frontiers | Frontiers in Forests and Global Change

TYPE Editorial
PUBLISHED 31 May 2023
DOI 10.3389/ffgc.2023.1197644

OPEN ACCESS

EDITED AND REVIEWED BY
John Robert Healey,
Bangor University, United Kingdom

*CORRESPONDENCE
Rishikesh Singh
✉ rishikesh.iesd@gmail.com

RECEIVED 31 March 2023
ACCEPTED 16 May 2023
PUBLISHED 31 May 2023

CITATION
Chaturvedi RK, Bhadouria R and Singh R (2023) Editorial: Variation in plant strategies with levels of forest disturbance.
Front. For. Glob. Change 6:1197644.
doi: 10.3389/ffgc.2023.1197644

Editorial: Variation in plant strategies with levels of forest disturbance

Ravi Kant Chaturvedi[1], Rahul Bhadouria[2] and Rishikesh Singh[3]*

[1]Center for Integrative Conservation, Xishuangbanna Tropical Botanical Garden, Chinese Academy of Sciences, Menglun, Yunnan, China, [2]Department of Environmental Studies, Delhi College of Arts and Commerce, University of Delhi, New Delhi, India, [3]Department of Botany, Panjab University, Chandigarh, India

KEYWORDS

allometric equations, biomass allocation, climate change, forest ecosystems, plant functional traits, vegetation productivity, medicinal plants, species conservation

Editorial on the Research Topic
Variation in plant strategies with levels of forest disturbance

The forest ecosystems across the globe are experiencing direct and indirect effects of climate change and anthropogenic disturbances, leading to a marked transformation in their structure and function (Hansen et al., 2020). Due to these two factors, tropical dry forests (TDFs), providing ~40% of global tropical forest cover, and accounting for a major share of primary productivity and carbon sequestration, are progressing toward permanent loss (Bonan, 2008; Allen et al., 2017). Disturbance events and plant responses ultimately shape the community structure and composition of a region and regulate its functional diversity (Allen et al., 2017; De Long et al., 2023). Subsequently, the variations in plant community functional diversity in response to disturbances modulate ecosystem functioning through biomass accumulation and litter decomposition, and help in sustaining the ecosystem via positive plant-soil feedback mechanisms (Chen et al., 2018; De Long et al., 2023). Nowadays, the conservation of forests via understanding their functional traits and adaptation strategies to different levels of disturbance events, has been given top priority for attaining the Sustainable Development Goals (SDGs) (Amigo, 2020; Hansen et al., 2020; Chaturvedi et al., 2021). In this Research Topic, emphasis has been given to the systematic understanding of the relationship between environmental change, anthropogenic disturbances, vegetation structure, plant community composition, and ecosystem functioning, with particular reference to TDFs. The major themes covered in this topic include (i) assessment of the impact of natural and anthropogenic disturbances on plant community functional diversity, (ii) the role of plant community functional diversity and functional traits in the prediction of the resilience of vegetation to disturbance, (iii) the significance of disturbance ecology for development of theory about the functional role of plant morphological and physiological traits, and (iv) interactions amongst plant functional diversity, productivity, and disturbances in relation to global climate change. The Research Topic consists of seven articles contributed by 23 authors belonging to five countries viz., Bangladesh, China, Ethiopia, India, and Kenya. These articles highlight several aspects of variation in plant strategies in response to disturbance events occurring in different forest ecosystems.

The first theme of this Research Topic provides insight into plant functional diversity and responses with respect to different disturbance levels. It is evident that the overexploitation of forest resources, accompanied by harsh environmental conditions, may result in

the disappearance of several plant species of economic importance. Moreover, in addition to the disturbance regime, the naturally existing features of the ecosystem have a considerable impact on plant species diversity and distribution patterns (Singh et al., 2017). The article by Singh et al. published in this Research Topic assesses the distribution pattern of important medicinal plants growing in Vindhyan TDFs of India with respect to the low and high disturbance levels in the form of illegal logging, cattle grazing, and fire. The findings of this article reveal a decline in population or even the disappearance of several valuable medicinal plants with increasing disturbance levels. In addition, the existing edaphic parameters such as soil texture, bulk density, water holding capacity, and soil organic C, and their alteration with disturbance also played a major role in species distribution. The plant species reflect different modes of propagation strategies for their survival and developing resistance to the disturbances. However, different levels of disturbances may not have similar impacts on plant community structure and composition. For instance, at some levels, they may significantly modify the diversity and ecosystem functioning depending on the forest types, age, and life forms. Studies have revealed that species distribution and richness exhibit a high level of diversity at moderate (intermediate) disturbance levels, to some extent (Connell, 1978; Sagar et al., 2003). The second article of the Research Topic by Singh describes the effects of anthropogenic disturbances on different plant functional traits and soil microbial attributes in western Himalayan temperate forests and shows a decrease in soil microbial biomass and diversity with increasing disturbance levels. According to this study, the plant functional traits such as specific leaf area, crown cover, plant height, and seed mass show variable patterns with varying disturbance levels. The take-home message of the study is that the continuously increasing levels of disturbance may pose a threat to the species having conservative ecological strategies. Overall, the study reports that a low to moderate level of disturbance may mimic the natural treefall gap conditions and act as a model system for studying plant adaptation strategies, species recruitment patterns, and resource availability with changing environmental conditions.

The studies conducted by Awasthi et al., Patel et al., and Tiwari et al. cover the second theme of the topic, i.e., the prediction of the resilience of vegetation components with respect to disturbances. According to Díaz et al. (2007), the plant species assemblage not only determines the structural appearance of a region but also regulates ecosystem functionality, such as nutrient cycling and regeneration of co-occurring species. For example, the plants rich in nutrient content exhibit a fast decomposition pattern, leading to a fast turnover of soil nutrients. These features of plant species in a community also help in maintaining resource availability for the co-occurring vegetation. The article by Awasthi et al. gives an example of such strategies for plants growing in the shrublands of degraded hills of Kumaun Himalaya, India. In this study, a shrub species (viz., *Coriaria nepalensis*), on one side, shows an immense potential to restore the degraded ecosystem by manipulating resource allocation, nutrient (N, P, and K) cycling, and soil fertility, while protects the ecosystem from various natural events and calamities (e.g., landslides), on the other side, compared to the other shrub species of the region. In addition to natural systems, several measures are also being practiced to manage plant diversity and forest resources in different anthropogenically-managed ecosystems. For instance, the home gardens are one of the key examples of indigenous practices for the conservation of a number of plant species by nurturing and directly linking them with community livelihoods. The fourth article of this collection, by Patel et al. reports on 133 plant species from 50 families, belonging to different life forms, which were being grown and conserved in the TDFs of the Vindhyan highlands, India. This study critically examined the variation in plant strategies in anthropogenically-managed areas. In this study, different life forms showed variations in their distribution depending on the anthropogenic impact. The study reported trees as the highly preferred life form followed by shrubs and herbs in the home gardens. The study suggests that the conservation measures through traditional home gardens may act as a repository of plant species which can help in achieving several SDGs, thereby improving the overall livelihood of the people associated with these homegardens. Besides, the amalgamation of traditional knowledge with advanced scientific techniques in developing home gardens in resource-poor and degraded ecosystems can be a sustainable approach for restoring vegetation and improving ecosystem conditions. Further, amongst several plant functional traits, seeds play a crucial role in plant regeneration and growth behavior under different conditions. The fifth article of this collection, by Tiwari et al. highlights measures for conserving the seeds of seven medicinal plants belonging to TDFs of India. The plant species selected in this study were overexploited, and faced local extinction, and thus needed special attention for their survival. The findings of the study revealed that improving seed viability can be crucial for maintaining genetic integrity, germination capacity, and biochemical activities. Besides, the study outlines species-specific requirements of storage conditions for the long-term viability of seeds which can further be utilized for the reclamation of degraded ecosystems. These reports emphasize that exploring seed traits and their proper storage strategies can be an important approach to species conservation, particularly in TDFs.

The third theme of the topic covers the role of different morphological and physiological plant traits in developing non-destructive measures for studying ecosystems' productivity and functionality. The article by Sileshi et al. highlights the role of non-destructive allometric scaling and allocation patterns in determining the plant productivity of different regions. In this study, the relative role of different plant morphological features such as stem height and diameter, crown radius, depth and volume, above- and below-ground biomass at different taxonomic levels, climatic zones, and disturbance regimes have been assessed by developing precise allometric equations. The authors of this study precisely emphasize different mathematical and technical aspects of allometry, their precise estimation measures, and related bias in predicting biomass productivity and stock of a plant community. The authors emphasize taking a large number of samples ($N > 60$) for precise estimation. The findings of the study can be helpful to researchers working on different aspects of non-destructive ecosystem productivity measurements. Moreover, such equations can be helpful in predicting the changes occurring in a forest ecosystem with changing climatic scenarios.

The fourth theme of this Research Topic provides insight into the interactions between plant productivity and disturbance

patterns with respect to changing climatic scenarios. Increasing anthropogenic interferences and environmental changes have resulted in a severe decline in vegetation in the last few decades. However, assessing how changes in global forest cover are linked with precipitation and temperature gradients at local and global levels is of paramount importance (Allen et al., 2017). The article by Hasnat explores the interrelationship between forest cover change and land surface temperature (LST) in the Dudpuluria-Dhopachari Wildlife Sanctuary, Bangladesh, based on the multi-spectral and multi-temporal satellite data of three decades (1990–2020). The findings of this study reveal an initial decrease (∼17%) in forest cover between 1990 and 2010, whereas an increase was observed between 2010 and 2020. This study suggests that the measures taken for forest restoration and conservation at local levels resulted in a positive forest cover change from 2010 onwards. However, a continuous increase (2.3–3.0 ^{o}C decade^{-1}) in LST was observed between 1990 and 2020. This study reveals that local efforts to restore forest cover may have relatively lesser effects in regulating local temperatures, since the changes occurring at a global scale (i.e., global warming) also have a substantial role in determining the local as well as global LSTs.

Overall, the articles in this Research Topic cover various aspects of plant strategies for their adaptations to different disturbance levels. These articles cover a broad dimension of studies from seed conservation, home gardening, plant diversity and conservation, nutrient partitioning and allocation pattern, soil microbial biomass dynamics, allometric measures for biomass estimations, and the use of remote sensing and GIS-based techniques for determining vegetation cover and LST under changing climatic scenarios. The scientific investigations described in this collection evaluate the interactions amongst plant functional diversity, productivity, and disturbances and give new insights into the role of plant community functional diversity in predicting the resilience of forest ecosystems to disturbances.

Author contributions

RC: conceptualization of the idea of the manuscript, reviewed, and finalized. RB: drafted the manuscript, reviewed, and finalized. RS: conceptualized and outlined the draft of the manuscript, wrote the initial version, reviewed, and finalized. All authors contributed to the article and approved the submitted version.

Acknowledgments

RC thanks Central Laboratory, XTBG for lab facilities, and National Natural Science Foundation of China (NSFC), Chinese Academy of Science, China (Award no. 31750110466) for financial support. RS is thankful to Science and Engineering Research Board (DST-SERB, Grant no. PDF/2020/001607), New Delhi, India, for providing research funding under the National Post-doctoral fellowship (NPDF) scheme.

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

References

Allen, K., Dupuy, J. M., Gei, M. G., Hulshof, C., Medvigy, D., Pizano, C., et al. (2017). Will seasonally dry tropical forests be sensitive or resistant to future changes in rainfall regimes?. *Environ. Res. Letters* 12, 023001. doi: 10.1088/1748-9326/aa5968

Amigo, I. (2020). When will the Amazon hit a tipping point?. *Nature* 578, 505–508. doi: 10.1038/d41586-020-00508-4

Bonan, G. B. (2008). Forests and climate change: forcings, feedbacks, and the climate benefits of forests. *Science* 320, 1444–1449. doi: 10.1126/science.1155121

Chaturvedi, R. K., Tripathi, A., and Raghubanshi, A. S., and Singh, J. S. (2021). Functional traits indicate a continuum of tree drought strategies across a soil water availability gradient in a tropical dry forest. *Forest Ecol. Manage.* 482, 118740. doi: 10.1016/j.foreco.2020.118740

Chen, S., Wang, W., Xu, W., Wang, Y., Wan, H., Chen, D., et al. (2018). Plant diversity enhances productivity and soil carbon storage. *Proc. Nat. Acad. Sci.* 115, 4027–4032. doi: 10.1073/pnas.1700298114

Connell, J. H. (1978). Diversity in tropical rain forest and coral reefs. *Science* 199, 1302–1310. doi: 10.1126/science.199.4335.1302

De Long, D., Heinen, J. R., Heinze, R., Morriën, J., Png, E., Sapsford, G. K., et al. (2023). Plant-soil feedback: incorporating untested influential drivers and reconciling terminology. *Plant Soil* 485, 7–43. doi: 10.1007/s11104-023-05908-9

Díaz, S., Lavorel, S., De Bello, D., Quétier, F., Grigulis, F. K., and Robson, T. M. (2007). Incorporating plant functional diversity effects in ecosystem service assessments. *Proc. Nat. Acad. Sci.* 104, 20684–20689. doi: 10.1073/pnas.0704716104

Hansen, A. J., Burns, P., Ervin, J., Goetz, S. J., Hansen, M., Venter, O., et al. (2020). A policy-driven framework for conserving the best of Earth's remaining moist tropical forests. *Nat. Ecol. Evol.* 4, 1377–1384. doi: 10.1038/s41559-020-1274-7

Sagar, R., Raghubanshi, A. S., and Singh, J. S. (2003). Tree species composition, dispersion and diversity along a disturbance gradient in a dry tropical forest region of India. *Forest Ecol. Manage.* 186, 61–71. doi: 10.1016/S0378-1127(03)00235-4

Singh, R., Sagar, R., Srivastava, P., Singh, P., and Singh, J. S. (2017). Herbaceous species diversity and soil attributes along a forest-savanna-grassland continuum in a dry tropical region. *Ecol. Eng.* 103, 226–235. doi: 10.1016/j.ecoleng.2017.04.020