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Editorial: Conserving plants in a changing climate

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Editorial on the Research Topic
Conserving plants in a changing climate

Climate change has emerged as one of the most disastrous drivers of biodiversity loss (Trew and Maclean, 2021; Jaureguiberry et al., 2022; Hald-Mortensen, 2023; Wani et al., 2025). Rising temperatures, altered precipitation regimes, extreme climatic events, shifting fire frequencies and biological invasions are transforming the ecological conditions based on climate change (Loucks, 2021; Kattel, 2022; Wani et al., 2023). Plants, being immobile, cannot escape rapidly from the changing environments. They adapt through phenotypic plasticity, genetic variation, symbiotic relationships, migration, or ultimately, risk decline or extinction instead (Schippers et al., 2021). Plants provide the foundation of ecosystems by regulating climate, stabilizing soils, supporting food systems and sustaining cultural economies, so their loss poses cascading threats to the other trophic levels of ecosystems, human societies and biosphere as well (Khan et al., 2013; Abdullah et al., 2019; Öztürk et al., 2022).

The Research Topic "*Conserving Plants in a Changing Climate*" was conceptualized to bring together research that advances our understanding of how plant species and plant-based systems respond to the climate-induced pressures and identifies the practical pathways for conserving them. We invited contributions that examine: (i) climate-driven shifts in species distribution and phenology, (ii) impacts of invasive species and biological invasions on native plant conservation, (iii) alterations in plant physiological performance and reproduction, (iv) fire activity and management in a warming world and (v) conservation strategies informed by restoration, *ex situ* and *in situ* management and indigenus/local knowledge. The published articles in this Research Topic span multiple continents (the Himalayan region, Kashmir and the Peruvian Amazon), diverse ecosystems (mountain forests to tropical rainforests) and plant types (medicinal plants, orchids, cacao and Amazonian fruits). These articles show the multifaceted responses of plant species to climate change and identify different conservation strategies.

Negi et al. worked on long-term forest restoration in the Western Himalaya Mountains. They transformed the degraded land into a flourishing forest ecosystem over three decades

through planting native Himalayan species, soil stabilization, and community involvement. The study highlights that ecological restoration is not simply growing plants, but a sustained process of ecosystem restoration guided through ecological principles and strengthened by local community participation. As climate change increases the likelihood of habitat degradation (Hermans and McLeman, 2021) such community-centered restoration approaches can provide a model for climate-resilient system recovery, ensuring that restored ecosystems are self-sustaining, biodiverse and functionally productive.

Wani et al. assess how rhizospheric fungi affect the growth and fitness of *Dactylorhiza hatagirea*, an endangered (according to A2bd criteria) alpine orchid from the Kashmir Himalaya. Orchids are highly sensitive to climate change (Yudaputra et al., 2024), as their reproduction depends on specific fungal associations (Li et al., 2021). The authors experimentally tested eight fungal species and demonstrated that a particular fungal combination significantly enhanced tuber and shoot biomass, leaf area, inflorescence and flower production. This work shows that microbial diversity is a form of biological insurance under climate change, improving plant survival in harsh alpine environments. Such symbiotic relationships for threatened orchids open new avenues in *ex situ* cultivation, reintroduction and assisted migration.

Qadir et al., work on plant meiotic behavior and reproductive output of a medicinal Himalayan plant, *Phlomis cashmeriana*. Meiotic irregularities lead to pollen sterility, decreased seed production and ultimately reduce species capability to reproduce under environmental stress (Rashid et al., 2022; Mehmood et al., 2025). This research highlights the overlooked consequences of climate change that decrease reproductive success prior to visible declines in *P. cashmeriana* population. It provides an early warning to vulnerable species before they reach a critical threshold through indicating how environmental conditions affect cellular instability and low fitness.

Climate resilient conservation may also safeguard the multifaceted genetic diversity (Ahmad et al., 2025). The two contributions from Imán et al., focus on *ex-situ* germplasm conservation of the economically important Amazonian species *Theobroma cacao* and *Myrciaria dubia*. They characterize the living germplasm bank representing the diverse *T. cacao* populations from 15 river basins of the Peruvian Amazon. The Research Topic showed phenotypic variation in seed and pod traits which is helpful for future breeding and selection of climate resilient *T. cacao* varieties. Imán et al. also describe one of the world's oldest germplasm banks of *M. dubia*, an Amazonian fruit plant known for its high vitamin C content. They report high phenotypic and genetic diversity. These studies conclude that genetic resource conservation outside their natural environment is a proactive asset that preserves adaptative potential. As climate change uncertainty the frequency of crop failures, disease outbreaks and habitat loss (Anjum et al., 2023) such germplasm banks become an important approach for global food and economic security. Magray et al. work on the conservation of medicinal herb *Phytolacca acinosa*. Its population is declining due to overharvesting and low seed germination rate. They developed cost-effective vegetative propagation methods using rhizome cutting and tested different soil composition and phytohormones. Porous nutrient rich soil with sand, pebbles and vermicompost give the best growth results. Whereas gibberellic acid (at 150 ppm) enhances sprouting, shoot and root development of *P. acinosa*. This study protocol enables large-scale cultivation and decreases harvesting pressure and supports sustainable conservation efforts.

The published articles in this Research Topic highlight that plant conservation in a rapidly changing climate requires an integrated understanding of genetics, physiology, ecology and community-driven restoration. The contribution demonstrates that plant conservation become more effective when designated through multiple directions, including restoration of degraded habitats with native species, preservation of genetic diversity through *ex-situ* germplasm conservation, supporting species with their ecological requirements through symbiotic and physiological interventions, identification of climate vulnerability through reproductive and cytological responses, enhancing stress tolerance through nutrient optimization, and developing propagation strategies to prevent overexploitation of threatened medicinal plants. These studies conclude that climate change is an efficient driver that effect plant physiology and ecosystem. At the same time, these studies suggest possible solutions for resilience through science-based conservation planning, restoration and protection of genetic and functional diversity. This Research Topic concludes that plant life conservation is not only important for biodiversity but also important to sustain human wellbeing and ecological balance through linking plant conservation to practical solutions in the Anthropocene.

Author contributions

ZA: Data curation, Project administration, Resources, Validation, Writing – original draft, Writing – review & editing. SK: Conceptualization, Data curation, Investigation, Methodology, Project administration, Resources, Supervision, Writing – original draft, Writing – review & editing. ZW: Conceptualization, Data curation, Investigation, Methodology, Resources, Validation, Writing – original draft, Writing – review & editing. SP: Conceptualization, Data curation, Investigation, Methodology, Project administration, Resources, Supervision, Writing – original draft, Writing – review & editing. JB: Conceptualization, Data curation, Investigation, Methodology, Project administration, Resources, Supervision, Validation, Writing – original draft, Writing – review & editing.

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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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