ORGANISATION EUROPEENNE ET MEDITERRANEENNE POUR LA PROTECTION DES PLANTES

EUROPEAN AND MEDITERRANEAN PLANT PROTECTION ORGANIZATION

Newsletter

of the EPPO Network of experts working on surveillance, monitoring, and control of the Emerald ash borer, *Agrilus planipennis*

No. 7

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Contents of the Newsletter

The webpage of the Network:

https://www.eppo.int/RESOURCES/special_projects/agrilus_planipennis_network

Photo of *Agrilus planipennis* above: Courtesy of Eduard Jendek.

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1. Introduction

Welcome to the 7th issue of the Newsletter of the EPPO Network of experts working on surveillance, monitoring, and control of the Emerald ash borer, *Agrilus planipennis*. This Network was established by the European and Mediterranean Plant Protection Organization (EPPO) following the decision made in October 2022 by its Panel on Quarantine Pests for Forestry. The Network was established in association with an EPPO-EU project.

Following the release of the 6th issue of the Newsletter, the Network coordinator received notes from the members of the Network as well as information about new field work, conferences, dissertations and publications focused on *A. planipennis* or closely related species. This information made it possible to prepare the 7th issue. Once again, the EPPO Secretariat would like to encourage participants to send all relevant information to the Network coordinator (Dmitrii Musolin, dm@eppo.int).

2. The Network is growing

In December 2024, the Network reached a new milestone – it has now more than **300 members (subscribers)** from more than **45 countries**. This is clearly the result of the recent webinar (see Section 3 below) and indicates a strong interest in the subject. The EPPO Secretariat welcomes you all. Please encourage your colleagues to join the Network via the link https://forms.office.com/e/7GxvJkS0YT (registered email addresses will not be disclosed).

3. The first EPPO webinar on *Agrilus planipennis*: 5 December 2024

The EPPO webinar 'Emerald ash borer (*Agrilus planipennis*) in the EPPO region: preparedness of countries for its further spread' took place on the 5th of December 2024, and was attended

by more than **450 participants from 55 countries** including 42 EPPO member countries. It was organized in the framework of our Network.

The purpose of this webinar was to give an opportunity to the National Plant Protection Organizations (NPPOs) of countries in which *A. planipennis* is present, and countries located near the current limits of the distribution of this species, in the EPPO region to share information on distribution of this pest and their preparedness for its further spread or arrival. NPPOs of Russia, Belarus, Estonia, Finland, and Latvia accepted an invitation from EPPO and participated in the webinar with detailed presentations. The international audience demonstrated a high interest in the topic and the panellists had more than 80 questions to answer.

Summaries, presentations, and a full video report are available on the webpage of the webinar. Summaries are also copied below in Section 4.

The EPPO Secretariat warmly thanks all attendees for their active participation during the webinar and all panellists who had kindly agreed to share their knowledge and experience with the audience.

NPPOs and research institutes of Russia and Ukraine published online reviews of the EPPO webinar:

Ukrainian Research Institute of Forestry and Forest Melioration Named After G.M. Vysotsky: European countries are vigilant to the appearance of emerald ash borer,

The All-Russian Center of Plant Quarantine (VNIIKR, Russia): FGBU "VNIIKR" took part in the International Webinar of the European and Mediterranean Plant Protection Organization (EPPO),

Sukachev Institute of Forest (the Siberian Branch of the Russian Academy of Sciences): Participation of Sukachev Institute of Forest in an international webinar on the emerald ash borer.

4. Summaries of presentations from the EPPO webinar on *Agrilus planipennis*

The European and Mediterranean Plant Protection Organization and its Network of experts working on surveillance, monitoring, and control of the Emerald ash borer, *Agrilus planipennis*

Nico Horn, Dmitrii Musolin

European and Mediterranean Plant Protection Organization (EPPO/OEPP), *dm@eppo.int*

The European and Mediterranean Plant Protection Organization is a intergovernmental organization for Europe, the Mediterranean and Central Asia working in the field of plant protection. EPPO works for and with national plant protection organizations (NPPOs). EPPO is one of ten regional plant protection organizations established under the International Plant Protection Convention (IPPC; https://www.ippc.int/en/). It was created in 1951 by 15 countries and now includes 52 member countries. In the field of plant quarantine, EPPO manages an early warning system (Alert List; https://www.eppo.int/ACTIVITIES/plant_quarantine/alert_list), evaluates the risks

presented by emerging pests (Pest Risk Analysis; https://www.eppo.int/ACTIVITIES/plant_quarantine/pra_activities), prepares phytosanitary recommendations on pests which should be regulated in the EPPO region (A1 and A2 Lists; https://www.eppo.int/ACTIVITIES/quarantine_activities), and prepares associated regional Standards (e. g., on diagnostics and phytosanitary measures; https://www.eppo.int/RESOURCES/eppo_standards). EPPO also works on biological control agents and some other topics.

In 2022, the EPPO Panel on Quarantine Pests for Forestry decided to organize a Network of experts working on surveillance, monitoring, and control of the Emerald ash borer, *Agrilus planipennis*. Following this decision, the Network was established (https://www.eppo.int/RESOURCES/special_projects/agrilus_planipennis_network). More than 280 experts from NPPOs, academia and industry of 50+ countries from Europe, Asia, Africa, Americas, and Oceania have joined it (http://meeting.eppo.int/index.php/V8542). The objective of the Network is to exchange data on monitoring and to get a better understanding of the current distribution and spread of *A. planipennis* in the EPPO region. The Network focuses on the EPPO region, however members from other regions are also welcome as significant knowledge on the pest biology, as well as experience on monitoring and control have been gathered in other parts of the world. In 2023–2024, six issues of the Network's Newsletter were published.

Emerald ash borer, *Agrilus planipennis* in the Russian Federation: its spread, damage and control

Oleg Kulinich[1], **Dmitry Ryaskin**[2]

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The native range of the Emerald ash borer in Russia is the Russian Far East (Primorsky and Khabarovsk Krais), however, the pest does not cause significant damage there to the native ash species, *Fraxinus mandshurica* (Manchurian ash) and *F. chinensis* (Chinese ash).

The area of forests in Russia where ash predominates is 6 012 km^2, including about 2 000 km^2 in the European part. The total volume of ash in stands in Russia is 71.6 million m^3.

The first information about spread of the Emerald ash borer to the European part of Russia became available in the early 2000s during research into mass die-off of ash trees in Moscow. *Agrilus planipennis* primarily attacked *F. pennsylvanica* (green ash) and, to a lesser extent – *F. excelsior* (European ash), however later almost all ash trees were killed in Moscow. Further, the beetle spread rapidly to the territories which surround Moscow.

Over a 20-year period, the Emerald ash borer spread over 600 km to the southwest and reached the territory of Ukraine. To the south, *A. planipennis* spread over 1300 km, reaching the Astrakhan Region, and in 2024 the pest was detected in the Altai Territory, which is more than 3000 km east of Moscow.

In the invasive range, death of ash trees infested by *A. planipennis* occurs within 2-3 years, but after 3-4 years the pest population rapidly decreases as a result of the activity of larval parasitoids, and new shoots of surviving ash trees are not infested by *A. planipennis*. The most widespread parasitoid of the *A. planipennis* in the European part of Russia is *Spathius polonicus* (Hymenoptera: Braconidae).

The spread of *A. planipennis* can occur by flying adults (primarily in forest belts along roads and railways), movement of infested wood or wood material, and hitchhiking.

According to the Russian NPPO, in 2024, elimination of outbreaks of *A. planipennis* is being carried out in 20 regions of Russia.

Preventing entry of the Emerald ash borer (*Agrilus planipennis*) into the Republic of Belarus: Safeguarding Belarusian ash trees

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State Institution 'Main State Inspectorate for Seed Breeding, Quarantine and Plant Protection' of the Republic of Belarus, Belarus, [1,3] rastenfito@ggiskzr.by, [2] glav_laboratorykarantin@ggiskzr.by

The Emerald ash borer (*Agrilus planipennis*) poses a significant threat to ash trees in various countries, including Belarus. In Belarus, the ash trees comprise several native species, with the most common being the European ash (*Fraxinus excelsior*). Ash trees are found in settlements, along roads, and in forests (in total, 13 482 ha, i.e. 0.16 % of the total forested area).

Systematic specific surveys have been conducted for the Emerald ash borer since 2019. Currently, *A. planipennis* has not been found in Belarus. However, the potential arrival of this invasive species has raised concern among forest managers and scientists.

Belarus has implemented several proactive measures aimed at monitoring for the Emerald ash borer and, if it arrives, preventing its spread. These measures include conducting regular surveys to detect early signs of infestation and educating the public about the potential risks of transporting ash wood.

Collaboration between governmental agencies, forestry departments, and other organizations is essential, and while the current cooperation is acknowledged, further enhancement of these efforts would benefit the overall strategy against this pest.

Public information campaigns are being conducted to raise awareness about the Emerald ash borer and its potential impact on local ecosystems. These campaigns include distribution of information materials and preparation of online resources to inform the population of Belarus about prevention and identification measures. Overall, proactive steps are crucial to protect Belarusian forests from the threat posed by the Emerald ash borer.

Survey of *Agrilus planipennis* in Estonia

Mart Kinkar

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The presentation gives an overview of the history of survey activities for *Agrilus planipennis* in Estonia.

The first survey for *A. planipennis* in Estonia was conducted in 2015 in the form of a visual inspection of ash trees for presence of symptoms. After the outbreak of *A. planipennis* in St. Petersburg in 2020, the risk areas of the survey in Estonia were re-evaluated and, since 2021, the survey of *A. planipennis* has mainly been focused in the areas close to the border with Russia.

In 2024, the survey was carried out in 91 survey sites in areas surrounding high-risk locations, e.g. border posts, stops along the main highways, importers of ash wood. Sticky traps baited with pheromone and kairomone are used that have been shown to be effective in catching different local *Agrilus* species (e.g. *A. convexicollis*). The main difficulty is locating the target hosts as the ash population has already been reduced due to ash bark beetles and ash dieback.

Awareness raising among the public about this pest is very important as part of the survey activities. In 2024, two colleagues from the Estonian NPPO went on a study visit to Oregon, USA to learn first-hand about dealing with an *A. planipennis* outbreak. Collaboration such as this is highly recommended.

Agrilus planipennis: preparedness of Finland for its possible arrival

Liisa Vihervuori

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Agrilus planipennis is a priority pest harmful to ash trees, listed in Commission delegated regulation (EU) 2019/1702. Surveys must be carried out for this beetle, and a contingency plan prepared.

The first surveys for *A. planipennis* were conducted in 2016 in Finland and since then repeated annually. There were no positive findings. Green prism traps and funnel traps were used, and these were baited with pheromone and leaf volatiles. Yearly, about 20-30 traps are installed in high-risk sites for the arrival of this pest, such as seaports, airports, parks, and wood storage areas.

The closest outbreak of *A. planipennis* to Finland is situated in 130 km from the south-eastern border of Finland (in Russia). Intensive surveys have been conducted in the south-eastern area of the country since 2021.

Only one native *Fraxinus* species grows in Finland, namely *Fraxinus excelsior*. Trees of this species grow in cities, parks, and forests. *Fraxinus excelsior* spreads in the wild but is partly of cultivated origin. *Fraxinus* spp. trees are mainly found in south-west Finland. The area covered by ash is not known, but there are about 5000 observations in Laji.fi. Non-native *Fraxinus* species (*F. pennsylvanica* and *F. mandshurica*) are also present in Finland, but they are not numerous.

It is difficult to find the host trees because no official distribution data is available. We started a campaign called *#bongaasaarni* in social media, newspapers, and radio. New observations of ash trees were collected in Laji.fi. Following this, a national risk map for *A. planipennis* was created.

We have prepared a contingency plan for *A. planipennis* comprising a general plan and a species-specific annex. The general plan includes, e.g. establishment of an emergency group, functioning of competent authorities, decision making processes, protocols, and actions.

Preparedness of Latvia for a potential outbreak of the Emerald ash borer, *Agrilus planipennis*

Sandra Zandere

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Emerald ash borer, *Agrilus planipennis* is a European Union priority pest which originates in East Asia. Known outbreaks in Russia, in Smolensk Region and St. Petersburg, are situated 300 km from Latvian border. Host plants of the Emerald ash borer are found throughout Latvia.

European ash (*Fraxinus excelsior*) is a native species distributed sparsely across Latvia and constitutes 0.5 % of all tree species in forests. Ash trees have been planted in urban plantations, along roads, and in parks. In addition, introduced host plant species (other *Fraxinus* spp. and *Chionanthus virginicus*) are present, although rare, in settlements in Latvia.

Agrilus planipennis specific detection surveys in Latvia have been conducted by the State Plant Protection Service (SPPS) since 2015. As of 2024, the pest has not been detected in the country.

Inspections are performed at high-risk areas, as well as at different inspection sites throughout the country. In recent years, SPPS has intensified surveys aimed at early detection of *A. planipennis*.

Territory of Latvia adjacent to the border with Estonia, Russia and Belarus has been designated as a high-risk area where ash trees in forests and parks are monitored. Sites where ash wood imported from the countries affected by *A. planipennis* is stored have been defined as high-risk locations. Visual inspections are performed and at selected sites traps are set.

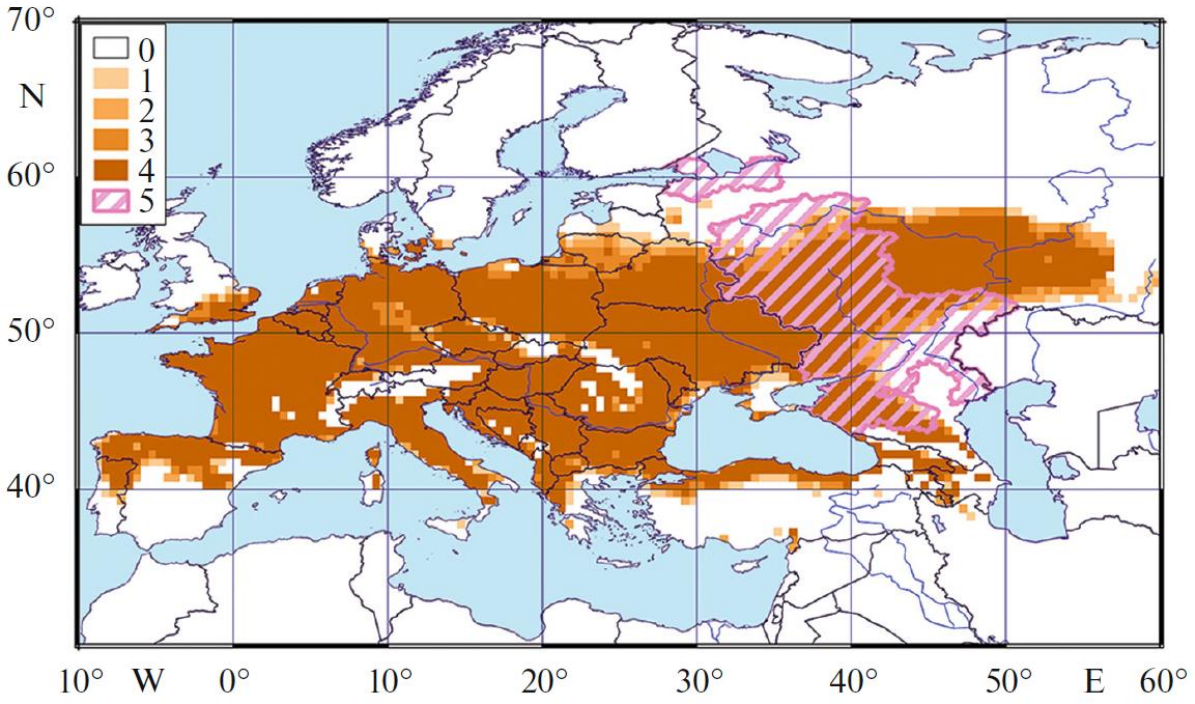
SPPS has prepared a contingency plan for *A. planipennis* and has prepared information campaigns and handout materials aimed to raise public awareness.

During preparation for a potential outbreak, several challenges have been indicated. Lack of readily available financial and human resources could present a serious problem if an extensive outbreak of *A. planipennis* occurs.

5. Climatic range of *Agrilus planipennis* in the Northern Hemisphere

In 2024, Y. Baranchikov and co-authors assessed **the climatic range** of *A. planipennis* in its native and invasive ranges. The climatic range of a species is a set of points in geographical space in which the climate allows the stable existence of populations of the species under a favorable combination of other factors controlling its population dynamics. For the Northern Hemisphere, the climatic range of *A. planipennis* was modelled for climates of 1990–1999, 2030–2039, and 2050–2059 under the SSP7.0 scenario, which describes a fairly moderate anthropogenic impact on the climate.

In North America, *A. planipennis* has colonized almost two-thirds of its modelled climatic range. The authors state that **there is no reason to believe that this expansion will be stopped**. In the primary (native) range of this species (in East Asia) and in Europe, the climatic ranges are also not fully occupied. Further expansion of the borer in its primary range is expected to be comparatively modest owing to the entire set of co-evolutionary biological factors restraining its population (e.g., resistance of Asian species of ash, natural enemies and pathogens).



The estimated climatic range of *Agrilus planipennis* in its invasive range in Europe corresponding to the climate of 1990–1999 (solid fill) and the current distribution (pink hatching). Probability of a point falling within the climatic range: (0) unlikely, (1) about as likely as not, (2) likely, (3) very likely, (4) virtually certain; (5) the current distribution. The map is from Baranchikov et al. (2024).

According to the model, **in Europe *A. planipennis* will be able to reach the Atlantic coast**, since biotic restraints are either absent or in early stages of establishment. The authors estimate that further climate change will result in the movement of the northern limits of *A. planipennis*' climatic range further north. In Russia, it is also expected that the pest's range will expand further into the Asian part of the country and Siberia, along a latitudinal band of 50–60 °N. The authors comment that when new ash plantations are established in these areas, it is advisable to use ash species that are resistant to this pest.

Note that the pest was recently recorded for the first time in Barnaul City (Altai Krai, Western Siberia) as predicted by this climatic model (see Section 6).

Read more:

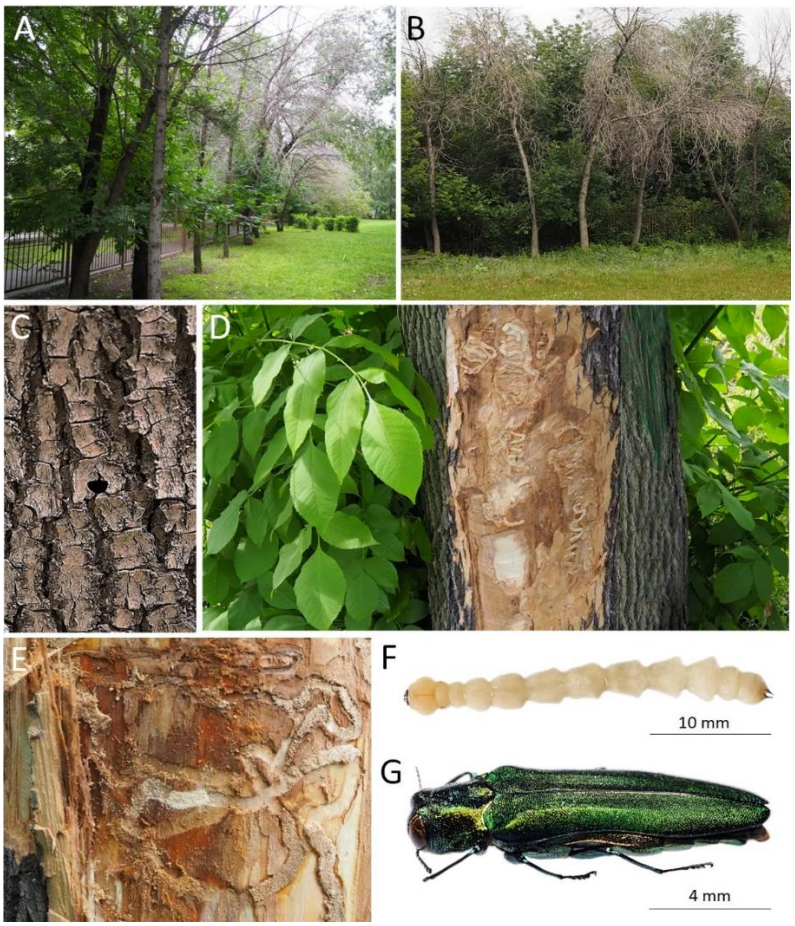
- in Russian: Baranchikov YN, Dobrolyubov YN, Semenov SM (2024) Changes in climatic range of the Emerald ash borer *Agrilus planipennis* Fairmaire (Coleoptera: Buprestidae) in the Northern Hemisphere. *Rossiiskii Zhurnal Biologicheskikh Invazii*, 3: 14–26. DOI: 10.35885/1996-1499-17-3-014-026; http://www.sevin.ru/invasjour/issues/2024_3/Baranchikov_24_3.pdf

- in English: Baranchikov YN, Dobrolyubov YN, Semenov SM (2024) Changes in climatic range of the Emerald ash borer *Agrilus planipennis* Fairmaire (Coleoptera: Buprestidae) in the Northern Hemisphere. *Russian Journal of Biological Invasions*, 15 (4): 480–490. DOI: 10.1134/S207511172470036X; https://doi.org/10.1134/S207511172470036X

6. First record of *Agrilus planipennis* in Siberia: Barnaul (Altai Krai, Russia)

Agrilus planipennis continues expanding its secondary range in Eurasia causing decline of stands of ash (*Fraxinus* spp., Oleaceae). In addition to its continues spread and tree damage in the European part of Russia, **the pest now also threatens ash stands in Siberia**.

On the 6th of July 2024, the photo of a buprestid resembling *A. planipennis* taken in the vicinity of **Barnaul City** (Altai Krai, Western Siberia, Russia), was deposited to iNaturalist. Following this record, on the 15th–20th July, Ms Lubov Snigireva, a specialist from the Altai Branch of the Centre for Grain Quality Assurance (Barnaul), performed a survey of ash stands (*F. pennsylvanica*) along the Pavlovsky route (which goes through the city centre) and in five city parks.



Agrilus planipennis and its damage in the ash stands (*Fraxinus pennsylvanica*) in Barnaul City (Altai Krai, Russia) in 2024. A and B, dead ash trees; C, exit hole; D and E, larval galleries under the bark; F, a mature larva; G, an adult. Photos from Baranchikov et al. (2024) by N. Babichev (A–E), A. Efremenko (F), and N. Kirichenko (G).

As a result, 12 beetles were collected on bark of ash trees. In all visited places, damaged trees and D-shape exit holes in the bark were noted. The beetles were sent for identification to the Krasnoyarsk Branch of the All-Russian Center of Plant Quarantine (VNIIKR, Krasnoyarsk) and to the main office of VNIIKR (Bykovo, Moscow Oblast). The beetles were identified as *A. planipennis* using morphological methods. Following this observation, in early August 2024, the researchers of the Sukachev Institute of Forest of the Siberian Branch of the Russian Academy of Sciences (Krasnoyarsk) conducted a field study in Barnaul to estimate the damage level on ash trees and clarify voltinism of the beetle in the newly invaded region. Altogether, 628 trees of *F. pennsylvanica* were examined in 28 localities in five districts of Barnaul. The situation in the city was dramatic (Figs A and B). Around 60% of the trees had been damaged by the buprestid, among which half were dying and the other half were already dead. On the bark, the characteristic exit holes were present (Fig. C); under the bark of dying trees, larval galleries were found (Figs D and E). The ratio of different instar larvae indicates that the buprestid produces one generation in two years in the city. We consider that the beetle may have arrived in the city in 2010s and that the pest arrived not from the primary pest range (the Russian Far East or China) but from the European part of Russia. The larvae found in Barnaul were collected for a planned molecular genetic study to clarify this hypothesis and define the donor population from which the invasion could happen.

To prevent further infestations, a quarantine zone was established in Barnaul and in four administrative districts of the Altai Krai covering altogether the area of 1.25 million ha.

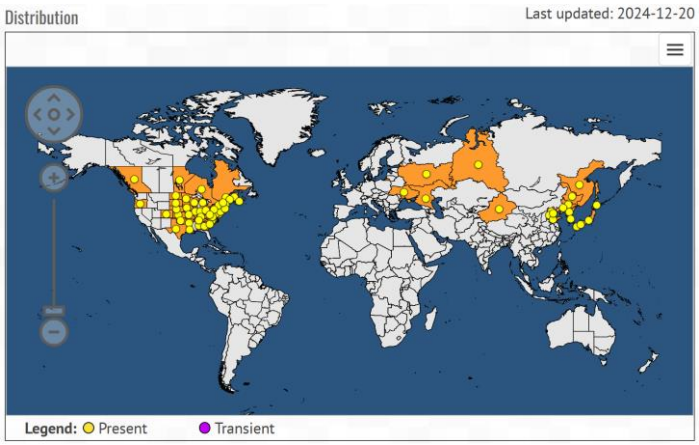
Note that the arrival of the pest in this region was recently predicted by a climatic model (see Section 5).

Read more:

Baranchikov YN, Babichev NS, Speranskaya NY, Demidko DA, Volkovitsh MG, Snigireva LS, Akulov EN, Kirichenko NI (2024) Emerald ash borer *Agrilus planipennis* Fairmaire (Coleoptera: Buprestidae) in Altai (Southern Siberia). *Siberian Journal of Forest Science* 5: 79–88 (in Russian with English abstract and references). https://www.sibjforsci.com/articles/baranchikov-yu-n-babichev-n-s-speranskaya-n-yu-demidko-d-a-volkovitsh-m-e-snigireva-l-s-akulov-e-n-k/

(prepared by **Natalia Kirichenko**, Sukachev Institute of Forest SB RAS and the All-Russian Center of Plant Quarantine (VNIIKR); **Evgeniy Akulov**, VNIIKR; and **Yuri Baranchikov**, Sukachev Institute of Forest SB RAS, Russia)

Based on this publication, the distribution of *A. planipennis* in the EPPO Global Database was updated in December 2024 (Western Siberia is added):



7. Contingency plans for *Agrilus planipennis* in the EU Member State

Regulation (EU) 2016/2031 on protective measures against pests of plants requires each EU Member State to draw up and keep up to date a contingency plan for each of the 20 EU priority pests which is capable of entering into and becoming established in its territory. These plans contain information on the decision-making processes, procedures and protocols to be followed, and resources to be made available in case of presence of a priority pest. Member States shall, on request, communicate their contingency plans to the Commission and to the other Member States, and shall inform all relevant professional operators through publication on the internet.

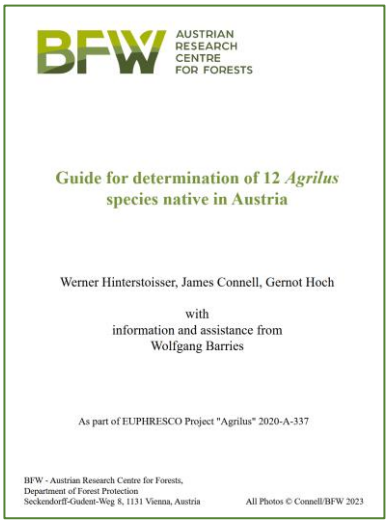
Concerning *Agrilus planipennis*, contingency plans are currently publicly available, for example, for: Austria, Bulgaria, Czech Republic, Germany, Ireland, Spain, Sweden.

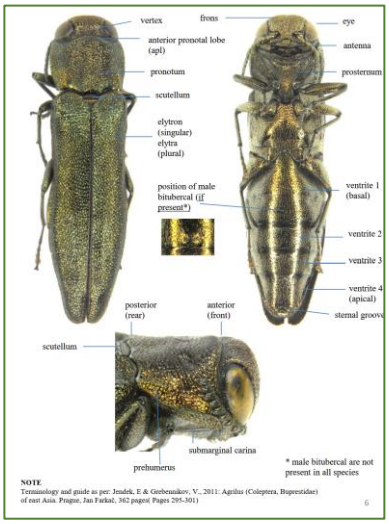
(prepared by **Maria Mirazchiyska,** European Commission)

P.S. Please let us know if similar plans are available for other countries of the EPPO region.

See also the new FAO forest pest contingency plan guidelines for Europe and Central Asia in Section 10.

8. Guide for determination of 12 *Agrilus* species native in Austria





The Austrian Research Centre for Forests in Vienna (BFW) prepared a **Guide for determination of 12 *Agrilus* species native in Austria**. This guide was developed based on

published keys used when identifying hundreds of specimens from a trapping experiment in oak forests in Eastern Austria. The document was made for internal usage at BFW and has limited representation of species and is considered a 'work in progress'. Despite the mentioned restrictions, the guide, which uses a photo-based combination process, might be useful for others involved in identification of *Agrilus* species. Detailed photos of morphological characters are provided for *Agrilus angustulus*, *A. biguttatus*, *A. convexicollis*, *A. derasofasciatus*, *A. graminis*, *A. hastulifer*, *A. laticornis*, *A. litura*, *A. obscuricollis*, *A. olivicolor*, *A. sulcicollis*, and *A. viridis*. The work was done as part of the EUPHRESCO Project '*Agrilus*' (2020-A-337). The pdf guide can be downloaded from the BFW website.

Read more:

Hinterstoisser W, Connell J, Hoch G. Guide for determination of 12 *Agrilus* species native in Austria. BFW (Austrian Research Centre for Forests), Vienna, Austria, 2024. Available at: https://www.bfw.gv.at/wp-content/uploads/neu_BFW-Agrilus-key-20240809.pdf

(prepared by **Gernot Hoch,** Austrian Research Centre for Forests, Vienna)

9. A review of the ecology, economics, and management of *Agrilus* beetles

Current Forestry Reports
https://doi.org/10.1007/s40725-024-00230-8

FOREST ENTOMOLOGY (B CASTAGNEYROL, SECTION EDITOR)

Check for updates

The Ecology, Economics, and Management of *Agrilus* Beetles

Jian J. Duan[1] · Todd D. Johnson[2] · Justin K. O'Dea[3] · Toby R. Petrice[4] · Robert A. Haack[4]

Accepted: 12 August 2024
This is a U.S. Government work and not under copyright protection in the US; foreign copyright protection may apply 2024

Fig. 1 Adults of several of the *Agrilus* species discussed in this paper. **A** *Agrilus planipennis* (Photo William Ravlin). **B** *A. sinuatus* (Gilles San Martin). **C** *A. ruficollis* (Chris Rorabaugh). **D** *A. bilineatus* (Robert Haack). **E** *A. occipitalis* (Eduard Jendek). **F** *A. acutus* (Subash Jeyan). **G** *A. biguttatus* (Trevor and Dilys Pendleton). **H** *A. mali* (A. V. Kovalev). **I** *A. anxius* (Tom Murray). **J** *A. hyperici* (U. R. Schmidt). **K** *A. viridis* (U. R. Schmidt). **L** *A. auroguttatus* (Mike Lewis)

A comprehensive review of the ecology, economics, and management of *Agrilus* beetles was recently published by Duan et al. (2024). The authors stress that the invasion of North America and Europe by *Agrilus planipennis* has caused severe economic and ecological damage to ash (*Fraxinus*) tree populations. Many other *Agrilus* species can potentially become invasive pests due to the cryptic nature of their immature stages that can be

inconspicuously transported within infested plant material. They review the ecology, economic impacts, and management strategies of *Agrilus* worldwide and highlight research gaps. The authors highlight that the genus *Agrilus* has over 3 341 described species, making it the largest genus in the Animal Kingdom. Most *Agrilus* species are univoltine and have a narrow host range. Chemical, tactile, and visual cues are used by adult *Agrilus* to select suitable hosts for consumption by adults and larvae. Most *Agrilus* larvae develop within the cambial region, constructing galleries that effectively girdle the host plant. Mechanisms of host plant resistance are being explored. Diverse groups of natural enemies attack all life stages of *Agrilus* species, with some coevolved specialist parasitoids being introduced successfully to suppress *A. planipennis* in North America. Climate change, leading to warmer and drier conditions, will influence the distribution and population dynamics of many *Agrilus* species. Many research gaps still exist in the areas of biocontrol, host plant resistance, and sustainable management strategies for this important group of plant pests.

Read more:

Duan JJ, Johnson TD, O'Dea JK, Petrice TR, Haack RA (2024). The ecology, economics, and management of *Agrilus* beetles. *Current Forestry Reports*, 10: 487-509. https://doi.org/10.1007/s40725-024-00230-8

10. Two new guidance documents published by FAO

In 2024, FAO published two guidance documents in which *Agrilus planipennis* is discussed.

The first one is the 2nd edition of the **Guide to implementation of phytosanitary standards in forestry**. This guide, produced by an international group of scientists, phytosanitary authorities, forest experts, and industry representatives and reviewed by more than 100 specialists from 46 countries, provides easy-to-understand information on how good

forest management practices and well implemented phytosanitary standards can minimize pest spread and facilitate safe trade. Specifically, it explains how the International Standards for Phytosanitary Measures (ISPMs) and national plant protection organization (NPPO) regulations affect the import and export of forest commodities; how relevant ISPMs can be used to prevent pest introduction and spread; and how forest-sector personnel can work together with NPPOs to contribute to the development and implementation of ISPMs and national phytosanitary regulations that help reduce pest movement while restricting trade as little as possible. The guide will be of vital interest to people involved in nursery activities, planting, managing, harvesting, manufacturing, trading and transporting forest products. It will also benefit forest policy-makers, planners, managers and educators, particularly in developing countries. This is the 2nd edition of the guide, originally published in 2011, including updated information.

The 2nd recent FAO document is the **Forest pest contingency plan guidelines for Europe and Central Asia**. Pest contingency plans (PCP) are used by national or regional plant protection organizations to ensure a plan is in place for when a new pest is detected in a particular country or region, and thus to facilitate a rapid and effective response to manage the situation. This guide outlines and discusses the elements and steps needed to formulate and implement a contingency plan for key forest pests in Europe and Central Asia. This effort is complemented by FAO's Forest Invasive Species Network for Europe and Central Asia (REUFIS), which aims to facilitate knowledge exchange, promote good practices, and build capacity related to forest invasive species, including the prevention and management of emerging pests. Suggestions are provided on the main steps, or elements, in a PCP for forest pests. The guidelines highlight the main information that should be included for a robust plan that can be activated in response to a new report of a pest or a pest outbreak, for example from official surveillance, reports from the public, or to an interception by an importing country. The report provides a step-by-step guide on developing an effective PCP tailored to specific needs. For some of the steps, examples are provided on the details that would be included for specific pests. These are (1) the emerald ash borer *Agrilus planipennis*, a potential insect pest introduction into parts of Europe and Central Asia; (2) the eight-toothed spruce bark beetle *Ips typographus*, native to many parts of Europe and Asia, but where outbreaks can cause substantial tree mortality; and (3) pitch canker *Fusarium circinatum*, a potential fungal pathogen introduction into parts of Europe and Central Asia. Most of the content of the guide is relevant for the development of PCPs across different regions, however, the examples provided are specific to Europe and Central Asia.

Read more:

FAO (2024) Guide to implementation of phytosanitary standards in forestry. Second edition. FAO Forestry Paper No. 164. Rome, FAO. https://doi.org/10.4060/cd3046en, https://openknowledge.fao.org/items/3198c57f-bfe9-4de7-9969-e34987f0ce49

Hurley B, Buglyó I, Horváth K, Winkler-Ráthonyi N, Sathyapala S (2024) Forest pest contingency plan guidelines for Europe and Central Asia. Budapest, FAO. https://doi.org/10.4060/cd2753en

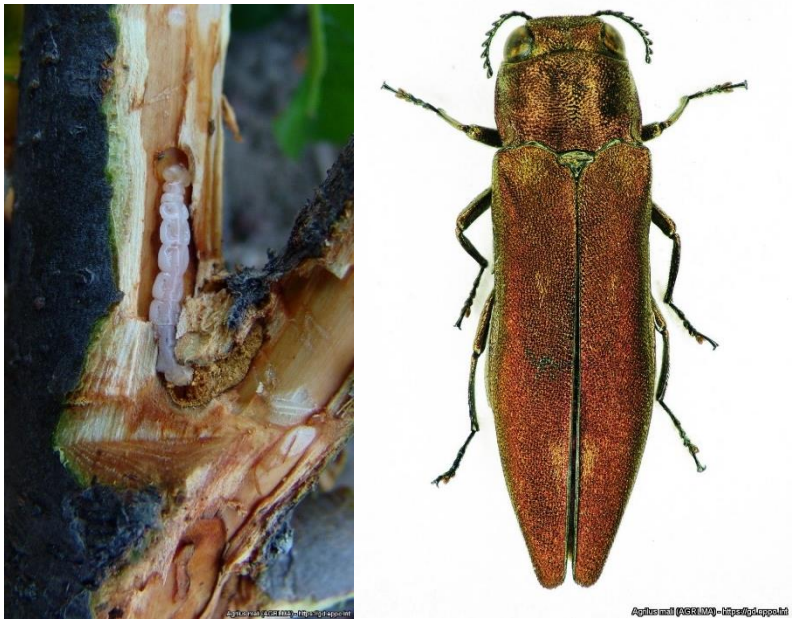
11. Biological control of *Agrilus planipennis*

The Journal *Biological Control* published a Special Issue entitled **Pre-emptive classical biological control: a novel approach to increase preparedness for potential biosecurity threats**. G. Avila, B. Barratt, K. Hoelmer, and T. Haye served as Guest Editors of this Special Issue. Classical biological control (CBC) is frequently adopted for sustainable management of invasive insect pests. However, the severity and imminent nature of new high-risk insect threats means that it would be advantageous if we could avoid waiting for a pest to arrive before adopting CBC. Pre-emptive biocontrol is a novel approach that provides the opportunity to select, screen and potentially pre-approve natural enemies prior to a pest establishing in the country at risk. The primary purpose of the Special Issue is to highlight the importance of pre-emptive biocontrol, and to collect scientific contributions addressing the concepts, applications, and its current status.

Three papers in this Special Issue focused on *A. planipennis* (see abstracts in Section 17):

- **Horrocks KJ, Seehausen ML, Down RE, Audsley N, Maggini R, Collatz J** (2024) Assessing the feasibility of pre-emptive biological control against the emerald ash borer, *Agrilus planipennis*, an imminent biosecurity threat to Europe. *Biological Control* 198: 105641 https://doi.org/10.1016/j.biocontrol.2024.105641
- **Kenis M, Eisenring M, Gossner MM, Seehausen ML** (2024) Parasitoids of *Agrilus* spp. in Europe: Anticipating the arrival of *Agrilus planipennis*. *Biological Control* 199: 105655. https://doi.org/10.1016/j.biocontrol.2024.105655
- **Reed K, Cole F, Audsley N, Uglow A, Down R, Barnard K, Inward D** (2025) Susceptibility of European *Agrilus* beetle species to the biocontrol agents of Emerald Ash Borer in the laboratory. *Biological Control* 200: 105678. https://doi.org/10.1016/j.biocontrol.2024.105678

12. A new addition to the EPPO A2 List: the Apple buprestid, *Agrilus mali*



A larva and an adult of *Agrilus mali* (photos from the EPPO Global Database; courtesy of Mr Wang Zhi-Yong, China).

In September 2024, the EPPO Council approved new changes proposed to **the EPPO A1 and A2 Lists of pests recommended for regulation as quarantine pests**. For each individual pest, PRA documents and datasheets have been prepared (or are under development) and will be available in due course in the EPPO Global Database (https://gd.eppo.int) and the EPPO Platform on PRAs (https://pra.eppo.int/). Among the species added to the A2 List (pests locally present in the EPPO region) was the Apple buprestid, *Agrilus mali* (Coleoptera: Buprestidae). The EPPO PRA for this species is freely available at: https://pra.eppo.int/pra/3d63745f-d3e3-4f19-b1a2-436123905799.

13. New PhD dissertation and MSc thesis using pests of ash as models

Recently, a PhD dissertation and a MSc thesis, in which *A. planipennis* and ash dieback caused by another important pest of ash trees - *Hymenoscyphus fraxineus* respectively were used as models, were presented in the USA and the United Kingdom:

Francis E (2024) Understanding private landowners involvement, knowledge sharing, and social networks in conservation of Brown Ash in the Face of Emerald Ash Borer. PhD Dissertation. The University of Maine (USA). Electronic Theses and Dissertations. 4015. Available at: https://digitalcommons.library.umaine.edu/etd/4015

Original abstract: North America is facing a deadly invasive forest pest: the emerald ash borer (EAB, *Agrilus planipennis* Marsh.), which has the ability to eliminate brown ash trees (*Fraxinus nigra*). The geopolitical boundary for Maine is the unceded territory of the Wabanaki People, and the final northeastern US state for EAB to infest. EAB threatens brown

ash which holds importance environmentally, economically, culturally, and intrinsically to the Wabanaki People and the state of Maine. This dissertation aims to determine the direction of outreach and research to sustain brown ash trees for the future through an important stakeholder group, private landowners, to explore how the network of those protecting against EAB has developed and the future for this as a long-term conservation problem. Objectives of this study include: determining private landowner understanding and intentions for managing ash against EAB, developing a community-focused ash seed collection manual, and analyzing the network of relationships of the parties involved with brown ash conservation and protection against EAB in Maine. Private landowners of forested land in Maine were surveyed using Involvement Theory to gain understanding of the knowledge of brown ash and EAB and the management intentions for protecting ash in Maine. An ash seed collection manual was developed with input and review by various research partners and ash experts to create a 'living document' to be updated in perpetuity as the ash seed research needs develop. The network of those protecting ash against EAB in Maine was analyzed for connectedness using Social Networking Analysis. The outcomes of this research will: increase protection of ash as an ecological and cultural resource providing insight into the plans of management by private landowners, increase the ability for ash to be protected and researched with community efforts in seed collection, and an understanding of the social network that iv works together to slow the spread of EAB and respond to the aftermath of EAB to sustain brown ash on the land.

Wu H (2024) Modelling tree mortality caused by ash dieback in a changing world: a complexity-based approach. Thesis for Master of Philosophy in Biodiversity, Conservation and Management. University of Oxford (GB) (https://www.researchgate.net/publication/385303625_Modelling_Tree_Mortality_Caused_by_Ash_Dieback_in_a_Changing_World_A_Complexity-based_Approach)

Original abstract: Forests cover ~31% of Earth's land surface, having the majority of the gross primary production and the worlds' terrestrial species. Forest damage caused by invasive pests and pathogens suddenly rose substantially after the 1980s. Forecasting tree mortality caused by invasive forest pathogens is challenging due to complex interactions between hosts, pathogens, and the environment. A central dilemma is to choose the level of model complexity for accurate forecasts. Ash dieback (*Hymenoscyphus fraxineus*) is a typical example, where the pathogenic fungus caused widespread damage and tree mortality in Europe, and the changing climate affects multiple stages of the life cycle of the host tree and the pathogen simultaneously. New modelling framework is required to study the complexity of host-pathogen-environment interactions and demonstrate the potential of data-model fusion. Based on complexity science theories, this thesis developed a novel framework for complexity-appropriate modelling for ecological management, using the ash dieback as the model system. A combination of qualitative (e.g. causal loop diagram, systematic review) and quantitative (e.g. system dynamical modelling) methods were used during the model development process. The result predicted (1) a decline of ~26% in ash population size at Wytham Woods in the next 10 year; (2) a ~8% uncertainty in 10-year population decline rate caused by ±10% error in mortality survey; (3) a 5% increase in resistant trees would save ~3 % population over 10 years, and maintaining a 12% resistant tree population would maximise the effect of replacing susceptible genes to resistant ones; (4) the warming temperature has limited effects on annual tree mortality driven by ash

dieback (<2% assuming a 1.5°C warming); (5) increase of annual tree mortality caused by elevated rainfall is also small (<1% with an precipitation increase of 100 m). Therefore, tree mortality driven by pathogen virulence would not likely be significantly enhanced by climate change, and society may still have time to breed resistant ash trees to mitigate the crisis. In this research, complexity science provides philosophy on how to determine the level of details in ecological modelling. It has the potential to link ecological theories and applications for ecosystem restoration and nature recovery.

14. *Agrilus planipennis* in talks presented at two conferences in late 2024

At the conference '*Plant Protection and Quarantine. Healthy Plants - Healthy Nation*': talks of D. Musolin (EPPO) and N. Kirichenko (Sukachev Institute of Forest SB RAS and VNIIKR, RU).

In late 2024, new studies on *Agrilus planipennis* were discussed at two conferences.

The Kataev Memorial Reading - XIII: Dendrobiotic Invertebrates and Fungi and their Role in Forest Ecosystems was organized in the Saint Petersburg State Forest Technical

University in late October to early November 2024. Three presentations focused on *A. planipennis*:

- **Baranchikov YN, Dobrolyubov NY, Semenov SM:** Climatic range of the emerald ash borer *Agrilus planipennis* Fairmaire (Coleoptera: Buprestidae) in Eurasia,
- **Volodchenko AN, Sergeyeva ES:** Dynamics of Emerald ash borer range expansion in the south-east of European Russia,
- **Kirichenko NI, Musolin DL:** Emerald ash borer range expansion into countries of Europe: appeal to citizen science to assistance in research.

Proceedings:

Dendrobiotic Invertebrates and Fungi and their Role in Forest Ecosystems. The Kataev Memorial Reading - XIII / Proceedings of the All-Russia conference with international participation. Saint Petersburg, October 24 – November 01, 2024, ed. by Selikhovkin AV, Baranchikov YN, Karpun NN, Mandelshtam MY and Ponomarev VI. Saint Petersburg (Russia): Saint Petersburg State Forest Technical University, 2024. 128 p. Available at: https://spbftu.ru/chteniakataeva2024

The second conference entitled **Plant Protection and Quarantine. Healthy Plants - Healthy Nation** was organized in the All-Russian Center of Plant Quarantine (VNIIKR) in December 2024 (with online translation). Eight presentations focused on *A. planipennis*:

- **Baranchikov YN, Kirichenko NI, Dobrolyubov NY, Babichev NS, Semenov SM:** The Emerald ash borer invasion to Siberia: Prognosis and it's realization,
- **Kasatkin DG, Mescheryakova IS:** New date on distribution and harmfulness of *Agrilus planipennis* (Coleoptera: Buprestidae) In Rostov Region,
- **Kirichenko NI, Akulov EN, Musolin DL:** The ongoing invasion of the Emerald ash borer in Eurasia: An invitation to cooperate in a large-scale research,
- **Kulinich OA, Ryaskin DI, Kozyreva NI, Arbuzova EN, Chalkin AA:** The spread of Emerald ash borer Agrilus planipennis in Russia and possible control measures,
- **Musolin DL:** Forest quarantine issues in the activities of the European and Mediterranean Plant Protection Organization (EPPO): 2024,
- **Orlova-Bienkowskaja MY, Bieńkowski AO:** Search for bacterial pathogens and mutualists of the Emerald ash borer (*Agrilus planipennis*),
- **Shabanov SI, Sivolapov VA, Orudzhov JS, Chaplin AM:** Invasive threats to ash plantations in the Kursk Region,
- **Shchurov VI, Zamotajlov AS:** Dynamics of the most important invasions of dendrophilous insects (Insecta: Heteroptera, Coleoptera, Hymenoptera, Lepidoptera) in the Krasnodar Territory over 25 years.

Proceedings are available in two issues of the journal *Plant Health and Quarantine*: part 1: https://phytosanitary.vniikr.ru/jour/issue/view/33/showToc and part 2: https://phytosanitary.vniikr.ru/jour/issue/view/35/showToc

15. New publications on *Agrilus planipennis* and related species

After the release of the previous Newsletter, information on **30 new publications** on *A. planipennis* and on other relevant species (taxonomically related *Agrilus* species and key pests of *Fraxinus* spp.) has been received (22 journal papers, 3 conference abstracts, 3 guidelines, and 2 preprints; in addition to the data on a new thesis and a dissertation – see Section 13).

The range of topics is very wide and includes the following:

- *A. planipennis* in **Russia** (Baranchikov et al., 2024b; Koveshnikov et al., 2024; Sergeeva, 2024; Volodchenko, 2024);
- *A. planipennis* in **Ukraine** (Meshkova et al., 2024; Tsybulskyi et al., 2024);
- *A. planipennis* in **the USA** (Liebhold et al., 2025);
- Modelling of the **climatic range** of *A. planipennis* (Baranchikov et al., 2024a);
- A review on ecology, economics, and management of *Agrilus* beetles (Duann et al., 2024);
- A Guide to implementation of **phytosanitary standards** in forestry (FAO, 2024);
- Forest **pest contingency plan** guidelines for Europe and Central Asia (Hurley et al., 2024);
- A Guide for determination of **native *Agrilus* species** in Austria (Hinterstoisser et al., 2024);
- **Biological control** against *A. planipennis* (Horrocks et al., 2024; Kenis et al., 2024; Quinn et al., 2024; Reed et al., 2025; Simeto et al., 2024);
- Lack of pronounced Allee effects in the Canadian population of *A. planipennis* (Caouette et al., 2024);
- Design of an **eDNA sampling** method for detection of *A. planipennis* (Kyle et al., 2024);
- **Detection** of *A. planipennis* using vibration signals (Li et al., 2024; Yin et al., 2025);
- **Detection** of *A. planipennis* using panel traps: comparing color, placement, and lure (Walters et al., 2025);
- **Management** of *A. planipennis* in **urban forests** (Morris et al., 2024);
- **Detection** and **management** of *A. planipennis* (Zhou et al., 2024);
- **Heat treatment** protocol for bronze birch borer *Agrilus anxius* (Noseworthy et al., 2025);
- Development of **a TaqMan Probe-Based qPCR** for identifying *Agrilus auroguttatus* (Rizzo et al., 2024);
- Resistance to ash dieback (*Hymenoscyphus fraxineus*) (Przybylski et al., 2024);
- Conservation of genetic resources (after a pandemic of ash dieback) (George et al., 2024);
- *Fraxinus latifolia* (Oregon ash): conservation and EAB-resistance breeding (Melton et al., 2025);
- Impact of *H. fraxineus* on tree decline (Wu et al., 2024).

A reference list and an abstract of each of these publications are given in Section 17. Most of the papers are available as full text via the provided links; others may be made available on request to the authors.

16. A closing remark

That is about all for the 7th issue of the Newsletter. The EPPO Secretariat looks forward to receiving your notes, news and publications, links to recently published papers and conference abstracts by you and your colleagues, any other relevant pieces of information

and announcements on Emerald ash borer so the Network can distribute them via these Newsletters.

Please inform your colleagues in your country and around the world about the Newsletter. The email for correspondence is dm@eppo.int (Dmitrii Musolin).

17. References received (December 2024; with original abstracts)

Baranchikov YN, Dobrolyubov YN, Semenov SM (2024a) Changes in climatic range of the Emerald ash borer *Agrilus planipennis* Fairmaire (Coleoptera: Buprestidae) in the Northern Hemisphere. *Rossiiskii Zhurnal Biologicheskikh Invazii* 3: 14–26. DOI: 10.35885/1996-1499-17-3-014-026, http://www.sevin.ru/invasjour/issues/2024_3/Baranchikov_24_3.pdf (English translation: *Russian Journal of Biological Invasions* 15(4): 480–490. DOI: 10.1134/S207511172470036X, https://doi.org/10.1134/S207511172470036X) **(See more details in Section 5)**

> The climatic range of a species is a set of points in geographical space in which the climate allows the stable existence of populations of the species under a favorable combination of other factors of its population dynamics. For the Northern Hemisphere, using a special set of climate predictors, the climatic range of the emerald ash borer *Agrilus planipennis* (EAB), a dangerous invasive pest of ash plantations, was assessed. Calculations were carried out for climates of 1990–1999, 2030–2039, and 2050–2059 under the SSP7.0 scenario, which describes a fairly moderate anthropogenic impact on the climate. Schematic maps indicating the contemporary distribution zones of the EAB have been constructed. In North America, the borer has colonized almost two-thirds of its climatic range. There is no reason to believe that this expansion will be stopped. In the primary zone of distribution of the borer—in East Asia—and in Europe, the climatic ranges are also not fully occupied. Further expansion of the borer in its primary zone of distribution is expected to be comparatively modest owing to the entire set of co-evolutionary biological factors restraining its number. On the contrary, in Europe the borer will be able to reach the Atlantic coast, since such restraints are either absent there or are just being formed. As calculations show, with further changes in the global climate, the dominant trend will be the movement of the northern limits of the EAB climatic range further north. At the same time, within the territory of Russia, it is also expected to expand into the Asian part and Siberia, along a latitudinal band of 50°–60° N with a climate suitable for *A. planipennis*. As soon as 2030–2039, in an eastern direction, this band will reach Krasnoyarsk krai and will further spread eastward. Therefore, when establishing ash plantations in this area, it is advisable not to use ash species that are not resistant to this pest.

Baranchikov YN, Babichev NS, Speranskaya NY, Demidko DA, Volkovitsh MG, Snigireva LS, Akulov EN, Kirichenko NI (2024b) Emerald ash borer *Agrilus planipennis* Fairmaire (Coleoptera: Buprestidae) in Altai (Southern Siberia). *Siberian Journal of Forest Science* 5: 79–88 (in Russian with English abstract and references). https://www.sibjforsci.com/articles/baranchikov-yu-n-babichev-n-s-speranskaya-n-yu-demidko-d-a-volkovitsh-m-e-snigireva-l-s-akulov-e-n-k/ **(See more details in Section** 6)

> Emerald ash borer (*Agrilus planipennis* Fairmaire (Coleoptera: Buprestidae)) is an aggressive East Asian invader that has destroyed millions of ash (*Fraxinus* L.) trees in North America and Eastern Europe. Researches and practitioners are concerned about ongoing westward distribution of the species into Central Europe. In addition to that, the invasion of this buprestid to Siberia is also not ruled out bearing in mind suitable climatic conditions, particularly on the south, and the presence its favorable host plant, the green ash (*Fraxinus pennsylvanica* Marshall). In 2024, the pest has been detected in Barnaul, the administrative center of Altai

Krai. By August, the beetle destroyed almost 30% of ash trees in the city and only 8% of trees looked healthy. Based on the ratio of larval instars, the pest develops two years per generation in Barnaul. No parasitized larvae of *A. planipennis* was documented in Barnaul suggesting that the parasitoid, the braconid *Spathius polonicus* Niezabitowski, which controls this buprestid in Europe, either has not yet appeared in Siberia or remains at a low, undetectable, density. The prospects of introduction of the East Asian parasitoid *Spathius galinae* Belokobylskij et Strazanac (the most effective biocontrol agent of *A. planipennis* at its primary range) and the Manchurian ash (*F. mandshurica* Rupr.) (the resistant host) to the secondary pest range are emphasized.

Caouette AP, Rutledge CE, Heard SB, Pureswaran DS (2024) No evidence for pronounced mate-finding Allee effects in the emerald ash borer (*Agrilus planipennis* Fairmaire). *NeoBiota* 95: 165-179. https://doi.org/10.3897/neobiota.95.127287

Allee effects are density-dependent barriers that can impact species establishment and population growth, such as through reduced mating success at low population densities. The emerald ash borer, *Agrilus planipennis* Fairmaire, has been extremely successful at rapidly expanding its North American range. The impact of mate-finding Allee effects (an important type of component Allee effect) early in the invasion period of the emerald ash borer remains unknown. We measured mating success in females as a function of beetle abundance in Halifax, Canada, where the emerald ash borer was recently discovered, and in Connecticut USA, where it has been established for over a decade. We measured relative population abundance and sampled beetles using different strategies. In Halifax, we placed clusters of prism traps along an invasion gradient of emerald ash borer abundance, and in Connecticut, we collected beetles from foraging *Cerceris fumipennis* females. We dissected female reproductive tracts to measure mating success. We fit a linear regression to the mating success of females as a function of beetle abundance. We found that emerald ash borer did not present a pronounced mate-finding Allee effect as there was no positive relationship between female mating success and abundance. Lack of pronounced component Allee effects that impede population growth may explain rapid range expansion in species that are highly invasive, such as the emerald ash borer.

Duan JJ, Johnson TD, O'Dea JK, Petrice TR, Haack RA (2024) The ecology, economics, and management of *Agrilus* beetles. *Current Forestry Reports* 10: 487-509. https://doi.org/10.1007/s40725-024-00230-8

The genus *Agrilus* has over 3,341 described species, making it the largest genus in the Animal Kingdom. Most *Agrilus* are univoltine and have a narrow host range. Chemical, tactile, and visual cues of host plants are used by adult *Agrilus* to select suitable hosts for consumption by adults and larvae. Most *Agrilus* larvae develop within the cambial region, constructing galleries that effectively girdle the host plant. Mechanisms of host plant resistance are being explored. Diverse groups of natural enemies attack all life stages of *Agrilus* species, with some coevolved specialist parasitoids being introduced successfully to suppress *A. planipennis* in North America. Climate change, leading to warmer and drier conditions, will influence the distribution and population dynamics of many *Agrilus* species. Many research gaps still exist in the areas of biocontrol, host plant resistance, and sustainable management strategies for this important group of plant pests.

FAO (2024) Guide to implementation of phytosanitary standards in forestry. Second edition. FAO Forestry Paper No. 164. Rome, FAO. https://doi.org/10.4060/cd3046en, https://openknowledge.fao.org/items/3198c57f-bfe9-4de7-9969-e34987f0ce49

This guide, produced by an international group of scientists, phytosanitary authorities, forest experts and industry representatives and reviewed by more than 100 specialists from

46 countries, provides easy-to-understand information on how good forest management practices and well implemented phytosanitary standards can minimize pest spread and facilitate safe trade. Specifically, it explains how the International Standards for Phytosanitary Measures (ISPMs) and national plant protection organization (NPPO) regulations affect the import and export of forest commodities; how relevant ISPMs can be used to prevent pest introduction and spread; and how forest-sector personnel can work together with NPPOs to contribute to the development and implementation of ISPMs and national phytosanitary regulations that help reduce pest movement while restricting trade as little as possible. The guide will be of vital interest to people involved in nursery activities, planting, managing, harvesting, manufacturing, trading and transporting forest products. It will also benefit forest policy-makers, planners, managers and educators, particularly in developing countries. This is the second edition of the guide, originally published in 2011, including updated information.

George JP, Rusanen M, Beuker E, Yrjänä L, Timmermann V, Potočić N, Välimäki S, Konrad H (2024) Lessons to learn for better safeguarding of genetic resources during tree pandemics: The case of ash dieback in Europe. *Biological Conservation* 299: 110802, https://doi.org/10.1016/j.biocon.2024.110802

Ash dieback (ADB) has been threatening populations of European ash (*Fraxinus excelsior* & *F. angustifolia*) for more than three decades. Although much knowledge has been gathered in the recent past, practical conservation measures have been mostly implemented at local scale. Since range contraction in both ash species is likely to be exacerbated already in the near future by westward expansion of the emerald ash borer and climate change, systematic conservation frameworks need to be developed to avoid long-term population-genetic consequences and depletion of genomic diversity. In this article, we address the advantages and obstacles of conservation approaches aiming to conserve genetic diversity in situ or ex situ during tree pandemics. We are reviewing 47 studies which were published on ash dieback to unravel three important dimensions of ongoing conservation approaches or perceived conservation problems: i) conservation philosophy (i.e. natural selection, resistance breeding or genetic conservation), ii) the spatial scale (ecosystem, country, continent), and iii) the integration of genetic safety margins in conservation planning. Although nearly equal proportions of the reviewed studies mention breeding or active conservation as possible long-term solutions, only 17% consider that additional threats exist which may further reduce genetic diversity in both ash species. We also identify and discuss several knowledge gaps and limitations which may have limited the initiation of conservation projects at national and international level so far. Finally, we demonstrate that there is not much time left for filling these gaps, because European-wide forest health monitoring data indicates a significant decline of ash populations in the last 5 years.

Hinterstoisser W, Connell J, Hoch G (2024) Guide for determination of 12 *Agrilus* species native in Austria. BFW (Austrian Research Centre for Forests), Vienna, Austria, 2024. https://www.bfw.gv.at/wp-content/uploads/neu_BFW-Agrilus-key-20240809.pdf

This guide was developed based on published keys used when identifying hundreds of specimens from a trapping experiment in oak forests in Eastern Austria. The document was made for internal usage at BFW and has limited representation of species and is considered a “work in progress”. Despite the mentioned restrictions, the guide, which uses a photo-based combination process, might be useful for others involved in identification of *Agrilus* species. Detailed photos of morphological characters are provided for *Agrilus angustulus, A. biguttatus, A. convexicollis, A. derasofasciatus, A. graminis, A. hastulifer, A. laticornis, A. litura, A. obscuricollis, A. olivicolor,*

A. sulcicollis, and *A. viridis*. The work was done as part of the EUPHRESCO Project '*Agrilus*' (2020-A-337). The pdf guide can be downloaded from the BFW website.

Horrocks KJ, Seehausen ML, Down RE, Audsley N, Maggini R, Collatz J (2024) Assessing the feasibility of pre-emptive biological control against the emerald ash borer, *Agrilus planipennis*, an imminent biosecurity threat to Europe. *Biological Control* 198: 105641 https://doi.org/10.1016/j.biocontrol.2024.105641

As the globalisation of trade increases, so does the spread of arthropod pests, leading to a growing focus on biosecurity preparedness. One approach to this is pre-emptive biological control, involving the importation of classical biological control (CBC) agents for risk assessments and acquiring approval for their release prior to the expected arrival of their target pests. This aims to mitigate the economic and/or environmental consequences of a delayed biological control response to pest invasions. Guidelines to assess the feasibility of pre-emptive biological control for high priority pests were recently developed. Emerald ash borer (EAB), *Agrilus planipennis*, is an invasive woodboring pest of ash (*Fraxinus* spp.) in North America, European Russia and Ukraine, and is spreading westward into Europe, threatening the future of European ash (*Fraxinus excelsior*). We applied the aforementioned guidelines to assess the feasibility of pre-emptive biological control in Europe using four EAB parasitoids, already released in North America for CBC. Three of the parasitoids; *Oobius agrili*, *Spathius galinae*, and *Tetrastichus planipennisi*, were found suitable for pre-emptive biological control. The fourth parasitoid, *Spathius agrili*, was found to have limited establishment in new environmental conditions, and was therefore deemed less suitable for pre-emptive biological control of EAB in Europe. This assessment can inform scientists and regulators in Europe on the most promising EAB parasitoids that should be considered for pre-emptive applications for importation and risk assessment to acquire pre-approval for immediate release should the target pest subsequently be discovered. In turn, this study contributes to the development of biosecurity preparedness against EAB's imminent spread throughout Europe.

Hurley B, Buglyó I, Horváth K, Winkler-Ráthonyi N, Sathyapala S (2024) Forest pest contingency plan guidelines for Europe and Central Asia. Budapest, FAO. https://doi.org/10.4060/cd2753en

Pest contingency plans (PCP) are used by national or regional plant protection organizations to ensure a plan is in place for when a new pest is detected in a particular country or region, and thus to facilitate a rapid and effective response to manage the situation. This guide outlines and discusses the elements and steps needed to formulate and implement a contingency plan for key forest pests in Europe and Central Asia. This effort is complemented by FAO's Forest Invasive Species Network for Europe and Central Asia (REUFIS), which aims to facilitate knowledge exchange, promote good practices, and build capacities related to forest invasive species, including the prevention and management of emerging pests. Suggestions are provided on the main steps, or elements, in a PCP for forest pests. The guidelines highlight the main information that should be included for a robust plan that can be activated in response to a new report of a pest or a pest outbreak, for example from official surveillance, reports from the public, or to an interception by an importing country. The report provides a step-by-step guide on developing an effective PCP tailored to specific needs. For some of the steps, examples are provided on the details that would be included for specific pests. These pests are the emerald ash borer *Agrilus planipennis*, a potential insect pest introduction into parts of Europe and Central Asia; the eight-toothed spruce bark beetle Ips typographus, native to many parts of Europe and Asia, but where outbreaks can cause substantial tree mortality; and pitch canker *Fusarium circinatum*, a potential fungal pathogen introduction into parts of Europe and Central

Asia. Most of the content of the guide is relevant for the development of PCPs across different regions. However, the examples provided are specific to Europe and Central Asia.

Kenis M, Eisenring M, Gossner MM, Seehausen ML (2024) Parasitoids of *Agrilus* spp. in Europe: Anticipating the arrival of *Agrilus planipennis*. *Biological Control* 199: 105655. https://doi.org/10.1016/j.biocontrol.2024.105655

The emerald ash borer (EAB), *Agrilus planipennis*, is a woodboring beetle native to East Asia. It is highly invasive in North America, where it causes large-scale dieback of American ash species, *Fraxinus* spp. EAB is also invasive in Western Russia and Ukraine, and it continues to spread towards Central and Western Europe where all three native ash species are susceptible. Biological control approaches offer sustainable solutions to control invasive pests. In North America, four Asian parasitoid species that have coevolved with EAB have been introduced to control the pest. In Europe, many species of the genus *Agrilus* occur, and it is likely that at least some of their parasitoids will adopt EAB as a host as it spreads across the continent. However, parasitoids of *Agrilus* spp., are very poorly known in Europe because of the difficulty of studying the parasitoid complex of these solitary wood boring insects. In this review, we provide a literature overview of studies and records of European parasitoids of *Agrilus* spp. to provide a basis for future studies on the emerging parasitoid complex of EAB in Europe. Parasitoid records were found for 24 European species of *Agrilus*. Sixty-four parasitoid species were recorded, mostly larval parasitoids. However, it is likely that several of them are erroneous host-parasitoid associations or misidentifications, and the biology of most species and their role in the population dynamics of their hosts has been poorly studied. It is recommended to conduct pre-emptive studies on these parasitoids and their suitability as potential biological control organisms with EAB.

Koveshnikov AI, Derzhavina NM, Silaeva ZG, Shiryaeva NA (2024) Ecological characteristics of stands of *Fraxinus excelsior* L. in the city of Orel. In: XV Readings in Memory of T.B. Dubyago. Collection of papers of the international conference 'Landscape and Design'. Saint Petersburg: Saint Petersburg State Forest Technical University named after S.M. Kirov, November 28 – December 01, 2023, p. 105-109 (in Russian) https://www.elibrary.ru/item.asp?id=71298338

Currently, in many cities of central Russia, urban woody plants of *Fraxinus excelsior* L. are damaged by *Agrilus planipennis* Fairm., which leads to the drying of the plant from the top of the crown. As a result, in urban plantings, ash completely loses its aesthetic appearance and does not fulfill its ecological functions. The aim of the work was to analyze urban plantings from *F. excelsior* and develop recommendations for care and prevention. It was revealed that in 2023, in the Sovetsky district of Orel, out of 1 196 surveyed trees, 759 were damaged by this pest. It is shown that the system for increasing the stability of woody plants and protecting plantings in the city should include the organization of general supervision over the appearance and spread of pests and diseases; quarantine measures and certification of planting material; preventive activities aimed at increasing plant resistance to negative factors of the urban environment; measures for active protection of plants from pests and diseases.

Kyle KE, Allen MC, Siegert NW, Grabosky J, Lockwood JL (2024) Design of an eDNA sampling method for detection of an endophagous forest pest. *NeoBiota* 95: 149-164. https://doi.org/10.3897/neobiota.95.118267

Invasive wood-boring insects are a major economic and ecological concern worldwide as they impact native woody plant populations. These pest species are increasing in prevalence, with devastating impact, as global trade leads to higher rates of introduction and establishment. The emerald ash borer (*Agrilus planipennis*; EAB) is one such species, which has caused

widespread damage across much of the United States and is now spreading across Europe. Non-indigenous woodborers such as EAB are difficult to detect at early stages of invasion, which is when management and eradication efforts are most effective and cost efficient. Environmental DNA (eDNA) surveys have demonstrated power in detecting invasive species when rare in the landscape due to their ability to detect trace amounts of DNA and identify to species. Here, we trialled a novel eDNA method for collecting environmental samples within host trees where invasive pest larvae are feeding, using EAB as a case study. We extracted tree cores approximately 1 cm in length using an increment hammer to assess detectability of eDNA from larvae feeding under the bark. In trees visibly infested with EAB, we observed a seasonal peak in EAB DNA detection probability (~ 64%; towards the end of the growing season), indicating a potential impact of ash tree phenology or EAB phenology on detection. When we trialled the method in a site with ash trees of low or uncertain EAB abundance, we did not record positive EAB eDNA detections. This outcome may have resulted from differing EAB phenology at the northern latitude of this survey site or because larval galleries were less numerous causing EAB DNA to be scarcer within the tree. Our results, however, provide preliminary evidence that increment hammer tree cores can be used to detect eDNA of EAB and, perhaps, other wood-boring pests. Further work is needed to clarify false negative survey detections at ash trees showing little to no signs or symptoms of infestation, as well as investigating the deposition, transport and persistence dynamics of EAB eDNA within trees.

Li J, Zhao X, Li X, Ju M, Yang F (2024) A method for classifying wood-boring insects for pest control based on deep learning using boring vibration signals with environment noise. *Forests* 15: 1875. https://doi.org/10.3390/f15111875

Wood-boring pests are difficult to monitor due to their concealed lifestyle. To effectively control these wood-boring pests, it is first necessary to efficiently and accurately detect their presence and identify their species, which requires addressing the limitations of traditional monitoring methods. This paper proposes a deep learning-based model called BorerNet, which incorporates an attention mechanism to accurately identify wood-boring pests using the limited vibration signals generated by feeding larvae. Acoustic sensors can be used to collect boring vibration signals from the larvae of the emerald ash borer (EAB), *Agrilus planipennis* Fairmaire, 1888 (Coleoptera: Buprestidae), and the small carpenter moth (SCM), *Streltzoviella insularis* Staudinger, 1892 (Lepidoptera: Cossidae). After preprocessing steps such as clipping and segmentation, Mel-frequency cepstral coefficients (MFCCs) are extracted as inputs for the BorerNet model, with noisy signals from real environments used as the test set. BorerNet learns from the input features and outputs identification results. The research findings demonstrate that BorerNet achieves an identification accuracy of 96.67% and exhibits strong robustness and generalization capabilities. Compared to traditional methods, this approach offers significant advantages in terms of automation, recognition efficiency, and cost-effectiveness. It enables the early detection and treatment of pest infestations and allows for the development of targeted control strategies for different pests. This introduces innovative technology into the field of tree health monitoring, enhancing the ability to detect wood-boring pests early and making a substantial contribution to forestry-related research and practical applications.

Liebhold AM, Ethington MW, Stadsvold B, Negrón JF (2025) Spread of the emerald ash borer, *Agrilus planipennis*, in the Front Range region of Colorado. *Biological Invasions* 27: 42. https://doi.org/10.1007/s10530-024-03512-1

Until it was discovered in Boulder, Colorado in 2013, the invaded range of the emerald ash borer, *Agrilus planipennis*, in the Western Hemisphere was entirely limited to natural and urban forests of eastern North America. Subsequently, this species has expanded its range through much of the Colorado Front Range region, utilizing non-native ash, *Fraxinus* spp. These host trees are widely planted there in urban settings but natural forests containing ash are lacking

in the region. Here we use survey data to quantify emerald ash borer regional spread across the Colorado Front Range as well as its local spread in the city of Longmont, Colorado. Across the region, spread rate was estimated at 3.9 km/yr, but within Longmont the rate was only 0.25 km/yr. These rates of spread are lower than what has been reported from comparable spatial scales in eastern North America and the slower spread may reflect reduced host resource availability, successful implementation of management, or differences in environmental conditions.

Melton AE, Faske TM, Sniezko RA, Thibault T, Williams W, Parchman T, Hamilton JA (2025) Genomics-driven monitoring of *Fraxinus latifolia* (Oregon ash) to inform conservation and EAB-resistance breeding. *Molecular Ecology* e17640. https://doi.org/10.1111/mec.17640

Understanding the evolutionary processes underlying range-wide genomic variation is critical to designing effective conservation and restoration strategies. Evaluating the influence of connectivity, demographic change and environmental adaptation for threatened species can be invaluable to proactive conservation of evolutionary potential. In this study, we assessed genomic variation across the range of *Fraxinus latifolia*, a foundational riparian tree native to western North America recently exposed to the invasive emerald ash borer (*Agrilus planipennis*; EAB). Over 1000 individuals from 61 populations were sequenced using reduced representation (ddRAD-seq) across the species' range. Strong population structure was evident along a latitudinal gradient, with population connectivity largely maintained along central valley river systems, and a centre of genetic diversity coinciding with major river systems central to the species' range. Despite evidence of connectivity, estimates of nucleotide diversity and effective population size were low across all populations, suggesting the patchy distribution of *F. latifolia* populations may impact its long-term evolutionary potential. Range-wide estimates of genomic offset, which indicate genomic change required to adjust to future climate projections, were greatest in the eastern and lowest in the southern portions of the species' range, suggesting the regional distribution of genomic variation may impact evolutionary potential longer-term. To preserve evolutionary capacity across populations needed for the development of breeding and restoration programmes, prioritising conservation of range-wide genomic diversity will provide a foundation for long-term species management.

Meshkova V, Zinchenko O, Us V, Skrylnyk Y (2024) Emerald ash borer in the park with a long-time history of black ash sawfly defoliation. *Environ. Earth Sci. Proc.* 31: 4. https://doi.org/10.3390/eesp2024031004

The Emerald ash borer (EAB) was found in Kharkiv (Ukraine) in 2022, infesting ash trees in the permanent focus of the ash black sawfly, *Tomostethus nigritus*. We aimed to recognize the characteristics of trees that attract EAB. Ash tree defoliation, dieback, epicormic shoots, health condition class, and ash bark beetle infestation were analyzed with EAB presence or absence. The EAB preferred to infest the trees with higher defoliation, epicormic shoots, and ash bark beetle, *Hylesinus* sp. infestation more than in the trees without these symptoms. Despite the deterioration in the health of most trees in the EAB outbreak, some specimens have maintained and even improved their health. This confirms the possibility of selecting resistant trees with subsequent reproduction.

Morris TD, Gould JR, Booth TC, Miller FD, Kaltenbach J, Fierke MK (2024) Managing emerald ash borer in urban forests: Integrating biocontrol and insecticide treatments. *Biological Control* 199: 105658. https://doi.org/10.1016/j.biocontrol.2024.105658

Ash trees (*Fraxinus* spp.) were commonly planted street trees in urban environments prior to the arrival of emerald ash borer (EAB), *Agrilus planipennis* Fairmaire, in the 1990 s and its

subsequent impacts. Insecticide treatments can provide consistent control of EAB and are used to protect high-value trees; however, control only lasts a few years before reapplication is needed. An EAB biological control program seeks to provide long-term control and several parasitoids have been released to that end, including the larval parasitoids *Tetrastichus planipennisi* Yang (Eulophidae) and *Spathius galinae* Belokobylskij (Braconidae). In 2015, we released parasitoids in three cities (Syracuse NY, Naperville IL, Boulder CO) while city arborists were simultaneously treating high-value street trees with insecticides. We hypothesized parasitoids would be able to establish on EAB in untreated trees and spread throughout the cities while treated trees remained healthy. We also hypothesized EAB densities would fall as non-treated ash died and would not subsequently rebound as insecticide treatments were removed from street trees due to the parasitism of biocontrol agents. Three-hundred trees were selected for monitoring in each city: 100 untreated, 100 treated, and 100 temporarily treated. *Tetrastichus planipennisi* successfully established in all three cities, while *S. galinae* established in Syracuse and Boulder. Untreated trees rapidly declined as expected while treated trees remained healthy. During the study subsets of trees were removed from the treatment cycle as EAB densities fell (≤ 10 larvae/m^2). Minor canopy decline was present in 2021–2023 in trees from which treatment was removed, with median crown classes declining from 1 to 2. Despite this shift, most of these trees remained un-infested (~75%) and retained healthy canopies. Trees that did become infested had high apparent parasitism and low EAB densities. Due to the high value of urban trees, we recommend managers continue monitoring trees and consider selectively reinstating insecticide treatments on trees that start to decline and/or are subject to additional urban stressors.

Noseworthy MK, Allen EA, Hébert C, Bélanger S, John EP, MacQuarrie CJK, Martel V, Souque TJ (2025) Reducing pest risk in birch wood products—the effective heat treatment for bronze birch borer *Agrilus anxius* (Coleoptera: Buprestidae) prepupae. Journal of Applied Entomology https://doi.org/10.1111/jen.13390

The protection of forest resources and the safe trade of forest products require phytosanitary measures to reduce the risk of pest movement to novel environments. Heat treatment is a widely available, efficient and effective method to produce phytosanitary wood products destined for trade. Defining the minimum effective heat treatment dose required to cause the mortality of insects in wood products reduces the risk of spreading pests to novel environments with the lowest possible energy cost, which in turn reduces environmental impacts and provides confidence in current guidelines for heat treatment regulations. The minimum effective heat treatment dose (time and temperature) for *Agrilus anxius* (bronze birch borer) prepupae was determined using the Humble water bath applying heat in vitro. Heat treatment was assessed using a controlled increase in temperature to simulate the heat ramp applied to wood in industrial kilns and conventional heat chamber operations. Target temperatures between 51°C and 56°C for exposure durations of 15 and 30 min were tested to determine the minimum effective dose. Prepupal *A. anxius* did not survive exposure to 53°C, 54°C, 55°C or 56°C for 30 min or 54°C and 56°C for 15 min. Chronic or delayed mortality was observed at 53°C for 15-min treatments. Evaluating the effect of specific heat treatment parameters for other forest pests is recommended to identify and validate the minimum temperature and time required to cause the mortality of wood pests in order to avoid introducing non-indigenous species with wood products and limit pest movement.

Przybylski P., Mohytych V, Sikora K (2024) Spring's signal: Can bud burst timing enhance resistance to ash dieback in Europe? https://doi.org/10.20944/preprints202409.1521.v1 **(this is a not peer-reviewed preprint)**

Ash dieback (ADB), caused by the invasive fungal pathogen *Hymenoscyphus fraxineus*, poses a significant ecological and economic challenge across Europe. *Fraxinus excelsior* (European ash),

a key component of forest ecosystems, has experienced mortality rates reaching up to 85% in affected regions, severely threatening its ecological role and economic value. This study examines the relationship between the phenological traits of ash clones, particularly the timing of spring bud burst, and their susceptibility to *H. fraxineus* infection. The study was conducted in a clonal seed orchard located in northeastern Poland, encompassing 31 ash clones from different bioclimatic regions. Phenological observations of bud burst were carried out from early April to late May during the years 2018-2020, and crown damage and de-foliation levels were assessed multiple times throughout the growing season. The results confirm that clones with earlier bud burst exhibit significantly higher survival rates and reduced crown damage. It was found that the timing of bud burst is strongly correlated with susceptibility to ash dieback, suggesting that phenological timing is a crucial factor in the selection of genotypes resistant to ash dieback. Statistical analyses, including ANOVA and mixed models, revealed significant differences in susceptibility to infection among clones from different bioclimatic regions. Furthermore, the study high-lights the potential of breeding strategies focused on these traits to enhance the resilience of ash populations. These findings are critical for the development of effective forest management practices aimed at conserving ash resources and maintaining biodiversity in the face of climate change and the ongoing spread of the pathogen.

Quinn NF, Robertson RR, Duan JJ (2024) Effect of storage conditions on host egg suitability and the reproductive fitness of *Oobius agrili* (Hymenoptera: Encyrtidae), an egg parasitoid of the invasive emerald ash borer (*Agrilus planipennis*) (Coleoptera: Buprestidae), *Environmental Entomology* 53 (6): 946–953, https://doi.org/10.1093/ee/nvae081

Oobius agrili Zhang and Huang (Hymenoptera: Encyrtidae) is an important egg parasitoid of the emerald ash borer (EAB), *Agrilus planipennis* Fairmaire (Coleoptera: Buprestidae). Methods for laboratory-rearing *O. agrili* have been developed but its mass-production depends on the continuous production and storage of freshly laid EAB eggs as well as diapaused parasitoid progeny (inside parasitized EAB eggs). The purpose of this study was to determine optimal environmental conditions for long-term storage of host eggs as well as diapaused parasitoid progeny. Fresh host eggs and diapaused parasitoid progeny were stored at two low storage temperatures (1.7 and 12.8°C) and three levels of relative humidity (low ~31%, medium ~74%, and high ~99.9%) for various length of time (15–270 days) and then evaluated for host egg suitability and the reproductive fitness of stored parasitoid progeny. EAB eggs were stored for approximately 30 days without significant reduction of their viability and suitability to *O. agrili* parasitism at low storage temperatures under high and medium relative humidity. Neither storage temperature or humidity had any significant effects on adult parasitoid emergence for storage durations of up to 270 days. When storage durations were over 120 days, however, both adult parasitoid longevity and fecundity declined approximately 20–30% across all temperature and humidity treatments. Relevance of findings to mass-production and storage of *O. agrili* for biocontrol is discussed.

Reed K, Cole F, Audsley N, Uglow A, Down R, Barnard K, Inward D (2025) Susceptibility of European *Agrilus* beetle species to the biocontrol agents of Emerald Ash Borer in the laboratory. *Biological Control* 200: 105678. https://doi.org/10.1016/j.biocontrol.2024.105678

The emerald ash borer (EAB, *Agrilus planipennis* Fairmaire (Coleoptera: Buprestidae) is devastating ash trees in its invaded range of North America and spreading rapidly towards Western Europe from European Russia and Ukraine. To allow a rapid response when the beetle is detected, slow its spread and protect trees as part of a wider integrated pest management programme, pre-emptive biological control strategies that are suitable for Great Britain and the rest of Europe must urgently be developed. Three classical hymenopteran biological control agents have been mass-reared and released within North America to control EAB: the egg parasitoid *Oobius agrili* Zhang and Huang (Hymenoptera: Encyrtidae), and the larval parasitoids

Tetrastichus planipennisi and *Spathius galinae* Belokobylskij & Strazanac (Hymenoptera: Braconidae). This study presents data on the risk these parasitoid wasps might pose to British *Agrilus* beetles. 'No-choice' laboratory assays tested the susceptibility of *A. biguttatus* Fabricius eggs and larvae and *A. sulcicollis* Lacordaire and *A. convexicollis* Redtenbacher eggs to the parasitoids. *Oobius agrili, T. planipennisi* and *S. galinae* all attacked *A. biguttatus*, and offspring were produced. *Oobius agrili* also attacked the eggs of *A. convexicollis*, but not *A. sulcicollis*. This study is the first to show parasitism of a non-target species by *T. planipennisi*. Further work is needed to fully assess the non-target risk of these parasitoids for release using more ecologically relevant tests, such as 'choice', semi-field and chemical ecology assays on the attacked *Agrilus* species.

Rizzo D, Carli M, Zubieta CG, Marrucci A, Ranaldi C, Palmigiano B, Bartolini L, Moriconi M, Nugnes F (2024) When frass meets gold: development of a TaqMan Probe-Based qPCR for identifying goldspotted oak borer, *Agrilus auroguttatus* Schäffer. *Preprints* **2024**, 2024122520. https://doi.org/10.20944/preprints202412.2520.v1 **(this is a not peer-reviewed preprint)**

This study presents a qPCR-based molecular diagnostic method utilizing a TaqMan probe to accurately identify *Agrilus auroguttatus* Schäffer (Coleoptera: Buprestidae) from adult insects, excreta samples, and frass residues. The method demonstrated excellent DNA amplification across all sample types, highlighting strong analytical specificity. The protocol exhibited high repeatability and reproducibility, with inter-run and intra-run variability standard deviations consistently at or below 0.5. This assay distinguished *A. auroguttatus* samples from non-target species with 100% sequence correspondence. Analytical sensitivity (LoD) for adult and frass samples was determined at 8 pg/µL and at a 1:5 dilution from an initial concentration of 5 ng/µL, yielding mean Cq values of 35.14 ± 0.71 and 37.07 ± 0.59, respectively. The indirect diagnostic capability of this method is particularly valuable for detecting the presence of wood-boring insects, potentially aiding in the early detection of *A. auroguttatus* in new environments or in managing current outbreak areas. This diagnostic tool could thus play a critical role in biosecurity efforts to limit the spread of this invasive species.

Sergeeva EC (2024) Expansion of the range of the invasive pest of ash – a buprestid *Agrilus planipennis* (Coleoptera, Buprestidae) in the south-east of middle Russia. In: Anthropogenic Transformation of Geospace: A Changing World - Strokes to a Portrait. Proceedings of the VI All-Russian Scientific and Practical Conference. Volgograd, December 11-12, 2023. Volgograd State University, 2024: 203-206 (in Russian) https://www.elibrary.ru/item.asp?id=73807858

The ash borer, *Agrilus planipennis*, is a highly destructive pest of ash trees (*Fraxinus* spp.) in the European part of Russia and North America. This species is currently distributed in the European part of Russia and in eastern Ukraine. The objective of this study was to determine the current distribution of the species in the south-east of central Europe. The study was conducted in 2023 in the Voronezh and Saratov Oblasts of Russia. The pest has almost completely spread over the Voronezh Oblast and penetrated into the western regions of the Saratov Oblast. *Agrilus planipennis* is rapidly spreading to the south-east of European Russia. It successfully colonizes the ash species growing in this area: *Fraxinus excelsior* L. and *F. pennsylvanica* Marsh. Further expansion of the range will cause significant ecological and economic damage.

Simeto S, Held BW, Showalter DN, Bushley KE, Blanchette RA (2024) Ovicidal effect of entomopathogenic fungi on Emerald ash borer, *Agrilus planipennis* Fairmaire, eggs. *Forests* 15: 2170. https://doi.org/10.3390/f15122170

> The emerald ash borer (EAB) is an invasive beetle that has killed hundreds of millions of ash trees throughout North America since its arrival. The use of entomopathogenic fungi as part of integrated pest management approaches is considered effective against a wide range of insect pests. The aim of this study was to screen and select locally adapted EAB-associated entomopathogenic fungi with ovicidal effect on EAB eggs under laboratory conditions. The pathogenicity of nine fungal strains, previously isolated from EAB galleries, and the commercial *Beauveria bassiana* strain GHA was tested. Three of these, *Akanthomyces muscarius* 48-27, *Lecanicillium longisporum* 66-14 *Lecanicillium psalliotae* 59-2, and GHA *B. bassiana* strain consistently showed significant ovicidal effects and a high percentage of inoculum recovery both from eggs and neonate larvae. The high levels of inoculum recovery from neonate larvae demonstrate that, even after emergence, larvae were infected. The possibility of disrupting EAB's life cycle at the egg stage through microbial control represents a potential management opportunity that should be explored in future field studies. Future work should also study the effect of EPF on neonate larvae survival and performance. To our knowledge, this is the first study to evaluate the effect of entomopathogenic fungi against the egg stage of EAB.

Tsybulskyi O, Bonjuk Z, Jarova L, Chumak P (2024) Emerald ash borer and ash trees condition in the Academ. O.V. Fomin Botanical Garden (Kiev, Ukraine). In: Objects of the Nature Reserve Fund of Ukraine: Current Status and Ways to Ensure Their Effective Activity: Collection of Materials of the All-Ukrainian Scientific and Practical Conference, Kyiv, June 27–28, 2024, Kyiv, 2024. P. 266-270 [Electronic edition] (in Ukrainian with English abstract) DOI: 10.61584/1-10-2024-57 https://doi.org/10.61584/1-10-2024 (http://malepolisja.in.ua/arkhivy/zbirnyk-materialiv-konferentsii-2024/94-rozhornutimaterialykonferentsiipdf/1414-2024-57)

> The condition of trees of the genus *Fraxinus* growing in the Botanical garden named Academ. O.V. Fomin was examined. Among 102 ash trees belonging to more than 10 species and forms, including those of North American and Euro-Asian origin, only 12.5% were undamaged. Young trees of all ash species planted in 2006- 2014 were the least damaged. It has been established that *Agrilus planipennis* has become widely distributed in the Botanic garden. The monitoring of the spread of *A. planipennis* include not only plants of the genus *Fraxinus*, but also plants of the family Juglandaceae that grow nearby.

Volodchenko AN (2024) Alien xylobiontic beetles in forest ecosystems of the northern steppe of European Russia. In: Anthropogenic Transformation of Geospace: A Changing World - Strokes to a Portrait. Proceedings of the VI All-Russian Scientific and Practical Conference. Volgograd, December 11-12, 2023. Volgograd State University, 2024: 187-191 (in Russian) https://www.elibrary.ru/item.asp?id=73807834

> The article provides a summary of data on alien beetle species found in the forests of the northern steppe of European Russia. 13 species of invaders were identified: *Carcinops pumilio* (Erichson, 1834), *Agrilus planipennis* Fairmaire, 1888, *Trogoderma glabrum* (Herbst, 1783), *Lyctus brunneus* (Stephens, 1830), *Tenebroides mauritanicus* (Linnaeus, 1758), *Necrobia violacea* (Linnaeus, 1758), *Cryptolestes ferrugineus* (Stephens, 1831), *C. pusillus* (Schönherr, 1817), *Tenebrio molitor* Linnaeus, 1758, *Tribolium castaneum* (Herbst, 1797), *T. madens* (Charpentier, 1825), *Trichoferus campestris* (Faldermann, 1835), *Xyleborinus attenuatus*

(Blandford, 1894). Distribution, relative frequency, and abundance are provided for the species. Most species do not pose a serious threat to the functioning of forest communities.

Walters B, Bataineh M, Clarke S, Johnson W, Bruce W (2025) Detection of Emerald ash borer (Coleoptera: Buprestidae) in ash (*Fraxinus* spp.) crowns in the Southern United States: Comparing panel trap color, placement, and lure. *Forests* 16: 54. https://doi.org/10.3390/f16010054

The emerald ash borer (EAB), *Agrilus planipennis* Fairmaire, is an invasive forest pest that is causing a rapid decline in ash (*Fraxinus* spp.). As EABs spread across North America to 35 U.S. states and 5 Canadian provinces, detection of the pest has proven difficult, especially at low population density sites. Panel traps have been commonly used in detection and monitoring of EAB populations. Over two sampling periods from 2016 through 2019, adult catches and detection rates were compared among four combinations of panel trap color, lure, and crown placement in southern Arkansas, northern Louisiana, and eastern Texas. The four combinations were as follows: (1) dark purple baited with (Z)-3-hexenol alone in the mid-upper crown; (2) light green with (Z)-3-hexenol plus (3Z)-lactone in the mid-upper crown; (3) dark purple with (Z)-3-hexenol in the lower crown; and (4) dark purple with (Z)-3-hexenol plus (3Z)-lactone in the lower crown. Mid-upper tree crown placement, ~13 m, of panel traps were more effective for EAB detection and adult capture, especially of males. The sex pheromone (3Z)-lactone deterred females but attracted males, while (Z)-3-hexenol attracted females. The green panel trap with both lures and mid-upper crown placement did not drastically increase male catches, contrary to previous studies at low EAB densities. The use of (3Z)-lactone on dark purple traps at low crown placements, such as those used in the National Survey Program, is not recommended for EAB detection due to its repellent effect on EAB females.

Wu H, Dahlsjö CAL, Malhi Y (2024) Evaluating the impact of an invasive pathogen on tree population decline: An evidence based modelling approach. *Forest Ecology and Management* 566: 122098 https://doi.org/10.1016/j.foreco.2024.122098

An upsurge of invasive forest pathogens (IFPs) has been causing widespread damage to forest ecosystems worldwide. Modelling future forest loss caused by IFPs is challenging, as it requires a sophisticated understanding of the pathogen-hosts-surrounding interactions. We developed a complexity-appropriate model using an evidence-based approach to predict the decline of the European ash (*Fraxinus excelsior* L.) population caused by ash dieback (*Hymenoscyphus fraxineus*) in a British deciduous woodland. Our model predicts that (1) the ash population will decline by ~26% in the next 10 year; (2) an ±10% relative error in mortality survey would cause a ~8% bias in 10-year population decline; and (3) a 5% increase in resistant trees would save ~3% population over 10 years. Our research demonstrates the merit of systematic reviews in balancing model complexity against generalisation. By scaling up the methodology to other IFPs, it is possible to forecast forest health with various management scenarios.

Yin J, Zhang H, Chen Z, Li J (2025) Detecting emerald ash borer boring vibrations using an encoder-decoder and improved DenseNet model. *Pest Management Science* 81: 384-401. https://doi.org/10.1002/ps.8442

Background: Forest ecosystems are under constant threat from wood-boring pests such as the Emerald ash borer (EAB), which remain elusive owing to their hidden life cycles within tree trunks. Early detection is vital to mitigate economic and ecological damage. The main current monitoring method is manual detection which is ineffective at early stages of infestation. This study introduces VibroEABNet, a deep learning-based joint recognition network designed to enhance the detection of EAB boring vibration signals, with a novel approach integrating denoising and recognition modules.

Results: The proposed VibroEABNet model demonstrated exceptional performance, achieving an average accuracy of 98.98% across multiple signal-to-noise ratios (SNRs) in test datasets and a remarkable 97.5% accuracy in real forest datasets, surpassing traditional models and other deep learning networks evaluated in this study. These findings were supported by rigorous noise resistance analysis and real dataset evaluation, indicating the model's robustness and reliability in practical applications. Furthermore, the model's efficiency was highlighted by its inference time of 26 ms and a compact model size of 8.43 MB, underscoring its suitability for deployment in resource-limited environments.

Conclusion: The development of VibroEABNet marks a significant advancement in pest detection methodologies, offering a scalable, accurate and efficient solution for early monitoring of wood-boring pests. The integration of a denoising module within the network structure addresses the challenge of environmental noise, one of the primary limitations in acoustic monitoring of pests. Currently, this research is limited to a specific pest. Future work will focus on the applicability of this network to other wood-boring pests.

Zhou Q, Zhang X, Yu L, Qi R, Ren L, Luo Y (2024), Determining the optimal time window to detect emerald ash borer damage for effective management. *Pest Management Science* https://doi.org/10.1002/ps.8533

Background: The emerald ash borer (EAB) is an invasive pest of global concern. Accurate detection of EAB is crucial for effective management. Traditional field surveys fail to meet large-scale monitoring requirements. Remote sensing methods offer a potential solution, but the phenological decline of ash trees may obscure the remote sensing features for detecting EAB. Therefore, determining the timing of leaf abscission caused by EAB before phenology is crucial for effective detection. We collected time-series data of Leaf Area Index (LAI), leaf sizes, and hyperspectral images of damaged ash trees throughout the growing season to determine the optimal detecting time window for EAB detection using field surveys or remote sensing techniques.

Results: Significant differences in LAI and leaf size were observed throughout the growing season among ash trees with different EAB infestation degrees, providing a basis for small-scale field surveys. However, in May and June, the hyperspectral reflectance showed no variation. The difference began to appear in July and became apparent from August to October. By October, severely EAB-infested ash trees had almost completely defoliated. Machine learning classification results showed that accuracies after July were higher than before July. After July, the highest classification accuracy reached 100%, while the highest accuracy before July was only 88.57%.

Conclusions: Selecting the optimal monitoring time significantly enhanced detection accuracy. The optimal period for field surveys is from May to November, whereas for remote sensing it is from August to October. Identifying the optimal months enables us to achieve more efficient decision-making and management.