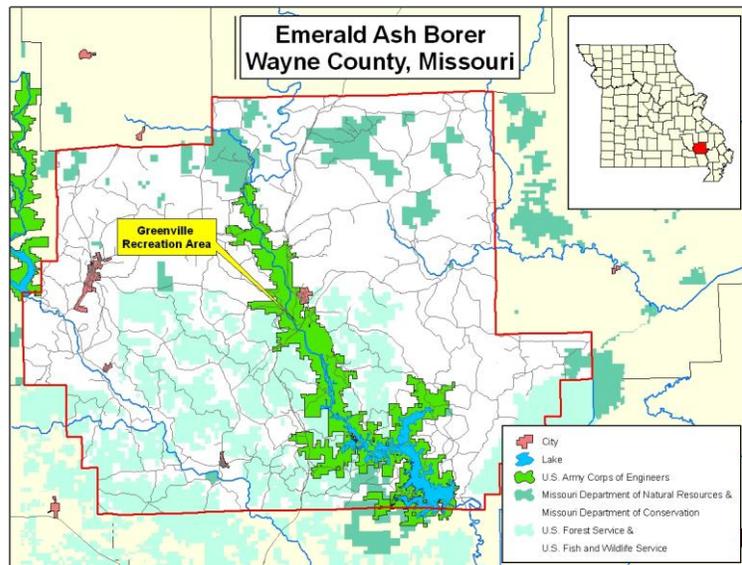
were captured outside of the central infestation area. One adult captured 1.4 miles northwest of the presumed introduction site represents the greatest distance that an EAB individual has been found from the infestation center.

An additional 264 sticky traps were monitored by the Missouri Department of Agriculture at 64 high-risk sites in 47 counties across the state as part of the National EAB Detection Survey. All traps were negative for EAB.

The known infested area at the Greenville site is located on US Army Corps of Engineers (USACE) land. The USACE removed and destroyed ash trees from about 200 acres of the Greenville Recreation Area during fall and winter 2008-2009 in an attempt to slow the spread of the infestation. Additional tree removals are planned for fall and winter 2009-2010.

In a complementary effort to detect and slow the spread of the EAB infestation, the Missouri Department of Agriculture, in cooperation with the US Forest Service and USACE, has taken initial steps to establish a SLAM (Slow Ash Mortality) project. In May 2009, ash trees located in a grid pattern surrounding the central infestation area were girdled by removing a strip of bark around the trunk's circumference.

Girdling stresses trees and makes them more attractive to EAB attack. At some locations, clusters of girdled trees were employed as sinks to trap EABs. A total of 67 trees were girdled. These trees will be cut, debarked and examined during winter 2010 to determine if they are infested with EAB. An additional 60 trees (non-girdled) exhibiting branch dieback and other stress symptoms were identified in fall 2009 within the sample grid and also will be cut and examined.



Outreach efforts increased this year to further raise public awareness about EAB, and particularly about the threat posed by movement of firewood. Many state, federal, university, green industry, forest industry, recreation industry, and other stakeholder groups were involved. MDC produced

brochures, news releases, magazine articles, and radio public service announcements, and provided presentations, trainings, and displays at a wide variety of green industry and public meetings. MDC staff responded to a large number of questions and reports of suspected EAB infestations submitted by the public via a toll-free phone number and web-based reporting form.

**Granulate Ambrosia Beetle** – Activity by the non-native granulate ambrosia beetle (GAB), *Xylosandrus crassiusculus*, has increased in Missouri in recent years. Reports of GAB attacks began coming in to the MDC forest health laboratory in 2002. This species and other ambrosia beetles are known for producing “frass sticks,” the stick-like accumulations of insect wastes and wood particles that extend from holes in the bark.



Frass sticks produced by granulate ambrosia beetles tunneling within black walnut log

The number of reported GAB attacks has fluctuated from year to year. There was a general increase in reported attacks in spring 2009, but especially in black walnut plantations in southwestern Missouri (Jasper, Newton and Lawrence Counties). In one plantation, one-third of walnut seedlings planted in the previous fall were attacked and killed by the GAB this spring.

The GAB attacks a wide variety of host trees. We know of confirmed GAB attacks in Missouri on black walnut, oak, plum, peach, and paper mulberry. Additionally, frass sticks have been observed on: red maple, sugar maple, Japanese maple, yellow poplar, American elm, Chinese chestnut,

golden raintree, and mimosa. The presence of frass sticks is not definitive evidence of GAB, but it is likely that GAB was involved in many of these attacks. Frass sticks had not been reported prior to 2002, when the first GAB reports were received.

**Gypsy Moth** - The multi-agency Missouri Cooperative Gypsy Moth Program continued its annual survey to detect the presence of gypsy moths by placing and monitoring over 9,700 traps across the state in 2009. Sites where gypsy moths were captured in 2008 were surveyed more intensively at a higher trap density (delimit areas).

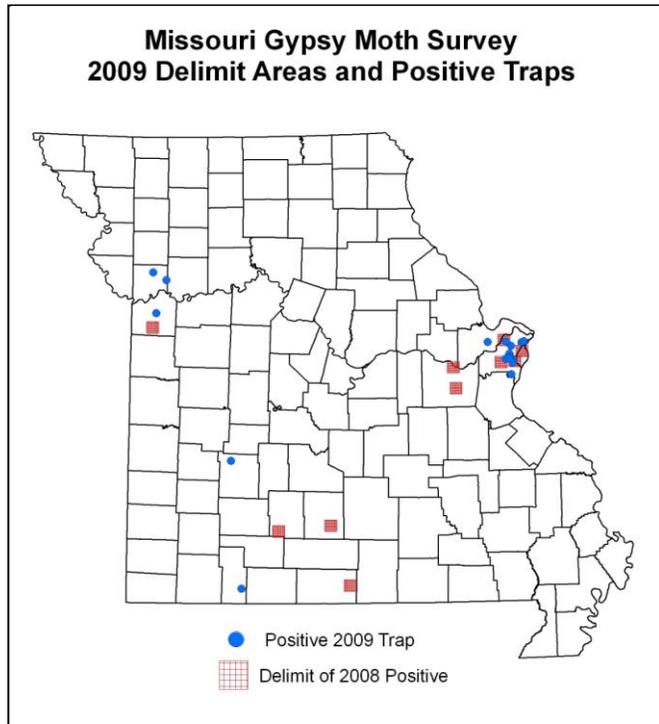
A total of 22 moths were captured statewide in 2009, a slight increase from recent years' results. Most were caught in the St. Louis area (14 in St. Louis County and one in St. Charles County). In other areas, four were captured in Clay County and one each in Jackson, Polk and Stone Counties. Only one moth (St. Louis County) was captured in a delimit area near a 2008 positive, although others in St. Louis were caught in areas where moths have been caught in previous years.

There are no known established populations of gypsy moths in Missouri. In most cases, survey results in the vicinity of past captures have been negative within one or two years following the original capture. Gypsy moth monitoring efforts will continue annually in Missouri.

### **Weather-Related Issues**

For the second consecutive year, precipitation was above normal during spring and summer across much of Missouri. Temperatures, although near normal in spring, were much below normal in July and August. July was among the top five coolest on record for Kansas City, St. Joseph, Columbia, Joplin, and West Plains. The summer as a whole was the 10<sup>th</sup>

coolest and 8<sup>th</sup> wettest for Kansas City. The general trend continued over the next few months resulting in one of the top five wettest autumns in some locations.

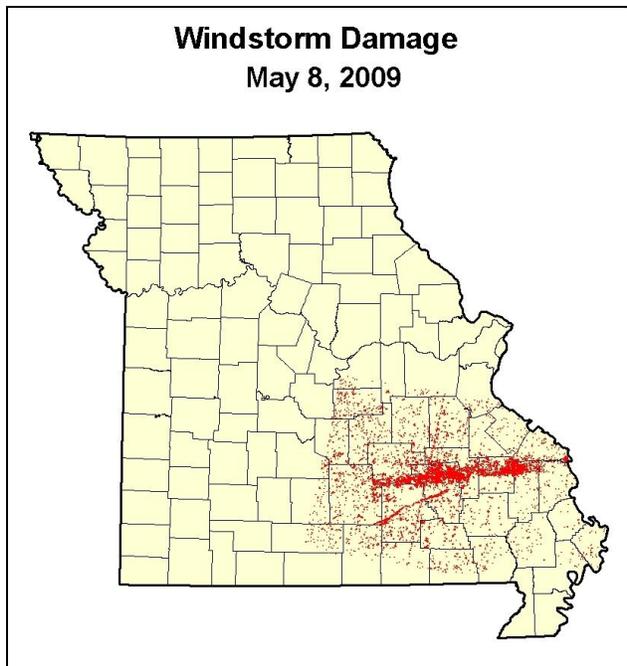


The cool, wet weather had both positive and negative impacts on tree health. Tremendous shoot growth and foliage production were observed on some trees, and trees were not affected by the typical drought stress of late summer. However, the cool, wet conditions were also favorable for proliferation of fungal diseases.

The unusual weather of 2009 is only the latest in a series of unusual weather events of the past few years that likely have induced stress in trees and other woody plants resulting in increased susceptibility to attack by various insects and pathogens. Among the more severe of these was a week-long freeze event in April 2007 following an unusually early spring warm-up and advanced shoot growth. The most obvious evidence of freeze damage was widespread foliar destruction and twig dieback across the state, but the extent of other damage is unknown. Many unexplained occurrences of dieback, decline and mortality among several tree species in 2009 are suspected of having a connection with that freeze event and other climatic stressors of the past few years.

Storm events in 2009 also caused damage that will have long lasting effects on forest health. On January 26-28 an ice storm brought down trees and power lines in the bootheel region of Missouri, especially in Scott, Stoddard, and Dunklin counties.

On May 8, an unusual storm event defined by the National Weather Service as a derecho (a widespread, long-lived thunderstorm-induced windstorm) moved across southern Missouri, causing the greatest damage in the southeastern part of the state. This complex of severe thunderstorms with damaging straight-line winds, large hail and tornadoes broke and uprooted



trees in swaths that covered hundreds of acres. MDC estimates the extent of damage at 204 million board feet of timber on 113,000 acres. That does not include areas with light damage, which covered approximately twice as many acres. Damage extended across private, state and federal land ownerships.

Although damage ranging from moderate to severe occurred in 36 counties, three-quarters of the destruction fell on six counties: Reynolds (28,351 acres), Madison (17,854 acres), Shannon (10,944 acres), Dent (9,920 acres), Iron (9,514 acres) and Bollinger (8,473 acres) counties. The Missouri Forest Products Association reported that statewide damage from the storm equaled approximately one-third of Missouri's annual timber harvest.

### **Other Forest Health Issues**

**Eastern Redcedar Mortality** – During 2009 many eastern redcedars were observed to die rapidly. Usually a few scattered trees died among many apparently healthy trees. No connection with topography or site was evident; mortality occurred on lowlands and on dry upland glades.

The phenomenon was reported from many locations across Missouri, but no clear cause was determined. The root rot pathogen *Heterobasidion annosum* was present in several but not all killed trees that were examined. Many dying trees were heavily infested with bark beetles, but bark beetles generally attack trees stressed by other factors. Blue stain fungi were occasionally associated with beetle galleries, but on only a minority of samples collected. Other attempts to consistently isolate a pathogen that may have weakened trees to allow bark beetle attacks were inconclusive. As described above, unusual weather events of the past few years may be more likely causes of stress in redcedars that resulted in increased susceptibility to attack by bark beetles and pathogens.

**The “D Complex”** – One of the most common tree health concerns in 2009 was a complex of “D symptoms”: discoloration, dropping leaves, dropping twigs, dieback and decline. Many reports were received by MDC of several tree species with some or all of these symptoms. No single causal agent was to blame. Again, climatic factors were often suspected of playing a role.

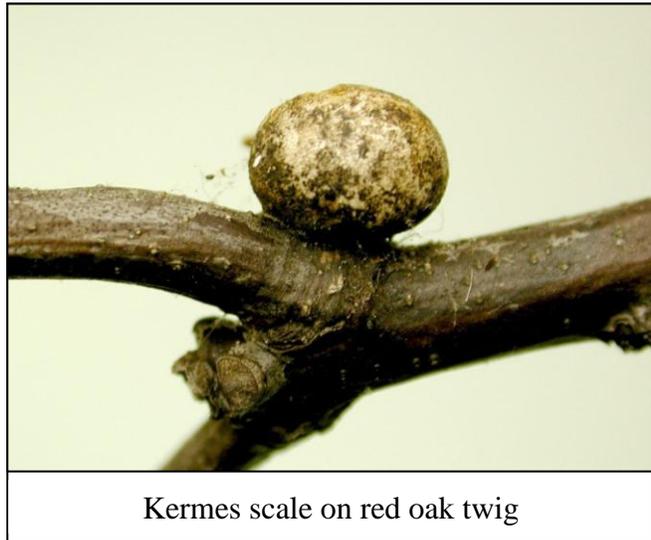
Leaf diseases and their resulting leaf spots and discoloration were abundant in the cool, wet weather. **Anthracnose** was rampant, particularly on sycamore, ash, oak, and maple. **Tubakia** leaf spot was often the cause of significant foliar browning on oaks. **Powdery mildews** and some **rusts** were also present on various hosts. The effects of 2008's wet weather was apparent

on conifers, especially Scots pine, Austrian pine, blue spruce, and Norway spruce, where reports of **needle casts** and **needle blights** were widespread.

Browning of major portions of white oak crowns was frequently caused by high populations of **jumping oak galls**, particularly in central Missouri. But widespread outbreaks of the gall-causing wasp as occurred in 2008 and previous years were not observed in 2009.

Discolored or dropping leaves and general decline were frequently observed on oaks and maples. Several reports of **white oak decline** were received. Without an apparent cause for these decline episodes, delayed impacts of the 2007 freeze event were often suspected. Damage and stress induced by that severe event may have set the stage for invasion by pathogens such as *Armillaria* sp. or *Phytophthora* sp., although this scenario has not been confirmed.

**Branch Flagging and Tip Dieback in Oaks** – Flagging (leaf browning on individual branches), dieback, and dropping of oak twigs was common in western Missouri by mid-summer. When this type of damage is found in late summer and fall, twig girdlers and twig pruners (longhorned beetles) are often the cause. But most of the damaged twig samples examined in mid-summer were damaged by ***Kermes* scale** infestations, ***Botryosphaeria*** cankers, or both. Mature *Kermes* scales are rather strange-looking spheres up to 3/8-inch diameter that may be overlooked as some kind of gall. Infestations can severely affect branch health causing stunted leaves, branch flagging and dieback, and small twig drop. Canker formation by *Botryosphaeria* infections can create similar symptoms of flagging and twig death.



**Defoliators** - Large populations of **shingle oak skeletonizers** returned in 2009, particularly in western Missouri. Every few years we see outbreak populations of these small moth larvae that feed on the lower surfaces of leaves leaving a lacy skeletonized upper leaf layer. They specialize almost exclusively on shingle oaks, although other oaks also may be used as hosts. Leaf damage is severe enough to cause entire tree crowns to lose their green color, and is caused by a complex of unidentified moth species. The heaviest damage this year occurred in Johnson and Lafayette Counties with additional reports from Carroll and Dade Counties. Past major outbreaks occurred in 1983, 1991, and 1996-1997. The 1996-1997 outbreak was also centered on Johnson and Lafayette Counties. Noticeable defoliation was observed in 2004 in southeastern Missouri (Ste. Genevieve, Perry, and Cape Girardeau Counties).

**Bagworm** populations were present at high levels in several areas in 2009. Emergence of young larvae was prolonged over much of the summer, sometimes having the appearance of multiple hatches. However, it is assumed this pattern was the result of egg hatching being delayed for portions of the one annual generation. Small larvae were present as late as August. The cooler temperatures of 2009 likely played a major role, but may not be the complete explanation for this emergence pattern.

**Walnut caterpillar** populations returned to lower levels in 2009 following outbreaks on walnut, pecan and hickories in western Missouri in 2007 and 2008.

**Oak Wilt** - Samples from 14 counties across the state were determined in the MDC forest health lab to be positive for oak wilt in 2009. Four of those counties (Ray, Randolph, Dent, and Jefferson Counties) produced positive oak wilt samples for the first time in recent years, bringing the total to 45 Missouri counties producing positive oak wilt samples since 2001. Oak wilt positives were obtained from suspect samples as late as September, which may be due to this year's cooler weather. The oak wilt fungus is heat sensitive and often difficult to detect in late-summer samples.

