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Editorial: Effect of forest disturbances on natural forest regeneration in a changing tropical environment

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Editorial on the Research Topic
Effect of forest disturbances on natural forest regeneration in a changing tropical environment

Introduction

In tropical forests, the human footprint continues to expand and recent estimates show that ~82% of the remaining tropical forest ecosystems are degraded (Watson et al., 2018). Disturbances are predicted to increase in tropical forests due to human activities such as agricultural expansion, timber extraction, charcoal production, livestock grazing, and infrastructure development (Vancutsem et al., 2021; Baumann et al., 2022). These activities threaten the survival of many species and reduce the ability of the forests to provide ecosystem goods and services to local communities. Forest regeneration in tropical forests is a dynamic and intricate process influenced by a myriad of interrelated elements. Understanding the effect of disturbances on natural regeneration is crucial for effective forest management and conservation, as well as fostering resilient and diverse tropical ecosystems. By unraveling the effects of disturbances on natural regeneration, we can develop strategies to support the long-term sustainability of tropical forests that are known to harbor more than half of the world's terrestrial floral and faunal species (Pillay et al., 2022).

The objective of this Research Topic was to gain a better understanding of the effects of disturbances on natural forest regeneration in a changing tropical environment. This editorial highlights the key findings of the seven papers submitted under this topic and contextualizes them in terms of disturbance implications on natural regeneration. Contributions to this topic can help conservationists and policymakers develop strategies to improve tropical forest ecosystem recovery and long-term sustainability in the face of continuous environmental issues. We acknowledge that the topic is complex and multifaceted because natural forest regeneration is controlled by a number of interconnected elements such as light availability, soil conditions, climate, nutrient availability, competition, herbivory, and seed predation.

Effect of forest disturbance on seed regeneration

Forest disturbances can trigger successional processes, leading to changes in vegetation composition and structure (Poorter et al., 2023). As the forest recovers, early successional species may be gradually replaced by later successional species with different seed regeneration strategies. Zhou et al. simulated the effect of light in canopy gaps on the growth rates of seedlings from early-, mid-, and late-successional stages in tropical montane forest in Hainan Island, China. These authors showed that light conditions under small canopy gaps (10–15% full sunlight) and large canopy gaps (40–50% full sunlight) induced greater growth rates for seedlings from early- and mid-successional stages than from late-successional stage. Their findings have important implications for the management of disturbed tropical forests because they show that canopy gaps created by disturbances (e.g., cyclones and wildfires) create a benign environment for seedlings of light-demanding tree species but not for seedlings of deep shade-adapted tree species.

Effect of forest disturbance on natural regeneration, soil carbon, and nutrient cycling

Forest disturbances such as wildfires, logging, or natural events can affect key ecosystem processes that support natural regeneration including soil carbon and nutrient cycling. A summary of several studies accepted under this topic reveals that tropical forests are undergoing alterations in carbon and nitrogen biogeochemical cycles, which may impair natural regeneration processes. A study by Tiwari et al. showed that human disturbance in the montane forests of the Garhwal Himalaya in India altered plant species composition, soil properties, and carbon stock. Their results indicate that some species may be more resilient to disturbances and have adaptations that allow them to thrive in disturbed environments, while others may be more susceptible to mortality. Tiwari et al. further highlighted that human pressures in tropical forests can accelerate soil erosion, which can transfer carbon-rich topsoil away from the site. According to Saleem et al., agroforestry can provide numerous benefits in terms of minimizing the effects of disturbances in tropical forests and helping in ecosystem restoration. Their findings highlight how the presence of trees in agroforestry systems may provide additional sources of organic matter via litterfall, which adds to soil nutrient inputs and organic matter.

The contribution of fine roots to soil organic matter through mortality is frequently underestimated in tropical forests. Awasthi et al. and Pandey et al. found that fine roots play an important role in soil organic matter accumulation and nutrient return to soil. Although these studies suggest that human disturbances can increase root turnover in tropical forests, detailed studies are required to address the effect of anthropogenic disturbances such as fire and logging on fine root mortality and decomposition and nutrient release to the soil. Depending on the severity and frequency of the disturbance, as well as the unique characteristics of the forest ecosystem, disturbances are anticipated to have varying impacts on fine root turnover in tropical forests.

George-Chacon et al. used chronosequence data, satellite observations, and a carbon cycle model to determine woody carbon dynamics in two dry forest ecotypes (semi-deciduous and semi-evergreen) in Yucatán, Mexico. The study demonstrated that the rate and extent of carbon storage and sequestration can vary depending on various factors including species composition, environmental conditions, and ecological processes. The study provided important insights on how woody biomass stocks can change under different disturbance frequencies. This study predicted that increases in temperature and declines in precipitation reduce the capacity of dry forests to regenerate and store carbon. Such predictions are useful for effective forest management, climate change mitigation, and conservation of carbon-rich tropical forests.

Yaseen et al. studied responses of plant functional traits in tropical dwarf forest on Hainan Island and highlighted that plant functional traits can be used to predict soil nutrients and ecosystem functioning. This study provided a better understanding of the importance of selecting different species across multiple trait axes in the restoration of degraded tropical forests. However, further studies are needed to explore the soil properties and their association with plant functional features and their role in ecosystem functioning.

Conclusion

The seven papers presented have enhanced our understanding on the effect of disturbances on natural forest regeneration in tropical environments thus far but there are still some research gaps that need to be addressed. First, there is need for studies that investigate the long-term effects of different types of disturbances (e.g., logging, fire, and climate change) on natural regeneration processes in tropical forests. Second, because tropical forests are exposed to several disturbances at the same time, the interacting effects of multiple disturbances on natural regeneration need to be investigated. Third, studies are scarce in the tropical region that demonstrate the role of different tree species and their regeneration strategies in post-disturbance recovery. Fourth, it is crucial to examine the effect of landscape (e.g., proximity to undisturbed forests or edge effects) on natural regeneration processes. Fifth, few studies in the tropical region have evaluated the effectiveness of different management strategies (e.g., active restoration or passive natural regeneration) in promoting forest recovery after disturbances. Lastly, there is a need for research that integrates socio-economic factors into forest regeneration studies. This includes understanding the impacts of local communities, land tenure systems, and economic incentives on forest regeneration outcomes.

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Conflict of interest

The 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.

Publisher's note

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