

Forest Health Alert - 3

Agrilus planipennis

EMERALD ASH BORER

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INTRODUCTION

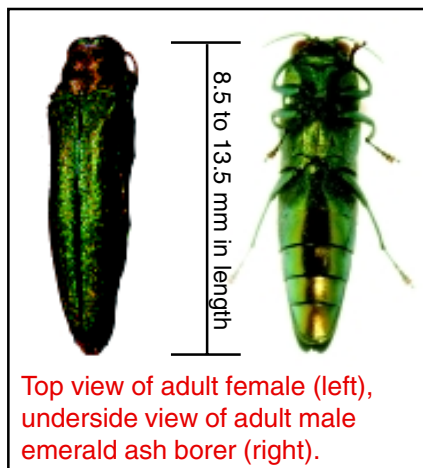
The emerald ash borer, *Agrilus planipennis* Fairmaire (formerly *A. marcopoli* Obenberger), is native to China, Japan, Korea, and Mongolia. The beetle was first identified in North America in July 2002, where its known distribution is currently thought to be restricted to an area in southeastern Michigan near Detroit, and Windsor, Ontario. In southeastern Michigan, initial surveys have detected it within six counties (Wayne, Washtenaw, Oakland, Macomb, St. Clair, and Livingston). In Ontario surveys the beetle has been found only within the city of Windsor plus a few sites just outside the city.

Although the beetle was identified in 2002, it has probably been established in Michigan for at least five years previously, based on the presence of dead trees killed by the beetle. The Windsor infestation is more recent, with trees showing one to two years of attack.

The following information was acquired from information reported in a Chinese publication, or from initial observations made in 2002. Further information will be forthcoming as we learn more about this new exotic species.

The beetle is behaving as a primary tree killer. It is able to attack and kill trees that appear to be otherwise healthy. Stressed trees are also susceptible to attack. Although similar to some native beetles, such as two-lined chestnut borer (*A. bilineatus* (Weber)) which attacks oak trees, and bronze birch borer (*A. anxius* Gory), a pest of birch trees, the emerald ash borer differs significantly in its ability to attack healthy trees.

It is not known at this time how the beetle became established here. In Michigan, areas of Wayne and Oakland Counties have relatively high numbers of ash



Top view of adult female (left),
underside view of adult male
emerald ash borer (right).

trees that are infested or dying and trees that were killed at least 1 or 2 years ago, suggesting that this may be the original point of establishment. In Windsor, the highest concentrations are near the Detroit River, which flows between Windsor and Detroit. The Windsor trees, though, were attacked more recently than those in Michigan, indicating the insect may have dispersed from Michigan to Windsor.

Other exotics, such as Asian longhorn beetle and brown spruce

longhorned beetle, are thought to have arrived in solid wood packing material such as wood pallets, crates, and dunnage - the logs used to stabilize cargo containers on ships. A similar situation may have led to the original introduction of this beetle.

THE THREAT

- This insect is able to attack and kill healthy trees.
- Trees of all sizes are susceptible to attack, from 5cm diameter at breast height to 90cm or greater.
- All native ash are susceptible: white ash (*Fraxinus americana* L.), black ash (*F. nigra* Marsh.), red ash (*F. pennsylvanica* Marsh.), and green ash (*F. pennsylvanica* var. *subintegerrima* (Vahl) Fern). Two uncommon species, blue ash (*F. quadrangulata* Michx.) and pumpkin ash (*F. profunda* (Bush) Bush), although not attacked yet, are likely to be susceptible as well.
- Ash trees are very widespread in Canada and the United States. Ash species are important wildlife species because of their seed production, and the wood is used for flooring, furniture, sports equipment, native baskets and other items, tool handles, and numerous items requiring strong, hard wood with less rigidity than maple.

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Photos provided by Ontario Ministry of Natural Resources and Michigan Department of Agriculture

- Green ash is one of the most commonly planted species in the urban forest. European black ash (*F. excelsior* L.) is also planted frequently.
- Both street trees and those growing in natural, forested areas within the southeastern Michigan and Windsor area are being attacked by the beetle.

WHAT IT DOES

- The beetle colonizes trees by laying eggs on bark and in bark crevices on the trunk and branches. The larvae then tunnel beneath the bark and feed in the cambial layer between the bark and the sapwood.
- The larval galleries meander in an S-shaped or serpentine pattern. Eventually, high numbers of larval tunnels girdle the trunk, cutting off the transport of nutrients in the phloem from the leaves to the roots. The tree then starts to die from the top down. Foliage on the tree wilts and the canopy may appear sparse.
- Maturation feeding by adults also occurs on the leaves of ash trees. The beetles eat irregular patches of foliage resulting in a jagged edge to the leaflet. This feeding damage is minor compared to the larval tunneling.

LIFE CYCLE

- The beetle appears to have a one year life cycle, similar to that in China, except in northern China where it has a two year life cycle.
- Eggs are laid singly in bark crevices from late May through July, and hatch in 7 to 9 days. In China, each female lays an average of about 77 eggs, with a range of 68-90 eggs.
- The larvae tunnel in the cambial layer, feeding on the phloem and outer sapwood, scoring deeper into the sapwood as the larvae increase in size.
- Larva feed aggressively until cooler fall temperatures arrive (mid-October in China), and then overwinter in the tree. All larval stages can overwinter.
- Pupation occurs in late April to June. The pupal chamber is constructed by tunneling into the sapwood at a shallow angle. The head of the pupa faces outward toward the bark. Newly-formed adults remain in their pupal chambers for 8-15 days, then bore through the bark to the outside.
- Adults emerge in China in mid-May, peaking in late June. Similar observations have been made in North America, but numerous adults were observed in southeastern Michigan and Windsor in late June, and even mid and late July, suggesting a longer emergence period.
- Adults prefer the sunnier, warmer sides of the trees and are often found resting or flying in the sunlit portions of



Larva has distinct flat segments, with a pair of pinchers at the tip of the abdomen.



Splitting of bark of young ash tree, with larval tunnel underneath.



Larval tunnels of emerald ash borer in serpentine pattern beneath the bark.

the crown. They are more active on clear days with little wind. Chinese reports indicate that adults often fly short distances of 8-10 m, within 1-2m of the ground and are most active between 09:00 and 13:00. In Windsor, however, peak flying seemed to be later in the day, closer to 15:00-17:00. Adult females live approximately 22 days; whereas males live an average of 13 days.

- **Mating** occurs during the first 7-10 days after emergence, with females mating multiple times. The beetles sometimes feign death and drop to the ground when disturbed. They are more sedentary when the weather is cloudy, rainy, windy, or very hot, when they sit immobile on foliage or in bark cracks.

WHAT TO LOOK FOR

- **Emerald ash borer adults** are metallic green, 8.5 to 13.5 mm long, and slender. They are slightly larger than the native two-lined chestnut borer and bronze birch borer. The head is flattened but slender, with black compound eyes that cover most of the side of the head. Short serrate antennae emanate from the face in front of the eyes, then curve back to just past the eyes. The prothorax is square, slightly wider than the head, and the same width as the anterior edge of elytra. The pronotum surface is covered in wavy ridges with multiple fine points. The back edge of the pronotum is sinuate, following the contour of the base of the elytra. Elytra have a horizontal ridge along the base, the surface appears granular rather than smooth, and the tips are rounded with small teeth along the edge. The abdomen under the elytra is copper to reddish bronze.
- **Eggs** are light yellow or cream-coloured, turning yellow-brown prior to hatching. They are approximately 1mm long and 0.6mm in diameter, elongate and somewhat flattened, but widest in the middle.



Bark splitting on older ash tree, with larval tunnel underneath.

- **Larvae** are slender, cream-coloured, flattened, with a brown head retracted into the prothorax and mouthparts extended. Mature larvae are 26-32 mm long. The prothorax is swollen relative to the meso- and methorax. The abdomen is 10-segmented, with spiracles on the first 8 segments, and a pair of brown pinchers at the tip.

- **Pupae** are 10-14mm long, cream-coloured, with terminal abdominal segments that curve upwards. Antennae extend to the base of the wings.

- **Tunnels** are oriented vertically, shallow, meandering under the bark, packed with frass (sawdust-like waste), with abrupt turns. Total length of the tunnels may be 50cm, with the tunnel covering approximately 16cm of the stem from top to bottom. Galleries are exposed 1-2 years after tree death as bark sloughs off.

- **Bark cracks:** Vertical splits in the bark over larval galleries are often present and are usually 7-10cm long. Excising the bark will expose the galleries and larvae (if present). Some trees produce callus tissue as they attempt to grow over the gallery. The cracks are more noticeable on young or pole-sized trees than on older trees with thick bark. On older trees, close inspection is required to distinguish the bark splits from normal expansion of the bark caused by vigorous diameter growth.

- **Exit holes** are distinctly D-shaped, 3.5-4.1mm across. Flat side of the D can form either the upper or lower part of the exit hole. In China the exit holes are reportedly found mostly in the lower 1.8m of the trunk. In Michigan and Windsor, however, exit holes are abundant on the trunk well up into the crown on mature trees, on large branches in the canopy, and on exposed major roots at the base of the trunk. Sawdust may be visible in the exit hole or on the bark just outside it, especially in June and July.



D-shaped exit holes 3.5-4 mm across, made by adult beetles.

•**Non-emerged adults:** Several dead adults were found in trees in Windsor, where the adults chewed an exit hole but were unable to fully emerge. Holes in the thorax of these beetles suggest that some parasitism may be occurring. Frequently the head of these beetles is absent, leaving behind a hollow exoskeleton

•**Trees:** Severely attacked trees may exhibit crown dieback from the top down in the first year of infestation. Often, 1/3 to 1/2 the branches die in one year and the entire tree dies the following year. Foliage may wilt or turn yellow during the growing season. A proliferation of epicormic branches is common on the trunk of dying trees. Dense root sprouts are often present at the base of dead trees or around stumps of cut trees.

•**Confounding symptoms:** Ash trees in southwestern Ontario and much of the north central region of the U.S. have been exhibiting several other tree health conditions (generalized crown dieback, ash yellows, anthracnose, and drought) in the last few years. *Thorough investigation is critical in identifying whether symptoms of ash decline are caused by the emerald ash borer or some other factor.*

WHY THE CONCERN?

- Ash trees are a very important component in the forests of the northeastern United States and eastern Canada, both ecologically and economically. They are a preferred species for urban tree planting, in part because they are not defoliated by gypsy moth - another exotic pest. Ironically, many of the large ash trees were originally planted to replace elm trees killed by Dutch elm disease - yet another exotic organism.
- The emerald ash borer, if not effectively controlled, has the potential to spread across the range of ash.
- In addition to the threat to ash trees, literature from China indicates the insect can also attack trees in the genus *Ulmus* (elms), *Juglans* (walnuts and butternut), and *Pterocarya* (wingnuts). The latter genus, though not native to North America, is in the same family as the walnuts, as are pecan and the hickories of the genus

Carya. The pecan and hickory trees may be susceptible as well, but there are none in the insect's home range to answer this question. One common trait of all these genera is the wood of the trees is ring porous. Only ash trees have been infested in North America to-date, even in mixed stands of ash and American elm.

- Exotic organisms are often able to be more destructive in a new range because they don't have their full suite of natural parasites, predators, or diseases, and the newly-exposed host plants often haven't evolved effective defenses against them.
- A Chinese report indicates that this insect undergoes population outbreaks that have resulted in death of entire stands of ash.

WHAT IS BEING DONE

- The identity of this beetle was determined only a short time ago. Surveys are underway to determine the extent and severity of the infestation.
- Investigations are being conducted to determine the insect's biology and habits in North America.
- The surveys, together with rapidly increasing knowledge about the beetle, will help determine what should be done about this most recent introduction.
- At the international trade level, Canada and the United States have recently imposed restrictions (e.g. fumigation, kiln-drying) of solid wood packing from China to reduce the chance of new organisms being introduced. Similar restrictions are being planned for solid wood packing from other countries as well. The emerald ash borer likely arrived in North America before any of the new regulations were in place.
- Michigan has imposed quarantines on ash nursery stock, ash lumber and related products in the infested area to reduce the risk of transporting beetles into new areas.
- Transport of ash firewood, or trees that cut because they were dead or dying, could introduce the beetle into new areas if the wood is infested. Education and awareness programs will be needed to reduce this risk.

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