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Editorial: Temporal and Large-Scale Spatial Patterns of Plant Diversity and Diversification

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Editorial on the Research Topic

Temporal and Large-Scale Spatial Patterns of Plant Diversity and Diversification

PLANT DIVERSITY AND DIVERSIFICATION

Plants have successfully colonized almost all of the Earth ecosystems and are among the most diverse eukaryote phyla (Mora et al., 2011; Pimm and Joppa, 2015). They also play a key role in the Earth system as a major actor in atmospheric, water and nutrient cycles that make possible life as we know it (Lucas, 2001; Payne et al., 2020). Numerous studies focused on plant diversity and evolution have been published and a large body of knowledge on plant diversity, evolutionary history, traits, physiology, and distribution has been generated. Such accumulation of knowledge combined with methodological and computational advances, and the ever-expanding biological databases (e.g., GenBank, TRY, GBIF) have allowed the study of plant diversity at large geographical and temporal scales as exemplified on **Figure 1** (Zanne et al., 2014; Smith and Brown, 2018; Igea and Tanentzap, 2020; Neves et al., 2021). However, despite numerous advances, plant diversity and diversification patterns remain contentions. For example, there is still no consensus about the crown age of angiosperms (flowering plants, the most diverse plant lineage) (e.g., Barba-Montoya et al., 2018; Sauquet et al., 2021). Many species remain undescribed and a large fraction of the described species have never been included in phylogenetic datasets (Stevens, 2017). Likewise, large gaps remain in distributional and trait databases (Cornwell et al., 2019).

The aim of this Research Topic is to bring together research that furthers our understanding of large-scale plant diversity and diversification patterns. It includes nine papers that tackle these issues from different evolutionary and ecological perspectives using diverse methods and study systems.

EVOLUTIONARY AND ECOLOGICAL DRIVERS OF PLANT DIVERSITY PATTERNS

Most of the articles in this Research Topic focus on the drivers of plant diversity and distribution patterns. Loiseau et al., using genome skimming data of the hyperdiverse genus *Vriesea* (Bromeliaceae), show that hybridization have likely played a major role in the diversification of this genus. Their results provide further evidence for the potential importance of hybridization for the diversification of Bromeliaceae.

Dispersal abilities and phenotypic adaptations are essential for the success of taxa in changing environments. Bitencourt et al. study the evolution of dispersal, habit, and pollination in Apocynaceae. They find that evolution of wind-dispersed seeds, climbing growth form, and pollinia have jointly shaped the diversification and diversity patterns of this family across Africa.

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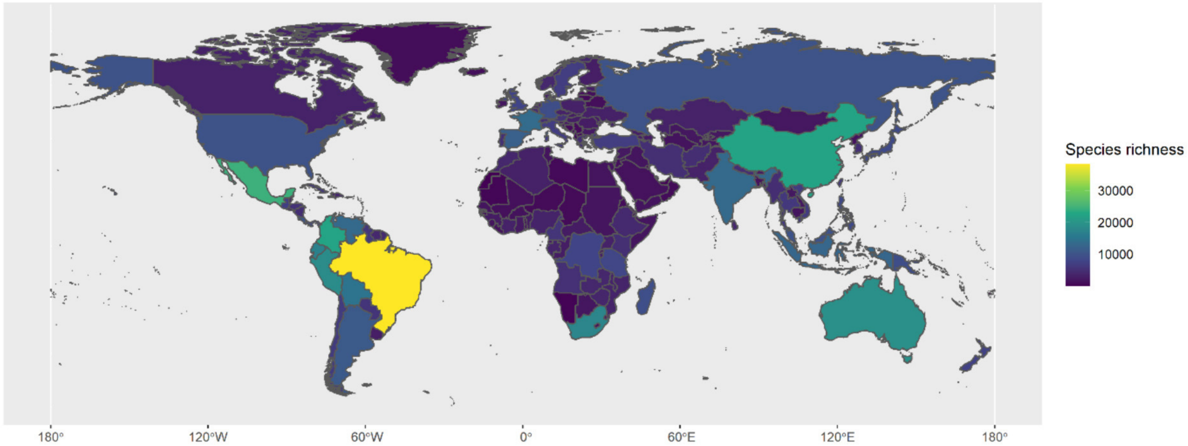

FIGURE 1 | Global patterns of terrestrial plant species richness per country (adapted from data available in BIEN—Botanical Information and Ecology Network; Maitner et al., 2018).

Fernandes et al. take a different approach and study the processes that have shaped the flora in a geographical region. They show that most lineages restricted to the Brazilian Caatinga seasonally dry forest emerged only recently during the Miocene when the region became drier. They also discuss the importance of local diversification processes driven by regional-scale geological history and local adaptations.

Diversity patterns along elevational gradients have attracted biologists since the time of Humboldt and Bonpland (1805). Griffiths et al. use plot inventory data and published phylogenies to investigate how evolutionary diversity varies along an elevation gradient. Similarly to taxonomic diversity (Rahbek, 1995), they find a mid-elevation pick in evolutionary diversity and they interpret this as a support for the Environmental Crossroads Hypothesis (Neves et al., 2020).

Song et al. study the patterns of species richness of bryophytes in China and find that the tropical and subtropical montane regions in China are both centers of diversification and refugia for bryophyte species. Different functional traits allow plant species to establish in diverse environments and co-exists in complex communities.

Yang et al. contribution investigates the patterns of leaf traits relationships in the Tibetan plateau, and the importance of particular traits for the adaptation of plants to aquatic environments.

Sedio et al. study chemical similarity among co-occurring trees and based on the comparison of more than 13,000 leaf metabolites conclude that plant metabolomes play an important role in community assembly. However, their importance is not homogenous along environmental gradients and is higher in wetter and warmer climates.

DEFINING BIOMES AND PREDICTING FUTURE DISTRIBUTIONS

Defining biomes and predicting suitable areas for species are central for conservation planning in the context of ongoing global warming.

Cardoso et al. present a new approach to biome delimitation that incorporates floristic, functional, and phylogenetic data and environmentally trained species distribution models. Their comprehensive analyses support a new, biologically meaningful delimitation of terrestrial biomes in eastern Brazil.

Global warming may cause major changes in the areas suitable for the growth and cultivation of plant species. Yan et al. estimate the areas that would be potentially suitable for *Codonopsis pilosula* (a medicinal plant from China) under global warming and suggest which regions may be optimal to cultivate this species.

CONCLUDING REMARKS

The articles in this Research Topic shed light on different aspects of plant diversity and diversification patterns in different regions of the world, across environmental gradients or trough evolutionary time. This Research Topic has highlighted the potential of integrative approaches that combine evolutionary, ecological, environmental, and geological data. It has also opened new questions and has provided new tools for future studies, and we hope that readers will find inspiration in the research presented here.

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DD, DMN and XX wrote the article together and all authors approved the submitted version.

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