FOREST PEST SPECIES PROFILE

November 2007

Agrilus planipennis Fairmaire

Other scientific names: *Agrilus feretrius* Obenberger; *Agrilus marcopoli* Obenberger; *Agrilus marcopoli ulmi* Kurosawa
Order and Family: Coleoptera: Buprestidae
Common names: emerald ash borer; EAB

Agrilus planipennis, commonly known as the emerald ash borer, is a metallic wood-boring beetle that is a highly destructive pest of ash trees (*Fraxinus* spp.). This pest is native to eastern Asia and has been accidentally introduced into North America, presumably through infested wood packaging materials from Asia, where it is a major threat to ash trees in forests, urban plantings and shelterbelts. It is responsible for the death and decline of millions of trees in Canada and the US.

Adult emerald ash borers (Photos: Bugwood.org - D. Cappaert, Michigan State University; Pennsylvania Department of Conservation and Natural Resources, Forestry Archive)

DISTRIBUTION

***Native*:** Democratic People's Republic of Korea, Japan, Mongolia, People's Republic of China, Republic of Korea, Russian Federation

***Introduced*:**
North America: Canada (2002), USA (2002)

IDENTIFICATION

Adult beetles are metallic blue-green, slender, elongate, hairless and approximately 7.5-14 mm long and 3.1-3.4 mm wide (Kimoto and Duthie-Holt, 2006; McCullough and Katovich, 2004). The head is flat with a shield-shaped top and the kidney-shaped eyes are bronze or black. The prothorax, the segment behind the head which contains the first pair of legs, is slightly wider than the head and transversely rectangular, but is the same width as the base of the wing covers (Kimoto and Duthie-Holt, 2006; McCullough and Katovich, 2004). Males are smaller than females and are further distinguished by the presence of fine hairs on the ventral side of the thorax (McCullough and Katovich, 2004).

Mature larvae are white to cream-coloured, 26-32 mm long with broad flattened bodies (Kimoto and Duthie-Holt, 2006; McCullough and Katovich, 2004). The head is relatively small, brown and retracted inside the enlarged prothorax (Haack *et al.*, 2002). The abdomen is 10-segmented, some with bell-shaped posterior ends. The first eight segments have one pair of spiracles each and the last segment has one pair of brownish, pincer-like appendages.

HOSTS

In its native distribution, hosts include *Fraxinus* species (*F. chinensis*, *F. japonica*, *F. lanuginosa*, *F. mandshurica*, *F. mandshurica* var. *japonica*, *F. rhynchophylla*); *Juglans* spp. (*J. mandshurica*, *J. mandshurica* var. *sieboldiana*); *Pterocarya* (*P. rhoifolia*); and *Ulmus* (*U. davidiana*, *U. davidiana* var. *japonica*, *U. propinqua*) (McCullough and Katovich, 2004; EPPO, 2005). In its introduced range in North America, only *Fraxinus* species (*F. americana*, *F. nigra*, *F. pennsylvanica*) have been attacked (Kimoto and Duthie-Holt, 2006).

BIOLOGY

The emerald ash borer typically has a one-year life cycle although in colder regions it could require up to two years to complete a generation (McCullough and Katovich, 2004). The length of the life cycle is also influenced by the age of the infestation, the health of host tree, and other biotic and abiotic factors (Bauer *et al.*, 2007). Immature beetles maturation feed on the leaves of host trees, creating irregular notches in the leaves (Kimoto and Duthie-Holt, 2006). Females can mate multiple times and egg-laying begins a few days after the initial mating. Egg-laying peaks toward the end of June, however eggs are laid throughout the summer and into the fall due to a prolonged adult emergence period and long adult longevity (Bauer *et al.*, 2007). Females can lay 60-90 eggs in their lifetime and they deposit them singly in bark crevices on the main trunk or branches (greater than 2.5 cm diameter) in the crown (Kimoto and Duthie-Holt, 2006; McCullough and Katovich, 2004).

Eggs hatch within 7-10 days after which first instar larvae bore through the bark until they reach the phloem where they continue feeding through four larval stages (Bauer *et al.*, 2007). Flat and wide 'S-shaped' galleries are created that are filled with a fine brownish frass. Galleries are typically 9-16 cm long, but can reach lengths of 20-30 cm, and increase in width as the larva grows (Kimoto and Duthie-Holt, 2006; McCullough and Katovich, 2004).

Pupation occurs during the spring or summer and takes place at the end of a gallery either just beneath the bark near the surface of the sapwood (5-10 mm) or in the corky tissue of thick-barked trees (Kimoto and Duthie-Holt, 2006). Adult beetles emerge through small, distinct 'D-shaped' exit holes which are 3-4 mm in diameter. Emergence typically begins in late May and peaks in June (Bauer *et al.*, 2007).

Larval galleries and adult exit holes
(Photo(s): A. Wagner, USDA-APHIS-PPQ; J. O'Brien, USDA Forest Service, Bugwood.org)

SYMPTOMS AND DAMAGE

In China, *A. planipennis* typically attacks ash trees in open areas or along forest edges while in North America it has infested ash trees in both open settings and closed forests (Haack *et al.*, 2002). Attacks are initiated along the upper trunk and lower portions of the main branches with the lower trunk being the target in successive attacks (Haack *et al.*, 2002). The borers are known to attack and kill trees of various sizes and conditions from small to large mature trees.

Trees attacked by the emerald ash borer are ultimately killed, typically within three years of the initial attack although under heavy infestations, trees can be killed within 1-2 years (Haack *et al.*, 2002). This pest kills trees by feeding under the bark and disrupting the flow of nutrients and water throughout the tree (CFS, 2006a).

Symptoms of attack include frass-filled larval galleries in the cambium, adult exit holes, yellowing and thinning of foliage, dying of branches, dieback and mortality of the host tree. In response to larval feeding, callus tissue may be produced by the tree and may cause vertical bark cracks to occur over a gallery (Kimoto and Duthie-Holt, 2006). Woodpecker activity may also indicate the presence of this pest.

Infested tree exhibiting root sprouts and crown dieback
(Photo: D. Herms, Ohio State University, Bugwood.org)

DISPERSAL AND INTRODUCTION PATHWAYS

Adult emerald ash borers are strong fliers, typically in 8-12 metre bursts, and have been known to fly over one kilometre in search of suitable host material (Haack *et al.*, 2002). Their relatively small size also subjects them to dispersal by air currents. The primary cause of long distance spread however, is human-assisted through the international trade and transport of plants, wood and wood products containing bark.

CONTROL MEASURES

No effective control methods are currently available although research is ongoing to investigate the biology of the pest, develop methods for early detection and evaluate possible control measures such as insecticides and natural enemies. Three hymenopteran parasitoids have been discovered in China that are considered suitable for use as biocontrol agents in North America including a larval ectoparasitoid *Spathius agrili*, a larval endoparasitoid *Tetrastichus planipennisi*, and a solitary, parthenogenic egg parasitoid *Oobius agrili* (Bauer *et al.*,

2007). After consultations with scientists and land managers at federal and state agencies, university faculty members and the public, it was agreed that these parasitoids would be released at selected sites in Michigan, US. Field releases of *O. agrili* and *T. planipennisi* began in July 2007 and releases of *S. agrili* were expected to begin in late summer or early fall (Bauer *et al.*, 2007).

A. planipennis is classed as a quarantine pest in Canada and the US and appears on the NAPPO alert list. Domestic phytosanitary measures have been imposed to restrict the movement of wood and wood products from infested to non-infested areas (Haack *et al.*, 2002; CFS, 2006a). Regulated materials include: nursery stock; trees; logs; wood; rough lumber including pallets and other wood packaging materials; bark; wood chips or bark chips from ash (*Fraxinus* species); and firewood of all host tree species (CFIA, 2007). Canada and the United States are working together on strategies to combat the spread of this pest.

In 2002 the emerald ash borer was added to the EPPO A2 action list, and it has been recommended that EPPO member countries regulate it as a quarantine pest. Suggested phytosanitary measures for commodities of *Fraxinus* include origin from a pest-free area or heat treatment for wood and bark.

References

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