

II. Emerald Ash Borer (EAB)

History

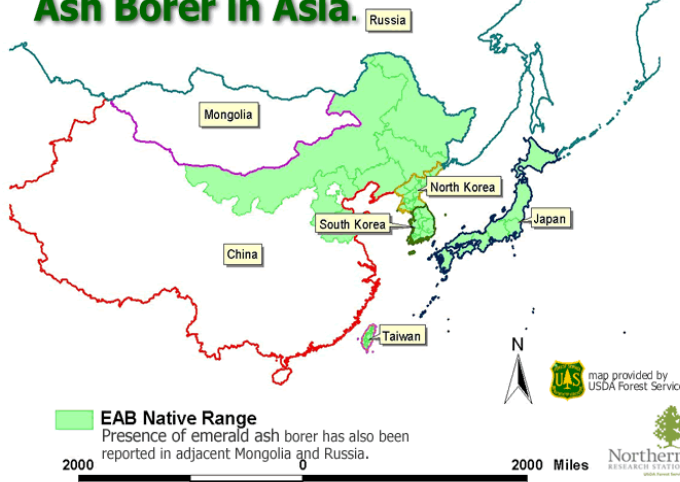
Emerald Ash Borer (*Agrilus planipennis*) is a non-native wood-boring insect that feeds on North American ash trees. EAB is native to Asia, in particular northeast China, Korea, Japan, Taiwan, and a small area in adjacent Russia and Mongolia.

EAB is thought to have been introduced to southeastern Michigan through solid wood packing material, such as crates and pallets, originating from Asia. The insect was found in 2002, but is believed to have arrived in the early 1990's. Experts suspect that the insect was present for 12 years before it was identified.



Emerald Ash Borer
Source: Wisconsin

Native range of Emerald Ash Borer in Asia.



EAB Native Range
Source: USDA Forest

In its native range, EAB feeds on a variety of plant species and is only considered a minor pest. This is partly due to the fact that Asian ash trees have been able to develop co-evolutionary resistant to EAB attacks and populations are also kept in check by predators and pathogens. However, this is not the case in North America where ash trees have no natural resistance and EAB has few predators. In North America, woodpeckers and a native wasp have been shown to attack EAB eggs and

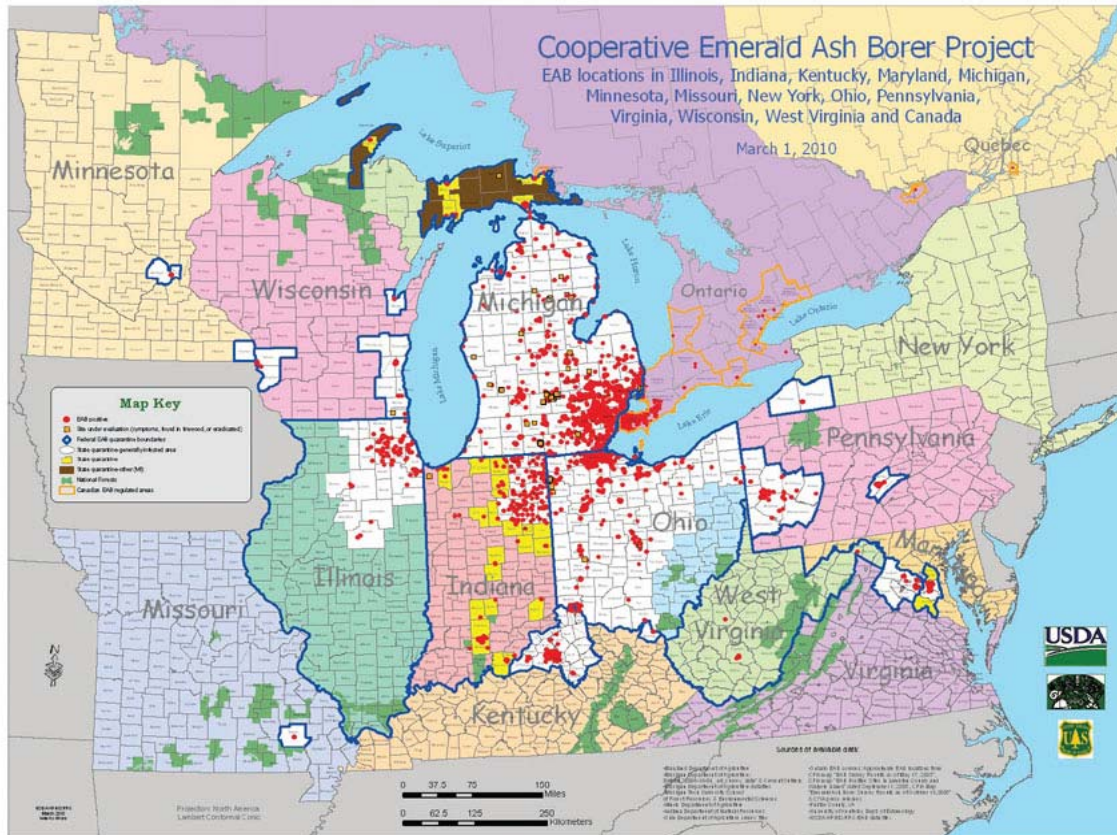
larvae, but with little impact on populations. In addition, research is being conducted with three species of wasps from China that show some promise of control (refer to *Section V – Preparation, Detection, and Control* for more information).

In North America, EAB attacks all ash trees in the genus *Fraxinus*, including green ash (*F. pennsylvanica*), white ash (*F. americana*), black ash (*F. nigra*), pumpkin ash (*F. profunda*), blue ash (*F. quadrangulata*), and other native species in the same genus. Mountain ash (*Sorbus* spp.), not a true ash, is unaffected.

EAB is known to attack both healthy and declining ash trees and can infest branches as small as one inch in diameter. Left on its own, EAB can travel ½ mile to several miles per year during its flight period. However, due to human activities EAB has

spread over much greater distances than it could have moved naturally. The number one human activity that has led to the spread of EAB is the movement of firewood. In addition, the movement of nursery stock has also played a role in its movement.

EAB has had a devastating effect on North American forests and has been compared to the effects of chestnut blight and Dutch elm disease. To date, EAB has killed 15 million ash trees in a 20-county area around Detroit and has been found in 13 states, and Ontario, Canada. If it is not contained or its effects mitigated, it will continue to infest and kill all species of ash tree in the genus *Fraxinus*.



Distribution Map of Emerald Ash Borer in North America as of March 1, 2010.
Source: USDA – APHIS.

In addition, if left unchecked, EAB could result in the losses of millions of dollars to the lumber and nursery industries as well as urban communities. Preliminary findings by the USDA Forest Service estimate that EAB's potential impact to the national urban landscape is a potential loss of between 0.5 to 2 percent of the total leaf area (30-90 million trees) and a value loss of between \$20-60 billion. In addition, if EAB is not contained or eradicated it could cause approximately \$7 billion in additional costs to state and local governments and landowners to remove and

replace dead and dying ash trees in urban and suburban areas over the next 25 years.¹

Identification and Lifecycle²

Emerald ash borer adults are very small, metallic green beetles. They are only 3/8 - 1/2 inch long and 1/16 inch wide (about the size of a cooked grain of rice). Adult emerald ash borers emerge from beneath the bark of ash trees in late May through mid-July, creating a D-shaped exit hole as they chew their way out of the tree. Adult beetles are most active during the day and prefer warm, sunny weather. They never wander far from where they exit a tree (less than one mile) in search of a mate. Once they find a mate, the female will lay 60 - 90 eggs, one at a time, in the crevices of ash tree bark. The adult beetles will feed lightly on ash tree leaves, but do not cause much harm by doing so. The adult beetles live a total of three to six weeks.



Emerald Ash Borer
Source: Wisconsin Emerald Ash Borer Information Source



Emerald Ash Borer Larvae
Source: Iowa DNR Forestry



Emerald Ash Borer Galleries
Source: University of Wisconsin, Department of Entomology

Emerald ash borer eggs are very small (1 mm), difficult to find and are rarely seen. Female adult beetles deposit them in the bark crevices and as larvae hatch from the egg, they immediately chew their way into the tree.

Emerald ash borer larvae are white and slightly flattened, with a pair of brown pincher-like appendages on the last abdominal segment. Their size varies as they feed under the bark on the ash tree's tissues and grow. Full grown larvae average 1½ inches in length. They wind back and forth as they feed, creating characteristic S-shaped patterns called galleries under the bark (starting in the phloem and extending into the xylem layers). Larvae will feed under the bark for one sometimes two years healthier trees, and can survive in green wood, such as firewood, even if the tree is no longer standing.

In autumn, after of feeding under the bark, larvae will create a chamber for themselves in the tree's sapwood. They stay in this chamber over winter and pupate in the spring, turning into adult beetles. The adults emerge

¹ New Pest Response Guidelines, Emerald Ash Borer *Agrilus planipennis* (Fairmaire), USDA-APHIS 2008.

² Wisconsin's Emerald Ash Borer Information Source, <http://www.emeraldashborer.wi.gov/index.jsp>.

from the pupa case and then emerge from the tree through D-shaped exit holes, completing the life cycle. The pupae, like the larvae, cannot be seen unless the bark is pulled away from the tree.

Keep in mind when identifying EAB that there are numerous metallic green insects common to Wisconsin that could easily be confused with EAB. In addition, there are several native pests other than EAB that attacks ash trees. For more information on these pests please refer to [Appendix x](#).

Ash Tree Identification

Since EAB attacks only ash trees, monitoring for its presence means knowing how to identify ash. Ash trees are most easily identified by their compound leaves (leaves are composed of 5-11 leaflets) and opposite branching pattern where branches, buds, and leaves grow directly across from each other not staggered and. The only other oppositely branched tree with compound leaves is boxelder (*Acer negundo*), which almost always has three to five leaflets. The bark on mature ash trees is tight with a distinct pattern of diamond-shaped ridges. On young trees, bark is relatively smooth. For more information on ash tree identification refer to [Appendix x](#).



Opposite branching and buds.
Source: WDNR EAB Field Guide



Green ash compound leaf
Source: WDNR EAB Field Guide



Example of diamond pattern bark typical of green and white ash.
Source: WDNR, Brian Schwingle

Ash Tree Signs and Symptoms



Woodpecker damage to EAB infested trees.
Source: WDNR EAB Field Guide

It is important to remember that since EAB is a wood-boring insect and spends most of its life under the bark of the tree, it is difficult to detect in ash trees. It is also difficult to detect because the decline of infected ash tree's is usually gradual. Looking for visible signs and symptoms is one method for detecting EAB. Symptoms of an infestation might include dead branches near the top of a tree or wild, leafy shoots growing out from its lower trunk. However, D-shaped exit holes and bark splits exposing S-shaped tunnels are significant signs of EAB.

A sign that a tree has become infested by EAB is bark with a mottled appearance and/or jagged holes,

both caused by woodpeckers looking for pre-pupal larvae. Another sign are the D-shaped exit holes present on the branches and the trunk left by emerging adults. For D-shaped holes to be present a tree has to be infested for at least one year. Since EAB prefers warm sunny areas of the tree the infestation usually begins in the tops of ash trees making it difficult to find D-shaped holes in the early stages of infestation. In addition, if a tree has EAB the bark may split vertically above larval feeding galleries. When the bark is removed from infested trees, the distinct, frass-filled larval tunnels that etch the outer sapwood and phloem are readily visible on the trunk and branches. An elliptical area of discolored sapwood, usually a result of secondary infection by fungal pathogens, sometimes surrounds larval feeding galleries.



EAB adult emerging through D-shaped exit hole.
Source: USDA-Forest Service



Epicormic branching and dying branches possibly associated with infested ash tree.

Source: WDNR. EAB Field Guide

The serpentine tunnels excavated by feeding larvae interrupt the transport of nutrients and water within the tree during the summer causing foliage to wilt and the tree's canopy becomes increasingly thin and sparse as branches die. Many trees appear to lose about 30% to 50% of the canopy after 2 years of infestation and trees often die after 3-4 years of infestation. Often at the margin of live and dead tissue, epicormic shoots may arise on the trunk of the tree. And dense root sprouting sometimes occurs after trees die.