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Infestation of ash emerald ash borer *Agrilus planipennis* Fairmaire, (*Coleoptera: Buprestidae*) on the territory of National University of Life and Environmental Sciences (NULES) of Ukraine

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Abstract. The aim of the study was to assess the sanitary condition of ash trees of the genus *Fraxinus* spp. on the territory of NULES of Ukraine and to monitor the number of invasive species *Agrilus planipennis*. The inventory data of 2021-2023 were presented, where it was noted that the condition of 66% of ash trees was characterised as good. A detailed survey in 2024 revealed a rapid deterioration of ash trees throughout the study area. It was found that a significant weakening of *Fraxinus* spp. trees was noted on the territory of the Botanical Garden of the National University of Life Sciences of Ukraine and near the stadium. It was worth noting that 13% of trees without signs of damage were located in the depths of the forest, as the emerald ash borer was a potential feeder for trees growing openly, although with a significant distribution the insect can inhabit trees in the depths of the plantation. During the detailed forest pathology survey, *Agrilus planipennis* adults and D-shaped flight holes were found. The number of typical D-shaped flight holes per 1 dm^2 was calculated to determine the density of settlement and production of young beetles. The maximum number of exit holes per 1 dm^2 was 4.2 ± 1.8, so with an average number of exit holes of 1-2.4 per 1 dm^2, 35 to 100% of the trees inhabited by the moth could dry out within 2-3 seasons. To determine the number and distribution of *Agrilus planipennis* adults, pheromone traps' surveys with artificially synthesised pheromone and traps without pheromone to attract insects by colour were conducted. According to the results of the counts, it was found that adults of *Agrilus planipennis* were presented only in traps with artificially synthesised pheromones

Keywords: *Fraxinus* spp.; monitoring; *Agrilus planipennis*; pheromone traps; invasive species

Introduction

Forests were increasingly being affected by a variety of impacts from biological invasions, including the spread of invasive species that spread naturally or by humans. Urban forests are more adversely affected because they are strongly affected by anthropogenic influence (Sovakov *et al.*, 2020). Invasive species had a possibility to expand and represent a potential threat to the flora and fauna of natural ecosystems, such species created competition in ecological niches, and if widespread, could cause the extinction of native species, displacing them and reducing ecosystem biodiversity. Given their high ecological potential, such species had a wide ecological amplitude, stress tolerance, intensive population growth, and a high degree of naturalisation. Aggressive species used the resources of the new environment that were not available to native species and significantly affect the ecosystem's homeostasis, transforming it.

According to A.M. Liebhold *et al.* (2017), under intense impacts, the consequences of invasion included changes in the composition of tree species, changes in forest succession, reduced biodiversity, and altered nutrient, carbon, and water cycles resulting from competition with native species, as well as trophic impacts that can lead to major changes in the structure of the biocenosis. R. Vasylyshyn *et al.* (2023) researched those irreversible changes in the natural environment due to increased synanthropisation, in particular of the adventive flora and fauna, had a destructive impact on the development of vegetation cover and negatively affected the ability of forest ecosystems to effectively ensure the bioproduction process.

Trees of the ash genus *Fraxinus* spp. had significant ecological and economic potential, were typical mesotrophs and occurred as subdominants in forest ecosystems. The researchers showed that due to climate change, there was a problem of ash tree drying out, the main causes of which were climatic factors, chalar necrosis caused by the invasive pathogen *Hymenoscyphus fraxineus* L. and the ash borer *Agrilus planipennis Fairmaire* L. (emerald ash borer (EAB), which in the future may leaded to the complete disappearance of ash trees from forest ecosystems (Drogvalenko *et al.,* 2019; Meshkova *et al.*, 2024). Natural ash-dominated forests were concentrated mainly on rich loamy and clayey soils in river floodplains and were characterised by a diverse species composition of trees, shrubs, and grasses. I. Matsiakh & V. Kramarets (2014) noted that derivative ash plantations most often grow on forest loamy soils and podzolized chernozems in the zone of oak and mixed forests, mostly single-aged, simplified structure, usually artificially created on the site of cut down complex oak forests. On the territory of Ukraine, stands of ash covered an area of 390,4 thousand hectares and were most often founded in the Forest-Steppe (57.7%), mainly in its right-bank part (38.4%), a significant part grew in the Steppe zone (32.0%), mainly in its north, as well as in Polissya – 4.8%, mountainous Crimea – 2.8% and the Carpathian zone – 2.7% (Bala, 2016). The authors S. Koval *et al.* (2023) claimed that in such plantations, along with ash, common oak (*Quercus robur* L.), common hornbeam (*Carpinus betulus* L.), forest beech (*Fagus sylvatica* L.), heart-leaved linden (*Tillia cordata* Mill.), and sharp-leaved maple (*Acer platonoides* L.) could grow. Black elderberry (*Sambucus nigra* L.) and blood-red sweed (*Swida sanguinea* L.) were found in the undergrowth.

Significant fluctuations in the drying area from year to year could be attributed to a variety of factors, thus, the reasons for the deterioration of the sanitary condition of ash plantations were climate change and anthropogenic pressure, which caused outbreaks of mass reproduction of insects and epiphytosis of pathogens. Thus, the assessment of the sanitary condition of plantations, early diagnosis of pathogens and the dynamics of insect numbers were relevant in a comprehensive study of ash tree drying factors. The priority was to identify the causes of ash drying in the study area and find effective measures to slow down this process in order to avoid disrupting the stable functioning of forest ecosystems. This was especially true in urbanised areas, where the ecosystem functions of green spaces were an important component of creating a comfortable living environment (Vasylyshyn *et al.*, 2023).

The aim of the study was to investigate the main factors of the rapid deterioration of the sanitary condition of trees of the ash genus *Fraxinus* spp. due to the invasion of *Agrilus planipennis* using pheromone monitoring.

Materials and Methods

The object of the study was the main factors of rapid drying of trees of the ash genus *Fraxinus* spp. under the intensive influence of natural factors. The subject of the study was the monitoring of the spread of the invasive species *Agrilus planipennis* on the trees of the ash genus *Fraxinus* spp. on the territory of the National University of Life and Environmental Sciences (NULES) of Ukraine, Kyiv.

The surveys were based on the materials of the inventory of green spaces on the territory of NULES of Ukraine, which were conducted in 2021-2023 by the Department of Forest Mensuration and Forest Management. The inventory of trees was carried out in accordance with the regulations, namely the "Instruction on Inventory of Green Areas in Settlements of Ukraine", approved by the Order of the State Committee for Construction, Architecture and Housing Policy of Ukraine No. 226 of 24.12.2001 (Order of State Committee..., 2001).

During the inventory, the category of the tree's qualitative condition was established:

good, satisfactory, unsatisfactory. According to the guidelines, healthy trees were in a good condition, normally developed, with dense foliage, evenly distributed on the branches, leaves of normal size and colour, no signs of diseases and pests, wounds, damage to the trunk and skeletal branches, or hollows. Satisfactory condition – trees were healthy, but with signs of slow growth, with an unevenly developed crown, few leaves on the branches, minor mechanical damage and small hollows. Unsatisfactory condition – trees were very weakened, trunks were curved, crowns were poorly developed, there were dry and drying branches, the growth of annual shoots was insignificant, trunks were mechanically damaged, hollows (Order of State Committee..., 2001). The mapping of the trees and the general area was carried out using Quantum GIS 3.22 software (Fig. 1).

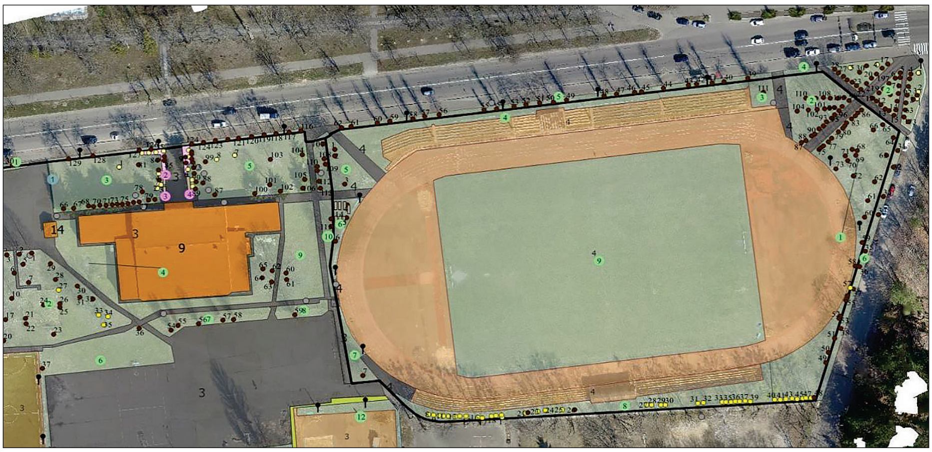

Figure 1. Fragment of the mapping of trees and the general area
Note: trees of the ash genus *Fraxinus* spp. were marked in yellow on the map
Source: developed by the authors

Detailed forest pathological surveys in the centres of drying out of ash trees of the genus Fraxinus spp. were carried out in accordance with generally accepted methods (Goychuk *et al.*, 2012; Methodological guidelines..., 2020; Puzrina *et al.*, 2022). To determine the number and distribution of *Agrilus planipennis* adults, pheromone traps (glue and barrier) with artificially synthesised *Agrilus planipennis* pheromone (produced by BioChemTech, Ukraine) and traps without pheromone with green and purple insect attraction were used (Matsiakh, 2019; International Plant Sentinel Network, 2023) (Fig. 2). Pheromone traps were hung at a height of 3.0 to 4.0 m above the ground on the first living branch of ash. Barrier and glue traps were used to capture *Agrilus planipennis* adults, for this purpose they were attached to the trunk of living trees between living and dead shoots. When hanging the traps, weather conditions and the duration of the flight of adults of the ash emerald ash borer *Agrilus planipennis* were taken into account (Puzrina *et al.*, 2022; Levchenko *et al.*, 2023). The number of adults was monitored after 14 days.

The collection of experimental material was carried out in the following sequence: transfer of insects from the collector to the container and identification of insects in Petri dishes (Fig. 3).

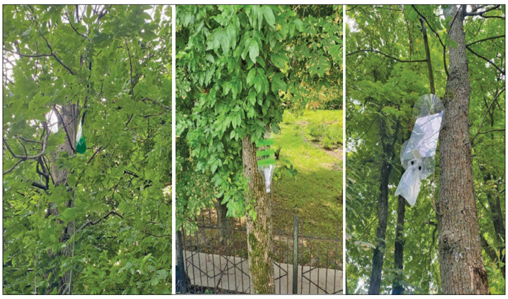

Figure 2. General view of tree traps
Source: photo by the authors

Figure 3. Collecting insect from traps
Source: photo by the authors

Number of insect populations that inhabited trees in the drying centres, namely the number, prevalence, production of young beetles (number of flight holes) and settlement density, were counted by the pallet method on model trees of common ash (Methodological guidelines..., 2020; Puzrina *et al.*, 2022). Within the identified settlement areas, counting pallets to determine the density of settlement and the production of young beetles by the number of typical D-shaped flight holes per 1 dm^2 were used. The average number of exit holes was calculated by counting on three sides of each tree from the location. The average population size of *Agrilus planipennis* was calculated based on the results obtained at the specified location. Experimental studies of plants complied with national and international recommendations. The authors followed the standards of the Convention on Biological Diversity (1992). In the office, the work was limited to processing the collected materials and analysing the results of the research.

Results and Discussion

During the inventory and mapping work in 2023 (Bilous *et al.*, 2024), it was found that there were 167 ash trees on the territory of NULES of Ukraine. Their main localisation was found in the Botanical Garden (89 trees) and in the area near the stadium (44 trees) (Fig. 4).

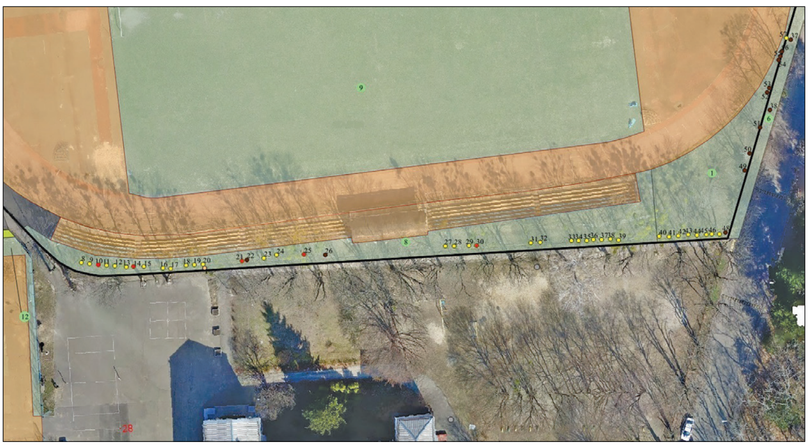

Figure 4. Fragment of mapping of common ash trees near the stadium of NULES of Ukraine
Note: trees of the ash genus *Fraxinus* spp. were marked in yellow on the map
Source: developed by the authors

The mapping data shows that the ash trees were in a regular planting along the stadium stands. During the inventory of 2023, the general condition of ash trees was determined based on the results of a reconnaissance survey (Fig. 5).

Figure 5. General condition of ash trees of the genus *Fraxinus* spp. (as of 2023) on the territory of NULES
Source: developed by the authors

It should be noted that according to the inventory in 2023, trees of the ash genus *Fraxinus* spp. were dominated by trees in good and satisfactory condition, and no visual signs of tree weakening during the inventory were noted. During the current reconnaissance survey in June 2024, pathological signs of ash trees drying out, namely crown defoliation and the presence of dry tops, were detected (Fig. 6).

A detailed survey revealed a rapid deterioration of ash trees throughout the study area. The results of the survey indicated a deterioration in the sanitary condition (Table 1).

Figure 6. Crown defoliation and ash tree dryness
Source: photo by the authors

Table 1. Results of surveys of *Agrilus planipennis* ash damage

Tree location (address)	Number of trees, amount				
	total	including			
		no signs of damage	signs of initial damage	moderately damaged	severely damaged
7, Gorikhuvatskyi Shlyakh Str.	2	1	1	–	–
7a, Horikhuvatskyi Shlyakh Str.	1	–	1	–	–
3, Horikhuvatskyi Shlyakh Str.	1	1	–	–	–
11, Horikhuvatskyi Shlyakh Str.	9	2	6	1	–
8, Blakytnoho Str.	2	–	2	–	–

Table 1, Continued

Tree location (address)	Number of trees, amount				
	total	including			
		no signs of damage	signs of initial damage	moderately damaged	severely damaged
4, Orikhuvatska Str.	7	2	4	1	–
12B, Heroiv Oborony Str.	1	1	–	–	–
12, Heroiv Oborony Str.	4	1	2	1	–
4, Selykhozemichnyi Ln.	3	–	2	1	–
14, Heroiv Oborony Str.	1	1	–	–	–
18A, Heroiv Oborony Str. (stadium)	44	–	4	28	12
16, Polkovnyka Potekhina Str.	3	–	2	1	–
2A, Heroyiv Oborony Str. (Botanical garden)	89	12	21	33	23
Total	**167**	21	45	66	35

Note: signs of initial damage – dry tops, presence of adults; moderately affected – openwork, drying out of individual shoots, presence of bark cracking; severely affected – defoliation, crown 50%, drying out of parts of the tree, bark peeling
Source: developed by the authors

It was found that a significant weakening of ash trees of the *Fraxinus* spp. genus was noted on the territory of the Botanical Garden of the NULES of Ukraine (21 trees with signs of initial damage, 33 and 23 ash trees moderately and severely damaged, respectively, and 12 trees without signs of damage) and near the stadium (4 trees with signs of initial damage, 28 and 12 common ash trees moderately and severely damaged, respectively) (Fig. 7). 13% of trees without signs of damage were located in the depths of the forest, and as for the emerald ash borer, potential hosts were trees growing openly, although with a significant distribution the insect was able to inhabit trees in the depths of the forest were noted (Meshkova *et al.*, 2024).

For successful and effective control of the ash emerald ash borer, its early detection was very important. The first emergence of *Agrilus planipennis* beetles coincided with the flowering period of *Robinia pseudoacacia* L., which occured in May-June in Ukraine, so this phenological indicator could serve as an indicator of the appearance of ash borer adults in different regions (Herms & McCullough, 2019).

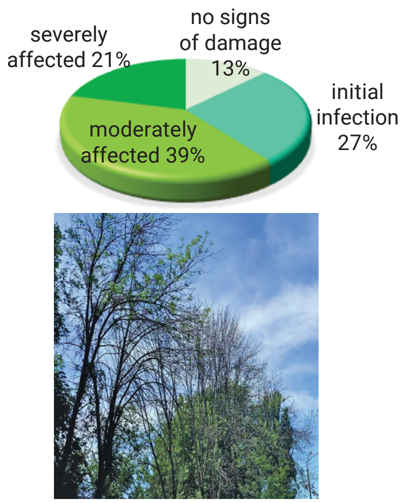

Figure 7. General condition of trees of the ash genus *Fraxinus* spp. (as of 2024)
Source: developed by the authors

Adults fed on ash leaves, after reaching sexual maturity, they mated in the crowns of trees, and females laid eggs on the surface or in cracks in the bark. The peak of egg laying and larval emergence usually occurred between early June and mid-August, depending on the region and weather conditions. The egg stage usually lasted from 7 to 18 days, which also depended on temperature. The newly hatched larvae make their way through the bark to the cambium, consuming phloem and outer xylem, forming powder-filled passages (Matsiakh, 2019).

In the first year of settlement, it was difficult to diagnose the presence of *Agrilus planipennis*. The first signs of infestation could be bird pecking of the bark and the presence of larval burrows under the bark. The characteristic D-shaped holes on trunks and branches appeared in the next year after the infestation of trees by the bark beetle. Infested trees usually had a thinned crown, dechromed leaves, swelling, cracks and necrosis on branches and thin trunks. Secondary shoots developed along the trunk and in the basal part of the trunks. In the third year of settlement, the crown was significantly thinned out, with many branches dying off and numerous D-shaped flight holes on the trunk and branches.

A clear sign of *Agrilus planipennis* infestation was the presence of D-shaped holes for adults to exit, which were difficult to detect but a reliable sign that the population was growing. As the insect's population grows, its natural enemy was the woodpecker (Schans *et al.*, 2020).

During a detailed forest pathology survey, adults of *Agrilus planipennis* and characteristic D-shaped flight holes were found (Fig. 8).

The number of typical D-shaped exit holes per 1 dm^2 was used to determine the settlement density and production of young beetles (Table 2).

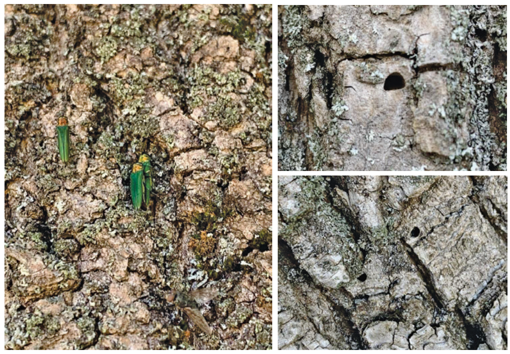

Figure 8. Adults and flight holes of the ash emerald ash moth *Agrilus planipennis*
Source: photo by the authors

Table 2. Degrees of settlement of *Agrilus planipennis* trees

Location of trees (address)	Number of trees, amount	Production of stem pests (average number of exit holes and average error per 1 dm^{-2})
7, Gorikhuvatskyi Shlyakh Str.	2	2.2 ± 0.2
7a, Horikhuvatskyi Shlyakh Str.	1	2.7 ± 1.3
3, Horikhuvatskyi Shlyakh Str.	1	0
11, Horikhuvatskyi Shlyakh Str.	9	0.9 ± 0.2
8, Blakytnoho Str.	2	0
4, Orikhuvatska Str.	7	2.6 ± 0.6
12B, Heroiv Oborony Str.	1	0
12, Heroiv Oborony Str.	4	0
4, Selykhozemichnyi lane	3	1.3 ± 0.2
14, Heroiv Oborony Str.	1	0
18A, Heroiv Oborony str. (stadium)	44	4.2 ± 1.8
16, Polkovnyka Potekhina Str.	3	1.1 ± 0.3
2A, Heroyiv Oborony str. (Botanical Garden)	89	3.8 ± 1.1
Total	**167**	-

Source: developed by the authors

The number of typical D-shaped exit holes per 1 dm^2 was used to determine the settlement density and production of young beetles (Table 2). According to D. Crook *et al.* (2012) and I. Matsiakh (2019), males and females were sensitive to ultraviolet light, violet and green ranges of the electromagnetic spectrum, and fertilised females were also sensitive to light in the red, with beetles attracted to green or violet traps set both in open spaces and under the canopy of the plantation. The trees on which pheromone traps were hung were marked on the map (Fig. 9).

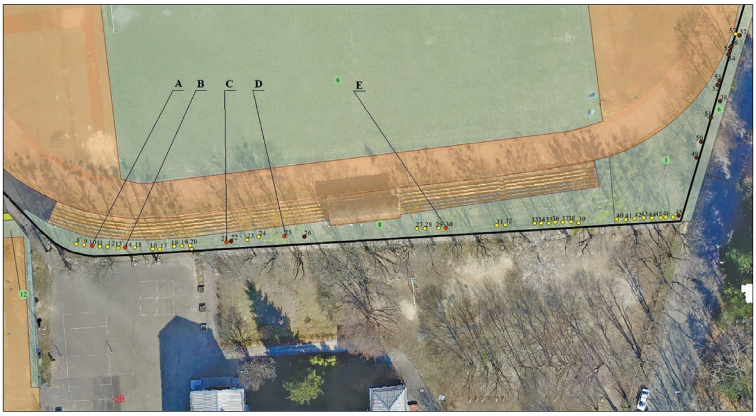

Figure 9. Location of the traps
Note: A – glue trap with pheromone; B – barrier transparent trap with purple stripes without pheromone; C – barrier transparent trap without pheromone; D – barrier transparent trap with green stripes without pheromone; E – barrier transparent trap with pheromone
Source: developed by the authors

During the inspection of the traps, the effectiveness of their use was assessed, but some traps were blocked by leaves, which was associated with a decrease in daylight hours and a slowdown in photosynthesis, which caused the physiological process of leaf fall.

According to A. Morozko *et al.* (2021), different trophic groups of insects damaged plant parts, caused damage to the assimilation apparatus, young shoots, generative organs, and trunk, respectively, but the spread of phytophages and their impact on plants depends on the insect species, population density, and plant response to damage, which has been confirmed by our research. According to the results of species diversity determination, it could be noted that the traps were mainly used for capturing insects of the *Coleoptera* order. In the barrier transparent trap with purple stripes without pheromone, representatives of the families *Curculionidae* and *Chrysomelidae* were found, in the barrier transparent trap without pheromone, insects of the subfamily *Scolytinae* of the family *Curculionidae* dominated. Representatives of the order *Hymenoptera* were found only in the barrier transparent trap with green stripes without pheromone. The family *Buprestidae* was represented by *Agrilus planipennis*, but adults were presented only in traps with artificially synthesised pheromones, so it could be noted the low efficiency of green and purple traps. It should be noted that all detected insects except *Agrilus planipennis* were not potential pests of ash trees of the genus *Fraxinus* spp.

The issue of *Agrilus planipennis* spread was quite relevant, as the invasive species had no natural enemies in our environment, which made it difficult to control. The issue of penetration and biology of invasive organisms was being studied by specialists of a separate working group of IUFRO, Invasive Species Specialist Group – ISSG, World Conservation Union – IUCN, European Plant Protection Organisation – EPPO, and a system of inventory of invasive species for Europe – Delivering Alien Invasive Inventories for Europe – DAISIE – has been created (Roques *et al.*, 2010).

The emerald ash borer (*Agrilus planipennis*, EAB) had been a focus of global entomological and forestry research due to its devastating impact on ash tree species (*Fraxinus* spp.) worldwide. Its rapid expansion and destructive behaviour have been extensively studied across various ecological, geographical, and management contexts.

The spread of the invasive species *Agrilus planipennis Fairmaire*. (*Coleoptera: Buprestidae*) caused intensive mortality of ash trees of the genus *Fraxinus* spp. in plantations throughout Europe (Flo *et al.*, 2015) and North America (Sun *et al.*, 2024). *Agrilus planipennis* originates from China and Korea, where it primarily attacks trees under stress, where the coevolutionary resistance mechanisms against this pest are weakened. According to V. Meshkova *et al.* (2024), the ash emerald ash borer was first discovered in the eastern part of Ukraine (Luhansk region) in 2019 and was spreading in all plantations with ash trees very fast. The ongoing infestation of *Agrilus planipennis* in Ukraine mirrors global trends while presenting unique challenges due to the region's specific ecological and climatic conditions. Studies such as those by T.V. Kucheryavenko *et al.* (2019) and V. Meshkova *et al.* (2024) provided critical insights into local dynamics, which are essential for developing tailored management strategies. The rapid spread of the pest in Kyiv in a short time indicated an increased threat of further spread to the West (Meshkova *et al.*, 2024). The role of host plants in shaping EAB distribution had been a recurring theme in literature. It should be noted that in its natural range (East Asia). *Agrilus planipennis* settles only on dying trees of the genus *Fraxinus* spp. and caused minor damage to viable plants. Y. Dang *et al.* (2021) conducted a retrospective analysis using native range data to identify factors affecting the distribution of invasive wood-boring insects like EAB. Their findings underscore the critical importance of host tree availability and physiological condition in facilitating pest establishment and spread.

Management of invasive species included prevention of arrival. eradication of new populations. biological control. selection of host trees for resistance. and the use of cultural practices (silviculture and restoration) to minimise their impact. In the future. the world's forests were likely to be subjected to an increasing number of invasions. and effective management will require greater international cooperation and interdisciplinary integration. A.M. Liebhold *et al.* (2017) examined the dynamics of invasive species within forest ecosystems, focusing on the ecological, economic, and management challenges posed by such invasions. Their research identified several critical factors that facilitated invasions, including global trade, climate change, and the characteristics of the invaded ecosystems.

Given the sharp decline in the share of ash in forests, UK scientists R.J. Mitchell *et al.* (2014) conducted a special study of the potential loss of ash from the forest. It was found that 955 species were trophically associated with trees of the ash genus *Fraxinus* spp: 12 birds, 28 mammals, 58 bryophytes, 68 fungi, 241 invertebrates, 548 lichens. There were 45 species that occurred only on ash trees, and 62 species that were associated with ash trees and occasionally use other trees, but proved that no other tree species could replace ash for supporting complex trophic chains. Tree species that supported more species associated with ash cannot replace it in terms of ecosystem functions.

As a result of climate change the boundaries of invasive species' ranges have been changing; under favourable conditions, they began to actively increase in number and spread, and with long-term adaptation to local conditions, they were able to maintain a population size sufficient for survival and mass dispersal. N. Puzrina *et al.* (2022) established that outbreaks of stem pests due to extreme temperatures and droughts had been observed in deciduous and coniferous plantations, and according to I. Matsiakh (2019), one of the factors of *Agrilus planipennis* spread was hot summers, which was confirmed by our observations. Further monitoring studies and the search for ways to solve the problem of *Agrilus planipennis* spread were naturally necessary.

Conclusions

Significant weakening of ash trees of the genus *Fraxinus* sp. was noted on the territory of the Botanical Garden of the NULES of Ukraine (21 trees with signs of initial damage, 33 and 23 ash trees moderately and severely damaged, respectively, and 12 trees without signs of damage) and near the stadium (4 trees with signs of initial damage, 28 and 12 common ash trees moderately and severely damaged, respectively). The average number of exit holes ranges from 0.9 to 4.2 per 1 dm^2, which indicates the potential for the species to increase in number. According to the results of determining the species diversity of insects using pheromone traps, it was noted the effectiveness of traps with artificially synthesised pheromones for *Agrilus planipennis*, in all other traps insects of the order *Coleoptera*, which are not potential pests of ash trees *Fraxinus* sp.

Among the promising areas of solving the problem of mass ash drying out, scientists identified the following: search for new methods and means of protecting ash plantations; determination of resistance criteria and selection of plants that were resistant to diseases; development of technologies and production of genetically modified plants with increased resistance.

Invasive insects and diseases could have catastrophic economic and environmental consequences for the structure and functioning of forest ecosystems. They could destroy large areas of forests, leading to loss of biodiversity, changes in the composition of forests and disruption of ecological processes. Therefore, further studies aimed at identifying the peculiarities of the development of the ash narrow-bodied emerald ash borer *Agrilus planipennis* and its distribution were necessary to assess the probability of the species spreading, threats to the condition of plantations, as well as for supervision and control, in particular, with the participation of natural enemies.

Acknowledgements

None.

Conflict of Interest

None.

References

[1] Bala, O.P. (2016). Current state and productivity of ash stands of Ukraine. *Scientific Bulletin of the National University of Life and Environmental Sciences of Ukraine. Series: Forestry and Landscape Gardening*, 255, 11-18.

[2] Bilous, A., Zadorozhniuk, R., Makarevych, A., Svynchuk, V., Lashko, A., Bilous, M., Myroniuk, V., & Matsala, M. (2024). Sampling protocol for measuring mean diameter at breast height of forked urban trees. *Forests*, 15(3), article number 458. doi: 10.3390/f15030458.

[3] Convention on Biological Diversity. (1992. June). Retrieved from https://zakon.rada.gov.ua/laws/show/995_030#Text.

[4] Crook, D., Khrimian, A., Cossү, A., Fraser, I., & Mastro, V. (2012). Influence of trap color and host volatiles on capture of the emerald ash borer (Coleoptera: Buprestidae). *Journal of Economic Entomology*, 105, 429-437. doi: 10.1603/EC11204.

[5] Dang, Y., Zhang, Y., Wang, X., Xin, B., Quinn, N., & Duan, J. (2021). Retrospective analysis of factors affecting the distribution of an invasive wood-boring insect using native range data: The importance of host plants. *Journal of Pest Science,* 94, 981-990. doi: 10.1007/s10340-020-01308-5.

[6] Drogvalenko, A.N., Orlova-Bienkowskaja, M.J., & Bienkowski, A.O. (2019). Record of the emerald ash borer (*Agrilus planipennis*) in Ukraine is confirmed. *Insects*, 10, article number 338. doi: 10.3390/insects10100338.

[7] International Plant Sentinel Network. (2023). *Emerald ash borer trapping guide*. Retrieved from https://surl.li/wxwlgd.

[8] Flo, D., Krokene, P., & Okland, B. (2015). Invasion potential of *Agrilus planipennis* and other *Agrilus* beetles in Europe: Import pathways of deciduous wood chips and MaxEnt analyses of potential distribution areas. *EPPO Bulletin,* 45, 259-268. doi: 10.1111/epp.12223.

[9] Goychuk, A.F., Reshetnyk, L.L., & Maksymchuk, N.V. (2012). *Methods of forest pathology examinations*. Zhytomyr: Polissya.

[10] Herms, D.A., & McCullough, D.G. (2019). Emerald ash borer invasion of North America: History, biology, ecology, impacts, and management. *Annual Review of Entomology*, 59, 13-30. doi: 10.1146/annurev-ento-011613-162051.

[11] Order of State Committee for Construction, Architecture and Housing Policy of Ukraine No. 226 "On Approval of the Instruction on the Inventory of Green Spaces in Settlements of Ukraine". (2001, December). Retrieved from https://zakon.rada.gov.ua/laws/show/z0182-02#Text.

[12] Koval, S., Ostapchuk, O., Shlapak, V., Bayura, O., Sovakov, O., Vitenko, V., Podzerei, R., & Lazariev, O. (2023). Conditional and productivity of marginal oak and beech plantations in the southern part of the Right bank Forest Steppe of Ukraine. *Forestry Ideas*, 29(1), 3-14.

[13] Kucheryavenko, T.V., Skrylnik, Yu.Ye., Davydenko K.V., Zinchenko O.V., & Meshkova V.L. (2019). The first data on the biological characteristics of *Agrilus planipennis* Fairmaire, 1888 (Coleoptera: Buprestidae) in Ukraine. *Ukrainian Entomological Journal*, 2(17), article number 58. doi: 10.15421/282008.

[14] Levchenko, V.B., Shulga, I.V., Romanyuk, A.A., Nemerytska, L.V., Vishnevskyi, A.V., & Kotkov V.I. (2020). *Forest pathology with the basics of monitoring*. Zhytomyr: Department of the State University named after I. Franka.

[15] Liebhold, A.M., Brockerhoff, E.G., Kalisz, S., Nuñez, M.A., Wardle, D.A., & Wingfield, M.J. (2017). Biological invasions in forest ecosystems. *Biological Invasions*, 19, 3437-3458. doi: 10.1007/s10530-017-1458-5.

[16] Matsiakh, I., & Kramarets, V. (2014). Drying of common ash (*Fraxinus excelsior* L.) in western Ukraine. *Scientific Bulletin of NLTU of Ukraine*, 24.7, 67-74.

[17] Matsiakh, I. (2019). Invasion of emerald ash borer *Agrilus planipennis* Fairmaire (Coleoptera: Buprestidae): The tactic of actions. *Forestry, Forest, Paper and Woodworking Industry*, 45, 65-90. doi: 10.36930/42194510.

[18] Meshkova, V., Borysenko, O., Kucheryavenko, T., Vysotska, N., Skrylnyk, Y., Davydenko, K., & Holusa, J. (2024). Forest site and stand structure affecting the distribution of emerald ash borer. *Agrilus planipennis* Fairmaire, 1888 (*Coleoptera: Buprestidae*), in Eastern Ukraine. *Forests*, 15(3), article number 511. doi: 10.3390/f15030511.

[19] *Methodological guidelines for monitoring, recording and forecasting the spread of forest pests and diseases for the flat part of Ukraine*. (2020). Kharkiv: Planeta-print.

[20] Mitchell, R., *et al.* (2014). Ash dieback in the UK: A review of the ecological and conservation implications and potential management options. *Biological Conservation*, 175, 95-109. doi: 10.1016/j.biocon.2014.04.019.

[21] Morozko, A., Kolesnichenko, O., & Puzrina, N. (2021). Analysis of the species composition of prevailing pests of Araliaceae Juss. in Kyiv, Ukraine. *AgroLife Scientific Journal*, 10(2), 122-128. doi: 10.17930/AGL2021215.

[22] Puzrina, N., Karpuk, A., Vasylyshyn, R., Melnyk, O., & Tokarieva, O. (2022). Thirty-year dynamics of the pine stand sanitary conditions of Boyarka Forestry Research Station. *Scientific Horizons*, 25(10), 43-52. doi: 10.48077/scihor.25(10).2022.43-52.

[23] Roques, A., Kenis, M., Lees, D., Vaamonde, C.L., Rabitsch, W., Rasplus, J.-Y., & Roy D.B. (2010). *Alien terrestrial arthropods of Europe* (vol. 4). Sofia: BioRisk.

[24] Schans, J., Schrader, G.a, Delbianco, A., Graziosi, I., & Vos, S. (2020). Pest survey card on *Agrilus planipennis*. *EFSA Supporting Publications*, 17(11), article number 1945E. doi: 10.2903/sp.efsa.2020.EN-1945.

[25] Sovakov, O., Sovakova, M., Ostapchuk, O., Bidolakh, D., Pidkhovna, S., & Kytaiev, O. (2020). Inventories of causes of leaf scorch of linden trees under anthropogenic conditions in Kyiv. *Forestry Ideas,* 26(2), 277-288.

[26] Sun, J., Koski, T., Wickham, J., Baranchikov, Y., & Bushley, K. (2024). Emerald ash borer management and research: Decades of damage and still expanding. *Annual Review of Entomology,* 2024, 69, 239-258. doi: 10.1146/annurev-ento-012323-032231.

[27] Vasylyshyn, R., Lakyda, I., Melnyk, O., Lakyda, M., Soshenskyi, O., & Pinchuk, A. (2023). Oxygen productivity of urban forests of Kyiv city as a constituent of its sustainable development. *IOP Conference Series: Earth and Environmental Science*, 1126(1), article number 012012. doi: 10.1088/1755-1315/1126/1/012012.

Інвазія ясеневої смарагдової златки *Agrilus planipennis* Fairmaire, (*Coleoptera: Buprestidae*) на території Національного університету біоресурсів і природокористування (НУБіП) України

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Анотація. Стаття присвячена питанню стрімкого погіршення санітарного стану дерев роду ясен *Fraxinus* sp. на території НУБіП України, спричиненого інвазією ясеневої смарагдової златки *Agrilus planipennis* Fairmaire, (*Coleoptera: Buprestidae*). Мета досліджень оцінка санітарного стану дерев роду ясен *Fraxinus* sp. на території НУБіП України та моніторинг чисельності інвазійного виду *Agrilus planipennis*. Наведено дані інвентаризації 2021-2023 років, де відмічено, що стан 66 % дерев роду ясен характеризується як добрий. Під час проведення детального обстеження 2024 року встановлено стрімке погіршення стану дерев ясеня на всій досліджуваній території. Встановлено, що значне ослаблення дерев роду *Fraxinus* sp. відмічено на території Ботанічного саду НУБіП України та біля стадіону. Відмічаємо, що 13 % дерев без ознак ураження розташовані в глибині лісового масиву, так як для смарагдової златки потенційними живителями є дерева, що ростуть відкрито, хоча за значного розповсюдження комаха може заселяти дерева у глибині насадження. Під час проведення детального лісопатологічного обстеження виявлено імаго *Agrilus planipennis* та характерні D-подібні вильотні отвори. Під час проведення підрахунків кількості типових

D-подібних вильотних отворів на 1 дм^2 визначали щільність поселення та продукцію молодих жуків. Кількість вильотних отворів максимально на 1 дм^2 становить 4,2 ± 1,8, відтак при середній кількості вильотних отворів 1-2,4 на 1 дм^2 протягом 2-3 сезонів може всохнути від 35 до 100 % заселених златкою дерев. Для визначення чисельності та поширення імаго *Agrilus planipennis* проводили обліки за допомогою феромонних пасток з штучно синтезованим феромоном та пастки без використання феромону з приваблюванням комах на колір. За результатами обліків встановлено, що імаго *Agrilus planipennis* наявні тільки у пастках з штучно синтезованими феромонами

Ключові слова: *Fraxinus* sp.; моніторинг; *Agrilus planipennis*; феромонні пастки; інвазійні види