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Short Communication / Nota Científica

What are the species of phorophytes of *Vanilla palmarum* (Orchidaceae) in Brazil? An assessment of emblematic specificity with palm tree species

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Abstract

Vanilla palmarum is an obligately epiphytic orchid distributed widely throughout South America with emblematic specificity for species of palms. This epiphyte-phorophyte association was examined through the analysis of specimens available via the database of Centro de Referência em Informação Ambiental and from Brazilian herbaria. We recognized nine species as hosts of *V. palmarum* in Brazil: *Acrocomia aculeata*, *Attalea phalerata*, *Attalea speciosa*, *Elaeis guineensis*, *Mauritia flexuosa*, *Syagrus cearensis*, *S. coronata*, *S. schizophylla*, and *S. vagans*. The most important phorophytes of *V. palmarum* were found to be *A. speciosa* (Cerrado), *A. phalerata* (Pantanal), *M. flexuosa* (Amazon Forest) and *S. coronata* (Caatinga). Future management actions must consider the association between *V. palmarum* and its phorophyte palm species in order to ensure the protection of this ecological interaction.

Key words: botanical collections, ecological interactions, endemism, orchid, phytogeographic domains.

Resumo

Vanilla palmarum (Orchidaceae) é uma holoepífita obrigatória, amplamente distribuída na América do Sul, e apresenta uma emblemática especificidade com palmeiras. A interação epífita-forófitos foi examinada através da análise de espécimes disponíveis na base de dados do Centro de Referência em Informação Ambiental e em herbários brasileiros. Nós reconhecemos nove espécies hospedeiras de *V. palmarum* no Brasil: *Acrocomia aculeata*, *Attalea phalerata*, *Attalea speciosa*, *Elaeis guineensis*, *Mauritia flexuosa*, *Syagrus cearensis*, *S. coronata*, *S. schizophylla* e *S. vagans*. Os principais forófitos de *V. palmarum* são: *A. speciosa* (Cerrado), *A. phalerata* (Pantanal), *M. flexuosa* (Floresta Amazônica) e *S. coronata* (Caatinga). As futuras ações de manejo devem considerar a associação entre *V. palmarum* e espécies de palmeiras, visando assegurar a proteção das interações ecológicas.

Palavras-chave: coleções botânicas, interações ecológicas, endemismos, orquídea, domínios fitogeográficos.

A great diversity of epiphytes is concentrated in the Neotropics, mainly in the Andes and the Amazon and Atlantic forests (Barthlott *et al.* 1999; Freitas *et al.* 2016). A better understanding of the specificity between epiphytes and their phorophytes is essential for the conservation of both groups, however, this association remains understudied (*e.g.*, Trapnell & Hamrick 2006; Huda & Wilcock 2011; Wagner *et al.* 2015).

Vanilla palmarum (Salzm. *ex* Lindl.) Lindl. is an obligately epiphytic orchid (misunderstood as an hemiepiphyte, see Pansarin *et al.* 2012) distributed widely throughout South America (Soto Arenas & Cribb 2010). In Brazil, the species occurs in the Amazon Forest, Atlantic Forest, Caatinga and Cerrado phytogeographic domains (Freitas *et al.* 2011; BFG 2015). *Vanilla palmarum* is autogamous and easily distinguished from other *Vanilla* Mill.

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species by characters such as yellow flowers without a penicillate callus, lip more than 5 cm long, with pubescent to hirsute longitudinal lines on the distal half, and mature odorless fruits (Householder *et al.* 2010; Soto Arenas & Cribb 2010).

The specificity of *V. palmarum* to palm tree phorophyte has been recognized for decades, having been first mentioned by Lindley (1840) and corroborated by Rolfe (1896) still in the 19th century. Later, Hoehne (1949) cited the growth of the species on *Attalea vitrivir* Zona. Since then, *V. palmarum* has been also recorded growing on *Mauritia* L.f., *Syagrus* Mart., and other *Attalea* Kunth. species (Soto Arenas & Cribb 2010; BFG 2015). Householder *et al.* (2010) recognized *V. palmarum* to be an obligate epiphyte on *Mauritia flexuosa* L.f. in Madre de Díos, Peru, whereas *Attalea butyracea* (Mutis *ex* L.f.) Wess.Boer was listed as its phorophyte in Colombia (Fotosíntesis 2012). Palms highlighted as phorophytes of *V. palmarum* in Brazil include *Attalea phalerata* Mart. *ex* Spreng. (Miranda & Guarim Neto 2012), *M. flexuosa* (Pansarin *et al.* 2012; Koch *et al.* 2014) and *Syagrus coronata* (Mart.) Becc. (Bastos & van den Berg 2012; Vieira *et al.* 2014; Castro *et al.* 2016), but the actual number of species that host *V. palmarum* has not been investigated. In the present study, we provided a list of phorophyte species associated with *V. palmarum* and briefly discussed future implications for the maintenance of this epiphyte-phorophyte interaction. Raw data for this study was obtained from the analysis of the labels of 326 specimens of *V. palmarum* available on the digital database developed by Centro de Referência em Informação Ambiental (CRIA 2017). The herbaria HF, HRB, IAN, MG, RB, RBR, which are not included in this database, were also consulted for an additional 59 specimens (acronyms according to Thiers, continuously updated). Data from the labels of specimens of *V. palmarum* regarding location of occurrence (state, municipality and phytogeographic domain) and phorophytes (mainly scientific and common names) were extracted and compiled. The main common name of each phorophyte in Brazil is presented. Data on the geographical distribution of *V. palmarum* and palm trees were obtained from BFG (2015). Maps were constructed using ARC-GIS software, version 10.2.

We recorded nine palm species as phorophytes of *V. palmarum* in Brazil: *Acrocomia aculeata* (Jacq.) Lodd. (macaúba), *A. phalerata* (acuri), *Attalea speciosa* Mart. *ex* Spreng. (babaçu), *E. guineensis* Jacq. (dendezeiro), *M. flexuosa* (buriti), *Syagrus cearensis* Noblick (catolé), *S. coronata* (Mart.) Glassman (licuri), *S. schizophylla* (aricuriroba), and *Syagrus vagans* (Bondar) A.D.Hawkes (ariri) (Tab. 1). Of these, six species are reported for the first time as phorophytes of *V. palmarum*, including one species of *Acrocomia* Mart. (Tab. 1). The geographic distribution of *V. palmarum* is extended to include the Pantanal phytogeographic domain and the states of Minas Gerais (municipalities of Salto da Divisa and Santa Maria do Salto) and Espírito Santo (municipality of Linhares) (Fig. 1). *Vanilla palmarum* is now known from 132 Brazilian municipalities, of which 57 are in the state of Bahia, followed by the states of Mato Grosso (12 municipalities), Sergipe (11 municipalities), and Pernambuco (nine municipalities), with less than seven municipalities in each of the other states (Fig. 1).

About 30% of specimens analyzed (119 specimens) had information about the identification of the phorophyte to the specific level (sometimes indirectly obtained through the common name), and another 13% (49 specimens) to the generic level or other poorly detailed levels (i.e. "palmeira", "palm tree"). The remaining 217 samples did not provide any information about the phorophytes.

We found that *Vanilla palmarum* occurs predominantly on a single phorophyte palm species in each phytogeographic domain and in most Brazilian states. The most important phorophytes of *V. palmarum* are *Attalea speciosa* (Cerrado), *A. phalerata* (Pantanal), *Mauritia flexuosa* (Amazon Forest) and *Syagrus coronata* (Caatinga). *Elaeis guineensis*, *S. coronata* and *S. schizophylla* host *V. palmarum* in the Atlantic Forest, where records are scarce (Fig. 2), making it difficult to determine if there is a most important species for this domain. In the Amazon Forest, *V. palmarum* was recorded growing on "buriti" palm in the states of Acre, Amazonas, Amapá and Pará (five municipalities in total; Fig. 2). *Acrocomia aculeata* is a secondary phorophyte within this domain with only one record (state of Mato Grosso). Similarly, *A. phalerata* is the most important phorophyte of *V. palmarum* in the Pantanal (records in six municipalities of Mato Grosso and two of Mato Grosso do Sul), followed by *A. speciosa* and *A. aculeata*. The three palm species also occur in ecotone areas of Cerrado-Pantanal, Cerrado-Amazon Forest or Amazon Forest-Pantanal (Fig. 2). *Attalea speciosa* is the main phorophyte of *V. palmarum* in Cerrado, where it has been reported in states of the North (Tocantins), Northeast (Ceará, Maranhão and Piauí) and Central-West (Goiás and Mato Grosso)

Table 1 – Phorophytes of *V. palmarum* (Salzm. *ex* Lindl.) Lindl. in Brazil. Phytogeographic domains: AF = Atlantic Forest; AM = Amazon Forest; CA = Caatinga; CE = Cerrado; PA = Pantanal. Species cited for the first time as phorophytes of *V. palmarum* are indicated by an asterisk (*), while Brazilian endemics are indicated by a hashtag (#). Information about phytogeographic domains was extracted from BGF (2015), with new records being indicated by boldface type.

Species	**Phytogeographic Domain**				
	AF	AM	CA	CE	PA
Acrocomia aculeata (Jacq.) Lodd. *ex* Mart. *	X	X	X	X	**X**
Attalea phalerata Mart. *ex* Spreng.		X		X	**X**
Attalea speciosa Mart. *ex* Spreng. * #		X		X	**X**
Elaeis guineensis Jacq. *	X				
Mauritia flexuosa L.f.		X	X	X	
Syagrus cearensis Noblick * #	X		X		
Syagrus coronata (Mart.) Becc. #			X	X	
Syagrus schizophylla (Mart.) Glassman * #	X				
Syagrus vagans (Bondar) A.D.Hawkes * #			X		

regions of the country, whereas *A. phalerata* is a secondary phorophyte with records only for Mato Grosso. *Syagrus coronata* was the most frequently colonized species in Caatinga. The importance of "licuri" palm for *V. palmarum* has been reported for the states of Alagoas, Bahia, Pernambuco and Sergipe (27 municipalities in total; Fig. 2). In the states of Piauí, Ceará and Maranhão, *V. palmarum* has been recorded only on *A. speciosa*, whereas *E. guineensis* is the only phorophyte reported for the state of Paraíba. In Bahia, *V. palmarum* was found on *E. guineensis* (mainly in Atlantic Forest), *S. schyzophylla* (exclusively in Atlantic Forest), *S. coronata* (mainly in Caatinga) and *S. vagans* (exclusively in Caatinga) (Tab. 1; Fig. 2). Specific records of *V. palmarum* on *S. cearensis* (Pernambuco) and *S. vagans* (Bahia) were checked. No information was found about phorophytes of *V. palmarum* in the states of Rondônia, Minas Gerais and Espírito Santo (Fig. 2).

Hoehne (1949) mentioned *A. vitrivir* as a phorophyte of *V. palmarum* in Mato Grosso. However, since *A. vitrivir* does not occur in this state, and it is morphologically similar to *A. speciosa*, we believe this was likely a misidentification (Lorenzi *et al.* 2010; BFG 2015). In addition, there is no information about this orchid-phorophyte relationship in any herbarium collection. For these reasons, we cannot validate *A. vitrivir* as a host of *V. palmarum*.

Although *M. flexuosa* ("buriti") occurs in the Northeast (Caatinga) and Central-West (Cerrado) regions of Brazil (BFG 2015), there are no records of orchid-"buriti" association in these regions. This may be due to smaller populations of the "buriti" palm, a lack of orchid collections in "buritizais" or commercial overexplotation of "buriti" in these domains. The last hypothesis is based on Vieira *et al.* (2016), who noticed extensive harvesting of parts of *M. flexuosa* in Maranhão, including the stipe, leaves, fruits and seeds. On the other hand, *Vanilla palmarum* was recorded on *M. flexuosa*, *Acrocomia aculeata* and *A. phalerata* in several municipalities (*e.g.,* Cáceres), which cover areas of Cerrado, Pantanal and Amazon, revealing that these palm species are phorophytes in more than one domain.

The greatest number of effective phorophytes (*E. guineensis*, *S. schizophylla*, *S. coronata* and *S. vagans*) and records of the *V. palmarum*-palm tree association in Bahia is probably because seven of nine palm species occur in this state (BFG 2015), with *S. coronata* forming large widely-distributed populations. The unexpected records of *S. coronata* in Atlantic Forest and *E. guineensis* in Caatinga can be explained by their use as ornamentals plants. Otherwise, these records may be indicative of the occurrence of *S. coronata* in Caatinga-Atlantic Forests ecotone areas, where the *V. palmarum*-palm species association needs to be further investigated.

Syagrus cearensis (endemic to few states of the Northeast Region) and *S. vagans* (endemic to Caatinga areas in Bahia) were the least common hosts of *V. palmarum* (only one record each). The scant records can be explained by endemism and the limited collecting that has been done in the areas of occurrence. Similarly, *V. palmarum* was recorded

growing on *Acrocomia aculeata* in only two municipalities. Petini-Benelli *et al.* (2009) reported the occurrence of individuals of *Cyrtopodium saintlegerianum* (Orchidaceae) on phorophytes of *A. aculeata*, *Attalea phalerata* and *M. flexuosa* in the municipality of Poconé in Mato Grosso, but a clear preference for *A. aculeata*. Thus, we assume that this palm species can be colonized by other epiphytes in the Central-West Region, which may interfere with the establishment of *V. palmarum*.

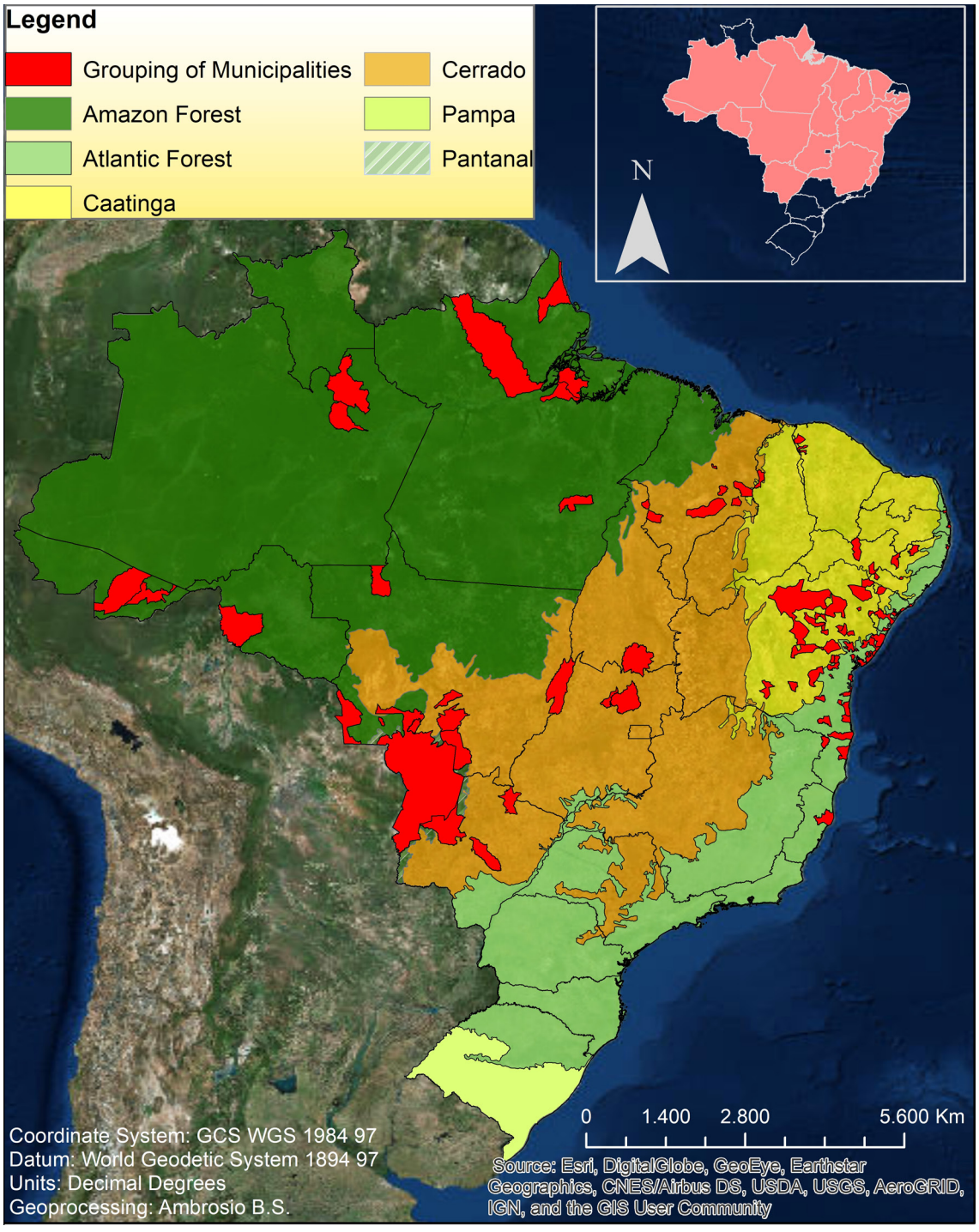

Figure 1 – Distribution of *Vanilla palmarum* (Salzm. *ex* Lindl.) Lindl. in Brazil.

Five of the nine species of palm phorophytes of *V. palmarum* are endemic to Brazil (Tab. 1), and include regional endemism (Northeast - *S. coronata* and *S. cearensis*) or endemism related to a phytogeographic domain (Caatinga - *S. vagans* and Atlantic Forest - *S. schizophylla*). Unfortunately, eight of the nine palm species do not have their conservation status evaluated in Brazil, while *S. schizophylla* is classified as Near Threatened (Flora do Brasil 2020). Furthermore,

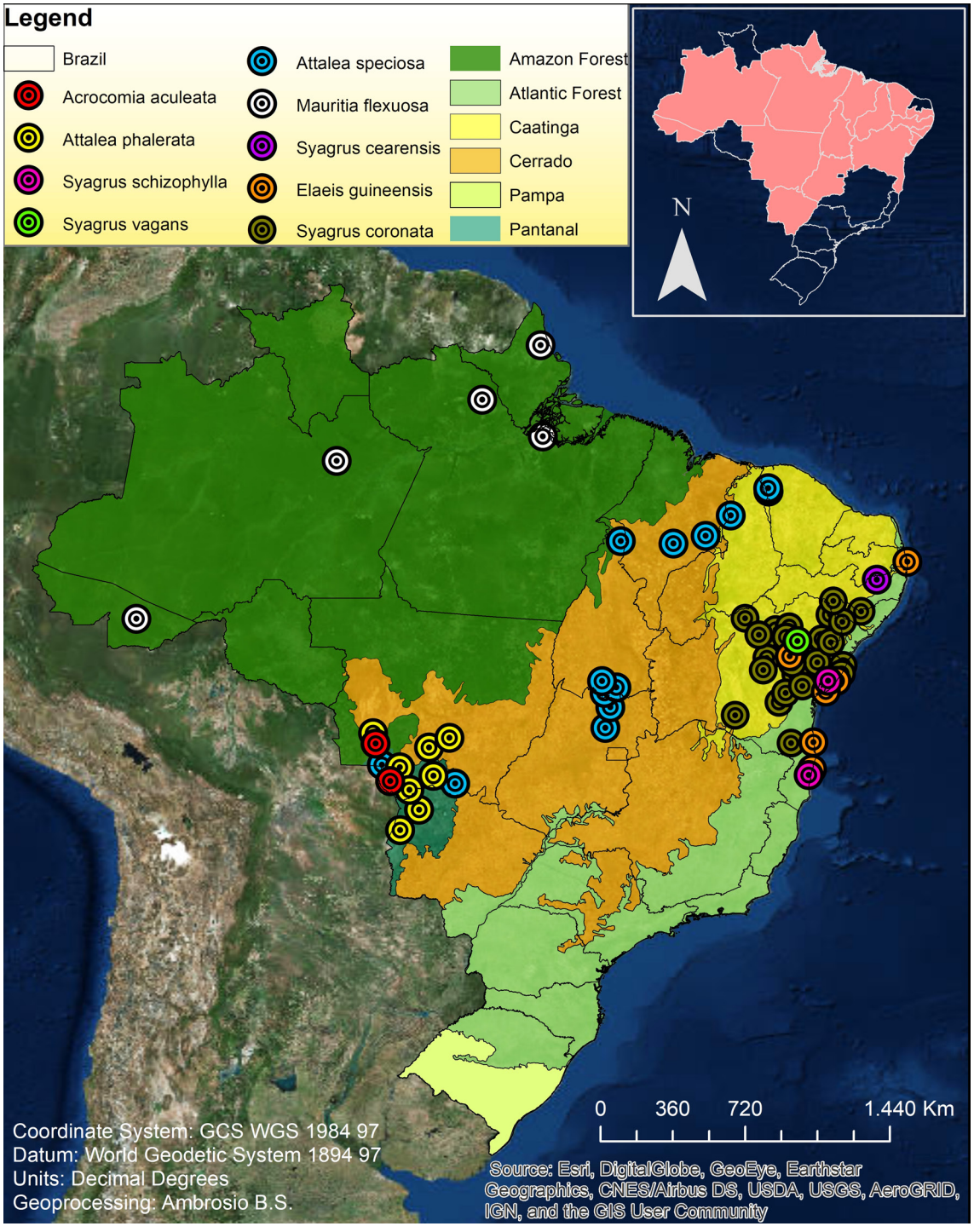

Figure 2 – Records of species of palm phorophytes of *Vanilla palmarum* (Salzm. *ex* Lindl.) Lindl. in Brazil.

the conservation status of *V. palmarum* has yet to be evaluated in Brazil (Flora do Brasil 2020), but according to the present study the species occurs in several phytogeographical domains and municipalities. Although the current geographical distribution of *V. palmarum* is broad, it is discontinuous and closely related to the joint distribution of its phorophytes in Brazil, which are concentrated in the North, Northestern and Central-West regions.

Therefore, it is expected that deforestation, habitat fragmentation and overexploitation of the natural resources associated with palm trees (*e.g., Mauritia flexuosa*) negatively influence the population size of the palm trees and *V. palmarum* (Hilário & Toledo 2016; Benchimol *et al.* 2017; Vieira *et al.* 2016).

Arecaceae is an important plant group in tropical forests, contributing to forest structure and composition, to the nesting of psittacines and to the feeding of mammals and birds (Petini-Benelli *et al.* 2009; see Hilário & Toledo 2016). The preservation of *S. schizophylla*, *M. flexuosa* and the other seven palm species would also conserve *V. palmarum*, as well as other orchids and epiphytes that use them as phorophytes. Inversely, since Orchidaceae is a flagship plant group (Rech *et al.* 2011; Cetzal-Ix *et al.* 2014), *V. palmarum* may be used to indirectly ensure the protection of palm species and ecological interactions, including plant-animal relationships.

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