

How to Identify an Ash Tree Infested by Emerald Ash Borer

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The emerald ash borer (*Agrilus planipennis*) is a threat to all the ash trees in our state. None of our native ash have any resistance to this insect and once attacked, unless insecticides treatments are started within a year or two, the tree will die. The emerald ash borer has been responsible for the loss of more than 60 million ash trees in the United States and Canada since its accidental introduction from Asia into Michigan during the 1990s.

When tree owners notice dieback and decline of their ash trees or see small holes in the tree trunk they may wonder whether their tree is infested with emerald ash borer (Figure 1). However, there are many possible

reasons an ash tree is declining, most commonly drought stress. These trees are often attacked by one of the many other boring insects and these insects may be confused with emerald ash borer. This guide will help you determine whether an ash tree may be infested by the emerald ash borer.

The first step is to be sure the tree is an ash tree.

The emerald ash borer infests only ash trees so identifying the tree is the first step in the diagnostic process. Emerald ash borer attacks all the native ash common to South Dakota: black ash (*Fraxinus nigra*), green ash (*F. pennsylvanica*), and white ash



Figure 1. Tree infested by emerald ash borer may be hard to distinguish from drought-stressed ash.



Figure 2. (top photo) Ash leaves are arranged opposite to one another along a twig and each leaf is divided into 5 to 9 leaflets with the margins smooth or having very fine teeth.

Figure 3. (bottom photo) The leaves on a green ash tree.



Figure 4. (top photo) Boxelder leaves are arranged opposite to one another along a twig and each leaf is divided into 3 to 5 leaflets with each leaflet coarsely toothed.



Figure 5. (bottom photo) The leaves on a boxelder tree.

(*F. americana*) along with their many cultivars. The Manchurian ash (*F. mandshurica*), native to Asia, is not usually killed by an attack unless drought-stressed.

How to identify ash trees.

All ash trees have opposite branching: when one leaf or twig appears, another one will be opposite to it along the shoot. The leaves are pinnately compound, meaning they are divided into leaflets that align along a common stalk (rachis). Ash leaves have at least 5, typically 7 and occasionally 9 leaflets, with each leaflet about 2 to 4 inches long (Figures 2 and 3).

Other trees that may have ash as part of their common name, such as ash-leaf maple, better known as boxelder (*Acer negundo*), and mountainash (*Sorbus*), are not attacked by the emerald ash borer. However, the leaves of these trees may resemble those of ash.

Boxelder has opposite, pinnately compound leaves with only 3 to 5 leaflets per leaf and these leaflets are often coarsely toothed (Figures 4 and 5). The shoots of boxelder are usually covered with a bluish bloom or powder which can be rubbed off whereas ash shoots are brown.



Figure 6. (top photo) Mountainash leaves are arranged alternately along a shoot and each leaf is divided into 9 to 11 leaflets with each leaflet toothed along the margin.



Figure 7. (bottom photo) The flowers and leaves on a mountainash tree.



Figure 8. Blonding of an infested green ash tree. The bark was shredded off by the woodpeckers as they search for the emerald ash borer larvae.

Mountainash has *alternately* arranged pinnately compound leaves, rather than opposite. Mountainash leaves also have more leaflets than ash, usually between 9 and 11 (Figures 6 and 7).

If the suspect tree is an ash

The next step is to determine if the symptoms present on the ash tree are consistent with those associated with an emerald ash borer infestation. Dead and dying ash trees are a common sight on the Northern Plains and there are many possible reasons for a tree's decline ranging from drought to attack by our native insects.

Ash trees infested by emerald ash borer often have their bark shredded off by woodpeckers searching for the larvae that live just beneath the bark. This generally appears as blinding, where the outer, rougher, layer of bark has been stripped off by the woodpecker exposing a smooth lighter bark (Figure 8). Dime-sized pits made by the woodpecker as they search for the borer usually dot the bark as well (Figure 9).

Woodpecker activity is most common on large infested ash, those more than 8-inches in diameter (measured on the trunk 4.5 feet from the ground). If the infested ash is smaller, often the woodpecker activity is very light and instead long (3- to 5-inch) vertical cracks occur along the trunk and undersides of the lower limbs (Figure 10). If these cracks are pried open, a network of tunnels created by the larvae may be seen (Figure 11). These should not be confused with the long, often several feet long, cracks that occur between the upright forks of ash trees.

Woodpecker activity and bark splits are the two best means of determining whether a tree is infested by the emerald ash borer. However, there are some other symptoms that may occasionally be associated with woodpecker activity and bark splitting. These include excessive production of epicormic shoots and suckers and canopy decline.

A tree infested by emerald ash borer may also produce epicormic shoots: long, slender, vertical shoots arising in clusters along the trunk and lower limbs (Figure 12). There may be long, slender shoots called suckers arising around the trunk (Figure 13). Both epicormic shoots and suckers are general symptoms of a declining or injured tree, rather than specific indicators of an emerald ash borer infestation.



Figure 9. Pits are made by the woodpeckers as they search for larvae beneath the bark.



Figure 10. Vertical splits in the trunk, usually between 3- and 5-inches long, are common in smaller trees infested by emerald ash borer.



Figure 11. If the crack is pulled open there will often be a network of tunnels created by the larvae.

Another symptom of an emerald ash borer infested tree is a thinning canopy, one in which there are individual branches dying throughout the crown (Figure 14). The thinning becomes more intense over several years with more branches dying until the complete canopy is dead. However, many of our ash out on the Northern Plains already have minor to severe dieback due to the harsh growing conditions so dieback and thinning by themselves are not good means of detecting emerald ash borer infested trees (Figure 15).

Identification of boring insect by exit holes and tunnels

There are many insects that infest ash trees and each makes a characteristic exit hole where the adult emerges. They each have distinctive galleries, the pattern to the tunnels made by the larvae as they burrow beneath the bark. These two features, the exit holes made by the adults and the tunneling pattern by the larvae, can be used as aids to separate them from the emerald ash borer. The adult borers are rarely seen on trees since they are easily disturbed so are not discussed in detail.



Figure 12. Long, slender epicormic shoots forming along the trunk of an infested tree.



Figure 13. Long suckers near the base may form on an infested tree.



Figure 14. Gradual thinning of the canopy of a tree infested by emerald ash borers.



Figure 15. Dieback is common on ash trees in South Dakota and by itself is not a good indicator of being infested by emerald ash borer.

Emerald ash borer adults create a crisp D-shaped, 1/8-inch long, exit hole (Figure 16). However, the exit holes may not appear along the lower 5 or 10 feet of the trunk until the tree is almost dead. The larvae form S-shaped, serpentine galleries just beneath the bark (Figure 17). These galleries are packed with a sawdust-like material called frass which is excrement from digested wood. A mature emerald ash borer larva is about 1- to 1-1/2 inches long, white, legless, and divided in 8 bell-shaped segments (Figure 18). At the posterior end of the larva there are two very small pinchers. The bell-shaped segmentations and the small pinchers are distinct larval characteristics are not shared by the native ash borers.

While rare, adult emerald ash borers may occasionally be observed on the bark or even emerging from the tree. The adult emerald ash borer is a slender, 3/8- to 1/2-inch long, metallic green beetle (Figure 19). The most common adult insect confused with emerald ash borer in South Dakota is the green metallic jewel beetle (*Buprestis confluenta*) which does not attack ash (Figure 20).

Native insects that infest ash

The following are the native borers that frequently attack stressed ash trees. Generally, the activity of these insects is not noticed until there is substantial decline or dieback in the canopy.

Ash bark beetles (*Hylesinus*) are very common in dying ash trees, typically in the branches. There are at least two species on the Northern Plains, the eastern ash bark beetle (*H. aculeatus*) and the western ash bark beetle (*H. californicus*). The adult insects create a round exit hole 1/16-inch in diameter, about the size of a BB, and these holes often encircle a small branch (Figure 21). The galleries are constructed just beneath



Figure 17. The powdery filled S-shape galleries made by the larvae just beneath the bark of an infested tree.



Figure 18. Emerald ash borer larvae have 8 bell-shaped segments and two small pinchers at the rear.



Figure 19. The adult beetles are slender, almost torpedo-shaped and about 1/2-inch long. They are a bright metallic green.



Figure 16. The distinct D-shaped exit hole made by the emerald ash borer adult as it emerges from the tree.



Figure 20. The adult green metallic jewel beetle is larger and wider than the emerald ash borer.

the bark and consist of a main gallery created by the adult beetles with numerous smaller galleries at right angle to this main gallery formed by the larvae (Figure 22). The mature larvae are about 1/8-inch long, legless, and C-shaped. They are white with a brown head capsule.

Ash/lilac borer (*Podosesia syringae*), also known as a clearwing borer, is a common insect on the Northern Plains that attacks the lower (10 to 15 feet) trunks of ash trees and the bases of lilac canes (Figure 23). The adults make an exit hole about the size of a pencil (1/4-inch) (Figure 24). Papery pupal skins may be found at these exit holes (Figure 25). The larval galleries may extend several inches into the sapwood rather than remaining just beneath the bark. The galleries are not packed with frass. Instead this material is pushed out of the tunnel by the mature larvae so the ground beneath the trunk is covered with this powdery material (Figure 26). The full grown white larvae are about 1-inch long, with 3 pair of short thoracic legs and several pairs of prolegs, short, stubby leg-like appendages, on the abdomen (Figure 27).

Banded ash borer (*Neolytus caprea*) and the **redheaded ash borer** (*N. acuminatus*) are probably the most common borers of dead or dying ash trees on the Northern Plains (Figures 28 and 29). These insects create a round-oval exit hole, sometimes almost D-shaped, and slightly less than 1/4-inch in diameter (Figure 30). The galleries beneath the bark are similar



Figure 22. The galleries made by the larvae of ash bark beetles have one long gallery with numerous side galleries perpendicular to it.



Figure 23. The adult ash/lilac borers closely resemble wasps.



Figure 21. The exit holes to the ash bark beetle adults are about the size of a BB.



Figure 24. The pencil-size exit hole created by the ash/lilac borer adult.



Figure 25. The pupal skin to a recently emerged ash/lilac borer.



Figure 26. A tree infested by the ash/lilac borer will have powdery dust at the base and by the exit holes.



Figure 27. The ash/lilac borer larvae are creamy white with a dark head capsule.



Figure 28. The adult banded ash borer



Figure 29. The adult redheaded ash borer

to those created by the emerald ash borer. They are winding and packed with frass, though the winding is often more meandering than the S-curved serpentine galleries made by the emerald ash borer (Figure 31). The galleries will also extend deeper into the wood than those created by the emerald ash borer. The mature larvae of these insects are about 3/4-inch long, legless and white. The prothorax, the area just behind the head capsule, is wider than the body (Figure 32).

Carpenterworm (*Prionoxystus robiniae*) is another native boring insect of ash trees, but it can also be found infesting cottonwoods, poplars and willows. This



Figure 30. The exit hole formed by the emerging banded ash borer adult is oval-shaped. The redheaded ash borer makes a similar size and shape exit hole.



Figure 31. The galleries made by the banded ash borer are more meandering rather than the serpentine galleries formed by the emerald ash borer.



Figure 32. Banded and redheaded ash borer larva have an enlarged thorax.



Figure 33. The exit holes for carpenterworms are slightly larger than the diameter of a pencil and may have powdery dust below them.



Figure 34. The carpenterworm larvae is the largest insect found in ash wood.



Figure 35. Carpenterworm larva burrow deep into the wood



Figure 36. The carpenterworm larvae is one of the larger borers found in ash.

insect creates an exit hole about 1/3- to 1/2-inch in diameter, slightly larger than a pencil (Figure 33). Sap may also be oozing from the exit holes and sometimes the empty pupal case left by the emerging adult insect can be found attached to the surrounding bark (Figure 34). The galleries are 5/8-inch wide, often empty of frass, and extend deep into the tree (Figure 35). Trees infested by carpenterworms often have their branches weakened by extensive tunneling and these often break off in high winds. The mature larvae are almost 2- to 3-inches long with 3 pairs of sharp, hooked, legs on the thorax and 3 pair of tiny leg-like appendages on the abdomen called prolegs. The larvae are pink to a creamy white with a darker brown head capsule (Figure 36).

Checklist to determine if your tree may be infested by emerald ash borer

If you believe you found a tree infested with emerald ash borer, do the following check:

- ✓ Is it an ash tree?
- ✓ Is bark peeling off from woodpecker activity?
- ✓ Are there vertical splits in the trunk?
- ✓ Are there serpentine galleries just beneath the bark that are filled with a powdery substance?
- ✓ Are there crisp 1/8-inch D-shaped exit holes on the trunk or branches?

Ash trees infested by emerald ash borer may not present all these symptoms and signs, but it is important to check for these points before reporting any suspected tree. If after completing the check-list you believe the tree may be infested with emerald ash borer, please contact your department of agriculture or your local extension office to request further investigation.

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