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Original Papers

Floristic survey of Rubiaceae in the largest remnant of *Cerrado* in the metropolitan region of São Paulo, Brazil

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Abstract

We present a floristic survey of the family Rubiaceae in Juquery State Park, a conservation unit that harbors the largest *Cerrado* area in the metropolitan region of São Paulo and is a refuge within the Atlantic Forest domain. The work was conducted using conventional methods in plant taxonomy, including fieldwork between 2020 and 2023, a literature survey, visits to herbaria, and requests for specimen loans. Previous articles revealed the high diversity of the family in the park, but no specific treatment had been published. In the present study, 35 species distributed in 15 genera were recorded in different phytophysiognomies, and *Borreria* (7 spp.), *Palicourea* (5 spp.), *Coccocypselum* (4 spp.), *Psychotria* (4 spp.), and *Galianthe* (3 spp.) are the richest. Four genera (*Cordiera*, *Hexasepalum*, *Malanea* and *Mitracarpus*) and 21 species are new records for this conservation unit. A dichotomous identification key and photos of the species are also provided. The diversity of Rubiaceae species in the study area is greater than previously recorded in broader surveys, and the mosaic formed by open and forest phytophysiognomies in the park probably contributes to this high level of diversity.

Key words: *campo cerrado*, *campo sujo*, neotropical flora, Palicoureeae, Spermacoceae.

Resumo

Apresentamos um levantamento florístico da família Rubiaceae no Parque Estadual do Juquery, uma Unidade de Conservação que abriga a maior área de Cerrado da região metropolitana de São Paulo. O trabalho foi elaborado com base nos métodos convencionais em taxonomia vegetal: trabalho de campo com expedições de campo entre 2020 e 2023, levantamento bibliográfico, visita a herbários e pedidos de empréstimo de materiais. Estudos anteriores revelaram uma alta diversidade da família no parque, mas nenhum tratamento específico havia sido realizado. No presente estudo foram registradas 35 espécies em diversas fitofisionomias, que estão distribuídas em 15 gêneros, sendo *Borreria* (7 spp.), *Palicourea* (5 spp.), *Coccocypselum* (4 spp.), *Psychotria* (4 spp.), e *Galianthe* (3 spp.) os mais diversos. Também reportamos quatro gêneros (*Cordiera*, *Hexasepalum*, *Malanea* e *Mitracarpus*) e 21 espécies sem registro prévio para essa Unidade de Conservação. Uma chave dicotômica de identificação e fotos das espécies são apresentadas em conjunto a lista de espécies. A diversidade de espécies de Rubiaceae na área de estudo é maior do que já tinha sido registrada em levantamentos mais amplos, e o mosaico formado por fitofisionomias abertas e florestais presentes no Parque deve contribuir para essa alta diversidade.

Palavras-chave: campo cerrado, campo sujo, flora neotropical, Palicoureeae, Spermacoceae.

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Introduction

One of the largest flowering plant families is Rubiaceae, which comprises over 14,000 species within 620 genera distributed throughout the world, although it is most diverse in the Neotropics (Govaerts *et al*. 2023). With all sorts of habits, ranging from herbs and shrubs to small trees and canopy trees, identifying Rubiaceae is easy using the following diagnostic traits that are common in the family: leaves opposite, blades undivided with an entire margin, interpetiolar stipules present; flowers radially symmetric, corollas gamopetalous, stamen and petal number the same, and ovary inferior (Jung-Mendaçolli 2007; Delprete & Jardim 2012). The high diversity found in this family and its abundance and presence in all vegetation layers make Rubiaceae a good indicator in ecological and conservation studies (Delprete & Jardim 2012). Furthermore, the plants of this family have an intricate relationship with several pollinators and their fruits are a common food source for tropical fauna (Gentry & Emmons 1987; Bremer & Eriksson 2009). In Brazil, the family Rubiaceae is represented by 1,417 species within 128 genera; it occurs in every phytogeographic domain (Flora e Funga do Brasil 2023, continuously updated) and is especially diverse in the Amazon basin, Atlantic Forest, and *Cerrado* (Delprete & Jardim 2012).

The Brazilian *Cerrado* is widespread in the states as Goiás and Tocantins; however, it is also present in several other states and regions of the country (Eiten 1972). According to some estimates, the *Cerrado* used to cover ca. 3,500,000 ha of São Paulo in the 18th century, which is about 14% of the state (Baitello *et al*. 2013). Currently, the remnants of the *Cerrado* in this state are small, fragmented, and surrounded by pasture, sugarcane and soy plantations, and urban areas (Durigan *et al*. 2007). Only a few of these remnants are protected as conservation units (Durigan *et al*. 2006; Rodrigues & Bononi 2008). As stated by Ratter *et al*. (2003), the *Cerrado* in São Paulo has a notably rich and heterogeneous flora compared to other states, including species that are rare or even absent in other areas.

The *Cerrado* consists mostly of savanna physiognomies and, therefore, the real richness occurs in the non-arboreal, herbaceous-subshrub stratum (Castro *et al.* 1999). However, phytosociological studies tend to focus on woody plants and neglect this other floristic component (Durigan *et al.* 2018). Several studies note that the family Rubiaceae is one of the most species-rich groups in herbaceous-subshrub and shrub-tree components of the *Cerrado* (Mantovani & Martins 1993; Batalha *et al.* 1997; Ratter *et al*. 1997; Batalha & Mantovani 2001; Tannus & Assis 2004; Ishara *et al*. 2008; Rossatto *et al.* 2008; Sasaki & Mello-Silva 2008; BFG 2015).

Considering the importance of Rubiaceae species for biodiversity conservation in fragments of native vegetation, and the high value of protected areas of the *Cerrado* in São Paulo state, this work includes a checklist of Rubiaceae for the largest *Cerrado* fragment in the São Paulo metropolitan region.

A dichotomous identification key, photos of species, and a discussion about some species determinations and comparisons with other savanna fragments in the state are also provided. Thus, this increases what is known about the Brazilian flora and the *Cerrado* in São Paulo and we expect it will contribute to the park's management plan.

Material and Methods

Study area

We conducted this study in Juquery State Park (Parque Estadual do Juquery - PEJY; Fig. 1), a fully protected conservation unit in Franco da Rocha, São Paulo state, Brazil (23º19' and 23º25'S, 46º45'and 46º35'W) (Secretaria de Infraestrutura e Meio Ambiente 2023a). The park's grounds were formerly a farm that belonged to Dr. Franco da Rocha and later became home to the Franco da Rocha Hospital - Psychiatric Department. Even though it used to be a psychiatric hospital, the original vegetation cover survived because of low usage (Baitello *et al*. 2013).

The park was created in 1993 and its protected area is about 2,000 hectares. It is bordered to the north by the Juquery River valley, to the west by the Paiva Castro Dam, and to the south and east by the valleys of the Morro Grande or Morro do Juquery hill complex. The Juquery River basin integrates the Cantareira Water System, which is one of the most important water supply systems in São Paulo (Baitello *et al*. 2013).

The region where the park is can be defined as semi-mountainous, with the elevation varying between 730 and 950 m, including several deep valleys (Baitello *et al*. 2013). The average annual temperature is 20 ºC, there is no defined dry season, and the climate is classified as Cfb by the Köppen-Geiger classification system (Alvares *et al.* 2013).

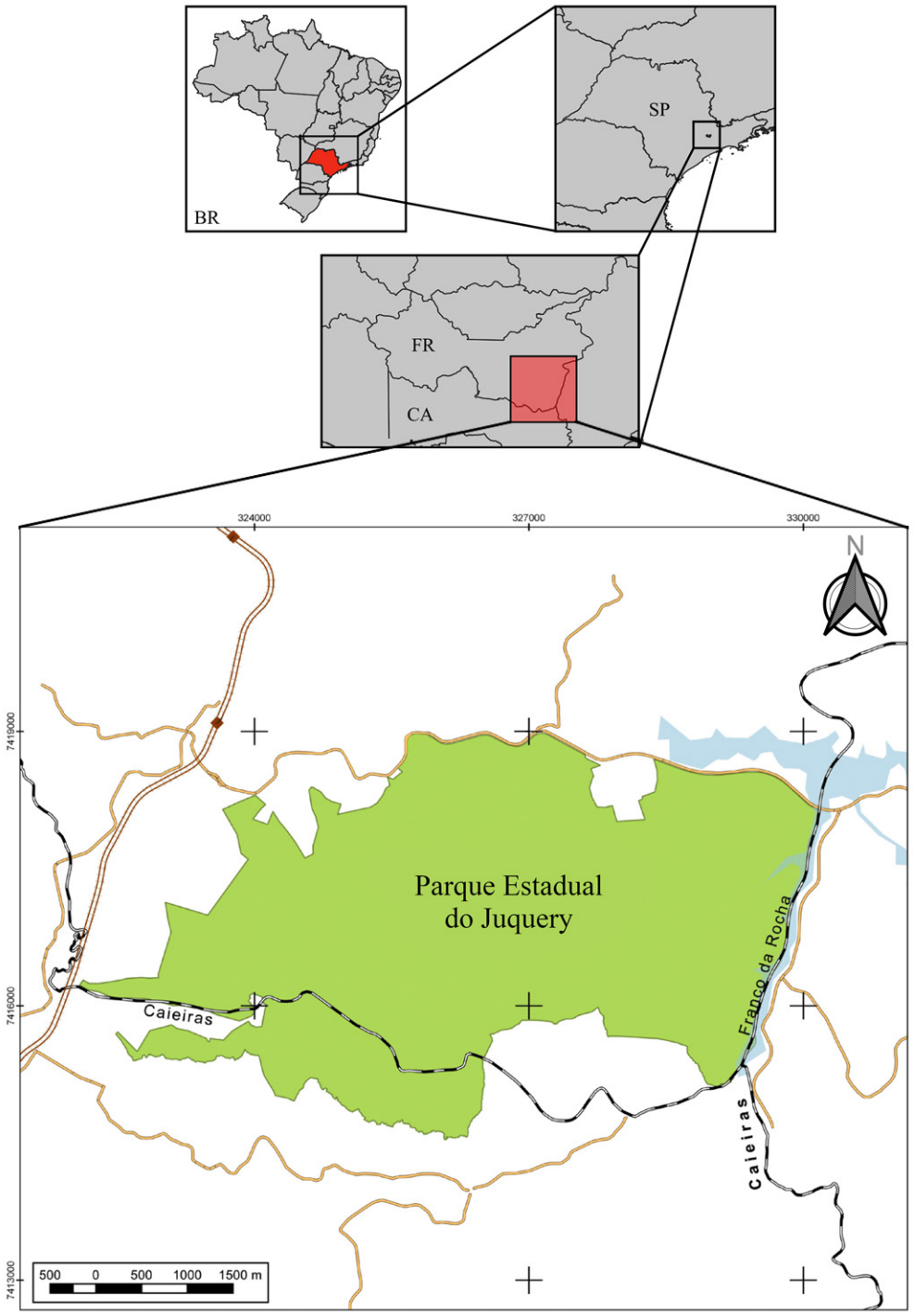

Figure 1 – Location of Juquery State Park in the city of Franco da Rocha, São Paulo state, Brazil. BR: Brazil; SP: São Paulo; FR: Franco da Rocha; CA: Caieiras. Black and white lines represent the boundaries between municipalities, yellow lines represent the road system, and crossed lines with ferrugineous color represent the railway system. The blue area depicts the Paiva Castro Dam. Map produced by Samantha F. Marcon with adaptation from São Paulo (2020).

Most of the vegetation cover consists of the following *Cerrado* phytophysiognomies: *campo limpo* (open fields) (Fig. 2a), *campo sujo* (fields with bushes and small scattered trees) (Fig. 2b), *campo cerrado* (fields with a greater number of bushes and trees) (Fig. 2c), and *cerrado sensu stricto* (a dominance of trees and shrubs, despite considerable herbaceous vegetation) (Coutinho 1978). The distinction between areas of *campo cerrado* and *cerrado sensu stricto* is not very clear in PEJY, and according Baitello *et al.* (2013) the areas of *cerrado sensu stricto* are rare and altered, so we decided to use only *campo cerrado* for these phytophysiognomies with a high number of woody individuals. In addition, the park has remnants of forest environments, such as forests at the bottom of valleys and riparian and gallery forests (Fig. 2d-f) (Baitello *et al.* 2013; Silva *et al.* 2018). It is also the largest *Cerrado* remnant in the São Paulo metropolitan region (Keller *et al.* 2021), which is an area composed by 39 municipalities and a population of almost 20 million inhabitants (Lima & Rueda 2018).

The park is open to the public to use for leisure and sports, as well as activities related to environmental education and the appreciation of nature (Secretaria de Infraestrutura e Meio Ambiente 2023b). However, previous studies (Silva *et al.* 2018; Keller *et al.* 2021) highlight the park's vulnerability to anthropogenic pressure because its surroundings are extremely urbanized and influenced by a nearby penitentiary. Furthermore, there are records of invasive species and the indiscriminate use of fire (Baitello *et al.* 2013).

Floristic survey

We took four field trips to the park between 2020 and 2023. We visited the savanna and forest phytophysiognomies to collect fertile Rubiaceae individuals; when not available, we collected vegetative vouchers. All the collected material was processed according to Fidalgo & Bononi (1984) and deposited in the Federal University of São Paulo herbarium (HUFSP); duplicates were sent to the Forestry Institute of São Paulo (SPSF), São Paulo University (SPF), and Rio de Janeiro Botanical Garden (RB) herbaria (acronyms according to Thiers, continuously updated). We also analyzed Rubiaceae material collected in the park and previously deposited in HUFABC, HUFSP and SPSF, which added up to about 150 specimens. We used digital databases, such as Reflora (<reflora.jbrj.gov.br/>), SpeciesLink (<http://splink.cria.org.br/>) and JSTOR Global Plants (<https://plants.jstor.org/>), to find and analyze other material from the park, as well as for comparisons with other specimens and type material to confirm identifications. We verified the accepted names, synonyms, and authors using the International Plant Names Index database (<https://www.ipni.org/>) and Tropicos (2023a) (<https://tropicos.org>). All analyzed material is listed in Appendix S1 (available on supplementary material <https://doi.org/10.6084/m9.figshare.25645581.v1>).

We identified the plants by consulting literature about Rubiaceae, including Lewis & Oliver (1974), Costa & Mamede (2002), Gomes (2003), Jung-Mendaçolli (2007), Pereira (2007), Taylor *et al.* (2007), Cabral (2009), Silveira (2010), Souza *et al.* (2010), Cabral *et al.* (2011), Sousa *et al.* (2013), Zappi *et al.* (2014, 2017), Nepomuceno *et al.* (2018), Fonseca *et al.* (2020), and the Flora & Funga do Brasil platform. In addition, we consulted specialists to confirm or identify doubtful specimens (see Acknowledgements).

We observed and categorized the morphological data about the habits, stipules, leaves, flowers, and fruits in a spreadsheet. The characteristics are listed in Appendix S2 (available on supplementary material <https://doi.org/10.6084/m9.figshare.25645581.v1>). We prioritized vegetative traits over reproductive traits in the identification key. The terminology used is based on Radford *et al.* (1974) and Robbrecht (1988).

Results and Discussion

Thirty-five species of Rubiaceae, in 15 genera, were found in Juquery State Park (Tab. 1; Figs. 3-8). Of these, *Borreria* (7 spp.), *Palicourea* (5 spp.), *Coccocypselum* (4 spp.), *Psychotria* (4 spp.), and *Galianthe* (3 spp.) were the most diverse. In relation to habit, 23 species are herbs and subshrubs, while the others are trees or shrubs. Despite the great diversity of phytophysiognomies present in the park, most of the woody species were found in forest environments. In contrast, all species found in the savanna phytophysiognomies are herbs or subshrubs.

Previous general floristic surveys carried out in the park reported 17 species (Baitello *et al.* 2013) and 12 species (Keller *et al.* 2021) of Rubiaceae. The first was made in the different

phytophysiognomies of the park, while the second focused on savanna grassland areas. In this work, we report four genera (*Cordiera*, *Hexasepalum*, *Malanea* and *Mitracarpus*) and 21 species with no previous records from the park, which corresponds to 62.8% of the species list.

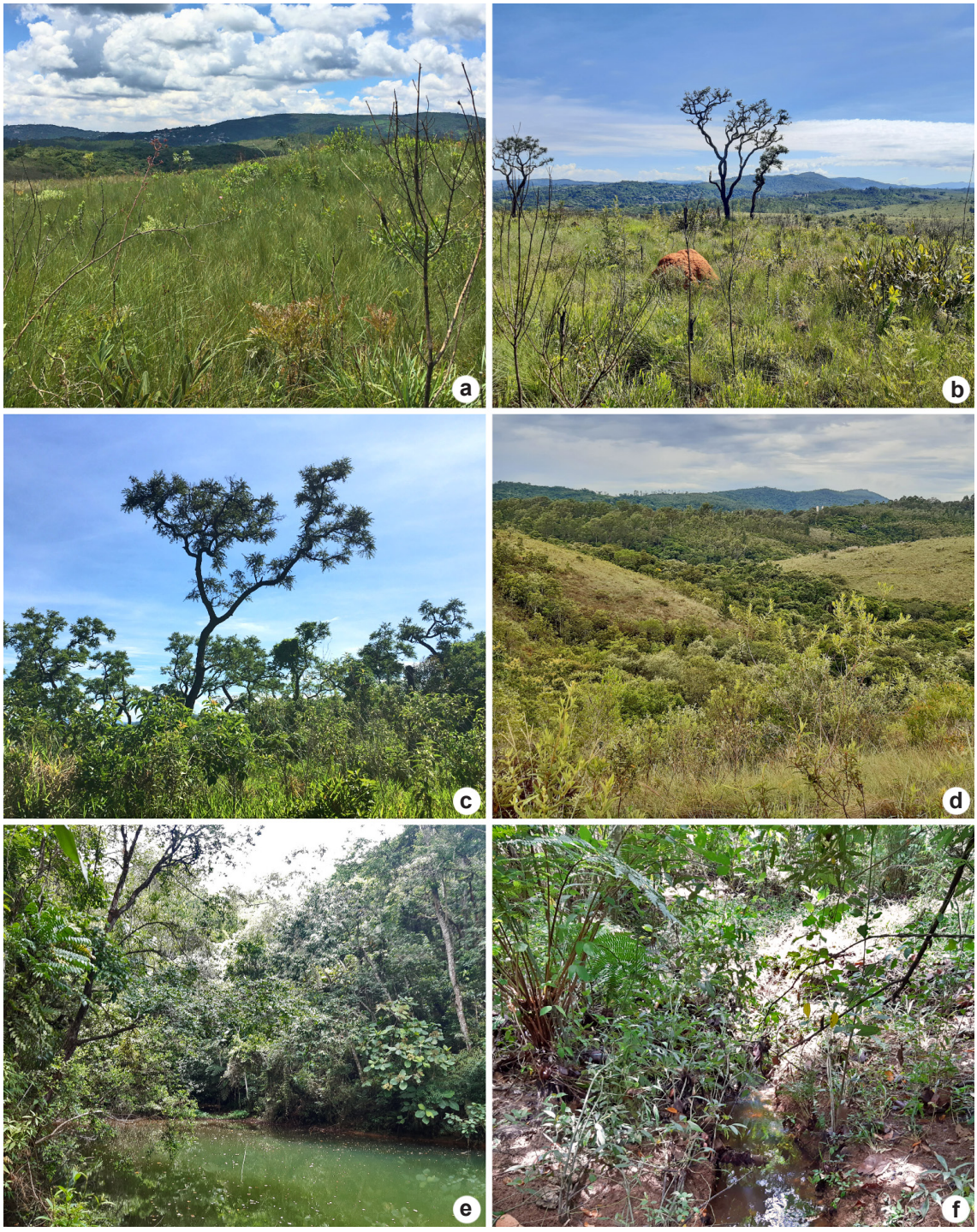

Figure 2 – a-f. Phytophysionogmies in Juquery State Park – a. *campo limpo*; b. *campo sujo*; c. *campo cerrado*; d. forest at the bottom of a valley with *campo limpo* in the foreground; e. riparian forest; f. gallery forest.

Table 1 – Rubiaceae species found in PEJY, along with their respective habits, vegetation where they occur, confirmed distribution in Brazil, and selected voucher material.

Species	Habit	Vegetation	Confirmed distribution (according to Flora e Funga do Brasil)	Voucher
Bathysa australis K.Schum. (Fig. 3a-c)	Tree	Forest	Southern and Southeastern regions, plus Bahia and Federal District	*I.C. Rossatto et al. 31* (HUFSP)
Borreria capitata (Ruiz & Pav.) DC. (Fig. 3d)	Herb	*Campo sujo*	All regions	*I.C. Rossatto et al. 104* (HUFSP)
Borreria dasycephala (Cham. & Schltdl.) Bacigalupo & E.L.Cabral (Fig. 3e)	Herb	Forest	Southern region plus São Paulo	*I.C. Rossatto et al. 12* (HUFSP)
Borreria runkii K.Schum.	Herb	*Campo sujo*	Mato Grosso, Mato Grosso do Sul and São Paulo	*I.C. Rossatto et al. 24* (HUFSP)
Borreria schumannii (Standl. *ex* Bacigalupo) E.L.Cabral & Sobrado (Fig. 3f)	Sub-shrub	Forest	Northern, Midwest, Southern and Southeastern regions, plus Bahia and Maranhão	*I.C. Rossatto et al. 39* (HUFSP)
Borreria tenella Cham. & Schltdl. (Fig. 4a-b)	Herb	*Campo cerrado* / *campo sujo*	Northern, Midwest, Southern and Southeastern regions, plus Bahia and Ceará	*I.C. Rossatto et al. 74* (HUFSP)
Borreria verticillata G.Mey. (Fig. 4d)	Sub-shrub	*Campo cerrado*	All regions	*I.C. Rossatto et al. 66* (HUFSP)
Borreria sp. (Fig. 4c)	Herb	*Campo cerrado*	-	*I.C. Rossatto et al. 98* (HUFSP)
Coccocypselum condalia Pers. (Fig. 4e)	Herb	Ombrophilous forest	Midwest, Northeastern, Southern and Southeastern regions, plus Roraima and Tocantins	*I.C. Rossatto et al. 53* (HUFSP)
Coccocypselum geophiloides Wawra (Fig. 4f)	Herb	Forest	Southern and Southeastern regions, plus Bahia	*C.P. Bruniera et al. 1112* (HUFSP)
Coccocypselum hasslerianum Chodat (Fig. 4g-h)	Herb	Forest	Midwest, Southern and Southeastern regions, plus Alagoas, Bahia and Ceará	*I.C. Rossatto et al. 42* (HUFSP)
Coccocypselum lanceolatum (Ruiz & Pav.) Pers. (Fig. 5a-b)	Herb	Forest / *campo cerrado*	Midwest, Northeastern, Southern and Southeastern regions, plus Tocantins	*I.C. Rossatto et al. 11* (HUFSP)

Species	Habit	Vegetation	Confirmed distribution (according to Flora e Funga do Brasil)	Voucher
Cordiera myrciifolia (K.Schum.) C.H.Perss. & Delprete (Fig. 5c-d)	Tree	Forest	All regions	*I.C. Rossatto et al. 32* (HUFSP)
Declieuxia cordigera Mart. *ex* Zucc. var. cordigera (Fig. 5e-f)	Herb	*Campo cerrado* / *Campo sujo*	Midwest region, plus Bahia, Minas Gerais, São Paulo and Paraná	*J.B. Baitello 1347* (SPSF)
Declieuxia cordigera var. *angustifolia* Müll.Arg. (Fig. 5g)	Herb	*Campo cerrado* / *Campo sujo*	Goiás, Mato Grosso, Minas Gerais, São Paulo, and Paraná	*I.C. Rossatto et al. 2* (HUFSP)
Faramea latifolia (Cham. & Schltdl.) DC.	Tree/Shrub	*Campo cerrado*/forest	Rio de Janeiro	*J.B. Baitello 1682* (SPSF)
Galianthe angustifolia (Cham. & Schltdl.) E.L.Cabral (Figs. 5h; 6a)	Sub-shrub	*Campo cerrado* / *campo sujo*	Midwest region, plus Minas Gerais, São Paulo and Paraná	*I.C. Rossatto et al. 67* (HUFSP)
Galianthe liliifolia (Standl.) E.L.Cabral (Fig. 6b-c)	Sub-shrub	*Campo cerrado* / *campo sujo*	Federal District, Goiás, Minas Gerais and São Paulo	*I.C. Rossatto et al. 68* (HUFSP)
Galianthe palustris (Cham. & Schltdl.) Cabaña Fader & E.L.Cabral (Fig. 6d-e)	Herb	Forest	Southern and Southeastern regions, plus Bahia	*C.P. Bruniera et al. 1115* (HUFSP)
Hexasepalum radulum (Willd.) Delprete & J.H.Kirkbr. (Fig. 6f)	Herb	Forest	Northeastern, Southern, and Southeastern regions, plus Tocantins and Goiás	*I.C. Rossatto et al. 26* (HUFSP)
Hexasepalum teres (Walter) J.H.Kirkbr. (Fig. 6g)	Herb/sub-shrub	*Campo cerrado* / *campo sujo*	All regions	*I.C. Rossatto et al. 23* (HUFSP)
Malanea forsteronioides Müll.Arg.	Herb	Forest	Southern and Southeastern regions	*I.C. Rossatto et al. 46* (HUFSP)
Mitracarpus hirtus (L.) DC.	Herb	*Campo cerrado*	All regions	*J.B. Baitello & F.S. Peres 1459* (SPSF)
Palicourea forsteronioides (Müll.Arg.) C.M.Taylor (Fig. 6h-i)	Shrub	Forest	Minas Gerais and São Paulo	*I.C. Rossatto et al. 37* (HUFSP)
Palicourea hoffmannseggiana (Roem. & Schult.) Borhidi (Fig. 6j-k)	Shrub	Forest	All regions	*I.C. Rossatto et al. 38* (HUFSP)

Species	Habit	Vegetation	Confirmed distribution (according to Flora e Funga do Brasil)	Voucher
Palicourea marcgravii A.St.-Hil. (Figs. 6l; 7a)	Tree/shrub	Forest	All regions	*I.C. Rossatto et al. 43* (HUFSP)
Palicourea rigida Kunth (Fig. 7b-c)	Subshrub	*Campo cerrado* / *campo sujo*	All regions	*I.C. Rossatto et al. 72* (HUFSP)
Palicourea sessilis (Vell.) C.M.Taylor (Fig. 7d)	Tree/shrub	Forest	Southern and Southeastern regions plus Bahia and Pernambuco	*I.C. Rossatto et al. 6* (HUFSP)
Psychotria carthagenensis Jacq. (Fig. 7e-f)	Tree/shrub	Forest	All regions	*I.C. Rossatto et al. 69A* (HUFSP)
Psychotria laciniata Vell. (Fig. 7g)	Tree/shrub	Forest	Southern and Southeastern regions	*I.C. Rossatto et al. 64* (HUFSP)
Psychotria stachyoides Benth. (Fig. 7h)	Shrub	Forest	Southern and Southeastern regions plus Bahia, Ceará and Goiás	*I.C. Rossatto et al. 51* (HUFSP)
Psychotria suterella Müll.Arg. (Fig. 7i-j)	Tree/shrub	Forest	Southern and Southeastern regions	*I.C. Rossatto et al. 30* (HUFSP)
Richardia brasiliensis Gomez (Fig. 7k-l)	Herb	*Campo cerrado*	All regions	*I.C. Rossatto et al. 18* (HUFSP)
Richardia stellaris Steud. (Fig. 8a-b)	Herb	*Campo cerrado*	Southern and Southeastern regions plus Mato Grosso do Sul	*I.C. Rossatto et al. 21* (HUFSP)
Rudgea gardenioides (Cham.) Müll.Arg. (Fig. 8c-e)	Tree	Forest	Southern and Southeastern regions	*C.P. Bruniera et al. 1178* (HUFSP)
Sabicea brasiliensis Wernham (Fig. 8f-g)	Subshrub	*Campo cerrado* / *campo sujo*	Bahia, Federal District, Goiás, Minas Gerais, Mato Grosso, São Paulo, and Tocantins	*C.P. Bruniera et al. 1125* (HUFSP)

Key to the Rubiaceae species in Juquery State Park

1. Stipules multifimbriate 2
   2. Leaves appearing whorled because of the presence of brachyblasts 3
      3. Inflorescence a glomerule 4
         4. Leaf blade elliptic to ovate, hirsutullous, venation distinct on both side ..... *Borreria capitata*
         4’. Leaf blade elliptic to oblong, glabrous, venation indistinct on both sides ..... *Borreria verticillata*
      3’. Inflorescence a thyrse 5
         5. Leaf blade filiform, secondary veins in 2–3 pairs, indumentum green ..... *Galianthe angustifolia*
         5’. Leaf blade elliptic, secondary veins in 4–5 pairs, indumentum ferruginous ..... *Galianthe liliifolia*
   2’. Leaves opposite, without brachyblasts 6
      6. Prostrate herbs 7
         7. Leaf blade elliptic to ovate, membranaceous, pilose; flowers hexamerous; schizocarp with 3 mericarps ..... *Richardia brasiliensis*
         7’. Leaf blade triangular to narrowly ovate, chartaceous, glabrous; flowers tetramerous; schizocarp with 4 mericarps ..... *Richardia stellaris*
      6’. Erect herbs 8
         8. Leaf blade elliptic to obovate, apex obtuse, rounded, or cuspidate ..... *Galianthe palustris*
         8’. Leaf blade elliptic, lanceolate or linear, apex acute or acuminate 9
            9. Stipular lobes 3, the middle one wider and longer than the others ..... *Borreria runkii*
            9’. Stipular lobes 5–11, same size 10
               10. Glomerules axillary 11
                  11. Stem glabrous ..... *Borreria schumanni*
                  11’. Stem pilose 12
                     12. Leaf blade membranous ..... *Borreria* sp.
                     12’. Leaf blade chartaceous to coriaceous 13
                        13. Leaf blade coriaceous, secondary veins inconspicuous on both sides; corolla light pink to lilac ..... *Hexasepalum teres*
                        13’. Leaf blade chartaceous, secondary veins evident on both sides; corolla white ..... *Hexasepalum radulum*
               10’. Glomerules terminal 14
                  14. Capsule-like fruit with transverse dehiscence ..... *Mitracarpus hirtus*
                  14’. Capsule-like fruit with longitudinal dehiscence 15
                     15. Leaf blade lanceolate, chartaceous, glabrous ..... *Borreria dasycephala*
                     15’. Leaf blade linear, membranaceous to coriaceous, glabrous to pubescent ..... *Borreria tenella*
1’. Stipules entire or bifid 16
   16. Herbs or subshrubs 17
      17. Leaves sessile 18
         18. Leaf blade ovate, base truncate to cordate ..... *Declieuxia cordigera* var. *cordigera*
         18’. Leaf blade narrowly elliptic to elliptic, base acute ..... *Declieuxia cordigera* var. *angustifolia*
      17’. Leaves petiolate 19
         19. Leaf blade chartaceous to coriaceous 20
            20. Stem and branches glabrous; leaf blade elliptic, oblanceolate, obovate or ovate, glabrous; inflorescence pyramidal, with yellow flowers ..... *Palicourea rigida*

20’. Stem and branches densely villous; leaf blade elliptical or ovate-lanceolate, lanate; inflorescence capitate, with white flowers ..... *Sabicea brasiliensis*
19’. Leaf blade membranaceous to chartaceous 21
21. Stipules triangular, foliaceous ..... *Malanea forsteronioides*
21’. Stipules linear to triangular aristate, not foliaceous 22
22. Stem and leaves glabrous 23
23. Leaf blade cordiform, secondary veins in 6–9 pairs ..... *Coccocypselum geophiloides*
23’. Leaf blade ovoid or lanceolate, secondary veins in 4–6 pairs ..... *Coccocypselum condalia*
22’. Stem and leaves hirsute or velutinous 24
24’. Leaf blade with cordate to truncate base; inflorescence sessile ..... *Coccocypselum hasslerianum*
24’. Leaf blade with cuneate, truncate, rounded, or asymmetrical base; inflorescence pedunculate ..... *Coccocypselum lanceolatum*
16’. Trees or shrubs 25
25. Stipules entire 26
26. Stipules deciduous, exposing a ring of colleters ..... *Psychotria carthagenensis*
26’. Stipules persistent 27
27. Stipules with dorsal appendages; stem with spongy bark ..... *Rudgea gardenioides*
27’. Stipules without appendages; stem with solid bark 28
28. Leaf blade coriaceous ..... *Faramea latifolia*
28’. Leaf blade chartaceous to membranaceous 29
29. Terminal stipules ca. 2cm long, leaf-like; leaf blade with about 30 pairs of secondary veins; inflorescence pyramidal ..... *Bathysa australis*
29’. Terminal stipules up to 3mm long, triangular; leaf blade with about 7 pairs of secondary veins; female flowers solitary and male flowers in groups of 5–6. ..... *Cordiera myrciifolia*
25’. Stipules bifid 30
30. Inflorescence with pink to orange peduncle; flowers with orange to yellowish corolla with lilac or pink apex ..... *Palicourea marcgravii*
30’. Inflorescence with green peduncle; flowers white or yellow 31
31. Inflorescence mainly axillary, sometimes terminal; fruit ellipsoid or obovoid ..... *Palicourea sessilis*
31’. Inflorescence only terminal; fruit globose 32
32. Inflorescence sessile or subsessile 33
33. Leaf blade elliptic, glabrous, apex acute or usually acuminate, base cuneate; flowers sessile, with yellow corolla ..... *Psychotria laciniata*
33’. Leaf blade elliptic to oblong, sometimes hirsutullous along the primary vein on the abaxial side, apex acuminate, base acute or cuneate; flowers subsessile, with white corolla ..... *Psychotria suterella*
32’. Inflorescence pedunculate 34
34. Bracts poorly developed; inflorescence spike-like ..... *Palicourea forsteronioides*
34’. Bracts well developed; inflorescence capitate or paniculate 35
35. Leaf blade elliptic, glabrous; inflorescence with green, purplish or white, glabrous bracts ..... *Palicourea hoffmannseggiana*
35’. Leaf blade narrowly elliptic, pilose on both sides; inflorescence with green, sericeous bracts ..... *Psychotria stachyoides*

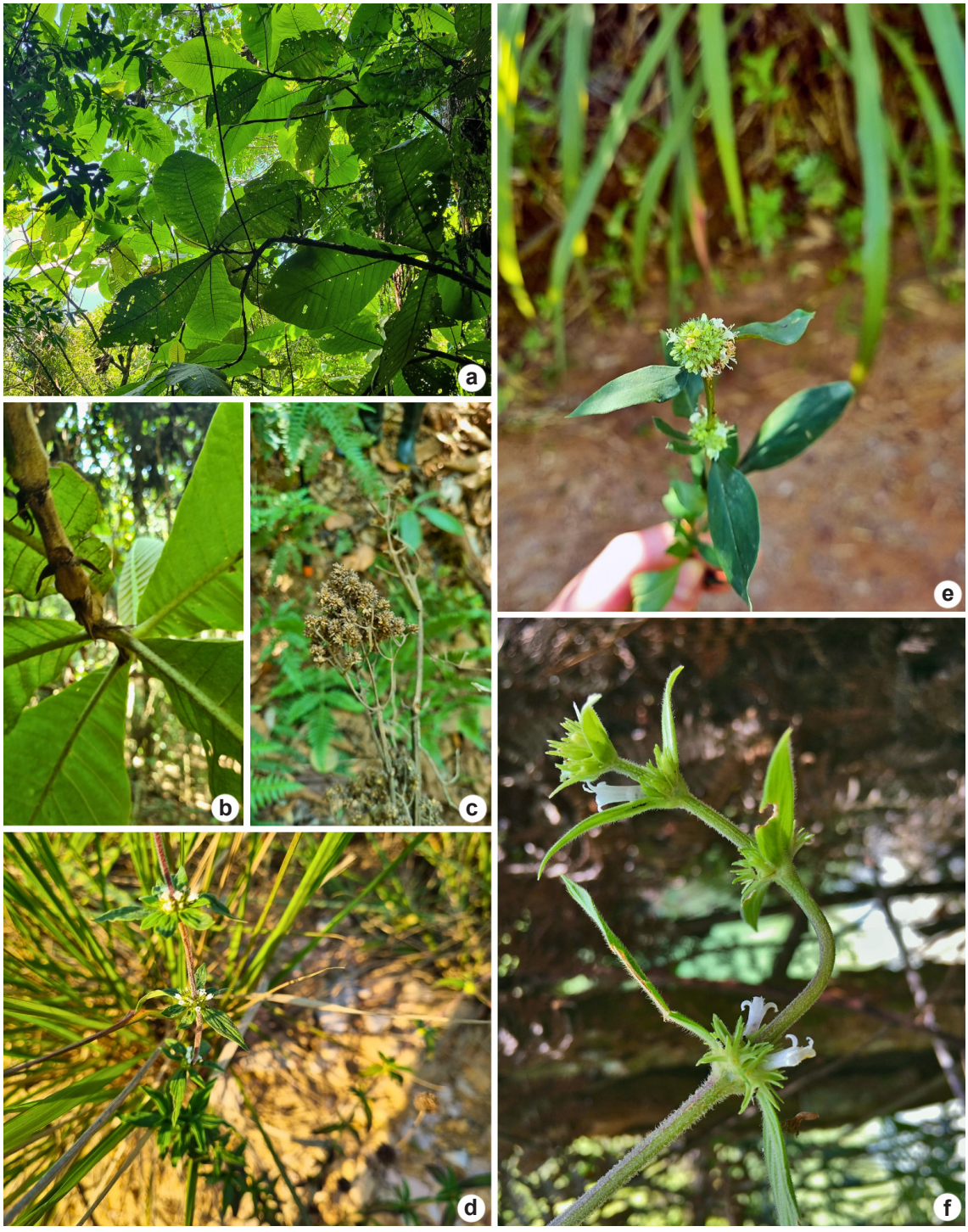

Figure 3 – a-c. *Bathysa australis* – a. vegetative branch; b. stipule; c. old inflorescence. d. *Borreria capitata* – flowering branch. e. *Borreria dasycephala* – flowering branch. f. *Borreria schumannii* – flowering branch.

Figure 4 – a-b. *Borreria tenella* – a. stipule; b. terminal inflorescence. c. *Borreria verticillata* – flowering branch. d. *Borreria* sp. – flowering branch. e. *Coccocypselum condalia* – flowering branch. f. *Coccocypselum geophiloides* – vegetative branch. g-h. *Coccocypselum hasslerianum*. g. flowering branch; h. immature fruits and one blue mature fruit.

Figure 5 – a-b. *Coccocypselum lanceolatum* –a. stipule; b. terminal inflorescence. c-d. *Cordiera myrciifolia* – c. masculine flowers; d. immature fruits. e-g. *Declieuxia cordigera* var. *cordigera* – e. terminal inflorescence; f. flowering branch; g. *D. cordigera* var. *angustifolia*. h. *Galianthe angustifolia* – leaves.

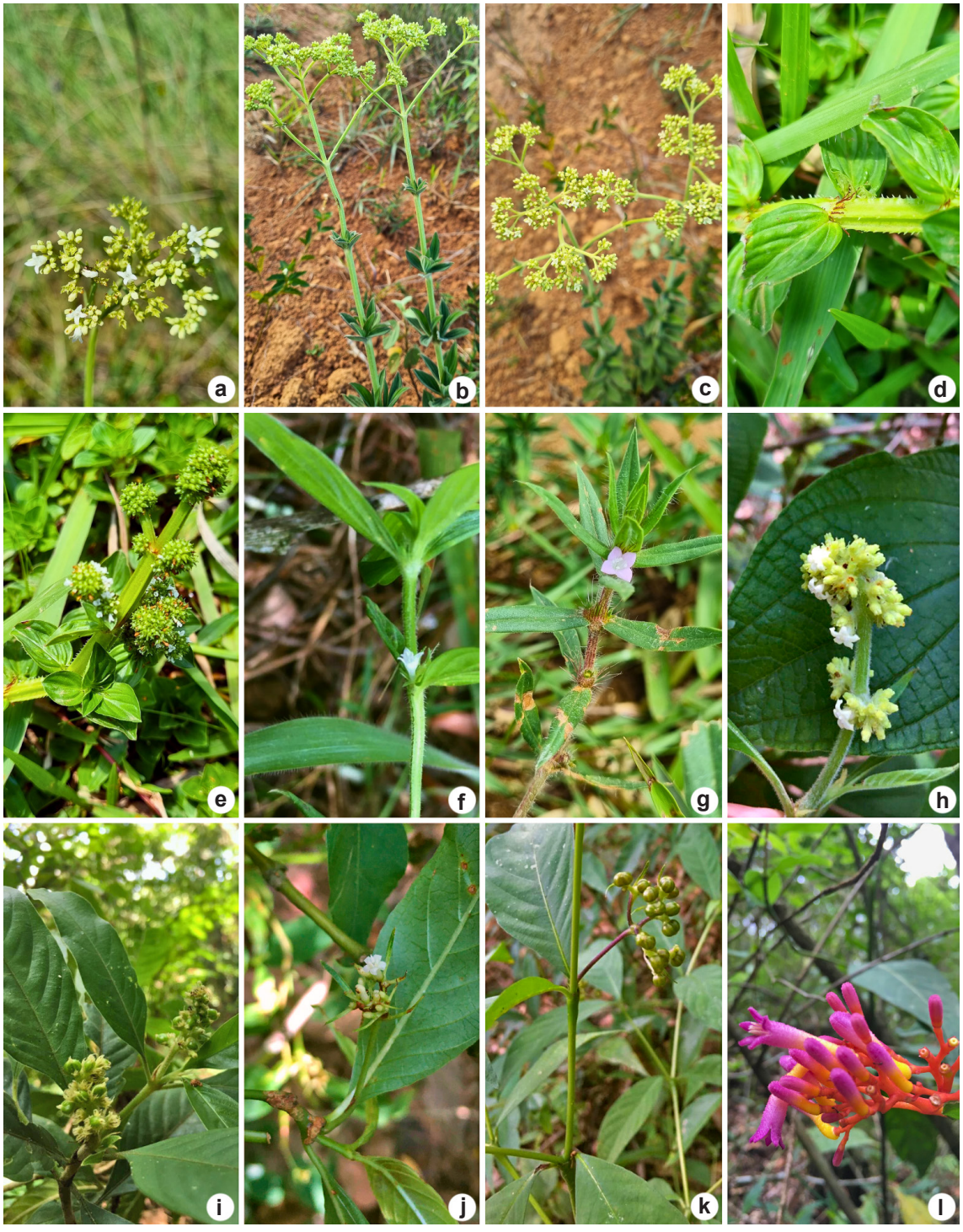

Figure 6 – a. *Galianthe angustifolia* – terminal inflorescence. b-c. *Galianthe liliifolia* – b. habit; c. terminal inflorescence. d-e. *Galianthe palustris* – d. stipule; e. flowering branch. f. *Hexasepalum radulum* – flowering branch. g. *Hexasepalum teres* – flowering branch with immature fruits. h-i. *Palicourea forsteronioides* – h. terminal inflorescence; i. immature fruits. j-k. *Palicourea hoffmannseggiana* – j. flowering branch; k. immature fruits. l. *Palicourea marcgravii* – terminal inflorescence.

Figure 7 – a. *Palicourea marcgravii* – immature fruits. b-c. *Palicourea rigida* – b. terminal inflorescence; c. inflorescence with red brown mature fruits. d. *Palicourea sessilis* – immature fruits. e-f. *Psychotria carthagenensis* – e. branch with terminal stipule and distal decidual stipule; f. inflorescence with immature fruits. g. *Psychotria laciniata* – purple mature fruits. h. *Psychotria stachyoides* – immature inflorescence. i-j. *Psychotria suterella* – i. flowering branch; j. purple mature fruit. k-l. *Richardia brasiliensis* – k. stipule; l. terminal inflorescence.

Figure 8 – a-b. *Richardia stellaris* – a. habit; b. flower bud. c-e. *Rudgea gardenioides* – c. leaves; d. barky stem; e. stipule. f-g. *Sabicea brasiliensis* – f. flowering branch; g. red brown mature fruits.

Notes about species identifications

Although five other species were listed by Baitello *et al.* (2013), they were not included on our list because we did not collect them during the expeditions or find herbarium material of these taxa [*Amaioua intermedia* Mart., *Galianthe peruviana* (Pers.) E.L. Cabral, *Manettia luteorubra* Benth., *Posoqueria acutifolia* Mart. and *Rudgea sessilis* (Vell.) Müll. Arg.]. According to C.P. Bruniera (personal communication), *Rudgea sessilis* is sometimes confused with *Palicourea sessilis*, as noted for herbarium specimens, probably because of the narrow leaves of these species. *P. sessilis* has a wide distribution in eastern Brazil, is quite abundant in its range and commonly found in PEJY, so it is likely that the specimen listed by Baitello *et al.* (2013) as *R. sessilis* is *P. sessilis*.

We were not confident in the identifications of some loaned specimens because they did not agree with the literature and photographs of type material. This was the case for *Borreria warmingii* K. Schum., *Declieuxia fruticosa* (Willd.) Kuntze, *Galianthe grandifolia* E.L. Cabral, and *Richardia schumannii* W.H. Lewis & Oliv. We redetermined them as *Borreria tenella*, *Declieuxia cordigera*, *Galianthe liliifolia* and *Richardia stellaris*, respectively, and discuss these decisions below.

Borreria tenella was determined based on the following: hirsute branches; leaf blades linear, membranous to coriaceous, with 3–4 pairs of secondary veins; and stipular sheath pubescent, with 6–8 lobes. However, *B. warmingii* has the following: glabrous branches; leaf blades linear, coriaceous, light green, with 2–3 pairs of secondary veins; and stipular sheath glabrous, with one larger central lobe and two smaller lateral lobes. Although *B. tenella* is classified as illegitimate (Tropicos 2023a), this name was maintained since the group that this species is in is constantly undergoing nomenclatural changes.

Declieuxia cordigera was determined because the analyzed material has the following: hirsutullous to pilose branches; non-decurrent stipules; leaf blades oblanceolate, ovate or narrowly elliptic to elliptic, coriaceous, base truncate, cordate or acute, adaxial surface glabrous, hirsute or hirsutullous, abaxial surface glabrous, hirsute or hirsutullous, secondary veins in 3–6 pairs; and corolla tubular-campanulate. The two varieties of *D. cordigera* were also identified; *D. cordigera* var. *cordigera* individuals have ovate leaf blades and *D. cordigera* var. *angustifolia* individuals have narrowly elliptic to elliptic leaf blades. On the other hand, *D. fruticosa* has the following: glabrous branches; decurrent stipules, which extend to the next node; leaf blades elliptic to ovate, membranous, glabrous, base obtuse to rounded, secondary veins in 5–7 pairs; and corolla hypocrateriform. After an analysis of material of the two species at the Reflora Virtual Herbarium and the types on JSTOR Global Plants, it became clear that the delimitation of these two species needs further study.

Galianthe liliifolia was determined due to the presence of a rusty indumentum that, according to Cabral (2009), is a striking feature of this species. In addition, it has leaves that are pseudoverticillate, with elliptic-lanceolate, hirsutullous, chartaceous blades, and a hirsute stipular sheath with 7–10 lobes. In turn, *G. grandifolia* has leaves that are opposite (rarely pseudoverticillate), with elliptic to lanceolate, subcoriaceous leaf blades, and a hirsute stipular sheath with 6–7 lobes.

Richardia stellaris was determined based on the key in Lewis & Oliver (1974), mainly because the stipular lobes are 5–7 mm long and the schizocarp has 4 glabrous mericarps. In contrast, *R. schumannii* has stipular lobes up to 2 mm long and a schizocarp with 4 mericarps that are scabrous at the apex.

Finally, *Borreria* sp. remained undetermined due to the scarcity of material; it was only found during one of the field expeditions.

Notes on diversity and occurrence data

Compared to other floristic surveys conducted in different *Cerrado* remnants in São Paulo (Mantovani & Martins 1993; Batalha *et al*. 1997; Batalha & Mantovani 2001; Tannus & Assis 2004; Ishara *et al*. 2008; Rossato *et al.* 2008; Sasaki & Mello-Silva 2008; Ishara & Maimoni-Rodella 2012; Cavassan & Weiser 2015), *Borreria*, *Declieuxia*, *Palicourea* and *Richardia* were present in all studies, but with different species compositions. *Borreria* was not as diverse, with up to three species in most studies, except for Sasaki & Mello-Silva (2008) who recorded five species, while we recorded seven species. *Coccocypselum lanceolatum* and *Palicourea rigida* were the only species recorded in all the surveys. *Chiococca* spp. and *Tocoyena* spp. are frequent in other localities but were not found in PEJY. Most of the species cited from forests, such as *Bathysa australis*, *Coccocypselum condalia*, *C. hasslerianum*, *C. geophiloides* and *Rudgea gardenioides*, were not recorded by the studies mentioned above. This is probably related to the heterogeneous landscape

in PEJY, including savanna phytophysiognomies interspersed with forest formations. Most of the studies recorded an average of 15 Rubiaceae species, while we found about twice as many species. This is probably because we only focused on this family, while the others were general surveys.

Species of the tribe Spermacoceae (*Borreria*, *Galianthe*, *Hexasepalum* and *Mitracarpus*) prevail in the open formations in the park, which is consistent with statistics that demonstrate these genera have high species richness in the *Cerrado* domain (Miguel *et al.* 2020; Salas *et al.* 2020; Souza *et al*. 2020). The forest formations are dominated by species of the tribe Palicoureeae (mainly *Palicourea* and *Psychotria*, but also *Rudgea*) that are commonly found in humid vegetation (Tropicos 2023b).

Based on an analysis of the data in Flora e Funga do Brasil, all the species recorded in this study were confirmed to occur in São Paulo State, except for *Faramea latifolia* that has only been confirmed to occur in Rio de Janeiro state and possibly in São Paulo. Most of the species are native to the South and Southeast regions of Brazil, while others, such as *Borreria verticillata*, *Cordiera myrciifolia*, *Hexasepalum teres*, *Palicourea hoffmannseggiana*, *P. marcgravii*, *P. rigida*, *Psychotria carthagenensis* and *Richardia brasiliensis*, have wide distributions throughout the country. In contrast, *Borreria runkii* and *Palicourea forsteronioides* have more restricted distributions; *B. runkii* occurs in the states of Mato Grosso, Mato Grosso do Sul and São Paulo, and *P. forsteronioides* occurs only in the states of Minas Gerais and São Paulo.

Thus, the importance of the park is reinforced as a home to a megadiversity of species. Also, the role the park plays to conserve the *Cerrado* and Atlantic Forest flora is essential to ensure the maintenance of such heterogeneous and diverse biota (Baitello *et al.* 2013; Keller *et al*. 2021). We hope the knowledge provided here can be used to encourage conservation and preservation actions (Forzza *et al.* 2012), since the park is under constant anthropogenic pressure due to the increasing urbanization in its surroundings and illegal fires.

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Data availability statement

In accordance with Open Science communication practices, the authors inform that raw data is available in the UNIFESP's data repository, which provides free access and guaranteed preservation: <https://hdl.handle.net/20.500.12682/rdp/BMUUDK>.

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