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Editorial: Invasive pathogens and arthropods: biogeography, drivers of invasion success, impacts on indigenous forest trees and emerging management strategies

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Editorial on the Research Topic
Invasive pathogens and arthropods: biogeography, drivers of invasion success, impacts on indigenous forest trees and emerging management strategies

With the ongoing global anthropogenic climate change, a silent war rages in forests, the lungs of the earth. Invasive pathogens and insect pests are decimating native trees, compromising ecological function, biodiversity, and ecosystem services. Many of the processes surrounding successful biotic invasions are broad and have been previously analyzed (Hobbs et al., 2006; Blackburn et al., 2011). For invasive insect pests and pathogens, globalization, the rise in human population and associated environmental disturbances are recognized as fundamental drivers of introduction of propagules of non-native species to novel environments. Superior tolerance of extreme climate environments, in particular temperature, is also associated with invasion propensity among ectotherms such as insect pests (Nyamukondiwa et al., 2022). A broad host range also contributes to the success of invasive species as it ensures population persistence even when otherwise favorable hosts may not be present in the invaded ranges (Kelley, 2014). The

ecological and economic impacts of such invasions are diverse, and the latter hugely underestimated (Diagne et al., 2021). However, it is increasingly apparent that there is modification of trophic interactions, eliciting both top-down and bottom-up feedback, that can compromise native biodiversity. These diverse attributes and consequences of species invasions call for an in-depth understanding of the factors contributing to invasion success. In particular, the role of climate stress resistance in geographic range expansion and chemically mediated below and above ground pest-pathogen interactions with trees are paramount. Such an understanding will significantly enhance management strategies through both improved prediction of potential outbreaks and development of biologically intensive novel approaches for invasive species pest control through disruption of trophic interactions that aid invasions. This Research Topic highlights how the knowledge on the biology, physiology, and ecology of the invasive organisms, as well as the mechanisms behind their successful expansion and establishment could aid protection of native forests.

Mendel et al. investigated the determinants of host range and reproductive success in the polyphagous shot hole borer (PSHB) *Euwallacea fornicatus* (Coleoptera: Scolytinae), native to Southeast Asia, in its invaded range of California and Israel. Of the 583 trees they examined, only 13.8% supported full reproduction of *E. fornicatus* with Salicaceae and Sapindaceae tree species being the most suitable hosts for reproduction, whilst 55.9% did not. The study highlights how the host range and reproductive success of *E. fornicatus* are highly constrained by host tree phylogeny. Traditionally, studies have largely focused on climate envelopes to map habitat suitability of specialist organisms in non-native ranges where hosts are already known to be present (Chidawanyika et al., 2020; Jiang et al., 2022). However, for generalists like the PSHB, phylogenetic studies of tree species in native forests may help refine these models to quantify vulnerability together with mapping high risk areas.

Dittrich-Schröder et al. characterized the diversity and invasion pathways of *Glycaspis brimblecombei*, a global invasive pest of *Eucalyptus* assumed to be originally from Australia. Through sequencing of sections of the cytochrome oxidase 1 (COI) gene from 105 individuals belonging to both the invaded and native ranges, followed by characterization using polymorphic microsatellite markers, they suggest distinct populations marked by two independent introductions from Australia firstly to the United States, followed by a second one to South America before spreading to South Africa. Another lineage was thought to have established in Mauritius and La Réunion islands through the second introduction from Australia. The study highlights the complexity of invasion pathways of noxious organisms through formation of bridgeheads in invaded territories, which in turn act as sources of new invasions. This therefore calls for the need for comprehensive knowledge-intensive biosecurity strategies to curb further invasions and protect forests.

Under field conditions, Fearer et al. tested a novel early warning system detecting asymptomatic beech leaf disease (BLD) in infected trees using near-infrared spectroscopy and machine learning. Although validation using qPCR-based protocols could not fully attribute spectral differences due to sole pathogen presence, such techniques could be key in tree disease surveillance and in-field diagnostics for BLD enabling timely mitigative measures if precision is improved.

In another study, molecular-based surveys together with cultivation-based growth experiments and microscopy were used to investigate the host and abiotic constraints mediating the distribution of *Sphaeropsis sapinea* (syn. *Diplodia sapinea*), a causal fungal agent of Diplodia tip blight, which is a major pathogen of economic importance in pine forestry worldwide (Roy et al.). The pathogen was detected on all the seven *Pinus* species that were studied. Interestingly, only *P. sylvestris* and *P. nigra* could host the pathogen with asymptomatic needles, suggesting that they may potentially be the original hosts. The distribution of the pathogen was also delimited by altitude, where trees in elevation above 800 m did not have any infections. This could also be explained by the fact that under controlled conditions, lower temperatures reduced the growth of *S. sapinea* isolates. Prior exposure at 35°C improved the growth of the pathogen isolates at high temperatures with optimal range being 20–30°C, suggesting presence of phenotypic plasticity for survival at higher temperatures. Thus, as climate change ensues, warming temperatures are projected to increase the geographic range of *S. sapinea* infection.

Articles published in this Research Topic "*Invasive pathogens and arthropods: biogeography, drivers of invasion success, impacts on indigenous forest trees and emerging management strategies*" highlight the processes mediating invasion patterns in indigenous forests and potential strategies for surveillance and management. Through this Research Topic, our goal was to showcase recent global advances in the biology and ecology of invasive insect pests and pathogens, and their management. The collected articles show potential for monitoring tools, even for cryptic species, and management through in-depth understanding of the biology and ecology of pest-pathogen and tree interactions. The role of temperature in defining geographic ranges of organisms was also highlighted. Under the ongoing climate change, surveillance and transboundary biosecurity measures should account for climatic factors for both robust predictive models and effective management.

Author contributions

FC: Conceptualization, Data curation, Formal analysis, Funding acquisition, Investigation, Methodology, Project administration, Resources, Software, Supervision, Validation, Visualization, Writing—original draft, Writing—review & editing. KA: Conceptualization, Methodology, Validation, Visualization, Writing—review & editing. TM: Investigation, Methodology, Validation, Visualization, Writing—review & editing. AY: Conceptualization, Investigation, Methodology, Validation, Visualization, Writing—review & editing. CN: Conceptualization, Investigation, Methodology, Validation, Writing—review & editing.

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Conflict of interest

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