STRUCTURE OF 15 HECTARES PERMANENT PLOTS OF TERRA FIRME DENSE FOREST IN CENTRAL AMAZON[1]

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[1] Received on 24.10.2013 accepted for publication on 01.12.2015.
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ABSTRACT – Terra Firme dense forest occurs in 65% of the Amazonian region and is characterized by the high diversity of plant species and high occurrence of rare plant species. The objective of this work was to analyze the horizontal structure of 15 hectares of plots, randomly chosen from a set of 400 ha of permanent plots situated at the Experimental Site of Embrapa, Manaus, Amazonas State, Brazil. All individuals with DBH $\geq$ 10 cm were identified at the level of species in 2005. The VI values (Values of importance) were separated in classes of range with one (01) standard deviation and the individuals distributed according to DBH classes of 10 cm in amplitude. In total, 8771 individuals were identified, distributed into 264 species and 53 families. A larger number of individuals is concentrated in a few number of species, such as *Protium hebetatum* D.C. Daly, *Eschweilera coriacea* (DC.) S.A. Mori and *Licania oblongifolia* Standl, which sum up 21% of the total number of individuals and 12% of the VI. There is a high occurrence of rare species (36%). The families Sapotaceae, Lecythidaceae and Burseraceae together accounted for 39% of the total number of individuals. The diametric structure in an inverse-J shape shows that 80% of the individuals are concentrated in the DBH classes ranging from 10 to 30 cm. The results highlight the high occurrence of rare species and those with low density, and with distribution restricted to some plots, particularly those belonging to the lowest classes of VI, which deserve special attention in actions for biodiversity conservation and forest management.

Keywords: Phytosociology; Tree species; Amazon.

ESTRUTURA DO COMPONENTE ARBÓREO EM 15 HA DE PARCELAS PERMANENTES DE FLORESTA DENSA DE TERRA FIRME NA AMAZÔNIA CENTRAL

RESUMO – A floresta densa de terra firme ocorre em 65% da região Amazônica e é caracterizada por possuir alta diversidade de espécies vegetais e elevada ocorrência de espécies raras. Este trabalho analisou a estrutura horizontal de 15 ha de parcelas aleatoriamente selecionadas de um conjunto de 400 ha de parcelas permanentes, localizadas no Campo Experimental da Embrapa em Manaus, AM.Todos os indivíduos com DAP $\geq$ 10 cm foram identificados em nível de espécie em 2005. Os valores de VI (Valor de Importância) foram separados em classes de amplitude de um (01) desvio padrão e os indivíduos distribuídos segundo classes de DAP de amplitude de 10 cm. Ao todo foram identificados 8771 indivíduos, distribuídos em 264 espécies e 53 famílias. Um maior número de indivíduos concentra-se em poucas espécies, tais como ***Protium hebetatum*** *D.C.Daly,* ***Eschweilera coriacea*** *(DC.) S.A. Mori e* ***Licania oblongifolia*** *Standl. que somaram21% do número total de indivíduos e 12% do VI. Há elevada ocorrência de espécies raras (36%). As famílias Sapotaceae, Lecythidaceae*

e Burseraceae somaram 39% do número total de indivíduos. A estrutura diamétrica em forma de J-invertido mostra que80% dos indivíduos estão concentrados nas classes de 10-30 cm de DAP. Os resultados chamam a atenção para a elevada ocorrência de espécies raras e daquelas com baixa densidade, e com distribuição restrita a algumas parcelas, principalmente aquelas pertencentes às menores classes de VI, as quais devem merecer atenção especial nas ações de conservação da biodiversidade e manejo florestal.

Palavras-chave: Fitossociologia; Espécies arbóreas; Amazônia.

1. INTRODUCTION

Brazil, a country with approximately one-third of the remaining rain forests in the world, is one of the most important repositories of global biodiversity (PAS 2008). In the Amazon, many areas are formed by mosaic of habitats, with different sets of plant species occurring in adjacent areas on different substrates. It can be seen, in general, , that the distribution of tropical tree species can occur due to habitat preferences and/or variations in their evolutionary history (PITMAN et al., 2001; NOVAES FILHO et al., 2007).

The dynamics and structure of rain forests vary across the Amazon basin in an east-west gradient, following a pattern that matches variations in soil fertility (QUESADA et al., 2009). To describe these patterns of variation, using large data sets, such as those in the present study, is extremely important to enhance the understanding of the mechanisms that determine the distribution of species in nature (CORONADO et al., 2009).

About 65% of the Amazon region is covered by a forest type named *terra firme* dense forest. This plant typology is the most representative of the Amazon rainforest, mainly characterized by high richness and diversity of species with few individuals of each species and generally showing high dissimilarity floristic between adjacent plots (FERREIRA; PRANCE, 1998; LIMA FILHO et al., 2001; CONDÉ; TONINI, 2013).

Oliveira and Amaral (2004) reported the occurrence of 239 species in a study on one (01) hectare of *terra firma* dense forest in Manaus, evidencing the high diversity in this typology. Climatic and soil factors such as more humid climates and less seasonal and soils relatively fertile in nutrients, have been cited as possible responsible for a greater diversity of plants in the Western Amazon (GENTRY, 1988, QUESADA et al., 2009). Other authors such as Phillips et al. (1994) report the higher species richness to the natural dynamics of mortality of trees, where forests with high rates of mortality and recruitment would be more diversified.

Most studies in the Amazon uses, on average, one sample area of one (01) hectare for studies of floristic composition and structure. This study contributes to this subject, using a large data set. Thus, the objective of this study was to describe the horizontal structure of 15 hectares of *terra firma* dense forest in central Amazonia, Manaus, state of Amazonas, in order to contribute to enhance the knowledge on the organization of species in the community, therefore, helping in forest conservation actions and forest management in the Amazon.

2. MATERIALAND METHODS

2.1. Study area

The study area is located in a *terra firme* dense forest in Central Amazonia, in the Experimental Field of Embrapa Amazônia Ocidental, Manaus, in the state of Amazonas, Brazil, at the coordinates 2° 32' 12.75" S; 60°0'14.62" W. The area comprises the project developed in the scope of Rede de Monitoramento da Dinâmica de Florestas da Amazônia Brasileira-REDEFLOR (Monitoring Net of Brazilian Amazon Forest Dinamics).

The weather in the area is "Am" type according to Köppen classification, with annual rainfall of 1,355 to 2,839 mm. Average annual temperature is 27.6 °C, with air relative humidity ranging from 84 to 90% over the year. The most humid months are from December to May, and the driest ones are from July to October, when those months receive less than 100 mm of rain (RADAM, 1978).

The average altitude ranges from 60 to 160 m (REGIS, 1993).The predominant soils in the area are Yellow Latosol with texture ranging from more clayey on the plateaus to sandy in the lower parts. They are soils predominantly covered by vegetation of *terra firme* dense forest, with emergent canopy (IBGE, 1999), consisting of trees ranging from medium to large sizes, reaching up to 55 m of height (REGIS, 1993).

2.2. Data collection and analysis

The plots were delimited at random in the Experimental Field, representing 15 plots of 100 x 100 m. All individuals with diameter at breast height (DBH) e" 10 cm were labeled and botanically identified at the species level in 2005. The plant material was identified by means of comparisons with dried plants available in the herbarium of the Instituto Nacional de Pesquisas da Amazônia – INPA (National Institute of Amazonian Research) as well as by consulting the literature on native species of the Amazon (RIBEIRO et al., 1999). The botanical names were conferred at the Missouri Botanical Garden Web page (MOBOT, 2012), APGII system.

Calculation of the plant structural parameters, such as basal area (BA), absolute and relative dominance (ADo, RDo), abundance (N), absolute and relative density (AD, RD) and absolute and relative frequency (AF, RF) for the composition of the Importance Value Index (IVI) were obtained according to Mueller-Dumbois and Ellenberg (1974), calculated on Mata Nativa 2 software (CIENTEC, 2006). The estimate of the ecological importance of families in the evaluated community was calculated by the Family Importance Index (FII), calculated by the sum of the diversity (number of species of the family/total number of species), relative density and dominance (MORI; BOOM, 1983) using the Microsoft Excel for Windows. Classes of IV (%) were defined using for the upper limit of the first class, the average value minus 0.5 standard deviations (M-0.5* standard deviation) and thereafter, they were added with 1 standard deviation. The diameter classes were defined with an amplitude of 10 cm.

3. RESULTS

Out of the fifteen sampled hectares, 8,771 individuals were identified, belonging to 264 species and 53 families. The number of trees and basal area per plot ranged from 497 to 688 and from 23.4 to 32.7 m^2, respectively. The ten most important species in the study area, on the Importance Value (IV) basis, Figure 1, represent 24% of total IV, which were *Protium hebetatum* D.C. Daly, *Eschweilera coriacea* (DC.) S.A. Mori, *Licania oblongifolia* Standl., *Pouteria minima* T.D.Penn. and *Ocotea cernua* (Nees) Mez, the ones that presented the highest IV values. Only the first three species have 20.7% of the total number of identified individuals. The complete list of species, with their respective IV values is presented in the appendix.

The most important families, according to the Family Importance Value (FIV), in a decreasing order were Sapotaceae, Lecythidaceae, Burseraceae, Fabaceae-Mimosoideae and Chrysobalanaceae (Figure 2), in which

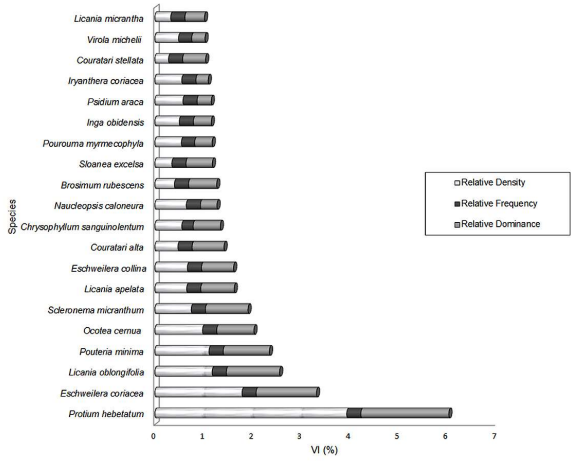

Figure 1 – Value index (VI%) for the 20 species with the highest values at the Experimental site of Embrapa Amazônia Ocidental, Manaus, Amazonas State, Brazil.

Figura 1– *Composição do Valor de Importância-VI(%) para as 20 espécies com os maiores valores no Campo Experimental da Embrapa Amazônia Ocidental, Manaus, AM, Brasil.*

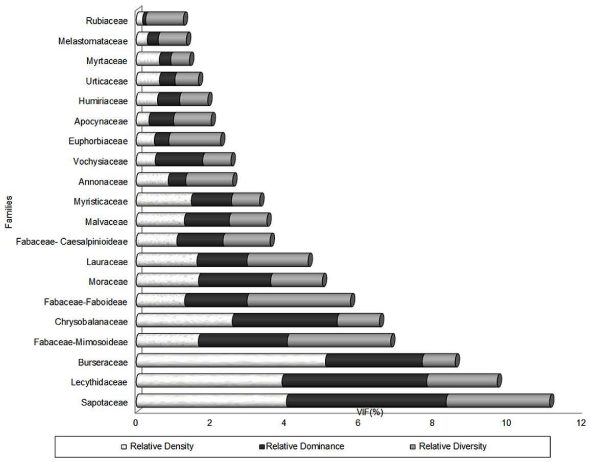

Figure 2 – Familiar importance value (VIF%) for the 20 families with the highest values at the Experimental site of Embrapa Amazônia Ocidental, Manaus, Amazonas State, Brazil.

Figura 2 – *Composição do Valor de Importância Familiar - VIF (%) para as 20 famílias com os maiores valores, no Campo Experimental da Embrapa Amazônia Ocidental, Manaus, AM, Brasil.*

the three first families grouped approximately 39% of the total number of individuals. A great occurrence of rare species was found (1 individual/plot-1ha), whose values ranged from 30 to 42% of the total number of species recorded in the sampled plots. The families Fabaceae-Mimosoideae, Fabaceae-Faboideae and Fabaceae-Caesalpinoideae, in a decreasing order, are the subfamilies that showed the largest number of species contributing to this value.

A great variability is found in the occurrence of species distributed in IV classes (%) within the 15 sampled plots (Figure 3), especially in the two smallest classes that group values lower than 0.66%. Those species correspond to approximately 83% of the species identified in the study area.

Plots 15, 150 and 273 have a larger number of exclusive species within the smallest class (<0.096%) and as the IV values increase, a more even distribution of species in the 15 plots is found. Of the 85 species grouped in the smallest class of IV (<0.096%), 41 species appear with exclusive occurrence. These species have low density, with 87% of them occurring with only one (01) individual and 13% with two to six. *Duckesia warty* (Ducke) Cuatrec. (Humiriaceae), presents six individuals that were registered only in the plot 106, which is on the low topographic position, containing higher content of moisture and with sandy texture. Considering the plots 15, 273 and 150, these sum 39% of the number of species, with the lowest value of IV and with occurrence restricted to these plots. The fact of working with a large set of data, allows better observation of these variations, giving greater reliability to the observed results (Table 1).

The distribution of individuals in diameter classes in 10 cm of amplitude (Figure 4) shows a J-inverse distribution, characteristic of natural forests. The total amplitude of diameters ranged from 10 to 210 cm, where it is observed the occurrence of individuals in almost all diameter classes, except for classes 140-180 cm and 190-200 cm.

Most individuals (61%) is distributed in the smallest diameter class (10-20 cm). The first two classes (10-30 cm) concentrate 80% of the total number of individuals in the 15 hectares sampled.

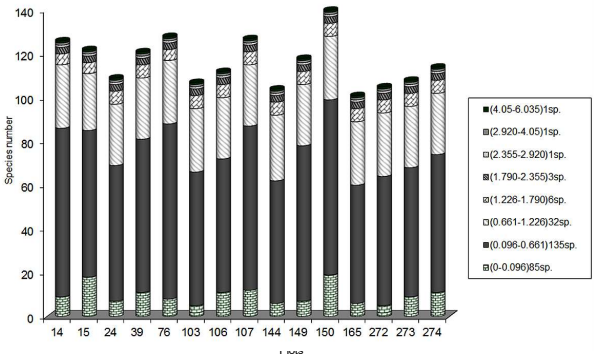

Figure 3 – Distribution of the number species within plots by class of VI (%) for the 15 plots of 100 x 100m, situated at the Experimental site of Embrapa Amazônia Ocidental, Manaus, Amazonas State, Brazil.

Figura 3 *– Distribuição do número de espécies nas parcelas segundo as classes de VI (%) para 15 parcelas de 100 x 100m localizadas no Campo Experimental da Embrapa Amazônia Ocidental, Manaus-AM, Brasil.*

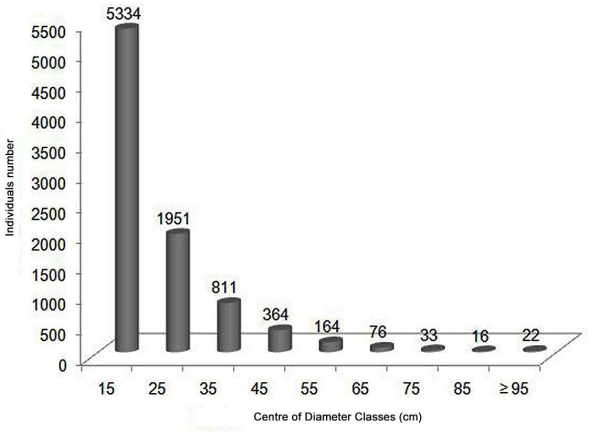

Figure 4 – Total number of individuals by classes of diameter of 10 cm range, at the Experimental site of Embrapa Amazônia Ocidental, Manaus, Amazonas State, Brazil.

Figura 4 *– Número total de indivíduos por classes de diâmetro de amplitude 10 cm, no Campo Experimental da Embrapa Amazônia Ocidental, Manaus, AM, Brasil.*

Buchenavia grandis Ducke (Combretaceae) and *Andira parviflora* Ducke (Fabaceae-Faboideae) occurred in diametric class 180-190 cm; *Caryocar pallidum* A.C. Sm. (Caryocaraceae) and *Dinizia excelsa* Ducke (Fabaceae-Mimosoideae), in the largest class (200-210 cm).

Table 1 – Horizontal structure of 15 ha of permanente plots in a terra firme dense forest in Central Amazônia.
Tabela 1 – *Estrutura horizontal de 15 ha de parcelas permanentes de uma floresta densa de terra firme na Amazônia Central.*

Family	Scientific name	N	DR	FR	DoR	VI	VI (%)
Burseraceae	*Protium hebetatum* Daly	1037	11.82	0.87	5.42	18.10	6.03
Lecythidaceae	*Eschweilera coriacea* (DC.) S.A. Mori	471	5.37	0.87	3.72	9.95	3.32
Chrysobalanaceae	*Licania oblongifolia* Standl.	310	3.53	0.87	3.28	7.68	2.56
Sapotaceae	*Pouteria minima* T.D.Penn.	293	3.34	0.87	2.85	7.06	2.35
Lauraceae	*Ocotea cernua*(Nees) Mez s.l.	258	2.94	0.87	2.30	6.10	2.03
Malvaceae	*Scleronema micranthum* Ducke	197	2.24	0.87	2.63	5.74	1.91
Chrysobalanaceae	*Licania apelata* (E.Mey.) Fritsch	172	1.96	0.87	2.06	4.89	1.63
Lecythidaceae	*Eschweilera collina* Eyma	176	2.01	0.87	1.98	4.85	1.62
Lecythidaceae	*Couratari alta* Kunth.	125	1.42	0.87	1.97	4.26	1.42
Sapotaceae	*Chrysophyllum sanguinolentum* (Pierre) Baehni	146	1.66	0.69	1.67	4.03	1.34
Moraceae	*Naucleopsis caloneura* (Huber) Ducke	170	1.94	0.87	1.02	3.83	1.28
Moraceae	*Brosimum rubescens* Taub.	106	1.21	0.87	1.73	3.81	1.27
Elaeocarpaceae	*Sloanea excelsa* Ducke	92	1.05	0.87	1.63	3.54	1.18
Urticaceae	*Pourouma myrmecophyla* Ducke	144	1.64	0.81	1.08	3.53	1.18
Fabaceae-Mimosoideae	*Inga obidensis* Ducke	132	1.50	0.87	1.10	3.47	1.16
Myrtaceae	*Psidium araca* Raddi	152	1.73	0.87	0.87	3.47	1.16
Myristicaceae	*Iryanthera coriacea* Ducke	146	1.66	0.87	0.75	3.28	1.09
Lecythidaceae	*Couratari stellata* A.C.Sm.	74	0.84	0.87	1.42	3.13	1.04
Myristicaceae	*Virola michelii* Heckel	128	1.46	0.81	0.82	3.09	1.03
Chrysobalanaceae	*Licania micrantha* Miq.	86	0.98	0.87	1.21	3.06	1.02
Combretaceae	*Buchenavia grandis* Ducke	31	0.35	0.75	1.92	3.03	1.01
Humiriaceae	*Vantanea macrocarpa* Ducke	93	1.06	0.87	1.05	2.97	0.99
Sapotaceae	*Pouteria laurifolia* (Gomes) Radlk	128	1.46	0.69	0.77	2.93	0.98
Sapotaceae	*Micropholis trunciflora* Ducke	89	1.01	0.81	1.05	2.87	0.96
Vochysiaceae	*Qualea albiflora* Warm	49	0.56	0.75	1.53	2.84	0.95
Fabaceae-Caesalpinioideae	*Sclerolobium helanocarpus* Ducke	75	0.85	0.75	1.16	2.77	0.92
Myristicaceae	*Osteophloeum platyspermum* (A.DC.) Warb.	54	0.62	0.69	1.38	2.69	0.90
Sapotaceae	*Glycoxylon pedicellatum* (Ducke) Ducke	90	1.03	0.87	0.77	2.66	0.89
Sapotaceae	*Pouteria venosa* (Mart.) Baehni ssp. amazonica T.D.Penn.	74	0.84	0.75	1.05	2.64	0.88
Goupiaceae	*Goupia glabra* Aubl.	32	0.36	0.58	1.69	2.64	0.88
Burseraceae	*Protium pilosissimum* Engl.	126	1.44	0.52	0.59	2.55	0.85
Burseraceae	*Trattinnickia burserifolia* Mart.	60	0.68	0.81	1.03	2.52	0.84
Fabaceae-Faboideae	*Bocoa viridiflora* (Ducke) R.S.Cowan	85	0.97	0.75	0.75	2.47	0.82
Apocynaceae	*Aspidosperma marcgravianum* Woodson	36	0.41	0.81	1.19	2.41	0.80
Fabaceae-Caesalpinioideae	*Eperua duckeana* R.S.Cowan	72	0.82	0.46	1.04	2.32	0.77
Olacaceae	*Minquartia guianensis* Aubl.	75	0.85	0.64	0.80	2.29	0.76
Burseraceae	*Protium heptaphyllum* (Aubl.) ssp. ulei (Swart) Daly	82	0.93	0.81	0.49	2.24	0.75
Annonaceae	*Unonopsis duckei* (R.&P.)Macba.	83	0.95	0.81	0.37	2.13	0.71
Fabaceae-Caesalpinioideae	*Eperua glabriflora* (Ducke) R.S.Cowan	50	0.57	0.87	0.68	2.11	0.70
Sapotaceae	*Micropholis guyanensis* (A.DC.) Pierre ssp.duckeana (Baehni)	60	0.68	0.69	0.73	2.11	0.70
Vochysiaceae	*Erisma bicolor* Ducke	37	0.42	0.81	0.84	2.07	0.69
Caryocaraceae	*Caryocar pallidum* A.C. Smith	12	0.14	0.52	1.40	2.06	0.69
Nyctaginaceae	*Neea oppositifolia* Ruiz & Pav.	69	0.79	0.81	0.45	2.05	0.68
Chrysobalanaceae	*Licania heteromorpha* Benth.	59	0.67	0.69	0.62	1.99	0.66

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Table 1...
Tabela 1...

Sapotaceae	*Manilkara bidentata* (A.DC.) A. Chev.	39	0.44	0.64	0.89	1.97	0.66
Fabaceae-Mimosoideae	*Zigia racemosa* (Ducke) Barneby & J.W. Grimes	44	0.50	0.75	0.70	1.95	0.65
Moraceae	*Clarisia racemosa* Ruiz & Pav.	29	0.33	0.69	0.91	1.93	0.64
Lecythidaceae	*Lecythis barnebyi* Mori	31	0.35	0.64	0.88	1.87	0.62
Melastomataceae	*Mouriri callocarpa* Ducke	37	0.42	0.87	0.57	1.86	0.62
Sapotaceae	*Pouteria caimito* (Ruiz & Pav.) Radlk.	41	0.47	0.75	0.59	1.81	0.60
Chrysobalanaceae	*Licania laevigata* Prance	26	0.30	0.58	0.93	1.81	0.60
Moraceae	*Brosimum lactescens* (S.Moore) C.C.Berg.	24	0.27	0.46	1.06	1.79	0.60
Fabaceae-Caesalpinioideae	*Tachigali cf. myrmecophila* Ducke	42	0.48	0.87	0.44	1.79	0.60
Lecythidaceae	*Eschweilera atropetiolata* S.A.Mori	47	0.54	0.75	0.50	1.78	0.59
Fabaceae-Mimosoideae	*Enterolobium schomburgkii* Benth.	33	0.38	0.69	0.71	1.78	0.59
Annonaceae	*Bocageopsis multiflora* (Mart.) R.E.Fr.	45	0.51	0.81	0.45	1.77	0.59
Fabaceae-Faboideae	*Swartzia recurva* Poepp.	47	0.54	0.64	0.54	1.71	0.57
Myristicaceae	*Virola calophylla* Warb.	57	0.65	0.69	0.28	1.62	0.54
Annonaceae	*Guatterria olivacea* R.R.Fr.	45	0.51	0.81	0.27	1.59	0.53
Fabaceae-Faboideae	*Andira trifoliata* S.A.Mori	50	0.57	0.46	0.56	1.59	0.53
Sapotaceae	*Ecclinusa guianensis* Eyma	30	0.34	0.46	0.77	1.57	0.52
Fabaceae-Faboideae	*Swartzia schomburgkii* Benth. Var. guyanensis R.S. Cowan	20	0.23	0.52	0.76	1.51	0.50
Euphorbiaceae	*Hevea guianensis* Aubl.	47	0.54	0.40	0.56	1.50	0.50
Lecythidaceae	*Lecythis graciena* S.A.Mori	34	0.39	0.64	0.46	1.49	0.50
Fabaceae-Mimosoideae	*Dinizia excelsa* Ducke	3	0.03	0.17	1.23	1.44	0.48
Malvaceae	*Theobroma sylvestre* Mart.	53	0.60	0.69	0.14	1.44	0.48
Opiliaceae	*Agonandra brasiliensis* Miers	20	0.23	0.58	0.62	1.43	0.48
Apocynaceae	*Geissospermum argenteum* Woodson	23	0.26	0.64	0.48	1.38	0.46
Fabaceae-Faboideae	*Andira parviflora* Ducke	14	0.16	0.46	0.75	1.37	0.46
Meliaceae	*Trichilia micropetala* T.D.Penn.	40	0.46	0.69	0.21	1.36	0.45
Fabaceae-Mimosoideae	*Inga alba* (Sw) Willd.	44	0.50	0.58	0.28	1.35	0.45
Dichapetalaceae	*Tapura amazonica* Poepp. & Endl.	45	0.51	0.58	0.26	1.35	0.45
Fabaceae-Mimosoideae	*Piptadenia suavolens* Miq.	18	0.21	0.52	0.60	1.33	0.44
Clusiaceae	*Distomovita brasiliensis* D' Arcy	37	0.42	0.69	0.20	1.31	0.44
Sapindaceaea	*Talisia cf. cupularis* Radlk.	41	0.47	0.64	0.20	1.30	0.43
Moraceae	*Helicostylis scabra* (Macbr.)	32	0.36	0.69	0.24	1.30	0.43
Lauraceae	*Licaria guianensis Aubl.*	33	0.38	0.64	0.28	1.29	0.43
Simaroubaceae	*Simarouba amara* Aubl.	21	0.24	0.58	0.44	1.26	0.42
Lecythidaceae	*Gustavia elliptica* S.A.Mori	37	0.42	0.69	0.13	1.25	0.42
Lauraceae	*Aniba hostmaniana* (Ness) Mez.	37	0.42	0.64	0.17	1.22	0.41
Humiriaceae	*Endopleura uchi* (Huber) Cuatrec.	21	0.24	0.58	0.41	1.22	0.41
Moraceae	*Helianthostylis* sprucei Baill.	44	0.50	0.58	0.14	1.22	0.41
Anacardiaceae	*Anacardium parvifolium* Ducke	16	0.18	0.46	0.55	1.20	0.40
Fabaceae-Mimosoideae	*Inga gracilifolia* Ducke	34	0.39	0.64	0.16	1.19	0.40
Sapotaceae	*Pouteria reticulata* (Engl.) Eyma	13	0.15	0.40	0.59	1.15	0.38
Olacaceae	*Pytchopetalum olacoides* Benth.	29	0.33	0.52	0.27	1.12	0.37
Vochysiaceae	*Ruizterania cassiquiarensis*	18	0.21	0.52	0.37	1.10	0.37

Continue...
Continua...

Table 1...
Tabela 1...

	(Spruce ex Warm.)						
Malvaceae	*Lueheopsis rosea* (Ducke) Burret	22	0.25	0.52	0.32	1.09	0.36
Fabaceae-Mimosoideae	*Stryphnodendron* sp.	26	0.30	0.58	0.21	1.08	0.36
Fabaceae-Mimosoideae	*Parkia pendula* (Willd.) Walp.	4	0.05	0.23	0.80	1.08	0.36
Lecythidaceae	*Lecythis usidata* Camb.	18	0.21	0.64	0.24	1.08	0.36
Fabaceae-Caesalpinioideae	*Macrolobium limbatum* Spruce ex Benth	33	0.38	0.46	0.22	1.06	0.35
Lauraceae	*Sextonia rubra* (Mez) Van der Werff	13	0.15	0.46	0.45	1.06	0.35
Lauraceae	*Mezilaurus itauba* (Meissn.) Taubert ex Mez	20	0.23	0.58	0.24	1.05	0.35
Vochysiaceae	*Vochysia vismiaefolia* Spruce ex Warm.	13	0.15	0.40	0.49	1.04	0.35
Malvaceae	*Sterculia pruriens* (Aubl.) K.Schum.	25	0.28	0.52	0.22	1.03	0.34
Fabaceae-Faboideae	*Swartzia corrugata* Benth.	26	0.30	0.52	0.19	1.01	0.34
Sapotaceae	*Pouteria oblanceolata* Pires	17	0.19	0.46	0.30	0.95	0.32
Euphorbiaceae	*Conceveiba guianensis* Aubl.	24	0.27	0.46	0.21	0.95	0.32
Lauraceae	*Licaria* sp.	20	0.23	0.58	0.13	0.93	0.31
Fabaceae-Mimosoideae	*Inga stipularis* DC.	19	0.22	0.46	0.24	0.92	0.31
Moraceae	*Brosimum utile* (H.B.K.) Pittier ssp. ovatifolium (Ducke) C.C.Berg.	15	0.17	0.40	0.33	0.90	0.30
Violaceae	*Rinorea racemosa* (Mart.) Kuntze	26	0.30	0.52	0.06	0.88	0.29
Annonaceae	*Xylopia calophylla* R.E. Fr.	21	0.24	0.52	0.10	0.86	0.29
Fabaceae-Mimosoideae	*Parkia multijuga* Benth.	13	0.15	0.40	0.30	0.85	0.28
Bignoniaceae	*Jacaranda copaia* (Aubl.) D. Don.	22	0.25	0.46	0.13	0.84	0.28
Simaroubaceae	*Simaba polyphylla* (Cavalcante) W.Thomas	21	0.24	0.52	0.08	0.84	0.28
Rubiaceae	*Duroia fusifera* Hook. F. ex K. Schum.	18	0.21	0.52	0.11	0.84	0.28
Chrysobalanaceae	*Couepia longipendula* Pilg.	19	0.22	0.35	0.25	0.81	0.27
Melastomataceae	*Tococa guianensis* Aubl.	17	0.19	0.52	0.09	0.80	0.27
Fabaceae-Faboideae	*Dipteryx magnifica* Ducke	12	0.14	0.40	0.25	0.79	0.26
Fabaceae-Mimosoideae	*Abarema jupunba* (Willd.) Britton &Killip	21	0.24	0.29	0.26	0.79	0.26
Fabaceae-Faboideae	*Diplotropis rodriguesii* Lima	18	0.21	0.35	0.22	0.77	0.26
Fabaceae-Faboideae	*Paramachaerium ormosioides* Ducke	13	0.15	0.52	0.09	0.76	0.25
Malvaceae	*Apeiba echinata* Gaertner	10	0.11	0.52	0.12	0.75	0.25
Vochysiaceae	*Qualea paraensis* Ducke	9	0.10	0.23	0.41	0.74	0.25
Fabaceae-Faboideae	*Swartzia reticulata* Ducke	13	0.15	0.40	0.18	0.74	0.25
Icacinaceae	*Emmotum* aff. nitens Benth. Ex Miers	15	0.17	0.46	0.10	0.73	0.24
Burseraceae	*Protium rubrum* Cuatrec.	27	0.31	0.29	0.14	0.73	0.24
Clusiaceae	*Platonia insignis* Mart.	11	0.13	0.40	0.20	0.73	0.24
Solanaceae	*Duckeodendron cestoides* Kuhlm.	6	0.07	0.29	0.37	0.72	0.24
Fabaceae-Mimosoideae	*Inga suberosa* T.D.Penn.	12	0.14	0.52	0.05	0.71	0.24
Euphorbiaceae	*Micranda siphonoides* Benth.	13	0.15	0.46	0.05	0.67	0.22
Malvaceae	*Theobroma subincanum* Mart.	15	0.17	0.40	0.08	0.66	0.22
Apocynaceae	*Ambelania duckei* Markgr.	12	0.14	0.46	0.05	0.65	0.22
Malvaceae	*Pseudobombax munguba* (Mart. & Zucc) Dugand	17	0.19	0.35	0.11	0.65	0.22
Melastomataceae	*Miconia reglelii* Cogn.	9	0.10	0.46	0.06	0.62	0.21
Meliaceae	*Carapa guianensis* Aubl.	23	0.26	0.06	0.29	0.61	0.20
Fabaceae- Caesalpinioideae	*Peltogyne paniculata* Benth.	8	0.09	0.40	0.11	0.61	0.20
Erythroxylaceae	*Erythroxylum amplum* Bth.	15	0.17	0.35	0.08	0.60	0.20

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Table 1...
Tabela 1...

Meliaceae	*Trichilia septentrionales* C.DC.	10	0.11	0.40	0.08	0.59	0.20
Vochysiaceae	*Qualea acuminata* Aubl.	8	0.09	0.29	0.20	0.58	0.19
Sapotaceae	*Manilkara amazonica* (Huber) Stand.	11	0.13	0.29	0.16	0.57	0.19
Bixaceae	*Bixa orellana* L.	15	0.17	0.35	0.05	0.57	0.19
Lauraceae	*Licania* sp.	11	0.13	0.29	0.15	0.57	0.19
Fabaceae-Mimosoideae	*Parkia nitida* Miq.	9	0.10	0.35	0.11	0.56	0.19
Fabaceae-Mimosoideae	*Inga cordatoalata* Ducke	14	0.16	0.35	0.05	0.56	0.19
Humiriaceae	*Vantanea guiannensis* (Aubl.) Ducke	10	0.11	0.35	0.09	0.56	0.19
Urticaceae	*Pouroma guianensis* Aubl.	12	0.14	0.35	0.07	0.55	0.18
Lauraceae	*Ocotea cymbarum* H.B.K.	11	0.13	0.29	0.12	0.53	0.18
Humiriaceae	*Vantanea micrantha Ducke*	11	0.13	0.29	0.11	0.53	0.18
Bignoniaceae	*Tabebuia serratifolia* (Vahl) Nichols	6	0.07	0.35	0.11	0.52	0.17
Annonaceae	*Pseudoxandra coriacea* R.E.Fr.	9	0.10	0.35	0.07	0.52	0.17
Anacardiaceae	*Astronium lecointei* Ducke	7	0.08	0.29	0.14	0.51	0.17
Melastomataceae	*Mouriri angulicosta* Morley	7	0.08	0.29	0.10	0.47	0.16
Myrtaceae	*Myrcia Paivae* O. Berg	8	0.09	0.35	0.03	0.47	0.16
Annonaceae	*Annona ambotay* Aubl.	12	0.14	0.23	0.10	0.47	0.16
Humiriaceae	*Sacoglotis matogrossensis* Aubl.	9	0.10	0.29	0.07	0.46	0.15
Rubiaceae	*Chimarrhis* sp.	7	0.08	0.35	0.03	0.46	0.15
Peraceae	*Pogonophora schomburgkiana* Miers ex Benth.	7	0.08	0.29	0.08	0.45	0.15
Fabaceae-Faboideae	*Dipteryx odorata* (Aubl.) Willd.	6	0.07	0.29	0.08	0.44	0.15
Moraceae	*Brosimum parinarioides* Ducke	6	0.07	0.12	0.24	0.43	0.14
Melastomataceae	*Miconia elaeagnoides* Cogn.	7	0.08	0.29	0.05	0.42	0.14
Fabaceae-Mimosoideae	*Pithecellobium elegans* Ducke	6	0.07	0.12	0.24	0.42	0.14
Fabaceae-Faboideae	*Swartzia ulei* Harms	12	0.14	0.17	0.10	0.41	0.14
Sapotaceae	*Pouteria ambelaniifolia* (Sandwith) . T.D.Penn	5	0.06	0.23	0.12	0.41	0.14
Sapotaceae	*Chrysophyllum sparsiflorum* Klotzsch ex Miq.	5	0.06	0.23	0.11	0.39	0.13
Lauraceae	*Licaria canella* (Meissn.) Kosterm.	7	0.08	0.23	0.08	0.39	0.13
Euphorbiaceae	*Pausandra macropetala* Ducke	12	0.14	0.17	0.07	0.38	0.13
Euphorbiaceae	*Mabea subsessilis* Pax & K. Hoffm.	10	0.11	0.23	0.03	0.38	0.13
Lecythidaceae	*Cariniana* sp.	3	0.03	0.17	0.17	0.37	0.12
Apocynaceae	*Couma utiles* Mart.	5	0.06	0.23	0.08	0.37	0.12
Burseraceae	*Protium divaricatum* Engl.	4	0.05	0.17	0.12	0.34	0.11
Lauraceae	*Ocotea* sp.	8	0.09	0.17	0.07	0.33	0.11
Salicaceae	*Casearia grandiflora* Cambess	6	0.07	0.23	0.03	0.33	0.11
Monimiaceae	*Siparuna* sp.	6	0.07	0.23	0.02	0.32	0.11
Quiinaceae	*Touroulia guianensis* Aubl.	6	0.07	0.23	0.02	0.32	0.11
Lauraceae	*Aniba megaphylla* Mez	5	0.06	0.23	0.03	0.32	0.11
Fabaceae- Caesalpinioideae	*Hymenea parvifolia* Huber	4	0.05	0.23	0.04	0.31	0.10
Combretaceae	*Terminalia dichotoma* G.Meyer	4	0.05	0.23	0.04	0.31	0.10
Euphorbiaceae	*Croton lanjouwensis* Jabl.	5	0.06	0.17	0.08	0.31	0.10
Fabaceae-Faboideae	*Dipteryx polyphylla* Huber	4	0.05	0.17	0.09	0.31	0.10
Apocynaceae	*Aspidosperma album* (Vahl.) R. Bem.	4	0.05	0.17	0.09	0.31	0.10
Lecythidaceae	*Lecythis prancei* S.A. Mori	4	0.05	0.23	0.03	0.31	0.10
Rubiaceae	*Palicourea corymbifera* Mull. Arg.	9	0.10	0.17	0.03	0.31	0.10
Moraceae	*Sorocea guilleminiana* Gaudich.	9	0.10	0.17	0.03	0.31	0.10
Fabaceae-Faboideae	*Dipteryx* sp.	4	0.05	0.06	0.20	0.30	0.10
Sapotaceae	*Poteuria platyphylla* (A.C.Sm.) Baehni	3	0.03	0.17	0.09	0.30	0.10
Sapotaceae	*Micropholis* sp.	3	0.03	0.17	0.08	0.29	0.10
Lecythidaceae	*Lecythis poiteaui* Berg.	6	0.07	0.12	0.10	0.29	0.10

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Table 1...
Tabela 1...

Clusiaceae	*Symphonia globulifera* L.	7	0.08	0.12	0.09	0.28	0.09
Sapotaceae	*Pouteria petiolata* T.D. Penn.	4	0.05	0.17	0.06	0.28	0.09
Euphorbiaceae	*Conceveiba martiana* Baill	5	0.06	0.12	0.10	0.27	0.09
Urticaceae	*Cecropia sciadophylla* Mart.	5	0.06	0.17	0.04	0.27	0.09
Fabaceae-Faboideae	*Platymiscium duckei* Huber	4	0.05	0.17	0.05	0.27	0.09
Euphorbiaceae	*Mabea* sp.	6	0.07	0.17	0.01	0.26	0.09
Chrysobalanaceae	*Couepia bracteosa* Benth.	4	0.05	0.12	0.09	0.26	0.09
Clusiaceae	*Vismia japurensis* Reichardt	4	0.05	0.17	0.04	0.26	0.09
Violaceae	*Rinorea guianensis* Aubl.	5	0.06	0.17	0.02	0.25	0.08
Apocynaceae	*Couma macrocarpa* Barb.	4	0.05	0.17	0.03	0.25	0.08
Moraceae	*Brosimum acutifolium* Huber ssp. Interjectum C.C.Berg	3	0.03	0.12	0.10	0.25	0.08
Sapotaceae	*Pradosia cochlearia*(Lecomte) T.D.Penn	3	0.03	0.17	0.04	0.25	0.08
Monimiaceae	*Siparuna guianensis* Aubl.	4	0.05	0.17	0.03	0.24	0.08
Sapotaceae	*Pouteria peruviensis* (Aubrév.) Bernardi	3	0.03	0.12	0.09	0.24	0.08
Ulmaceae	*Ampelocera edentula* Rusby	4	0.05	0.17	0.02	0.24	0.08
Apocynaceae	*Hymatanthus sucuba* (spruce)Woodson	3	0.03	0.17	0.03	0.24	0.08
Annonaceae	*Guatteria* sp.	4	0.05	0.17	0.01	0.23	0.08
Euphorbiaceae	*Glycydendron amazonicum* Ducke	3	0.03	0.17	0.02	0.23	0.08
Fabaceae-Faboideae	*Swartzia tomentifera* Harms	6	0.07	0.12	0.04	0.23	0.08
Annonaceae	*Xylopia amazonica* R.E. Fr.	3	0.03	0.17	0.01	0.21	0.07
Fabaceae-Faboideae	*Ormosia grossa* Rudd	2	0.02	0.12	0.08	0.21	0.07
Putranjivaceae	*Drypetes variabilis* Uittien	6	0.07	0.12	0.02	0.21	0.07
Anisophylleacea	*Anisophyllea manausensis* Pires & W.A.Rodrigues	3	0.03	0.12	0.05	0.20	0.07
Caryocaraceae	*Caryocar villosum* (Aubl.) Pers.	2	0.02	0.12	0.06	0.20	0.07
Rubiaceae	*Warszewiczia schwackei* K.Schum.	3	0.03	0.12	0.05	0.20	0.07
Humiriaceae	*Duckesia verrucosa* (Ducke) Cuatr.	6	0.07	0.06	0.06	0.18	0.06
Peraceae	*Pera heteranthera* (Schrank) I.M. Johnst.	2	0.02	0.12	0.04	0.18	0.06
Lecythidaceae	*Corythophora rimosa* W.A.Rodrigues	2	0.02	0.12	0.04	0.18	0.06
Linaceae	*Roucheria punctata* Ducke	3	0.03	0.12	0.03	0.18	0.06
Sapotaceae	*Pouteria guianensis* Aubl.	4	0.05	0.06	0.07	0.17	0.06
Lauraceae	*Aniba canellila* (H.B.K.)Mez	3	0.03	0.12	0.02	0.17	0.06
Icacinaceae	*Emmotum acuminatum* (Benth.) Miers	2	0.02	0.12	0.03	0.17	0.06
Anacardiaceae	*Anacardium spruceanum* Engl.	1	0.01	0.06	0.10	0.17	0.06
Lauraceae	*Aniba rosaeodora* Ducke	3	0.03	0.12	0.01	0.16	0.05
Rubiaceae	*Chimarrhis duckeana* del Prete	3	0.03	0.12	0.01	0.16	0.05
Rubiaceae	*Duroia saccifera* (Mart.) Hook. F. ex K. Schum.	3	0.03	0.12	0.01	0.16	0.05
Apocynaceae	*Couma* sp.	2	0.02	0.12	0.02	0.16	0.05
Moraceae	*Brosimum potabile* Ducke	2	0.02	0.12	0.01	0.15	0.05
Burseraceae	*Protium subserratum* Engler	2	0.02	0.12	0.01	0.15	0.05
Annonaceae	*Xylopia brasiliensis* Spreng.	2	0.02	0.12	0.01	0.15	0.05
Myrtaceae	*Myrcia magna* Legrand	2	0.02	0.12	0.01	0.15	0.05
Myristicaceae	*Iryanthera juruensis* Warb.	2	0.02	0.12	0.01	0.15	0.05
Fabaceae-Faboideae	*Swartzia cuspidata Spruce* ex Benth.	2	0.02	0.12	0.01	0.15	0.05
Myristicaceae	*Virola caducifolia* W.A. Rodrigues	2	0.02	0.12	0.01	0.15	0.05
Fabaceae-Mimosoideae	*Abarema* sp.	2	0.02	0.12	0.00	0.14	0.05
Chrysobalanaceae	*Licania adolphoduckei* Prance	2	0.02	0.12	0.00	0.14	0.05
Fabaceae-Faboideae	*Dipteryx punctata* (Blake) Amshoff	1	0.01	0.06	0.07	0.13	0.04
Fabaceae-Mimosoideae	*Stryphnodendron pulcherrimum* (Willd.) Hochr.	1	0.01	0.06	0.05	0.12	0.04
Urticaceae	*Cecropia concolor* Willd.	1	0.01	0.06	0.05	0.12	0.04

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Table 1...
Tabela 1...

Lecythidaceae	*Couratari guianensis* Aubl.	2	0.02	0.06	0.03	0.11	0.04
Fabaceae-Mimosoideae	*Parkia decussata* Ducke	1	0.01	0.06	0.04	0.11	0.04
Sapindaceaea	*Matayba* sp.	3	0.03	0.06	0.01	0.11	0.04
Fabaceae-Faboideae	*Hymenolobium sericeum* Ducke	1	0.01	0.06	0.03	0.10	0.03
Fabaceae-Caesalpinioideae	*Dialium guianense* Steud.	1	0.01	0.06	0.03	0.09	0.03
Clusiaceae	*Vismia* sp.	1	0.01	0.06	0.02	0.09	0.03
Euphorbiaceae	*Alchornea discolor* Klotzsch	2	0.02	0.06	0.01	0.09	0.03
Urticaceae	*Cecropia purpurascens* C.C. Berg	2	0.02	0.06	0.01	0.09	0.03
Annonaceae	*Guatteria poeppigiana*	2	0.02	0.06	0.01	0.09	0.03
Sapotaceae	*Pouteria eugenifolia* (Pierre)Baehni	1	0.01	0.06	0.02	0.09	0.03
Malpighiaceae	*Byrsonima crispa* Juss.	1	0.01	0.06	0.01	0.08	0.03
Fabaceae-Mimosoideae	*Pithecellobium racemosum* Ducke	1	0.01	0.06	0.01	0.08	0.03
Malpighiaceae	*Byrsonima duckeana* W.R. Anderson	1	0.01	0.06	0.01	0.08	0.03
Euphorbiaceae	*Croton cajucara* Benth.	1	0.01	0.06	0.01	0.08	0.03
Celastraceae	*Maytenus guyanensis* Klotzsch	1	0.01	0.06	0.01	0.08	0.03
Melastomataceae	*Miconia* sp.	1	0.01	0.06	0.01	0.08	0.03
Araliaceae	*Schefflera morototoni* (Aubl.) Frondin	1	0.01	0.06	0.01	0.08	0.03
Malvaceae	*Scleronema praecox* Ducke	1	0.01	0.06	0.01	0.08	0.03
Fabaceae-Mimosoideae	*Stryphnodendron guianensis* (Aubl.)Benth.	1	0.01	0.06	0.01	0.08	0.03
Fabaceae-Faboideae	*Swartzia tessmannii* Harms	1	0.01	0.06	0.01	0.08	0.03
Rubiaceae	*Albertia edulis* A. Rich.	1	0.01	0.06	0.00	0.07	0.02
Fabaceae-Faboideae	*Andira micrantha* Ducke	1	0.01	0.06	0.00	0.07	0.02
Boraginaceae	*Cordia* sp.	1	0.01	0.06	0.00	0.07	0.02
Chrysobalanaceae	*Couepia canomensis* (Mart.) Benth. ex Hook.f.	1	0.01	0.06	0.00	0.07	0.02
Lecythidaceae	*Eschweilera rhododendrifolia* (Knuth) A.C.Sm.	1	0.01	0.06	0.00	0.07	0.02
Myrtaceae	*Eugenia diplocampta* Diels	1	0.01	0.06	0.00	0.07	0.02
Rubiaceae	*Ferdinandusa elliptica* Pohl.	1	0.01	0.06	0.00	0.07	0.02
Meliaceae	*Guarea* sp.	1	0.01	0.06	0.00	0.07	0.02
Quiinaceae	*Lacunaria jenmani* (Oliv.)Ducke	1	0.01	0.06	0.00	0.07	0.02
Fabaceae-Caesalpinioideae	*Macrolobium angustifolium* (Benth.) R.S.Cowan	1	0.01	0.06	0.00	0.07	0.02
Simaroubaceae	*Simaba cedron* Planch.	1	0.01	0.06	0.00	0.07	0.02
Monimiaceae	*Siparuna amazonica* Mart.	1	0.01	0.06	0.00	0.07	0.02
Lamiaceae	*Vitex cimosa* Bert. ex Spreng	1	0.01	0.06	0.00	0.07	0.02
Fabaceae-Mimosoideae	*Zigia juruana* (Harms) L.Rico	1	0.01	0.06	0.00	0.07	0.02
Fabaceae- Caesalpinioideae	*Zollernia paraensis*	1	0.01	0.06	0.00	0.07	0.02

4. DISCUSSION

In general, the evaluated *terra firme* forest has floristic composition and structure that are characteristic of this plant type, with most individuals concentrated in few species and few families concentrating the highest percentage of species richness. These results are corroborated by other studies carried out in the same plant typology (PRANCE; RODRIGUES, 1976; MILLIKEN, 1998; LIMA FILHO et al., 2004; OLIVEIRA; AMARAL, 2004; OLIVEIRA et al., 2008).

The Burseraceae family, despite the less richness in species compared to the Fabaceae, showed higher FIV mainly due to higher number of individuals observed for that family. This family (Burseraceae) appears with the third highest FIV and is the one with the species with the highest IV in the area (*Protium hebetatum*).

This shows the great variability in the tropical forests related to the abundance of individuals and diversity in families.

Gama et al. (2005) and Oliveira et al. (2008) reported in their studies that *Protium hebetatum* and *Eschweilera coriacea* are the species most commonly recorded in *terra firme* forests in the Amazônia. Those species have wide geographical distribution and the highest values of abundance. This was also observed in this study, where the density and dominance, in general, contributed to the greater importance of the species in the area.

The greater relative density found for *Protium hebetatum* has decisively contributed to a higher value of dominance and consequent higher value of IV. The ten species, with the highest IV values showed similar frequency values, with wide distribution in the sampled plots.

The variability in the distribution of the number of species per IV classes, within the plots, especially in the smaller classes can be attributed to the influence of the rare species. Plots 15 and 150 were those that had the highest occurrence of these species in the total set of 15 plots, also being the ones with the highest percentage of exclusive species, occurring with low abundance.

Several studies have reported the occurrence of a significant number of rare species in the Amazonian *terra firme* forests. These values are similar to those found in this study, on average 34% of the total number of species (FERRERIA; PRANCE, 1998; OLIVEIRA et al., 2008). Gentry (1988) and Quesada et al. (2009), among others, reported the "preference" for habitats, probably due to variations in soil characteristics, among other factors, as those responsible for the great diversity and dynamics in tropical forests. The high diversity is favored by the occurrence of rare species, whose mechanisms are poorly understood and discussed (Silva, 2010).

In the context of the IV classes, our results show that some species with low abundance have restricted occurrence in the plots and deserve special attention along with rare species (1 individual/plot), in order to avoid local extinctions due to management actions. Except for the first lower IV class, it can be considered in general that all plots have species of all IV classes, suggesting that based on this classification, the horizontal structure observed is well represented in the set of plots.

The shape of the distribution curve of the diameters in J-inverted in this study is typical of rain forests with a high proportion of trees with DBH <30cm (FERREIRA; PRANCE, 1998; LIMA FILHO et al., 2001; HAUGAASEN et al., 2006; GUIMARÃES et al., 2009). The diametric structure found in this work suggests that the area had not suffered major disturbances and the natural dynamics of mortality and recruitment of new individuals, due to the occurrence of small natural clearings may be responsible for the observed distribution (Oliveira et al., 2008). The occurrence of some individuals in classes of diameter greater than 80 cm also suggests that the forest has not been affected by large disturbances, in which it is observed, for example, individuals of *Dinizia excelsa* with DBH of approximately 200 cm

5. CONCLUSIONS

The use of a large set of data from the 15 permanent plots, allowed us to observe more broadly the variations in the composition and distribution of the species throughout the study area. This was evidenced by the high occurrence of rare species, of species with low density and distribution restricted to some plots. This fact leads us to reflect on how to properly define and discuss the ecological importance of these species, considering that the indexes usually used may not represent their function in the plant community. Studies on the relationship between the species with their occurrence environment can assist in this regard.

Generally, the species and most abundant families, observed in this study are those considered as typical of terra firme dense forest in the Amazon.

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