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Editorial: Challenges and opportunities in orchid ecology and conservation

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Editorial on the Research Topic
Challenges and opportunities in orchid ecology and conservation

Understanding diversity patterns and how they are affected by global change are topics of active discussion in biodiversity research. In response to species declines, it is important to not only understand patterns of diversity but also develop a knowledge base for use in species conservation. We still do not know, for example, the abiotic and biotic requirements for population persistence for most species.

Orchid ecology and conservation are the subjects of this Research Topic. We focus on orchids because the family has the most species and more than 50% of the species that have been assessed fall into one or more risk categories. Given the large number of orchid species, relatively few have been studied in detail. As a result, it is difficult to determine the best approach for conserving species. Given the increasing threats to orchids globally, the editors chose to focus on orchid ecology and conservation and the contributing authors have provided a range of relevant topics.

Orchid-fungal interactions are the focus of three papers

Most orchids are mixotrophic, indicating that they obtain resources from fungal interactions as well as photosynthesis. Orchid responses to changes in environmental conditions have rarely been investigated, especially in terms of orchid-fungal interactions. McCormick et al. experimentally manipulated light and soil moisture for two terrestrial species and used isotopes to compare changes in carbon and nitrogen. They found that reductions in light and soil moisture increased the dependence of both species on fungal carbon and nitrogen.

Zhang et al. identified orchid mycorrhizal fungi (OMF) associated with *Dendrobium officinale*, an orchid of medicinal value. Almost 84% of the OMF identified from plants at six sites were in the Tulasnellaceae and Serendipitaceae families and the relative abundance of the two fungi varied between plants that grew on rocks versus plants on trees. They demonstrated that two of the fungi supported the germination and growth of *Dendrobium*, providing evidence that there are differences among OMF in their ability to support germination and growth. They suggested that future research should focus on the use of *in situ* seed baiting as a method for obtaining OMF from protocorms that are most likely to support the early growth stages of orchids in nature.

Like terrestrial species, epiphytic orchids interact with mycorrhiza. Johnson et al. identified the mycorrhiza associated with the Ghost Orchid (*Dendrophylax lindenii*) and other epiphytic orchids. They also compared the fungi on the bark of trees that had the Ghost Orchid with bark from trees where the orchid did not occur. They found that the fungus associated with *Dendrophylax* was very specific and was a species of *Ceratobasidium* that was not found in other epiphytes. Furthermore, they found that plants grown in the lab had a lower abundance of *Ceratobasidium* than plants that occurred naturally. Their results provide evidence that the distribution of fungi influences the distribution of the Ghost Orchid.

Surprisingly, taxonomy had the second-highest number of contributions

Likely the result of the rapid development of powerful computers and sophisticated genetic and molecular biology methods, taxonomy is becoming a Cinderella in systematic research, including orchids. An increased knowledge of orchid identity is, however, necessary to support ecological and conservation research.

Baranow et al. revised the *Sobralia*, section *Racemosae*, a large and diverse genus that can be divided into four sections and some informal species groups based mainly on inflorescence architecture. The section *Racemosae* has species with an elongated inflorescence with distinct internodes, but the species are often similar and easily misidentified, especially with herbarium specimens. Baranow et al. present species' morphological characteristics, keys for identification, ecological data, and distribution maps. They describe a new species, *Sobralia gambitana*, and a neotype for *S. hoppii* Schltr. is proposed.

Tools that can integrate genetic and phenotypic data in taxonomic studies have been recently developed and were used by Joffard et al. to investigate species in the genus *Pseudophrys*. Using an approach termed iBPP they identified four groups of species rather than 12 and they merged two groups of species. They demonstrated that phenotypic data are particularly informative in section *Pseudophrys*, and the approach that they used improves species identification. They recommended that an integrative taxonomic approach holds great promise for conducting taxonomic revisions in other orchid groups.

Climate change, a globally important topic, was the focus of two papers

Evans and Jacquemyn examined the impact of climate change on 14 *Epipactis* species with a focus on species that are habitat specialists or generalists. Species with a wide distribution are more capable of shifting habitats but only if they can fully expand into habitats at the leading edge of their distributions. This study provides valuable insights into how terrestrial orchid species with differing niche breadths may respond to climate change.

Kolanowska et al. investigated the impact of climate change on the future distribution of the small-white orchid (*Pseudorchis albida*). The niche model that they used predicted that although the number of suitable niches will increase significantly in Greenland, suitable habitats will severely decline in continental Europe. Importantly, their research indicated that global warming might have an opposite effect on the pollinators of *P. albida* because of insect habitat loss, but some pollinators are expected to remain within the orchid's potential geographical range, supporting its long-term survival.

The remaining four papers are examples of topics that are relevant to a more complete understanding of orchid ecology and conservation

"Can orchids occur in landscapes that have been modified by human activities"? That question is the topic addressed by Ospina-Calderón et al. They studied the distribution of epiphytes in undisturbed forests in the Andes and their distribution on shade trees in coffee plantations and trees in a grassland matrix. They collected data over 2 years and constructed demographic transition matrices with transition probabilities calculated using the Bayesian approach. Population growth rates were higher on trees in coffee plantations compared with forests. Although the orchids also occurred on trees in the grassland matrix, the authors suggested that those populations represented a temporal phase that would not be sustainable.

Wallace and Bowles explored the topic of genetic variation as a function of gene flow in *Spiranthes dilitata*, a widespread species in Alaska. They found evidence for small-scale genetic variation associated with different habitats and differences in the ability of pollinators to pollinate different morphotypes. This research provided clear evidence that evolution in orchids can occur at spatially small scales and can be influenced by pollinators.

Ramírez-Martínez et al., like Wallace and Bowles, found that differences in species performance can operate at small scales in response to habitat conditions. They compared the population dynamics of two epiphytic species in Mexico that occurred on deciduous and semi-deciduous trees. It was demonstrated that in years with normal rainfall, there were no differences in plant performance, but during dry years, *Alamania punicea* was more vulnerable to drying conditions—most likely because it has smaller pseudobulbs that have less storage capacity. This research provides evidence that climate change will potentially influence the population dynamics of epiphytic orchids.

Djordjevic et al. sampled orchids along an elevation gradient in the Balkans, with a focus on the belowground features of the different species and their pollination. Results showed that species diversity peaked at 900–1,000 m, with variations in distribution patterns for different life history traits and habitat types. Deceptive orchids were most abundant at lower and mid-elevations. By contrast, rewarding orchids were more common at mid to high elevations. This study demonstrates that data that link orchid species to habitats are important for conservation efforts.

Author contributions

All authors listed have made a substantial, direct, and intellectual contribution to the work and approved it for publication.

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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.