



Research article

Does phylogeny have a role in the liana-phorophyte interaction in tropical forests?



Zulqarnain^{a,*}, Igor A. Silva^{c,1}, Julia C. Sfair^d, Juliano van Melis^a, Veridiana L. Weiser^b, Fernando R. Martins^{c,*}

^a Plant Biology Graduate Program, Institute of Biology, P.O. Box 6109, University of Campinas—UNICAMP, 13083-970 Campinas, SP, Brazil

^b Department of Biological Sciences, Faculty of Sciences, UNESP—Universidade Estadual Paulista, 14-01 Eng. Luiz Edmundo Carrijo Coube Avenue, 17033-360 Bauru, SP, Brazil

^c Department of Plant Biology, Institute of Biology, P.O. Box 6109, University of Campinas—UNICAMP, 13083-970 Campinas, SP, Brazil

^d Department of Botany, Federal University of Pernambuco, Av. Prof. Moraes Rego 135, Cidade Universitária, 50670-901 Recife, PE, Brazil

ARTICLE INFO

Article history:

Received 19 August 2015

Received in revised form 8 April 2016

Accepted 11 April 2016

Available online 14 April 2016

Keywords:

Atlantic forest

Climbing traits

Originality

Plant interactions

Quantile regression

ABSTRACT

We assessed the influence of species phylogenetic relatedness on the interaction between woody climbing plants (lianas) and their host trees (phorophytes). Considering that closely related species tend to have similar niches, we expected (1) closely related lianas to co-occur in similar phorophyte sets and (2) original lianas (phylogenetically distinct lianas with unique set of features) to occur on distinct phorophyte sets. We sampled three highly diverse forest sites in SE Brazil (a tropical rainforest, a savanna woodland and a tropical semideciduous forest), and sought for (1) a phylogenetic signal in liana climbing traits; (2) a phylogenetic signal in the liana-phorophyte interaction by testing the correlation between (a) phylogenetic distances and similarity of interacting species sets and (b) the species phylogenetic originality and the number of their interactions; and (3) a positive relationship between phylogenetic originality and the specificity of liana-phorophyte interactions. We found a phylogenetic signal in climbing systems of liana species. In the semideciduous forest, we observed that closely related lianas share similar phorophyte sets, and original lianas occur on a small number of phorophyte species. However, when we evaluated the interactions of species with high originality, we found an opposing pattern in forests and savanna. In forests, the phylogenetically original liana species co-occurred more frequently with very distinct phorophyte sets; whereas in the savanna woodland, the phylogenetically original liana species co-occurred conversely with common phorophyte sets. We argued that environmental differences in forests and savannas could have mediated different tree morphological traits, such as bark characteristics, which might structure different liana-phorophyte interactions.

© 2016 Elsevier GmbH. All rights reserved.

1. Introduction

An important antagonistic interaction occurs in tropical forests between lianas (woody climbing plants) and host trees or phorophytes (Schnitzer and Bongers, 2002; Sfair et al., 2010), since lianas compete with phorophytes above ground for light and below ground for nutrients, decreasing phorophyte fecundity (Kainer et al., 2006) and growth rate (Campanello et al., 2007). Lianas depend on phorophytes for support to reach the canopy and get suitable light conditions to grow (Putz, 1984a). Therefore,

phorophyte species may be regarded as an important set of resources for liana species (Sfair and Martins, 2011). In the liana-phorophyte interplay, species morphological features, such as those relatives to liana climbing system or tree bark, for instance, have a very important role (Hegarty, 1991).

Each morphological feature can be more or less frequent in a community, that is, trait frequency ranges from exclusive (present in only one species) to very common (present in most species). Species with infrequent and rare features are called original, whereas species with highly frequent traits are called common (Pavoine et al., 2005). The originality of a species in a set of species is usually measured as an average of differences of traits between this species and all the other species in the set. Therefore, if many species contribute with specific traits, originality will be well distributed, whereas if a few species contribute most of the rare traits,

* Corresponding authors.

E-mail addresses: mezulqi@gmail.com (Zulqarnain), fmartins@unicamp.br (F.R. Martins).

¹ In memoriam.

originality will be concentrated into few species (Pavoine et al., 2005). In other words, the relative contribution of each species to the richness of features in a community depends on each species' originality (Pavoine et al., 2005). For example, Mouillot et al. (2008) reported 52% of phenotypic original species in a fish phylogeny, whereas Pavoine et al. (2005) found 50% of original species in a carnivore phylogeny.

Besides being an original in traits, species can be distinct in phylogeny. A species distinctness is measured by the information content of its cladistic classification, that is, the sum of the length of the species' branches in a phylogenetic tree (Vane-Wright et al., 1991), which is called phylogenetic originality. In phylogenetic trees, the branch lengths represent the expected number of features that species have inherited from their common ancestor (May, 1990; Nee and May, 1997). Therefore, the total length of the branches of a single species may be used as a proxy for the number of its features (Pavoine et al., 2005). Considering that species with distinct sets of features have particular niches with low functional overlap with the rest of the species (Mouillot et al., 2005), we investigate whether phylogenetic originality plays a role in the pattern of liana-phorophyte assemblages. If so, we expect original lianas, with their distinct and rare set of features, to occur on original phorophyte species.

Considering the whole range of features in a community, some tree species have certain traits, such as exfoliating bark or palm architecture, that avoided lianas; whereas other trees have other traits, such as rough, fissured barks, that favor lianas (Putz, 1984; Pinard and Putz, 1992). In consequence, the degree of tree occupation by lianas looks like a gradient, in which there are tree species without any liana species, others with many liana species, and a whole range of tree occupation by liana species in between (Sfair et al., 2010). The traits related to habitat use are generally conserved in the species lineages (Prinzing et al., 2001; Losos, 2008). Since species may have retained their ancestral traits, phylogenetically close species tend to resemble in their phenotype traits (Blomberg et al., 2003). Phylogeny is an important tool for assessing interactions both among plants and between plants and animals (Rezende et al., 2007; Verdú and Valiente-Banuet, 2011). Therefore, the interactions between lianas and phorophytes may have been shaped by the phylogenetic baggage that organisms inherit from their ancestors (Thompson, 1994). In other words, the interaction between lianas and phorophytes may be influenced by phylogenetically conserved traits in lianas and phorophyte species lineages. Bearing in mind that species traits are related to their specialized interactions (Gómez et al., 2010), we expect that related liana species may have conserved certain traits that are specialized for a set of phylogenetically close phorophyte species; and, conversely, related phorophyte species may have conserved certain features that favor or prejudice phylogenetically close liana species.

We studied three different tropical forests in southeastern Brazil to investigate the phylogenetic pattern of liana-phorophyte interactions. Considering that closely related plant species tend to have similar niches (Prinzing et al., 2001; Losos, 2008) and that related lianas may have conserved strategies to use a specific set of tree species as supports to reach the canopy, we expect closely related lianas to co-occur on similar phorophyte species. Likewise, we expect that phylogenetically original lianas, with their unique set of features, occur on distinct phorophyte sets. Although there are some studies on a co-occurrence of lianas and phorophytes (e.g. Sfair et al., 2010; Blick and Burns, 2011), none has assessed the role of phylogeny and phylogenetic originality in the relationships between lianas and phorophytes. Here, we investigate the role of species originality and phylogenetic relatedness in liana-phorophyte interaction in tropical forests and proposes the following questions as guidelines: (1) Do liana species conserve climbing traits in their lineages? (2) Do phylogenetically close a

liana species climb on similar phorophyte species? (3) Are phylogenetically close phorophyte species climbed by similar liana species? (4) Is the number of interactions related to the phylogenetic originality of liana and phorophyte? (5) Do original lianas and phorophytes constitute original phorophyte-liana sets?

2. Methods

2.1. Study sites and sampling

We surveyed three sites in São Paulo state, southeastern Brazil, with three different vegetation types: rainforest, savanna woodland, and semideciduous forest. These vegetation types cover the most part of the Brazilian territory. (1) The rainforest is located in an area of 4700 ha in Ubatuba municipality (23°21'S, 45°05'W), northern coast of the state, as a part of the Serra do Mar State Park. The regional climate is Af (Koeppen, 1948), that is, megathermic tropical rainforest without dry season (Alvares et al., 2013). The mean annual temperature is 20.6 °C, and the mean annual rainfall is 2320 mm (Sfair et al., 2010). The rainforest is classified as Submontane Dense Rainforest, which has a closed canopy at about 25–30 m in height (IBGE, 2012). (2) The savanna woodland has 321.71 ha in Bauru municipality (22°19'S, 48°59'W). The regional climate is Cwa (Koeppen, 1948), that is, mesothermic humid subtropical with dry winter and hot summer (Alvares et al., 2013). The mean annual temperature is 22.6 °C, and the mean annual rainfall is 1331 mm (Sfair et al., 2010). The savanna woodland has an open canopy at about 6–10 m in height and is one of the extreme physiognomies that the Cerrado (Brazilian savanna) can have, since Cerrado physiognomies range from pure grassland, through true savanna, to woodland (IBGE, 2012). (3) The semideciduous forest has 245 ha in Campinas municipality (22°50'S, 46°55'W) in the central region of the state. The regional climate is also mesothermic humid subtropical with dry winter and hot summer (Cwa, Koeppen, 1948; Alvares et al., 2013). The mean annual temperature ranges between 22 °C and 24 °C, and the mean annual rainfall is 1372 mm (Cielo-Filho et al., 2007). This forest is classified as Seasonal Semideciduous Forest and has an irregular canopy at about 20–25 m, with emergent trees up to 30 m in height (Cielo-Filho et al., 2007).

In each site, a grid of 100 contiguous plots of 10 m × 10 m each was settled down to sample liana and tree species. In each plot, all the trees and lianas that fulfilled the sampling criteria were sampled. The sampling criteria had to be adapted to each vegetation type, since rainforest, semideciduous forest, and savanna woodland has their own peculiarities, such as different average height, diameter, and density of lianas and trees, and we intended to include the greatest number of plant species in each sample. In the rainforest, we sampled trees with DBH ≥ 7.5 cm; in the semideciduous forests, trees with DBH ≥ 5 cm, since only the canopy trees, that is, those with greater diameter, had lianas, but trees were slender in the semideciduous forest. In both rain and semideciduous forests, we sampled lianas with a stem diameter at breast height (DBH) ≥ 1 cm. In the savanna woodland, both the trees and lianas are thinner than those in the rain and semideciduous forests, and few trees would be sampled if the forest sampling criteria were adopted in the savanna plots. Thus, in the savanna woodland we sampled lianas with DBH ≥ 0.1 cm (Weiser, 2007). We sampled this smallest diameter due to the presence of a few very young lianas in the site. Likewise, as very young tree species already bore lianas in the savanna woodland, we sampled trees with DBH ≥ 0.3 cm (Weiser, 2007). For each vegetation type we adjusted our sampling procedure to assure that no less than ten trees were sampled in each plot, in order to result in total sample sizes greater than one thousand stems (Caiafa and Martins, 2007), at least for trees.

In each one of the three sites, liana and phorophyte species establish a network of interactions, which was investigated by Sfair

Download English Version:

<https://daneshyari.com/en/article/4400902>

Download Persian Version:

<https://daneshyari.com/article/4400902>

[Daneshyari.com](https://daneshyari.com)