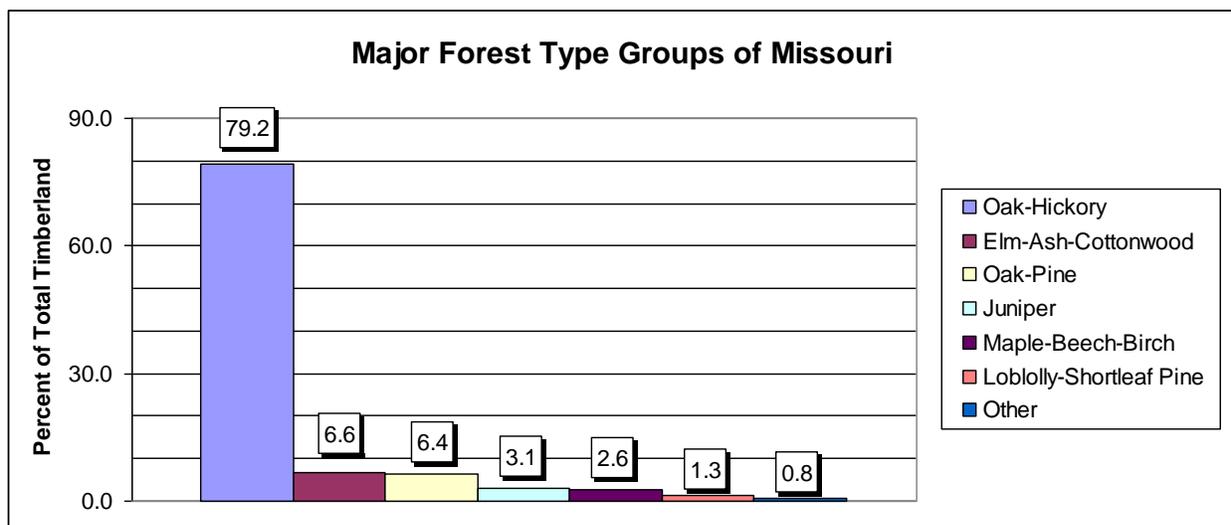


Missouri Forest Health Highlights - 2008

The Resource

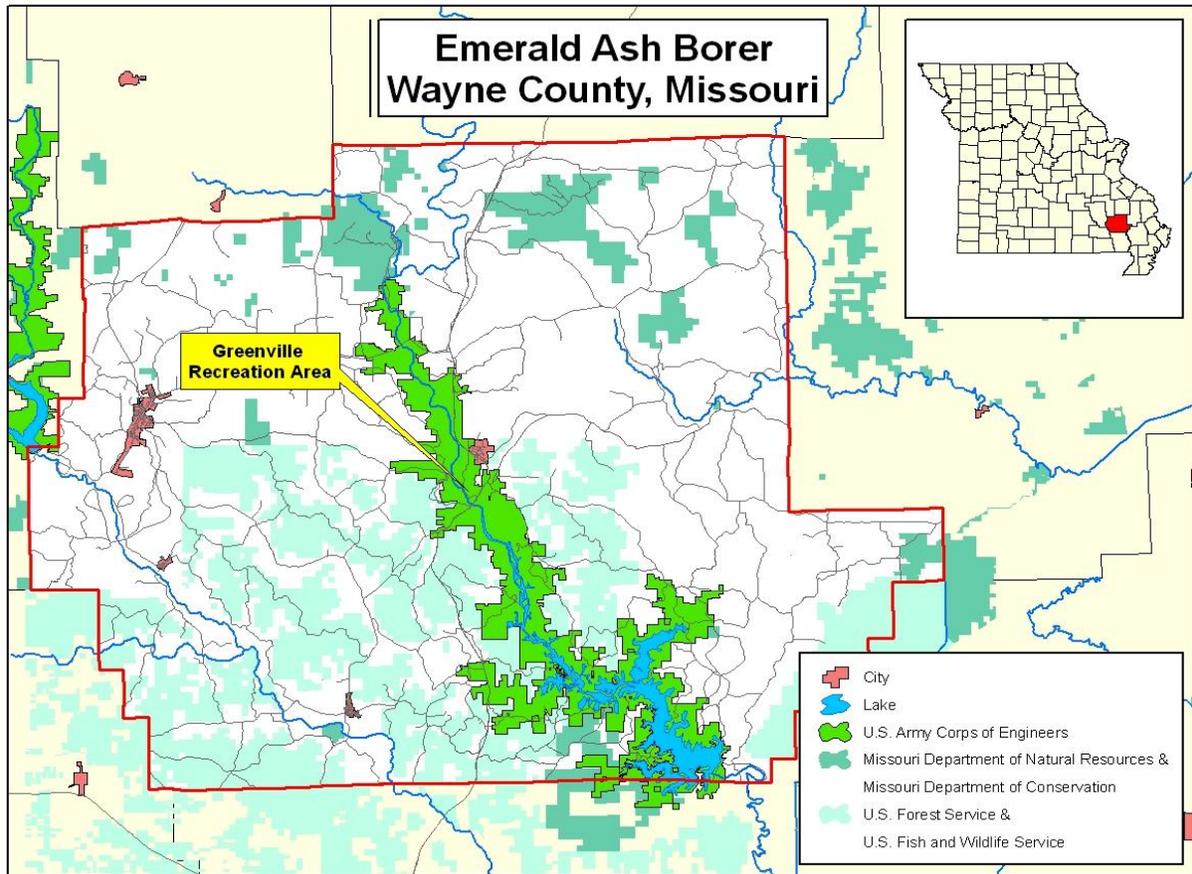
Missouri is about one-third forested and well-known for its oak-hickory forests. There are over 15 million acres of forest land based on the 2006 forest inventory, an increase of 8% since 1989. Nearly four-fifths of the forest land in Missouri is dominated by oaks, hickories and associated species.



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 \$4.43 billion annually to the Missouri economy in 2005 dollars. The industry supports over 32,250 jobs at a payroll of about \$1.1 billion and is responsible for over \$360 million in taxes, including \$54 million in state sales tax.

Invasive Species

Emerald Ash Borer – The first known infestation in Missouri of the emerald ash borer (EAB), *Agrilus planipennis*, was detected on July 23, 2008 in Wayne County in southeastern Missouri. This non-native wood borer, first detected in North America in Michigan in 2002, has killed millions of ash trees in the U.S. and Canada. EAB was detected in Missouri when seven adults were captured on a sticky trap at the U.S. Army Corps of Engineers' Greenville Recreation Area. Traps had been placed by USDA-APHIS at over 40 high-risk sites across Missouri in 2008.

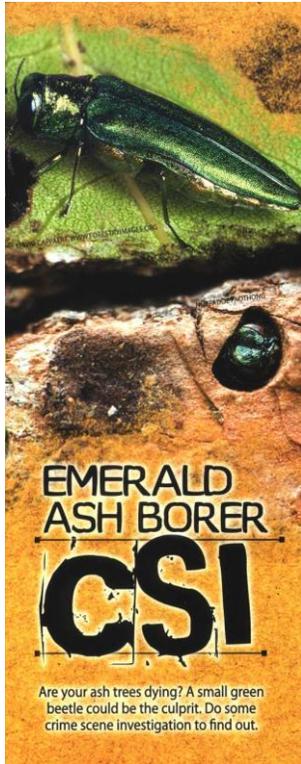


Additional high-risk sites were evaluated across the state with a visual survey by the Missouri Department of Agriculture and establishment of detection trees (girdled ash trees) by a University of Missouri crew. Detection trees were felled, debarked and examined in the fall. All visual survey and detection tree sites were negative for EAB, except at the Greenville site where all three detection trees were infested with emerald ash borers.

Response to the EAB infestation followed procedures outlined in the Missouri Emerald Ash Borer Action Plan that was completed in May 2008. The Plan established an EAB Action Team consisting of the Missouri Departments of Agriculture, Conservation and Natural Resources, University of Missouri Extension, USDA-APHIS-PPQ, and USDA Forest Service, with collaboration of numerous public and private stakeholders.



EAB larvae in S-shaped tunnels,
Wayne County, Missouri



Diagnostic Brochure

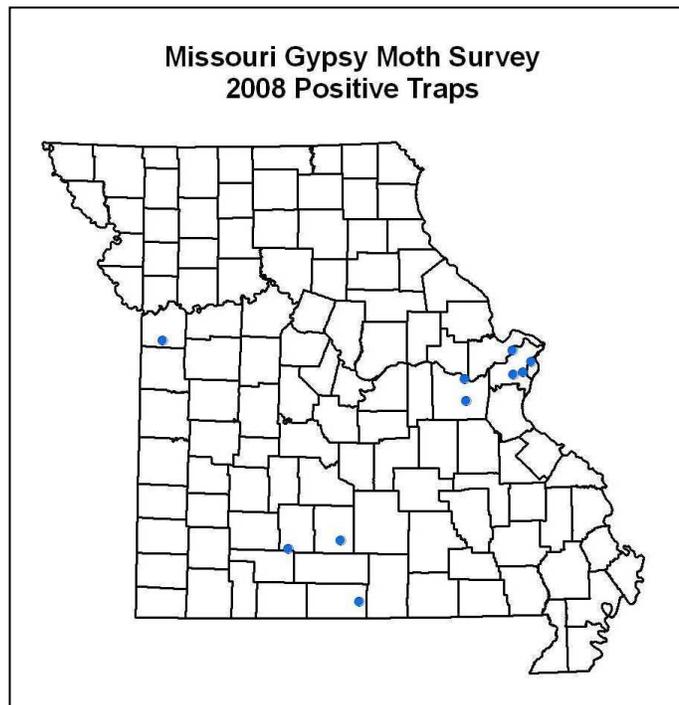
Following confirmation of the EAB infestation at the Greenville site, a visual survey revealed many infested trees within a one-mile radius of the positive trap. Movement of infested firewood into the Recreation Area campground is presumed to be the pathway of EAB introduction. State and federal quarantines were implemented on Wayne County prohibiting movement of regulated articles (deciduous firewood, ash trees and their components, and emerald ash borers). A public meeting was held in Greenville on August 25 where state and federal officials answered questions about the infestation and quarantine. In the fall, the Army Corps of Engineers began removing and destroying ash trees in the vicinity of the Recreation Area in an attempt to slow the spread of the infestation. EAB survey efforts will increase in 2009 and include an intensive trap survey in southeastern Missouri.

Public outreach efforts about EAB continued to increase in 2008. Information was expanded on the Missouri Dept. of Conservation web site (<http://mdc.mo.gov/forest/health/ashborer>). A web-based reporting form and a toll-free phone number were set up by which the public could submit questions or reports of suspected EAB infestations. University of Missouri Extension established a comprehensive EAB web site (<http://eab.missouri.edu>). A new brochure, *Emerald Ash Borer CSI*, was produced to assist the public in diagnosing EAB infestations in their trees. Public service

announcements, web-based videos and media releases were produced, and presentations were given at numerous workshops, fairs and stakeholder group meetings.

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 almost 11,800 traps across the state in 2008. Ten moths were captured statewide, a total that is typical for recent Missouri surveys. Four moths were caught in St. Louis County, two in Franklin County immediately west of St. Louis, one in the Kansas City area (Jackson County), and one each in Ozark, Webster and Wright Counties in south central Missouri.

There are no known populations of gypsy moths in Missouri. Sites where gypsy



moths have been captured are surveyed with a higher trap density in the following year. 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

Missouri forests, stressed in 2007 by several climatic events, received near record high levels of precipitation across the state in 2008. Climatic stressors in 2007 included a severe ice storm across southern Missouri in January, a week-long freeze event statewide in April following unusually early warm-up and leaf expansion, late-summer drought in southeastern Missouri, and additional damaging ice storms in much of the state in December. These events were followed by a very wet 2008. This was the wettest year on record for St. Louis which received 57.96 inches precipitation, compared with a long-term average of 38.75 inches (NOAA). It ranked as the second highest precipitation year in Columbia (56.78, average = 40.28) and the third highest in Springfield (60.11, average = 44.97).

A pattern of heavy rain events continued throughout the spring and summer. Heavy rains in March resulted in flooding in many parts of southern and eastern Missouri. Nearly 11.5 inches of rain fell in Cape Girardeau on March 18, establishing an all-time 24-hour rainfall record for the city. Flooding due to heavy rains occurred in June in several locations in northern and eastern Missouri. Heavy rains in Wisconsin and Iowa resulted in extensive flooding along the Mississippi River. Remnants of hurricane Dolly in July and hurricanes Gustav and Ike in September crossed the state bringing heavy rains and damaging winds.

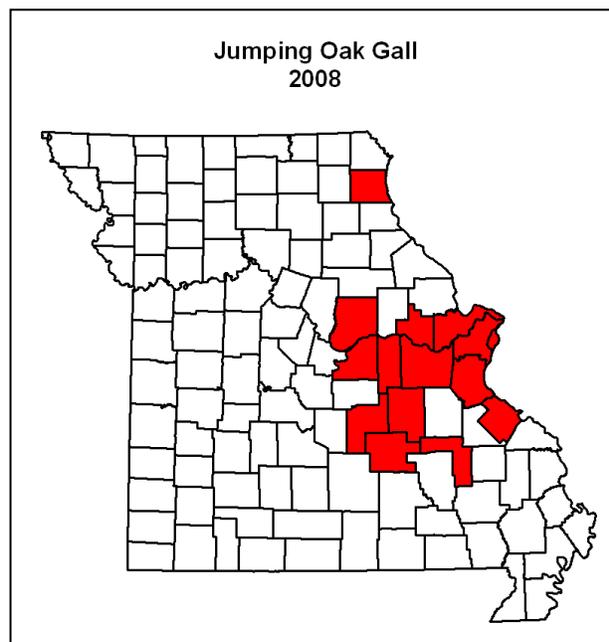
The April 2007 freeze event caused nearly 100% leaf damage statewide. Branch tip death was common. Some impacts of the freeze damage carried over into 2008. Acorn production was severely affected and differed as expected between white oak and red oak species groups. Acorn production among white oaks in 2007 was the lowest on record since 1960 when MDC's annual oak mast survey began. The white oak acorn crop rebounded to above average levels in 2008. The pattern was reversed among red oaks in which acorn production was well above average in 2007, but the lowest on record in 2008. This pattern reflects species differences in acorn production in which white oak acorns are produced in the same season in which flowers are fertilized, and red oak acorns mature in the year following fertilization.

Although tree seed production is controlled by many factors, it is interesting to note that in 2008, the year following many climatic stressors, seed production was exceptionally high among several additional species: black walnut, hickories, ashes, river birch, persimmon and pawpaw.

Other evidence of possible effects of the 2007 freeze and other abiotic stresses came from many reports received in 2008 of declining tree health, particularly among silver maples. Reported symptoms included a greatly delayed spring leaf flush and leaves that were reduced in size to as little as one-third of normal. Upper crown branch dieback was common by late June and July.

Other Forest Insects

Jumping Oak Gall - An outbreak of the jumping oak gall occurred on white oaks in eastern Missouri in 2008. Heavy infestations caused significant leaf damage resulting in entire tree crowns turning brown. Damage became obvious by mid- to late June. Similar outbreaks have occurred intermittently in past years in various parts of Missouri, but most often on the eastern side of the state. High population levels typically decline in one or two years.



Walnut Caterpillar - Outbreaks of walnut caterpillars caused severe defoliation on black walnut and pecan in 2007 in southwestern Missouri (from Bates, St. Clair and Hickory Counties south to Jasper, Lawrence and Christian Counties). Significant population levels were still present in 2008 in some of those areas. Outbreaks also occurred in 2008 in additional areas farther north between Kansas City, St. Joseph and Chillicothe, where high populations were reported on walnut, pecan and hickories.

Pine Bark Beetles - Reported cases of pine bark beetle activity dropped in 2008 to typical lower levels from the high number of drought-related outbreaks seen in 2007. This year's high precipitation levels provided moisture beneficial to tree defense against bark beetle attack.

Sapfeeders - The massive aphid populations present on walnuts and other hardwood species in 2007 were not seen in 2008. However, lace bugs were again frequently reported on white oaks.

Seed Insects - With the heavy seed crops present on some tree species this year came some larger than normal populations of seed insects. Ash seed weevils (*Lignyodes* sp.) were observed "raining down" in large numbers from ash trees at several locations in northern and western Missouri as they dropped to overwintering sites in the soil during October. Some reports were also received of heavy seed insect damage in hickories.

Forest Diseases

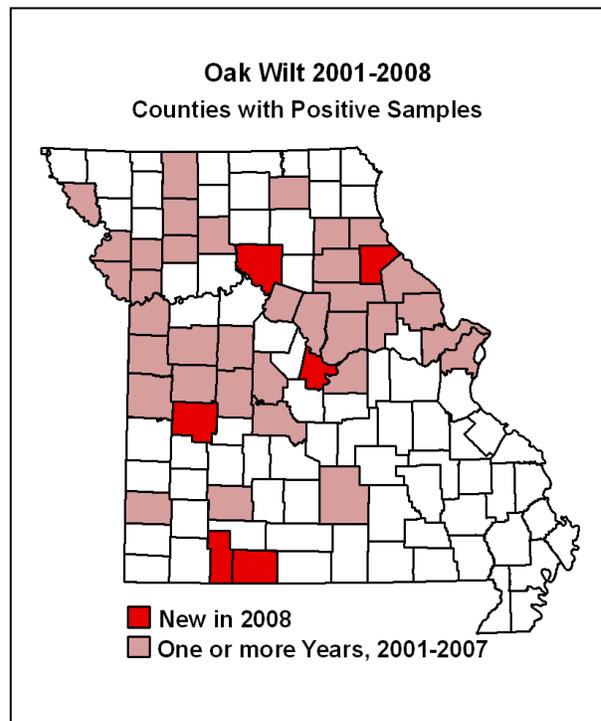
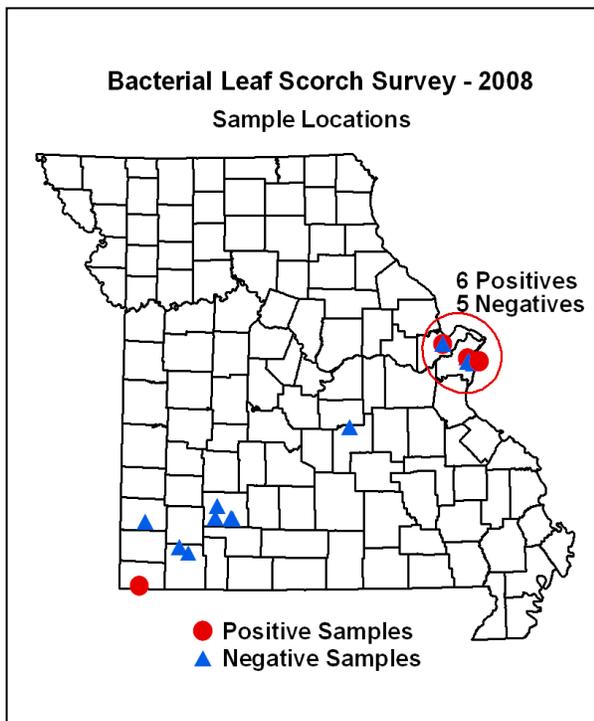
The cool, wet weather that persisted through spring and summer provided favorable conditions for fungal diseases.

Anthracnose - Numerous samples of anthracnose from oaks, maples, ash and yellow poplar were received in June by the Missouri Department of Conservation forest health laboratory.

Tubakia Leaf Spot - In late August and early September, a large number of *Tubakia* (formerly *Actinopelte*) samples were submitted to the MDC forest health lab from throughout the state. Infections were present on black, northern red, white, post, chinkapin, and pin oaks.

Bacterial Leaf Scorch (BLS) is a disease caused by the bacterium *Xylella fastidiosa* that affects oaks and many other tree species. Leaf scorching symptoms are followed by premature leaf drop and eventual tree mortality. In 2008, the Missouri Department of Conservation and other Missouri cooperators participated in a multi-state study to evaluate the incidence and distribution of BLS. Suspected samples of BLS were submitted to Dr. Gerry Adams at Michigan State University for testing.

Higher precipitation levels in 2008 nearly eliminated late-summer drought-related leaf scorch that is common in Missouri, thus reducing some confusion when attempting to identify leaves with possible BLS symptoms. However, oak wilt symptoms also may be confused with those of BLS. Suspect samples were collected in an area stretching from southwestern to east central Missouri. Six positive samples were detected from the St. Louis area and one positive sample from McDonald County in southwestern Missouri.



Oak Wilt - Samples from 11 counties across the state were determined in the MDC forest health lab to be positive for oak wilt in 2008. Six of those counties (Chariton, Cole, Ralls, St. Clair, Stone and Taney Counties) produced positive oak wilt samples for the first time in recent years, bringing the total to 40 Missouri counties producing positive oak wilt samples since 2001.