forests

MDPI

Editorial

Pests and Pathogens of Urban Trees

Rostislav Zemek [1,*] and Katarína Pastirčáková [2]

[1] Institute of Entomology, Biology Centre, Czech Academy of Sciences, Branišovská 1160/31, 370 05 České Budějovice, Czech Republic
[2] Department of Plant Pathology and Mycology, Institute of Forest Ecology, Slovak Academy of Sciences, Akademická 2, 949 01 Nitra, Slovakia; uefezima@hotmail.com
* Correspondence: rosta@entu.cas.cz

1. Introduction

Trees play a vital role in enhancing public open spaces, such as city parks, gardens, inter-block spaces of greenery, urban forests, and recreational areas, providing green spaces and leisure opportunities for both residents and visitors. Unlike production forests, the value of woody plant vegetation grown in and around human settlements lies in its numerous benefits, including aesthetics, shade provision, mitigating the urban heat island effect, and creating habitats for wildlife. However, the well-being of urban trees is under constant threat from various pests and pathogens, both native and invasive species.

One noteworthy example is the *Cameraria ohridella* Deschka & Dimić (Lepidoptera: Gracillariidae) infestation that has hampered the ornamental function of thousands of horse chestnut trees (*Aesculus hippocastanum* L. (Sapindales: Sapindaceae)) in Europe [1]. This infestation leads to significant aesthetic damage to leaves and premature leaf shedding, impacting the overall appeal of these trees. Despite some studies indicating the adaptation of autochthonous parasitoids to a new host over the years [2], the control of this invasive pest by natural enemies is still not sufficient. Furthermore, horse chestnut trees are also vulnerable to attacks from the bacterial pathogen *Pseudomonas syringae* pv. *aesculi* (causing bleeding canker) [3], the pathogenic fungus *Guignardia aesculi* (Peck) V.B. Stewart (Botryosphaeriales: Botryosphaeriaceae) [4], and the powdery mildew species *Erysiphe flexuosa* (Peck) U. Braun & S. Takam. (Erysiphales: Erysiphaceae) [5]. The combined effect of these organisms can severely compromise the health of horse chestnut trees.

Planting trees in close proximity to buildings, streets, and concrete-covered areas often results in reduced tree vigor due to soil compaction and the impermeability of the substrate surface, hindering the proper absorption of water and nutrients. Additionally, exposure to pollution from busy roads, factories, and other sources can further weaken urban trees, making them more susceptible to pests and pathogens. The impact of global warming, with changes in temperature and humidity, can affect the development and survival of these pests and pathogens [6], as well as their natural enemies, competitors, and vectors. Moreover, climate change may potentially transform usually harmless species into damaging organisms through its effects on host plant physiology. Consequently, the combination of adverse abiotic factors and the damage caused by native and non-native pests and pathogens may exacerbate tree health issues in urban green spaces in the future.

The aim of this Special Issue is to present recent advances in knowledge regarding arthropod pests and pathogens specifically affecting trees in urban environments. Within this compilation, we have gathered contributions covering a broad range of research topics related to pests and pathogens of urban trees. This includes studies on diversity, new emerging and invasive species, population dynamics, dispersal, antagonistic interactions, the role of natural enemies, pollution and climate change impacts, pest management methods, and simulation models. We strongly encouraged studies focusing on cutting-edge research in the realm of insect, plant, and pathogen interactions, research on the innovative

check for updates

Citation: Zemek, R.; Pastirčáková, K. Pests and Pathogens of Urban Trees. *Forests* **2023**, *14*, 1653. https://doi.org/10.3390/f14081653

Received: 9 August 2023
Accepted: 12 August 2023
Published: 16 August 2023

tools used for detecting and identifying tree pests and pathogens, as well as ecological and field studies conducted in urban tree environments.

2. Summary of Papers Included in the Special Issue

This Special Issue comprises 11 papers authored by 54 researchers from 11 countries: China, Croatia, Czech Republic, Denmark, Lithuania, Serbia, Slovakia, Switzerland, Taiwan, UK, and USA. The collection represents a diverse array of aspects related to urban tree pests and pathogens, offering valuable examples of recent research activities in this field conducted worldwide.

Five articles focus on different invasive insect pests, their impacts on urban trees or their management. The review paper by Lin et al. [7] discusses the invasive gall wasp, *Quadrastichus erythrinae* Kim, which induces galls on coral trees (*Erythrina* species) in urban and suburban landscapes. The article consolidates and summarizes two decades of information on the distribution, invasion route, ecology, infestation levels, and management strategies of this invasive species. The researchers also analyze the challenges in effectively managing the populations of *Q. erythrinae*.

Havelka et al. [8] report on the first occurrence of the Nearctic aphid *Cinara splendens* Gillette & Palmer in the Palearctic region. They studied the bionomy of this species in Central Europe, providing detailed descriptions of all available morphs. The research included monitoring sites in South Bohemia, Czech Republic, from 2009 to 2019, evaluating morphological characteristics and comparing samples with those of North American origin. The study also explores factors influencing *C. splendens*' population density and potential as a pest of Douglas fir (*Pseudotsuga menziesii* (Mirb.) Franco) in Central Europe.

The spread and impact of the invasive box tree moth (*Cydalima perspectalis* Walker) in Slovakia was investigated by Kulfan et al. [9]. The article examines the probability of occurrence and damage to box trees (*Buxus sempervirens* L.) by the moth's larvae, using temperature and altitude data as predictors. Their findings show the distribution of the moth and the damage intensity correlated with altitude and mean annual temperature, providing valuable insights for its management.

Two other papers deal with the horse chestnut leaf miner (*C. ohridella*). Nedveckytė et al. [10] assess the mortality caused by various fungi under laboratory conditions. The study identifies the dominant fungi associated with the different developmental stages of the moth. Additionally, the research highlights the effectiveness of *Lecanicillium aphanocladii* Zare & W. Gams as an entomopathogen for controlling the horse chestnut pest, suggesting its potential use in eco-friendly pest management methods. The paper by Kopačka et al. [11] examines the interaction between *C. ohridella* and the fungal disease horse chestnut leaf blotch caused by *G. aesculi*. The researchers assessed leaf damage caused by both species during the vegetation season in the Czech Republic. Digital image analysis of sampled leaves was employed for accurate measurements. They found that the damage caused by both pests and the fungus varied significantly across different sampling sites within the city. In August, the overall leaf damage exceeded 50% in sites where leaves were not regularly raked. The researchers developed a simple phenomenological model to describe the expected dynamics of the two species' interaction. The results indicated that the infestation by *C. ohridella* was more influenced by *G. aesculi* than vice versa. Therefore, *G. aesculi* was identified as the superior competitor between the two species. The above two studies highlight the need for further research to understand the interplay between several organisms and develop effective management strategies for horse chestnut trees.

Six other papers focus on tree pathogens. The first study by Kovač et al. [12] uncovers the causal agents behind canker and die-back disease observed in the majestic *Sequoiadendron giganteum* (Lindl.) J. Buchholz in Croatia. The researchers identified *Botryosphaeria dothidea* (Moug.) Ces. & De Not. and *Neofusicoccum yunnanense* G.Q. Li & S.F. Chen as the culprits responsible for the alarming decline in these iconic trees. This finding highlights the importance of vigilant monitoring and disease management strategies to protect the valuable ornamental tree in Croatian landscapes.

Continuing the exploration of canker and die-back diseases in giant sequoias, Haenzi et al. [13] present their findings on the identification of *Neofusicoccum parvum* (Pennycook & Samuels) Crous, Slippers & A.J.L. Phillips as a new agent causing cankers and diebacks in *Sequoiadendron giganteum* in Geneva, Switzerland. Their research underscores the potential threat posed by this fungus to the survival of giant sequoias in the Geneva Lake area.

The impact of wood-decay fungi on old and valuable trees in Hong Kong is examined by Ding et al. [14]. This study provides insight into the diversity, abundance, and distribution of wood-decay fungi associated with standing trees and stumps in major parks of Hong Kong. The findings call for careful conservation and management of these trees to safeguard them from wood decay and potential risks of falling.

Turning our attention to powdery mildews, Mieslerová et al. [15] investigate the occurrence of these fungal pathogens in botanical gardens, parks, and urban green areas in the Czech Republic. The identification of new records of powdery mildew species emphasizes the importance of monitoring and understanding the spectrum of these pathogens for effective management in urban environments. Pastirčáková et al. [16] investigated the potential invasion of non-native *Phyllactinia* species affecting ash trees in urban areas of Europe and Southeast Asia. They identified two species associated with powdery mildew on ash leaves in Eurasia: *Phyllactinia fraxinicola* U. Braun & H.D. Shin from Southeast Asia and *Phyllactinia fraxini* (DC.) Fuss from Europe. The study confirmed the absence of *P. fraxinicola* in Europe, suggesting it may not pose an invasive threat. However, habitat suitability models indicate some susceptible areas in northwest Europe. Early detection and management strategies are crucial to protect urban ash trees.

Finally, Pastirčáková et al. [17] explore the host range of the invasive pathogenic fungus *Hymenoscyphus fraxineus* (T. Kowalski) Baral, Queloz & Hosoya in Slovak arboreta. Their research reveals the alarming impact of ash dieback symptoms on various *Fraxinus* taxa, including native species and introduced North American and Asian ash species. The study highlights the need for robust management strategies to curb the spread of this destructive pathogen in order to safeguard ash populations for future generations.

3. Conclusions

Overall, this Special Issue provides valuable insights into the invasion and management of various insect pests and pathogens affecting urban ecosystems. As trees play a vital role in environmental health, aesthetics, and ecosystem services, it is essential to understand and address the threats posed by invasive pests and pathogens. The collection of papers found in this Special Issue contribute to the understanding of these invasive species' impacts and offers potential strategies for mitigating their effects. In addition, presented findings underscore the significance of host plant–pest–pathogen interactions. We hope that this collection of research will inspire further studies, inform policymakers, and guide efforts to conserve and protect trees in urban settings.

Author Contributions: Conceptualization, R.Z. and K.P.; writing—original draft preparation, R.Z.; writing—review and editing, K.P. All authors have read and agreed to the published version of the manuscript.

Funding: This research received no external funding.

Data Availability Statement: Not applicable.

Acknowledgments: We would like to thank all authors contributing their work to this Special Issue and all reviewers who provided very constructive and helpful comments and suggestions which helped to improve the quality of the papers.

Conflicts of Interest: The authors declare no conflict of interest.

References

1. Bras, A.; Avtzis, D.N.; Kenis, M.; Li, H.; Vétek, G.; Bernard, A.; Courtin, C.; Rousselet, J.; Roques, A.; Auger-Rozenberg, M.-A. A Complex Invasion Story Underlies the Fast Spread of the Invasive Box Tree Moth (*Cydalima perspectalis*) across Europe. *J. Pest Sci.* **2019**, *92*, 1187–1202. [CrossRef]
2. Volter, L.; Prenerová, E.; Weyda, F.; Zemek, R. Changes in the Parasitism Rate and Parasitoid Community Structure of the Horse Chestnut Leafminer, *Cameraria ohridella* (Lepidoptera: Gracillariidae), in the Czech Republic. *Forests* **2022**, *13*, 885. [CrossRef]
3. Percival, G.C.; Banks, J.M. Studies of the Interaction between Horse Chestnut Leaf Miner (*Cameraria ohridella*) and Bacterial Bleeding Canker (*Pseudomonas syringae* pv. *aesculi*). *Urban For. Urban Green.* **2014**, *13*, 403–409. [CrossRef]
4. Pastirčáková, K.; Pastirčák, M.; Celar, F.; Shin, H.-D. *Guignardia aesculi* on Species of *Aesculus*: New Records from Europe and Asia. *Mycotaxon* **2009**, *108*, 287–296. [CrossRef]
5. Zimmermannová-Pastirčáková, K.; Adamska, I.; Błaszkowski, J.; Bolay, A.; Braun, U. Epidemic Spread of *Erysiphe flexuosa* (North American Powdery Mildew of Horse Chestnut) in Europe. *Schlechtendalia* **2002**, *8*, 39–45.
6. Choi, W.I.; Park, Y.-S. Management of Forest Pests and Diseases. *Forests* **2022**, *13*, 1765. [CrossRef]
7. Lin, S.-F.; Tung, G.-S.; Yang, M.-M. The *Erythrina* Gall Wasp *Quadrastichus erythrinae* (Insecta: Hymenoptera: Eulophidae): Invasion History, Ecology, Infestation and Management. *Forests* **2021**, *12*, 948. [CrossRef]
8. Havelka, J.; Havelka, J.; Starý, P. *Cinara splendens* (Hemiptera: Aphididae: Lachninae)—First Record in Palaearctic Region. *Forests* **2020**, *11*, 911. [CrossRef]
9. Kulfan, J.; Zach, P.; Holec, J.; Brown, P.M.J.; Sarvašová, L.; Skuhrovec, J.; Martinková, Z.; Honěk, A.; Váľka, J.; Holecová, M.; et al. The Invasive Box Tree Moth Five Years after Introduction in Slovakia: Damage Risk to Box Trees in Urban Habitats. *Forests* **2020**, *11*, 999. [CrossRef]
10. Nedveckytė, I.; Pečiulytė, D.; Būda, V. Fungi Associated with Horse-Chestnut Leaf Miner Moth *Cameraria ohridella* Mortality. *Forests* **2021**, *12*, 58. [CrossRef]
11. Kopačka, M.; Nachman, G.; Zemek, R. Seasonal Changes and the Interaction between the Horse Chestnut Leaf Miner *Cameraria ohridella* and Horse Chestnut Leaf Blotch Disease Caused by *Guignardia aesculi*. *Forests* **2021**, *12*, 952. [CrossRef]
12. Kovač, M.; Diminić, D.; Orlović, S.; Zlatković, M. *Botryosphaeria dothidea* and *Neofusicoccum yunnanense* Causing Canker and Die-Back of *Sequoiadendron giganteum* in Croatia. *Forests* **2021**, *12*, 695. [CrossRef]
13. Haenzi, M.; Cochard, B.; Chablais, R.; Crovadore, J.; Lefort, F. *Neofusicoccum parvum*, a New Agent of *Sequoia* Canker and Dieback Identified in Geneva, Switzerland. *Forests* **2021**, *12*, 434. [CrossRef]
14. Ding, S.; Hu, H.; Gu, J.-D. Diversity, Abundance, and Distribution of Wood-Decay Fungi in Major Parks of Hong Kong. *Forests* **2020**, *11*, 1030. [CrossRef]
15. Mieslerová, B.; Sedlářová, M.; Michutová, M.; Petřeková, V.; Cook, R.; Lebeda, A. Powdery Mildews on Trees and Shrubs in Botanical Gardens, Parks and Urban Green Areas in the Czech Republic. *Forests* **2020**, *11*, 967. [CrossRef]
16. Pastirčáková, K.; Adamčíková, K.; Bacigálová, K.; Caboň, M.; Mikušová, P.; Senko, D.; Svitok, M.; Adamčík, S. Ash Trees (*Fraxinus* Spp.) in Urban Greenery as Possible Invasion Gates of Non-Native *Phyllactinia* Species. *Forests* **2021**, *12*, 183. [CrossRef]
17. Pastirčáková, K.; Adamčíková, K.; Barta, M.; Pažitný, J.; Hoťka, P.; Sarvašová, I.; Kádasi Horáková, M. Host Range of *Hymenoscyphus fraxineus* in Slovak Arboreta. *Forests* **2020**, *11*, 596. [CrossRef]