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Editorial: Barren lives: biodiversity and diversification in arid regions

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Editorial on the Research Topic
Barren lives: biodiversity and diversification in arid regions

The biodiversity legacy of arid regions around the globe has been strongly affected by different processes associated with geological and climatic events (Meng et al., 2015; Brooks et al., 2020; Rull and Carnaval, 2020). Although they may be hostile to life, arid ecosystems harbor a remarkable array of plant and animal species that have evolved to thrive in these extreme conditions (Gurera and Bhushan, 2020; Qianwen et al., 2022). However, even though a great number of species seem to have diversified in extreme xeric conditions, arid ecosystems are among the most understudied biomes on Earth (Pepper and Keogh, 2021). In this Research Topic, we bring together four papers that collectively explore different dimensions elucidating the biodiversity in arid ecosystems. The Research Topic is titled "*Barren lives*" in honor of the Brazilian writer Graciliano Ramos, who wrote the novel *Vidas Secas* (translated as *Barren Lives*), depicting the challenges faced by a migrant family living in the harsh and arid landscape of the Caatinga, which is the largest area of seasonally dry tropical forests in South America (Werneck et al., 2011)

Overall, the papers published in this Research Topic offer an opportunity to reflect on how we can aggregate multidisciplinary data to learn about ecological and historical events that have shaped and continue to drive the biodiversity of arid regions around the globe. In summary, the papers navigate through ecological and biogeographical issues, raising questions such as how alpha and beta diversities are affected by water availability in arid regions (see Guo et al.), the role of ecogeographic factors (see Ruhm et al.) and physical barriers (see Coelho et al.) and changes in the rates of net species diversification due to climatic conditions in these regions (see Loiseau et al.).

Water availability is a crucial factor that limits the structure and assembly of plant communities in arid regions. Several studies have emphasized the significance of precipitation levels and their influence on various ecosystem services and processes, including multifunctionality (Garland et al., 2021). In their research on herbaceous plant communities found in the drylands of Northwest China, Guo et al. provide empirical evidence that species alpha and functional beta diversity are both key factors that drive multifunctionality in dryland ecosystems.

Differentiation in climatic conditions and floristic connectivity are phenomena also observed in dry areas, such as the loma (hill) and precordillera (foothills) floras in southern Peru and northern Chile. Ruhm et al. conducted multivariate analyses to examine the similarities in floristic composition and environmental factors across 53 locations. They found that the Peruvian and Chilean lomas exhibit significant floristic differentiation, as do the Chilean precordillera and lomas. However, there was clear connectivity between the Peruvian loma and precordillera floras, as well as between the Peruvian and Chilean precordillera floras. The authors identified divergent environmental conditions as the primary factor driving the separation between the precordillera and lomas, while there was no discernible differentiation in environmental conditions between Peruvian and Chilean lomas. Habitat suitability models revealed a gap in loma vegetation along the coast between Peru and Chile, indicating an ecogeographic barrier responsible for the divergence of lomas in these regions. In contrast, a continuous belt of suitable habitats was observed along the Andean precordillera. The study also highlighted the presence of extensive potentially suitable habitats for both loma and precordillera vegetation that had not been detected through remote sensing methods. These findings provide a comprehensive understanding of the spatial distribution, connectivity, and floristic relationships within dry area vegetation in southern Peru and northern Chile. The identified ecogeographic barriers and connectivity patterns contribute to our knowledge of diversification processes in arid regions. Overall, this study enhances our understanding of the unique dynamics of vegetation and biodiversity in arid regions and offers insights for conservation and management efforts.

The role of barriers to gene flow and connectivity patterns was also investigated in the study of Coelho et al. The focus of this work is the hypothesis of rivers as barriers in dry regions, which has raised less attention than in the rainforests. Coelho et al. introduce the riverine barrier biogeographic hypothesis for the context of Caatinga region, a seasonally dry tropical forest in northeastern Brazil, bisected by the São Francisco River (SFR). By using multilocus next-generation data from six vertebrate species, model-based approaches, and divergence time estimation, the authors inferred population divergence at around 450kya, a period in which SFR achieved its current course. Although the authors identified low levels of gene flow between most of the populations distributed north and south of the river, it appears that the river did not act as a hard barrier for all species, suggesting a scenario of divergence with gene flow for some species.

Arid regions are often subjected to complex hydric stress conditions, which can pose significant challenges to plant survival and evolution. One such region is the Namib Desert and its surrounding areas, which is home to the woody shrub genus Petalidium, comprising 36 species. In a study conducted by Loiseau et al., the evolutionary diversification of this genus was investigated using a nearly fully sampled and temporally calibrated phylogeny. The study examined net diversification rates across the phylogeny and the ancestral climatic niche of lineages. The findings suggest that arid climatic conditions are associated with increased rates of net species diversification in the genus, with the most rapidly diversifying clade occurring in the most arid regions of the genus's range. Despite the age of the Namib Desert, recent plant radiations were found, which can be explained by high evolutionary turnover caused by alternating hyper-arid and mesic phases. These findings are consistent with better-studied arid floras of the world, such as the Atacama Desert, suggesting a common pattern between these important desert regions.

In conclusion, the papers included in this Research Topic, along with the entire editorial process, have provided us with a brief overview of various hypothesis-driven perspectives concerning arid regions. We strongly advocate for concerted efforts to aggregate data and research conducted in these regions, as they remain significantly less explored compared to mesic environments worldwide. Finally, we would like to extend our sincere appreciation to the invaluable contribution of the referees who have collaborated on this Research Topic, as well as to the authors who have chosen to publish their papers with us.

Author contributions

IASB conceived the initial idea for the editorial. All authors participated in discussions and contributed critically to the ideas and writing presented in the paper. All authors contributed to the article and approved the submitted version.

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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.

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