

Agrilus planipennis Fairmaire in Moscow Ash Trees

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Abstract—An invasive species of an aggressive plant pest, the emerald ash borer (EAB), *Agrilus planipennis* Fairmaire (= *A. feretriue* Obenberger, *A. marcopoli* Obenberger), was found and identified in Moscow ash trees for the first time in 2005. The widespread withering of Moscow ashes had been registering since 2004 and EAB was considered to be the main reason for this process. A short description of the insect structure, biology, and usual ranges of distribution is presented. The Palaearctic *Oobius zahaikovi* Trjapitzin [Tryapitsyn, 1989], which parasitizes in the eggs of narrow-body borers, may be considered as an available species for EAB pest control. It seems likely that the EAB was brought in at the beginning of the 1990s with planting material from North America. Transport of the insects with wooden tare from China directly could be another possible path of the invasion. The species should be viewed as a quarantine one.

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In the second half of summer 2004, the Plant Protection Service of the Moscow Park Administration Moszelenhoz began to receive evidence about the not good condition of ash plantations in different parts of the city. The inspection confirmed this information. Substantial crown thinning, withering of upper branches, untimely fall and withering of leaves, and a profuse occurrence of epicormic branches on trunks was observed in many trees.

Any distinct signs of a certain disease were absent in weakened and stag-headed trees. Their location both near and away from highways indicated that their condition was not due to the level of atmospheric air pollution from motor vehicle emissions. The examination of withering trees revealed deep frost-shattered fractures in many skeletal branches and trunks. This fact allowed the presumption that in winter 2003/04 Moscow ash trees had severely suffered from frost.

In 2005–2006, the mass weakening and withering of Moscow ash trees continued; the amount of trees with signs of withering increased. Clumps of withering ash trees were noticed in many regions of the city: on Leningradskii prospekt, along the Volokolamskoe highway, on the crossroads of the Volokolamskoe highway and the Moscow Automobile Ring Road (near the Trikotazhnaya Platform), in the floodplain plantations in Strogino district, in the Meshcherskoe recreation zone, in the plantations along Shepilovskii proezd, and in a number of other places.

Mainly, trees 30–60 years of age were subjected to withering within various types of plantations, including boulevards, public gardens, shelter belts along the roads, and in parks and sports complexes. Everywhere the withering had the same pattern: it began from the

top, and gradually descending it occupied the whole crown.

Among two kinds of ash trees growing in the city, the common ash (*Fraxinus excelsior*) and the Pennsylvania ash (*F. pennsylvanica*), the latter appeared to be the most subjected to withering. The process of withering was accompanied by the colonization of the trunks by pests, mainly by the bark beetles. It was known that, in their native places, ash trees are infested by capricorn beetles and a whole group of borers. The most common among them are *Trachypteris picta* (Pall.), *Agrilus viridis* (L.), *A. coeruleus* Rossi., and *Anthaxia bicolor* Fald. However, borers had not been found in Moscow ash trees before that time.

But in 2005, for the first time, D-shaped exit holes were found in the bark on the trunks of trees which were withering or were already withered. Larval tunnels of narrow-body borers were found under the bark. They were evidently larger in size than tunnels of any known indigenous species of borers in this genus (*A. viridis*, *A. ater*, etc.).

In the same year, one individual of the beetle was caught on the trunk of an ash tree. One more individual was found on the asphalt in the city by well-known Moscow coleopterist N.B. Nikitskii (oral communication). The identification of both individuals was performed by a specialist in the taxonomy of borers, A.V. Alekseev. The species was identified as emerald ash borer (EAB) *Agrilus planipennis* Fairmaire (= *A. feretriue* Obenberger, *A. marcopoli* Obenberger).

This species was noticed in the Moscow region for the first time [M.G. Volkovich].

EAB belongs to a group of aggressive trunk pests which are able to settle in living, usually weakened,

trees, but possibly also in trees without any signs of weakening. The area of EAB natural habitation includes the leafy forests of the Korean Peninsula, Northeast China, Japan, Mongolia, and Taiwan. Also, this borer occurs in forests of Primorskiy krai and Khabarovsk krai in Russia. In the range of its natural habitat, the borer settles not only in ash trees such as *F. chinensis*, *F. japonica*, *F. lanuginosa*, *F. mandshurica*, and *F. rhynchophylla*, but also in some other species such as *Juglans mandshurica*, *Pterocarya rhoifolia*, *Ulmus davidiana*, and *U. propinqua*. The trunk accommodation density of larvae in China can reach 284 individuals per square meter [Liu et al., 2003].

The species of ash trees from North America that are growing in China (*F. velutina* and *F. pennsylvanica*) appeared to be more amenable to attack of EAB than indigenous species. Chinese entomologists note that susceptibility of ash trees to borers in open habitats (along roads and in parks) always is much greater than in forests [Liu et al., 2003].

EAB may act as a first settler, inhabiting the lower and the middle parts of the trunk in trees with bark of intermediate or large thickness.

Usually the emergence of beetles takes place in June. The vital cycle of the borer takes one year [Haack et al., 2002].

EAB is larger than other narrow-body borers in the *Agrilus* genus. The adult beetle is 7.5–14.0 mm in length and 3.0–3.4 mm width. It has an oblong metallic green body. Its belly has iridescent reddish purple coloration. The eyes are usually black, although they may have copper coloration.

The eggs, which are 1 × 0.6 mm in size, are oviposited by the females in the bark fractures. Primarily, the eggs are white, and in 2–3 days, they gain reddish brown coloration and become barely visible. The larvae penetrate under the bark and bite out flat spiral tunnels, which are gradually widened. An adult larva reaches 26–32 mm in length. It is creamy white colored. The belly consists of ten segments. The larvae spend the winter deep in the bark or in the surface layer of the timber, where it prepares cradles for pupation beforehand. The next spring, the larvae pupate. The pupa is 10–14 mm in length and has the same coloration as the larva. The beetles make specific exit holes in the bark.

In comparison with other narrow-body borers in the genus *Agrilus* (green, black, and oak), EAB is larger in size; the width and the length of its larval tunnels also exceed those of other species.

The appearance of an allogenic insect species that also is a pest of valuable wood species urged us to become more acquainted with this insect species and try to understand how it had appeared on Moscow territory.

EAB was first found in 2002 in North America on the territory of Michigan (United States) [Haack et al., 2002]. Soon it was found in Ohio, and then in

Canada, in the province of Ontario [Canadian..., 2002; Nomura, 2002; Mecteau and Marchant, 2003].

Everywhere the borer was found in ash tree forests that showed obvious signs of withering. After the species had been identified by specialists in taxonomy in Canada and the United States, it was declared to be a quarantine object.

The American and Canadian entomologists believe that carrying of the borer into the territory of the United States occurred with wooden packing of imported equipment, supposedly from China.

The liquidation of the borer foci detected in the United States and Canada failed, and at present, the borer is swiftly expanding its range. It causes huge damage to ash tree forests. The ash trees *F. americana*, *F. nigra*, and *F. pennsylvanica* often play the role of forest-forming species in North America. At present, the scale of the inflicted damage is so great that it allows American entomologists to even speak about the beginning of the end of American ash tree forests [Hermes et al., 2003].

EAB was not found in European territory before the cases of its detection in Moscow described above. On the basis of information about the considerable damage that it caused to ash plantations in North America, EAB was included in the List A1 of the Specification of Quarantine Organisms of the European and Mediterranean Plant Protection Organization (EPPO) as a dangerous species which is still absent in the territory of EPPO. The Quarantine Service in Russia did not show any interest in this species.

A particular danger of EAB spreading outside of its initial range consists in the absence of specialized enemies which are able to control the species numerical strength. And in the initial range, they do exist and are known to entomologists. The first of them is braconid *Spathius* sp., which destroys up to 50% of larvae in some trees (on average, it destroys 6.3%). Recently, a new species of EAB larval parasite, evlophid *Tetrastichus planipennis*, was found, described and studied by Chinese entomologists. It has the same efficiency as *Spathius* sp. [Yang et al., 2006]. This evlophid is going to be introduced in the territory of North America for acclimatization and use against the pest.

According to the assumption of V.A. Tryapitsyn (oral communication), the palaeartic encyrtid *Oobius zahaikevitshi*, which parasitizes in eggs of a number of narrow-body borers, may be promising in EAB control [Tryapitsyn, 1989].

In what way and when did EAB come to the territory of Moscow?

Most probably, it was carried at the beginning of the 1990s with planting material from North America. In that period, a number of companies bought in a great amount of tree planting material from abroad. The ash tree from Canada was imported along with other numerous trees and bushy species. A large part of the

large-sized planting material was planted inside the city, and a lot of trees were sold to private individuals.

In that period, the system of quarantine gardens no longer existed (at present, it is also absent). The whole service for plant quarantine experienced hard times; the All-Russia Research Institute of Plant Quarantine actually did not work for one year. Therefore, the inspection of imported plant material was performed with a formal attitude or even was not performed at all. Probably, this was the reason that made possible the carrying of this species into our territory. Carrying of insects with wooden tares from China directly could have been another path of invasion. Industrial material coming from this country is usually packed into half log, which is a waste product of timber processing. In addition, the reels for cables from Asian countries are made from second-grade timber material.

It seems probable that the all-round weakening of trees because of the freezes facilitated the rapid increase in numbers of the borer.

In the European countries, quarantine control was strictly implemented. Imported planting material is held in quarantine nurseries, which makes early detection of alien insects and diseases possible. Owing to this, EAB has not been carried to Europe yet.

As is well known, very frequently, alien insect species, which accidentally in one way or another appear on a territory new to them, are found not immediately. Usually, for some years, the species is unnoticed. During this time, the population density of the invader gradually increases, and the trees damaged by it become weakened. And only when the population density reaches the extent where the damage caused to the trees becomes visible do the reasons for the damage begin to be investigated. American and Canadian specialists believe that EAB was carried into the territory of North America five years before it was noticed, or possibly earlier.

Uncontrolled mass reproduction of the emerald ash borer in Moscow may have the same result as the spread of Dutch elm disease. At present, a large fraction of trees of this precious species have withered and been liquidated.

As long as there are plantations in the city which are not yet inhabited by EAB, and before EAB travels beyond Moscow, the species must be acknowledged as quarantine one, with stenotopic species status, with all that it implies.

REFERENCES

- Canadian Food Inspection Agency, *Agrilus Planipennis* Fairmaire, Emerald Ash Borer. Science Branch, 2002 // <http://www.inspection.gc.ca/english/sci/surv/data/agrplae.shtml>
- Haack, R.A., Jendek, E., Houping, Liu, Narchant, K.R., Petrice, T.R., Poland, T.M., and Hui, Ye., The Emerald Ash Borer: a New Exotic Pest in North America, *Newsletter of the Michigan Entomological Society*, 2002, vol. 47, nos. 1–5.
- Hermes, D.A., Stone, A.K., and Chatfield, J.A., *Emerald ash borer: the beginning of the end of ash in North America?* 2003 // <http://hancock.osu.edu/hort/mgpdf/hermsbeginofend.pdf>
- Liu, H.-P., Bauer, L.S., Gao, R.-T., Zhao, T.-H., Petrice, T.R., and Haack, R.A., Exploratory Survey for the Emerald Ash Borer, *Agrilus Planipennis* (Col.: Buprestidae), and Its Natural Enemies in China, *The Great Lakes Entomologist*, 2003, vol. 36, pp. 191–204.
- Mecteau, M. and Marchant, K., Emerald Ash Borer in Essex County, Ontario, *NAPPO Newsletter*, 2003, pp. 4–5.
- *NAPPO Pest Alert. *Agrilus planipennis* Fairmaire 1888 – Exotic Emerald Ash Borer (EAB), *Agrilus planipennis*, reported in Michigan, United States and Ontario, Canada // <http://www.pest.alert.org>
- *Nomura, S., *Agrilus planipennis*. Canadian food inspection Agency Science Branch // <http://www.inspection.gc.ca/english/sci/surv/data/agrplae.shtml>
- Tryapitsyn, V.A., *Naezdniki-entsirtidy (Hymenoptera, Encyrtidae) Palearktiki* (The Encyrtid Wasps (Hymenoptera, Encyrtidae) of the Palearctic), Leningrad: Nauka, 1989.
- *Volkovich M.G., *Spisok zlatok (Buprestidae) fauny Rossii* (A list of the metallic wood borers (Buprestidae) of the Russian Fauna) // http://www.zin.ru/Animalia/Coleoptera/rus/bup_rus.htm
- Yang, Z.-Q., Strazanac J.S., Yao Y.-X., and Wang X.-Y., A New Species of Emerald Ash Borer Parastoid To the Genus *Tetrastichus* Haliday (Hym.: Eulopidae), *Proc. Entomol. Soc. Wash.*, 2006, vol. 108, no. 3, pp. 550–558.