

EMERALD ASH BORER

A THREAT TO MINNESOTA ASH TREES - COULD MY TREE HAVE IT?

ADULT

Because of its size and short period of activity, the metallic green adult is often difficult to detect even in areas of high infestation.



CROWN DECLINE

The typical pattern of crown decline caused by EAB is the top 1/3 dying first and then progressing down the tree.

LARVA

The distinctly segmented larva is relatively easy to locate by peeling back loose bark of infested trees.



EPICORMIC SPROUTS

As the top of the tree declines, new shoots may be produced lower on the tree.

S-SHAPED GALLERIES

Even after larvae have matured and exited the tree, the distinct S-shaped galleries under the bark are diagnostic of EAB.



SYMPTOMS ON MULTIPLE TREES

Detectable levels of EAB infestation will almost always include a number of declining ash in an area. Always look for other ash nearby with similar symptoms.

D-SHAPED EXIT HOLES

Although they are difficult to find, D-shaped exit holes are diagnostic of EAB activity.



WOODPECKER HOLES

Woodpeckers love EAB larvae and woodpecker holes may indicate the presence of EAB. However, not all EAB infested trees are attacked by woodpeckers and other insect larvae may also attract woodpeckers.



For more information on the EAB threat in Minnesota or to report a possible EAB-infested ash tree:

(651) 651-201-6684 (Metro)
1-888-545-6684 (Toll Free)
www.mda.state.mn.us/invasives

state.mn.us / keyword: ash borer



In accordance with the Americans With Disabilities Act, an alternative form of communication is available upon request. (TTY) 1-800-627-3529

Emerald Ash Borer



An exotic beetle from Asia was discovered in July 2002 feeding on ash (*Fraxinus* spp.) trees in southeastern Michigan. It was identified as *Agrilus planipennis* Fairmaire (Coleoptera: Buprestidae). Larvae feed in the cambium between the bark and wood, producing galleries that eventually girdle and kill branches and entire trees. Evidence suggests that *A. planipennis* has been established in Michigan for at least six to ten years. More than 3000 square miles in southeast Michigan are infested and more than 5 million ash trees are dead or dying from this pest. This exotic pest is also established in Windsor, Ontario, Canada. In 2003, newly established populations were detected in other areas of southern Michigan and several locations in Ohio. Infested ash nursery trees were also found in Maryland and Virginia.

Identification

Adult beetles are generally larger and a brighter green than the native North American species of *Agrilus* (Fig. 1). Adults are slender, elongate and 7.5 to 13.5 mm long. Males are smaller than females and have fine hairs on the ventral side of the thorax, which the females lack. Color varies but adults are usually bronze or golden green overall, with darker, metallic, emerald green wing covers. The top of the abdomen under the wings is metallic purplish red and can be seen when the wings are spread. The prothorax, the segment behind the head to which the first pair of legs is attached, is slightly wider than the head but the same width as the base of the wing covers.

Larvae reach a length of 26 to 32 mm, are white to cream-colored and dorso-ventrally flattened (Fig. 2). The brown head is mostly retracted into the prothorax and only the mouth-parts are visible externally. The 10-segmented abdomen has a pair of brown, pincer-like appendages on the last segment.

Biology

The emerald ash borer generally has a one-year life cycle in southern Michigan but could require two years to complete a generation in colder regions. In 2003, adult emergence began in early June, peaked in late June and early July, and continued into late July. Beetles usually live for about 3 weeks and are present into mid-August. Adult beetles are active during the day, particularly when conditions are warm and sunny. Most beetles remain in protected locations in bark crevices or on foliage during rain, heavy cloud cover, high winds, or temperatures above 32°C (90°F). Beetles feed on ash foliage, usually in small, irregularly-shaped patches along the margins of leaves.

Females can mate multiple times and egg laying begins a few days after the initial mating. Females can lay at least 60 to 90 eggs during their lifetime. Eggs are deposited individually in bark crevices on the trunk or branches. Eggs hatch in 7 to 10 days.

After hatching, first instar larvae chew through the bark and into the cambial region. Larvae feed on phloem and the outer sapwood for several weeks. The S-shaped feeding gallery winds back and forth, becoming progressively wider as the larva grows (Fig. 3). Galleries are packed with fine, sawdust-like frass. Individual galleries often extend over an area that is 20 to 30 cm in length, though the length of the affected area can range from 10 to 50 cm or longer.

Feeding is completed in autumn and pre-pupal larvae overwinter in shallow chambers excavated in the outer sapwood or in the bark on thick-barked trees. Pupation begins in late April or May. Newly eclosed adults often remain in the pupal chamber for 1 to 2 weeks before emerging head-first through a D-shaped exit hole that is 3–4 mm in diameter (Fig. 4).



Figure 1. Adult emerald ash borer.



Figure 2. Second, third, and fourth stage larvae.



Figure 3. Galleries excavated by larvae.

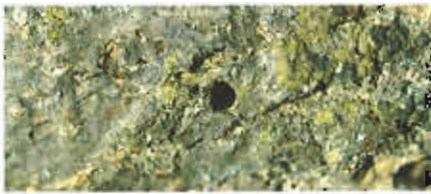


Figure 4. D-shaped exit holes where adult beetles emerged.



Figure 5. Jagged holes left by woodpeckers



Figure 6. Much of the canopy is dead on a heavily infested ash tree.

Distribution and Hosts

The emerald ash borer is native to Asia and is known to occur in China, Korea, Japan, Mongolia, the Russian Far East and Taiwan. A Chinese report indicates high populations of the borer occur primarily in *Fraxinus chinensis* and *F. rhynchophylla* forests. Other reported hosts in Asia include *F. mandshurica* var. *japonica*, *Ulmus davidiana* var. *japonica*, *Juglans mandshurica* var. *sieboldiana* and *Pterocarya rhoifolia*. In North America, this borer has only attacked ash trees. Green ash (*F. pennsylvanica*), white ash (*F. americana*) and black ash (*F. nigra*), as well as several horticultural varieties of ash have been killed.

Symptoms

It is difficult to detect emerald ash borer in newly infested trees. Jagged holes excavated by woodpeckers feeding on pre-pupal larvae may be the first sign that a tree has become infested (Fig. 5). When a tree has been infested for at least one year, the D-shaped exit holes left by emerging adults will be present on the branches and the trunk (Fig 4). 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 (Fig. 3). An elliptical area of discolored sapwood, usually a result of secondary infection by fungal pathogens, sometimes surrounds larval feeding galleries.

Serpentine tunnels excavated by feeding larvae interrupt the transport of nutrients and water within the tree during the summer. Foliage wilts and the tree 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 (Fig. 6). Epicormic shoots may arise on the trunk of the tree, often at the margin of live and dead tissue. Dense root sprouting sometimes occurs after trees die.

Emerald ash borer has killed trees of various size and condition in Michigan. Larvae have developed in trees and branches ranging from 2.5 cm (1 inch) to 140 cm (55 inches) in diameter. Stress likely contributes to the vulnerability and rapid decline of infested ash trees. However, emerald ash borer has killed apparently vigorous trees in woodlots and urban trees under regular irrigation and fertilization regimes.

Bibliography

- Yu, Chengming.** 1992. *Agrilus marcopoli* Obenberger. In Xiao, G., ed. Forest insects of China. 2d ed. Beijing, China: China Forestry Publishing House; 400-401. Translation by Houping Liu, USDA Forest Service.
- Jendek, E.** 2002. *Agrilus planipennis* fact sheet. PDF file provided by Eduardo Jendek, Institute of Zoology, Slovak Academy of Sciences, Bratislava, Slovak Republic.

Resources

Visit the following websites for information on emerald ash borer biology, identification, management, quarantines and related topics:

1. Michigan Multi-Agency Emerald Ash Borer Web Site: <http://www.emeraldashborer.info>
2. USDA Forest Service: <http://www.na.fs.fed.us/spfo/eah/>
3. Michigan Department of Agriculture: <http://www.michigan.gov> (keyword emerald ash borer)

Contact your State Department of Agriculture, State Forester, or County Extension Office for more information.

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Emerald Ash Borer Field Guide



EAB larvae
Agrilus planipennis



EAB gallery
and exit hole
(1/8 inch)



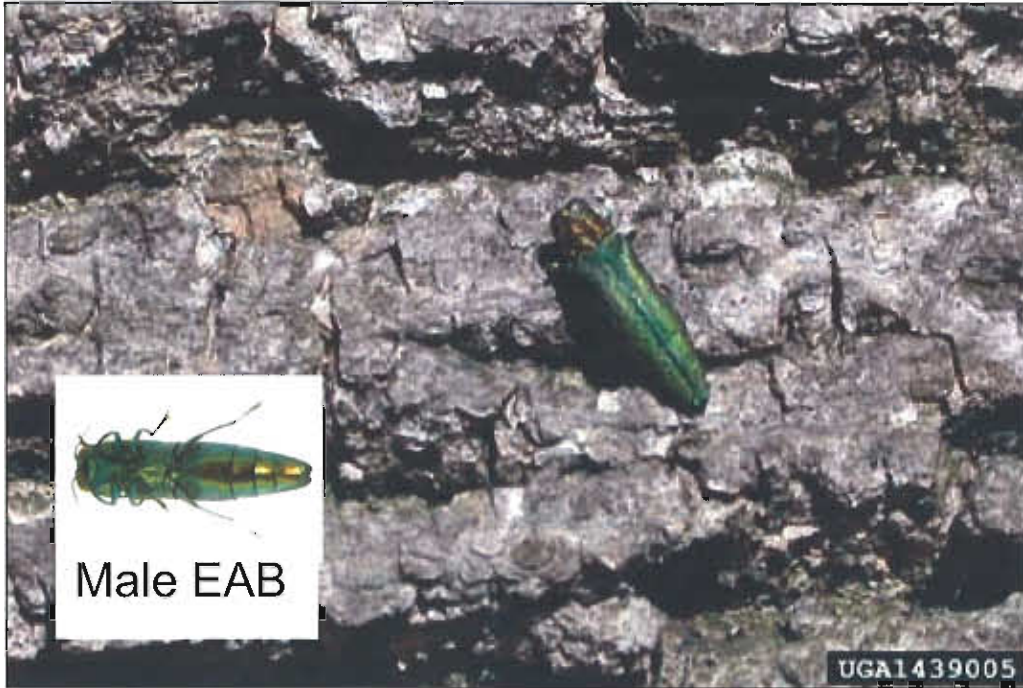
Signs of EAB attack in bark
1/8 inch exit hole



EAB adult
(1/2 inch) and
gallery
Look for adults –
May through July



Adult EAB, 1/2 inch



NOT an emerald ash borer





D-shaped exit holes, 1/8 inch



Look closely for the
d-shaped exit hole,
1/8 inch



Canker formed from EAB infestation.
Note WINDING galleries



Typical crack at
infested region of
bole



Epicormic branching
associated with
infested tree



Sprouts beneath
infested area of bole



Dying branches possibly associated with infested ash



Possible early symptoms of EAB attack



Possible EAB symptoms -later stage of infestation



Woodpeckers may be a sign of EAB
or other borer or bark beetle
infestation

Ash leaves, compound and opposite



Healthy ash trees





White ash
Fraxinus americana



Compound and
opposite





Green ash
Fraxinus pennsylvanica
Compound
and opposite



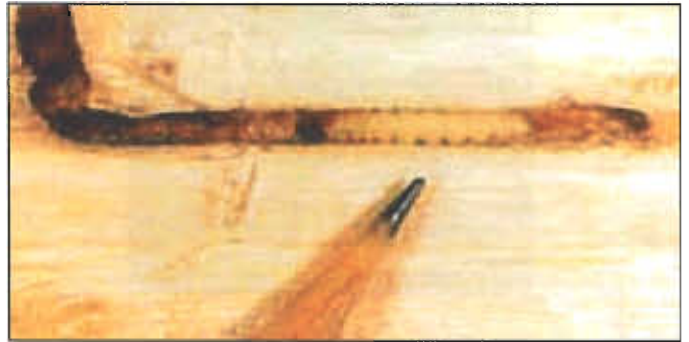


Stem canker caused by *Cytospora pruinosa*

Ash yellows



Banded Ash Clearwing
Podosesia aureocincta



Larvae exude strands of woody frass from 1/8 inch holes in the trunk. Frass can often be found piled at the base of infested trees.

Banded ash borer
Neoclytus caprea



Round exit holes. Larval galleries packed with frass.

Redheaded
Ash Borer,
Neoclytus
acuminatus



Look for sap spots with fine boring dust –early attack
Later, frass is discharged from entrance holes,
Exit holes are round

Ash/Lilac Borer (trunk borer),
Podosesia syringae

Adults are
clearwing moths
that mimic paper
wasps in
appearance and
flight



Circular exit holes often with pupal skins
protruding

Eastern ash bark beetle
Hylesinus aculeatus



Ash cambium miner
Phytobia spp.

Mining can only be
seen under the
bark



Photos obtained from the following sources:

Michigan State University

<http://www.forestryimages.org>

Michigan Department of Agriculture

University of Georgia

University of Illinois

University of Nebraska

Emerald Ash Borer Contacts & Links

Several agencies and organizations are working in partnership to prevent the introduction and spread of this pest in Minnesota. If you suspect Emerald Ash Borer is present in your community, your first line of defense is to contact the Minnesota Department of Agriculture at the numbers below.

Minnesota Department of Agriculture- Emerald Ash Borer Hotline

(651) 201-6684 (Metro Area)

(888) 545-6684 (Greater Minnesota)

Minnesota Department of Agriculture:

Their Role: The lead Minnesota agency in charge of preventing the introduction and dissemination of plant pests into and within Minnesota.

MDA Emerald Ash Borer Website:

<http://www.mda.state.mn.us/plants/pestmanagement/eab.htm>

USDA-APHIS, Plant Protection & Quarantine:

Their Role: The lead federal agency to prevent the introduction and dissemination of plant pests into and within the United States. This agency is in charge of maintaining the interstate quarantine and investigating the pest introduction and movement.

PPQ Website: http://www.aphis.usda.gov/plant_health

PPQ Telephone: (612) 725-1904

Minnesota Department of Natural Resources:

Their Role: The state agency participating in survey and investigation of EAB on state-owned lands. DNR will lead the utilization effort for wood affected by EAB and administers a cost-share, urban forestry grant program for Minnesota communities.

MnDNR ReLeaf Website: <http://www.dnr.state.mn.us/grants/forestmgmt/releaf.html>

MNDNR Information Center: (888) 646-6367

Minnesota State Statutes:

Their Role: The Minnesota state legislature is in the process of revising the old statutes which allow municipalities to manage shade tree pests on private property. Several existing municipal ordinances give reference to the state statute 18G, which will need to be updated as the statutes are updated. Check this website periodically for an update to the state statutes.

<http://www.leg.state.mn.us/leg/statutes.asp> Go to the search menu and type in "shade tree pests".

Tree Trust:

Their Role: Tree Trust is working in partnership with the USDA Forest Service and Minnesota DNR to provide this Dutch Elm Disease and Emerald Ash Borer Awareness Packet for Minnesota communities. Tree Trust also provides technical assistance to communities through the Minnesota DNR ReLeaf program.

Tree Trust Website: www.treetrust.org

Tree Trust Telephone: (651) 644-5800

Emeraldashborer.info

This website contains a nation-wide collection of Emerald Ash Borer information and resources. www.emeraldashborer.info

MnTrees.org

This website allows communities to access a wealth of information about Minnesota trees and urban forest management from one web portal. www.mntrees.org

USDA Forest Service

The USDA Forest Service Northeastern Area website provides great links to new urban forestry technology and resources for managing Minnesota urban forests and tree pests. <http://na.fs.fed.us/urban/inforesources>

International Society of Arboriculture

Find examples of municipal tree ordinances, best management practices for tree care, and search for a certified arborist in your area. www.isa-arbor.org

