Forest Health Alert - 3

Emerald Ash Borer (Agrilus planipennis)

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INTRODUCTION The emerald ash borer, *Agrilus planipennis* Fairmaire, is an invasive insect species that was first found in North America in June 2002. Shortly after the Detroit , Michigan discovery, forest health monitoring staff from the Ontario Ministry of Natural Resources (OMNR) and Canadian Forest Service (CFS) determined the beetle was also present in Windsor , Ontario . The Canadian Food Inspection Agency (CFIA) was immediately notified. Surveys conducted in Canada and the U.S. found the beetle was well-established in the Detroit and Windsor areas.

Little information was known about the beetle at the time. Arriving in North America through improperly treated wooden packaging material from Asia , the insect didn't even have a common English name. Despite substantial research and control efforts, the beetle has continued to spread to new areas. Some of this spread has been natural dispersal, but the long distance spread has been helped by people, especially through the movement of nursery stock or infested firewood from infested areas.

Emerald Ash borer

The emerald ash borer is an invasive insect which attacks all species of ash trees in North America

Emerald ash borer is now found throughout much of Essex County and part of Chatham-Kent in Ontario . In Michigan , the beetle is concentrated in the southeastern portion of the state, but has also spread to multiple locations in the Lower Peninsula and as far north as the Mackinac Bridge. Spot infestations have also been found in Ohio and Maryland . Researchers, regulators, and urban foresters are in a race to halt the spread of the insect long enough to develop effective control measures to save native ash trees, an important hardwood species in North America.

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The Threat

- The emerald ash borer is able to attack and kill healthy trees.
- All native ash species are at risk.
- Ash trees of all sizes are susceptible to attack, from 5 cm DBH (diameter at breast height) to 90 cm DBH or greater. Larvae have been found in branches as small as 1.1 cm in diameter.
- Ash trees are widespread in Canada and the United States , both in natural and urban settings, and green ash is one of the most commonly planted species in the urban forest.
- Emerald ash borer is very difficult to detect early. When infested trees are found, it's often 1 year or more after the attack occurred. In addition, there are several other factors affecting ash health in Ontario which may disguise its presence.
- Estimates show the emerald ash borer has killed several hundred thousand ash trees in Essex County , Ontario , and 8 to 10 million ash trees in southeastern Michigan . Tree loss includes ornamental, rural and woodlot trees.
- If not effectively controlled, the emerald ash borer is expected to spread across the entire range of ash, causing widespread tree mortality.

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ADULT RECOGNITION Emerald ash borer adults are metallic green, 8.5 to 13.5 mm long, and slender. The head is flattened, with black compound eyes that cover most of the side of the head. Short antennae extend from the face, then curve back to just past the eyes. The upper side of the abdomen is copper to purplish, and is visible when the wings are open.

EGG RECOGNITION Eggs are light yellow or cream-coloured, turning yellow-brown prior to hatching. They are approximately 1mm long and 0.6 mm in diameter, and are very difficult to spot on the tree.

Egg Recognition

LARVA RECOGNITION Larvae are slender, cream-coloured, flattened, with a brown head. Mature larvae are 26-32 mm long and have a pair of brown pinchers at the tip.

PUPA RECOGNITION Pupae are10-14 mm long, cream-coloured, with terminal abdominal segments that curve upwards. Antennae extend to the base of the wings.

SYMPTOMS AND DAMAGE Ash trees in Ontario and much of the north central region of the U.S. have been exhibiting a range of poor tree health conditions, including generalized crown dieback, leaf diseases and drought. *Thorough investigation is critical in identifying whether symptoms of ash decline are caused by the emerald ash borer or some other factor.*

Emerald ash borer larva grow to between 10 to 14mm in length. The adult beetle measures 8.5 and 13mm

What to look for:

Tunnels

Tunnels are oriented vertically, shallow, meander under the bark with abrupt turns and are packed with frass (sawdust-like waste). Total length of the tunnels may be 50cm. 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 7-10 cm long. The cracks are more noticeable on young or pole-sized trees than on older trees with thick bark where close inspection is required to distinguish the bark splits from normal expansion caused by vigorous growth. Removing the bark will expose the galleries and larvae, if present.

Exit holes

Once fully mature, the adult beetle will emerge through an exit hole it has chewed through the bark. These exit holes are distinctly D-shaped and measure 3.5-4.1 mm across. Exit holes may be found anywhere on the tree trunk, root flare, exposed roots or in the crown. Sawdust may be visible in the exit hole or on the bark just outside it, especially in June and July.

Non-emerged adults

Dead adults are sometimes found in exit holes where the beetle was unable to fully emerge. Frequently, the head of these beetles is absent, leaving behind a hollow exoskeleton, suggesting the beetle was killed by another insect.

Trees

Severely attacked trees may exhibit crown dieback from the top down in the first year of infestation. Often, one-third to one-half of the branches die in one year and the entire tree dies the following year. Foliage may wilt or turn yellow during the growing season. New, or epicormic, branches are common on the trunk of dying trees and dense root sprouts are often present at the base of dead trees or around stumps of cut trees.

Woodpeckers

Woodpeckers are very good at finding larvae under the bark. Look for increased woodpecker feeding activity in the trees or for signs of their probing of the bark.

What it does:

- The adult beetles will colonize a tree by laying eggs on the bark and in bark crevices on the trunk and branches. The larvae then tunnel beneath the bark and feed on the cambium, a layer of live cells 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 and water. The tree then starts to die from the top down – foliage on the tree wilts and the canopy may appear sparse.
- Feeding by adult beetles also occurs on the leaves of ash trees, but this feeding damage is minor compared to the larval tunneling.

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Life Cycle

- The beetle appears to have a one-year life cycle, but there is evidence that some may take two years to mature.
- Single eggs are laid in bark crevices from late May through July, and hatch in about 20 days. The larvae go through four development stages (instars) as they feed on the phloem and outer sapwood, scoring deeper into the sapwood as they increase in size.
- Larvae feed aggressively until cooler fall temperatures arrive in October or November, and then overwinter in the tree.
- Pupation occurs late April to June. Newly-formed adults remain in their pupal chambers for 8-15 days, then bore through the bark to the outside.
- Adults begin to emerge in mid- to late May, with peak emergence in mid-June. Adults live about one month.
- Adults prefer the sunnier, warmer sides of the trees and are often found resting or flying in the sunlit portions of the crown and are more active on clear days with little wind.
- Mating occurs 7-10 days after emergence, with females mating multiple times. Females average about 70 eggs, but laboratory studies show some may lay as many as 250 eggs.
- The beetles will feign death and drop to the ground when disturbed.
- The adults are capable fliers. Although it's unknown how far they will fly in the wild, laboratory experiments show they are capable of flying 10 km or more.

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HOST SPECIES

All ash trees native to North America appear to be susceptible to attack. Anecdotal evidence suggests green ash and red ash appear to be preferred over white ash, followed by blue ash, black ash, or European black ash. There is no clear evidence that these latter species are resistant to attack. Even if green and red ash trees are attacked first, the insect appears to be able to attack and kill the remaining ash species. Pumpkin ash, an uncommon species in Ontario , also appears to be vulnerable to attack.

Ash is an important species because it grows readily in disturbed habitats where it can be a major component of woodlots, fence rows or shelterbelts. They often grow along stream banks where they

Host Species

provide wildlife habitat, shelter, soil protection, and bank stabilization. Ash species are also important to wildlife because of their seed production which serves as an important food source. Commercially, ash wood is used for flooring, furniture, sports equipment, native baskets and items, tool handles and numerous products requiring strong, hard wood with less rigidity than maple.

All species of native ash are susceptible to attack by the emerald ash borer

Although literature from China indicated the insect also attacked a few other hardwood species (elm, walnut, Japanese wingnut), only ash trees have been attacked in North America .

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HISTORY OF INFESTED AREAS Initial 2002 surveys indicated the emerald ash borer had infested six Michigan counties, but only the western portion of Essex County was thought to be infested in Ontario . Examinations of the trees indicated the beetle first appeared in Michigan where tree mortality suggested the infestation was 5-7 years old. At the same time in southern Ontario , there was very little, if any, tree mortality associated with the emerald ash borer indicating the Ontario infestation was much more recent.

Surveys have continued since 2002. By the end of 2004, most of Essex County was infested and spot infestations were found in Chatham-Kent in Ontario . In Michigan 's Lower Peninsula , the infestation covered 20 counties in the southeastern portion, with outlying populations detected in 19 other counties. Spot infestations were also found in northern Indiana, as well as six counties in Ohio and two in Maryland .

The spot infestations clearly demonstrate the need for effective, ongoing surveys and the need to prevent people from spreading the beetle through the movement of infested materials. The US infestations outside Michigan likely originated from the transport of infested firewood and nursery stock. A similar situation has occurred in Ontario where firewood operations and movement of logs is thought to have spread the beetle into Chatham-Kent.

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QUARANTINES Immediately upon discovering the beetle, the Michigan Department of Agriculture (MDA) imposed a quarantine banning the movement of ash material (logs, trees, branches, firewood) out of the known infested counties. The CFIA imposed a similar quarantine in the western portion of Essex County in September 2002, but went one step further to include restrictions on firewood of all species. Marshalling yards were established for residents and contractors to bring potentially-infested ash material for disposal.

The quarantines have since expanded as new infestations have been found. The MDA's quarantine in Michigan was expanded from 13 counties in 2003 to 20 counties in 2004. The state-level MDA quarantine was augmented by a federal quarantine by the U.S. Department of Agriculture, Animal and Plant Health Inspection Service (APHIS) in October 2003. State-level quarantines also exist in Ohio , Indiana , and Maryland .

In Ontario , there are three separate areas regulated by the CFIA: Essex County , the Municipality of Chatham-Kent , and the Ash-Free Zone. Essex County and the Municipality of Chatham-Kent are under separate ministerial orders that restrict the movement of ash material and

firewood. The Ash-Free Zone (AFZ), created by the CFIA as a barrier to the natural spread of the insect, is under a regulation that restricts the movement of ash material and firewood, as well prohibiting the growing of ash trees.

RESEARCH Scientists in the United States and Canada are collaborating on a comprehensive research program to answer questions about the insect's life cycle, feeding habits, host tree selection, reproduction, mate selection, dispersal, and impacts on trees in urban and rural forests.

Several studies have examined ways to control the beetle through the use of insecticides applied to the tree foliage or injected into the trees. There has also been research into biological control using predators, parasites, or diseases. One of the most challenging areas of investigation has been the attempt to find a reliable early detection method using symptoms of attack, aerial surveys, host chemicals, or traps to detect adult beetles.

WHAT IS BEING DONE

- The Canadian Food Inspection Agency (CFIA) is the lead agency for invasive species such as the emerald ash borer. The CFIA has established a multi-agency approach involving the Ontario Ministry of Natural Resources, Canadian Forest Service and the Ontario Ministry of Agriculture and Food. Conservation authorities and many other groups, agencies and associations are also being consulted to ensure an effective, comprehensive approach.

  In Ontario , the CFIA started out by establishing the initial quarantine area in western Essex County in 2002.
- In 2003, the CFIA continued to survey, and cut and burned about 8,000 infested trees on what was then the leading edge of infestation. By the end of 2003, the beetle was found in much of Essex County , with a couple of spot infestations in Chatham-Kent. The CFIA expanded the quarantine to the rest of Essex County .
- In 2004, the CFIA cut the Ash-Free Zone along the eastern edge of Essex County by cutting and chipping or burning approximately 80,000 trees in a 10 km wide area, about 30 km long, from Lake St. Clair south to Lake Erie .
- Surveys in 2004 and 2005 found approximately 72 infested locations in Chatham-Kent, east of the Ash-Free Zone. The CFIA plan is to cut and chip or burn all known infested trees at these sites, as well as any potentially-infested ash trees within 500 m of the known trees.
- Ontario Parks has mounted an intensive public awareness program to reduce the risk of people bringing in infested firewood. Park tabloids and website warnings alert visitors of the risk of moving wood infested with the emerald ash borer. Visitors from quarantine areas are asked to exchange their firewood with that provided by the park, which immediately burns the potentially infested firewood. In 2004, the CFIA fined park visitors $400 for moving firewood from the regulated areas.
- In February 2004, the Ontario Ministry of Natural Resources announced up to $1 million for tree planting in areas affected by the emerald ash borer, or the Asian long-horned beetle, which had been discovered in Toronto and Vaughan .
- In June, 2004, the CFIA announced a $6.5 million tree replacement program for property owners whose trees were cut by the CFIA to control emerald ash borer, Asian long-horned beetle or the brown spruce longhorn beetle in Nova Scotia .

Research

Extensive research has been conducted since the emerald ash borer was first identified

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HOW THE PUBLIC CAN HELP

- Report signs and symptoms of infested trees to the CFIA by phone 1 800 442-2342 (toll free) or online at www.inspection.gc.ca, or contact the OMNR at 1 800 667-1940 (toll free), or your local municipal parks or forestry department.
- Manage for healthy trees and healthy forests. Follow best management practices for woodlots, and encourage a diversity of tree species.
- Don't move infested wood material to new areas.
- Firewood should be obtained locally, burned on-site, and not left behind.
- The CFIA program is focussed on the leading edge of the infestation to slow its spread. Property owners within the rest of the infested area should watch for signs of infestation and keep trees well-watered and fertilized. Trees dead or dying from emerald ash borer should be cut and burned, chipped. If the appropriate permit is obtained from a CFIA inspector, trees from within an infested area may be properly processed for lumber.

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