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Editorial: Lianas, ecosystems, and global change

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Editorial on the Research Topic
Lianas, ecosystems, and global change

Lianas (woody vines) are an abundant and diverse plant group in tropical ecosystems (Gentry, 1991; Dewalt et al., 2014). While they enhance forest canopy connectivity and provide food and shelter for tropical fauna (Yanoviak and Schnitzer, 2013; Schnitzer, 2018), lianas also intensely compete with trees for resources, and hence negatively influence a wide range of tropical ecosystem processes (van der Heijden et al., 2013), such as regeneration (Schnitzer et al., 2000; Pérez-Salicrup, 2001), tree reproduction (García León et al., 2018), and carbon storage and sequestration (van der Heijden et al., 2015).

Although the knowledge on lianas has developed significantly since Darwin's initial work on climbing plants (Darwin, 1865), studies in tropical forests still overwhelmingly focus on trees (da Cunha Vargas et al., 2020). This special issue brings together a collection of papers that provide new insights into the diversity of lianas, their impact on the ecosystem, and their relationships with climate.

Liana (functional) diversity

Lianas are plants that rely on the architecture of other plants to ascend to the forest canopy (Schnitzer and Bongers, 2002). They have therefore developed a wide diversity of techniques for finding and climbing hosts (Darwin, 1865; Putz, 1984; Dias et al., 2021). For example, many liana species use searcher shoots capable of movement. Hatterman et al. found that liana species vary considerably in their reach, i.e., the distance these searcher shoots can span. The liana species with the longest reach required sufficient rigidity at its basal part, an attribute that comes at the cost of their ability for active movements of the distal parts. There may therefore be a trade-off in lianas between reach and movement, possibly explaining differences in their ability to explore the environment.

Lianas are hypothesized to possess fast-acquisitive functional traits while trees are generally thought to be more conservative (Collins et al., 2016). In concurrence with this hypothesis, Harrison et al. showed that lianas had an increased cellular infrastructure with a high turnover of nutrients and leaf volume demands when compared to trees. Being able to find and use resources effectively may give lianas a growth advantage in dry conditions (Schnitzer, 2005; Schnitzer and van der Heijden, 2019). To test this hypothesis, Smith-Martin et al. compared xylem anatomical traits in lianas and trees both in a wet and seasonally dry forest. They found that lianas have greater vessel diameters than trees particularly in dry forests, but that there was no difference in levels of resistance to embolism, hydraulic failure nor in withstanding greater levels of water-deficit between life-forms. The larger vessels of lianas may support greater hydraulic conductive capacity (Tyree and Ewers, 1999), needed to support the proportionally greater leaf canopy of lianas (Wyka et al., 2013), without the risk of embolism formation.

Lianas, however, are not a functionally homogeneous entity. For example, Coppieters et al. found that two abundant, co-occurring liana species differed substantially in their hydraulic traits, as found in previous studies (Ewers et al., 1989, 1990). Liana diversity is highly variable across the landscape. Souza Gerolamo et al. showed that liana taxonomic diversity across the Brazilian Amazon increased along a hydro-edaphic gradient but decreased slightly along a forest disturbance gradient. Reduction in liana habitat specialization occurred on plateaus with deeper water tables while in valleys liana assemblages were phylogenetically overdispersed. Further research into the spectrum of liana traits and the relationships defining their economic spectrum (see Harrison et al.), ecological filtering, and phylogenetic history is needed to increase our understanding of liana ecology.

The effect of lianas on tropical forest ecosystems

Lianas have long been associated with decreased tree growth (Putz, 1984), but the evidence that supports this negative impact mostly came from primary and seasonally moist forests. However, Becknell et al. now reported significant decreases of the relative growth of trees heavily infested by lianas in a secondary seasonally dry tropical forest. Estrada-Villegas et al. further provided unequivocal evidence that a negative liana impact on trees is found across continents, climates, and forest types. Using a meta-analysis of 50 liana removal experiments across the tropics, they showed that lianas have a significant impact on tree growth, reproduction and recruitment, as well as on biomass accretion and physiological performance.

Meunier et al. further suggested that by accounting for belowground biomass the reduced carbon sequestration and storage in trees and ecosystems caused by lianas could be larger than previously anticipated.

Lianas and global change

Lianas have repeatedly been shown to be increasing in abundance and biomass in the Neotropics (e.g. Phillips et al., 2002 and illustrated in this issue by Becknell et al.). Yet, evidence from other parts of the tropics remains scarce or contradictory (see e.g., Bongers et al., 2020). The underlying drivers of such trends could be related to global change (Schnitzer and Bongers, 2011). Using 15-years of liana fruiting and flowering data, Vogado et al. showed that liana reproduction increased as a response to higher temperatures, reduced rainfall, and following El Niño events in a tropical Australian site. Liana reproduction and abundance are therefore likely to increase under future climate regimes.

Novel methods to study lianas

Liana ecology is benefiting from emerging methods to study lianas. Firstly, the incorporation of lianas in a vegetation model has previously enabled an exhaustive quantification of the impact of lianas on the carbon (di Porcia E Brugnera et al., 2019) and energy (Meunier et al., 2022) cycles. Here, it further provided a first assessment of the effects of lianas on below-ground carbon storage (Meunier et al.), which is inherently challenging to quantify using field techniques. Secondly, Kaçamak et al. demonstrated that combining RGB and multispectral images with Lidar data from drones could generate high resolution views of liana distribution at the top of the canopy that ground-based measurements alone cannot provide. Combining ground- and drone- based data therefore have the potential to provide a major step forward in liana ecology.

Liana research is on the rise, which offers an exciting opportunity to answer many important research questions in liana ecology. As such, we hope that this special issue will contribute to a better understanding of the current and future effects of lianas on tropical forests across continents in a changing climate.

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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