FORMATIONS OF COASTAL FORESTS IN THE AMAZON AND ECOLOGICAL RELATIONS WITH VASCULAR EPIPHYTES[1]

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ABSTRACT – Was investigated the vascular epiphytes and relate it to the composition and structure of the arboreal component in two formations of coastal forests in the Algodoal-Maiandeua Environmental Protetion Area, Maracanã, Pará, Brazil. We demarcated four 50m x 50m parcels (two in a dry forest and two in a flooding forest). Were registered and identified all the vascular epiphytes as well as their phorophytes. The abundance and richness of epiphytes were evaluated by the epiphyte/phorophyte ratio and differences in the use of phorophytic species by epiphytes were verified using a MDS. To analyze the influence of phorophyte diameter and height we used a multiple regression. In the dry forest we registered 193 arboreal individuals, of which 96 were phorophytes. *Anacardium occidentale* was the most abundant arboreal and phorophyte species as well. In the flooding forest we registered 234 arboreal individuals, 131 phorophytes. The most abundant arboreal species were also the ones with the greater number of phorophytes. In both forests the phorophytes were occupied in different ways by the epiphytes. No significant relation was found between phorophyte diameter and height and epiphytes abundance in the dry forest, nevertheless, there was a significant relation in the flooding forest.

Keywords: Ecological interactions; Epiphytism; Environmental Protection Area.

FORMAÇÕES FLORESTAIS DE RESTINGA AMAZÔNICA E AS RELAÇÕES ECOLÓGICAS COM EPÍFITAS VASCULARES

RESUMO – O objetivo foi investigar a flora de epífitas vasculares e relacionar com a composição e a estrutura do componente arbóreo em duas formações florestais de restinga. Foram demarcadas quatro parcelas de 50m x 50m (duas em floresta de restinga seca e duas em floresta de restinga inundável) e registradas as epífitas vasculares bem como seus respectivos forófitos. A abundância e riqueza de epífitas sobre a comunidade arbórea foram avaliadas pelo cálculo de razão epífita/forófito e diferenças no uso das espécies forofíticas pelas epífitas foram verificadas pela análise de NMDS. Para verificar a influência do diâmetro e da altura do forófito na abundância de epífitas vasculares, realizou-se uma análise de regressão múltipla. Na Floresta de restinga seca foram registrados 193 indivíduos arbóreos, destes 96 eram forófitos e ***Anacardium occidentale*** *em maior abundância. Na floresta de restinga inundável foram registrados 234 indivíduos arbóreos e 131 forófitos. As espécies arbóreas mais abundantes foram também as que apresentaram maior número de forófitos. Em ambas as florestas os forófitos são ocupados de forma diferente pelas epífitas vasculares. Não foi encontrada relação significativa entre o diâmetro e a altura do forófito para a floresta de restinga seca, contudo, houve relação para a floresta de restinga inundável. As epífitas, na APA Algodoal-Maiandeua, ocupam de forma diferente os forófitos. As espécies arbóreas mais abundantes são as que possuem maior número de forófitos e maior abundância de epífitas, com algumas espécies estando mais disponíveis à ocupação pelas epífitas. O diâmetro e a altura não foram variáveis explicativas da abundância de epífitas.*

Palavras-chave: Interações ecológicas; epifitismo; Área de Proteção Ambiental.

1. INTRODUCTION

The coastal forests consist in a plant formations mosaic, differentiated in structure and floristic, with the occurrence herbaceous and shrubby plants to the arboreal ones, which are often found close to each other in areas with distinct topography (Martins et al., 2008; Menezes et al., 2010). At the Amazon, they occupy an estimated area of 1000 km², that corresponds to less than 0.1% of the others vegetation types (Amaral et al., 2008) and even with the low territorial representation it is still poorly studied regarding its floristic composition and respective ecological interactions.

The importance of ecological interactions in tropical forests has motivated several studies aiming to understand the forests canopy functionality and their relations with other organisms. Among these, with the vascular epiphytes, that are plants engaged in a commensal relation with other plants (phorophytes) use them only as supporter and for fixation, without the direct removal of nutrients (Giongo and Waechter, 2004; Mania and Monteiro, 2010).

Studies with epiphytes revealed that normally, the number of species increases with the size (diameter and height) of the host tree (phorophyte) (Zotz and Vollrath, 2003; Flores-Palacios and Garcia-Franco, 2006; Laube and Zotz, 2006; Bonnet et al., 2010). However, Kersten et al. (2009) observed in a epiphytic community at the coastal forest of the Mel Island, Paraná state, southern Brazil, that in only in three of 10 phorophytes was verified that the epiphytes abundance increased with the phorophyte size affirming that this is not a pattern found all along the community.

The vascular epiphytes are important at the forest dynamics, for they contribute to the biological diversity in terms of richness and biomass (Gentry and Dodson, 1987; Dettke et al., 2008), as resource source for canopy animals and in nutrient cycling (Benzing, 1990). However forest management plans, are usually restricted to the arboreal component, registering epiphytes as elements interacting with the local floristic and faunal biodiversity. In this sense Fontoura et al. (2009) considered relevant to investigate the relations between the arboreal and epiphytic community to establish ecological indicators for management strategies in different regions.

This work aimed to investigate the vascular epiphyte flora and relate it to the structure and component of the arboreal component in two coastal forest formations at the Algodoal-Maiandeua Environmental Protection Area.

2. MATERIAL AND METHODS

The Algodoal-Maiandeua Environmental Protection Area is located at Maracanã town, at the northeastern coast of Pará state (00º38’29"S e 47º31’54" W). The region climate is tropical humid of the Awi type according to Köppen’s classification, with average maximum annual temperature of 31.7°C and annual minimum of 25.2°C, with a average pluviometric index annual value close to 2800mm (Jardim et al., 2013). The plant formations found in the area are: Mangrove, ‘Secondary forest’, Saline field, Shrub field, Beach/Dune sandy barrier, Dune fields, Interdune spaces and Forestry areas with minor extensions (Jardim et al., 2013).

The forestry formations in this coastal forest were described based in Amaral et al. (2008) and Jardim et al. (2013) and with in loco observations such as: a) dry forest: it has a topographic level from a bit plane to undulated; a very sandy soil with pH equal to 4.95, organic matter content (69.46 $g.kg^{-1}$),concentrations of phosphorus (12,58 $mg.dm^{-3}$), nitrogen (0.83 $g.kg^{-1}$) and iron (69.5 $mg.dm^{-3}$); regular luminosity; leaf biomass is high over the ground surface and with dominance of *Anacardium occidentale* L., *Pouteria ramiflora* (Mart.) Radlk., *Pradosia pedicellata* (Ducke) Ducke and *Myrcia rufipila* McVaugh.and; b) Flooding forest: with a plane topography but there are some flooded depressions mainly at the rainy season of the region; the soil is less sandy with pH equal to 4.36, organic matter content (57.67 $g.kg^{-1}$), concentrations of phosphorus (2.58 $mg.dm^{-3}$), nitrogen (0,83 $g.kg^{-1}$) and iron (7.5 $mg.dm^{-3}$); very shady with little light incidence; high leaf biomass over the ground surface and with dominance of *Virola surinamensis* (Rol. ex Rottb.) Warb., *Symphonia globulifera* L. f., *Macrolobium pendulum* Willd. ex Vogel and *Euterpe oleracea* Mart) those are characteristic species of other flooding areas in the Amazon (Jardim and Vieira, 2001; Batista et al., 2011; Maués et al., 2011).

In the period from August 2011 to january 2012 three parcels of 50 x 50 m (0.75ha) were demarcated in the dry forest (P1 - 00º35’15,2"S, 47º34’21"W; P2 - 00º35’8,4"S, 47º34’24,7"W and P4 - 00º36’10,0"S and 47º34’2,8W) and two parcels 50 x 50m corresponding to 0.50 ha in the flooding forest (P3 - 00º36’34,1" S, 47º34'39,3" W and P5 - 00º36'35,5" S e 47º34'34,2" W) totalizing 1.25 ha of forest.

All the trees (denominated phorophytes) with a diameter at breast height (DBH) ≥10 cm, with presence or absence of epiphytes were registered and identified in loco, with the help of a parataxonomist. The epiphytes, if possible, were identified in loco too. Epiphytes and phorophytes with difficulties of identification were photographed and/or collected for posterior identification using identification keys, consults to the specialized literature or presented to experts and for comparison at the Herbarium João Murça Pires (MG).We used binoculars and free climbing, when necessary, for better visualization of the species.

The epiphyte abundance was noted as the number of times that the species was observed over the phorophyte and was based in the number of groups formed, without considering the constituent branches. The phorophytes, on the other hand, were analyzed for DBH, height (estimated), epiphytes abundance and richness.

The abundance and richness of epiphytes over the arboreal community were evaluated by the ratio between epiphytes and phorophytes, dividing: a) the epiphytes abundance by the phorophytes abundance belonging to the arboreal species *x*; and b) the epiphytes richness by the phorophytes abundance belonging to the arboreal species *x*. Epiphytes abundance or richness ratios > 2 were considered high, as suggested by Fountoura et al. (2009).

To investigate differences in the use of phorophytes species by the epiphytes, we constructed similarity matrixes using the Bray-Curtis index as distance measurement, based on the abundance data, which were transformed into relative abundance to reduce the dominant species bias. After that we ordinated the data using a non-metric multidimensional scaling (MDS), that calculates the stress between the similarity matrixes and ordination produced in the graphic representations of the axis. In this study, we found a stress close 0.1, which corresponds to a good ordination, guarantying the good reliability in the interpretation of results. To evaluate the influence of phorophyte diameter and height on the abundance of vascular epiphytes we used a multiple regression (Sokal and Rohlf, 1995), using Sistat 11.0.

3. RESULTS

In the dry forest we registered 193 arboreal individuals, among these 96 were phorophytes. The more abundant arboreal species were *Anacardium occidentale* (32), *Pouteria ramiflora* (26), *Astrocaryum vulgare* (21) and *Tapirira guianensis* (20). Regarding phorophytes, stand out *A. occidentale* and *P. ramiflora* (17 each), followed by *Acacia farnesiana* (7), *Humiria balsamifera* (6) and by *P. pedicellata*, *T. guianensis*, *Parkia pendula* (5 each) (Table 1). The abundance and richness of epiphytes were greater at *A. ocidentale*, *P. ramiflora, Sacoglottis guianensis*, *H. balsamifera, A. farnesiana, P. pedicellata* and *Parkia pendula*. Regarding NE/NP ratio *S. guianensis, P. pedicellata*, *H. balsamifera, E. tapacumensis* stand out. The RE/NP was not ≥ 2 in none of the phorophytes (Table 1).

The phorophyte species in the dry forest formed distinct groups according to the similarity of specific species, thus, phorophytes that shared epiphytic species tended to be next to each other at the ordination (Figure 1). *Sacoglottis guianensis* (SAGU) stands out as it formed a separated group, because it was host to two epiphytic species (*Aechmea tocantina* Baker and *Serpocaulon triseriale* (Sw.) A.R. Sm.).

In the flooding forest we registered 234 arboreal individuals and 131 phorophytes. The more abundant arboreal species were *Virola surinamensis* (71), *Tapirira guianensis* (31), *Xylopia emarginata* (16), *Symphonia globulifera* (14), *Euterpe oleracea* and *Macrolobium pendulum* (13 each). All the species listed above, except for *Euterpe oleracea*, presented the greater number of phorophytes as well. The major epiphyte abundances were registered in *V. surinamensis* (97), *T. guianensis* (28), *S. globulifera* (16), *M. pendulum* (13) and *Xylopia emarginata* (11).*Virola surinamensis* and *T. guianensis* presented the major epiphyte richness too. Regarding the NE/NP ratio *Ocotea glomerata*, *Ilex inundata*, *O. nobilis*, *Symphonia globulifera* and *Licania heteromorpha* stand out. The RE/NP was not ≥ 2 in none of the phorophytes (Table 1).

The phorophytic species formed two well-distinct main groups according to phorophytes occupation, mainly, by the two more abundant epiphytes species. The phorophytes in which occurred only *Philodendrum muricatum* formed a group at graphic's right and the phorophytes in which occurred only *Philodendrum acutatum* formed a group at the graphics left. The

Table 1 – Calculated parameters of the phorophytic species in 0.50 ha of dry forest and flooding forest at the Algodoal-Maiandeua Environmental Protection Area, Maracanã, Pará. Number of trees (NI), number of phorophytes (NP), abundance of epiphytes (NE), ratio between epiphyte and phorophyte abundance (NE/NP), epiphyte richness (RE), ratio between epiphyte richness and phorophyte abundance (RE/NP).Table following the decreasing order of number of arboreal individuals.

***Tabela 1 –** Parâmetros calculados das espécies forofíticas em 0,50 ha de Floresta de Restinga Seca (FRS) e de Floresta de Restinga Inundável (FRI) da Área de Proteção Ambiental, Algodoal-Maiandeua, Maracanã, Pará. Número de árvores (NI), número de forófitos (NF), abundância de epífitas (NE), razão entre abundância de epífitas e de forófitos (NE/NF), riqueza de epífitas (RE), razão entre riqueza de epífitas e abundância de forófitos (RE/NF). Tabela por ordem decrescente de número de indivíduos arbóreos.*

Família	Espécies	FRS	FRI	NI	NF	NE	NE/NF	RE	RE/NF
Myristicaceae	*Virola surinamensis* (Rol. Ex Rottb.) Warb.	x		71	54	97	1,7	4	0,07
Anacardiaceae	*Anacardium occidentale* L.		x	32	17	25	1,4	2	0,1
Anacardiaceae	*Tapirira guianensis* Aubl.	x		31	17	28	1,6	2	0,1
Sapotaceae	*Pouteria ramiflora* (Mart.) Radlk.		x	26	17	25	1,4	3	0,1
Arecaceae	*Astrocaryum vulgare* Mart.		x	21	2	2	1	2	1
Anacardiaceae	*Tapirira guianensis* Aubl.		x	20	5	5	1	2	0,4
Annonaceae	*Xylopia emarginata* Mart.	x		16	6	11	1,8	2	0,3
Clusiaceae	*Symphonia globulifera*	x		14	8	16	2	2	0,2
Arecaceae	*Euterpe oleracea* Mart.	x		13	4	4	1	2	0,5
Fabaceae	*Macrolobium pendulum* Willd.ex Vogel	x		13	9	13	1,4	2	0,2
Fabaceae	*Ormosia coccinea* (Aubl.) Jacks.		x	12	1	1	1	1	1
Fabaceae	*Acacia farnesiana* Wall.		x	10	7	11	1,5	2	0,2
Arecaceae	*Astrocaryum vulgare* Mart.	x		8	2	2	1	1	0,5
Fabaceae	*Aniba citrifolia* (Nees) Mez	x		8	1	1	1	1	1
Apocynaceae	*Himatanthus articulatus* (Vahl) Woodson		x	8	0	0	0	0	0
Apocynaceae	*Malouetia tamaquarina* (Aubl.) A.DC.	x		7	4	4	1	2	0,5
Simaroubaceae	*Simaba amara* Aubl.	x		7	1	1	1	1	1
Humiriaceae	*Humiria balsamifera* Aubl.		x	6	6	12	2	3	0,5
Fabaceae	*Ormosia nobilis* Tul.	x		6	4	8	2	2	0,5
Ebenaceae	*Diospyros guianensis* (Aubl.) Gurke	x		6	2	2	1	1	0,5
Sapotaceae	*Pradosia pedicellata* (Ducke) Ducke		x	5	5	11	2,2	3	0,6
Fabaceae	*Parkia pendula* (Willd.) Benth. ex Walp.		x	5	5	8	1,6	3	0,6
Burseraceae	*Protium heptaphyllum* (Aubl.) Marchand		x	5	4	7	1,7	3	0,7
Aquifoliaceae	*Ilex inundata* Poepp. Ex Reissek	x		5	4	9	2,2	2	0,5
Lauraceae	*Ocotea glomerata* (Nees) Mez	x		4	3	9	3	3	1
Humiriaceae	*Humiria balsamifera* Aubl.	x		4	3	5	1,6	1	0,3
Chrysobalanaceae	*Licania macrophylla* Benth.	x		4	2	2	1	1	0,5
Fabaceae	*Aniba citrifolia* (Nees) Mez		x	4	0	0	0	0	0
Humiriaceae	*Sacoglottis guianensis* Benth.		x	3	3	15	5	4	1,3
Chrysobalanaceae	*Licania heteromorfa* Benth.	x		3	1	2	2	1	1
Burseraceae	*Protium ovatum* Engl.		x	3	3	5	1,6	2	0,6
Olacaceae	*Heisteria ovata* Benth.		x	3	3	4	1,3	2	0,6
Malpighiaceae	*Byrsonima crassifolia* (L.) Kunth		x	3	2	3	1,5	1	0,5
Fabaceae	*Copaifera martii* Hayne		x	3	2	2	1	2	1
Rubiaceae	*Pagamea guianensis* Aubl.		x	3	2	2	1	1	0,5
Annonaceae	*Unonopsis guatterioides* R.E.Fr.	x		2	2	3	1,5	2	1
Arecaceae	*Mauritia flexuosa* L.f.	x		2	2	2	1	2	1
Arecaceae	*Maximiliana maripa* (Aubl.) Drude	x		2	1	1	1	1	1
Opiliaceae	*Agonandra brasiliensis* Miers ex Benth. & Hook. f.		x	2	2	2	1	1	0,5
Myrtaceae	*Eugenia flavescens* DC.		x	2	2	2	1	2	1
Fabaceae	*Ormosia nobilis* Ducke	x		1	1	1	1	1	1
Myrtaceae	*Eugenia tapacumensis* O. Berg		x	1	1	2	2	1	1
Malvaceae	*Eriotheca globosa* (Aubl.) A. Robyns		x	1	1	1	1	1	1

Continue...
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Table 1...
Tabela 1...

Lecythidaceae	*Lecythis jarana* (Huber ex Ducke) A.C. Sm.		x	1	1	1	1	1	1
Sapotaceae	*Manilkara bidentata* (A. DC.) A. Chev.		x	1	1	1	1	1	1
Rutaceae	*Metrodorea flavida* K.Krause		x	1	1	1	1	1	1
Myrtaceae	*Myrcia cuprea* (O. Berg) Kiaersk.		x	1	1	1	1	1	1
Sapotaceae	*Pouteria cearensis* Baehni		x	1	1	1	1	1	1
Fabaceae	*Swartzia laevicarpa* Amshoff		x	1	1	1	1	1	1
Salicaceae	*Casearia javitensis* Kunth		x	1	0	0	0	0	0
Myrtaceae	*Eugenia multiflora* Lam.		x	1	0	0	0	0	0
Sapindaceae	*Cupania diphylla* Vahl		x	1	0	0	0	0	0
Apocynaceae	*Himathantus sucuuba* (Spruce ex Müll. Arg.) Woodson		x	1	0	0	0	0	0
Fabaceae	*Inga nobilis* Willd.		x	1	0	0	0	0	0
Chrysobalanaceae	*Licania octandra* (Hoffmanns. ex Roem. & Schult.) Kuntze		x	1	0	0	0	0	0
Arecaceae	*Maximiliana maripa* (Aubl.) Drude		x	1	0	0	0	0	0
Myrtaceae	*Myrcia atramentifera* Barb. Rodr.		x	1	0	0	0	0	0
Myrtaceae	*Myrcia fallax* (Rich.) DC.		x	1	0	0	0	0	0
Melastomataceae	*Mouriri collocarpa* Ducke	x		1	0	0	0	0	0
Melastomataceae	*Mouriri guianensis* Aubl.	x		1	0	0	0	0	0
Myrtaceae	*Myrcia fallax* (Rich.) DC.	x		1	0	0	0	0	0
Nyctaginaceae	*Neea oppositifolia* Ruiz & Pav.	x		1	0	0	0	0	0
Chrysobalanaceae	*Parinari excelsa* Sabine	x		1	0	0	0	0	0
Rubiaceae	*Posoqueria latifólia* (Rudge) Roem. & Schult.	x		1	0	0	0	0	0
Clusiaceae	*Tovomita brasiliensis* (Mart.) Walp	x		1	0	0	0	0	0
Total				427	227	372			

phorophytes species *Aniba citrifolia* (ANCI), *Virola surinamensis* (VISU), *Ocotea glomerata* (OCGL) and *Mauritia flexuosa* (MAFL) separated from the principal groups because they were host to both dominant species and/or epiphytes of exclusive occurrence (Figure 2).

In the multiple regression no significant relation between phorophyte diameter and height with the abundance of epiphytes at the dry forest (N:138; R^2: 0.038; F:2.641; P<0.075), even though, in the flooding forest this relation was significant (N:110; R^2: 0.060; F:3.433; P<0.036) showing that the increase of phorophyte diameter and height , the abundance of vascular epiphytes tends to increase.

4. DISCUSSION

By establishing a dependence relation with their hosts the vascular epiphytes are affected when these hosts are taken from the forestry environment (Barthlott et al., 2001; Borgo and Silva, 2003). So, in the flooding forest the five more abundant arboreal species were the ones with the greater number of phorophytes too, indicating exclusion of some individuals belonging to those species can produce slight effects in the epiphyte community, as a great number of individuals are serving as supporters.

In the dry forest, among the five more abundant epiphyte species only two presented a great number of phorophytes, indicating that the withdrawing of some species such as *Humiria balsamifera*, *Pradosia pedicellata* and *Parkia pendula*, can generate a reduction in the populations of vascular epiphytes, because 100% of their individuals were phorophytes and presented a high abundance and richness of epiphytes. Fact similar to that demonstrated by Fontoura et al. (2009) in the dry forest of Jacarepiá (RJ) where the arboreal species aggregated a high richness and abundance of epiphytes too. These same authors, emphasized yet the need for additional studies to confirm the effects of the removal of arboreal species on the epiphytic community.

With the identification of what phorophytic species have the larger or smaller epiphytes proportion imply that some species as *Sacoglottis guianensis*, *Pradosia pedicellata*, *Humiria balsamifera* in the dry forest and *Ocotea glomerata*, *Ilex inundata*, *Ormosia nobilis*

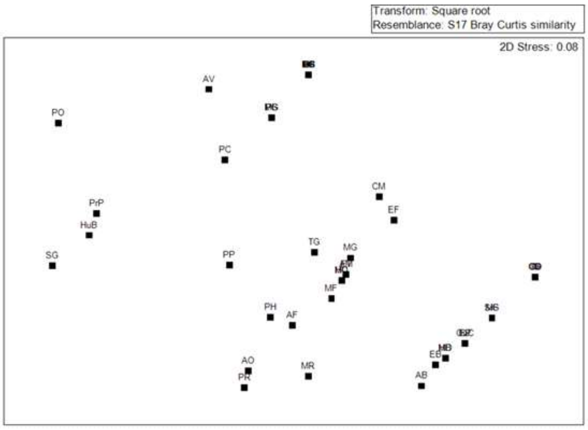

Figure 1 – Non-metric multidimensional scaling technic, showing the grouping patterns of phorofitc species in 0.50 ha of dry forest at the Algodoal-Maiandeua Environmental Protection Area, Maracanã, Pará. AO –Anacardium occidentale, PR – Pouteria ramiflora, SG – Sacoglottis guianensis, HuB –Humiria balsamifera, AF –Acacia farnesiana, PrP –Pradosia pedicellata, PP – Parkia pendula,PH – Protium heptaphyllum, PO – Protium ovatum, TG – Tapirira guianensis, HO – Heisteria ovata, BC – Byrsonima crassifolia, AB – Agonandra brasiliensis, AV – Astrocaryum vulgare, CM – Copaifera martii, EF - Eugenia flavescens, PG – Pagamea guianensis, EG – Eriotheca globosa, LJ – Lecythis jarana, MB – Manilkara bidentata, MF – Metrodorea flavida, MC – Myrcia cuprea, OC – Ormosia coccinea, PC – Pouteria cearensis, SL – Swartzia laevicarpa.

Figura 1 – *Técnica de escalonamento multidimencional não métrica, mostrando os padrões de agrupamento das espécies forofíticas da formação florestal de restinga seca. AO - Anacardium occidentale, PR - Pouteria ramiflora, SG - Sacoglottis guianensis, HuB - Humiria balsamifera, AF - Acacia farnesiana, PrP - Pradosia pedicellata, PP - Parkia pendula, PH - Protium heptaphyllum, PO - Protium ovatum, TG - Tapirira guianensis, HO - Heisteria ovata, BC - Byrsonima crassifólia, AB - Agonandra brasiliensis, AV - Astrocaryum vulgare, CM - Copaifera martii, EF - Eugenia flavescens, PG - Pagamea guianensis, EG - Eriotheca globosa, LJ - Lecythis jarana, MB - Manilkara bidentata, MF - Metrodorea flavida, MC - Myrcia cuprea, OC - Ormosia coccinea, PC - Pouteria cearensis, SL - Swartzia laevicarpa.*

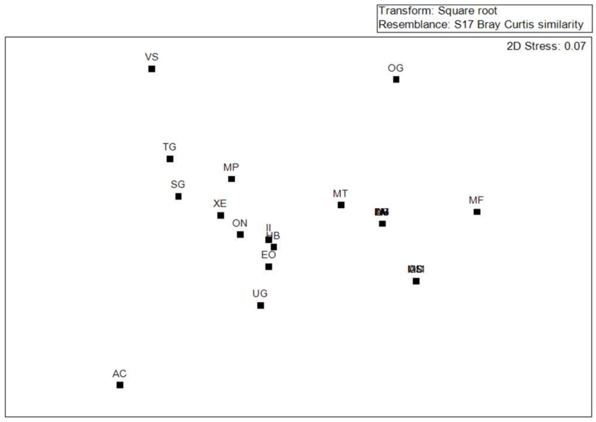

Figure 2 – Non-metric multidimensional scaling technic, showing the grouping patterns of the phorophytic species in 0.50 ha of flooding forest at the Algodoal-Maiandeua Environmental Protection Area, Maracanã, Pará.VS – Virola surinamensis, TG – Tapirira guianensis, SG – Symphonia globulifera, MP–Macrolobium pendulum, XE –Xylopia emarginata, II –Ilex inundata, OG – Ocotea glomerata, ON– Ormosia nobilis, HB – Humiria balsamifera, EO – Euterpe oleracea, MT – Malouetia tamaquarina, UG – Unonopsis guatterioides, AV – Astrocaryum vulgare, DG – Diospyros guianensis, LH – Licania heteromorpha, LM – Licania macrophylla, MF – Mauritia flexuosa, AC – Aniba citrifolia, MM – Maximiliana maripa, ON – Ormosia nobilis, SA – Simaba amara.

Figura 2 – *Técnica de escalonamento multidimencional não métrica, mostrando os padrões de agrupamento das espécies forofíticas da formação florestal de restinga inundável. VS - Virola surinamensis, TG - Tapirira guianensis, SG - Symphonia globulifera, MP - Macrolobium pendulum, XE - Xylopia emarginata, II - Ilex inundata, OG - Ocotea glomerata, ON - Ormosia nobilis, HB - Humiria balsamifera, EO - Euterpe oleracea, MT - Malouetia tamaquarina, UG - Unonopsis guatterioides, AV - Astrocaryum vulgare, DG - Diospyros guianensis, LH - Licania heteromorpha, LM - Licania macrophylla, MF - Mauritia flexuosa, AC - Aniba citrifolia, MM - Maximiliana maripa, ON - Ormosia nobilis, SA - Simaba amara.*

in the flooding forest are more inclined to host vascular epiphytes, because few individuals host a high proportion of species. Those host conditions can be related to the characteristics of these phorophytes such as rhytidome type, canopy size, inclination of branches, habitat selection by the dispersers that are acting on some species allowing a greater proportion of epiphytes (Gentry and Dodson, 1987; Nieder et al., 2000; Fontoura et al., 2009).

The MDS analysis clearly showed that the epiphyte community occupies different phorophitic species in different ways, both in the dry and flooding forests, making phorophytes to form groups that are expressed in a multivariate design. These patterns can be explained in the two forestry formations, overall by intrinsic characteristics common to phorophytes (type of rhytidome and architecture) that together operates to select some epiphyte species in spite of others (Gentry and Dodson, 1987).

The interspecific competition between the two dominant epiphyte species, make that, when one species establish itself in one phorophyte it precludes others to coexist Specifically to the flooding forest (Tilman, 1982).

The MDS analysis for both studied forests evidenced that some phorophytes species, for presenting exclusive epiphytes, were separated from the others in the ordination. Thus, corroborating what was discussed by Fontoura et al. (2009) that observed that some phorophytes are more inclined to host specific epiphytes and hence, acting as possible key species, perhaps being an ecological indicator to the conservation of vascular epiphytes.

As for to the influence of phorophytes diameter and height on the abundance of epiphytes, Zotz and Vollrath (2003) and Laube and Zotz (2006) in a flooded forest at Panama, Flores-Palacios and Garcýa-Franco (2006) in a submontane forest at Mexico, and Bonnet et al. (2010) in several forestry environments at Paraná state, Brazil, found relations between these variables. Those results corroborate that found for the flooding forest but disagree to those found for the dry forest. What might justify these differences is that the occurrence of a positive relation indicates that tree species are able to constantly host new epiphytic individuals and this pattern is expected for young forests where the trees are growing continually and generating new habitats for epiphytes (Flores-Palacios and Garcia-Franco, 2006).

In the flooded coastal forest, in spite of the existence of a positive relationship between diameter and height to epiphytes abundance, this relation is weak, suggesting that other variables, and not only the analyzed ones, may influence on the dynamics of the epiphytic community as well, as discussed and emphasized by several studies with the epiphytic flora (Gentry and Dodson, 1987; Nieder et al., 2000; Fontoura et al., 2009).

In a coastal forest at Paraná, Brazil, was observed that there is a relation between diameter and height with the epiphytes abundance, but it is not an universal pattern in the community. Among ten tree species studied only in three this relation was positive (Kersten et al., 2009).Then, to clarify the influence on the epiphytic community dynamics, is necessary to analyze a greater number of variables, because depending on the phorophytes taxonomic identity, some variables may or may not influence.

5. CONCLUSIONS

The epiphytes in the Algodoal-Maiandeua Environmental Protection Area, occupy the phorophytes in different ways. The more abundant arboreal species are the ones with a greater phorophytes number and epiphytes abundance, with some species being more available for epiphytes occupation. The diameter and height of phorophytes were not enough to explain the epiphytes abundance, because they were not significant for the dry forest and were significant for the flooding forest.

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