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Editorial: Impacts of invasive plant management on forest biodiversity and ecosystem services

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Editorial on the Research Topic
Impacts of invasive plant management on forest biodiversity and ecosystem services

Introduction

Forest ecosystems and biodiversity are considered integral to maintaining carbon capture capacity, forest health and resilience on the one hand while supporting human wellbeing, and livelihoods, and providing other important ecosystem services to sustain life on the planet (Rawat, 2017). Biological invasion is caused by non-native organisms such as plants, insects, or pathogens that have been intentionally or accidentally introduced outside of their native distribution range for specific purposes. These invasive alien species escape from their areas of introduction, aggressively spread out and overwhelmingly dominate the entire landscape (e.g., forest ecosystems) by out-competing native species. Invasiveness can also be described as the tendency of an introduced species to aggressively spread due to its defining characteristics (i.e., introduction history, species traits, ecology, and evolutionary processes) into a recipient ecosystem (such as a forest ecosystem) (van Kleunen et al., 2010). Invasion in complex forest ecosystems is often a concern when the system is no longer able to regulate itself and when the invasion has already altered the regular composition, abundance and diversity. Early detection of invasiveness and the implementation of subsequent restorative measures are of paramount importance (van Wilgen and Wannenburgh, 2016). In a holistic approach, detection comes first, followed by an understanding of the dynamics, exploration of mitigating options, implementation of mitigation measures and an attempt to restore the pre-invasion state (Rai and Singh, 2020). Some of the invasions are responses to the impacts of climate change such as flooding and local weather conditions which call for the implementation of a multidimensional investigation so as to identify and avail effective mitigation measures. While mitigation and restorative intervention measures are being urgently sought, managing invasiveness in complex forest ecosystems poses a strong challenge as the

outcomes are not straightforward. Nevertheless, targeted multi-dimensional interventions that are supported by adequate empirical evidence are helpful in managing invasiveness in the absence of a comprehensive understanding of interactions and causations. Thus, this Research Topic presents five recent contributions from dedicated scholars that provided empirical investigations and results on the impacts of invasive plant management on forest biodiversity and ecosystem services with regard to detection, application of restorative measures and outcomes.

Invasion detection

In many regions of the world, measures for the detection and management of invasive alien plant species are either in their early stages or are still being developed (Rai and Singh, 2020). Evidence shows that the abundance of invasive alien plants has increased in forest ecosystems due to global climate change and their ability of these plants to quickly adapt to adverse conditions (Rawat et al., 2023, 2024). Even conservation areas have been invaded, and regions that have not yet been affected may be invaded in the near future due to global environmental change and the expansive pathways of distribution associated with international trade (van Wilgen and Wannenburgh, 2016). There is a need for simple, quick and early detection of increasing pathways of spread.

In the study aimed at investigating detection tools and contributed by Bérubé et al. "*Comparison of intercept trap fluids and aerial spore collectors to survey fungal spores*" a comparison was made of the efficacy of passive spore collection devices and insect intercept traps (with wet collection cups) for the sampling of fungal species. Bérubé et al. also tested the effect of site type (rural, urban) on the abundance and number of fungal species detected. In this comparative investigation, a total of 1,277 fungal operational taxonomic units (OTUs) were detected, of which 220 were plant pathogens, and 101 were forest pathogens. Ninety percent (90%) of all fungi collected were detected by trap fluids, while 63% of all fungi were detected by aerial spore collectors. In all sites, trap fluids have detected a significant amount of fungi as compared to aerial spore collectors. Similar results were also obtained for plant and forest pathogens at the Nova Scotia and Ontario sites. Species richness and abundance of fungi and pathogens (i.e., plant and forest pathogens) were significantly affected by the collection methods. The study suggests that insect trap fluids have excellent potential for the detection of non-native forest pathogens superior to aerial spore collectors. It was concluded that surveillance of plant pathogens and the diseases they cause is critical for the early detection of invasive species and changes in the population densities of naturalized and native pest species.

The other research article by Seifu et al. "*Allelopathic potential of root and leaf aqueous extracts of invasive alien plant species, Cryptostegia grandiflora, on germination and seedling growth of Linum usitatissimum and Guizotia abyssinica*" examines the allelopathic potential of *C. grandiflora* on the germination and seedling growth of *L. usitatissimum* and *G. abyssinica*. Seifu et al. found that the inhibitory effect of water extracts on root and leaf samples was concentration-dependent and affected seedling dry weight, plumule, and radicle length. Alternatively, these invasive plant extracts had herbicidal properties. Finally, the authors considered *C. grandiflora*, to be the worst invasive alien plant species with negative effects on the forest ecosystem.

The article by Kumar et al. "*Perceptions of impacts and management of invasive alien plants: a case study from Mirzapur, India*" analyzed the perceptions of ecosystem services (ES) and ecosystem disservices (EDS), including the ecological and economic impacts of invasive alien plants. Kumar et al. found that 95% of respondents were familiar with at least one of the 12 invasive alien plants identified in the region. The study revealed a preference for the eradication of invasive alien plants that have direct harmful effects on human health and biodiversity in line with previous work by Rai and Singh (2020) and Rawat et al. (2023, 2024). Uprooting was the most commonly used management practice to control plant species invasions in the region. This study was useful in accounting for and incorporating people's perceptions into the control and management of invasive alien plants in the forest region.

Empirical evidence for managing invasion and restoration

Invasive alien plants have contributed to the destruction and suppression of indigenous species (flora and fauna), disruption of ecosystem services (such as water resources), and the reduction of forest biodiversity (van Wilgen and Wannenburgh, 2016; Rawat et al., 2023, 2024). This has increased forest disturbances (e.g., pests, pathogens and disease outbreaks, fire, and floods) and altered species competition in forest ecosystems (Roy et al., 2014; Rawat, 2017; Rai and Singh, 2020). Thus, integrated efforts are needed to address the expanding populations of invasive alien plants that affect forest ecosystems (Rai and Singh, 2020; Rawat et al., 2023, 2024). It is critical to prevent the deterioration of forest ecosystems caused by invasive alien plant species (Rawat et al., 2023, 2024) thereby contribute to the sustainable forest management, the UN Decades on Ecosystem Restoration and the Sustainable Development Goals. As a result, an ecosystem approach is required to prioritize invasive species and areas for management. In doing so, a variety of interdependent positive outcomes related to ecosystem services, including protection of water resources and land productivity, preservation of biodiversity, and creation of job opportunities can be affected (Rawat et al., 2023, 2024). Managing invasion means understanding invasiveness and invasive alien plants; Invasiveness (e.g., abundance and density) of invasive alien plants in forests needs to be conceptualized not only in terms of forest biodiversity and ecosystem services but also in the context of using biomass of invasive plant species as a control tool and method for sustainable forest management.

The study by Sward et al.; "*Shrub expansion in maritime forest responding to sea level rise*" consists of a comparative investigation. The authors examined shrub distributions and compared them with the distribution of the invasive grass *Phragmites australis* so as to test whether competition had a role in the shrub distribution. Maritime forests growing along coastal areas support prominent biodiversity. The researchers found that shrubs were most abundant in the mid forest (stressed forest, about 200 m from the edge of the marsh), whereas *P. australis* was most abundant in the low forest (developing ghost forest, closest to the marsh, 100 m from the edge of the marsh). Therefore, the rapid growth of shrubs in the mid and high forest (apparently healthy forest,

furthest inland, about 300 m from the edge of the marsh) radically changed the forest understory structure (Rai and Singh, 2020). This study suggests that high salinity, rather than competition with *P. australis*, filters *Morella cerifera* from the low forest, whereas moderate salinity in the mid and high forests favors *M. cerifera* growth and expansion. The increase in shrubs is the effect of salt-affected maritime forest, which is an indicator of transgression ahead of *P. australis* and the coastal forest tree line.

In the same vein, the article by Jäger et al. "*Restoring the threatened Scalesia forest: insights from a decade of invasive plant management in Galapagos*" assessed the impacts of blackberry *Rubus niveus*, *Cestrum auriculatum* and *Tradescantia fluminensis* and their removal on the cover, composition and diversity of native plant communities in the area. The study revealed that there were significant changes in both plant community species composition and the average percentage of species cover over time when comparing removal plots with invaded plots (Rawat et al., 2023, 2024). Species composition in removal plots changed significantly more than in invaded plots, toward a plant community with a higher percent cover of endemic species. This study suggests that failure to remove invasive alien plant species will result in the extinction of native species like *Scalesia pedunculata* from Santa Cruz Island, Galapagos. Therefore, integrated invasive alien plants management, is imperative for sustainable forest ecosystem management under global change scenarios. All manuscripts underscored that integrated efforts are needed to address the ever-expanding invasive alien plant species for sustainable forest management thereby contributing to ecosystem services and biodiversity conservation (van Wilgen and Wannenburgh, 2016; Rai and Singh, 2020). Therefore, a sustainability approach (such as inclusive, equitable and sustainable biodiversity stewardship) is required for invasive plant species management to protect the forest ecosystem (Rawat, 2017).

The five research articles that comprise this Research Topic offer a comprehensive understanding of invasive alien plant management in forest ecosystems. We, therefore, acknowledge the tireless efforts of the authors, reviewers and handling editors for their contribution in making this Research Topic a reality. Their ideas and commitment to addressing the gaps and exploring future research opportunities were invaluable in advancing our understanding and enhancing the knowledge base on invasive alien plant management in forests, thereby contributing to ecosystem services and biodiversity conservation. Additionally, present study is commendable and will certainly inspire further investigation on invasive alien plants management in the forests and global change context.

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Conflict of interest

AT was employed by the GFA Consulting Group GmbH.

The remaining authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

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References

Rai, P. K., and Singh, J. S. (2020). Invasive alien plant species: their impact on environment, ecosystem services and human health. *Ecol. Indic.* 111:106020. doi: 10.1016/j.ecolind.2019.106020

Rawat, Y. S. (2017). Sustainable biodiversity stewardship and inclusive development in south africa: a novel package for a sustainable future. *Cur. Opin. Environ. Sustain.* 24, 89–95. doi: 10.1016/j.cosust.2017.03.003

Rawat, Y. S., Negi, V. S., Pant, S., and Bachheti, R. K. (2023). Collaborative adaptive stewardship for invasive alien plants management in south africa. *Sustainability* 15:4833. doi: 10.3390/su15064833

Rawat, Y. S., Singh, G. S., and Tekleyohannes, A. T. (2024). Optimizing the benefits of invasive alien plants biomass in South Africa. *Sustainability* 16:1876. doi: 10.3390/su16051876

Roy, B. A., Alexander, H. M., Davidson, J., Campbell, F. T., Burdon, J. J., Sniezko, R., et al. (2014). Increasing forest loss worldwide from invasive pests requires new trade regulations. *Front. Ecol. Environ.* 12, 457–465 doi: 10.1890/130240

van Kleunen, M., Weber, E., and Fischer, M. (2010). A meta-analysis of trait differences between invasive and non-invasive plant species. *Ecol. Lett.* 13, 235–245. doi: 10.1111/j.1461-0248.2009.01418.x

van Wilgen, B. W., and Wannenburgh, A. (2016). Co-facilitating invasive species control, water conservation and poverty relief: achievements and challenges in south africa's working for water programme. *Curr. Opin. Environ. Sustain.* 19, 7–17. doi: 10.1016/j.cosust.2015.08.012