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Species composition of climbers in seasonal semideciduous forest fragments of Southeastern Brazil

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SANTOS, K., KINOSHITA, L. S. & REZENDE, A. A. **Species composition of climbers in seasonal semideciduous forest fragments of Southeastern Brazil.** Biota Neotrop., 9 (4): http://www.biotaneotropica.org.br/v9n4/en/abstract?inventory+bn00309042009.

Abstract: In this study we evaluated floristic composition patterns of communities of climbers within ten inventories carried out in semideciduous forest fragments of southeastern Brazil. One of the inventories is original, being carried out for the present study in Ribeirão Cachoeira forest, Campinas, São Paulo State, Southeastern Brazil. This inventory was then pooled together to other nine climbers' inventories made in other forests of Southeastern Brazil to form a data base, which was examined regarding species richness, similarity, species distribution and climbing methods. The total number of species obtained was 355, belonging to 145 genera and 43 families. The ten most diverse families Bignoniaceae (45 species), Fabaceae (42), Malpighiaceae (36), Asteraceae (31), Apocynaceae (29), Sapindaceae (28), Convolvulaceae (21), Cucurbitaceae (14), Passifloraceae (10), and Euphorbiaceae (8) contributed to 74.4% of the total number of species recorded. The commonest climbing method in the studied sites was main stem or branch twining, accounting for 178 species or 50.1% of the total, the second commonest was tendril climbing (121 species, 34.1%), and the least, scrambling (56 species, 15.8%). We found a high percentage of exclusive species i.e., those occurring in only one forest site, which accounted for 49.3% of the total recorded. The mean similarity among forest sites (30%) may be considered low. The climbing species contribution to the total wood plant richness recorded on the forests sites was very high in some of the sites (up to 52.5%). These results indicated the importance of climber communities to plant diversity for semideciduous forests in Southeastern Brazil, enhancing the regional diversity and the conservation value of these forest remnants.
Keywords: *lianas, climbing mechanism, floristic, similarity, NMS.*

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Resumo: No presente estudo avaliamos as variações na composição de espécies das comunidades de trepadeiras abordando dez inventários florísticos realizados em fragmentos de floresta estacional semidecidual do sudeste do Brasil. Um destes inventários é inédito e foi realizado especialmente para o presente estudo. Comparamos este levantamento a outros nove inventários florísticos de trepadeiras realizados em outras florestas do sudeste para investigar aspectos como riqueza, similaridade, distribuição de espécies e mecanismos de escalada. Ao todo foram encontradas 355 espécies, pertencentes a 145 gêneros e 43 famílias. As dez famílias mais ricas Bignoniaceae (45 espécies), Fabaceae (42), Malpighiaceae (36), Asteraceae (31), Apocynaceae (29), Sapindaceae (28), Convolvulaceae (21), Cucurbitaceae (14), Passifloraceae (10), e Euphorbiaceae (8) representaram 74,4% do total de espécies encontrado. Considerando os mecanismos de escalada, observamos o predomínio de espécies volúveis (178 espécies ou 50,1%), sobre espécies com gavinhas (121 espécies, 34,1%), e apoiadoras (56 espécies, 15,8%). A porcentagem de espécies exclusivas, i.e. aquelas que ocorreram em apenas uma das localidades estudadas, foi de 49,3% do total amostrado e pode ser considerada alta. Além disso, a similaridade entre as florestas analisadas foi bastante baixa e a contribuição das espécies de trepadeiras para a diversidade de plantas lenhosas nestas áreas foi bastante elevada em algumas áreas, chegando a 52,5%. Estes resultados indicaram a importância das comunidades de trepadeiras para a diversidade vegetal nas florestas semideciduais do sudeste do Brasil, aumentando a valor de conservação desses remanescentes florestais.
Palavras-chave: *lianas, mecanismos de escalada, ordenação NMS, similaridade.*

Introduction

The semideciduous seasonal forest of the Southeastern Brazil is probably one of the most threatened and fragmented ecosystems on earth. The maintenance of its biodiversity depends on the conservation of small fragments spread over an agricultural landscape. The biological studies on these forest remnants have improved a lot during the last three decades, enhancing the required background for management and conservation actions. However, climbers' communities have been neglected by most of those studies, which focused mainly on trees. This study comes as a small contribution towards fulfilling this gap.

Climbers are an abundant and diverse group of plants in forests throughout the world, particularly in the tropics. They can constitute ~25% of woody stem density and represent from 25 to 44% of the woody species diversity in tropical forests (Gentry 1991, Pérez-Salicrup et al. 2001), providing a remarkable food source for the associated fauna and, by physically linking trees together, furnishing canopy-to-canopy access for arboreal animals (Emmons & Gentry 1983, Morellato & Leitão Filho 1996). Thus, the importance of improving the knowledge about lianas (woody climbers) lies on the crucial ecological role they play in many aspects of tropical forest dynamics.

Lianas are commonly seen as structural parasites, invaders or weedy species, which respond positively to increased CO2 concentrations, light penetration and forest disturbance, and consequently thrive in fragmented/disturbed landscapes (Putz 1984, Laurance 1991, 1997, Laurance et al. 2001, Phillips et al. 2002). When abundant, this life form is considered to be an inconvenient for economic and conservational reasons. Abundant lianas can reduce the sylvicultural value of a forest by reducing tree growth and fecundity, and increasing tree mortality and stem deformation (Stevens 1987, Putz 1991, Pérez-Salicrup & Barker 2000, Phillips et al. 2005). Additionally, tree supporting lianas are more prone to break and cause logging damage on their neighbours due to intercrown connections between adjacent trees, enhancing tree turnover in heavy infested forests (Appanah & Putz 1984, Vidal et al. 1997, Phillips et al. 2005). Lianas can also arrest or suppress gap-phase regeneration, and harm some species while promoting others (Schnitzer et al. 2000). All these factors indicate that forest dynamics and composition can be altered due to lianas' influence, with implications for forest's conservation and sustainability (Putz 1984, Stevens 1987, Pérez-Salicrup & Barker 2000, Schnitzer et al. 2000, Schnitzer & Carson 2001, Phillips et al. 2002, 2005).

Few quantitative and qualitative data are available to evaluate these claims in the semideciduous seasonal forests of southeasthern Brazil. This ecosystem is facing an extremely high anthropogenic pressure given its high degree of forest fragmentation, disturbance history, and location, among the larger cities and the most industrialized region of Brazil. Heavy liana infestations are expected for this region, however, little is known about variations in their communities and the contribution of their species to overall diversity in these forests (but see Udulutsch et al. 2004, Tibiriçá et al. 2006, Rezende et al. 2007). Further investigations and data are highly desirable and required to address these questions in semideciduous seasonal forests of southeastern Brazil (Udulutsch et al. 2004). Floristic inventories are the first step towards a better understanding of climbers' communities in this region; they provide the basic information for further investigations and to support management and conservation policies.

The goal of this study is to contribute to increase the knowledge of communities of climbers in the Southeastern Brazil by describing their floristic composition in a semideciduous seasonal forest fragment of Campinas municipality, State of São Paulo, and providing a preliminary evaluation of the floristic patterns of their communities by comparing the current floristic inventory to other nine inventories carried out in different semideciduous forest fragments of Southeastern Brazil.

Material and Methods

The tropical semidecidous forest from Southeastern Brazil occurs in areas with rainfall between 1,250 and 2,550 mm. The vegetation is characterized by dense forests with high tree species diversity. The average canopy stature is 15 m with emergent trees reaching up to 35 m tall. There are two distinct seasons, the rainy summer, from December through February and the dry winter, from June through August. During the dry season approximately 40% of the trees composing the canopy are deciduous to some degree (Morellato & Leitão Filho 1992). The canopy is commonly dominated by families Myrtaceae, Fabaceae, Meliaceae, Apocynaceae and Euphorbiaceae. The most dominant species are *Esenbeckia leiocarpa* Engl.,

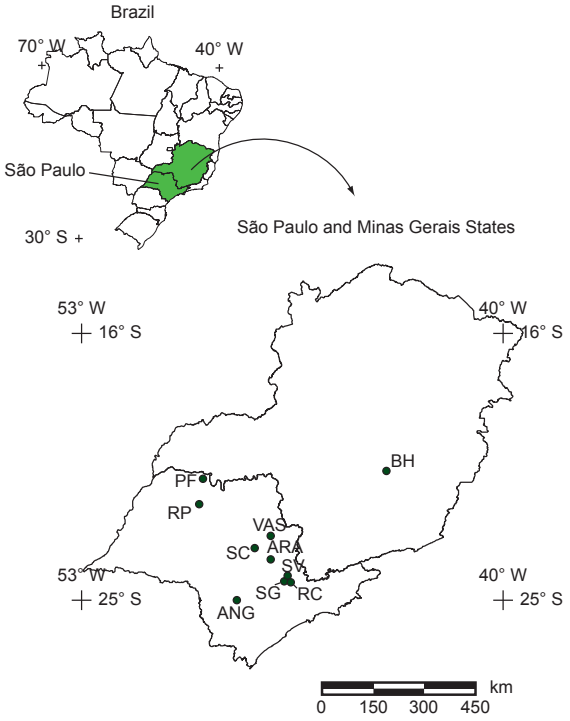

Figure1. Locations of the 10 semideciduous forest sites of southeastern Brazil. ANG = Angatuba (Torres 1989); ARA = Araras (Udulutsch et al. 2004); BH = Belo Horizonte (Lombardi et al. 1999); RC = Ribeirão Cachoeira forest (Present study); RP = São José do Rio Preto (Rezende & Ranga 2005); PF = Paulo de Faria (Rezende et al. 2007); SC = São Carlos (Hora & Soares 2002); SG = Santa Genebra (Morellato & Leitão Filho 1996); SV = Fazenda São Vicente (Bernacci & Leitão Filho 1996); VAS = Vassununga (Tibiriçá et al. 2006).

Figura 1. Localização dos dez fragmentos de floresta estacional semidecidual estudados no sudeste do Brasil. ANG = Angatuba (Torres 1989); ARA = Araras (Udulutsch et al. 2004); BH = Belo Horizonte (Lombardi et al. 1999); RC = Mata Ribeirão Cachoeira (Presente estudo); RP = São José do Rio Preto (Rezende & Ranga 2005); PF = Paulo de Faria (Rezende et al. 2007); SC = São Carlos (Hora & Soares 2002); SG = Santa Genebra (Morellato & Leitão Filho 1996); SV = Fazenda São Vicente (Bernacci & Leitão Filho 1996); VAS = Vassununga (Tibiriçá et al. 2006).

Piptadenia gonoacantha (Mart.) J.F.Macbr., *Trichilia clausseni* C.DC*, Croton floribundus* Spreng., *Gallesia integrifolia* (Spreng.) Harms, *Lonchocarpus muehlbergianus* Hassl.,and *Aspidosperma polyneuron* Müll.Arg. (K. Santos et al. unpubl. data).

The floristic inventory of the present study was carried out at the Ribeirão Cachoeira Forest, which is the second largest (244.9 ha) of the former continuous semideciduous seasonal forest of Campinas municipality, State of São Paulo. The species composition of climbers was sampled randomly, by walking along the network of paths within the forest fragment and also at forest edges. Every climber found in reproductive state was collected for later identification and recorded for the checklist. Collecting was done mainly from March through December 1996. Identification followed the usual taxonomic techniques and vouchers have been deposited in the UEC Herbarium (Department of Botany, Institute of Biology, State University of Campinas – UNICAMP). Family classification followed APG II (APG 2003).

There are many different kinds of climbers, differing in climbing strategy, morphology and ecology (Gentry 1991). In this study we included woody, subwoody and herbaceous climbing plants which can be defined as plants that begin their life cycles as seedlings rooted in the ground and rely on other plants for physical support in order to reach the top of the forest canopy, never loosing the contact with the ground as they keep rooted in the soil permanently. This means that we excluded hemiepiphytes and epiphytes. Nonetheless, because the majority of the species being considered in this study is woody and also because the other inventories treated here followed the same definition, we may also refer to the studied group of plants using the more widespread term lianas, especially when referring to available literature focusing the theme.

The obtained list of species plus other nine floristic inventories of climbers carried out in different locations of the southeastern Brazil were pulled together to build a presence/absence main matrix data. Only forests belonging to the seasonal semideciduous forests domain were included, being eight forest inventories from the interior of the São Paulo state and one from the State of Minas Gerais (Figure 1, Table 1). The sampling methods and criteria of inclusion adopted by each study included in the main matrix data varied little, most of them adopted the same methods as in the current inventory (Table 1).

Only taxa identified up to species level were included in the presence/absence main matrix, and the full list was checked for synonymies among taxa. For all species recorded on the main matrix, the climbing mechanisms were determined based on field observation, personal knowledge and/or reference to literature. Species were classified into one of the following categories according to Putz (1984) and Hegarty (1991): a) tendril climbers, b) main stem or branch twiners, and d) scramblers.

We examined the patterns of climbers composition using non-metric multidimensional scaling (NMS) ordination in PC-ORD version 4.0 (McCune & Mefford 1999). The ordinations were based on the Sorenson's similarity matrices of species presence–absence data. We also accessed liana species' contribution to the total wood plant richness recorded on the studied forests sites by calculating the proportion of climber species in relation to the total wood species number (trees, shrubs and climbers). The number of trees/shrubs species in each site was also compiled from the literature for most studied sites, with exception of Belo Horizonte (BH), São José do Rio Preto (RP), and Vassununga (VAS).

Results

Considering all the forests inventories pulled together, we found a total of 355 species of climbers belonging to 145 genera and 43 families (Table 2). The ten most diverse families were Bignoniaceae (45 species), Fabaceae (42), Malpighiaceae (36), Asteraceae (31), Apocynaceae (29), Sapindaceae (28), Convolvulaceae (21),

Table 1. List of the ten semideciduous seasonal forests where liana inventories were conducted in southeastern Brazil.

Tabela 1. Lista dos dez inventários florísticos de lianas realizados em florestas estacionais semideciduais do sudeste do Brasil.

Forest site	Coordinates	Area[a]	Sample method	Inclusion criteria[b]	Reference
Angatuba (ANG)	23° 29' S and 48° 45' W	1394	Random walks	Reproductive material	Torres (1989)
Araras (ARA)	22° 21' S and 47° 28' W	230	Random walks	Reproductive material	Udulutsch et al. (2004)
Belo Horizonte (BH)	19° 52' S and 43° 58' W	150	Plots	DBH ≥ 0.5 cm	Lombardi et al. (1999)
Paulo de Faria (PF)	19° 55'S and 49° 32' W	650	Plots	DBH ≥ 1 cm	Rezende et al. (2007); Stranghetti & Ranga (1998)
Ribeirão Cachoeira (RC)	22° 49' S and 46° 55' W	244.9	Random walks	Reproductive material	Present study
Santa Genebra (SG)	22° 44' S and 47° 06' W	250	Random walks	Reproductive material	Morellato & Leitão Filho 1996
São Carlos (SC)	21° 57' S and 47° 50' W	112	Plots	DBH ≥ 2.5 cm	Hora & Soares 2002
São José do Rio Preto (RP)	20° 48' S and 49° 22' W	168.63	Random walks	Reproductive material	Rezende & Ranga 2005
São Vicente (SV)	22° 55' S and 47° 03' W	70	Random walks/ Plots	Unspecified	Bernacci & Leitão Filho 1996
Vassununga (VAS)	21° 41' S and 47° 34' W	127.08	Random walks	Reproductive material	Tibiriçá et al. 2006

[a] = Forest fragment size in hectares; [b] = this column refers to the criteria adopted by each study to select the plants to be included in the survey. Where DBH = diameter at breast high; Reproductive material = all the plant stems were collected as long as they were found in reproductive state (flowering or fruiting).

[a] = Área do fragmento florestal em hectares; [b]= esta coluna se refere ao critério de inclusão adotado na amostragem. Onde DBH = diâmetro à altura do peito; Reproductive material = todas as plantas encontradas em estado reprodutivo (flor ou fruto) foram coletadas.

Table 2. List of 43 families and 355 liana species occurring at the 10 semideciduous forest sites of Southeastern Brazil (See Table 1 and Figure 1 for sites legend). *Climbing methods, where ten = tendril climbers; twi = branch/stem twiners; scr = scramblers. x = indicates species occurrence.

Tabela 2. Lista das 43 famílias e 355 espécies de lianas encontradas nos dez fragmentos de floresta estacional semidecidual estudados no sudeste do Brasil (Siglas dos fragmentos como na Figura 1 e Tabela 1). *Mecanismos de escalada, onde ten= gavinhas; twi = volúveis; scr = escandentes. X = ocorrência da espécie.

Family and species	Climb*	ANG	ARA	BH	PF	RC	RP	SC	SG	SV	VAS
ACANTHACEAE											
Mendoncia puberula Mart.	twi	-	x	-	-	-	-	-	x	-	-
Mendoncia velloziana Mart.	twi	-	x	-	-	-	-	-	x	-	-
AGAVACEAE											
Herreria salsaparilha Mart.	twi	-	-	-	x	x	x	-	-	-	-
ALSTROEMERIACEAE											
Alstroemeria nemorosa Gardner	twi	-	x	-	-	-	-	-	-	-	-
Bomarea martiana Schen.	scr	x	-	-	-	-	-	-	-	-	-
AMARANTHACEAEE											
Chamissoa altissima (Jacq.) Kunth	scr	x	x	-	x	-	-	-	x	x	x
Hebanthe paniculata Mart.	twi	x	-	-	x	x	x	-	x	x	x
APOCYNACEAE											
Araujia sericifera Brot.	twi	-	-	-	-	-	x	-	-	-	-
Calotropis procera (Aiton) R.Br.	scr	-	-	-	-	-	-	-	-	-	x
Condylocarpon isthmicum (Vell.) A.DC.	twi	x	x	-	-	x	-	x	x	-	x
Ditassa anomala Mart.	twi	-	-	-	-	-	-	-	x	-	-
Forsteronia glabrescens Müll.Arg.	twi	-	-	-	-	-	x	-	-	-	-
Forsteronia leptocarpa (Hook. & Arn.) A.DC.	twi	-	x	-	-	-	-	-	x	-	-
Forsteronia pilosa (Vell.) Müll.Arg.	twi	-	x	-	x	x	-	-	-	-	x
Forsteronia pubescens A.DC.	twi	-	x	-	x	x	x	x	-	-	x
Forsteronia refracta Müll.Arg.	twi	-	x	-	-	-	-	-	-	-	x
Forsteronia rufa Müll.Arg.	twi	-	-	-	-	-	-	-	x	-	-
Forsteronia velloziana (A.DC.) Woodson	twi	-	-	x	-	-	-	-	-	-	-
Gonioanthela hilariana (E.Fourn.) Malme	twi	-	x	-	-	-	-	-	-	-	-
Gonolobus rostratus (Vahl) Schult.	twi	-	-	-	-	-	-	-	x	-	-
Gonolobus selloanus (E.Fourn.) Bacigalupo	twi	-	x	-	-	-	-	-	-	-	-
Mesechites mansoanus (A.DC.) Woodson	twi	-	-	-	-	-	x	-	-	-	-
Orthosia urceolata E.Fourn.	twi	-	x	-	-	-	-	-	-	-	-
Oxypetalum appendiculatum Mart.	twi	-	-	-	-	-	-	-	x	-	-
Oxypetalum balansae Malme	twi	-	-	-	-	-	x	-	-	-	-
Oxypetalum erianthum Decne.	twi	-	-	-	x	-	x	-	-	-	-
Oxypetalum molle Hook. & Arn.	twi	-	-	-	-	-	-	-	x	-	-
Prestonia coalita (Vell.) Woodson	twi	-	x	-	x	x	x	-	x	x	x
Prestonia dusenii (Malme) Woodson	twi	-	-	-	-	-	x	-	-	-	-
Prestonia lagoensis (Müll.Arg.) Woodson	twi	-	-	-	x	-	-	-	-	-	-
Prestonia riedelii (Müll.Arg.) Markgr.	twi	-	-	-	-	-	-	-	x	-	-
Prestonia tomentosa R.Br.	twi	-	-	-	x	x	x	-	x	-	-
Sarcostemma clausum (Jacq.) Schult.	twi	-	-	-	-	-	-	-	-	-	x
Schubertia grandiflora Mart. & Zucc.	twi	-	-	-	-	x	x	-	-	-	-
Secondatia densiflora A.DC.	twi	-	-	-	x	-	x	-	-	-	-
Tassadia propinqua Decne.	twi	-	-	-	-	-	-	-	x	-	-
ARACEAE											
Philodendron propinquum Schott	twi	-	-	-	-	-	-	-	-	x	-
ARISTOLOCHIACEAE											
Aristolochia arcuata Mast.	twi	-	x	-	-	x	-	-	x	-	-
Aristolochia esperanzae Kuntze	twi	-	-	-	-	-	x	-	-	-	-
Aristolochia galeata Mart.	twi	x	x	-	-	-	-	-	x	-	-
Aristolochia melastoma Silva Manso ex Duch.	twi	-	x	-	-	-	-	-	x	x	-

Table 2. Continued...

Family and species	Climb*	ANG	ARA	BH	PF	RC	RP	SC	SG	SV	VAS
ASTERACEAE											
Baccharis quitensis Kunth	scr	-	x	-	-	-	-	-	-	-	x
Bidens brasiliensis Sherff	twi	-	-	-	-	-	-	-	x	-	-
Bidens squarrosa Kunth	twi	-	x	-	-	-	-	-	-	-	-
Calea pinnatifida (R.Br.) Less.	scr	x	x	-	-	x	-	-	x	-	-
Chromolaena maximilianii (Schrader) R.M.King & H.Rob.	scr	-	x	-	-	-	-	-	-	-	-
Cyrtocymura scorpioides (Lam.) H.Rob.	scr	-	x	-	-	x	-	-	-	-	x
Dasyphyllum brasiliense (Spreng.) Cabrera	scr	x	-	-	x	x	x	-	x	-	-
Dasyphyllum flagellare (Casar.) Cabrera	scr	x	-	-	-	-	-	-	-	-	-
Dasyphyllum spinescens (Less.) Cabrera	scr	-	-	-	-	-	-	-	x	x	-
Dasyphyllum synacanthum (Baker) Cabrera	scr	-	-	x	-	-	-	-	-	-	-
Eupatorium megaphyllum Baker	scr	-	x	-	-	-	-	-	-	-	-
Eupatorium vauthierianum DC.	scr	-	x	-	-	-	-	-	-	-	-
Heterocondylus vitalbae (DC.) R.M.King & H.Rob.	twi	-	x	-	-	-	-	-	x	-	-
Mikania biformis DC.	twi	x	-	-	-	-	-	-	-	-	-
Mikania cordifolia (L.f.) Willd.	twi	-	-	-	-	-	x	-	-	-	-
Mikania cynanchifolia Hook. & Arn. ex Baker	twi	-	-	-	-	-	-	-	x	-	-
Mikania glomerata Spreng.	twi	x	x	-	-	x	-	-	x	x	x
Mikania hemisphaerica Sch.Bip. ex Baker	twi	-	-	-	-	-	-	-	-	x	-
Mikania hirsutissima DC.	twi	-	-	x	-	-	-	-	x	-	-
Mikania lundiana DC.	twi	-	-	-	-	-	-	-	-	-	x
Mikania micrantha Kunth	twi	-	x	-	-	x	x	-	x	x	x
Mikania pyramidata Donn.Sm.	twi	-	x	-	-	-	-	-	-	-	-
Mikania ramosissima Gardner	twi	-	x	-	-	-	-	-	-	-	x
Mikania salviaefolia Gardner	twi	-	-	x	-	-	-	-	-	-	-
Mikania triangularis Baker	twi	-	x	-	-	-	-	-	x	x	-
Mutisia coccinea A.St.-Hil.	twi	x	x	-	-	-	-	-	x	-	-
Pseudogynoxys cumingii (Benth.) H.Rob. & Cuatrec.	scr	-	-	-	-	-	-	-	-	x	x
Trixis antimenorrhoea (Schrank) Kuntze	scr	-	-	-	-	-	-	-	x	x	-
Trixis divaricata (Kunth) Spreng.	scr	-	x	-	-	-	-	-	-	-	-
Vernonanthura crassa (Vell.) H.Rob.	scr	-	x	-	-	-	-	-	-	-	-
Vernonanthura diffusa (Less.) H.Rob.	scr	-	x	-	-	-	-	-	-	-	-
BASELLACEAE											
Anredera cordifolia (Ten.) Steenis	twi	-	-	-	-	-	-	-	x	-	-
BIGNONIACEAE											
Adenocalymma bracteatum (Cham.) DC.	ten	-	x	-	x	x	x	x	x	-	x
Adenocalymma dusenii Kraenzl.	ten	x	-	-	-	-	-	-	-	-	-
Adenocalymma marginatum (Cham.) DC.	ten	-	x	-	-	x	-	-	x	x	x
Adenocalymma paulistarum Bureau & K.Schum.	ten	-	x	-	-	-	-	-	-	-	x
Amphilophium paniculatum (L.) Kunth	ten	-	x	-	x	x	x	x	x	-	-
Anemopaegma chamberlaynii (Sims) Bureau & K.Schum.	ten	-	x	-	-	x	-	x	x	x	-
Arrabidaea chica (Bonpl.) Verl.	ten	-	x	-	x	-	x	-	-	-	x
Arrabidaea conjugata (Vell.) Mart.	ten	-	-	-	-	x	-	x	-	-	x
Arrabidaea craterophora (DC.) Bureau	ten	-	-	x	-	-	x	-	-	-	-
Arrabidaea florida DC.	ten	-	-	-	-	x	x	-	-	-	x
Arrabidaea formosa (Bureau) Sandwith	ten	-	x	x	x	-	-	-	-	-	-
Arrabidaea leucopogon (Cham.) Sandwith	ten	-	-	-	x	-	x	-	-	-	-
Arrabidaea mutabilis Bureau & K.Schum.	ten	-	-	-	-	-	-	x	-	-	-
Arrabidaea pubescens (L.) A.H.Gentry	ten	-	x	-	-	-	-	-	-	-	-

Table 2. Continued...

Family and species	Climb*	ANG	ARA	BH	PF	RC	RP	SC	SG	SV	VAS
Arrabidaea pulchella (Cham.) Bureau	ten	x	x	-	x	-	-	-	-	-	x
Arrabidaea pulchra (Cham.) Sandwith	ten	-	x	x	-	-	-	-	-	-	-
Arrabidaea samydoides (Cham.) Sandwith	ten	x	x	x	-	-	-	-	x	-	-
Arrabidaea selloi (Spreng.) Sandwith	ten	-	x	-	x	x	-	x	x	-	x
Arrabidaea triplinervia (Mart. ex DC.) Baill.	ten	x	x	x	x	x	x	x	x	x	-
Bignonia binata Thunb.	ten	-	-	-	-	-	-	-	-	-	x
Bignonia campanulata Cham.	ten	-	x	-	-	x	-	x	x	x	x
Clytostoma sciuripabulum (K.Schum.) Bureau & K.Schum.	ten	-	x	-	-	-	-	-	-	-	x
Cuspidaria convoluta (Vell.) A.H.Gentry	ten	-	x	-	-	-	-	-	x	-	-
Cuspidaria floribunda (DC.) A.H.Gentry	ten	-	x	-	-	-	x	-	x	-	x
Distictella elongata (Vahl) Urb.	ten	-	-	-	-	-	-	-	-	-	x
Distictella granulosa (Klotzsch) Urb.	ten	-	-	-	-	-	-	-	-	x	-
Distictella magnoliifolia (Kunth) Sandwith	ten	-	-	-	-	x	-	-	-	-	-
Fridericia speciosa Mart.	ten	x	x	-	x	x	-	x	x	-	-
Lundia obliqua Sond.	ten	x	x	-	x	x	x	x	x	x	x
Lundia virginalis DC.	ten	-	-	-	-	-	-	-	x	-	-
Macfadyena mollis (Sond.) Seem.	ten	-	x	-	-	-	-	-	-	-	x
Macfadyena unguis-cati (L.) A.H.Gentry	ten	x	x	x	x	x	x	x	x	x	x
Mansoa difficilis (Cham.) Bureau & K.Schum.	ten	x	x	-	-	-	-	x	x	x	x
Melloa quadrivalvis (Jacq.) A.H.Gentry	ten	-	x	-	-	-	-	x	-	x	-
Paragonia pyramidata (Rich.) Bureau	ten	-	-	-	x	-	x	x	x	-	x
Pithecoctenium crucigerum (L.) A.H.Gentry	ten	-	x	-	-	-	-	x	x	x	x
Pleonotoma stichadenia K.Schum.	ten	-	-	x	-	-	-	-	-	-	-
Pleonotoma tetraquetra (Cham.) Bureau	ten	-	x	-	x	-	-	-	x	-	x
Pyrostegia venusta (Ker Gawl.) Miers	ten	x	x	x	x	-	x	x	x	x	x
Stizophyllum perforatum (Cham.) Miers	ten	-	x	x	-	x	x	x	x	x	x
Tynanthus cognatus (Cham.) Miers	ten	-	-	-	-	x	-	-	x	-	-
Tynanthus elegans Miers	ten	-	x	-	x	-	-	x	-	-	-
Tynanthus fasciculatus (Vell.) Miers	ten	-	x	-	-	-	-	-	x	-	x
Tynanthus labiatus (Cham.) Miers	ten	-	-	-	-	x	-	-	-	-	-
Tynanthus micranthus Corr.Méllo ex K.Schum.	ten	-	-	-	-	-	-	-	-	-	x
BORAGINACEAE											
Cordia polycephala (Lam.) I.M.Johnst.	scr	x	-	-	-	-	-	-	-	-	-
Tournefortia bicolor Sw.	scr	-	-	-	-	-	-	-	x	-	-
Tournefortia elegans Cham.	scr	-	x	-	-	-	-	-	-	-	-
Tournefortia paniculata Vent.	scr	-	x	-	-	-	x	-	-	-	-
Tournefortia rubicunda Salzm. ex DC.	scr	-	-	-	-	x	x	-	-	-	-
Tournefortia villosa Salzm. ex DC.	scr	-	-	-	-	-	-	-	x	-	-
CACTACEAE											
Pereskia aculeata Mill.	scr	-	x	-	-	x	-	x	x	x	x
CAMPANULACEAE											
Centropogon argutus E.Wimm.	scr	-	-	-	x	-	-	-	-	-	-
Cannabaceae											
Celtis iguanaea (Jacq.) Sarg.	scr	-	x	-	x	-	-	-	-	-	x
CELASTRACEAE											
Anthodon decussatum Ruiz & Pav.	ten	-	x	-	x	x	-	-	-	-	x
Cheiloclinium cognatum (Miers) A.C.Sm.	ten	-	-	-	x	-	-	-	-	-	-
Hippocratea volubilis L.	ten	x	x	x	-	x	x	x	x	x	-
Peritassa calypsoides (Cambess.) A.C.Sm.	scr	-	-	-	-	-	-	-	x	-	-
Pristimera andina Miers	twi	-	-	-	-	x	-	x	x	-	-
Semialarium paniculatum (Mart. ex Schult.) N.Hallé	scr	-	-	-	-	-	-	x	-	-	x

Table 2. Continued...

Family and species	Climb*	ANG	ARA	BH	PF	RC	RP	SC	SG	SV	VAS
COMBRETACEAE											
Combretum discolor Taub.	twi	-	-	-	x	-	-	-	-	-	-
COMMELINACEAE											
Dichorisandra hexandra (Aubl.) Standl.	scr	-	x	-	-	-	-	-	-	-	-
CONVOLVULACEAE											
Bonamia burchellii (Choisy) Hallier	twi	-	-	-	-	-	x	-	-	-	-
Ipomoea acuminata (Vahl) Roem. & Schult.	twi	-	-	-	-	-	-	-	x	-	-
Ipomoea alba L.	twi	-	-	-	-	-	-	-	-	-	x
Ipomoea brasiliana Meisn.	twi	-	x	-	-	-	-	-	-	-	-
Ipomoea cairica (L.) Sweet	twi	-	-	-	-	x	-	-	x	x	-
Ipomoea coccinea L.	twi	-	-	-	-	x	-	-	-	-	-
Ipomoea hederifolia L.	twi	-	x	-	x	-	x	-	x	-	x
Ipomoea nil (L.) Roth	twi	-	x	-	-	-	-	-	-	-	-
Ipomoea pes-caprae (L.) R.Br.	twi	-	-	-	-	-	-	-	-	-	x
Ipomoea purpurea (L.) Roth	twi	x	-	-	x	-	-	-	-	-	-
Ipomoea quamoclit L.	twi	-	x	-	-	-	-	-	x	-	x
Ipomoea saopaulista O'Donell	twi	-	x	-	-	x	-	-	-	-	-
Ipomoea syringifolia Meisn.	twi	-	x	-	-	-	-	-	-	-	-
Ipomoea tubata Nees	twi	-	-	-	-	-	-	-	-	-	x
Jacquemontia ciliata Sandwith	twi	-	x	-	-	-	-	-	-	-	-
Jacquemontia densiflora (Meisn.) Hallier f.	twi	-	-	-	x	-	x	-	-	-	-
Jacquemontia evolvuloides Meisn.	twi	-	-	-	-	-	x	-	-	-	-
Jacquemontia velutina Choisy	twi	-	-	-	-	-	x	-	-	-	-
Merremia aegyptia (L.) Urb.	twi	-	-	-	x	-	-	-	-	-	-
Merremia cissoides (Lam.) Hallier f.	twi	-	-	-	-	-	x	-	-	x	-
Merremia macrocalyx (Ruiz & Pav.) O'Donell	twi	x	x	x	x	x	x	-	x	-	x
CUCURBITACEAE											
Cayaponia espelina (Silva Manso) Cogn.	ten	-	-	-	x	-	-	-	-	-	-
Cayaponia tayuya (Vell.) Cogn.	ten	-	-	-	x	x	x	-	-	-	-
Ceratosanthes hilariana Cogn.	ten	-	-	-	x	-	-	-	-	-	-
Luffa cylindrica M.Roem.	ten	-	-	-	-	-	-	-	-	-	x
Melothria cucumis Vell.	ten	-	-	-	-	-	-	-	-	x	x
Melothria fluminensis Gardner	ten	-	-	-	-	-	x	-	x	-	-
Melothria warmingii Cogn.	ten	-	-	-	-	-	x	-	-	-	-
Momordica charantia L.	ten	-	x	-	x	-	x	-	x	-	x
Psiguria ternata (M. Roem.) C.Jeffrey	ten	-	x	-	-	-	-	-	-	x	x
Psiguria triphylla (Miq.) C.Jeffrey	ten	-	-	-	x	-	x	-	-	-	-
Psiguria warmingiana (Cogn.) C.Jeffrey	ten	-	x	-	-	-	-	-	-	-	-
Wilbrandia hibiscoides Silva Manso	ten	-	-	-	-	-	-	-	x	-	-
Wilbrandia longibracteata Cogn.	ten	-	x	-	-	-	-	-	-	-	-
Wilbrandia verticillata Cogn.	ten	-	-	-	x	-	-	-	-	x	-
DILLENIACEAE											
Davilla rugosa Poir.	twi	-	x	x	-	-	-	x	x	-	x
Doliocarpus dentatus (Aubl.) Standl.	twi	-	-	x	-	-	x	-	-	-	-
Tetracera oblongata DC.	twi	x	-	-	-	-	-	-	-	-	-
Tetracera willdenowiana Steud.	twi	-	-	-	-	-	-	-	-	-	x
DIOSCOREACEAE											
Dioscorea altissima Lam.	twi	-	-	-	-	-	-	-	-	x	-
Dioscorea dodecaneura Vell.	twi	-	x	-	-	-	x	-	-	-	-
Dioscorea macrocapsa R.Knuth	twi	-	-	-	-	-	-	-	x	-	-
Dioscorea macrocarpa Uline	twi	-	-	-	-	-	-	-	x	-	-

Table 2. Continued...

Family and species	Climb*	ANG	ARA	BH	PF	RC	RP	SC	SG	SV	VAS
Dioscorea monandra Hauman	twi	-	-	-	x	-	-	-	-	-	x
Dioscorea multiflora Griseb.	twi	-	-	-	-	x	x	-	-	x	x
Dioscorea pseudomacrocapsa G.M.Barroso, E.F.Guim. & Sucre	twi	-	-	-	-	-	-	-	x	-	-
EUPHORBIACEAE											
Bia alienata Didr.	twi	-	x	-	-	-	-	-	x	-	-
Dalechampia olfersiana Müll.Arg.	twi	-	-	-	-	-	-	-	x	-	-
Dalechampia pentaphylla Lam.	twi	-	-	-	x	-	x	-	x	x	x
Dalechampia scandens L.	twi	-	x	-	-	-	x	-	-	-	-
Dalechampia stipulacea Müll.Arg.	twi	-	x	-	-	-	-	-	x	-	x
Dalechampia triphylla Lam.	twi	-	x	-	-	x	x	-	x	-	-
Romanoa tamnoides (A.Juss.) Radcl.-Sm.	twi	-	-	-	x	-	-	-	-	-	-
Tragia volubilis L.	twi	-	-	-	-	x	-	-	-	x	-
FABACEAE											
Acacia adhaerens Benth.	scr	-	-	-	-	-	-	-	-	x	-
Acacia paniculata Willd.	twi	-	x	x	-	-	-	x	-	-	x
Acacia plumosa Mart. ex Colla	scr	-	-	-	-	-	-	x	-	-	-
Bauhinia leiopetala Benth.	ten	-	-	x	-	-	-	-	-	-	-
Bauhinia microstachya (Raddi) J.F.Macbr.	ten	-	-	-	x	x	-	x	-	x	-
Bauhinia siqueiraei Ducke	ten	-	-	-	-	-	-	-	-	-	x
Calopogonium caeruleum (Benth.) C.Wright	twi	-	-	-	x	-	-	-	-	-	-
Calopogonium mucunoides Desv.	twi	-	-	-	x	-	x	-	-	-	-
Camptosema ellipticum (Desv.) Burkart	twi	-	-	-	-	-	x	-	-	-	-
Canavalia grandiflora Benth.	twi	-	-	-	-	x	x	-	-	-	-
Canavalia palmeri (Piper) Standl.	twi	-	-	-	x	-	-	-	-	-	-
Canavalia parviflora Benth.	twi	-	-	-	-	-	-	-	x	-	-
Canavalia picta Mart. ex Benth.	twi	-	-	-	-	-	-	-	x	x	-
Centrosema arenarium Benth.	twi	-	-	-	x	-	-	-	-	-	-
Centrosema grandiflorum Benth.	twi	-	-	-	x	-	-	-	-	-	-
Centrosema pascuorum Mart. ex Benth.	twi	-	-	-	x	-	-	-	-	-	-
Centrosema plumieri (Turpin ex Pers.) Benth.	twi	-	-	-	x	-	-	-	-	-	-
Centrosema pubescens Benth.	twi	x	-	-	x	-	x	-	-	-	-
Centrosema sagittatum (Humb. & Bonpl. ex Willd.) Brandegee	twi	-	x	-	x	x	x	-	-	-	-
Centrosema venosum Mart. ex Benth.	twi	-	-	-	x	-	-	-	-	-	-
Centrosema vexillatum Benth.	twi	-	-	-	x	-	-	-	-	-	-
Centrosema virginianum (L.) Benth.	twi	x	-	-	x	-	-	-	-	-	-
Chaetocalyx brasiliensis (Vogel) Benth.	twi	-	-	-	x	-	-	-	-	-	-
Clitoria falcata Lam.	twi	-	-	-	-	-	x	-	-	-	-
Dalbergia frutescens (Vell.) Britton	scr	-	-	-	-	-	-	x	x	-	-
Dioclea latifolia Benth.	twi	-	-	-	-	x	-	-	-	-	-
Dioclea rufescens Benth.	twi	-	-	-	-	-	-	-	x	-	-
Dioclea violacea Mart. ex Benth.	twi	-	-	-	-	-	-	-	x	-	-
Dioclea virgata (Rich.) Amshoff	twi	-	-	-	x	-	-	-	-	-	-
Galactia striata (Jacq.) Urb.	twi	-	-	-	-	-	-	-	-	x	-
Machaerium dimorphandrum Hoehne	scr	-	-	-	-	-	-	x	-	-	-
Machaerium oblongifolium Vogel	scr	-	x	-	x	-	-	-	-	-	x
Machaerium uncinatum (Vell.) Benth.	scr	-	-	x	-	-	-	-	-	-	-
Macroptilium atropurpureum (DC.) Urb.	twi	-	-	-	-	x	x	-	-	-	-
Macroptilium bracteatum (Nees & C. Mart.) Maréchal & Baudet	twi	-	-	-	-	-	x	-	-	-	-

Table 2. Continued...

Family and species	Climb*	ANG	ARA	BH	PF	RC	RP	SC	SG	SV	VAS
Mucuna pruriens (L.) DC.	twi	-	-	-	x	-	x	-	-	-	-
Phaseolus lunatus L.	twi	-	-	-	x	-	-	-	-	-	-
Rhynchosia phaseoloides (Sw.) DC.	twi	-	-	-	x	x	x	-	x	-	-
Teramnus uncinatus (L.) Sw.	twi	-	-	-	-	-	x	-	-	x	-
Vigna candida (Vell.) Maréchal, Mascherpa & Stainier	twi	-	-	-	-	-	-	-	x	x	-
Vigna caracalla (L.) Verdc.	twi	-	-	-	x	-	-	-	-	-	-
Vigna peduncularis (Kunth) Fawc. & Rendle	twi	-	-	-	x	-	-	-	-	-	-
LOGANIACEAE											
Strychnos brasiliensis (Spreng.) Mart.	scr	-	-	x	-	-	-	-	-	-	-
MALPIGHIACEAE											
Banisteriopsis adenopoda (A.Juss.) B.Gates	twi	x	x	x	-	-	-	-	x	-	x
Banisteriopsis anisandra (A.Juss.) B.Gates	twi	-	-	x	-	-	-	-	x	x	-
Banisteriopsis argyrophylla (A.Juss.) B.Gates	twi	-	-	x	-	-	x	-	x	-	-
Banisteriopsis lutea (Griseb.) Cuatrec.	twi	-	x	-	x	-	-	-	x	-	x
Banisteriopsis muricata (Cav.) Cuatrec.	twi	-	-	-	-	x	x	-	x	-	-
Banisteriopsis nitrosiodora (Griseb.) O'Donell & Lourteig	twi	-	-	-	-	-	x	-	-	-	-
Banisteriopsis oxyclada (A.Juss.) B.Gates	twi	x	x	x	x	-	x	-	-	x	x
Banisteriopsis pubipetala (A.Juss.) Cuatrec.	twi	-	-	x	-	-	x	-	x	-	-
Dicella bracteosa (A.Juss.) Griseb.	twi	-	x	-	-	x	-	-	x	x	x
Heteropterys aceroides Griseb.	twi	-	-	-	x	-	-	-	x	-	-
Heteropterys acutifolia A.Juss.	twi	-	-	-	-	-	-	-	x	-	-
Heteropterys argyrophaea A.Juss.	twi	-	-	-	x	-	-	-	-	-	-
Heteropterys bicolor A.Juss.	twi	-	-	-	-	-	-	-	x	-	-
Heteropterys byrsonimifolia A.Juss.	twi	-	x	-	-	-	-	-	-	-	-
Heteropterys campestris A.Juss.	twi	-	-	x	-	-	-	-	-	-	-
Heteropterys dumetorum (Griseb.) Nied.	twi	-	-	-	x	-	x	-	-	-	-
Heteropterys escalloniifolia A.Juss.	twi	-	-	x	x	-	-	-	-	-	-
Heteropterys intermedia (A.Juss.) Griseb.	twi	-	x	-	-	-	-	-	-	-	-
Heteropterys pauciflora A.Juss.	twi	-	-	-	-	-	-	x	x	-	x
Janusia guaranitica (A.St.-Hil.) A.Juss.	twi	-	-	-	-	-	x	-	-	-	-
Mascagnia anisopetala (A.Juss.) Griseb.	twi	-	-	-	-	-	-	-	x	x	x
Mascagnia chlorocarpa (A.Juss.) Griseb.	twi	-	-	-	x	-	x	x	-	-	x
Mascagnia cordifolia (A.Juss.) Griseb.	twi	-	x	x	-	x	x	-	x	-	x
Mascagnia lasiandra (A.Juss.) Nied.	twi	-	x	-	-	-	-	-	-	-	-
Mascagnia sepium (A.Juss.) Griseb.	twi	-	-	-	-	-	-	-	x	-	-
Peixotoa paludosa Turcz.	twi	-	-	x	-	-	-	-	-	-	-
Peixotoa reticulata Griseb.	twi	-	-	-	-	-	x	-	-	-	-
Stigmaphyllon lalandianum A.Juss.	twi	-	x	-	-	-	-	x	x	-	x
Stigmaphyllon puberulum Griseb.	twi	-	-	-	x	-	-	-	-	-	-
Stigmaphyllon tomentosum A.Juss.	twi	-	-	-	-	-	-	-	-	-	x
Tetrapterys chamaecerasifolia A.Juss.	twi	-	-	x	-	-	-	-	-	-	-
Tetrapterys guilleminiana A.Juss.	twi	-	-	-	-	-	-	x	x	x	x
Tetrapterys multiglandulosa A.Juss.	twi	x	-	-	-	-	-	-	-	-	x
Tetrapterys phlomoides (Spreng.) Nied.	twi	-	x	-	-	-	-	-	-	-	-
Tetrapterys ramiflora A.Juss.	twi	-	-	-	-	-	-	-	-	-	x
Tetrapterys xylosteifolia A.Juss.	twi	-	-	-	-	-	-	-	x	-	-
MALVACEAE											
Byttneria australis A.St.-Hil.	scr	-	x	-	-	-	-	-	-	-	-
Byttneria catalpifolia Jacq.	scr	-	x	-	-	-	-	-	x	-	x

Table 2. Continued...

Family and species	Climb*	ANG	ARA	BH	PF	RC	RP	SC	SG	SV	VAS
Byttneria laevigata Schott ex Pohl	scr	-	-	x	-	-	-	-	-	-	-
MARCGRAVIACEAE											
Marcgravia polyantha Delpino	scr	-	-	-	-	x	-	-	-	-	-
MENISPERMACEAE											
Cissampelos andromorpha DC.	twi	-	x	-	x	-	-	-	-	-	-
Cissampelos glaberrima A.St.-Hil.	twi	-	x	-	x	x	x	-	x	x	-
Cissampelos pareira L.	twi	-	x	-	x	-	x	-	-	-	x
Odontocarya acuparata Miers	twi	-	x	-	-	-	-	-	-	-	-
NYCTAGINACEAE											
Bougainvillea spectabilis Willd.	scr	-	-	x	-	-	-	-	-	-	-
Pisonia aculeata L.	scr	-	-	-	-	-	-	-	x	-	-
PASSIFLORACEAE											
Passiflora amethystina J.C.Mikan	ten	-	x	-	x	-	-	-	x	-	-
Passiflora capsularis L.	ten	x	x	-	-	x	-	-	-	x	-
Passiflora cincinnata Mast.	ten	-	-	-	-	-	x	-	-	-	-
Passiflora foetida L.	ten	-	-	-	-	x	x	-	-	-	-
Passiflora galbana Mast.	ten	-	-	x	-	-	-	-	-	-	-
Passiflora miersii Mart.	ten	-	-	-	-	-	x	-	x	-	-
Passiflora sidiifolia M.Roem.	ten	-	-	-	-	x	-	-	-	x	-
Passiflora suberosa L.	ten	-	-	-	-	x	x	-	x	x	-
Passiflora tricuspis Mast.	ten	-	-	-	x	-	x	-	-	-	-
Passiflora vespertilio L.	ten	-	-	-	-	-	-	-	x	-	-
PIPERACEAE											
Sarcorhachis obtusa (Miq.) Trel.	twi	-	-	-	-	-	-	-	-	x	-
POLYGALACEAE											
Bredemeyera floribunda Willd.	scr	x	x	x	x	-	x	-	-	-	-
Diclidanthera laurifolia Mart.	twi	-	x	-	-	x	-	-	x	-	-
Securidaca sellowiana Klotzsch	ten	x	-	-	x	-	-	-	-	-	-
RANUNCULACEAE											
Clematis dioica L.	twi	x	x	x	-	x	-	-	x	x	x
Gouania latifolia Reissek	ten	-	x	-	-	-	-	-	x	-	-
Gouania ulmifolia Hook. & Arn.	ten	x	-	-	-	-	x	-	-	-	-
Gouania virgata Reissek	ten	-	x	-	x	x	x	-	x	x	x
ROSACEAE											
Rubus brasiliensis Mart.	scr	-	-	-	-	-	-	-	-	x	-
Rubus urticifolius Poir.	scr	-	x	-	-	-	-	-	-	-	-
RUBIACEAE											
Chiococca alba (L.) Hitchc.	scr	-	x	x	x	x	x	-	x	x	-
Coccocypselum lanceolatum (Ruiz & Pav.) Pers.	scr	x	-	-	-	-	-	-	-	-	-
Coutarea hexandra (Jacq.) K.Schum.	scr	-	-	-	-	x	-	-	-	-	-
Manettia cordifolia Mart.	twi	x	x	-	x	x	x	-	x	-	x
Manettia luteorubra (Vell.) Benth.	twi	-	-	-	-	-	-	-	-	-	x
SAPINDACEAE											
Cardiospermum corindum L.	ten	-	-	-	-	-	x	-	-	-	-
Cardiospermum grandiflorum Sw.	ten	-	x	-	x	-	x	-	x	x	-
Paullinia elegans Cambess.	ten	-	x	-	-	-	x	-	-	-	x
Paullinia firma Radlk.	ten	-	-	-	x	-	-	-	-	-	-
Paullinia meliifolia Juss.	ten	x	-	-	-	-	-	-	-	x	x
Paullinia pinnata L.	ten	-	-	-	-	-	-	-	x	-	-
Paullinia rhomboidea Radlk.	ten	-	-	-	-	x	-	-	x	-	x
Paullinia seminuda Radlk.	ten	-	-	-	-	x	-	-	-	-	-

Table 2. Continued...

Family and species	Climb*	ANG	ARA	BH	PF	RC	RP	SC	SG	SV	VAS
Paullinia spicata Benth.	ten	-	x	-	-	x	x	-	-	-	x
Paullinia trigonia Vell.	ten	-	-	-	-	-	-	-	-	x	-
Serjania caracasana (Jacq.) Willd.	ten	-	x	-	x	x	x	x	x	x	x
Serjania communis Cambess.	ten	-	-	-	x	-	-	-	x	x	-
Serjania elegans Cambess.	ten	x	-	-	-	-	-	-	-	-	-
Serjania fuscifolia Radlk.	ten	-	x	-	-	x	-	-	-	-	x
Serjania glabrata Kunth.	ten		x	-	-	-	-	-	-	-	-
Serjania hebecarpa Benth.	ten	-	-	-	x	-	x	-	x	-	-
Serjania laruotteana Cambess.	ten	-	x	-	x	x	x	x	-	-	x
Serjania lethalis A.St.-Hil.	ten	-	x	x	x	x	x	-	-	-	x
Serjania meridionalis Cambess.	ten	x	x	-	-	x	x	-	-	-	x
Serjania multiflora Cambess.	ten	x	-	-	-	-	x	-	x	x	-
Serjania paradoxa Radlk.	ten	-	-	-	-	-	-	-	-	-	x
Serjania perulacea Radlk.	ten	-	-	-	-	-	-	-	-	x	-
Serjania reticulata Cambess.	ten	x	x	-	-	-	-	-	x	-	-
Serjania tristis Radlk.	ten	-	-	-	-	-	x	-	-	-	-
Thinouia mucronata Radlk.	ten	-	-	-	-	-	-	x	x	-	-
Urvillea laevis Radlk.	ten	-	x	-	x	x	x	x	x	x	x
Urvillea ulmacea Kunth	ten	x	x	-	-	x	x	x	x	x	x
Urvillea uniloba Radlk.	ten	-	-	-	x	x	-	-	-	-	-
SMILACACEAE											
Smilax brasiliensis Spreng.	ten	-	-	-	-	-	-	-	x	-	-
Smilax campestris Griseb.	ten	x	-	-	-	x	x	-	x	-	-
Smilax elastica Griseb.	ten	-	x	-	-	-	-	-	x	-	-
Smilax fluminensis Steud.	ten	-	x	-	-	-	x	-	x	x	-
Smilax polyantha Griseb.	ten	-	-	-	-	-	x	-	-	-	-
Smilax rufescens Griseb.	ten	-	x	-	-	-	-	-	-	-	-
Smilax spicata Vell.	ten	x	-	-	-	-	-	-	-	-	-
SOLANACEAE											-
Solanum alternatopinnatum Steud.	scr	-	x	-	x	-	-	-	-	-	-
Solanum concinnum Sendtn.	scr	-	-	-	-	-	-	-	x	-	-
Solanum pabstii L.B.Sm. & Downs	scr	-	-	-	-	-	-	-	x	-	-
Solanum swartzianum Roem. & Schult.	scr	-	x	-	-	-	-	-	-	-	-
Solanum wendlandii Hook.f.	scr	-	-	-	-	-	-	-	x	-	-
TRIGONIACEAE											
Trigonia nivea Cambess.	twi	x	-	-	-	x	-	-	x	x	-
VERBENACEAE											
Aloysia virgata (Ruiz & Pav.) Pers.	scr	-	x	-	-	-	-	-	-	-	-
Petrea volubilis L.	scr	x	x	-	-	x	x	-	x	x	-
VIOLACEAE											
Anchietea pyrifolia A.St.-Hil.	twi	x	-	x	-	-	-	-	-	x	-
Anchietea salutaris A.St.-Hil.	twi	-	-	-	-	-	-	-	x	-	-
VITACEAE											
Cissus campestris (Baker) Planch.	ten	-	-	-	x	-	-	-	-	-	-
Cissus erosa Rich.	ten	-	-	-	x	-	x	-	-	-	-
Cissus serroniana (Glaz.) Lombardi	ten	-	x	-	-	-	-	-	-	-	-
Cissus simsiana Schult. & Schult.f.	ten	-	-	-	-	-	-	-	-	x	-
Cissus subrhomboidea (Baker) Planch.	ten	-	-	-	-	-	x	-	-	-	-
Cissus sulcicaulis (Baker) Planch.	ten	-	x	-	-	-	-	-	-	-	-
Cissus verticillata (L.) Nicolson & C.E.Jarvis	ten	-	x	-	-	x	x	-	x	-	-

Table 3. Characteristics of liana species composition in ten semideciduous forest sites of Southeastern Brazil. Sites legend as in Table 1 and Figure 1.

Tabela 3. Características da composição florística de lianas nos dez fragmentos de floresta estacional semidecidual estudados no sudeste do Brasil. Siglas dos fragmentos como na Figura 1 e Tabela 1.

	Forest sites										
	ANG	**ARA**	**BH**	**PF**	**RC**	**RP**	**SC**	**SG**	**SV**	**VAS**	**Total**
Richness[a]											
Liana species	48	138	39	96	79	104	39	135	69	94	355
Families	22	32	17	23	27	24	8	32	27	20	43
Exclusive species	9	34	13	25	7	22	3	35	11	16	175
Tree species[b]	188	162	-	87	175	-	109	250	202	-	-
Richest families[a,c]											
Bignoniaceae	9	29	9	15	16	13	18	22	12	24	45
Fabaceae	2	3	3	21	6	11	5	7	6	3	42
Malpighiaceae	3	10	10	8	3	10	4	17	5	13	36
Asteraceae	6	17	3	1	5	3	0	12	7	7	31
Apocynaceae	1	9	1	7	6	11	2	11	1	7	29
Climbing mechanisn[a]											
Tendril climbers	21	57	13	39	38	45	25	48	32	43	121
Twiners	18	56	19	49	32	53	9	70	28	41	178
Scramblers	9	25	7	8	9	6	5	17	9	10	56

[a] = number of species; [b] = Number of tree species for referred site compiled from ANG: Torres (1989); ARA: Pagano & Leitão Filho (1987); PF: Rezende et al. (2007); RC: Santos and Kinoshita (2003); SC: Hora (1999); SG: Morellato (1995); [c] = rankof the five richest family when considering all the sites pulled together, and the number of species of these families occurring in each forest site; - = non availiable information.

[a] = número de espécies; [b] = número de espécies arbóreas encontradas no referido fragmento compilado de ANG: Torres (1989); ARA: Pagano & Leitão Filho (1987); PF: Rezende et al. (2007); RC: Santos & Kinoshita (2003); SC: Hora (1999); SG: Morellato (1995); [c] = ranking das famílias mais ricas quando considerado o total de espécies encontradas em todos os fragmentos e o número de espécies dessas famílias em cada uma das áreas; - = informação não disponível.

Cucurbitaceae (14), Passifloraceae (10), and Euphorbiaceae (8). These families contributed to 74.4% of the total species richness, whereas another 20 families were represented by only one or two species. The set of richest families varied little between the analysed forest sites (Table 3).

The contribution of the climbing species to the total number of wood species recorded on the examined forests ranged from 20.3% to 52.5% (Table 3). The exclusive species i.e., those occurring in only one forest site, accounted for 49.3% (175 species) of the total recorded (Table 3), 17.2% were present in two sites and 11% of the species occurred in three sites. Only one species, *Macfadyena unguis-cati* (L.) A.H.Gentry was common to all the studied forests.

The commonest climbing method within forest sites were main stem or branch twining, accounting for 178 species or 50.1% of the total recorded, followed by tendril climbing (121 species, 34.1%), and scrambling (56 species, 15.8%). Comparing the mean proportion of species (±95% confidence interval) in climbing mechanisms among forest sites, we found that 12.7% (+3.3 –3.01%) were scramblers, 44.1% (+6.1 –6.0%) were tendril climbers, and 42.7% (+6.5 –6.4%) were twiners. The proportions of species in climbing mechanisms varied little among forest sites (Table 3). The highest proportion of twiners was observed at Santa Genebra (SG) and the lowest at São Carlos (SC) (Table 3).

The mean (±SE) similarity among forest sites was 30.2% (+1.45 –1.47%), ranging from 14.8 to 52.6%. The NMS ordination of the ten forest sites based on presence/abcence of climbing species showed a cluster including 9 forest sites (Figure 2). Only Belo Horizonte (BH) forest site appeared isolated from the others. The NMS ordination represented 81.4% of the variation in the dataset, with 59.2% loaded on axis 1 and 22.2% on axis 2.

Figure 2. Two-dimensional MNS plot for the 10 semideciduous forest sites of southeastern Brazil. Sites legend as in Table 1 and Figure 1.

Figura 2. Ordenação bidimensional MNS obtida para os dez fragmentos de floresta estacional semidecidual estudados no sudeste do Brasil. Siglas dos fragmentos como na Figura 1 e Tabela 1.

Discussion

Climbing species composition is described to be a function of stand age, geographical location, altitude and disturbance (DeWalt et al. 2000, Laurance et al. 2001, Parthasarathy et al. 2004). In our ordination analysis the geographical location appears to play a major role on the observed similarity among forests, since the only forests plotted separated from all others (BH) is also the one located farthest apart geographically. Our results corroborate those found by Rezende & Ranga 2005, which compared some of the floristic inventories (including BH), using Jaccard index and clustering analysis UPGMA.

The list of the most speciose families on forest sites confirms partially Gentry's (1991) predictions that the communities of climbers in the neotropics may vary little from one forest site to another, in terms of floristic composition of families, with Bignoniaceae and/or Fabaceae almost always among the richest families. Bignoniaceae was the richest family in nine out of ten forest sites examined in the present study. Fabaceae was the second richest family when considering all the sites together, but it did not figured within the five richest families in every forest site, for instance in Araras (ARA) and Vassununga (VAS) this family presented only three species, figuring in tenth and eighth place in the ranking of the richest families, respectively. Gentry (1995) suggested that the Bignoniaceae tend to be the richest family in climbing species in neotropical forests with a strong dry season, such as the semideciduous forest of Southeastern Brazil. This family is the fifth richest family in climbing species in the neotropics (Gentry 1991). The largest Bignoniaceae tribe, Bignonieae, includes nearly half of the genera (47 of 104) and more than one third of the family's species (360 of 860) (Lohmann 2006). The entire tribe is composed exclusively or predominantly by tendrillate lianas and most of them are represented within Brazilian limits, having probably evolved there (Gentry 1980). It is possible that these factors are correlated with the high diversity of family Bignoniaceae on studied sites.

The proportion of species comprised by the ten richest families (74.4%) is in accordance to what has been reported for the neotropics (64-69%; Gentry 1991, DeWalt et al. 2000), and again confirms Gentry (1991) predictions.

Twining is frequently cited as the most common climbing method within liana communities, being the most species diverse and also the most abundant (Putz & Chai 1987, Hegarty & Caballé 1991, DeWalt et al. 2000, Laurance et al. 2001, Parthasarathy et al. 2004). Our results agreed with this when considering the whole pool of species, but when analyzing forest sites separately, we found that tendril species predominated over twiners in six locations. Campanello et al. (2007) also found tendril climbers as a majority of species in an Atlantic Forest patch in Argentina. The high proportion of tendril climbers in most of the studied sites is also an effect of the large amount of Bignoniaceae species in the data, since most of them are tendrilate species. Nonetheless, the supremacy of twinners and tendrilate species over scrambler species was found in all the studied sites and in most tropical forests elsewhere (Hegarty & Caballé 1991). The absence of obviously specialized climbing organs in scrambler species is pointed out by Gentry (1991) as the possible reason for their relatively lower success than twinners and tendrilate species. According to Putz (1984), the main factor influencing the richness and abundance of different climbing mechanisms seems to be the support availability. Twiners can climb larger supports than do tendril climbers. Thus, forests with high density of small stems, characteristic of the earlier sucessional stages and gaps, tend to present a larger proportion of tendril climbers, while in mature forests twiners may be more successful due to their ability to climb larger supports (DeWalt et al. 2000, Laurance et al. 2001). Nonetheless, further investigation with appropriate designed experiments is required to address this question properly in semideciduous forests.

Climbing species contributed for up to 52.5% of the total wood plant species recorded on the studied sites. According to Gentry & Dodson (1987) lianas can account for up to 25% of wood stem diversity on tropical forests. Thus, the climbers' contribution to the total wood species richness in some sites, such as RC, PF, and ARA, can be considered high. As stated by Udulutsch et al. (2004), it is evident that climbers may represent a great proportion of the species richness in semideciduous forests of Southeastern Brazil, which clearly enforces the need for further investigations and the conservation value of these forest fragments.

Comparisons among forest inventories differing in sampling methods are always difficult and should be interpreted with caution. Therefore, further investigation, especially with the inclusion of quantitative data, is strongly recommended to enhance the knowledge on lianas communities in semideciduous forests of Southeastern Brasil. Nevertheless, the high liana species contribution to the total wood plant richness found here, allied to the observation that almost half of species were present in just one site (49.3%), and the low mean similarity between analyzed forests indicates the importance of liana communities to the plant diversity in semideciduous forests of Southeastern Brazil. Climbing species appeared to compose unique floras in each forest site, enhancing the regional diversity and the conservation value of forest remnants.

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