



Amazon *canga*: the unique vegetation of Carajás revealed by the list of seed plants

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Abstract

The *Floresta Nacional de Carajás* (FLONA of Carajás) and the *Parque Nacional dos Campos Ferruginosos* (PNCF) are home to *canga* vegetation where 856 species distributed in 116 families of seed plants were recorded. The richest families were Poaceae (86), Fabaceae (65) and Rubiaceae (46) and the best represented habit was herbaceous. Two genera, 24 species and one subspecies are considered endemic from the *canga* of the studied area. Within the FLONA of Carajás, the Serra Norte was the best sampled site, and is home for 659 species of seed plants, while 545 species were recorded for the Serra Sul. Approximately 60% of the species documented, including the endemics, have no record within the PNCF. Through the taxonomic list here presented, it was possible to demonstrate considerable distinction between the *canga* of the Serra dos Carajás and the same formation in the Quadrilátero Ferrífero, in Minas Gerais, with little correspondence between these two lists and the one from Corumbá, Mato Grosso do Sul state. The richness and singularity of the regional flora, which includes many endemisms, associated to the current threats to these environments due to mineral exploration, point to the need for careful and consistent planning to ensure the conservation of the flora of the *canga* of Carajás.

Key words: Amazon, Angiosperms, endemism, Gymnosperms, floristics, species richness.

Resumo

Nas *cangas* da Floresta Nacional (FLONA) de Carajás e no Parque Nacional dos Campos Ferruginosos (PNCF) foram registradas 856 espécies, distribuídas em 116 famílias de fanerógamas. As famílias mais ricas foram Poaceae (86), Fabaceae (65) e Rubiaceae (46). O hábito herbáceo foi o melhor representado. Dois gêneros, 24 espécies e uma subespécie são apontadas como endêmicas das *cangas* da área de estudos. Na FLONA de Carajás, a Serra Norte, com maior amostragem, possui 659 espécies de fanerógamas e na Serra Sul foram registradas 545 espécies. Aproximadamente 60% das espécies documentadas na área de estudos, incluindo espécies endêmicas, não possuem registro para o PNCF. Através da lista taxonômica aqui apresentada, foi possível demonstrar considerável distinção entre as *cangas* da Serra dos Carajás e as do Quadrilátero Ferrífero, em Minas Gerais, apontando também pouca correspondência dessas duas listas com a *canga* de Corumbá, no Mato Grosso do Sul. A riqueza e singularidade da flora da região, que inclui diversas espécies endêmicas, associada à ameaça a que estão submetidos estes ambientes por atividades de mineração, apontam para a necessidade de um planejamento para conservação das espécies da flora das *cangas* de Carajás.

Palavras-chave: Amazônia, Angiospermas, endemismo, Gimnospermas, florística, riqueza de espécies.

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Introduction

The Amazon covers an area of approximately 6 million square kilometers, comprising predominantly diverse types of rainforest (Pires & Prance 1985). In order to assess the diversity of plants found within this biome, a recent survey recorded over 14 thousand species of seed plants in lowland rainforest (Cardoso *et al.* 2017). Almost 12 thousand seed plants were recorded in the Brazilian Amazon (BFG 2015), considering all its diverse phytophysionomies that include, alongside the forests, several types of open vegetation. Meanwhile, a relatively low number of species was referred to these open areas, such as campinaranas (1.350 species), cerrado (876), highland rocky fields (683) and rock outcrops (625) (FBO 2020, under construction). These data, however, are underestimated as the Brazilian Amazon is still in need of floristic studies. The sheer size and access difficulties (Zappi *et al.* 2016) and the relatively recent history of the scientific investigations in the area result in a very low density of collections and, consequently, patchy knowledge of the plant diversity in the region (BFG 2015).

The Serra dos Carajás, in the state of Pará, is home to an open type of vegetation that is mostly formed by herbs and shrubs associated to iron-rich conglomerates that occur on the top of some local ranges. This vegetation, known as *canga* (Rizzini 1979; Secco & Mesquita 1983; Viana *et al.* 2016), comprises a peculiar flora with high number of endemic species. Plants growing there are adapted to extreme conditions of acid and nutrient poor soils (Nunes *et al.* 2015), high concentrations of heavy metals (Schettini *et al.* 2018), high temperatures and strong seasonality, with a clearly defined dry season (Mota *et al.* 2015).

The Serra dos Carajás spans between the municipality of São Félix do Xingu to the west and Curionópolis at the east, with the main plateaus found within Parauapebas and Canaã dos Carajás (Viana *et al.* 2016). Two conservation units include areas of *canga* within the last two municipalities: the *Floresta Nacional de Carajás* (FLONA Carajás), a sustainable use preservation area encompassing Serra Norte and Serra Sul, where mining activities occur, and the *Parque Nacional dos Campos Ferruginosos* (PNCF), a full protection area that includes the Serra do Tarzan and Serra da Bocaina (Zappi 2017).

The Flora of the *canga* of Carajás (FCC) project (Viana *et al.* 2016) began in 2015, with the objective of developing a detailed information base for the local flora, contributing to the knowledge of the Amazonian plants. This project culminated with the publication of four fascicles of monographs that provide detailed information regarding 164 families of land plants and 1,108 species that grow in the region of the Serra dos Carajás, including bryophytes, ferns and lycophytes, gymnosperms and angiosperms. The project aimed to monograph only native and or naturalized species found on the *canga* (*sensu* Mota *et al.* 2015) from the FLONA Carajás (Serra Norte and Serra Sul) and the PNCF (Serra da Bocaina and Serra do Tarzan) (Viana *et al.* 2016; Zappi 2017). However, some species that occur in the forest and/or on other rock formations (*e.g.*, granitoid inselbergs) were included by some authors in order to increase the usefulness and scope of their monographs and to facilitate the identification of the species from the *canga*, considering the shortage of similar studies within the Brazilian Amazon (Viana *et al.* 2016).

Intensive collecting expeditions to the area carried out during the FCC Project were aimed at ensuring sufficient sampling for the authors to prepare their monographs. Images of the species in nature and associated material, including samples for micromorphology and tissues to extract DNA, destined to form a DNA bank for molecular studies at the Instituto Tecnológico Vale (ITV) were also targeted by the expeditions. The continued collecting activity even after the publication of some of the monographs has brought occasional new records of species to light, and these were included in the present list.

The results obtained by the FCC have contributed considerably to improve the knowledge of the floristic composition of the *canga* of Carajás, as the last available compilation for this area (Silva 1991), counted with 231 species found in 144 genera and 57 seed plant families. Nowadays, the seed plants are represented by 120 families and 977 species monographed by a wide network of 131 plant specialists from Brazil and elsewhere. Some of the monographs, however, included species that were not recorded for the *canga*, and, as some new species records were made after the conclusion of some of the first monographs,

it became necessary to prepare this updated compilation of the species that occur on the *canga* of the Serra dos Carajás.

The present work brings a list of seed plants from the FLONA of Carajás and the PNCF discriminated by area of occurrence, highlighting the endemic taxa found exclusively in the *canga* of these conservation units. The results allowed for a comparison of the seed plants from the studied area with other *canga* sites elsewhere in Brazil. This work focuses only on the seed plants while ferns and lycophytes (Salino *et al.* 2018) and bryophytes (Ilkiu-Borges & Oliveira-da-Silva 2018) were treated similarly in separate papers within this volume.

Material and methods

The study area was delimited at the onset of the FCC Project (Viana *et al.* 2016), that included the *canga* of the FLONA of Carajás (Serra Sul: blocks S11A, S11B, S11C, S11D;

and Serra Norte: N1, N2, N3, N4, N5, N6, N7, N8) and PNCF (Serra do Tarzan, Serra da Bocaina), within the municipalities of Canaã dos Carajás and Parauapebas (Fig. 1). The plateaus of the study area add up to an area of approximately 120 km² of *canga* vegetation calculated using Google Earth software, by delimiting polygons encompassing the rock outcrops that were visible on satellite imagery (Google Earth 2018).

During the years between 2015 and 2017, 30 collecting expeditions were organized to the Serra dos Carajás, covering all months of the year and resulting in 3,533 new plant samples that are deposited at the MG herbarium. This material has been added to the material already available at the start of the project, of around 3,300 specimens from the BHCB herbarium and another 6,000 from MG (Viana *et al.* 2016). These collections constitute the main source of data consulted by monograph authors. Some

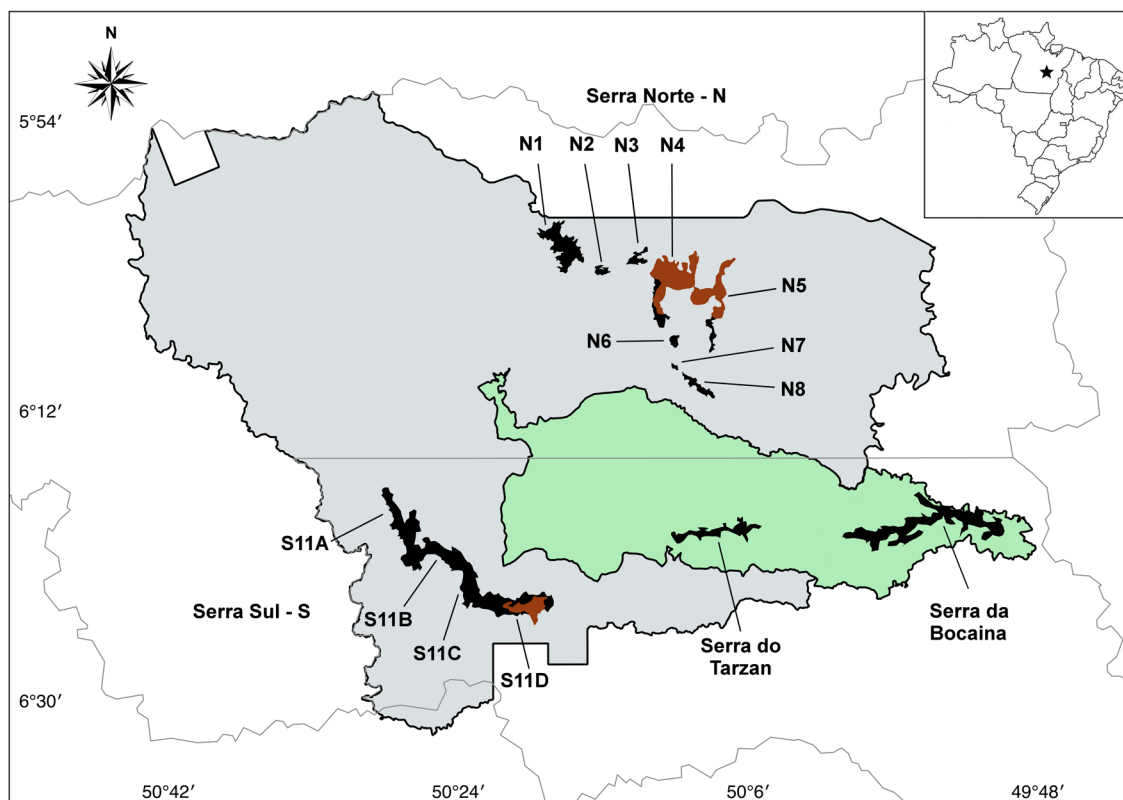


Figure 1 – Study area, indicating the *canga* plateaus sampled. In black, remaining *canga* areas; in red, suppressed *canga* areas (representation based on satellite image taken in December 2016, available on Google Earth). In grey, Floresta Nacional de Carajás. In green, Parque Nacional dos Campos Ferruginosos.

authors have also examined specimens from the HCJS, IAN, INPA, NY, RB and UB herbaria.

Collecting records from the *canga* were compiled from the published monographs - Rodriguésia 2016/67(5), 2017/68(3), 2018/69(1), 2018/69 (current) - including taxonomic information, type of environment and location of the specimens. The reference for the publications consulted for this end is cited on the heading for each plant family in Table 1. These data, together with collections made after the publications and named by specialists were organized as a database from where the floristic list presented here was extracted. This list is restricted to the plants that were recorded in the *canga* of the FLONA of Carajás and PNCF. Records made after the publications are accompanied by a voucher citation per species. The list excludes species that did not have at least one collection for specific areas of *canga*.

The new collecting efforts and study of the resulting specimens by specialists helped to detect families that were not yet listed by Viana *et al.* (2016) at the onset of the FCC Project, such as Apodanthaceae, Bixaceae, Cannabaceae, Droseraceae, Meliaceae, Monimiaceae, Quinaceae and Siparunaceae. On the other hand, despite having been listed by Viana *et al.* (2016), Haloragaceae and Heliconiaceae were found to occur only in the forest, thus these have not been monographed. After verifying herbarium material and checking the complete Carajás database, it was also found that some plant families listed in the introductory paper (Viana *et al.* 2016), such as Peraceae and Ranunculaceae, are not found in the *canga*. Additionally, Elaeocarpaceae and Rhizophoraceae monographs, despite not having been listed in the introductory paper, were published despite the fact that no species recorded in the *canga* were represented in these families. Therefore, the Peraceae, Ranunculaceae, Elaeocarpaceae and Rhizophoraceae were not included in the present list.

APG IV (APG 2016) was the base for the classification used in the seed plant list, except for Passifloraceae (segregated from Turneraceae), Ochnaceae (published separately from Quinaceae) and Boraginaceae (represented by Cordiaceae and Heliotropiaceae). Species that appeared as indeterminate in the FCC treatments and were subsequently published as new were updated in the present list, and recent

nomenclatural updates were also provided for relevant names.

The determination of species habits followed the categories: trees (including palms with stem), shrubs, subshrubs, herbs, lianas and parasites. Some species were attributed more than one habit, following publications of the FCC. When the information was incomplete or lacking, available databases were consulted, such as Flora do Brasil (2020, under construction) and WCSP (2018).

Species distribution in the study area was discriminated between *canga* blocks of the Serra Norte (N1, N2, N3, N4, N5, N6, N7, N8), Serra Sul (S11A, S11B, S11C, S11D), Serra do Tarzan and Serra da Bocaina (Fig. 1). Species with known distribution restricted to the *canga* of the FLONA of Carajás and PNCF were indicated as endemic. Species that occurred in *canga* outside the study area (*e.g.*, Serra de Campos, Serra do Cristalino, Serra Arqueada), even if considered endemic of the *canga* of Carajás were not indicated as endemic within this study.

The species were assigned to one or more of the following vegetation categories proposed for the *canga* of Carajás by Mota *et al.* (2015): a. open rupestral vegetation, represented by herbaceous to shrubby plants found on the more or less bare iron-rich, rocky soil; b. hydromorphic vegetation, including lakes, marshes and seasonal or perennial streams; and c. forest formations including deciduous to semi-deciduous forest groves and low forest that grow over the iron outcrops.

Floristic comparisons between different *canga* sites in Brazil were carried out by compiling a list for the Quadrilátero Ferrífero, in Minas Gerais (Carmo & Jacobi 2016, Messias & Carmo 2015 and Viana & Lombardi 2007), and for the Corumbá region, Mato Grosso do Sul (Takahasi 2015). Not fully determined species (*cf.* or *aff.*) were excluded from the comparisons. Nomenclatural and taxonomic adjustments between the lists were performed when needed using the Flora do Brasil 2020 (under construction) database.

The indication of invasive exotic or native species follows the Brazilian law (Instrução Normativa 4 (2011) and 11 (2014)), with modifications suggested Giulietti *et al.* (2018). Data from the FCC monographs was considered for this purpose. Species with DNA samples banked at ITV were also indicated.

Table 1 – List of species of seed plants occurring in the *canga* of the Serra dos Carajás. Caption: * nomenclatural update; † problem native; †† invasive exotic; ® sample of DNA tissue; Δ also occurs in the *canga* of Corumbá; □ also occurs in the *canga* of Quadrilátero Ferrífero; ST = Serra do Tarzani; SB = Serra da Bocaina; Ar = tree; Arb = shrub; Sb = subshrub; Li = liana; Er = herb; Par = parasite; Pal = palm; E-Sb = herb or subshrub; Ar-Arb = tree or shrub; Sb-Arb = subshrub or shrub; Vr = open rupestrian vegetation; Ff = Forest Formation; Vh = hydromorphic vegetation; Aa = disturbed areas. Endemic species of the *canga* of the Serra dos Carajás in **bold**. Only for the new records, subsequent to the publication of the floras, a voucher will be given after the species name.

Family - monograph / species – Voucher	Habit	Habitat	Distribution in the study area
Acanthaceae - Reis et al. (2017)			
<i>Justicia divergens</i> (Nees) A.S.Reis, A.Gil & C.Kameyama	Sb	Vr, Ff	N1, ST
<i>J. potamogeton</i> Lindau ®	Sb	Ff	N8, S11D
<i>J. riedeliana</i> (Ness) V.A.W.Graham	Sb	Ff	S11D
<i>J. sprucei</i> V.A.W.Graham ®	Sb	Vr	N1, N2, N3, N4, N8
<i>Justicia</i> sp. 1	Sb	Vr, Ff	S11A, S11D, ST
<i>Justicia</i> sp. 2	Arb	Vr, Ff	S11A, S11B, S11D
<i>Justicia</i> sp. 3	Arb	Vr, Ff	N2, N3, N4, N5, S11A, S11B, S11D, ST, SB
<i>Justicia</i> sp. 4	Sb	Vr, Ff	ST
<i>Justicia</i> sp. 5	Sb	Vr	S11C, ST
<i>Mendoncia aspera</i> Ruiz & Pav.	Li	Vr, Ff	N1, N3, ST, SB
<i>Ruellia anamariae</i> A.S.Reis, A.Gil & C.Kameyama	Arb	Vr, Ff	N1, N2, N3, N4, N5
<i>R. exserta</i> Wassh. & J.R.I. Wood	Li	Vr, Ff	N1, N2, N3
<i>R. inflata</i> Rich. ®	Arb	Vr, Ff	N1, N3, N4, N5, S11D
<i>R. wurdackii</i> Wassh. ®	Sb	Vr, Ff	S11B, ST
Alismataceae - Hall & Gil (2016)			
<i>Helanthium tenellum</i> (Mart. ex Schult.f.) J.G.Sm. ®	Er	Vh	N1, N3, N7, S11A, ST
<i>Sagittaria rhombifolia</i> Cham.	Er	Vh	S11A, S11B, S11C,
Alstroemeriaceae - Koch (2016)			
<i>Bomarea edulis</i> (Tussac) Herb.	Li	Ff	N5, S11B, S11D
Amaranthaceae - Senna & Lima (2017)			
<i>Alternanthera dentata</i> (Moench) Stuehlik ex R.E.Fr.	Sb	Vr	N1, N5
<i>A. tenella</i> Colla †®	Sb	Aa	N4
<i>Cyathula achyranthoides</i> (Kunth) Moq.	Sb	Vr, Ff	N4

Family - monograph / species – Voucher	Habit	Habitat	Distribution in the study area
<i>C. prostrata</i> (L.) Blume	Sb	Vr, Ff	S11D
Anacardiaceae - Hall & Gil (2017)			
<i>Anacardium occidentale</i> L.	Ar	Vr	N1, N2, N3, S11A, S11B, ST
<i>Tapirira guianensis</i> Aubl.	Ar	Ff	N4, S11D
<i>Thyrsodium spruceanum</i> Benth.	Ar	Ff	N6
Annonaceae - Lobão (2016)			
<i>Guateria punctata</i> (Aubl.) R.A.Howard	Ar	Ff	N1, N4, S11D
<i>Xylopia aromatica</i> (Lam.) Mart. ®	Ar	Vr, Ff	N1, N2, N3, N4, N5, N6, S11D, ST, SB
Apocynaceae - Fernandes et al. (2018)			
<i>Asclepias curassavica</i> L. **®□	Er	Aa	N5, S11D
<i>Aspidosperma brasiliense</i> A.S.S.Pereira	Ar	Vr, Ff	S11C
<i>A. multiflorum</i> A.DC.	Ar	Vr, Ff	S11D
<i>A. subincanum</i> Mart. ex A.DC.	Ar	Vr, Ff	S11D
<i>Blepharodon pictum</i> (Vahl) W.D.Stevens △□	Li	Vr	N1, S11A, S11B, S11C, S11D
<i>Forsteronia affinis</i> Müll.Arg. ®	Li	Vr, Ff	N1, S11D
<i>Forsteronia</i> sp.	Li	Vr, Ff	S11D
<i>Hemipogon sprucei</i> E.Fourn. ®	Sb	Vr	N1, N3, N4, N5, N6, S11A, S11D
<i>Lacmellea arborescens</i> (Müll.Arg.) Markgr.	Ar	Vr, Ff	N1, SB
<i>Mandevilla scabra</i> (Hoffmanns. ex Roem. & Schult.) K.Schum. ®	Li	Vr, Ff	N1, N2, N3, N4, N5, N6, N7, S11A, S11B, S11C, S11D
<i>M. tenuifolia</i> (J.C.Mikan) Woodson ®□	Sb	Vr	N1, N2, N3, N4, N7, N8, S11A
<i>Marsdenia bergii</i> Morillo ®	Li	Vr, Ff	N5, N7, S11A, S11B, S11D
<i>Matelea microphylla</i> Morillo	Li	Vr	N1, N2, N3
<i>Odontadenia nitida</i> (Vahl) Müll.Arg.	Li	Vr	N1, N4, N5, S11D
<i>Prestonia ornata</i> (Hoehne) J.F.Morales	Li	Vr	N1, SB
<i>P. quinqueangularis</i> (Jacq.) Spreng.	Li	Vr, Ff	N1, N5
<i>Secondatia densiflora</i> A.DC. ®	Li	Vr, Ff	N1, N3, N4, N5, N6, S11A, S11B, S11C, S11D
<i>Tabernaemontana flavicans</i> Will ex Roem. & Schult. ®	Arb	Vr, Ff	S11B, S11D, SB

Family - monograph / species – Voucher	Habit	Habitat	Distribution in the study area
<i>T. heterophylla</i> Vahl	Arb	Vr, Ff	S11D, ST
<i>Tabernaemonatana</i> cf. <i>linkii</i> A.DC.	Arb	Vr, Ff	S11B, S11D
<i>T. macrocalyx</i> Müll.Arg.®	Arb	Vr, Ff	N1, N3, N5, S11A, S11B, S11D
Apodanthaceae – Pastore et al. (2018)			
<i>Pilosyles blanchetii</i> (Gardner) R.Br. □	Par	Vr	N1
Araceae - Coelho (2018)			
<i>Anthurium bonplandii</i> G.S.Bunting	Er	Vr, Ff	S11A, S11B, S11D
<i>A. gracile</i> (Rudge) Lindl.	Er	Vr, Ff	S11A, S11C, S11D
<i>A. kunthii</i> Poepp.	Er	Ff	S11B
<i>A. lindmanianum</i> Engl.®	Er	Vr, Ff	N1, N4, N5, S11B, S11C, S11D
<i>A. sinuatum</i> Benth. ex Schott	Er	Vr, Ff	N3, S11A, S11B, S11C
<i>Anthurium</i> . sp.	Er	Vr, Ff	N7
<i>Dieffenbachia</i> cf. <i>seguine</i> (Jacq.) Schott	Er	Ff	S11D
<i>Heteropsis oblongifolia</i> Kunth	Er	Ff	N1, N3, S11D
<i>Philodendron blanchetianum</i> Schott - <i>Vasconcelos 764</i> ®	Er	Ff	N5
<i>P. carajasense</i> E.g., Gonç. & A.J.Arruda	Er	Ff	N1, N4, N7, S11A, S11D, SB
<i>P. distantilobum</i> K.Krause	Er	Ff	N1, N3
<i>P. solimoense</i> A.C.Sm.	Er	Ff	N1, N8
<i>P. wulfschlaegelii</i> Schott®	Er	Vr, Ff	N1, N4, S11B, SB
<i>Philodendron</i> sp.	Er	Ff	N1, S11A
<i>Spathiphyllum gardneri</i> Schott	Er	Ff	S11A, S11D
<i>S. humboldtii</i> Schott	Er	Ff	Serra Norte
<i>Wolffia brasiliensis</i> Wedd.	Er	Ff	Serra Sul
Araceae - Hiura & Rocha (2018)			
<i>Attalea maripa</i> (Aubl.) Mart.	Pal	Ff	N6
<i>A. spectabilis</i> Mart.	Pal	Ff	N1
<i>Mauritia flexuosa</i> L.f.	Pal	Vh	S11C, SB

Family - monograph / species – Voucher	Habit	Habitat	Distribution in the study area
<i>Mauritiella armata</i> (Mart.) Burret	Pal	Vh	N5, SB
<i>Oenocarpus distichus</i> Mart.	Pal	Ff	N1, N3
<i>Syagrus cocoides</i> Mart. ®	Pal	Vr, Ff	Serra Norte
Aristolochiaceae - Abreu et al. (2018)			
<i>Aristolochia rugosa</i> Lam.	Li	Vr	S11D
Asteraceae - Cruz et al. (2016)			
<i>Ageratum conyzoides</i> L. + □	Er	Aa	N3, N4, S11D, SB
<i>Aspilia attenuata</i> (Gardner) Baker ®	Arb	Vr	N1, N4, N5, S11D
<i>Bidens bipinnata</i> L. +	Arb	Aa	S11D
<i>B. pilosa</i> L. + □	Arb	Aa	S11D, ST
<i>Calea caleoides</i> (DC.) H. Rob.	Arb	Vr	S11D
<i>Cavalcantia glomerata</i> (G.M.Barroso & R.M.King) R.M.King & H. Rob.	Er	Vr, Ff	N1, N2, N3, N4, N5, N6, N8, S11A
<i>C. percyosa</i> R.M.King & H. Rob. ®	Er	Vr	N7, N8, S11A, S11B, S11C, S11D
<i>Chromolaena maximiliani</i> (Schrad. ex DC.) R.M.King & H. Rob. ® □	Arb	Ff	N1, ST
<i>Eclipta prostrata</i> (L.) L. + ®	Er	Aa	N3, S11D
<i>Elephantopus mollis</i> Kunt. +	Sb	Aa	S11D
<i>Emilia sonchifolia</i> (L.) DC. + □	Er	Aa	N4, N5, S11A, S11D, ST, SB
<i>Erechtites hieracifolius</i> (L.) Raf. ex DC. + □	Er	Vh, Aa	N4, N5, S11D, ST, SB
<i>Hebeclinium macrophyllum</i> (L.) DC.	Arb	Ff	N4
<i>Ichthyothere terminalis</i> (Spreng.) S.F.Blake ®	Er	Vr, Ff	S11A, S11B, S11D, ST, SB
<i>Ichthyothere</i> sp.	Arb	Ff	ST
<i>Lepidaploa arenaria</i> (Mart. ex DC.) H. Rob. ®	Arb	Vr	N1, N4, N5, N6, N8, S11A, S11B, S11C, S11D, ST
<i>L. paraensis</i> (H. Rob.) H. Rob. ®	Sb	Vr	N1, N3, N7, S11A, S11B, S11C, S11D, ST, SB
<i>L. remotiflora</i> (Rich.) H. Rob.	Arb	Ff	N7, S11A, S11B, ST, SB
<i>Lessingianthus monocephalus</i> (Gardner) H. Rob.	Arb	Vr	S11D
<i>Mikania divaricata</i> Poepp.	Li	Ff	N1, S11A, S11B
<i>M. psilostachya</i> DC.	Li	Ff	N4

Family - monograph / species – Voucher	Habit	Habitat	Distribution in the study area
<i>M. micrantha</i> Kunth [□]	Li	Ff	ST
<i>Mikania</i> sp.	Li	Ff	N3
<i>Monogereion carajensis</i> G.M.Barroso & R.M.King [®]	Er	Vr, Ff	N1, N2, N3, N4, N5, N7, N8, S11A, S11B, S11C, S11D, ST, SB
<i>Parapiqueria cavalcantei</i> R.M.King & H.Rob. [®]	Er	Vr, Ff	N1, S11A, S11C
<i>Pluchea sagittalis</i> (Lam.) Cabrera [□]	Er-Sb	Vh, Aa	N1, N3, S11D
<i>Porophyllum ruderale</i> (Jacq.) Cass. ^{+ □}	Arb	Aa	N1, N5, SB
<i>Praxelis asperulacea</i> (Baker) R.M.King & H.Rob.	Er	Vr	S11A, S11B, S11C, S11D, SB
<i>Pterocaulon alopecurooides</i> (Lam.) DC. [®]	Sb	Aa	Serra Norte
<i>Riencourtia pedunculosa</i> (Rich.) Pruski [®]	Er	Vr	N1, N2, N3, N4, N5, N6, N7, N8, S11A, S11B, S11C, S11D, ST, SB
<i>Rolandra fruticosa</i> (L.) Kuntze ^{+®}	Arb	Ff, Aa	N1
<i>Tilesia baccata</i> (L.) Pruski [□]	Arb	Vr, Ff	N1, S11C, ST, SB
<i>Unxia camphorata</i> L.f.	Arb	Vr, Ff	N1, N2, N3, N4, N5, N7, N8, S11D, SB
<i>Vernonanthura cf. brasiliiana</i> (L.) H.Rob.	Ar	Ff	N1
Balanophoraceae - Meirelles (2016)			
<i>Helosis cayennensis</i> (Sw.) Spreng. [®]	Par	Ff	N1, S11B, S11D, ST
<i>Langsdorffia hypogaea</i> Mart.	Par	Ff	N1, N3, ST, SB
Begoniaceae - Kollman (2016)			
<i>Begonia guaduensis</i> Kunth	Arb	Vr, Ff	N3, N4
<i>B. humilis</i> Aiton [®]	Er	Vr, Ff	N1, N2, N3, N4, N5, S11A, S11B, S11C, S11D, SB
<i>B. saxicola</i> A.DC.	Arb	Vr, Ff	N4, N5, N8, S11A, S11C, S11D
<i>B. wollyni</i> Herzog	Sb	Vr, Ff	N7, S11A, S11B, S11D
Bignoniaceae - Lohmann et al. (2018)			
<i>Amphilophium mansoanum</i> (DC.) L.G.Lohmann	Li	Vr, Ff	N8, S11A, S11B
<i>A. rodriguesii</i> (A.H. Gentry) L.G.Lohmann	Li	Vr, Ff	N3, N4
<i>Anemopaegma carajasense</i> A.H.Gentry ex Firetti-Leggieri & L.G.Lohmann	Arb	Vr, Ff	N1, N3, N4, N6, S11A, S11B, S11C, S11D
<i>A. longipetiolatum</i> Sprague	Li	Vr	N1, N3, S11D
<i>Bignonia corymbosa</i> (Vent.) L.G.Lohmann	Li	Vr, Ff	N1, N3, N4, N5, S11A, S11D, SB

Family - monograph / species – Voucher	Habit	Habitat	Distribution in the study area
<i>Fridericia cinnamomea</i> (DC.) L.G.Lohmann	Li	Ff	N4, S11B
<i>F. craterophora</i> (DC.) L.G.Lohmann	Arb	Vr, Ff	N3, N4
<i>F. tuberculata</i> (DC.) L.G.Lohmann	Li	Vr	N7
<i>Jacaranda ulei</i> Bureau & K.Schum. □	Arb	Vr, Ff	N1, S11D, SB
<i>Lundia densiflora</i> DC.	Li	Vr	N5
<i>Pachyptera incarnata</i> (Aubl.) J.N.C.Francisco & L.G.Lohmann	Li	Vr, Ff	N2
<i>Pleonotoma melitoides</i> (S.Moore) A.H.Gentry [®]	Li	Vr, Ff	S11D, ST
<i>P. orientalis</i> Sandwith	Li	Vr, Ff	N1, N3, N8, S11A, S11B, S11C, S11D
Bixaceae - Fernandes-Junior & Gil (2017)			
<i>Cochlospermum orinocense</i> (Kunth) Steud.	Ar	Ff	N3, S11A, S11D
Bromeliaceae - Monteiro & Forzza (2016)			
<i>Aechmea angustifolia</i> Poepp. & Endl.	Er	Vr	N1, S11D
<i>A. bromeliifolia</i> (Rudge) Baker □	Er	Vr, Ff	S11D
<i>A. castelnavii</i> Baker [®]	Er	Vr, Ff	N1, S11A, S11B, S11D
<i>A. mertensii</i> (G.Mey.) Schult. & Schult.f. [®]	Er	Ff	S11B
<i>A. tocatina</i> Baker	Er	Ff	N5, S11C, S11D
<i>Ananas ananassoides</i> (Baker) L.B.Sm. [®]	Er	Vr, Ff	N1, N7, S11B, S11C, S11D
<i>Bromelia eitenorium</i> L.B.Sm.	Er	Ff	Serra Sul
<i>Bromelia</i> aff. <i>lagopus</i> Mez	Er	Ff	N1
<i>Dyckia duckei</i> L.B.Sm. [®]	Er	Vr	N1, N2, N3, N4, N5, N6, S11A, S11C, S11D, SB
<i>Pitcairnia burchellii</i> Mez	Er	Vr	N1, N4, SB
<i>P. torrestiana</i> L.B.Sm.	Er	Ff	N1, N4, N7, S11D
<i>Tillandsia paraensis</i> Mez	Er	Vr, Ff	N4, S11A, S11C, S11D
<i>T. streptocarpa</i> Baker □	Er	Vr, Ff	S11A, S11B, S11C, S11D
Burmanniaceae - Giulietti (2016a)			
<i>Burmannia capitata</i> (Walter ex J.F.Gmel.) Mart. [®]	Er	Vh	N2, N3, N7, S11A, S11B, ST
<i>B. flava</i> Mart. [®]	Er	Vh	N1, N2, N4, N5, N6, N7, N8, S11A, S11B, S11C, S11D, ST

Family - monograph / species – Voucher	Habit	Habitat	Distribution in the study area
Burseraeae - Hiura & Watanabe (2017)			
<i>Protium pilosissimum</i> Engl. ®	Ar	Ff	N4, S11D
Cabombaceae - Lima & Gil (2016)			
<i>Cabomba furcata</i> Schult. & Schult.f.	Er	Vh	N1, N5, S11A, S11B, S11C, ST
<i>C. haynesii</i> Wiersema	Er	Vh	N1, N4
Cactaceae - Zappi & Taylor (2017)			
<i>Cereus hexagonus</i> (L.) Mill. ®	Arb	Vr	N1, N4, N7, S11A, S11B, S11C, S11D, SB
<i>Epiphyllum phyllanthus</i> (L.) Haw. ® □	Sb	Ff	N1, N8, S11D
Calophyllaceae - Marinho & Amorim (2016a)			
<i>Calophyllum brasiliense</i> Cambess. ®	Ar	Vh, Ff	S11A, S11B
Cannabaceae - Viana & Gil (2018)			
<i>Trema micrantha</i> (L.) Blume ®	Ar	Ff	N5
Caryocaraceae - Nunes & Gil (2016)			
<i>Caryocar villosum</i> (Aubl.) Pers.	Ar	Ff	N5
Caryophyllaceae - Lovo & Devecchi (2018)			
<i>Drymaria cordata</i> (L.) Willd. ex Roem. & Schult. +	Er	Aa	N3
Celastraceae - Lombardi & Biral (2016)			
<i>Anthodon decussatum</i> Ruiz & Pav.	Li	Ff	N1, S11C, S11D, ST
<i>Cheiloclinium hippocrateoides</i> (Peyr.) A.C.Sm.	Li	Ff	Serra Norte
<i>Maytenus guyanensis</i> Klotzsch ex Reissek	Arb	Ff	N1, N3, S11D
<i>Tontelea laxiflora</i> (Benth.) A.C.Sm.	Li	Ff	N4
Chrysobalanaceae - Sothers & Prance (2018)			
<i>Hirtella hispidula</i> Miq.	Ar	Ff	N6
<i>H. pilosissima</i> Mart. & Zucc. ®	Ar	Ff	S11A, S11B, S11C, ST
<i>H. racemosa</i> Lam.	Ar	Ff	N1, N2, S11C
<i>Leptobalanus octandrus</i> (Hoffmanns. ex Roem. & Schult.) Sothers & Prance	Ar	Ff	S11C
<i>Moquilea egléri</i> (Prance) Sothers & Prance ®	Ar	Ff	N1, N3, S11A, S11B

Family - monograph / species – Voucher	Habit	Habitat	Distribution in the study area
Cleomaceae - Soares-Neto (2017)			
<i>Melidiscus giganteus</i> (L.) Raf.	Arb	Ff	SB
<i>Tarenaya spinosa</i> (Jacq.) Raf. *	Sb	Aa	N5
Clusiaceae - Alencar & Marinho (2017)			
<i>Clusia nemorosa</i> G.Mey	Ar	Ff	S11A, S11B, S11C, S11D
<i>C. panapanari</i> (Aubl.) Choisy ®	Ar-Arb	Ff	N4, N5, ST
<i>Clusia</i> aff. <i>weddelliana</i> Planch. & Triana ®	Ar-Arb	Ff	N1, N4, S11A, S11B, S11C, S11D
<i>Garcinia madruno</i> (Kunth) Hammel	Ar	Ff	S11A, S11B
<i>Symphonia globulifera</i> L.f.	Ar	Ff	S11A, S11B, S11C
Combretaceae - Praia (2017)			
<i>Combretum laxum</i> Jacq. ®	Li	Vr, Ff	N1, SB
Commelinaceae - Aona et al. (2016)			
<i>Commelina benghalensis</i> L. ** □	Er	Aa	S11D
<i>C. erecta</i> L. △ □	Er	Vh, Ff	S11D
<i>C. obliqua</i> Vahl	Er	Vh, Ff	S11D
<i>C. rufipes</i> var. <i>glabrata</i> Seub.	Er	Ff	S11A
<i>Dichorisanthra hexandra</i> (Aubl.) C.B. Clarke ®	Er	Vr, Vh, Ff	N4, N5, S11A, S11C, S11D, SB
<i>D. villosula</i> Mart. ex Schult & Schult.f.	Er	Ff	N5
<i>Tipogandra diuretica</i> (Mart.) Handlos	Er	Vh	N5
Connaraceae - Pastore & Vasconcelos (2017)			
<i>Connarus perrotteii</i> (DC.) Planch.	Ar	Ff	N2, N4, S11B, S11C
<i>Rourea doniana</i> Baker ®	Li	Ff	N1, N5, SB
<i>R. ligulata</i> Baker ®	Li	Vr, Ff	N1
Convulvulaceae - Simão-Bianchini et al. (2016)			
<i>Aniseia martinicensis</i> (Jacq.) Choisy *	Li	Vr, Vh, Ff	N5, SB
<i>Cuscuta insquamata</i> Yunck. ®	Par	Vr, Vh, Ff	N1, N2, N3, N4, N5, N6, N7, SB
<i>Evohulus filipes</i> Mart. ® △ □	Er	Vr, Vh	N5, N7, ST, SB

Family - monograph / species – Voucher	Habit	Habitat	Distribution in the study area
<i>E. lithospermoides</i> Mart. ^{Δ □}	Er	Vr	N1, S11A
<i>Ipomoea asplundii</i> O'Donell [®]	Li	Vr, Ff	N3, N6, N7, ST
<i>I. cavalcantii</i> D.F.Austin [®]	Li	Vr, Ff	N1, N2, N3, N4, N5
<i>I. decora</i> Meisn.	Li	Vr, Ff	N4, S11A, S11B, S11C, S11D, ST
<i>I. goyazensis</i> Gardner [®]	Li	Vr, Ff	N1, N5, S11D, ST
<i>I. hederifolia</i> L.	Li	Vr, Ff, Aa	N5
<i>I. marabensis</i> D.F.Austin & Secco [®]	Li	Vr, Ff	N4, N5, N6, N7, N8, S11A, S11B, S11C, S11D, ST, SB
<i>I. maurandiooides</i> Meisn. [*] [®]	Li	Vr	N1, N2, N3, N4, N5, N7, S11A, S11B, S11C, S11D, ST
<i>I. minutiflora</i> (M.Martens & Galeotti) House	Li	Vr, Ff	S11D
<i>I. procumbens</i> Mart. ex Choisy - Zappi 3510 ⁺ [□]	Li	Aa	S11A, S11B
<i>I. ramosissima</i> (Poir.) Choisy	Li	Vr, Ff	N4, N5, SB
<i>I. reticulata</i> O'Donell - Sperling 5680	Li	Vr, Ff	N5
<i>I. setifera</i> Poir. - Zappi 3561 ⁺ [®]	Li	Aa	S11D
<i>Jacquemontia tannifolia</i> (L.) Griseb. [®]	Li	Vr, Ff	N1, N3, N4, N5, N6, N7, S11A, S11B, S11C, S11D, ST
<i>Distimake macrocalyx</i> (Ruiz & Pav.) A.R.Simões & Staples [*] [□]	Li	Vr, Ff	N4, N5, ST, SB
<i>Operculina hamiltonii</i> (G.Don) D.F.Austin & Staples	Li	Ff	N7, S11D
<i>Turbina cordata</i> (Choisy) D.F.Austin & Staples	Li	Ff	N3
Cordiaceae - Watanabe <i>et al.</i> (2017)			
<i>Cordia exaltata</i> Lam. [®]	Arb	Ff	N1, N4, N5, SB
<i>C. nodosa</i> Lam.	Arb	Ff	N1, S11D, SB
<i>Varronia multispicata</i> (Cham.) Borhidi ⁺	Arb	Aa	N4
Costaceae - André & Sousa (2018)			
<i>Costus lasius</i> Loes.	Er	Ff	N1, S11D
<i>C. scaber</i> Ruiz & Pav. [®]	Er	Ff	N5, S11D
<i>C. spiralis</i> (Jacq.) Roscoe	Er	Ff	N7, S11D
Cucurbitaceae - Gomes-Klein <i>et al.</i> (2016)			
<i>Cayaponia tayuya</i> (Vell.) Cogn.	Li	Vr, Ff	N4, SB

Family - monograph / species – Voucher	Habit	Habitat	Distribution in the study area
<i>Gurania bignoniacea</i> (Poepp. & Endl.) C.Jeffrey [®]	Li	Ff	N1, N3, S11D
<i>G. sinuata</i> (Benth.) Cogn.	Li	Ff	N1, N2, N6, S11A, ST
<i>G. subumbellata</i> (Miq.) Cogn. [®]	Li	Ff	ST
<i>Helmontia cardiophylla</i> Harms	Li	Ff	N5, S11B, ST, SB
<i>Melothria pendula</i> L.	Li	Vh	N1
Cyperaceae - Nunes et al. (2016)			
<i>Becquerelia cymosa</i> Brongn.	Er	Vr,Vh	N5
<i>Bulbostylis cangae</i> C.S.Nunes & A.Gil ^{*®}	Er	Vr	N1, S11A, ST
<i>B. conifera</i> (Kunth) C.B.Clarke ^{®Δ□}	Er	Vr	N1, N2, N4, N5, N6, N7, N8, S11A, S11B, S11C, S11D, ST, SB
<i>B. lagoensis</i> (Boeckeler) Prata & M.G.López	Er	Vr,Vh	N4, N5, S11A, S11B, S11C, S11D, ST, SB
<i>Bulbostylis</i> sp.	Er	Vh	S11D
<i>Cyperus aggregatus</i> (Willd.) Endl. ^{+ Δ□}	Er	Vh,Ff,Aa	N1, N5, S11B, S11C, S11D, SB
<i>C. distans</i> L.f.	Er	Vr, Ff	N3, N4
<i>C. haspan</i> L. ^{®□}	Er	Vr,Vh	N1, N2, N3, N4, N5, N8, S11B, S11C, S11D, ST, SB
<i>C. hortensis</i> (Salzm. ex Schltld.) Dorr [*]	Er	Vr	N1, N5, S11D
<i>C. laxus</i> Lam. ^{Δ□}	Er	Vr	N1, S11A, S11B, S11D, ST, SB
<i>C. luzulae</i> (L.) Rottb. ex Retz. [®]	Er	Vr,Vh	N2, N5, ST
<i>C. polystachyos</i> Rottb. [*]	Er	Vh	N3, N4, S11C
<i>C. sesquiflorus</i> (Torr.) Mattf. & Kük ^{**®Δ□}	Er	Vr, Vh	S11C, S11D
<i>C. sphacelatus</i> Rottb. ⁺	Er	Vr,Aa	N1, N3, N4, N5, S11A, S11B
<i>C. subquarrosus</i> (Muhl.) Bauters [*]	Er	Vr	N3
<i>C. surinamensis</i> Rottb. ^{+ Δ}	Er	Vr,Aa	N1, S11D
<i>Cyperus</i> sp. 1	Er	Vr	S11D
<i>Cyperus</i> sp. 2	Er	Vr	ST
<i>Eleocharis acutangula</i> (Roxb.) Schult. [□]	Er	Vh	N1, N4, S11B, S11D, SB
<i>E. ayacuchensis</i> S.González & Reznicek	Er	Vh	N1, N2, N4, N5, S11D, ST, SB
<i>E. endoumifascis</i> Hinchliff & Roalson	Er	Vh	N1, S11B, S11C, SB

Family - monograph / species – Voucher	Habit	Habitat	Distribution in the study area
<i>E. flavescens</i> (Poir.) Urb.	Er	Vh	N1, N4, N5, S11A, S11B, S11C, S11D, ST, SB
<i>E. geniculata</i> (L.) Roem. & Schult.	Er	Vh	N5
<i>E. pedroviana</i> C.S.Nunes, R.Trevis. & A.Gil ®	Er	Vh	N1, N3, N4, N7, N8, S11A, S11C, S11D, ST, SB
<i>E. plicarhachis</i> (Griseb.) Svenson □	Er	Vh	N1, N3
<i>Fimbristylis dichotoma</i> (L.) Vahl	Er	Vr	N1, ST
<i>F. quinqueangularis</i> (Vahl) Kunth *	Er	Vr	N4, S11D, ST
<i>Hypolytrum paraense</i> M.Alves & W.W.Thomas®	Er	Ff	N1, N2, N3, N5, S11D
<i>Lagenocarpus verticillatus</i> (Spreng.) T.Koyama & Maguire	Er	Vr	S11A, S11B, S11C
<i>Rhynchospora acanthoma</i> A.C.Araújo & Longhi-Wagner	Er	Vr	N1, N3, N4, N5, N6, N7, N8, SB
<i>R. bar-bata</i> (Vahl) Kunth®	Er	Vr, Vh	N1, N2, N3, N4, N5, N6, N8, S11A, S11B, S11C, S11D, ST, SB
<i>R. candida</i> (Nees) Boeckeler®	Er	Vh	N3, N5, N6
<i>R. corymbosa</i> (L.) Britton	Er	Vr, Vh	N2, N4, N8, S11C, S11D
<i>R. divaricata</i> (Ham.) M.T.Strong	Er	Vr	N1, N2, N3, N4, N5, N7, S11A
<i>R. extimita</i> (Nees) Boeckeler	Er	Vr, Vh	N3, N4, N5, N7, ST, SB
<i>R. filiformis</i> Vahl □	Er	Vr, Vh	N1, N2, N3, N4, N5, N7, S11A, S11B, S11C, S11D, ST, SB
<i>R. holoschoenoides</i> (Rich.) Herter	Er	Vr, Vh	N1, N3, N4, N6, S11A, S11B, S11C, S11D, ST, SB
<i>R. pubera</i> (Vahl) Boeckeler	Er	Vr, Aa	N1, N2, N3, N4, N5, S11A, S11B, S11C, S11D, ST, SB
<i>R. rugosa</i> (Vahl) Gale □	Er	Vh	N1, N3, S11D
<i>Rhynchospora</i> sp. 1	Er	Vr, Vh	ST, SB
<i>Rhynchospora</i> sp. 2	Er	Vr, Vh	N1, N2, N3, N4, N5, N6, S11A, S11C, S11D, ST, SB
<i>Scleria cyperina</i> Willd. ex Kunth	Er	Vr, Vh	S11A, S11B
<i>S. microcarpa</i> Nees ex Kunth	Er	Vh	N1, N3, N5, N8, S11A, S11D, ST, SB
<i>S. secans</i> (L.) Urb.®	Er	Vr, Ff	N6, S11A, S11B, S11D, SB
<i>S. verticillata</i> Muhl. ex Willd.	Er	Vr, Vh	N2, N3, S11B, ST, SB
Dilleniaceae - Zappi (2018a)			
<i>Davilla cearenensis</i> Huber	Li	Vr, Ff	N1, N3
<i>D. rugosa</i> Poir.	Li	Vr, Ff	N2

Family - monograph / species – Voucher	Habit	Habitat	Distribution in the study area
<i>Doliotocarpus brevipedicellatus</i> Garcke	Li	Ff	N2, S11A
Dioscoreaceae - Fraga & Sousa (2018)			
<i>Dioscorea pilosiuscula</i> Bertero ex Spreng.	Li	Ff	N1
<i>D. piperifolia</i> Humb. & Bonpl. ex Willd.	Li	Vr, Ff	N1, N8
<i>D. planistipulosa</i> Uline ex R.Kunth.	Li	Vr	S11C
Droseraceae - Mota (2017a)			
<i>Drosera sessilifolia</i> A.St.-Hil.	Er	Vh	S11D
Eriocaulaceae - Watanabe et al. (2017)			
<i>Eriocaulon carajense</i> Moldenke [®]	Er	Vr, Vh	N1, N3, N4, N6, S11A, S11D, SB
<i>E. cinereum</i> R.Br. [®]	Er	Vh	N1, N3, N4, N5, N6, N7, N8, S11A, S11B, S11C, S11D, ST, SB
<i>E. tenuifolium</i> Klotzsch ex Körn.	Er	Vh	S11A
<i>E. aff. setaceum</i> L. [®]	Er	Vh	N1, N3, N4, N6, N8, S11A, S11B, S11C, S11D, ST
<i>Paepalanthus fasciculooides</i> Hensold [®]	Er	Vr, Ff	N1, N4, N5, N6, N8, S11A, S11B, S11C, S11D, SB
<i>Syngonanthus caulescens</i> (Poir.) Ruhland [®]	Er	Vh	S11D,
<i>S. discretifolius</i> (Moldenke) M.T.C.Watan. [®]	Er	Vh	N1, N2, N3, N4, N5, N6, N7, N8, S11A, S11B, S11C, S11D, SB, ST
<i>S. heterocephalus</i> (Körn.) Ruhland [®]	Er	Vh	N1, S11A, S11D
<i>S. simplex</i> (Miq.) Ruhland [®]	Er	Vh	N5
<i>S. aff. saxicola</i> (Koern.) Trovó & Stützel [®]	Er	Vh	N1
Erythroxylaceae - Costa-Lima & Loliola (2018)			
<i>Erythroxylum carajasense</i> (Plowman) Costa-Lima ^{*®}	Arb	Vr, Ff	N1, N2, N3, N4, N5, N6, N8, SB
<i>E. citrifolium</i> A.St.-Hil.	Arb	Vr, Ff	N1, N2, N4, N5, S11A, S11B, S11C, S11D
<i>E. leptoneurum</i> O.E.Schulz	Arb	Ff	S11C, S11D
<i>E. mucronatum</i> Benth.	Arb	Ff	N4, N5
<i>E. nelson-rosae</i> Plowman [®]	Arb	Vr	N1, N2, N3, N4, N5, N6, N8, S11A, S11B, S11C, S11D, ST, SB
<i>E. rifium</i> Cav.	Arb-Arb	Vr, Ff	N7, S11B
<i>E. squamatum</i> Sw. [®]	Arb	Vr, Ff	N4, N5, S11C
<i>E. subracemosum</i> Turcz.	Arb	Vr, Ff	S11D

Family - monograph / species – Voucher	Habit	Habitat	Distribution in the study area
Euphorbiaceae - Costa et al. (2018)			
<i>Alchornea discolor</i> Poepp. ®	Ar	Vr, Ff	N1, N5, S11D, ST
<i>Aparisthium cordatum</i> (A.Juss.) Baill.	Ar	Ff	N1, N5, N6, ST
<i>Astraea paulina</i> Didr. □	Er	Vr, Ff, Aa	N1, N3, N4, S11A, S11B, S11C, S11D
<i>Croton</i> aff. <i>subferrugineus</i> Müll.Arg. ®	Arb	Vr	N1, N2, N4, N5, N7, N8, S11A, S11B, S11C, ST
<i>C. cajucara</i> Benth.	Ar-Arb	Vr, Ff	N5
<i>Croton</i> sp.	Arb	Vr	N1, N2, N3, S11A, S11B, S11C, S11D, ST, SB
<i>Mabea angustifolia</i> Spruce ex Benth. ®	Ar-Arb	Ff	N1, N5, S11D
<i>Manihot marajoara</i> Chermont de Miranda ex Huber emend. Secco & Costa	Arb	Ff	S11B, S11D, ST
<i>M. quinquepartita</i> Huber ex D.J.Rogers & Appan	Arb	Vr, Ff	N1, N3, N4, N5, S11C, ST
<i>M. tristis</i> subsp. <i>surumuensis</i> (Ule) Rogers & Appan ®	Arb	Ff	S11D, ST
<i>Sapium argutum</i> (Müll.Arg.) Huber	Ar-Arb	Vr	N1, N4
Fabaceae - Mattos et al. (2018)			
<i>sAbrus melanospermus</i> subsp. <i>tenuiflorus</i> (Spruce ex Benth.) D.Harder ®	Li	Vr, Ff	N1, N3, N4, N5, N6, N8, S11A, S11B, S11C, S11D, SB
<i>Aeschynomene americana</i> Hard glandulosa (Poir.) Rudd	Sb	Ff, Aa	N1, N5, S11D
<i>A. filosa</i> Mart.	Sb	Vh	SB
<i>A. sensitiva</i> var. <i>hispidula</i> (Kunth) Rudd	Sb	Vh	N4, N7, S11A, S11D
<i>Aeschynomene</i> sp.	Sb	Vr, Vh	N1, N2, N3, N4, N5, N7, N8, S11A, S11B, S11D, ST
<i>Anadenanthera peregrina</i> (L.) Speg.	Ar	Ff	N1
<i>Ancistrotropis peduncularis</i> (Kunth) A.Delgado ®	Li	Vr, Ff	N1, N5, N8, S11A, S11B, S11C
<i>Bauhinia longicuspis</i> Benth.	Ar-Arb	Vr, Ff	N8, S11B
<i>B. longipedicellata</i> Ducke	Ar-Arb	Vr, Ff	N1, N3
<i>B. pulchella</i> Benth. ®	Arb	Vr, Ff	N1, N3, N4, N5, N6, S11C, S11D, ST, SB
<i>Calopogonium mucunoides</i> Desv. +	Li	Aa	N1, N5, S11D
<i>Camptosema ellipticum</i> (Desv.) Burkart ®	Li	Vr, Ff	N1, N3, N4, N5, N6, N8, S11A, S11B, S11C, S11D, ST, SB
<i>C. carajásense</i> Cavalcante ®	Li	Vr, Vh, Ff	N1, N4, N5, S11A, S11B, SB
<i>Centrosema grazielae</i> V.P.Barbosa	Li	Vr, Vh, Ff	N1, N3, N5, S11B

Family - monograph / species – Voucher	Habit	Habitat	Distribution in the study area
<i>Chamaecrista desvauxii</i> var. <i>langsdorfii</i> (Kunth ex Vogel) H.S.Irwin & Barneby [□]	Arb	Vr	N1, S11D, SB
<i>C. desvauxii</i> var. <i>mollissima</i> (Benth.) H.S.Irwin & Barneby	Arb	Vr	S11A, S11B, S11C, S11D, ST
<i>C. diphylla</i> (L.) Greene [□]	Er	Vr, Ff	N1, N4, N5
<i>C. flexuosa</i> L.	Arb	Vr, Vh	N1, N2, N3, N4, N5, N8, S11A, S11D
<i>C. nictitans</i> subsp. <i>patellaria</i> (DC. ex Collad.) H.S.Irwin & Barneby ^{+ □}	Arb	Ff, Aa	N4, N5
<i>C. rotundifolia</i> (Pers.) Greene ^{+ □}	Arb	Aa	N5
<i>C. trichopoda</i> (Benth.) Britton & Rose ex Britton & Killip	Er	Vr, Vh	N1, N3, N4, N8, S11B
<i>Chloroleucon acacioides</i> (Ducke) Barneby & J.W.Grimes	Ar-Arb	Vr, Ff	Serra Norte, Serra Sul
<i>Clitoria falcata</i> Lam. [®]	Li	Vr, Vh, Ff	N1, N3, N4, N5, N6, N7, S11A, S11B, S11C, S11D, SB
<i>Copaifera martii</i> Hayne [®]	Ar	Ff	N2, N4, N5, N8, S11A, S11B, ST
<i>Crotalaria maypurensis</i> Kunth [®]	Sb	Vr, Vh, Ff	N1, N2, N4, N5, N6, N8, S11A, S11B, S11C, S11D
<i>Dalbergia spruceana</i> Benth.	Ar	Ff	S11C, SB
<i>D. subcymosa</i> Ducke	Li	Ff	N3
<i>Deguelia amazonica</i> Killip [®]	Li	Vh, Ff	N3, N8, ST
<i>Desmodium barbatum</i> (L.) Benth. ⁺	Er	Vr, Ff	N1, N5
<i>D. incanum</i> (Sw.) DC. ^{+ □}	Sb	Aa	N1, N5
<i>D. triflorum</i> (L.) DC. ⁺	Sb	Aa	S11D
<i>Dimorphandra gardneriana</i> Tul.	Ar	Ff	Serra Sul
<i>Dioclea apurensis</i> Kunth [®]	Li	Vr, Vh	N1, N2, N3, N4, N5, N8, S11A, S11C, S11D, ST
<i>D. bicolor</i> Benth. [®]	Li	Vr, Ff	N1, N3, S11A, ST, SB
<i>D. megacarpa</i> Rolfe	Li	Vr, Ff	ST
<i>Enterolobium schomburgkii</i> (Benth.) Benth.	Ar	Vr, Ff	S11B, S11C
<i>Galactia jussiaeana</i> Kunth [®]	Sb	Vr, Ff	N1, N2, S11A, S11B, S11C, S11D, ST, SB
<i>Inga alba</i> (Sw.) Willd.	Ar	Vr, Vh, Ff	S11C
<i>I. capitata</i> Desv.	Ar	Ff	N5, S11C
<i>I. thibaudiana</i> subsp. <i>thibaudiana</i> DC.	Ar	Ff	S11C, S11D, SB
<i>Machaerium acutifolium</i> Vogel	Ar	Ff	Serra Sul

Family - monograph / species – Voucher	Habit	Habitat	Distribution in the study area
<i>Mimosa acutistipula</i> var. <i>ferrea</i> Barneby [®]	Ar-Arb	Vr, Ff	N1, N2, N3, N4, N5, N6, N7, N8, S11A, S11B, S11D, ST, SB
<i>M. camporum</i> Benth.	Er	Vr, Aa	N1, N5
<i>M. candollei</i> R. Grether	Er	Vr, Aa	N1, N5
<i>M. guilandinae</i> var. <i>spruceana</i> (Benth.) Barneby	Li	Vr, Vh	N1, N4
<i>M. pigra</i> var. <i>pigra</i> L.	Arb	Vh, Aa	N1
<i>M. piresii</i> Barneby [®]	Arb	Vr, Vh	S11A
<i>M. pudica</i> var. <i>hispidula</i> Brenan ⁺	Arb	Aa	N1, N5
<i>M. setosa</i> var. <i>paludosa</i> (Benth.) Barneby	Arb	Vr, Aa	N1, N4, N5
<i>M. skinneri</i> var. <i>carajarum</i> Barneby [®]	Er	Vh	N1, N2, N3, N4, N5, N8, S11A, S11B, S11C, S11D, SB
<i>M. somnians</i> var. <i>viscida</i> (Willd.) Barneby [®]	Arb	Vr, Ff	N1, N3, N4, N5, N6, N8, S11A, S11B, S11C, S11D, ST
<i>M. xanthocentra</i> var. <i>mansii</i> (Mart.) Barneby ^{® Δ}	Sb	Vr, Vh, Ff	N1, N3, N4, N5, N7, N8, S11A, S11D, ST
<i>Parkia platycephala</i> Benth. [®]	Ar-Arb	Vr, Ff	N1, S11A, SB
<i>Periandra coccinea</i> (Schrud.) Benth.	Li	Vr, Ff	N1, N3, N4, N5, N6, N7, N8, S11C, S11D, ST, SB
<i>P. mediterranea</i> (Vell.) Taub. ^{® □}	Arb	Vr, Vh	N1, N2, N3, N4, N5, N6, N8, S11A, S11C, S11D, ST, SB
<i>Senna macranthera</i> (DC. ex Collad.) H.S.Irwin & Barneby [□]	Arb	Vr, Aa	S11B, S11D, ST
<i>S. pendula</i> (Willd.) H.S.Irwin & Barneby	Arb	Ff, Aa	N5, S11B, ST
<i>S. quinqueangulata</i> (Rich.) H.S.Irwin & Barneby	Arb	Ff, Aa	N4
<i>S. silvestris</i> (Vell.) H.S.Irwin & Barneby	Arb	Aa	N4, Serra Sul, ST
<i>Stryphnodendron pulcherrimum</i> (Willd.) Hochr.	Ar	Ff	Serra Norte, S11C, ST
<i>Stylosanthes capitata</i> Vogel ^{® Δ}	Sb	Vr, Ff, Aa	N1, S11D
<i>S. hispida</i> Rich.	Sb	Vr, Vh, Ff	N1, N2, N4, N8, ST, SB
<i>S. humilis</i> Kunth	Sb	Vr, Ff, Aa	N1, S11D
<i>Tachigali vulgaris</i> L.G.Silva & H.C.Lima	Ar	Vr, Ff	N1, N5, N8, SB
<i>Zornia latifolia</i> Sm.	Sb	Vr, Ff	N1, N4, N5
Gentianaceae - Guimaraes et al. (2018)			
<i>Chelonanthus purpurascens</i> (Aubl.) Struwe, S.Nilsson & V.A.Albert [®]	Sb	Vr	N1, N2, N3, S11A, S11B, S11C, S11D, ST
<i>C. viridiflorus</i> (Mart.) Gilg	Sb	Vh	N1, N3, N4

Family - monograph / species – Voucher	Habit	Habitat	Distribution in the study area
<i>Curtia tenuifolia</i> (Aubl.) Knobl.	Er	Vh	N1, N2
<i>Schultesia benthamiana</i> Klotzsch ex Griseb.®	Er	Vr, Vh	N1, N2, N3, N4, N5, N8, S11A, S11B, S11C, S11D, ST, SB
Gesneriaceae - Chautems et al. (2018)			
<i>Diastema</i> sp.	Er	Ff	S11C
<i>Goyazia rupicola</i> Taub.	Er	Vr, Ff	N1, S11D
<i>Mandirola rupestris</i> (Gardner) Roalson & Boggan	Er	Vr	S11C
<i>Nautilocalyx kohlerioides</i> (Leeuwenb.) Wiehler	Li	Ff	ST
<i>Phinaea albolineata</i> (Hook.) Benth. ex Hemsl.	Er	Ff	N3, S11A, S11B, S11C
<i>Sinningia minima</i> A.O.Araujo & Chautems®	Er	Ff	N1, N3, N4, N5, N8, S11A, S11B, S11C, S11D
Gnetaceae - Mota & Giulietti (2016a)			
<i>Gnetum nodiflorum</i> Brongn.®	Li	Ff	N1, N2, N4, N8
Heliotropiaceae - Watanabe & Hiura (2018)			
<i>Euploca humistrata</i> (Cham.) J.I.M.Melo & Semir	Er	Vh	SB
<i>E. lagoensis</i> (Warm.) Diane & Hilger	Er	Vh	N5, SB
Humiriaceae - Antunes & Holanda (2018)			
<i>Sacoglottis guianensis</i> Benth.	Ar	Ff	N4
<i>S. mattogrossensis</i> Malme®	Ar	Ff	S11D, SB
Hydrocharitaceae - Hall & Gil (2016)			
<i>Apalanthe granatensis</i> (Humb. & Bonpl.) Planch.	Er	Vh	N5, S11A
<i>Ottelia</i> cf. <i>brasiliensis</i> (Planch.) Walp.	Er	Vh	N1
Hypericaceae - Marinho et al. (2017)			
<i>Vismia cayennensis</i> (Jacq.) Pers.	Ar	Ff	S11C, S11D,
<i>V. gracilis</i> Hieron.®	Ar	Ff	N1, N4
<i>Vismia</i> cf. <i>schultesii</i> N.Robson®	Arb	Ff	N1, N2, N3, S11C, S11D
Iridaceae - Damasceno & Gil (2016)			
<i>Cipura xanthomelas</i> Maxim ex Klatt®	Er	Vr	S11A, S11B, S11C, S11D, ST

Family - monograph / species – Voucher	Habit	Habitat	Distribution in the study area
Lacistema			
Lacistema - Marinho & Amorim (2016b)			
<i>Lacistema aggregatum</i> (P.J.Bergius) Rusby	Arb	Ff	S11D
Lamiaceae - Harley (2016)			
<i>Aegiphila integrifolia</i> (Jacq.) Moldenke [®]	Ar-Arb	Ff	N2, N3, N4, N5, N7, N8, ST
<i>A. racemosa</i> Vell.	Li	Ff	N1, N5
<i>Amasonia campestris</i> (Aubl.) Moldenke [®]	Sb	Ff	N1, N2, N3, N4, N5
<i>A. hirta</i> Benth.	Sb	Ff	N1, N3, N8
<i>A. lasiocaulos</i> Mart. & Schauer ex Schauer	Sb	Ff	N1, N4, N5, ST, SB
<i>Cantinoa americana</i> (Aubl.) Harley & J.F.B.Pastore ⁺	Er	Aa	SB
<i>C. mutabilis</i> (Rich.) Harley & J.F.B.Pastore	Er	Aa	ST, SB
<i>Hyptis atrorubens</i> Poit.	Er	Vr, Vh, Ff	N1, N5, S11B, S11D, ST
<i>H. brevipes</i> Poit. ^Δ	Er	Vh, Ff, Aa	ST, SB
<i>H. parkeri</i> Benth. [®]	Er	Vh	N3, N4, N5, ST
<i>H. recurvata</i> Poit. [®]	Er	Vr, Vh	N1, SB
<i>Leonotis nepetifolia</i> (L.) R.Br. ⁺⁺	Er	Aa	N5
<i>Marsypianthes chamaedrys</i> (Vahl) Kuntze	Er	Vr, Aa	N1, N3, N5, N7, S11D, SB
<i>Mesosphaerum pectinatum</i> (L.) Kuntze ⁺	Er	Aa	N1, N3, N4, S11D
<i>M. suaveolens</i> (L.) Kuntze ⁺	Sb	Aa	N8, ST, SB
<i>Vitex triflora</i> Vahl [®]	Ar-Arb	Vr, Ff	N1, N4, N5, S11A, S11B, S11D, ST, SB
Lauraceae - Moraes (2018)			
<i>Cassytha filiformis</i> L. [□]	Par	Vr	N1, N4, N5, S11C, S11D
<i>Mezilaurus itauba</i> (Meisn.) Taub. ex Mez	Ar	Vr, Ff	N1, N3, N4, N5, S11A, S11D
<i>Ocotea camphoromoea</i> Rohwer	Ar	Ff	N1, N2, S11A, S11D
<i>Ocotea leucoxyton</i> (Sw.) Laness.	Ar	Ff	S11C
<i>Ocotea puberula</i> (Rich.) Nees [□]	Ar	Ff	S11D

Family - monograph / species – Voucher	Habit	Habitat	Distribution in the study area
Lentibulariaceae - Mota & Zappi (2018)			
<i>Gentlisea filiformis</i> A.St.-Hil.	Er	Vh	N3, N7, S11D
<i>Utricularia amethystina</i> Salzm. ex A.St.-Hil. & Girard	Er	Vh	N3, N7, S11D, SB
<i>U. breviscapa</i> C. Wright ex Griseb.	Er	Vh	N6
<i>U. calycifida</i> Benj.®	Er	Vh	N1, N2, N5
<i>U. costata</i> P.Taylor	Er	Vh	N1, N3, N5, S11B, ST, SB
<i>U. gibba</i> L.	Er	Vh	N1, S11D, SB
<i>U. neottioides</i> A.St.-Hil. & Girard®	Er	Vh	N1, N3, N4, N6, S11A, S11C, S11D, ST
<i>U. nigrescens</i> Sylvén	Er	Vh	N1, N3, S11D
<i>U. physoceras</i> P.Taylor®	Er	Vh	N1, N2, N3, N4, N5, N6, N7, N8, S11B, S11C, S11D, ST, SB
<i>U. pusilla</i> Vahl®	Er	Vh	N3, N4, N5, N6, S11D
<i>U. subulata</i> L.	Er	Vh	N1, N2, N3, N4, N5, N7, N8, S11A, S11B, S11C, S11D, ST
<i>U. trichophylla</i> Spruce ex Oliv.	Er	Vh	S11A, S11B
Linderniaceae - Scatigna & Mota (2016)			
<i>Lindernia brachyphylla</i> Pennell®	Er	Vh	N1, N2, N3, N5, N6, N7, S11B, S11D, ST, SB
<i>L. crustacea</i> (L.) F.Muell.	Er	Vr	N4, N5, N7, N8, S11D, ST, SB
<i>L. diffusa</i> (L.) Wettst.	Er	Vh	N4
Loganiaceae - Zappi & Setubal (2016)			
<i>Spigelia flemmingiana</i> Cham. & Schlttdl.	Er	Aa	N4, N8
<i>Strychnos cogens</i> Benth.	Er	Vr, Ff	ST
Loranthaceae - Caires (2018)			
<i>Oryctanthus alveolatus</i> (Kunth) Kuijt	Par	Vr, Ff	N3, N6
<i>O. florulentus</i> (Rich.) Tiegh.	Par	Vr, Ff	S11C
<i>Passovia disjectifolia</i> (Rizzini) Kuijt	Par	Ff	S11A
<i>P. pedunculata</i> (Jacq.) Kuijt®	Par	Vr	N1, N3, N4, N6
<i>P. pyrifolia</i> (Kunth) Tiegh.	Par	Vr, Ff	SB
<i>Peristethium reticulatum</i> (Rizzini) Caires	Par	Vr, Ff	S11D, SB

Family - monograph / species – Voucher	Habit	Habitat	Distribution in the study area
<i>Psittacanthus eucalyptifolius</i> (Kunth) G. Don	Par	Ff	N3, N4, N5, N6
<i>Struthanthus marginatus</i> (Desr.) G. Don [□]	Par	Vr, Ff	N4, S11A, S11B, S11D
<i>S. polyrhizus</i> Mart.	Par	Vr	S11D
Lythraceae - Cavalcanti et al. (2016)			
<i>Cuphea annulata</i> Koelne [®]	Sb-Arb	Vr, Ff	N1, N3, N4, N5, N7, N8, S11A, S11B, S11C, S11D, ST
<i>C. carajasensis</i> Lourteig [®]	Sb	Vr	N1, N3, N4, N5, N6, N7, N8, S11A, S11B, S11C, S11D, ST, SB
<i>C. carthagenensis</i> (Jacq.) J.F.Macbr. ^{+ □}	Sb	Aa	N1, N4, N5, S11D
Malpighiaceae - Amorim et al. (2018)			
<i>Banisteriopsis malifolia</i> (Nees ex Mart.) B.Gates ^{® □}	Li	Vr	N2, N3, N4, N5, N6, N8, S11A, S11B, S11C, S11D, ST
<i>B. muricata</i> (Cav.) Cuatrec. ^{® Δ}	Li	Vr, Ff	N1
<i>B. stellaris</i> (Griseb.) B.Gates [®]	Li	Vr	N1, N3, N4, N5, S11A, S11B, S11C, S11D, ST, SB
<i>Byrsonima chrysophylla</i> Kunth [®]	Ar	Vr	N1, N2, N4, N5, N8, S11C, S11D, SB
<i>B. crispa</i> A. Juss.	Ar	Vr, Ff	S11D
<i>B. stipulacea</i> A. Juss. [®]	Ar	Ff	N1
<i>Coleostachys genipifolia</i> A. Juss.	Arb	Ff	N1, N4
<i>Diplopterys pubipetala</i> (A. Juss.) W.R. Anderson & C. Davis [®]	Li	Vr, Ff	N1, N2, N3, N5, S11B, S11C, ST
<i>Heteropterys nervosa</i> A. Juss. [®]	Li	Vr	N1, S11A, S11B, S11C, S11D,
<i>H. trigoniifolia</i> A. Juss.	Li	Vr, Ff	N4, ST
<i>Niedenzuella acutifolia</i> (Cav.) W.R. Anderson [□]	Li	Vr, Ff	S11B, S11D
<i>Peixotoa reticulata</i> Griseb.	Arb	Vr	N7, ST
<i>Stigmaphyllon paraense</i> C.E. Anderson	Li	Vr, Ff	N4, SB
Malvaceae - Fernandes-Júnior & Cruz (2018)			
<i>Eriotheca globosa</i> (Aubl.) A. Robyns	Ar	Vr	N1
<i>Helicteres brevispira</i> A. St.-Hil.	Arb	Vr	N1
<i>H. eitenii</i> Leane	Arb	Vr	N1
<i>H. guazumifolia</i> Kunth	Arb	Vr	SB
<i>Hibiscus furcellatus</i> Lam. [□]	Arb	Vh	SB

Family - monograph / species – Voucher	Habit	Habitat	Distribution in the study area
<i>Melochia arenosa</i> Benth.	Arb	Vr, Vh	N6, S11C, ST, SB
<i>M. melissifolia</i> Benth.	Arb	Vr, Vh	N1, N2, N3, N4, N8
<i>M. splendens</i> A.St.-Hil. & Naudin.	Arb	Vh, Aa	N1, N2, N3, N4, N5, N6, N7, S11A, S11B, S11D, ST
<i>Pavonia malacophylla</i> (Link & Otto) Garcke	Arb	Ff	SB
<i>Pseudobombax longiflorum</i> (Mart.) A.Robyns	Arb	Vr	S11D
<i>P. marginatum</i> (A.St.-Hil., Juss. & Cambess.) A.Robyns	Arb	Vr	ST
<i>Sida linifolia</i> Juss. ex Cav. ^Δ □	Sb	Vr	ST
<i>S. rhombifolia</i> L. + □	Sb	Vr, Aa	N3, N4
<i>S. tuberculata</i> R.E.Fr. □	Sb	Vr	SB
<i>S. urens</i> L.	Sb	Vr, Ff	N4
<i>Urena lobata</i> L. +	Arb	Aa	N1
<i>Waltheria indica</i> L. + □	Arb	Aa	N1, N4, ST
Marantaceae - Saka (2017)			
<i>Maranta ruiziana</i> Körn.	Er	Ff	N4
<i>Monotagma plurispicatum</i> (Körn.) K.Schum.	Er	Ff	N1, N4, N5, N7, S11A, S11B, S11D
Marcgraviaceae - Viana & Cruz (2017)			
<i>Norantea guianensis</i> Aubl. ®	Li	Vr	N1, N4, S11A, S11C, S11D
<i>Souroubea guianensis</i> Aubl.	Li	Ff	N1
Mayacaceae - Mota e Koch (2016)			
<i>Mayaca fluviatilis</i> Aubl. ® □	Er	Vh	N1, N3, N4, N5, S11A, S11B, S11D, SB
<i>M. kanthii</i> Seub. ®	Er	Vh	N1, N3, N7, S11D, SB
<i>M. longipes</i> Mart. ex Seub. ®	Er	Vh	N4, N5
Melastomataceae - Rocha et al. (2017)			
<i>Aciotis acuminifolia</i> (Mart. ex DC.) Triana	Er	Vr, Vh	N1, N2, N3, N4, S11A, S11B, S11D, SB
<i>Acisanthera crassipes</i> (Naudin) Wurdack ®	Er	Vh	N1, N3, ST, SB
<i>Bellucia egensis</i> (DC.) Penneys, Michelangeli, Judd, & Almeida	Ar	Ff	SB
<i>Brasilianthus carajensis</i> Almeida & Michelangeli ®	Er	Vr, Vh	N1, N2, N3, N4, N5, N6, N7, N8, S11A, S11B, S11C, S11D, ST, SB

Family - monograph / species – Voucher	Habit	Habitat	Distribution in the study area
<i>Clidemia capitellata</i> (Bonpl.) D. Don	Arb	Ff	N1, N4
<i>C. hirta</i> (L.) D. Don	Arb	Vr, Ff	S11A, S11D
<i>C. microthyrsa</i> R.O. Williams	Arb	Ff	S11B, S11D
<i>Desmoscelis villosa</i> (Aubl.) Naudin	Arb	Vh	N3
<i>Henriettea ramiflora</i> (Sw.) DC.	Ar	Vh, Ff	N5, S11D
<i>Leandra micropetala</i> (Naudin) Cong.	Arb	Ff	N1, N5, S11A, S11B, S11D
<i>Macairea radula</i> (Bonpl.) DC.	Arb	Vr, Vh	S11D
<i>Miconia affinis</i> DC.	Ar	Vr, Ff	S11B, S11C, S11D
<i>M. alata</i> (Aubl.) DC.	Arb	Vr, Ff	N3, S11D
<i>M. albicans</i> (Sw.) Steud.	Arb	Vr, Vh	N1, S11D
<i>M. alternans</i> Naudin	Arb	Vh	N3, N4, S11C, S11D, ST, SB
<i>M. bracteata</i> (DC.) Triana	Arb	Ff	N1
<i>M. chrysophylla</i> (Rich.) Urb.	Ar	Vr, Ff	N2, N5, S11D
<i>M. ciliata</i> (Rich.) DC.	Arb	Vr	N1, N4
<i>M. cuspidata</i> Mart. ex Naudin	Ar	Vr, Ff	N1, N4, N5, S11A, S11D
<i>M. elata</i> (Sw.) DC.	Ar	Vr, Vh	N1, N5
<i>M. heliotropoides</i> Triana	Arb	Ff	N1, N7, S11C, S11D
<i>M. holosericea</i> (L.) DC.	Ar	Vr, Vh, Ff	N3, N4, N5, N7, N8, S11A, S11B, S11C, S11D, ST
<i>M. ibaguensis</i> (Bonpl.) Triana	Arb	Vh	S11D
<i>M. lepidota</i> DC. □	Ar	Vh, Ff	N1, N2, N4, S11D
<i>M. manauara</i> R. Goldenb., Caddah & Michelang.	Ar	Vr, Ff	N1
<i>M. minutiflora</i> (Bonpl.) DC.	Ar	Ff	N2, S11D
<i>M. nervosa</i> (Sm.) Triana	Arb	Ff	S11D
<i>M. prasina</i> (Sw.) DC.	Ar	Vh	N1, N5, S11D
<i>M. splendens</i> (Sw.) Griseb.	Ar	Ff	Serra Norte
<i>M. tomentosa</i> (Rich.) D. Don ex DC.	Ar	Ff	N1, N3, S11A, S11C, S11D
<i>Miconia</i> sp.	Arb	Ff	N1, N2, N3, N4, N5, S11A, S11B, S11C, S11D, ST, SB

Family - monograph / species – Voucher	Habit	Habitat	Distribution in the study area
<i>Mouriri cearensis</i> subsp. <i>carajásica</i> Montley	Ar	Ff	N1, N5, S11A, S11B, S11C, S11D
<i>M. vernicosa</i> Naudin	Ar	Ff	N1, N2, N5, N6, S11D,
<i>Nepsera aquatica</i> (Aubl.) Naudin	Arb	Vh	N1, N5
<i>Pleroma carajásense</i> K.Rocha, R.Goldenb. & F.S.Mey	Arb	Vr	N1, N2, N4, N5, N8, S11A, S11C, S11D
<i>P. stenocarpum</i> Triana	Arb	Vh	S11A, S11B, S11D
<i>Pterolepis trichotoma</i> (Rottb.) Cogn.	Er	Ff, Aa	N3, S11A, S11B, S11D, ST, SB
<i>Rhynchanthera hispida</i> Naudin	Arb	Vr, Ff	N2, ST
<i>Tibouchina edmundoi</i> Brade	Arb	Vr	N1, N5, S11A, S11C, S11D, SB
<i>Tibouchina</i> sp.	Ar	Vr	ST
<i>Tococa guianensis</i> Aubl.	Arb	Vr	N3
Meliaceae – Fernandes-Júnior et al. (2017)			
<i>Guarea macrophylla</i> Vahl	Ar	Ff	N1
<i>G. pubescens</i> (Rich.) A.Juss.	Ar	Ff	N4
<i>G. sibvatica</i> C.DC.	Ar	Ff	S11A, S11B
<i>Trichilia micrantha</i> Benth.®	Ar	Vr, Ff	N1
Menispermaceae Lima & Teixeira (2018)			
<i>Abuta grandifolia</i> (Mart.) Sandwith®	Li	Vr	N1, S11D
Menyanthaceae – Giulietti (2016b)			
<i>Nymphoides humboldtiana</i> (Kunth) Kuntze® □	Er	Vh	N1, N4, N5, N7, N8, S11A, S11C, S11D
Metteniusaceae – Cruz e Viana (2016)			
<i>Emmotium nitens</i> (Benth.) Miers	Ar	Ff	N1, N4, N5, N7, N8, S11C, S11D, ST
Monimiaceae – Mota (2017b)			
<i>Mollinedia ovata</i> Ruiz & Pav.	Ar	Ff	N7, S11A, S11B
Moraceae – Romaniuc-Neto & Gaglioti (2018)			
<i>Ficus americana</i> subsp. <i>guyanensis</i> (Desv. ex Ham.) C.C.Berg	Ar	Ff	N4, S11A, S11D
Myrtaceae – Trindade et al. (2018)			
<i>Calypttranthes bipennis</i> O.Berg®	Ar	Ff	S11C

Family - monograph / species – Voucher	Habit	Habitat	Distribution in the study area
<i>Campomanesia aromatica</i> (Aubl.) Griseb.	Ar	Ff	S11D
<i>Eugenia anastomosans</i> DC. ®	Ar-Arb	Ff	N2, N5
<i>E. cupulata</i> Amshoff	Ar	Ff	S11A
<i>E. densiracemosa</i> Mazime & Faria	Ar-Arb	Ff	S11D
<i>E. egensis</i> DC.	Ar	Ff	ST
<i>E. flavescens</i> DC. ®	Ar	Vr, Ff	N1, N4, N8, S11D, ST
<i>E. florida</i> DC.	Ar-Arb	Ff	N1
<i>E. puniceifolia</i> (Kunth) DC. ® □	Arb	Vr, Ff	N1, N4, N5, S11D
<i>Eugenia</i> sp.	Arb	Ff	S11C
<i>Myrcia amazonica</i> DC. □	Ar-Arb	Vr, Ff	N2, N5
<i>M. atramentifera</i> Barb.Rodr.	Ar-Arb	Ff	N2, N5
<i>M. bracteata</i> (Rich.) DC. ®	Ar-Arb	Vr, Ff	N3, N7, S11D, ST
<i>M. clusiiifolia</i> (Kunth) DC.	Ar	Ff	N4, N5
<i>M. cuprea</i> (O.Berg) Kiaersk. ®	Ar-Arb	Ff	S11D, ST, SB
<i>M. grandis</i> McVaugh	Ar	Vr	N1, N4
<i>M. guianensis</i> (Aubl.) DC. ® □	Ar	Vr	N1, N3, N4, S11A
<i>M. inaequiloba</i> (DC.) Lemée	Ar	Ff	N1
<i>Myrcia</i> aff. <i>maguirei</i> (McVaugh) E.Lucas & C.W.Wilson	Arb	Ff	N3
<i>M. multiflora</i> (Lam.) DC. ®	Ar-Arb	Vr, Ff	N1, N2, N3, N4, N5, S11A, S11D
<i>M. paivae</i> O.Berg	Ar	Ff	N5
<i>M. splendens</i> (Sw.) DC. □	Ar	Vr, Ff	N1, N2, N4, S11D, SB
<i>M. subsessilis</i> O.Berg	Ar	Ff	N1, N2
<i>M. sylvatica</i> (G.Mey.) DC. ®	Ar	Vr, Ff	N1, N4, S11D, ST
<i>M. tomentosa</i> (Aubl.) DC.	Ar	Vr, Ff	N3, S11D, SB
<i>Myrciaria floribunda</i> (H. West ex Willd.) O.Berg □	Ar	Ff	N4, SB
Nyctaginaceae - Giulietti & Nogueira (2017)			
<i>Guapira venosa</i> (Choisy) Lundell	Ar	Ff	N1, N5

Family - monograph / species - Voucher	Habit	Habitat	Distribution in the study area
<i>Neea floribunda</i> Poepp. & Endl.®	Ar	Ff	N5, ST
<i>N. macrophylla</i> Poepp. & Endl.®	Ar-Arb	Vr, Ff	N1, N2, N5, S11A, S11B, S11D, ST
<i>N. oppositifolia</i> Ruiz & Pav.®	Ar-Arb	Vr, Ff	N1, N5, N8, S11A, S11B, S11C, S11D, ST, SB
Nympheaceae - Lima (2018)			
<i>Nymphaea rudgeana</i> G.Mey.	Er	Vh	S11B
Ochnaceae - Zappi (2018b)			
<i>Oouratea castaneifolia</i> (DC.) Engl.®	Arb	Vr, Ff	N1, N4, S11A, S11C, SB
<i>O. racemiformis</i> Ule®	Ar-Arb	Vh, Ff	N1, N3, N4, N6, S11D, SB
<i>Sauvagesia tenella</i> Lam.®	Er	Vr	N1, N2, N4, N6, N8, S11A, S11D, SB
Oliaceae - Meirelles & Fernandes-Júnior (2017)			
<i>Heisteria ovata</i> Benth.®	Ar-Arb	Ff	N1, N2, N3, N4, N5, S11A, S11B, S11C, S11D
<i>Ximentia americana</i> L.®	Ar-Arb	Vr, Ff	N1, S11A, S11D
Onagraceae - Lovo & Zappi (2018)			
<i>Ludwigia decurrens</i> Walter	Er	Vh, Ff, Aa	S11D
<i>L. erecta</i> (L.) H.Hara	Arb	Vh, Aa	N4
<i>L. hyssopifolia</i> (G.Don.) Exell	Er	Vh	N1
<i>L. leptocarpa</i> (Nutt.) H.Hara □	Er	Vh, Aa	N4
<i>L. nervosa</i> (Poir.) H.Hara® □	Arb	Vh	S11A
<i>L. octovalvis</i> (Jacq.) P.H.Raven*® □	Er	Vh, Aa	N1, N2, S11D, ST
<i>L. tortulosa</i> (Arn.) H.Hara	Er	Vh	N5, SB
Opliliaceae - Ramalho & Zappi (2017)			
<i>Agonandra sivatica</i> Ducke®	Ar-Arb	Ff	N1, N7, S11A
Orchidaceae - Koch et al. (2018)			
<i>Campylocentrum fasciola</i> (Lindl.) Cogn.®	Er	Ff	N5
<i>Catasetum discolor</i> (Lindl.) Lindl.®	Er	Vr	N1, N2, N4, N8, S11A, S11D, ST, SB
<i>Cranichis muscosa</i> Sw.	Er	Vr	Serra Sul

Family - monograph / species – Voucher	Habit	Habitat	Distribution in the study area
<i>Cyrtopodium andersonii</i> (Lamb. ex Andrews) R.Br.	Er	Vr, Ff	N1, ST
<i>Dichaea panamensis</i> Lindl.	Er	Ff	S11A, S11D
<i>Encyclia randii</i> (Barb.Rodr.) Porto & Brade [®]	Er	Vr, Ff	S11D
<i>Epidendrum amblostomoides</i> Hoehne	Er	Ff	S11A
<i>E. nocturnum</i> Jacq. [®]	Er	Vr, Ff	S11A, S11C, S11D, SB
<i>E. purpurascens</i> Focke [®]	Er	Vr, Ff	N3, S11C, S11D, SB
<i>Erycina pusilla</i> (L.) N.H. Williams & M.W.Chase	Er	Vr	S11D
<i>Habenaria ludibundiciliata</i> J.A.N.Bat. & Bianch.	Er	Vr	N2, N7, ST
<i>H. aff. nuda</i> Lindl. [®]	Er	Vr	N8
<i>Ionopsis utricularioides</i> (Sw.) Lindl.	Er	Vr, Ff	S11D
<i>Laelia marginata</i> (Lindl.) L.O.Williams	Er	Ff	S11A
<i>Macroclinium wulschlaegelium</i> (Focke) Dodson	Er	Vr	N1
<i>Mesadenella cuspidata</i> (Lindl.) Garay	Er	Vr	N3, S11D
<i>Mormodes paraensis</i> Salazar & J.B.F.Silva	Er	Ff	
<i>Nolyia barkeri</i> Lindl.	Er	Ff	ST
<i>N. lyrata</i> S.Moore	Er	Ff	S11D
<i>Peristeria guttata</i> Knowles & Westc.	Er	Ff	N1
<i>Polystachya concreta</i> (Jacq.) Garay & H.R.Sweet	Er	Ff	S11A, S11D
<i>Prosthechea fragrans</i> (Sw.) W.E.Higgins	Er	Vr, Ff	S11D
<i>Scaphyglottis prolifera</i> (R.Br.) Cogn.	Er	Ff	S11C, S11D
<i>S. stellata</i> Lodd. ex Lindl.	Er	Vr, Ff	N1, N3
<i>Sobralia liliastrum</i> Lindl. [®]	Er	Vr, Ff	N1, N2, N4, N5, S11D
<i>Trichocentrum sprucei</i> (Lindl.) M.W.Chase & N.H.Williams [®]	Er	Ff	N4
<i>Uletochis longipedicellata</i> A.Cardoso & Ilk.-Borg.	Er	Vr, Ff	N5
Orobanchaceae - Scatigna & Mota (2017)			
<i>Buchnera carajasensis</i> Scatigna & N.Mota [®]	Er	Vr, Vh	N2, N3, N6, N7, S11A, S11B, S11C, S11D, ST, SB

Family - monograph / species – Voucher	Habit	Habitat	Distribution in the study area
Oxalidaceae - Hall et al. (2017)			
<i>Oxalis barrelieri</i> L. ^Δ	Er	Vr, Ff	SB
<i>O. mucronulata</i> Norlind	Er	Vr, Ff	N4
Passifloraceae - Koch & Ilkiu-Borges (2016)			
<i>Passiflora ceratocarpa</i> F.Silveira	Er	Vr, Ff	N7, SB
<i>P. foetida</i> L. - Harley 57373 ^{Δ □}	Er	Ff	N7
<i>P. glandulosa</i> Cav. [®]	Er	Vr	S11D, ST
<i>P. tholozanii</i> Sacco [®]	Er	Ff	N1, N2, N3, S11D, ST
<i>Passiflora</i> sp.	Er	Ff	N7
Phyllanthaceae - Secco & Silveira (2016)			
<i>Phyllanthus hyssopifoloides</i> Kunth	Er	Vh	N1, N3, N4, N5, N6, ST, SB
<i>P. minutulus</i> Müll.Arg. [□]	Er	Vh	N1, N3, N4, N5, S11B, S11C, S11D, ST, SB
<i>P. orbiculatus</i> Rich. ^Δ	Er	Ff, Aa	N1, SB
<i>P. stipulatus</i> (Raf.) G.L.Webster	Er	Vr	N4
Phytollaceae - Meirelles (2016)			
<i>Phytolacca thyrsoiflora</i> Fenzl ex J.A.Schmidt ⁺	Er	Aa	N4, N5, N8, SB
Picramniaceae - Pirani & Devecchi (2016)			
<i>Picramnia ferrea</i> Pirani & W.W.Thomas [®]	Ar-Arb	Vr, Ff	N1, N5, S11A, S11B, S11C, S11D, ST, SB
Piperaceae - Monteiro (2018)			
<i>Peperomia albopilosa</i> D.Monteiro [®]	Er	Vr, Ff	N3, N4, N6, S11A, S11B, S11C, S11D
<i>P. circinnata</i> Link	Er	Ff	N3, S11D
<i>P. macrostachya</i> (Vahl) A.Dietr.	Er	Ff, Aa	N5, N6, S11B, S11C, S11D, SB
<i>P. magnoliifolia</i> (Jacq.) A.Dietr.	Er	Vr, Ff	S11C, S11D
<i>P. obtusifolia</i> (L.) A.Dietr. [®]	Er	Ff	N4, S11C, S11D
<i>P. pseudoserriatirhachis</i> D.Monteiro	Er	Ff	N3, N4, N7, N8, S11D
<i>P. uaupesensis</i> Yunck.	Er	Vr, Ff	N1, N4, S11A, S11D
<i>Piper aduncum</i> L.	Arb	Vr, Ff	N5

Family - monograph / species – Voucher	Habit	Habitat	Distribution in the study area
<i>P. aequale</i> Vahl	Arb	Vr, Ff	N1, N5, S11A
<i>P. aleyreanum</i> C.DC.	Arb	Vr, Ff, Aa	N1, N5, S11A, S11B
<i>P. arboreum</i> var. <i>arboreum</i> Aubl.	Arb	Vr, Ff, Aa	N1, S11B, S11D
<i>P. arboreum</i> var. <i>hirtellum</i> Yunck.	Arb	Vr, Ff, Aa	S11D
<i>P. carniconnectivum</i> C.DC.	Arb	Vr, Vh, Aa	N5
<i>P. demeraranum</i> (Miq.) C.DC.	Arb	Ff	S11A, S11B
<i>P. kegelianum</i> (Miq.) C.DC.	Arb	Ff	N1
<i>P. krukoffii</i> Yunck.	Arb	Vr, Ff	S11A, S11B
<i>P. nematanthera</i> C.DC.	Arb	Ff, Aa	S11D
<i>P. obliquum</i> Ruiz & Pav.	Arb	Ff	N1, N4, S11A
<i>P. pellitum</i> C.DC.	Arb	Ff	N5, S11B
Plantaginaceae - Scatigna & Mota (2017)			
<i>Bacopa monnierioides</i> (Cham.) B.L.Rob.®	Er	Vh	N7, S11D, SB, ST
<i>B. myriophylloides</i> (Benth.) Wettst.®	Er	Vh	N1, SB
<i>B. reflexa</i> (Benth.) Edwall®	Er	Vh	N3, N4, N5, S11B, S11D, ST
<i>Scoparia dulcis</i> L. +	Er	Aa	N4, S11D
<i>Stemodia verticillata</i> (Mill.) Hassl.	Er	Aa	N1, N3
Poaceae - Viana et al. (2018)			
<i>Acroceras zizanioides</i> (Kunth) Dandy	Er	Vh	N5
<i>Andropogon bicornis</i> L. + □	Er	Vr, Aa	N1, N3, N4, N5, S11D
<i>A. leucostachyus</i> Kunth + □	Er	Vr, Aa	N3, ST, SB
<i>A. virgatus</i> Desv. ex Ham. □	Er	Vr, Vh	N3
<i>Anthaenantia lanata</i> (Kunth) Benth.® □	Er	Vr	N2, S11D, SB
<i>Axonopus aureus</i> P.Beauv.	Er	Vr	SB
<i>A. capillaris</i> (Lam.) Chase + □	Er	Vr, Ff, Aa	N1, N3, N4, N5, N6, N8, S11D
<i>A. carajaisensis</i> M.N.Bastos	Er	Vr	N1, S11D
<i>A. compressus</i> (Sw.) P.Beauv. △ □	Er	Vr	N3

Family - monograph / species – Voucher	Habit	Habitat	Distribution in the study area
<i>A. longispicus</i> (Döll) Kuhlms.	Er	Vr	N1, N2, N3, N4, N5, N8, S11D, ST, SB
<i>A. pressus</i> (Nees ex Steud.) Parodi □	Er	Vr	N1
<i>A. purpusii</i> (Mez) Chase	Er	Vr	N1, N4, N5, N6
<i>A. rupestris</i> Davidse ®	Er	Vr, Vh	N1, N3, N6, N7, N8, ST, SB
<i>Cenchrus polystachios</i> (L.) Morrone ++	Er	Aa	N3, N4
<i>Chloris barbata</i> Sw. +	Er	Aa	S11D
<i>Coleataenia scabrida</i> (Döll) Zuloaga	Er	Vh	N5, ST, SB
<i>C. stenodes</i> (Griseb.) Soreng	Er	Vh	S11D, ST, SB
<i>Digitaria ciliaris</i> (Retz.) Koeler +	Er	Aa	S11D
<i>D. insularis</i> (L.) Fedde + □	Er	Aa	S11D, SB
<i>D. violascens</i> Link ++	Er	Aa	N4, S11D
<i>Eleusine indica</i> (L.) Gaertn. ++	Er	Aa	S11D
<i>Eragrostis bahiensis</i> Schrad. ex Schult.	Er	Vr, Vh	N1, N4, N5
<i>E. curvula</i> (Schrad.) Nees ++ □	Er	Aa	N1
<i>E. maypurensis</i> (Kunth) Steud. ®	Er	Vr	N1, N4, N5, N8, S11D
<i>E. pilosa</i> (L.) P.Beuv. ex Roem. & Schult. ++	Er	Aa	S11D
<i>E. rufescens</i> Schrad. ex Schult. □	Er	Vr, Aa	N1, N4, N6, S11D
<i>E. tenella</i> (L.) P.Beuv. ex Roem. & Schult. ++	Er	Aa	S11D
<i>E. unioloides</i> (Retz.) Nees ex Steud. ++	Er	Aa	N1, N2
<i>Hilidaea breviscrops</i> (Döll) C.Silva & R.P.Oliveira ®	Er	Ff	S11D
<i>H. pallens</i> (Sw.) C.Silva & R.P.Oliveira □	Er	Ff	N7, N8
<i>H. tenuis</i> (J.Presl & C.Presl) C.Silva & R.P.Oliveira	Er	Ff	N3, N5, S11B, ST
<i>Hilidaea</i> sp.	Er	Vr, Ff	N4, N5, S11A, S11B, ST
<i>Homolepis aturensis</i> (Kunth) Chase +	Er	Ff, Aa	N3, N4
<i>Ichnanthus calvescens</i> (Nees ex Trin.) Döll ®	Er	Vr, Ff	N4, N7, S11D, ST, SB
<i>I. leptophyllus</i> Döll	Er	Vr, Ff	S11A, ST
<i>Isachne polygonoides</i> (L.am.) Döll	Er	Vh	N1, N3, N5, N7, N8, S11B, S11D, SB

Family - monograph / species – Voucher	Habit	Habitat	Distribution in the study area
<i>Lasiacis ligulata</i> Hitchc. & Chase	Er	Ff	N2
<i>Luziola peruviana</i> Juss. ex J.F.Gmel. ®	Er	Vh	SB
<i>Melinis minutiflora</i> P.Beauv. ++ □	Er	Aa	N5, SB
<i>Mesosetum annuum</i> Swallen	Er	Vr	N1, N3, N6, N7, S11A, S11B, S11D, SB
<i>M. cayennense</i> Steud. ®	Er	Vr	N1, N3, N4, N5, S11C, S11D, ST, SB
<i>M. filifolium</i> F.T.Hubb.	Er	Vr	N1, N3, N6, N7, S11A, S11D, ST,
<i>Olyra latifolia</i> L. ®	Er	Ff	N4, S11D
<i>Oryza glumipatula</i> Steud.	Er	Vh	N7, S11A, S11D
<i>Otachyrium versicolor</i> (Döll) Henrard	Er	Vh	S11A
<i>Panicum aquarum</i> Zuloaga & Morrone	Er	Vh	SB
<i>P. millegrana</i> Poir. ® ^	Er	Ff	N5, S11D, ST
<i>Paratheria prostrata</i> Griseb. ®	Er	Vh	S11D, SB
<i>Parodiolyra micrantha</i> (Kunth) Davidse & Zuloaga ®	Er	Ff	N1, N2, N4
<i>Paspalum axillare</i> Swallen ®	Er	Vr, Ff	N3, N4, N5, S11A, S11C
<i>P. carajasense</i> S.Denham	Er	Vr	N1, N4, N5, N7, N8
<i>Paspalum cangarum</i> C.O. Moura, P.L. Viana, R.C. Oliveira	Er	Vr	S11A, S11B, SB
<i>P. cinerascens</i> (Döll) A.G.Burm. & M.Bastos □	Er	Vr, Ff	N1, S11A, S11D, ST
<i>P. conjugatum</i> P.J.Bergius +	Er	Aa	N1, N7, N8, ST, SB
<i>P. densum</i> Poir.	Er	Aa	N2, N4, N5
<i>P. expansum</i> Döll	Er	Vr, Ff	N7, SB
<i>P. foliiforme</i> S.Denham ®	Er	Vr	N3, N4, N7, N8, SB
<i>P. gardnerianum</i> Nees	Er	Vr	N1
<i>P. lanciflorum</i> Trin.	Er	Vr	N1, N3, N4, S11A, S11C, S11D, SB
<i>P. melanospermum</i> Desv. ex Poir.	Er	Vr, Aa	N1, N2, N4, N7
<i>P. multicaule</i> Poir. +	Er	Vr, Aa	N1, N3, N4, N6, N7, SB
<i>P. pallens</i> Swallen	Er	Vh	N7, S11D, ST, SB
<i>P. paniculatum</i> L. + □	Er	Aa	ST

Family - monograph / species – Voucher	Habit	Habitat	Distribution in the study area
<i>P. parviflorum</i> Rhode ex Flüggé	Er	Vr, Vh	N1, N4, N5
<i>P. reticulinerve</i> Renvoize [®]	Er	Vr	N1, N3
<i>P. spissum</i> Swallen	Er	Vr	N1, N3, N4, N5, N6, S11A, S11B, S11D
<i>P. virgatum</i> L. +	Er	Aa	N1, S11D
<i>Paspalum</i> sp.	Er	Vr, Ff	S11D, SB
<i>Rhytachne gonzalezii</i> Davidse [®]	Er	Vh	N1, N4, N7, N8, S11A, S11B, S11D, SB
<i>Rugoloa pilosa</i> (Sw.) Zuloaga +	Er	Vr, Ff, Aa	N3, N4, N6, N7, N8, S11C, S11D, SB
<i>R. polygonata</i> (Schrad.) Zuloaga	Er	Vh	N1, N4, N5, N8
<i>Sacciolepis myuros</i> (Lam.) Chase	Er	Vh	ST
<i>Sorghum halepense</i> (L.) Pers. +	Er	Aa	S11D
<i>Sporobolus indicus</i> (L.) R.Br. ++	Er	Aa	S11D
<i>S. multiramosus</i> Longhi-Wagner & Boechat [®]	Er	Vr	N1, N2, N3, N4, N5, N6, N7, N8, S11B, S11D, ST, SB
<i>Steinchisma laxum</i> (Sw.) Zuloaga [□]	Er	Vr, Vh, Aa	N1, N4, N7, S11B, S11C, S11D, ST, SB
<i>Steirachne barbata</i> (Trin.) Renvoize	Er	Vr	N1
<i>Streptostachys asperifolia</i> Desv.	Er	Vr, Ff	N1, N3, N4, N5, N6, N7, S11D, ST,
<i>Trachypogon spicatus</i> (L.f.) Kuntze	Er	Vr	N1, N3, N4, N5, N6, N8, S11D, SB
<i>Trichantheicum</i> cf. <i>arctum</i> (Swallen) Zuloaga & Morrone	Er	Vr, Vh	N1, N4, N5, N6, N7, N8, S11A, S11B, S11C, S11D, SB
<i>T. cyanescens</i> (Nees ex Trin.) Zuloaga & Morrone	Er	Vr, Vh	N3, N4, N6, S11B, ST, SB
<i>T. parvifolium</i> (Lam.) Zuloaga & Morrone	Er	Vh	N1, N4, N6, S11B, S11D, ST, SB
<i>Tristachya chrysothrix</i> Nees	Er	Vr	S11D
<i>Urochloa brizantha</i> (Hochst. ex A.Rich.) R.D. Webster ^{++□}	Er	Aa	N4
<i>U. decumbens</i> (Stapf) R.D. Webster ^{++□}	Er	Aa	Serra Norte
<i>U. maxima</i> (Jacq.) R.D. Webster ⁺⁺	Er	Aa	SB
Polygalaceae - Pastore & Silveira (2016)			
<i>Bredemeyera divaricata</i> (DC.) J.F.B. Pastore	Li	Vr	N1, S11B
<i>B. floribunda</i> Willd. ^{® Δ □}	Li	Vr	N4, N6, S11A, ST, SB

Family - monograph / species – Voucher	Habit	Habitat	Distribution in the study area
<i>Caamembeca spectabilis</i> var. <i>spectabilis</i> (DC.) J.F.B.Pastore [®]	Er	Vr, Ff	N1, N4, N5, N7, N8, S11A, S11B, S11C, S11D, SB
<i>Polygala adenophora</i> DC. [®]	Er	Vh	N1, N3, N4, N5, N6, N7, S11A, S11B, S11C, S11D, ST, SB
<i>Securidaca diversifolia</i> (L.) S.F.Blake	Li	Vr, Ff	N1, N6, N7, S11A, S11B, S11C, S11D,
<i>S. rivinifolia</i> var. <i>parvifolia</i> A.W.Benn.	Li	Vr, Ff	N5, N6, ST
<i>S. rivinifolia</i> var. <i>rivinifolia</i> A.St.-Hil. & Moq. [®]	Li	Vr, Ff	N3, ST, SB
Polygonaceae - Melo (2018)			
<i>Coccoloba coronata</i> Jacq.	Ar-Arb	Ff	S11D
<i>C. parimensis</i> Benth.	Li	Ff	S11C
<i>Polygonum acuminatum</i> Kunth [□]	Er	Vh	N3
<i>P. hydropiperoides</i> Michx.	Er	Vh	SB
Pontederiaceae - Sousa & Giuletta (2016)			
<i>Heteranthera oblongifolia</i> Mart. ex Schult. & Schult.f.	Er	Vh	S11D
<i>H. reniformis</i> Ruiz & Pav.	Er	Vh	S11D
Portulacaceae - Giuletta & Coelho (2018)			
<i>Portulaca sedifolia</i> N.E.Br. [®]	Er	Vr, Vh	N4, N6, N7, N8, S11D, ST, SB
Primulaceae - Freitas & Luma (2017)			
<i>Clavija lancifolia</i> subsp. <i>chermontiana</i> (Standl.) B.Stühl	Arb	Ff	N4, S11A, S11C, S11D
<i>C. macrophylla</i> (Link ex Roem. & Schult.) Miq.	Arb	Ff	N4
<i>Cybianthus detergens</i> Mart. [®]	Ar-Arb	Ff	N1, N4, S11C, S11D
<i>C. penduliflorus</i> Mart.	Ar-Arb	Vr, Ff	N1, N3, N4, N7, S11D
<i>Cybianthus</i> sp.	Arb	Vr	N1
Proteaceae - Hall (2016)			
<i>Roupala montana</i> Aubl. ^{®□}	Ar	Vr, Ff	N1, N3
Quinaceae - Botelho & Rocha (2018)			
<i>Quina pteridophylla</i> (Radlk.) Pires	Ar	Ff	N1
Rubiaceae - Zappi et al. (2017)			
<i>Alibertia edulis</i> (Rich.) A.Rich. ex DC.	Ar-Arb	Vr, Ff	N1, N3, N5, S11A, S11C, S11D, ST

Family - monograph / species – Voucher	Habit	Habitat	Distribution in the study area
<i>Augusta longifolia</i> (Spreng.) Rehder	Arb	Ff	S11B, S11D
<i>Borreria alata</i> (Aubl.) DC. + ®	Sb	Aa	N5, N7, S11B, S11D, ST, SB
<i>B. carajasensis</i> E.L.Cabral & L.M.Miguel ®	Sb	Vr	N1, S11A, S11B, S11C, S11D, ST, SB
<i>B. elatiusculata</i> E.L.Cabral & L.M.Miguel ®	Sb	Vr	N1, N2, N3, N4, N5, N6, N8, S11A, S11B, S11C, S11D, ST, SB
<i>B. heteranthera</i> E.L.Cabral & Sobrado ®	Er	Vr	N1, N4, N5, S11A, S11B, S11C, S11D, ST, SB
<i>B. hispida</i> Spruce ex K.Schum. ®	Er	Vr, Aa	N1, N4, N7, S11A, S11B, S11C, S11D, ST
<i>B. hyssopifolia</i> (Roem. & Schult.) Bacigalupo & E.L.Cabral	Er	Vh	Serra Norte, Serra Sul
<i>B. ocyimifolia</i> (Willd. ex Roem. & Schult.) Bacigalupo & E.L.Cabral + ®	Sb	Aa	N3, S11D
<i>B. paraensis</i> E.L.Cabral & Bacigalupo ®	Er	Vr	N1, N2, N3, N4, N5, N6, N7, N8, S11B, S11C, S11D, ST, SB
<i>B. semiamplexicaulis</i> E.L.Cabral ®	Er	Vr, Vh	N1, N2, N3, N4, N5, N6, N7, N8, S11A, S11B, S11D, SB
<i>B. spinosa</i> Cham. & Schltdl. ex DC.	Sb	Vr	S11A
<i>B. verticillata</i> (L.) G.Mey. + ® Δ □	Sb	Aa	N1, N2, N3, N5, S11B, S11D, SB
<i>Borreria</i> sp.	Sb	Vr	N5, ST
<i>Carajasia cangae</i> R.M.Salas, E.L.Cabral & Dessein ®	Er	Vr	S11A, S11B, S11C, S11D
<i>Chomelia ribesoides</i> Benth. ex A.Gray ®	Sb	Vr, Vh	N2, S11A, S11C, SB
<i>Cordia myrciifolia</i> (K.Schum.) C.H.Perss. & Delprete ®	Arb	Vr, Ff	N1, N2, N6, S11A, S11C, S11D, ST
<i>Faramaea capillipes</i> Müll.Arg.	Arb	Ff	N1, N2, N5, S11A, S11B, S11D, ST
<i>F. multiflora</i> A.Rich.	Arb	Ff	S11B, S11C, ST, SB
<i>Geophila cordifolia</i> Miq.	Er	Ff	N5
<i>Hexasepalum teres</i> (Walter) J.H.Kirkbr.	Er	Vr, Aa	N3
<i>Limnosipanea spruceana</i> Hook.f. ®	Er	Vh	SB
<i>Margaritopsis inconspicua</i> C.M.Taylor	Arb	Ff	S11B
<i>Mitracarpus carajasensis</i> E.L.Cabral, Sobrado & E.B.Souza ®	Er	Vr, Ff	N1, N2, N3, N4, N5, N6, N7, N8, S11A, S11B, S11C, S11D, ST, SB
<i>Palicourea deflexa</i> (DC.) Borhidi	Arb	Ff	N3, S11A, S11B, S11D, SB
<i>P. guianensis</i> Aubl.	Ar-Arb	Ff	N2, S11A, S11B, S11C, S11D
<i>P. marcgravii</i> A.St.-Hil. ® □	Arb	Ff	S11D, ST
<i>P. racemosa</i> (Aubl.) Borhidi®	Arb	Ff	S11A, S11D, SB

Family - monograph / species – Voucher	Habit	Habitat	Distribution in the study area
<i>Perama carajensis</i> J.H.Kirkbr. ®	Er	Vr, Ff	N1, N2, N3, N4, N5, N6, N7, N8, S11A, S11B, S11C, S11D, ST, SB
<i>Psychotria appendiculata</i> Müll.Arg.	Arb	Ff	S11D, ST
<i>P. carthagensis</i> Jacq.	Arb	Ff	N2, N7, S11B, S11D
<i>P. colorata</i> (Willd. ex Schult.) Müll.Arg.	Arb	Ff	N1, N5, S11A, S11C, S11D, ST, SB
<i>P. hoffmannseggiana</i> (Willd. ex Schult.) Müll.Arg. ®	Sb	Ff	N1, N3, N4, N5, S11B, S11C, S11D, ST, SB
<i>P. iodotricha</i> Müll.Arg	Sb	Ff	S11D
<i>P. lupulina</i> Benth.	Sb	Ff	S11D, SB
<i>P. prunifolia</i> (Kunth) Steyerm.	Sb	Ff	S11A, SB
<i>P. trichosepala</i> Müll.Arg.	Sb	Ff	N1, ST, SB
<i>P. variegata</i> Steyerm.	Er	Ff	N4
<i>Remijita amazonica</i> K.Schum. ®	Arb	Ff	S11A, S11C, S11D
<i>Richardia scabra</i> L.	Er	Aa	SB
<i>Rudgea longiflora</i> Benth.	Arb	Ff	S11A, S11B, S11D
<i>Sabicea grisea</i> Cham. & Schldl. ®	Li	Vr, Ff	N2, ST
<i>Schizocalyx cuspidatus</i> (A.St.-Hil.) Kainul. & B.Bremer	Ar	Vr, Ff	N1, S11A, S11B, S11C, S11D
<i>Spermacoce exilis</i> (L.O.Williams) C.D.Adams	Er	Ff, Aa	N7, ST, SB
<i>Tocoyena formosa</i> (Cham. & Schldl.) K.Schum. ® ^	Ar-Arb	Vr	N1, SB
<i>Uncaria guianensis</i> (Aubl.) J.F.Gmel.	Li	Ff	S11A, S11D
Rutaceae - Pirani & Devecchi (2018)			
<i>Dictyoloma vandellianum</i> A.Juss. ® □	Arb	Vr, Aa	Serra Norte
<i>Ertela trifolia</i> (L.) Kuntze ®	Sb	Ff	N8, ST, SB
<i>Esenbeckia cowanii</i> Kastra	Arb	Vr, Ff	N1
<i>Pilocarpus carajaensis</i> Skorupa ®	Arb	Vr, Ff	N4, N5, S11D
<i>P. microphyllus</i> Stapf ex Wardleworth ®	Arb	Ff	N1, N2, N3, N6
<i>Spiranthera parviflora</i> Sandwith	Arb	Ff	N1, N2, N3
<i>Zanthoxylum apiculatum</i> (Sandwith) P.G. Waterman	Ar	Ff	Serra Norte
<i>Z. monogynum</i> A.St.-Hil.	Ar	Ff	Serra Norte

Family - monograph / species – Voucher	Habit	Habitat	Distribution in the study area
Salicaceae - Marquete & Zappi (2018)			
<i>Casearia arborea</i> (Rich.) Urb.	Ar	Vr, Ff	N5, S11D
<i>C. grandiflora</i> Cambess.	Ar	Vr, Ff, Aa	N2, N3, N7, S11D
<i>C. javitensis</i> Kunth [®]	Ar	Ff	N1, N2, S11B, S11D
<i>C. pitumba</i> Sleumer	Ar	Ff	S11D
<i>Ryania pyrifera</i> (Rich.) Uittien & Sleumer	Ar-Arb	Ff	N1, N5, N7
<i>R. speciosa</i> Vahl	Ar-Arb	Ff	N1
Santalaceae - Caires (2017)			
<i>Dendrophthora warmingii</i> (Eichler) Kuijt	Par	Ff	ST
<i>Phoradendron crassifolium</i> (Pohl ex DC.) Eichler [□]	Par	Ff	N3
<i>P. dipterum</i> Eichler	Par	Ff	N3
<i>P. mucronatum</i> (DC.) Krug & Urb.	Par	Ff	N1
<i>P. obtusissimum</i> (Miq.) Eichler	Par	Ff	Serra Norte
<i>P. piperoides</i> (Kunth) Trell.	Par	Ff	Serra Sul
<i>P. quadrangulare</i> (Kunth) Griseb. [®]	Par	Vr, Ff	N1, N2, N3, N4, S11A, S11B, S11D, ST
<i>P. tunaeforme</i> (DC.) Eichler [®]	Par	Vr, Ff	S11A, S11B, S11C, S11D
Sapindaceae - Barbosa et al. (2018)			
<i>Allophylus latifolius</i> Huber	Ar	Ff	N2, S11B, S11D
<i>A. racemosus</i> Sw.	Ar	Vr	N1, S11D
<i>A. semidentatus</i> (Miq.) Radlk.	Ar	Ff	S11A, S11D, ST
<i>Matayba guianensis</i> Aubl. [□]	Ar	Vr, Ff	N5, S11A, S11B, S11C, S11D
<i>M. inelegans</i> Spruce ex Radlk.	Ar	Vr, Ff	S11D
<i>M. spruceana</i> (Benth.) Radlk.	Ar	Ff	N1
<i>Serjania caracasana</i> (Jacq.) Willd. [△]	Li	Vr, Ff	S11A, S11B, S11C, S11D, ST
<i>S. lethalis</i> A.St.-Hil.	Li	Vr, Ff	S11B
Sapotaceae - Terra-Araújo & Zappi (2018)			
<i>Pouteria ramiflora</i> (Mart.) Radlk. [®]	Ar	Vr	N1, N2, N3, N4, N6, S11A, S11B, S11D, ST

Family - monograph / species – Voucher	Habit	Habitat	Distribution in the study area
Simaroubaceae - Devecchi & Pirani (2016)			
<i>Simaba guianensis</i> Aubl.	Ar-Arb	Vr, Ff	N1, N4, N5
<i>Simarouba amara</i> Aubl. ®	Ar	Vr	N1, N6, S11A, S11C, S11D
Siparunaceae - Hall & Meirelles (2017)			
<i>Siparuna ficoides</i> S.S.Renner & Hausner	Ar	Ff	SB
Smlacaceae - Andreata & Watanabe (2018)			
<i>Smilax irrorata</i> Mart. ex Griseb. ®	Li	Vr, Ff	N1, N2, N6, S11A, S11C, S11D, ST, SB
<i>S. siphilitica</i> Humb. & Bonpl. ex Willd.	Li	Ff	N1, N3, S11A, S11B, S11C, S11D
Solanaceae - Giacomini & Gomes (2018)			
<i>Hawkesiophyton ulei</i> (Dammer) Hunz.	Arb	Ff	S11A, S11D
<i>Physalis angulata</i> L. ++	Er	Aa	N5, SB
<i>Schwenckia americana</i> L. □	Er	Vr, Ff	S11D, ST
<i>Solanum acanthodes</i> Hook.f.	Arb	Ff	Serra Norte
<i>S. americanum</i> Mill. + □	Er	Aa	N1, N4, SB
<i>S. campaniforme</i> Roem. & Schult. ® □	Arb	Vr, Ff	N1, N2, N5, N6, N7, S11A, S11D, ST
<i>S. coriaceum</i> Dunal	Li	Ff	N1
<i>S. crinitum</i> Lam.	Ar-Arb	Vr, Ff	N4, N5, S11D
<i>S. incarceratum</i> Ruiz & Pav.	Arb	Vr, Ff	SB
<i>S. leucocarpon</i> Dunal	Ar-Arb	Ff, Aa	S11D
<i>S. paniculatum</i> L. □	Arb	Vr, Aa	ST
<i>S. rugosum</i> Dunal ®	Ar-Arb	Vr, Aa	N4, S11D
<i>S. schlechtendalitanum</i> Walp.	Arb	Vr, Ff, Aa	N1, N3, N4, S11D
<i>S. semotum</i> M.Nee	Ar-Arb	Ff	N1, N5, ST
<i>S. sisymbriifolium</i> Lam. □	Arb	Vr, Aa	S11D, SB
<i>S. subinerme</i> Jacq. ®	Arb	Vr, Ff	N1, N2, ST
<i>S. tegore</i> Aubl.	Ar	Ff	Serra Norte
<i>S. torvum</i> Sw. +	Arb	Vr, Aa	S11D

Family - monograph / species – Voucher	Habit	Habitat	Distribution in the study area
<i>S. uncinellum</i> Lindl.	Li	Ff	N1, N4, S11D, SB
<i>S. velutinum</i> Dunal [®]	Arb	Vr, Ff	N5, S11C, S11D, ST, SB
Styracaceae - Viana & Mota (2016)			
<i>Syrax griseus</i> P.W.Fritsch	Arb	Vr	N1, N3, N4, N7, S11A, S11B, S11C, S11D
<i>S. pohlii</i> A.DC.	Ar-Arb	Ff	N1, N5, S11A, S11B, S11C, S11D
Thymelaeaceae - Mota & Giulletti (2016b)			
<i>Daphnopsis filipedunculata</i> Nevlng & Barringer [®]	Ar	Ff	N1, N2, N3, N4, N5, N6, N7
Trigoniaceae - Nunes & Gil (2017)			
<i>Trigonia nivea</i> Cambess.	Sb	Ff	N1, N3, N4, N5, ST
Turneraceae - Rocha (2018)			
<i>Turnera coerulea</i> var. <i>surinamensis</i> (Urb.) Arbo & Fernández [®]	Arb	Vr	SB
<i>T. glaziovii</i> Urb. [®]	Arb	Vr, Ff	N2, N3, N4, N6, S11A, S11B, S11C, S11D, ST
<i>T. laciniata</i> Arbo	Sb	Vr	S11D
<i>T. melochioides</i> var. <i>arenaria</i> Urb.	Sb	Vr	N1, N3, N4, N8, ST
<i>T. melochioides</i> var. <i>latifolia</i> Urb.	Sb	Vr	N5, N6, N7, S11D, ST
Urticaceae - Gaglioti et al. (2016)			
<i>Urera caracasana</i> (Jacq.) Griseb.	Arb	Ff	S11D, SB
Velloziaceae - Mello-Silva (2018)			
<i>Vellozia glauca</i> Pohl [®]	Er	Vr	N1, N2, N3, N4, N5, N6, N7, N8, S11B, S11D, ST, SB
Verbenaceae - Carodos et al. (2018)			
<i>Lantana hirsuta</i> M.Martens & Galeotti	Arb	Aa	SB
<i>L. paranaensis</i> (Moldenke) R.W.Sanders.	Arb	Aa	N1, N2, N5
<i>Lippia grata</i> Schauer [®]	Arb	Vr, Ff	N1, N4, N5, S11A, S11B, S11C, S11D, ST
<i>Stachytarpheta cayannensis</i> (Rich.) Vahl + [®] □	Arb	Aa	S11D, ST
Vitaceae - Lombardi (2016)			
<i>Cissus appendiculata</i> Lombardi [®]	Li	Vr, Ff	N1, N4, N7, S11A, S11B, S11C, ST,
<i>C. erosa</i> Rich. [®]	Li	Vr, Ff	N1, N4, N5, S11A, S11B, S11D, SB

Family - monograph / species – Voucher	Habit	Habitat	Distribution in the study area
<i>C. sulcicaulis</i> (Baker) Planch. – Fernandes 179	Li	Ff	N5
<i>C. tinctoria</i> Mart. in Spix & Mart.	Li	Vr, Ff	N1, N3, N4, N5
<i>C. verticillata</i> (L.) Nicolson & C.E.Jarvis □	Li	Aa	N5
Vochysiaceae - Shimizu & Gonçalves (2017)			
<i>Callisthene microphylla</i> Warm. ®	Ar	Ff	N1, N3, N4, N5, N6, N8, S11B, S11C, S11D, ST, SB
<i>Qualea multiflora</i> Mart.	Ar	Ff	S11D
<i>Q. parviflora</i> Mart.	Ar	Ff	N4, S11A, S11B, S11D
<i>Vochysia haenkeana</i> Mart. ®	Ar	Ff	N1, S11D
Xyridaceae - Mota & Wanderley (2016)			
<i>Xyris brachysepala</i> Kral ®	Er	Vr, Vh	N1, N2, N3, N4, N5, N6, N7, N8, S11A, S11B, S11C, S11D, ST, SB
<i>X. lacerata</i> Pohl ex Griseb. – Falcão 453	Er	Vr, Vh	SB
<i>X. macrocephala</i> Vahl ®	Er	Vh	N3, N4, N6, S11A, S11C, ST
<i>X. savanensis</i> Miq. – Falcão 451	Er	Vh	SB
Species total by individual outcrop			N1(392), N2(130), N3(224), N4(282), N5(267), N6(100), N7(114), N8(104), S11A(240), S11B(209), S11C(186), S11D(416), ST(228) e SB(230).

Results

The list of seed plants of the *canga* of Serra dos Carajás comprises 116 families, 419 genera and 856 species (Tab. 1). Eight species that were not monographed in the FCC Project are included here: *Philodendron blanchetianum* (Araceae), *Ipomoea procumbens*, *I. reticulata*, *I. setifera* (Convolvulaceae), *Passiflora foetida* (Passifloraceae), *Cissus sulcicaulis* (Vitaceae), *Xyris lacerata* and *X. savanensis* (Xyridaceae), with the first record of *C. sulcicaulis* for the state of Pará. Amongst these species, 258 count with extracted total DNA sample (Tab. 1).

The richest plant family in the *canga* of the Serra dos Carajás was Poaceae (86 spp.), followed by Fabaceae (65), Rubiaceae (46), Cyperaceae (45), Melastomataceae (41), Asteraceae (34), Orchidaceae (27), Myrtaceae (26), Apocynaceae (21), Convolvulaceae and Solanaceae (20 spp. each), representing around 48% of the sampled species (Tab. 2; Fig. 2). Out of the total of 419 genera, 269 are represented by a single species, 64 by two, 38 by three, that together add up to nearly 60% of the generic richness of the FCC. The most representative genera, *Miconia* (20), *Paspalum* (19), *Solanum* (16), *Myrcia* (14), *Cyperus* (13), *Rhynchospora*, *Piper*, *Borreria* and *Ipomoea* (12 spp. each), *Mimosa* and *Utricularia* (11 spp. each), represent approximately 16% of the richness of the FCC (Fig. 3).

Regarding the large angiosperm groups, three aquatic species belong to order Nymphaeales. The Magnoliids are represented by 28 spp. (3.2%), including a high number of Piperaceae (19 spp.), that represent more than half of the species of this group. The Monocots comprise 239 spp. (28%), spread

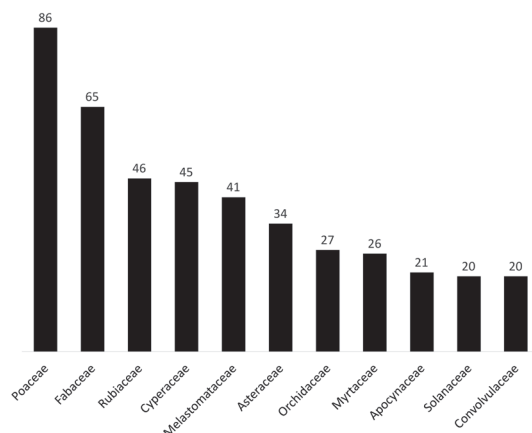


Figure 2 – Top 10 families in the *canga* of the Serra dos Carajás

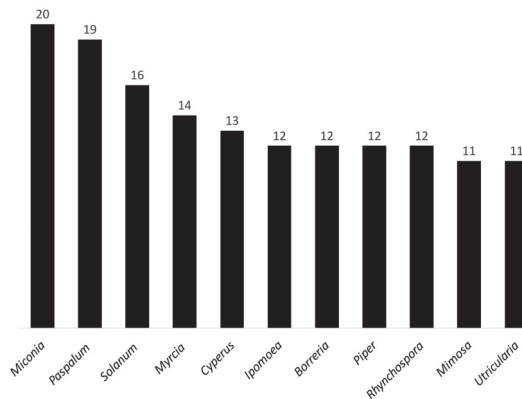


Figure 3 – Most representative genera of the *canga* of the Serra dos Carajás

throughout the orders with the exception of Acorales and Petrosaviales. The Eudicots are the taxonomic group with higher species richness, including 585 species (68.3%) distributed in almost all groups from Rosids to Asterids. The only Gymnosperm recorded in the FCC was *Gnetum nodiflorum*.

When considering plant habit, the herbs are the predominant group, with 347 spp. (40.5%), while subshrubs were 62 spp. (7.2%), shrubs 153 spp. (17.9%). Among the species, 45 (5.1%) had variable habit, fitting more than one category. The trees, including five species of palm (Arecaceae) were represented by 119 spp. (14%). The lianas were 109 spp. (12.7%). Parasites were 22, representing 2.6% of the habit total.

In terms of habitat, out of 856 species recorded, 497 (247 exclusive) were recorded in forest formations, while 418 (128 exclusive) occur in open rupestral vegetation and 174 (99 exclusive) occur in hydromorphic sites. It is worth recording that 319 species are found in more than one habitat. If considering rupestral and hydromorphic vegetation as open areas, these concentrate 534 species of seed plants. Forest formations share a much more expressive number of species (223 spp.) with rupestral vegetation when compared with hydromorphic vegetation (22 spp. in common with forest formations). Only 12 species were shared by all three habitat. Finally, there are 119 species that are associated to anthropized environments, of which 64 were recorded solely in those sites (Tab. 1).

Serra Norte was the location with higher species count, with 659 species of seed plants, followed by Serra Sul (545), Serra da Bocaina (230) and Serra do Tarzan (228). Together, the *canga* of PNCF (Serra da Bocaina and Serra do Tarzan) are

Table 2 – List of the ten richest seed plant families in the *canga* of Carajás, Corumbá, Quadrilátero Ferrífero

	Serra dos Carajás	Corumbá	Quadrilátero Ferrífero
1	Poaceae	Poaceae	Asteraceae
2	Fabaceae	Fabaceae	Poaceae
3	Rubiaceae	Cyperaceae	Orchidaceae
4	Cyperaceae	Malvaceae	Fabaceae
5	Melastomataceae	Euphorbiaceae	Melastomataceae
6	Asteraceae	Convolvulaceae	Myrtaceae
7	Orchidaceae	Apocynaceae	Rubiaceae
8	Myrtaceae	Malpighiaceae	Cyperaceae
9	Apocynaceae	Portulacaceae	Apocynaceae
10	Convolvulaceae/Solanaceae	Cactaceae	Solanaceae

home for 351 species. Looking in more detail at the first two locations, the blocks with highest richness were S11D (416 spp.) at the Serra Sul, followed by N1 (392), N4 (283) and N5 (267), at Serra Norte (Tab. 1). These blocks also figure among the better sampled areas: N1 (1737 specimens), S11D (1411), N4 (747) and N5 (648), and are amongst the largest in area.

Based on the FCC data and subsequent publications (Nunes *et al.* 2015), 24 species and one subspecies were marked as endemic from the *canga* of the FLONA of Carajás and the PNCF. These are *Philodendron carajasense* (Araceae), *Cavalcantia glomerata*, *Lepidaploa paraensis*, *Parapiqueria cavalcantei* (Asteraceae), *Ipomoea cavalcantei* (Convolvulaceae), *Bulbostylis*

cangae, *Eleocharis pedroviana*, *Hypolytrum paraense* (Cyperaceae), *Erythroxylum carajasense*, *Erythroxylum nelson-rosae* (Erythroxylaceae), *Sinningia minima* (Gesneriaceae), *Cuphea carajasensis* (Lythraceae), *Mouriri cearensis* subsp. *carajasica* (Melastomataceae), *Uleiorchis longipedunculata* (Orchidaceae), *Picramnia ferrea* (Picramniaceae), *Peperomia albopilosa*, *Peperomia pseudoserratifirhachis* (Piperaceae), *Axonopus carajasensis*, *Paspalum cangarum*, *P. carajasense* (Poaceae), *Borreria elaiosulcata*, *B. heteranthera*, *Carajasia cangae* (Rubiaceae), *Daphnopsis filipedunculata* (Thymelaeaceae) and *Xyris brachysepala* (Xyridaceae) (Tab. 1).

Amongst potential invasive species, the record of 53 native, problematic species alongside 17 exotic invasives (Tab. 1) was made, and the outcrops with highest number of these species were S11D (36 spp.), N1 (23 spp.), N4 e N5 (22 spp.), Serra da Bocaina (19 spp.) and N3 (14 spp.).

A small number of shared species between FCC *canga* and other areas was found, with 96 shared species between FCC and the QF, totalling 11% of the species. Only 25, or 3% of species, were found to occur both in the FCC and Corumbá. The *canga* of Corumbá has also shown very little correspondence with the ones at QF, with 18 shared species (Tab. 1; Fig. 4).

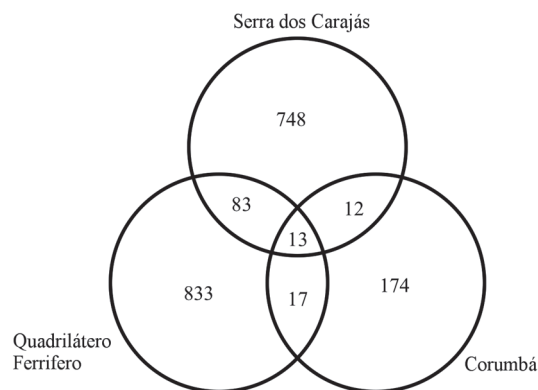


Figure 4 – Venn diagram showing the floristic relationships between *canga* sites in the Serra dos Carajás in Pará state, of the Quadrilátero Ferrífero in Minas Gerais and in Corumbá, Mato Grosso do Sul.

Discussion

Taxonomic richness of the flora of the *canga* of Carajás

During the first comprehensive floristic study of the *canga* of the Serra de Carajás, Silva *et al.*

(1991) recorded 231 species in 57 angiosperm families. The initial estimate from the introductory chapter of the FCC was of around 600 species in 111 families of angiosperms and one of gymnosperms (Viana *et al.* 2016). However, the accurate determination of specimens that were still unnamed or incorrectly named, together with a considerable contribution from recent collections (2015-2017) have collaborated to the increase of species recorded for FCC, with 856 species in 115 angiosperm and one gymnosperm families. The collections carried out as part of the FCC project have also provided data to understand the species distribution in the area. A pioneering list for the Serra Norte was presented by Secco & Mesquita (1983), including 85 species of seed plants. The present work increases the number of species occurrences many fold, with 659 species recorded for the *canga* of this location.

When looking at family composition, the ten richest plant families of the FCC represent 48.1% of the flora, while the remaining half of the species is distributed in the 106 remaining families. When comparing with overall figures provided by BFG (2015), we find a similar pattern, where the ten largest families contribute towards around 60% of the flora while the remainder 233 families represent the other 40% of Brazil's flowering plants.

The 856 species recorded in the FCC represent 2.6% of the Brazilian flora, 7% of the flora of the Brazilian Amazon domain and 13.1% of the seed plants that are recorded for the state of Pará (Flora 2020, under construction). The 419 genera from the FCC respectively 14%, 21.7% and 28.6% of the genera recorded for Brazil, the Brazilian Amazon and Pará (Flora 2020 under construction). Taking into account the small parcel of the Brazilian territory occupied by the *canga* of Carajás (~ 0.001%), this area can be highlighted as a site of extreme importance for its plant biodiversity.

There is a trend involving large number of genera represented by few species that may result from the high number of micro-habitat found in the *canga* of Carajás (*sensu* Mota *et al.* 2015). This situation is reflected by the following five groups: genera that are typical from forest formations such as *Tapirira* (Anacardiaceae), *Protium* (Burseraceae), *Hirtella* (Chrysobalanaceae), *Hypolytrum* (Cyperaceae), *Bellucia* (Melastomataceae), *Olyra* (Poaceae) amongst others; genera exclusive from hydromorphic

environments, such as *Sagitaria* (Alismataceae), *Cabomba* (Cabombaceae), *Apalanthe* and *Ottelia* (Hydrocharitaceae), *Nymphoides* (Menyanthaceae), *Nymphaea* (Nymphaeaceae), *Limnosipanea* (Rubiaceae), *Helantium* (Alismataceae), *Lindernia* (Linderniaceae), *Mayaca* (Mayacaceae), *Bacopa* (Plantaginaceae), *Oryza* (Poaceae), *Genlisea* (Lentibulariaceae); genera associated to open, not hydromorphic environments such as *Cavalcantia* and *Lepidaploa* (Asteraceae), *Anemopaegma* (Bignoniaceae), *Cereus* (Cactaceae), *Lagenocarpus* (Cyperaceae), *Euploca* (Heliotropiaceae), *Cipura* (Iridaceae), *Cuphea* (Lythraceae), *Habenaria* and *Sobralia* (Orchidaceae); rupicolous genera from forest interior such as *Diastema*, *Goyazia* and *Phinea* (Gesneriaceae), *Epidendrum* (Orchidaceae); open rocky area genera such as *Parapiqueria* (Asteraceae), *Ananas* and *Dyckia* (Bromeliaceae), *Brasilianthus* (Melastomataceae) and *Carajasia* (Rubiaceae), all these genera represented by three or less species within the study area. This situation contrasts strongly with what is found in the eastern Brazilian *campo rupestre*, where some genera contribute with many sympatric species (Zappi *et al.* 2017).

Amongst the better represented genera of seed-plants in the study area, forest groups such as *Miconia* (20 species), *Solanum* (16), *Myrcia* (14) and *Piper* (12) (Cardoso *et al.* 2017) appear in the forest formations that occur on the iron-rich *canga*, namely small groves and transitional forest between open areas and the adjacent ombrophilous forests (Tab. 1). The other genera with high number of species in the area are either herbaceous, such as *Paspalum* (19 spp.), *Cyperus* (13 spp.), *Rhynchospora* (12 spp.), *Utricularia* (11 spp.), or herbaceous to shrubby, such as *Borreria* (12 spp.) (Tab. 1).

Plant habits

Herbaceous habit (347 species, or 40.5% of the total number of seed plants) predominates over other plant habit types, following the pattern found in other Brazilian biomes with exception of the Amazon, such as Cerrado, Pantanal, Caatinga e Pampa (BFG 2015). The habit proportion found in the FCC is one tree (including those with variable habit between tree and shrub and the palms) for each four species of herb, subshrub, shrub or liana. This proportion is rather different from that recorded for the Brazilian Amazon Rainforest, where the proportion is of one tree for each two different plant habits (BFG 2015).

The diversity of the herbaceous layer is not exclusive to the FCC, being a strong feature of the open vegetation of eastern Brazil, such as the quartzitic outcrops of the Cadeia do Espinhaço, however, there the floristic composition is markedly dominated by subshrubs or shrubs with subterranean structures (xylopodia) adapted to strongly seasonal climates as well as to natural fires (Neves & Conceição 2010). The *canga* of Carajás substrate differs from the lateritic soil with deep water-table found in cerrado vegetation (Eiten 1972), and also from the shallow, stony soil of quartzitic *campo rupestre*, as there are evidences that the *canga* is more permeable, porous and capable to store water for longer periods of time (Carmo & Jacobi 2016).

Taking into account the Amazonian context, the Carajás region is an area with high richness of herbaceous species (347 spp.). If we consider that 476 herbaceous species are referred for all the Amazonian *campinarana* areas in Brazil (FBO 2020, under construction), the FCC are very relevant in their contribution to herbaceous species richness for this domain, especially when considering the small area covered by this vegetation (approx. 120 km²). On the other hand, this information also suggests that the *campinarana* areas of the region may be under-sampled, calling for the need to develop similar taxonomic projects in the diverse vegetation types of the Amazon Rainforest.

Well defined rain seasonality may represent another particularity of the *canga* of Carajás. The region has a well defined rainy summer followed by a dry winter, with $\frac{3}{4}$ of the total precipitation concentrated in the three rainiest months, typically between January and March (Viana *et al.* 2016). During the dry season, the open landscape is marked by the presence of deciduous or semi-deciduous shrubs and treelets, such as *Cochlospermum orinocense* (Bixaceae), *Callisthene microphylla* (Vochysiaceae), *Mimosa acutistipula* var. *ferrea* (Fabaceae), *Erythroxylum* spp. (Erythroxylaceae), *Croton* spp. (Euphorbiaceae), a smaller number of evergreen shrubs and lianas, such as *Clusia* spp. (Clusiaceae) and *Norantea guianensis* (Marcgraviaceae), and an impoverished herbaceous layer represented by perennial herbs such as Bromeliaceae (e.g., *Dyckia duckei*, *Pitcarnia burchellii*), Cyperaceae (e.g., *Bulbostylis cangae*), Orchidaceae (e.g., *Catasetum discolor* and *Sobralia liliastrum*), Poaceae (e.g., *Axonopus longispicus*, *Paspalum*

cinerascens), Velloziaceae (*Vellozia glauca*), among others. The rainy period is marked by the proliferation of annual herbaceous plants such as *Cavalcantia glomerata*, *C. percymosa*, *Monogereion carajensis*, *Praxelis asperulacea* (Asteraceae), *Bulbostylis conifera* and *Rhynchospora acanthoma* (Cyperaceae), *Eriocaulon carajense* (Eriocaulaceae), *Utricularia physoceras* (Lentibulariaceae), *Lindernia brachyphylla* (Linderniaceae), *Brasilianthus carajensis* (Melastomataceae), *Paspalum cangarum*, *P. carajasense*, *Sporobolus multiramosus*, *Trichantheicum* aff. *arctum* (Poaceae), *Perama carajasensis* (Rubiaceae) and *Xyris brachysepala* (Xyridaceae) that, together with the shrubs, treelets and lianas that are in full leaf and often in blossom during this period, transform what was a greyish place into a colourful landscape (Zappi 2017).

The flora and environments of the *canga* of Carajás

At the Serra dos Carajás, the *canga* is characterized by a mosaic formed by different phytophysionomies associated to the iron-rich substrate (Cleef & Silva 1994; Mota *et al.* 2015). However, in order to organize the species into vegetation types, we considered only the tree major groups proposed by Mota *et al.* (2015), without considering the subgroups proposed therein.

The importance of forest formations within *canga* is obviated by the fact that, from the 492 forest species recorded, 247 are exclusive to this environment. However, if adding up the two open formations (open rupestral + hydromorphic vegetation), a total of 534 species, of which 271 are exclusive, a balance between open and forest vegetation can be observed.

While the hydromorphic vegetation contributes with the smaller number of recorded species (174 spp.), it is also the habitat with largest proportion of exclusive species (c. 57%) in relation to the forest (50%) and rupestral (31%) habitats.

The role played by each type of habitat in the floristic richness fo the *canga* of Carajás is evident, and the deciduous to semi-deciduous low forests found as groves or transitional areas support a peculiar flora, that presents endemic taxa such as *Hypolytrum paraense* (Cyperaceae), *Sinningia minima* (Gesneriaceae), *Mouriri cearensis* subsp. *carajasica* (Melastomataceae) and *Peperomia pseudoserratirhachis* (Piperaceae) and *Daphnopsis filipedunculata* (Thymelaeaceae) (Tab. 1).

Endemic taxa

The *canga* of Carajás is an area of ancient mountains in the Amazon of pre-Cretaceous origin, when supergenic events in what is now southern Pará originated expressive lateritic crust in the region (Ab'Saber 1986; Viana *et al.* 2016). Isolated by a rainforest matrix, the blocks of *canga* of Carajás resemble vegetation islands over a peculiar substrate where geographic isolation events may have promoted speciation processes and generated endemic patterns. A list of 24 species and a subspecies are endemic to the *canga* of the FLONA of Carajás and PNCF, representing 2.9% of the flora of the study area (Tab. 1).

The two monospecific genera endemic to the study area, *Parapiqueria* (Asteraceae) and *Carajasia* (Rubiaceae), when added to two other genera, *Monogereion* (Asteraceae) and *Brasilianthus* (Melastomataceae), that are restricted to the *canga* of Carajás, however occurring over a wider set of outcrops that neighbour the FCC study area (Cruz *et al.* 2016; Rocha *et al.* 2017) show how important the region is in terms of endemism. Other relevant point is that the 24 putative endemic species make up nearly 5% of the 443 species considered endemic for Pará state (FBO 2020, under construction), highlighting the importance of the contribution of the *canga* of the FLONA of Carajás and the PNCF towards the number of endemic seed plants at state level.

The 120 monographs published by the FCC project encompass 40 species that were marked not fully identified, of which around 50% were flagged by the authors as possible new to science (Cruz *et al.* 2015; Koch & Ilkiu-Borges 2016; Nunes *et al.* 2016; Reis *et al.* 2017; Watanabe *et al.* 2017; Zappi *et al.* 2017; Chautems *et al.* 2018; Coelho 2018; Costa *et al.* 2018; Fernandes *et al.* 2018; Mattos *et al.* 2018; Rocha *et al.* 2017; Koch *et al.* 2018; Viana *et al.* 2018). Of these, a number has been found only on the *canga* of Carajás, being thus potentially endemic. Efforts to solve these taxonomic problems are urged, together with widening the scope for fieldwork in and around the areas in order to ascertain the true level of endemism found in the region.

Potentially invasive species

Species considered as potential invasives (exotic and problem native species) add up to approximately 12% of the species analysed. The blocks of *canga* with larger number of these species coincide with the location of open mines, such as

S11D, N4 e N5, or with areas that were transformed recently into conservation units, but that were formerly under strong anthropic pressure, such as the Serra da Bocaina, that was included in the PNCF in 2017. Areas that have a long history of occupation and others used as support for mining activities, such as N1 and N3 (STCP 2016), also feature among these.

The outcrops that have operating mines have suffered an increase of the number of invasives. As an example of this, we can cite some new occurrences for the FCC for the S11D mine at the Serra Sul, such as *Ipomoea procumbens*, first recorded in 2017 (Zappi 3510), *Bidens pilosa*, in 2012 (Arruda 1222), *Digitaria ciliaris* with two records, one in 2009 and other in 2015, both near the Geosol camp at the S11D site (Viana 4376 and Afonso 120), as well as *Eragrostis pilosa*, collected in 2015 (Afonso 118) and *E. tenella*, in 2009 and 2015 (Viana 4371 and Afonso 115). Furthermore, there are recent records associated probably to the increase of the area of the N4 mine, such as *Digitaria violascens*, with the first record in 2012 at N4WS (Viana 5315). All the above mentioned species were not collected before 2000 in the study area. An identification guide for invasive plants was prepared specifically for block S11D, comprising also has management proposals for control and eradication of exotic species (Giulietti *et al.* 2018).

The presence of many invasive species in the Serra da Bocaina, including *Ageratum conyzoides*, *Emilia sonchifolia*, *Porophyllum ruderale*, *Cyperus aggregatus*, *Cantinoa americana*, *Phytolacca thyrsoiflora* and *Paspalum conjugatum*, may be associated to the long history of landscape change and degradation linked to intensive and disordinated land use, with forest felling, timber harvesting and frequent criminal fires. Before its inception as part of the PNCF in June 2017, the Serra da Bocaina did not have status as a protected area. It is desirable to provide adequate management to the exotic and native problem species in this conservation unit to avoid their dissemination in the *canga* area that is now under full legal protection.

Local diversity in Carajás

The area covered by this study is of approximately 120 km², with four major subdivisions: Serra Sul (~ 46 km²), Serra Norte (~ 35 km²), Serra da Bocaina (~ 20 km²) and Serra do Tarzan (~ 8 km²), at altitudes between 500 and 800 m a.s.l. Within the FLONA of Carajás, the Serra Norte and Serra Sul encompass, respectively, 77%

and 64% of the species of seed plants found in the study area. The area covered by the Serra Sul is larger than the Serra Norte (~ 46 km² vs. 35 km²), however the comparison here shows that the Serra Sul harbours less species. Two factors may be used to explain this difference, namely that the sampling effort dedicated to the Serra Norte is comparably much larger (4,900 specimens vs. 2,806 in the Serra Sul) and that the discontinuity between the blocks of Serra Norte may contribute towards the higher richness documented there. The Serra Sul has been divided in four sectors (S11A, S11B, S11C and S11D) that are, however, interconnected.

A separate analysis of the blocks within the major outcrops highlights higher richness in S11D, N1, N4 and N5, and these also correspond to areas historically better sampled. The Serra Norte was the first accessible point of the region back at the end of the 1960's to be investigated by botanist Paulo Bezerra Cavalcante at the onset of the Projeto Ferro Carajás (Viana *et al.* 2016), while block N1, one of the largest *canga* blocks, was repeatedly visited over 45 years of exploration in the region. It has the highest documented plant richness of all blocks, with 392 species.

Meanwhile, blocks N4 and N5 were studied from the implementation of the Projeto Ferro Carajás as part of the prospecting for the first operating iron mines in the area (STCP 2016). Due to the economic importance of this enterprise, many environmental impact reports were prepared for these plateaus and, together with the effort employed by the FCC projects culminated with the high number of species recorded in these blocks. However, a large part of the original area of *canga* of these blocks has been suppressed through mining activities, and a comparison using Google Earth historical images shows that about 20% and 9% of the original area of N4 and N5, respectively, is left. A similar landscape is under construction in the Serra Sul, with the implementation of the S11D iron mine, where approximately 12% of the *canga* has already been suppressed. The periodic evaluation of the composition of the flora and the populations of endemic species found within these plateaus is paramount to ensure that measures are in place for local flora conservation.

The Serra da Bocaina and Serra do Tarzan encompass the lowest number of plant species found in the study area, with respectively 27% e 26%. These are also the least sampled outcrops and have much smaller area than the Serra Norte and Serra Sul. They are the only areas of *canga*

included in the PNCF and, together, comprise 351 species of seed plants, or nearly 41% of the species number recorded for the FCC. Despite being an important step towards plant conservation in the region of Carajás, the creation of this fully protected area has not ensured that several endemic *canga* species from the FLONA of Carajás, such as *Parapiqueria cavalcantei* (Asteraceae), *Ipomoea cavalcantei* (Convolvulaceae), *Axonopus carajasensis* and *Paspalum carajasense* (Poaceae), *Carajasia cangae* (Rubiaceae) and *Daphnopsis filipedunculata* (Thymelaeaceae).

Canga of Carajás, a unique vegetation

The 13 species shared by the three areas of *canga* compared here (Carajás, QF and Corumbá) are widely distributed plants: *Cyperus aggregatus*, *C. laxus*, *C. sesquiflorus* (Cyperaceae), *Passiflora foetida* (Passifloraceae) and *Axonopus compressus* (Poaceae) are found in all Brazilian biomes; *Blepharodon pictum* (Apocynaceae), *Commelina erecta* (Commelinaceae), *Evolvulus filipes* (Convolvulaceae), *Bulbostylis conifera* (Cyperaceae), *Sida linifolia* (Malvaceae), *Bredemeyera floribunda* (Polygalaceae) and *Borreria verticillata* (Rubiaceae) are in all biomes excepting the Pampa (BFG 2015); and *Evolvulus lithospermoides* (Convolvulaceae) is cited for the Amazon Rainforest and the Cerrado in open areas including grasslands, *campo rupestre* and Amazonian savanna (BFG 2015). Amongst the above cited species, *C. aggregatus* and *B. verticillata* are also considered potentially invasive (Tab. 1).

The FCC and QF shared 96 species, the majority of which are widely distributed in Brazil, are comprised by nearly a third (28 species) considered potentially invasive (exotic or problem natives) (Tab. 1): *Asclepias curassavica* (Apocynaceae), *Ageratum conyzoides*, *Bidens pilosa*, *Emilia sonchifolia*, *Porophyllum ruderale* (Asteraceae), *Commelina benghalensis* (Commelinaceae), *Ipomoea procumbens* (Convolvulaceae), *Cyperus aggregatus*, *C. surinamensis* (Cyperaceae), *Chamaecrista nictitans*, *C. rotundifolia*, *Desmodium incanum* (Fabaceae), *Cuphea carthagenensis* (Lythraceae), *Sida rhombifolia*, *Waltheria indica* (Malvaceae), *Ludwigia octovalvis* (Onagraceae), *Andropogon bicornis*, *A. leucostachyus*, *Axonopus capillaris*, *Digitaria insularis*, *Eragrostis curvula*, *Erechtites hieracifolius*, *Melinis minutiflora*, *P. paniculatum*, *Urochloa brizantha*, *U. decumbens*

(Poaceae), *Borreria verticillata* (Rubiaceae), *Solanum americanum* (Solanaceae), *Stachytarpheta cayannensis* (Verbenaceae).

Between the families with higher number of species, only Poaceae, Fabaceae, Cytoeraceae and Apocynaceae appear among the top ten for all areas. The list of top families in Carajás and QF is similar, however the ranking of the families is different in the two areas, with Carajás three top families being Poaceae, Fabaceae and Rubiaceae, while QF has Asteraceae, Poaceae and Orchidaceae, as its top families (Tab. 2).

Some families recorded in the FCC are not present in the *canga* of the QF, such as Gnetaceae, Burseraceae, Caryocaraceae, Chrysobalanaceae, Combretaceae, Costaceae, Marantaceae, Marcgraviaceae, Simaroubaceae, Trigoniaceae. Gnetaceae is a pantropical family with its centre of diversity in the Amazon (Price 1996). Widely distributed in the Amazon, *Gnetum nodiflorum*, the only gymnosperm species found in the *canga* until the present moment was found in forest groves over *canga* in Carajás. Some angiosperm families not recorded in the QF have their diversity centre in the Amazon biome, such as Chrysobalanaceae, Burseraceae, Costaceae, Combretaceae, Marantaceae (Daly *et al.* 2012; Stace 2010; Costa *et al.* 2011).

Many of the genera with higher species diversity in FCC were not present or had low representativeness at the QF (Viana & Lombardi 2007; Carmo & Jacobi 2012; Messias & Carmo 2015): *Philodendron* and *Anthurium* (Araceae), *Justicia* and *Ruellia* (Acanthaceae), *Rhynchospora* (Cyperaceae), *Peperomia* and *Piper* (Piperaceae). From these, only *Rhynchospora* occupies open types of vegetation, while the others had most of their species associated to forest formations within the FCC.

Likewise, amongst the angiosperm families that are well represented in the QF, many were not recorded at the FCC: Amaryllidaceae, Apiaceae, Aquifoliaceae, Araliaceae, Brassicaceae, Campanulaceae, Clethraceae, Cunoniaceae, Ericaceae, Haloragaceae, Hypoxidaceae, Juncaceae, Pentaphragmaceae, Peraceae, Rhamnaceae, Rosaceae, Scrophulariaceae, Symplocaceae, Theaceae, Violaceae and Winteraceae (Viana & Lombardi 2007; Carmo & Jacobi 2012; Messias & Carmo 2015). Many of these families are associated to temperate climates, such as Aquifoliaceae, Campanulaceae, Clethraceae, Cunoniaceae, Ericaceae, Rosaceae, Symplocaceae, Theaceae,

Violaceae and Winteraceae (Safford 1999), and this may explain their absence in the Carajás region, where monthly temperatures vary between 25,1°C and 26,3°C, with the absolute minimum between 15,6°C and 18,3°C recorded between July and October, and the maximum of 34,3°C e 38,1°C spread through all the remaining months (Viana *et al.* 2016).

Another important difference between the QF and FCC floras is the high floristic representativity of some of the families in the QF that is not observed at the FCC. For instance, the Eriocaulaceae (QF 5% × 1,2% FCC), Xyridaceae (1,4% × 0,5%) and Velloziaceae (1% × 0,1%) show this pattern, as well as several genera that are absent or poorly represented at the FCC, such as *Baccharis* (QF 18 spp. × 0 FCC), *Lippia* (10 × 1), *Microlicia* (9 × 0), *Ditassa* (9 × 0) and *Stachytarpheta* (8 × 1) (Carmo & Jacobi 2012). In this case is possible to notice the strong influence of the Cerrado and *campo rupestre* from the Espinhaço Range in the floristic composition of the *canga* of the QF. The Eriocaulaceae, Xyridaceae and Velloziaceae appear among the families with more species in the quartzitic *campo rupestre* of the Espinhaço Range, while the abovementioned genera have an important rôle in the composition of several floras studied in that region (Giulietti *et al.* 1987; Giulietti & Pirani 1988) and may thus influence the QF *canga* composition.

Recent studies by Zappi *et al.* (2017) point to strong influence of the Atlantic Rainforest biome in the composition of the QF *canga*. The data generated by FCC make it possible to envisage the influence of the Amazon Rainforest over the floristic composition of the *canga* of Carajás. To enable us to extend and deepen a discussion within this context it is necessary to perform quantitative analyses and to obtain more representative sample of other neotropical *canga* areas, involving different biogeographical context. Other important areas, such as the Rio Santo Antônio basin (transition between Cerrado and Mata Atlântica) and the Vale do Peixe Bravo (Caatinga), in Minas Gerais state, as well as the *canga* of Caetité, within the Bahian Caatinga, still lack suitable authoritative floristic lists (Carmo & Kamino 2015). For the moment, only the *canga* of Carajás (Amazon Rainforest) and the Quadrilátero Ferrífero (transition between Atlantic Rainforest and Cerrado) are relatively well sampled, but it is necessary to intensify collections and listing exercise for the rest of the areas of *canga* of Brazil.

Conclusion

The collecting effort invested in getting to know the areas of *canga* of the FLONA of Carajás and the PNCF and the involvement of 131 plant taxonomists in the study of these specimens have built the most detailed floristic study so far for an area in the Brazilian Amazon. The results of the total publication of the FCC show an impressive species richness that is significantly higher than what was referred earlier, surpassing even the estimates made at the start of the project. Supposing this is a pattern that may encompass other plant formations in the Amazon, it is necessary to apply similar effort to other sites within this biome, especially focussing on conservation units, coupled with the involvement of taxonomists, to start to reveal the real biodiversity of the Amazon flora.

The floristic composition of the *canga* of Carajás has been revealed as different from the *canga* of the Quadrilátero Ferrífero, in Minas Gerais, and of Corumbá, in Mato Grosso do Sul. Despite the similarity between the iron-rich substrate where this vegetation occurs, the phytogeographic context appears to have a determining role in the floristic identity of each site.

The richness and singularity of the local flora, including its endemic species, frame the area of Carajás as an important region for the conservation of the Amazon flora. Associated to the threat that land transformation for mining poses towards this vegetation, as well as the man made fires and competition with exotic species through land use in the general region, the situation calls for rigorous planning towards conservation of the flora of the *canga* of Carajás. We hope that the detailed knowledge regarding taxonomy and distribution of the *canga* species can be of use to provide a basis for the management of this area, contributing to the informed dialogue between the productive sector and the organs that provide the environmental licencing in order to safeguard the country's nature.

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