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Flora of the *canga* of the Serra dos Carajás, Pará, Brazil: Piperaceae

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Abstract

Aiming to increase the knowledge concerning the *canga* vegetation of the Serra dos Carajás, a taxonomic treatment of the Piperaceae species was prepared. Thirty species were recorded for the region, of which 20 taxa were found growing on *canga* substrate (ferruginous rupicolous vegetation). The majority of the species studied belong to *Piper* (23 species). The first record of *P. goeldii* for the state of Pará is presented, while the fruit of *P. pellitum* is described for the first time. Two out of seven *Peperomia* species studied - *P. albopilosa* and *P. pseudoserratirhachis* are described as new. Identification keys, detailed descriptions, geographical distribution and comments for taxa, besides illustrations of those poorly known or that are reported for the first time in the region, are provided.

Key words: Brazilian Amazon, FLONA Carajás, new *Peperomia* species, new records, *Piper*.

Resumo

Com o objetivo de ampliar o conhecimento sobre a vegetação de canga da Serra dos Carajás, foi realizado um tratamento taxonômico das espécies de Piperaceae. Foram registradas 30 espécies na região, sendo que 20 táxons foram encontrados crescendo sobre o substrato de canga (vegetação rupestre ferruginosa). A maioria das espécies estudadas pertence ao gênero *Piper* (23 espécies). O primeiro registro de *P. goeldii* para o estado do Pará é apresentado, enquanto o fruto de *P. pellitum* é descrito pela primeira vez. Duas das sete espécies de *Peperomia* estudadas - *P. albopilosa* e *P. pseudoserratirhachis* são aqui descritas como novas. São fornecidas chaves de identificação, descrições detalhadas, distribuição geográfica e comentários para os táxons, além de ilustrações para aqueles pouco conhecidos ou registrados pela primeira vez na região.

Palavras-chave: Amazônia brasileira, FLONA Carajás, novas espécies de *Peperomia*, novos registros, *Piper*.

Piperaceae

Piperaceae Giseke comprises ca. 3.600 pantropical species (Smith *et al.* 2008), subdivided into three subfamilies and five genera: Verhuellioideae (*Verhuellia* Miq.), Zippelioideae (*Zippelia* Blume and *Manekia* Trel.) and Piperoideae (*Piper* L. and *Peperomia* Ruiz & Pav., the two largest genera) (Samain *et al*. 2008). The family includes herbs, shrubs, small trees or climbers, frequently aromatic, mostly with alternate, sometimes opposite or whorled, simple leaves, quite variable in shape, size and venation; the inflorescences are racemose or more commonly spike-like, solitary, umbellate or paniculate, terminal, axillary or leaf-opposed, erect, curved or pendulous; the flowers are numerous, small, perianthless, generally bisexual, subtended by a floral bract; stamens (1–)2–4(–10); 1–4 fused carpels; ovary 1–locular with a single basal ovule. The fruits are variously shaped, have a thin pericarp, endocarp generally hardened and a small seed, with endosperm scanty, perisperm abundant and very small embryo (Guimarães & Monteiro 2010).

South America was recognized as one of the family`s centers of diversity (Yuncker 1958), and in Brazil, *Piper* and *Peperomia* appear between the 30 largest genera of Angiosperms (BFG 2015). The more than 460 species recorded in the Brazilian flora (Flora do Brasil 2020) are more diverse in the Atlantic and Amazon Rainforest biomes, with high numbers of endemic species (BFG 2015). In the area of this flora 30 species were recognized, distributed in *Peperomia* (7 spp.) and *Piper* (23 spp.), of which 20 taxa (7 and 13 respectively) were found growing on *canga* substrate - ferruginous rupicolous vegetation, that includes shrubby rupicolous vegetation, *campo rupestre* over *canga* and low forest (Viana *et al.* 2016). In this survey poorly known taxa or new occurrences were prioritized for the illustrations.

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Key to genera of Piperaceae in the *canga* of the Serra dos Carajás

1. Herbs; 1 stigma, 2 stamens ..... 1. *Peperomia*
1'. Shrubs; 3–4 stigmas, 4 stamens ..... 2. *Piper*

1. *Peperomia* Ruiz & Pav.

Peperomia consists of annual or perennial herbs, with decumbent, reptant, stoloniferous, pendulous or erect branches, epiphytic, terrestrial or rupicolous habit. Often succulent and with glands, the plants can be glabrous or bear some indument. The leaves can be alternate, opposite or whorled, quite variable in shape, size, consistency and venation. The spikes are terminal, axillary or leaf-opposed, with flowers densely or sparsely arranged in the rachis, which can be glabrous or with trichomes and is generally cylindrical. Each flower is composed of a carpel and two lateral stamens, subtended by a rounded floral bract, generally glabrous. The fruits are generally viscid, variable in shape, acute, apiculate, mammiform, oblique or rostrate apically, sessile or pedicellate and sometimes with a pseudocupule (Monteiro & Guimarães 2008).

Peperomia is one of the largest genera of Angiosperms and the second of the family, comprising approximately 1,600 species (Wanke *et al.* 2006). It has a pantropical distribution with greatest diversity in the Neotropics (Wanke *et al.* 2006), and numerous endemic species in the Andes and Amazon region (Mathieu *et al.* 2015). Its monophyly is supported by molecular and morphological synapomorphies, such as a single carpel, two stamens (Wanke *et al.* 2006), and the new infrageneric classification, over 100 years after the first taxonomic revision (Dahlstedt 1900), distinguished fourteen monophyletic groups, based on morphological and molecular data (Frenzke *et al.* 2015). Important in the epiphytic stratum, it is the 22nd largest genus of Angiosperms in Brazil (BFG 2015), with about 170 species (Yuncker 1974; BFG 2015). Of the 57 taxa recorded for Brazilian Amazon, 20 occur in Pará state and seven in the Serra dos Carajás. Two species could not to be assigned to any previously described species of the genus, and are proposed here as new to science. In the flora area, *P. albopilosa*, *P. circinnata* and *P. pseudoserratirhachis* were found only on *canga* substrate, and the other species, besides this environment were also collected in forest patches (transition forest associated to the ferruginous ranges, *terra firme* forest or disturbed areas).

Key to species of *Peperomia* from the *canga* of the Serra dos Carajás

1. Leaf blade less than 4 cm long; spikes less than 5 cm long.
    2. Leaves opposite, orbicular; fruits globose-ovoid, densely arranged in the rachis, with a basal pseudocupule ..... 1.2. *Peperomia circinnata*
    2'. Leaves alternate, ovate-cordate; fruits ovoid to elliptic, sparsely arranged in the rachis, without a basal pseudocupule
        3. Leaf blade short-pilose along all veins on the abaxial surface; fruits villous ..... 1.1. *Peperomia albopilosa*
        3'. Leaf blade glabrous or pilose in the veins near the base on the abaxial surface; fruits glabrous ..... 1.6. *Peperomia pseudoserratirhachis*
1'. Leaf blade 4 cm long or more; spikes more than 5 cm long.
    4. Leaf blade elliptic, chartaceous to membranous, commonly with white-dentritic macules on adaxial surface; floral bract marginally fimbriate; fruits cylindric, apically obliquely scutellate ..... 1.3. *Peperomia macrostachya*
    4'. Leaf blade obovate, elliptic-obovate, elliptic-lanceolate or lanceolate, coriaceous, without white-dentritic macules on adaxial surface; floral bract glabrous; fruits elliptic, apically rostrate
        5. Peduncle glabrous ..... 1.4. *Peperomia magnoliifolia*
        5'. Peduncle hirtellous to glabrescent
            6. Leaf blade obovate to elliptic-obovate ..... 1.5. *Peperomia obtusifolia*
            6'. Leaf blade elliptic-lanceolate to lanceolate ..... 1.7. *Peperomia uaupesensis*

1.1. *Peperomia albopilosa* D. Monteiro, *sp. nov***.** Type: BRAZIL. PARÁ: Canaã dos Carajás, Floresta Nacional de Carajás, Serra Sul, Corpo D, 6°24'22"S, 50°18'44"W, 696 m, 23.V.2010, fl. and fr., *L.L. Giacomin et al. 1174* (holotype BHCB, isotype RB). Fig. 1a-f

Delicate, translucent and rupicolous herb, with erect, short-pilose or glabrescent branches; leaves alternate, ovate-cordate, membranaceous, scattered white-long-pilose above, short-pilose along the veins beneath; spikes solitary with ovoid to elliptic, white pilose fruits, sparsely arranged in the glabrous rachis, apically apiculate with apical stigma.

Rupicolous, delicate herb; branches erect, translucent, 4–10 cm tall, moderate to sparsely short-pilose or glabrescent, trichomes up to 0.5 mm long, variable in length, sometimes more concentrated at the nodes. Leaves alternate with petiole (0.3–)0.6–1(–1.5) cm long, moderate to sparsely short-pilose or glabrescent, with trichomes more concentrated in the apex, near the leaf insertion; lamina (0.6–)1–2.3 × 0.5–1.7 cm, ovate-cordate, base rounded to cordate, apex acute to acuminate, membranaceous, translucent, concolor, adaxial surface in general densely glandular, moderate to sparsely white-long-pilose, trichomes 0.5–1 mm long, appressed to suberect, scattered throughout the blade, abaxial surface moderate to sparsely short-pilose along the veins or glabrescent; margin flat, glabrous; venation acrodromous-camptodromous, with 3–7 veins getting out the base and 2–4 additional veins near the middle of the midrib. Spikes (1.5–)2–3(–4.5) × 0.05 cm, terminal or leaf-opposed, solitary, erect; peduncle 0.5–1 cm long., short-pilose to glabrescent; rachis smooth, glabrous; floral bract rounded, peltate, glandular, glabrous. Fruits ca. 1 × 0.5 mm, ovoid to elliptic, white pilose, sparsely arranged in the rachis, sessile to pseudo-pedicellate, without basal pseudocupule; apex apiculate with apical stigma.

Material selected (paratypes): Canaã dos Carajás, S11A, 700 m, 21.V.2010, fl. and fr., *L.V. Costa et al. 898* (BHCB, K); S11B, 6°20'36"S, 50°24'30"W, 575 m, 24.V.2012, fl. and fr., *A.J. Arruda et al. 1186* (BHCB, MG, MO); S11C, 6°22'32"S, 50°22'58"W, 715 m, 22.III.2012, fl. and fr., *P.B. Meyer et al. 1162* (BHCB, NY); S11D, 30.III.2015, fr., *A. Cardoso et al. 2016* (MG). Parauapebas, N3, 6°2'35"S, 50°13'10"W, 633 m, 23.VI.2012, fl. and fr., *L.V.C. Silva et al. 1309* (BHCB); N4, 6°4'22"S, 50°11'42"W, 505 m, 24.III.2012, fl. and fr., *P.B. Meyer et al. 1199* (BHCB); N6, 6°7'53"S, 50°10'33"W, 695 m, 25.VI.2012, fl. and fr., *L.V.C. Silva et al. 1332* (BHCB). São Felix do Xingú, Serra de Campos, Platô SF1, 6°23'48"S, 51°54'20"W, 650 m, 2.V.2016, fr., *P.L. Viana et al. 6169* (MG, RB).

Peperomia albopilosa is a delicate, translucent, erect herb, distinguished by the erect branches, alternate and ovate-cordate leaves, presence of pilose trichomes, with variable length, in various parts of the plant, long and notably scattered on adaxial surface of the lamina, erect spikes with ovoid to elliptic fruits that are white-pilose, sessile to pseudo-pedicellate and sparsely arranged in the rachis. It is morphologically similar with *P. albert-smithii* var. *villosa* Trel. & Yunck., from Colombia (known only by its holotype - Cuatrecasas 8725, US - photo!), differing from *P. albopilosa* by its life form (terrestrial), branches and petiole more densely villous and rachis papillate-hispid. It is also similar to *P. chazaroi* G. Mathieu & T. Kömer, endemic to Veracruz - Mexico, but this species has creeping habit, smaller and orbicular leaves (ca. 1 mm diam), rounded at apex, usually peltate at base and initially glabrous fruits. Differs from *P. hispiduliformis* Trel. (that occurs in Argentina, Bolívia and Peru) and *P. hispiduliformis* var. *ciliosa* Yunck. (recorded only in Peru) because these species have round-ovate leaves with obtuse apex and smaller spikes (1–2 cm long). The last species cited also has strongly villous branches and conspicuously ciliate margin, with longer (1mm long or more) trichomes.

Among the *Peperomia* species found in Brazil, *P. albopilosa* resembles *P. hispidula* (Sw.) A. Dietr., differing by its ovate-orbicular leaves with rounded-obtuse apex, that are distally concentrated and by its obviously pedicellate fruits. The new species occurs between 370 and 750 m of altitude, flowers and fruits between February to June. The specific epithet refers to the white-pilose trichomes observed in different parts of the plant, mainly in adaxial surface of the leaves and in the fruits.

Peperomia albopilosa should be considered Endangered (EN B1ab[i, ii, iii]) (IUCN 2017) because, although 16 specimens have been collected in eight localities in the Serra dos Carajás (one in Serra de São Felix: SF1, three in Serra Norte: N3, N4, N6 and the others in Serra Sul: S11A, S11B, S11C, S11D), these are recorded over the *canga* substrate, considered a severely fragmented area under severe exploitation pressure, as the iron-ore deposits of the Serra dos Carajás are part of one of the largest mineral provinces of the world (Almeida *et al.* 2016; Viana *et al.* 2016).

1.2. *Peperomia circinnata* Link., Bot. Jahrb. Syst. 1(3): 64. 1820.

Epiphytic, stoloniferous herb; branches sulcate, pilose-pubescent, trichomes up to 0.5 mm

long. Opposite leaves with petiole ca. 1 mm long, pilose-pubescent; lamina 3–9 × 3–9 mm, orbicular, chartaceous, slightly discolor, pilose-pubescent to glabrescent on both sides; margin flat, ciliate; venation acrodromous, with 3 inconspicuous veins. Spikes 1–2 × 0.2 cm, terminal, solitary, erect; peduncle ca. 1 cm long, pilose-pubescent, 2–bracteate near the middle; peduncle bract ca. 1.5 mm long, spathulate, pilose-pubescent; rachis verruculose, foveolate, glabrous; floral bract rounded, subpeltate, glabrous. Fruits ca. 1 mm long, globose-ovoid, glabrous, densely arranged at the rachis, with basal pseudocupule above the middle; apex acute with apical stigma.

Material selected: Canaã dos Carajás, FLONA de Carajás, Serra Sul, S11C, 700 m, 21.V.2010, fl., *D.T. Souza et al. 1151* (BHCB). Parauapebas, Serra Norte, N3, 6°2'34"S, 50°13'11"W, 621 m, 22.VIII.2012, fl., *A.J. Arruda et al. 1265* (BHCB).

Material additional examined: BRAZIL. GOIÁS: Cavalcante, córrego a 1,5 km de Cavalcante na estrada para Colinas do Sul, próximo ao Morro da Cruz, 13°48'37"S, 47°27'19"W, 26.XI.2011, fr., *D.P. Saraiva et al. 298* (CEN, RB).

Peperomia circinnata, recently illustrated (Guimarães *et al.* 2007), is a delicate herb, easily recognized by the presence of pilose-pubescent trichomes, leaves opposite and orbicular, erect spikes with two peduncle bracts and globose-ovoid fruits with a basal pseudocupule. It occurs in Suriname (Yuncker 1957), Peru (Brako *et al.* 1993), Bolivia (Callejas *et al.* 2015), Argentina, Paraguay (Zuloaga *et al.* 2008) and Brazil, in almost all states (BFG 2015). It has been collected in the flora area in Serra Norte: N3 and Serra Sul: S11C, between 620 and 700 m altitude, growing in forest over *canga* substrate, flowering in May and August.

1.3. *Peperomia macrostachya* (Vahl) A. Dietr., Sp. pl. 1: 149. 1831.

Epiphytic herb; branches glabrous, rarely slightly hirtellous, sometimes escamose and with white-dentritic macules. Leaves alternate with petiole 0.5–1.2(–2) cm long, glabrous to slightly hirtellous, sometimes escamose and with white-dentritic macules; lamina 4–7(–10) × 2–2.7(–4.5) cm, elliptic, base obtuse to rounded, sometimes acute or cordate, apex acuminate, chartaceous to membranaceous, discolor, glandular on both sides, adaxial surface glabrous and commonly with white-dentritic macules, abaxial glabrous to villous, trichomes up to 1 mm long; margin flat, villous to glabrescent; venation eucamptodromous, with 3 pairs of inconspicuous secondary veins, arranged below the middle, not reaching the leaf apex. Spikes 10–20 × 0.3 cm, terminal, 2–4, reunited in panicle, pendulous; common peduncle 1–2.5 cm long, hirtellous to pubescent; peduncle of the spikes 0.8–2 cm long, hirtellous, pubescent or glabrous, bracteate, bract 5–10 mm long, lanceolate, glabrous; rachis smooth, foveolate, glabrous; floral bract rounded, peltate, fimbriate throughout the margin. Fruits 2.5 × 1 mm, cylindric, glabrous, densely arranged in the rachis; apex obliquely scutellate; stigma central, sessile.

Material selected: Canaã dos Carajás, Serra Sul, S11B, 700 m, 3.VIII.2010, fl. and fr., *L.V. C. Silva et al. 985* (BHCB, RB); Corpo C, 6°23'2"S, 50°23'43"W, 788 m, 28.VI.2010, fl., *T.E. Almeida et al. 2413* (BHCB); Corpo D, 6°23'27"S, 50°21'3"W, 700 m, 27.IX.2009, fl., *V.T. Giorni & F. Marino 283* (BHCB); estrada para Alemão, antes da entrada para Águas Claras, 6°8'44"S, 50°20'5"W, 26.VIII.2012, fl. and fr., *A.J. Arruda et al. 1276* (BHCB); Serra do Rabo-Leste [Bocaina], 6°18'53"S, 49°53'38"W, 715 m, 18.XII.2010, fr., *N.F.O. Mota et al. 1951* (BHCB). Parauapebas, Serra Norte, mina N5, 19.II.2008, fl., *L. Carreira et al. 2837* (MG, RB); N6, 6°7'52"S, 50°10'33"W, 3.IX.2015, fl., *A. Gil et al. 542* (MG); [Marabá] Serra Norte, estrada para o acampamento azul, 1.VI.1982, fl., *R. Secco et al. 401* (MG, NY, RB); Serra Norte, ca. 20 km N of AMZA exploration camp, 6°S, 50°15'W, 17.X.1977, fl., *C.C. Berg et al. BG 611* (MG, RB); área do rio Salobo, estrada para captação 3-Alfa-FLONA, 21.VII.1990, fl. and fr., *N.A. Rosa & P. Rodolfo 5313* (MG); estrada Mascarenhas, 26-X-1992, fl., *J. Sales & C. Rosário 65* (MG); Parque Zoobotânico, logo na entrada, próximo a loja, 23.II.2008, fr., *L. Carreira et al. 2892* (MG, RB); Serra dos Carajás, igarapé Baia, Projeto Alemão, área do POND, XI-2012, fl., *L.C.B. Lobato & L. Ferreira 4122* (MG); 2 km past camp CIMCOP on road south to rock quarry, 6°4'S, 50°13'W, 600–650 m, 28.V.1982, fl., *C.R. Sperling et al. 5849* (MG, NY).

Peperomia macrostachya, illustrated in Steyermark (1984), can be easily identified by its alternate and elliptic leaves, commonly with white-dentritic macules above and by long spikes with fimbriate floral bracts and cylindrical fruits, obliquely scutellate in the apex. It occurs in Mexico, Central America, the Guianas, Venezuela, Colombia, Ecuador (Steyermark & Callejas 2003), Bolivia (Callejas *et al.* 2015) and Peru (Brako *et al.* 1993). In Brazil, it has been recorded in all states of the North region, and also in Maranhão, Bahia, Mato Grosso, Espírito Santo, Rio de Janeiro, São Paulo and Paraná (Flora do Brasil 2020), where it seems to reach its Southern limit. In Carajás it was collected in the Serra Norte: N5, N6, and Serra Sul: S11B, S11C, S11D and Serra da Bocaina, between altitudes of 600 and 700 m, commonly associated

with "tracuá" ants (*Camponotus* sp.) as cited by J. Sales & C. Rosário 65 (MG). Found in transition forest, low forest over *canga* substrate, *terra firme* and anthropized forests.

1.4. *Peperomia magnoliifolia* (Jacq.) A. Dietr., Sp. pl. 1: 153. 1831.

Epiphytic or rupicolous herb, glabrous, with erect branches. Leaves alternate with petiole 1–4.5 cm long; lamina 7–12 × 3.5–5.5 cm, elliptic-obovate to elliptic-lanceolate, base decurrent, apex short-acute to obtuse or rounded, sometimes contracted, coriaceous, discolor, impressed-glandular on both sides, without white-dentritic macules adaxially; margin revolute; venation eucamptodromous, with 4–5 pairs of inconspicuous secondary veins. Spikes 10–22 × 0.2 cm, terminal or leaf-opposed, 1 to 2 or in panicle, erect; common peduncle 2–3.5 cm long; peduncle of the spikes 2.5–6.5 cm long; rachis smooth, foveolate, glabrous; floral bract rounded, peltate, glabrous. Fruits 1 × 0.5 mm, elliptic, glabrous, densely arranged in the rachis; apex with rostrum ca. 5 mm long, slightly curved; stigma at the base of the beak, sessile.

Material selected: Canaã dos Carajás, Serra Sul, S11C, 6°22'58"S, 50°24'0"W, 750 m, 20.III.2012, fl. and fr., *P.B. Meyer et al. 1128* (BHCB); Corpo D, 6°23'8"S, 50°23'5"W, 16.III.2009, fl. and fr., *V.T. Giorni et al. 174* (BHCB).

Peperomia magnoliifolia, recently illustrated (Melo *et al.* 2013), is a glabrous herb with elliptic-obovate to elliptic-lanceolate, coriaceous leaves that are quite variable in size and elliptic fruits, rostrate in the apex. With Neotropical distribution, it occurs from Mexico to the Antilles, Nicaragua (Callejas 2001), Guatemala, Honduras (Mathieu & Callejas 2006), Panama (Correa *et al.* 2004), the Guianas (Steyermark & Callejas 2003), Venezuela, Colombia (Steyermark 1984), Ecuador (Callejas & Burger 1999), Peru (Brako *et al.* 1993) and Bolivia (Callejas *et al.* 2015). In Brazil it occurs in Acre, Amazonas, Amapá, Pará, Rondônia, Maranhão, Pernambuco, Alagoas, Sergipe, Bahia, Goiás, Mato Grosso, Espírito Santo, Minas Gerais, Rio de Janeiro and Paraná (Flora do Brasil 2020), where it seems to reach its Southern limit. In the flora area it was collected in the Serra Sul: S11C, S11D, between altitudes of 300 and 750 m. Found in *campo rupestre* over *canga*, low and transition forests.

1.5. *Peperomia obtusifolia* (L.) A. Dietr., Sp. pl. 1: 154. 1831.

Epiphytic or rupicolous herb, glabrous, except by the peduncle. Leaves alternate with petiole 2–4 cm long; lamina 6–12 × 2.5–5.5 cm, obovate to elliptic-obovate, base decurrent, apex short-acute to obtuse or rounded, sometimes emarginate, coriaceous, discolor, impressed-glandular on both sides, without white-dentritic macules on adaxial surface; margin revolute; venation eucamptodromous, with 3–5 pairs of inconspicuous secondary veins. Spikes 10–17 × 0.2 cm, terminal or leaf-opposed, 1 to 2 or in panicles, erect; common peduncle 1–3 cm long, peduncle of the spikes ca. 3.5 cm long, both densely hirtellous to glabrescent; rachis smooth, foveolate, glabrous; floral bract rounded, peltate, glabrous. Fruits 1 × 0.5 mm, elliptic, glabrous, densely arranged in the rachis; apex with rostrum ca. 5 mm long; stigma at the base of the beak, sessile.

Material selected: Canaã dos Carajás, FLONA de Carajás, Serra dos Carajás, Serra Sul, S11C, 6°23'8"S, 50°23'30"W, 2.XII.2015, fl., *C.S.P. Dias et al. 10* (MG); S11D, beira da estrada, próximo a lagoa das macrofitas, 6°21'33"S, 50°23'25"W, 738 m, 2.XII.2015, fl., *A.S. Reis et al. 25* (MG). Parauapebas, Serra dos Carajás, platô N4, 15.IV.2010, fl. and fr., *L.C.B. Lobato et al. 3901* (MG); Igarapé Baia, projeto alemão, estrada do Pojuca, 27.XI.2013, fl. and fr., *L.C.B. Lobato et al. 4271* (MG).

Peperomia obtusifolia, recently illustrated (Melo *et al.* 2016), is morphologically similar and commonly confused with *P. magnoliifolia*, and was previously considered a synonymous of this species by Standley & Steyermark (1952). It differs mainly by its hirtellous peduncle (*vs*. entirely glabrous in *P. magnoliifolia*). However, the leaf size and the length of the fruit beak, also generally used to differentiate them, are variable. Widely distributed in the Neotropic, it is found in Mexico, Antilles (Steyermark 1984), Guatemala, Honduras (Standley & Steyermark 1952), Nicaragua (Callejas 2001), Costa Rica (Burger 1971), Panama (Correa *et al.* 2004), the Guianas (Callejas *et al.* 2007), Venezuela, Colombia (Trelease & Yuncker 1950), Ecuador (Callejas & Burger 1999), Peru (Brako *et al.* 1993) and Bolivia (Callejas *et al.* 2015). In Brazil it occurs in Amapá, Pará, Roraima, Ceará, Pernambuco, Alagoas, Sergipe, Bahia, Espírito Santo, Rio de Janeiro, Minas Gerais, São Paulo, Paraná, Santa Catarina and Rio Grande do Sul states (Flora do Brasil 2020), where it seems to reach its Southern limit. In the Serra dos Carajás it was recorded at the Serra Norte: N4 and Serra Sul: S11C, S11D, growing on low forest over *canga* substrate and transition forest, reaching an altitude of ca. 740 m.

1.6. *Peperomia pseudoserratirhachis* D. Monteiro, *sp. nov***.** Type: BRAZIL. PARÁ: Canaã dos Carajás, Serra Sul, Corpo D, 6°23'55"S, 50°16'39"W, 700 m, 17.III.2009, fl. and fr., *P.L. Viana et al. 4104* (holotype BHCB, isotype RB). Fig. 1g-l

Rupicolous or terrestrial, delicate, translucent herb with erect branches; leaves alternate, ovate-cordate, membranaceous, scattered white-long-pilose above, glabrous or short-pilose in the veins near the base beneath; petiole glabrous, forming a sheath over the nodes. Spikes 1–3, with elliptic, glabrous fruits, sparsely arranged in the glabrous rachis, sessile to pseudo-pedicellate, apically apiculate, with vestige of the sticky stratum, and apical stigma.

Rupicolous or terrestrial herb, delicate; branches erect, translucent, 10–20 cm tall, generally glabrous or rarely sparse short-pilose in the nodes over the sheath, trichomes less than 0.5 mm long, sometimes extending in line up to part of the branches. Leaves alternate with petiole 0.5–1(–1.5) cm long, glabrous, usually translucent-membranous in the margin, forming a sheath over the nodes; lamina 1–2.5 × 0.8–1.5 cm, ovate-cordate, base cordate to rounded, apex acuminate, membranaceous, translucent, discolor, adaxial surface moderate to sparsely white-long-pilose, trichomes 0.5–1 mm long, scattered throughout the blade, abaxial surface glabrous or moderate to sparsely short-pilose in the veins near the base, occasionally with trichomes in the veins near the margin; margin flat, glabrous; venation acrodromous-camptodromous, with 3–7 veins getting out the base and 1–2 additional veins near the middle of the midrib. Spikes 2–3.5 × 0.05 cm, terminal, axillary or leaf-opposed, 1–3, erect; peduncle 0.5–1 cm long., glabrous; rachis smooth, glabrous; floral bract rounded, peltate, glandular, glabrous. Fruits ca. 1 × 0.5 mm, elliptic, glabrous, smooth, sparsely arranged in the rachis, sessile to pseudo-pedicellate, without basal pseudocupule; apex apiculate, usually with vestige of the sticky stratum, even when dry, and apical stigma.

Material selected (paratypes): Parauapebas, N4, 6°6'49"S, 50°11'4"W, 687 m, 20.IV.2012, fl. and fr., *A.J. Arruda et al. 965* (BHCB, K); N7, 6°9'28"S, 50°10'13"W, 23.III.2012, fl. and fr., *A.J. Arruda et al. 811* (BHCB); N8, 6°11'2"S, 50°7'47"W, 701 m, 23.III.2012, fl., *A.J. Arruda et al. 784* (BHCB).

Peperomia pseudoserratirhachis is a translucent, delicate herb, recognized by its erect, generally glabrous branches, petiole glabrous, forming a sheath over the nodes, alternate leaves, ovate-cordate, scattered white-long-pilose on adaxial surface, glabrous or pilose in the veins near the base on abaxial surface, erect spikes with fruits elliptic, glabrous, sparsely arranged in the rachis, usually with vestige of the sticky stratum in the apex, sessile to pseudo-pedicellate. Among the other taxa found in the region of Carajás, this species resembles *P. albopilosa*, differing from it mainly by its pilose fruits. The new species also resembles another endemic taxon from Brazil - *P. serratirhachis* Yunck. (holotype: Kuhlmann 1953, R!), differing mainly by the flattened rachis with floral bracts on tooth-like projections of the rachis and verrucose fruits. The species described here also bears similarities with *P. pellucida* (L.) Kunth, *P. pellucidoides* Yunck. and *P. tenuilimba* C.DC., differing by absence of trichomes and longitudinally striate fruits of these taxa. The leaves of the last two species are also larger. *P. pseudoserratirhachis* also differs from *P. huberi* C.DC. and *P. congero* Trel. & Yunck. because they are completely glabrous.

Peperomia pseudoserratirhachis should be considered Endangered (EN B1ab[i, ii, iii]) (IUCN 2017) since it is recorded only for the *canga* of the Serra dos Carajás, a severely fragmented area, with intense mining activities. The species is known only from four collections in the Serra dos Carajás, three in Serra Norte: N4, N7, N8 and one in Serra Sul: S11D, between altitudes of 645 and 700 m. Found in low forest over *canga* substrate, flowering and fruiting between March and May. The specific epithet refers to its morphological similarity with *P. serratirhachis*.

1.7. *Peperomia uaupesensis* Yunck., Bol. Inst. Bot. (São Paulo) 3: 194, fig. 171. 1966.

Epiphytic or rupicolous herb, glabrous, except by the peduncle. Leaves alternate with petiole 2–5 cm long; lamina (10–)13–16 × 5–7(–8.5) cm, elliptic-lanceolate to lanceolate, rarely elliptic-obovate, base decurrent, apex short-acute to obtuse or rounded, coriaceous, discolor, impressed-glandular on both sides, without white-dentritic macules on the adaxial surface; margin revolute; venation eucamptodromous, with 4–5 pairs of inconspicuous secondary veins. Spikes 10–20 × 0.2 cm, 1 to 2 or in panicle, terminal or leaf-opposed, erect; common peduncle 2–4 cm long, peduncle of the spikes (2.5–)3.5–4.5 cm long, both hirtellous to glabrescent; rachis smooth, foveolate, glabrous; floral bract rounded, peltate, glabrous. Fruits 1 × 0.5 mm, elliptic, glabrous, densely arranged in the rachis; apex with rostrum ca. 5 mm long, slightly curved; stigma at the base of the beak, sessile.

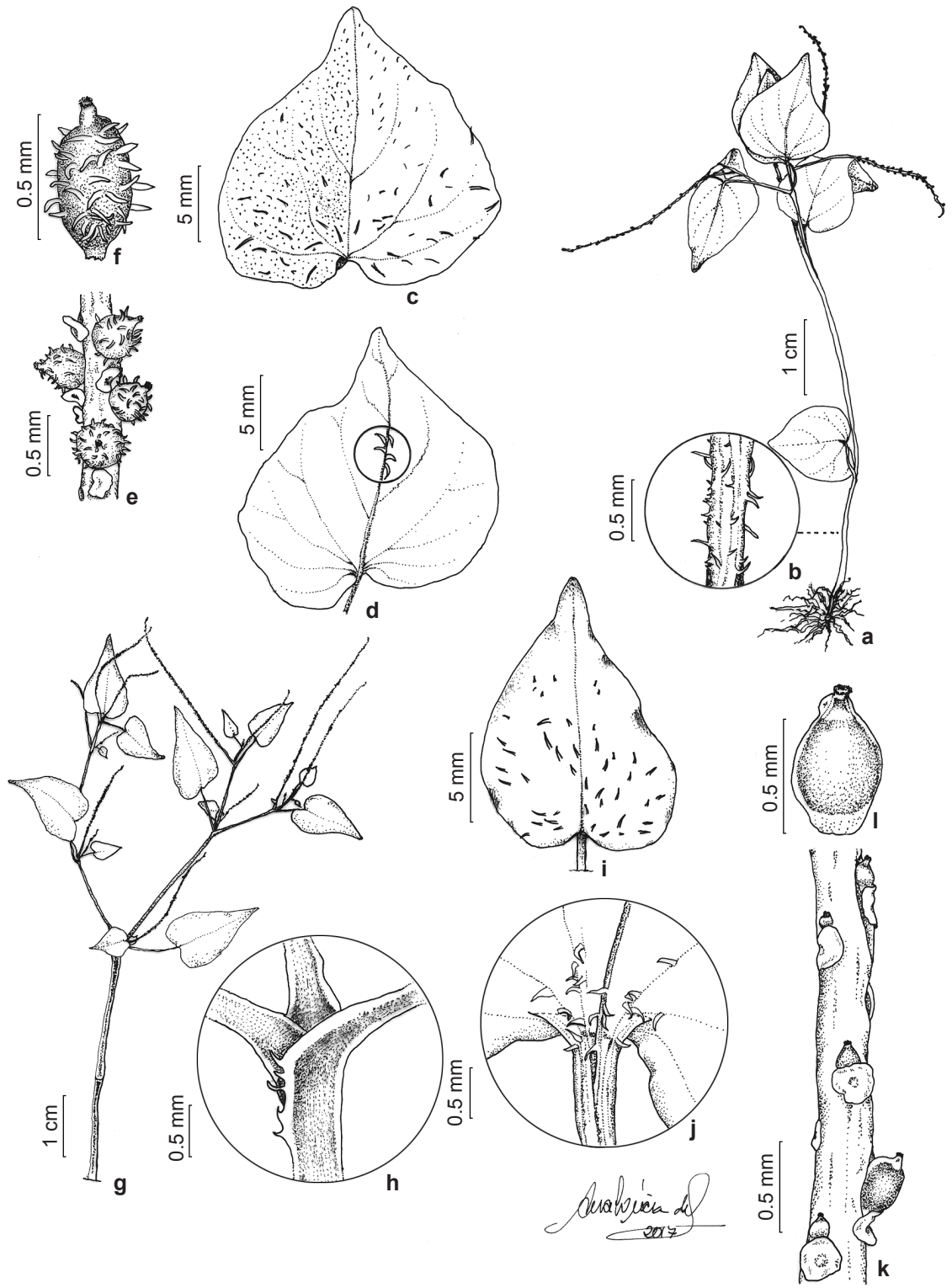

Figure 1 – a-f. *Peperomia albopilosa* – a. habit; b. trichomes of the branch; c. trichomes of adaxial surface of the lamina; d. trichomes of abaxial surface of the lamina; e. detail of the spike; f. fruit. g-l. *Peperomia pseudoserratirhachis* – g. habit; h. detail of the branch; i. trichomes of adaxial surface of the lamina; j. trichomes of abaxial surface of the lamina; k. detail of the spike; l. fruit (a-e. *Giacomin et al. 1174*; f. *Viana et al. 6169*; g-l. *Viana et al. 4104*).

Material selected: Serra dos Carajás, Serra Norte, ca. 20 km SE of AMZA exploration camp, 6°S, 50°15'W, 400 m, 11.X.1977, fl., *C.C. Berg & A.J. Henderson BG 452* (MG, RB); Serra Norte, near water fall, near AMZA exploration camp, 6°S, 50°15'W, 14.X.1977, fl., *C.C. Berg & A.J. Henderson BG 531* (INPA, MG, MO, RB). Canaã dos Carajás, Serra Sul, Corpo A, canga adjacente ao capão de mata, 6°22'34"S, 50°23'6"W, 721 m, 13.II.2010, fl., *F.D. Gontijo et al. 32* (BHCB); Serra Sul, S11D, 6°23'56"S, 50°21'52"W, 650–750 m, 4.X.2009, fl., *P.L. Viana et al. 4393* (BHCB); Racha placa, ADA Usina S11, próximo a drenagem, 6°24'33"S, 50°14'50"W, 275 m, 28.I.2012, fl., *L.F.A. de Paula et al. 472* (BHCB). Parauapebas, Serra Norte, Platô N1, 6°18'S, 50°16'W, 29.XI.2013, fl. and fr., *R.S. Santos et al. 131* (MG); [Marabá], Serra dos Carajás, N4, mina piloto para exploração de ferro, local onde foi realizado inventário em V.1983, 700–750 m, 14.III.1984, fl. and fr., *A.S.L. da Silva et al. 1771* (MG, NY).

Peperomia uaupesensis resembles *P. magnoliifolia* and *P. obtusifolia*, differing from both especially by the more elongated leaves. More studies are needed to better attest the morphological identity of these taxa. It occurs in Colombia, Peru (Steyermark & Callejas 2003), Venezuela (Callejas *et al.* 2007) and Brazil, in Acre, Amapá, Amazonas and Pará states (Flora do Brasil 2020). In the flora area it was collected in Serra Norte: N1, N4 and Serra Sul: S11A, S11D, between altitudes of 275 and 750 m, growing on *campo rupestre* over *canga* and forest patches.

2. *Piper* L.

Piper consists of small trees, erect or scandent shrubs, climbers or more rarely herbs. They are frequently aromatic, the stems presents swollen nodes, persistent or deciduous prophyll and can be glabrous or bear variable indumentum and glands. The leaves are always alternate and vary considerably in shape, size, consistency and venation, sometimes with unequal base. The leaf-opposed inflorescences can be in racemes, spikes or umbels of spikes, erect, curved or pendulous, varying in length and thickness. The flowers are generally bisexual, composed of (1–)2–4(–10) stamens and 3–4 fused carpel, subtended by a floral bract, which shows a wide range of shapes. The fruits are variable in shape and emerge or sunken in depressions of the rachis (Bornstein & Coe 2007).

This is a very large, monophyletic, pantropical genus, comprising approx. 2,000 species, many of which are endemic or with restricted distribution, growing more abundantly in moist conditions from sea level to 2,500 m of altitude (Quijano-Abril *et al.* 2006; Jaramillo *et al.* 2008). Its highest diversity is in the Neotropical region where the Andean slopes, Central American lowlands and Central Amazonia are considered centers of species richness (Quijano-Abril *et al.* 2006). The last phylogenetic analysis for the genus provided support for ten clades, divided in three major groups that represent large geographical regions - Neotropics, Tropical Asia and South Pacific (Jaramillo *et al.* 2008). In Brazil, *Piper* is the fifth largest genus, with approximately 300 species (BFG 2015), distributed across all phytogeographical domains, in different types of vegetation. Of this total ca. 185 are recorded for the northern region, of which 104 occur in Pará state (Flora do Brasil 2020).

At the Serra dos Carajás, 23 *Piper* species were recorded, of which 10 (*P. anonifolium* Kunth, *P. belterraense* Yunck., *P. callosum* Ruiz &Pav., *P. crassinervium* Kunth, *P. cyrtopodon* C.DC., *P. goeldii* C.DC., *P. hispidum* Sw., *P. hostmannianum* (Miq.) C.DC., *P. marginatum* Jacq. and *P. reticulatum* L.) were collected only in forest patches and the remaining 13 species were also found on *canga* substrate. *Piper carniconnectivum* C.DC., *P. hoffmannseggianum* Schult. and *P. krukoffii* Yunck. occur only in Brazil as well as *P. belterraense* and *P. goeldii*, that deserve to be considered for the red list of endangered species. Other species that should have their conservation status better evaluated are *P. cyrtopodon*, *P. kegelianum* (Miq.) C.DC., *P. nematanthera* C.DC. and *P. pellitum* C.DC. due to their sparse occurrence in Brazil. The fruit of *P. pellitum* is described for the first time and the first record of *P. goeldii* for the state of Pará is presented here.

Key to species of *Piper* from the *canga* of the Serra dos Carajás

1. Leaves with acrodromous or campylodromous venation
   2. Branches glabrous; leaves with petiole more than 1.5 cm long, cordate at base and campylodromous venation; spikes more than 5 cm long, with glabrous rachis; fruits glabrous, with 3 stigmas, without a dilated base ..... 2.19. *Piper marginatum*
   2'. Branches papillose-hirtellous to glabrescent; leaves with petiole up to 1.5 cm long, rounded at base and acrodromous venation; spikes up to 5 cm long, with pilose rachis; fruits papillose with 3–4 stigmas, on a dilated base ..... 2.23. *Piper reticulatum*

1’. Leaves with camptodromous or brochidodromous venation
3. Leaf blade with secondary veins arranged near or up to the leaf apex
4. Leaf base symmetric or slightly asymmetric
5. Branches and leaf blade glabrous on both sides
6. Leaf blade up to 12 cm long; petiole with keel of pilose trichomes in the dorsal region; spikes less than 4.5 cm long, apiculate ..... 2.4. *Piper anonifolium*
6’. Leaf blade more than 12 cm long; petiole without keel of pilose trichomes in the dorsal region; spikes 4.5 cm long or more, not apiculate
7. Leaf blade commonly with two small callus at base, submarginally hirtellous to pilose on abaxial surface; rachis pilose; floral bract saccate-galeate; fruits oblong and 4–angled, papillate or smooth ..... 2.15. *Piper hoffmannseggianum*
7’. Leaf blade without callus at base, submarginally glabrous on abaxial surface; rachis glabrous; floral bract triangular; fruits obpyramidal, glabrous .... 2.2. *Piper aequale*
5’. Branches with trichomes; leaf blade with trichomes beneath
8. Branches and veins on abaxial surface pubescent to glabrescent; leaf blade elliptic; fruits globose-obovoid, glabrous ..... 2.8. *Piper carniconnectivum*
8’. Branches and veins on abaxial surface hirsute; leaf blade lanceolate; fruits oblong pilose-pubescent ..... 2.17. *Piper kegelianum*
4’. Leaf base asymmetric, sometimes forming lobes
9. Scandent shrub; spikes unisexual ..... 2.20. *Piper nematanthera*
9’. Erect shrub; spikes bisexual
10. Spikes erects, less than 20 cm long
11. Branches and veins villous beneath, trichomes ca. 2 mm long; fruits globose with apex acute-apiculate and with style and stigma ..... 2.10. *Piper cyrtopodon*
11’. Branches and veins glabrous, hirtellous or pilose-pubescent beneath, trichomes up to 0.5 mm long, sometimes up to 1 mm long; fruits oblong with apex truncate and sessile stigma
12. Branches glabrous or hirtellous with erect trichomes; leaf blade obtuse to rounded at base; spikes more than 3.5 cm long; fruits glabrous .... 2.5. *Piper arboreum*
12’. Branches pilose-pubescent with erect or retrorse trichomes; leaf blade cordate-auriculate at base; spikes up to 3.5 cm long; fruits pilose-puberulent ..... 2.11. *Piper demeraranum*
10’. Spikes pendulous, more than 20 cm long
13. Branches, petiole and peduncle moderate to densely tomentose-villous .... 2.18. *Piper krukoffii*
13’. Branches, petiole and peduncle sparsely tomentose-villous to glabrescent ... . 2.21. *Piper obliquum*
3’. Leaf blade with secondary veins arranged up to the middle or just above, not reaching the leaf apex (rarely in *P. callosum*)
14. Leaf blade obvious or slightly rough to the touch in one or both sides
15. Branches and leaves villous; spikes up to 3 cm long; fruits with apex acute-apiculate and stylus stigma ..... 2.22. *Piper pellitum*
15’. Branches and leaves with other kind of trichomes; spikes more than 3 cm long; fruits with truncate or convex apex and sessile stigma
16. Spikes curve; fruits glabrous ..... 2.1. *Piper aduncum*
16’. Spikes erect or curve; fruits with trichomes
17. Branches hispid-scabrous; leaf blade elliptic; fruits oblong .... 2.14. *Piper hispidum*
17’. Branches pubescent or subvillous to glabrescent; leaf blade elliptic to rhombic-elliptic; fruits obpyramidal ..... 2.12. *Piper dilatatum*

14’. Leaf blade smooth to the touch on both sides
18. Leaf blade ovate-elliptic; fruits with style and stigma
19. Branches glabrous; leaf blade up to 13 cm long with two small callus at base, glabrous on both sides; floral bract glabrous, diminute mainly in fruiting .... 2.7. *Piper callosum*
19’. Branches hirtellous to glabrescent; leaf blade more than 13 cm long, without callus at base, hirtellous on abaxial surface; floral bract fringed throughout the margin, conspicuous in fruiting ..... 2.9. *Piper crassinervium*
18’. Leaf blade elliptic, lanceolate, elliptic-lanceolate, ovate-elliptic; fruits with sessile stigma
20. Branches hirsute with erect trichomes ..... 2.17. *Piper kegelianum*
20’. Branches pubescent, glabrescent or villous, with trichomes erect, retrorse or recurved
21. Leaf blade acute to obtuse at base; floral bract more conspicuously or coarsely fringed in the lower margin
22. Branches pubescents, trichomes up to 0.5 mm long .... 2.3. *Piper aleyreanum*
22’. Branches villous, trichomes 0.5–1 mm long .... 2.6. *Piper belterraense*
21’. Leaf blade obtuse, rounded or rounded-cordate at base; floral bract equally fringed throughout the margin
23. Scandent shrub; leaf blade rounded-cordate at base, translucent, opaque and with trichomes on both sides; spikes less than 5 cm long; fruits globose-ellipsoidal, glabrous ..... 2.13. *Piper goeldii*
23’. Erect shrub; leaf blade obtuse to rounded at base, chartaceous, glossy and glabrous on adaxial surface, abaxial pubescent; spikes 5 cm long or more; fruits oblong or 3–4 angled papilose to glabrescent .... 2.16. *Piper hostmannianum*

2.1. *Piper aduncum* L., Sp. pl. 1: 29. 1753.

Erect shrub, 1.5–6 m tall; branches moderately puberulous to glabrescent, trichomes up to 0.5 mm long. Leaves with petiole 3–10 mm long, pubescent, canaliculate with short basal sheath; lamina 11–21 × 3–8 cm, elliptic, base asymmetric, one side 2–4 mm shorter than the other, obtuse to rounded on both sides or rare acute on smaller side, apex acuminate, discolor, chartaceous, adaxial surface scabrous and pubescent along the veins, abaxial sub-appressed pubescent, glandular and obviously rough to the touch on both sides, more in the adaxial surface; margin flat, ciliate; venation eucamptodromous, with 4–6 pairs of secondary veins arranged up to just above the middle, not reaching the leaf apex. Spikes 4–7 × ca. 0.2 cm, curved, sometimes apiculate; peduncle 7–12 mm long, puberulous to glabrescent; rachis glabrous; floral bract rounded to triangular, subpeltate, densely fringed throughout the margin. Fruits ca. 0.9 mm long, obovoid, glabrous, convex at apex, more or less trigonous; stigmas 3, sessile.
Material selected: Parauapebas, FLONA de Carajás, Serra Norte, mina N5, 19.II.2008, st., *L. Carreira et al. 2838* (MG, RB); núcleo urbano, área onde estão instaladas as oficinas mecânicas, 19.II.2008, fl. and fr., *L. Carreira et al. 2848* (MG, RB); km 8 da estrada que vai da Serra Sul a Serra Norte, 21.II.2008, fl., *L. Carreira et al. 2866* (MG, R); AMZA camp Azul, an abandoned manganese exploration camp, 6°6’S, 50°17’W, 500–550 m, 31.V.1982, fl., *C.R. Sperling et al. 5882* (MG); [Marabá], Estrada da pedreira, até km 13, 30.I.1985, fl. and fr., *O.C. Nascimento & R.P. Bahia 1065* (MG).

Piper aduncum, illustrated in Tebbs (1993), can be distinguished by puberulous to glabrescent branches, elliptic leaves with asymmetric base and secondary veins reaching up to the middle of the leaf. The lamina is obviously rough to the touch on both sides and the spikes are curved with obovoid and glabrous fruits. With Neotropical distribution, this species extends from Mexico to Brazil (Tebbs 1993), where it is recorded from Acre to Rio Grande do Sul (BFG 2015), reaching Argentina and Paraguay (Zuloaga *et al.* 2008). At the Serra dos Carajás the species was recorded in Serra Norte: N5, at an altitude of ca. 500 m. Found in wet palm forest, transition area and forest over *canga* substrate.

2.2. *Piper aequale* Vahl, Eclog. amer. 1: 4, tab. 3. 1797.

Erect shrub, 1–6 m tall, entirely glabrous. Leaves with petiole 1–1.5(–2) cm long, canaliculate; lamina 13–21.5 × 7.5–10.5 cm, elliptic, base symmetrically acute to obtuse, without callus, apex acuminate, concolor, chartaceous; margin flat; venation eucamptodromous, with 4–5 pairs of secondary veins reaching near the leaf apex. Spikes 4.5–7.5 × 0.25 cm, erect, not apiculate; peduncle ca. 0.8 cm long; rachis glabrous; floral bract triangular, subpeltate, submarginal fringed to glabrescent, with pilose pedicel. Fruits 1–1.5 mm long, obpyramidal, glabrous, convex at apex, trigonous; stigmas 3, sessile.
Material selected: Canaã dos Carajás, FLONA de Carajás, Serra Sul, Corpo A, S11A, 6°19'43"S, 50°27'68"W, 741 m, 14.II.2010, fr., *F.D. Gontijo et al. 54* (BHCB, RB). Parauapebas [Marabá], Serra Norte, N1, beira do igarapé azul, 16.III.1985, fr., *R.S. Secco et al. 468* (MG, RB); mina N5, 19.II.2008, fl. and fr., *L. Carreira et al. 2841* (MG, RB); projeto Bahia até a portaria principal, distante da sede 52 km, 22.II.2008, fr., *L. Carreira et al. 2883* (MG, RB); Rodovia Raimundo Mascarenhas, encosta da Serra Norte, 23.II.2008, fl., *L. Carreira et al. 2900* (MG, RB); "Azul", near camp at Serra Norte, 22km NW then 10–15 km SW, 5°59'S, 50°28'W, 8.XII.1981, fr., *D.C. Daly et al. 1860* (MG, NY).

Piper aequale, illustrated in Steyermark (1984) and Tebbs (1990), is an entirely glabrous shrub, easily recognized by the broadly elliptic leaves with 4–5 pairs of secondary veins reaching nearly the leaf apex and by the erect spikes with obpyramidal fruits. It occurs in Mexico, Antilles, Guatemala, Belize, Honduras, Nicaragua, Costa Rica, Panama, the Guianas, Venezuela, Colombia (Tebbs 1990), Bolivia (Callejas *et al*. 2015), Ecuador (Callejas & Burger 1999) and Peru (Brako *et al.* 1993). In Brazil it occurs in the states of Acre, Amazonas, Pará, Goiás, Distrito Federal, Bahia, Minas Gerais, Rio de Janeiro, São Paulo and Paraná (Flora do Brasil 2020), where it seems to reach its Southern limit. In Carajás it was collected in the Serra Norte: N1, N5 and Serra Sul: S11A, growing on forest, over and in transition with *canga* substrate, between 600 and 740 m altitude.

2.3. *Piper aleyreanum* C.DC., Notizbl. Bot. Gart. Berlin-Dahlem 6: 448. 1917. Fig. 2a–d

Erect shrub, 0.5–5 m tall; branches moderate to densely pubescent, trichomes up to 0.5 mm long, retrorse. Leaves with petiole 0.5–1 cm long, pilose, canaliculate with short basal sheath; lamina 9.5–17(–20) × 3.5–6.5 cm, elliptic to lanceolate, base asymmetric, one side ca. 0.3 mm shorter than the other, acute on both sides or the longer obtuse, rarely both obtuse, apex acuminate, discolor, chartaceous, adaxial surface glabrous or rarely with trichomes in the midrib near the base, abaxial surface pilose-pubescent, mainly along the veins, with appressed to suberect trichomes, smooth to the touch on both sides; margin flat, glabrous; venation eucamptodromous, with 3–5 pairs of secondary veins arranged up to the middle, not reaching the leaf apex. Spikes 3–7 × 0.3 cm, apiculate, erect; peduncle ca. 1 cm long, pilose; rachis pilose; floral bract triangular to rounded, subpeltate, fringed throughout the margin, sometimes with longer and more conspicuous trichomes in the lower margin. Fruits 1.5–2 mm long, obpyramidal, glabrescent, truncate at apex, trigonous; stigmas 3, sessile.
Material selected: Canaã dos Carajás, Serra Sul, Corpo A, 6°19'43"S, 50°27'17"W, 741 m, 14.II.2010, fr., *F.D. Gontijo 46* (BHCB); Corpo B, 6°21'23"S, 50°23'22"W, 700 m, 19.III.2009, fl., *P.L. Viana et al. 4167* (BHCB). Parauapebas, mina de cobre 4 Alfa, FLONA, 19.VII.1990, fl., *N.A. Rosa et al. 5297a* (MG); Serra Norte, N5, 19.II.2008, fr., *L. Carreira et al. 2846* (MG, RB); Serra Norte, ca 15 km W of AMZA Exploration Camp, 6°S, 50°15'W, 12.10.1977, fl., *C.C. Berg & A.J. Henderson BG 477* (MG, NY, RB); km 10 da estrada que vai da Serra Sul a Serra Norte, 21.II. 2008, fr., *L. Carreira et al. 2869* (MG, RB); km 47 da estrada que vai da portaria do projeto Bahia à sede/GABAM, ramal do igarapé Bahia, 22.II.2008, fr., *L. Carreira et al. 2891* (MG, RB); Igarapé Baia, projeto Alemão, Estrada do Pojuca, 18.IX.2013, fr., *L.C.B. Lobato & L. Ferreira 4235* (MG); "Azul", near camp at Serra Norte, 22km NW, then 10–15 km SW, 5°59'S, 50°28'W, 8.XII.1981, fr., *D.C. Daly et al. 1868* (INPA, MG, MO, NY).

Piper aleyreanum is characterized by branches retrorsely pubescent, elliptic to lanceolate leaves with abaxial surface pilose-pubescent and secondary veins arranged up to the middle of the lamina, and by its obpyramidal fruits. It occurs in Colombia (Lleras & Cruz 2005), Peru (Brako *et al.* 1993), Bolivia (Callejas *et al.* 2015) and Brazil, in Acre, Amazonas, Amapá, Pará, Rondônia, Roraima and Mato Grosso states (Flora do Brasil 2020). At the Serra dos Carajás it was collected at the Serra Norte: N5 and Serra Sul: S11A, S11B, between altitudes of 570 m and 740 m. Found in forest over *canga* substrate, slopes of transition forest and disturbed area.

2.4. *Piper anonifolium* Kunth, Linnaea 13: 619. 1839.

Erect shrub, 1–2 m tall; branches glabrous. Leaves with petiole 5–10 mm long, canaliculate with a keel of pilose trichomes in the dorsal region, sometimes extending to the part of the branch, trichomes up to 0.5 mm long; lamina 9–12 ×

3.5–4 cm, lanceolate, base symmetric, decurrent, apex acuminate, concolor, chartaceous, glabrous on both sides; margin flat to narrowly revolute, glabrous; venation brochidodromous, with 8–10 pairs of secondary veins reaching the leaf apex. Spikes ca. 1.5 × 0.4 cm, apiculate, erect; peduncle ca. 3 mm long, glabrous; rachis glabrous; floral bract triangular slightly winged to lunate-cucullate, subpeltate, glabrous. Fruits ca. 1.5 mm long, oblong to tetragonous, glabrous, concave and rough at apex; stigmas 3, sessile.

Material selected: Canaã dos Carajás, Racha Placa, 6°27'31"S, 50°19'28"W, 310 m, 7.XII.2012, fr., *M.O. Pivari et al. 1653* (BHCB, MG). Parauapebas, Serra Norte, ca. 15 km W of AMZA exploration camp, 6°S, 50°15'W, 12.X.1977, fl., *C.C. Berg & A.J. Henderson BG 476* (MG, NY, RB); área do rio Salobo, estrada para captação 3-ALFA-FLONA, 21.VII.1990, fl., *N.A. Rosa & P. Rodolfo 5314* (MG); FLONA de Carajás, Rodovia Raimundo Mascarenhas - vai de Parauapebas ao núcleo urbano km 2, margem da estrada, 24.II.2008, fl., *L. Carreira et al. 2903* (MG, RB).

Piper anonifolium, illustrated in Steyermark (1984) and Steyermark & Callejas (2003), is a glabrous shrub, except by the pilose keel-like petiole, easily recognized by its lanceolate leaves with secondary veins arranged up to the leaf apex and by the short and apiculate spikes. It occurs in the Guianas, Venezuela (Steyermark & Callejas 2003), Bolivia (Callejas *et al.* 2015) and Brazil, where it is likely to have a disjunct distribution, occurring in Amazon and Atlantic forests, in the states of Acre, Amazonas, Amapá, Pará, Rondônia, Roraima, Mato Grosso, Maranhão, Bahia, Minas Gerais, Espírito Santo, Rio de Janeiro and São Paulo (Flora do Brasil 2020), where it seems to reach its Southern limit. In the flora area it was recorded in the Serra Norte, at an altitude of 310 m, growing on slopes of transition forest and disturbed area.

2.5. *Piper arboreum* Aubl., Hist. pl. Guiane 1: 23. 1775.

Erect shrub, 1–3 m tall. Leaves with petiole 1.5–2.5 cm long, canaliculate with winged sheath throughout, extending over the base of the leaf blade; lamina (10–)15–26 × 5–8(–11) cm, broad-lanceolate, elliptic, base asymmetric, obtuse to rounded on both sides, sometimes cordate, rare acute, one side 1–2 cm shorter than the other, apex acute to acuminate, discolor, chartaceous; margin flat to narrowly revolute; venation brochidodromous, with 8–10 pairs of secondary veins arranged up to the leaf apex. Spikes 7–11 × 0.2–0.4 cm, erect, bisexual; peduncle 3–8 mm long; rachis glabrous; floral bract triangular, subpeltate, densely fringed throughout the margin. Fruits ca. 1 mm long, oblong, truncate at apex, glabrous; stigmas 3, sessile.

Key to varieties of *Piper arboreum* from the *canga* of the Serra dos Carajás

1. Young branches, petiole, peduncle and veins of abaxial surface glabrous .... 2.5.1. *Piper arboreum* var. *arboreum*
1'. Young branches, petiole, peduncle and veins of abaxial surface hirtellous .... 2.5.2. *Piper arboreum* var. *hirtellum*

2.5.1. *Piper arboreum* Aubl. var. ***arboreum***

Branches, petiole, peduncle and veins of the both sides of the leaves glabrous.

Material selected: Canaã dos Carajás, Serra Sul, Corpo B, 6°21'21"S, 50°23'23"W, 820 m, 4.VIII.2010, fl. and fr., *M.O. Pivari et al. 1639* (BHCB); S11D, 6°23'58"S, 50°17'60"W, 621 m, 29.VIII.2010, fr., *T.E. Almeida et al. 2493* (BHCB, RB). Parauapebas [Marabá], Serra Norte, Carajás, N1, beira do Igarapé Azul, 16.III.1985, fl., *R.S. Secco et al. 467* (MG, RB); [Marabá], Serra Norte, arredores da barragem, 35 km do acampamento, 2.VIII.1982, fl. and fr., *U.N. Maciel et al. 722* (MG, NY); Serra dos Carajás, Salobo, 3-ALFA, jazida de cobre, FLONA, 12.XI.1980, fl., *N.A. Rosa & M.F.F. Silva 5288* (MG); Igarapé Baia, projeto Alemão, estrada do Pojuca, 23.VI.2013, fl., *L.C.B. Lobato & L. Ferreira 4189* (MG); 8,5 km west of AMZA camp, N1 on the road to rio Itacaiúnas, 5°59'S, 50°20'W, 21.V.1982, fl., *C.R. Sperling et al. 5778* (MG, NY); AMZA camp 3-ALFA, ca. 6km on the road of northwest of 3-ALFA to camp 4-ALFA, 5°47'S, 50°34'W, 250 m, 9.VI.1982, fl., *C.R. Sperling et al. 6007* (MG, NY).

2.5.2. *Piper arboreum* var. ***hirtellum*** Yunck., Ann. Missouri Bot. Gard. 37(1): 64. 1950.

Differs from the typical variety by the presence of hirtellous trichomes on the young branches, petiole, peduncle and leaf veins beneath.

Material examined: Canaã dos Carajás, Racha placa, ADA Usina S11, 6°27'1"S, 50°12'11"W, 28.I.2012, fl., *A.J. Arruda et al. 515* (BHCB); Serra Sul, S11D, 6°27'38"S, 50°19'41"W, 9.XII.2012, fl., *M.O. Pivari et al. 1672* (BHCB).

Piper arboreum is easily recognized by broad-lanceolate to elliptic leaves, asymmetric at the base, with winged sheath throughout the petiole, extending over the base of the lamina, erect spikes with triangular, densely fringed floral bract and by oblong and glabrous fruits, as illustrated by several authors (Steyermark 1984; Tebbs 1989; Guimarães & Monteiro 2006). The hirtellous trichomes differs *P. arboreum* var. *hirtellum* from the typical variety. Both have Neotropical distribution, with records for Mexico, Cuba, Jamaica, Trinidad, Porto Rico, Guatemala, Belize, Honduras, Nicaragua, Costa Rica, Panama (Tebbs 1989), the Guianas (Görts-van Rijn 1997), Venezuela, Colombia, Ecuador (Steyermark 1984), Peru (Brako *et al.* 1993), Bolivia (Callejas *et al.* 2015), Paraguay (Zuloaga *et al.* 2008) and Brazil, where it is found in almost all states (BFG 2015). In the Serra dos Carajás *P. arboreum* var. *arboreum* was recorded in the Serra Norte: N1 and Serra Sul: S11B, S11D, growing on transition forest, low moist forests over *canga* substrate and disturbed area, at altitudes between 250 and 820 m. *Piper arboreum* var. *hirtellum* was found only in the Serra Sul: S11D, in forest over *canga* substrate and anthropized area.

2.6. *Piper belterraense* Yunck., Bol. Inst. Bot. (São Paulo) 3: 30, fig. 24. 1966. Fig. 2e-f

Erect shrub, ca. 1–5 m tall; branches dense to sparsely villous, trichomes 0.5–1 mm long, erect or retrorse. Leaves with petiole 4–7 mm long, dense to sparsely villous, canaliculate with short basal sheath; lamina 11–15 × 4–6 cm, elliptic to elliptic-lanceolate, base asymmetric, one side ca. 0.2 mm shorter than the other, acute to obtuse on both sides, apex acuminate, discolor, chartaceous, adaxial surface glabrous, abaxial pilose, mainly along the veins, with appressed to suberect trichomes, smooth to the touch on both sides; margin flat, glabrous; venation eucamptodromous, with 3–4 pairs of secondary veins arranged up to the middle, not reaching the leaf apex.

Material examined: Serra dos Carajás, 7 km west of camp ECB on the ferrovia, ca. 52 km west of road BR 150, 5°35'S, 49°15'W, 150 m, 26.VI.1982, fl., *C.R. Sperling et al. 6356* (MG, NY).

Piper belterraense is a very rare shrub, that deserves to be considered for the red list of endangered species. Occurring only in Brazil, in the states of Acre, Amapá and Pará (Flora do Brasil 2020). It is morphologically similar and commonly confused with *P. aleyreanum*, differing mainly by its villous branches. According to Yuncker (1972) the floral bracts coarsely fringed in the lower angle and the oblong-obovoid fruits that are truncate at apex and moderately hispidulous also help in the recognition of this species. In the Serra dos Carajás it was collected only in the 1980s, at an altitude of 150 m, growing in forest with occasional rock outcrops.

2.7. *Piper callosum* Ruiz & Pav., Fl. peruv. 1: 34, pl. 53, fig. a. 1798. Fig. 2g-i

Erect shrub, ca. 1 m tall, entirely glabrous. Leaves with petiole 0.5–1 cm long, canaliculate with short basal sheath; lamina 9–13 × 4–5.5 cm, ovate-elliptic, base acute to obtuse, slightly asymmetric, one side ca. 1.5 mm shorter than the other, with two small callus, apex acuminate, discolor, chartaceous, smooth to the touch on both sides; margin revolute, glabrous; venation eucamptodromous, with 4–6 pairs of secondary veins arranged above the middle, rarely reaching the leaf apex. Spikes 2.3–2.8 × 0.4 cm, erect; peduncle 0.5–1 cm long, rachis glabrous; floral bract rounded-triangular and fleshy to inflexed, subpeltate, glabrous, diminute mainly in fruiting. Fruits ca. 2 mm long, ovate, glabrous, acute-apiculate at apex; stigmas 3, on a short style, 0.5–1 mm long.

Material examined: Canaã dos Carajás, Racha Placa, ADA, Usina S11, 6°25'54"S, 50°14'1"W, 275 m, 28.I.2012, fr., *L.F.A. de Paula et al. 495* (BHCB, MG).

Piper callosum is a totally glabrous shrub, easily recognized by its ovate-elliptic leaves, with two small callus at base near the petiole, short spikes with very small floral bract and by ovate fruits, with apical style. It occurs in Bolivia (Callejas *et al.* 2015), Ecuador (Callejas & Burger 1999), Peru (Brako *et al.* 1993) and Brazil, where it is likely to have a disjunct distribution, occurring in Acre, Amazonas, Amapá, Pará, Rondônia, Mato Grosso, Distrito Federal, Espírito Santo, Rio de Janeiro and Paraná states (Flora do Brasil 2020), where it seems to reach its Southern limit. In Carajás it was collected only once, in transition forest, at an altitude of 275 m.

2.8. *Piper carniconnectivum* C.DC., Annuaire Conserv. Jard. Bot. Genève 21: 277. 1920.

Erect shrub, 0.5–2 m tall; branches densely pubescent to glabrescent, trichomes ca. 2 mm long. Leaves with petiole 2–4(–10) mm long, with basal sheath or elongate to the blade on lower leaves, dense to sparsely pubescent; lamina 10–14 × 4–5.5 cm, elliptic, base slightly asymmetric, one side 2–4 mm shorter than the other, acute to obtuse on both sides, occasionally rounded in the longer side, apex acuminate, chartaceous, discolor, adaxial surface

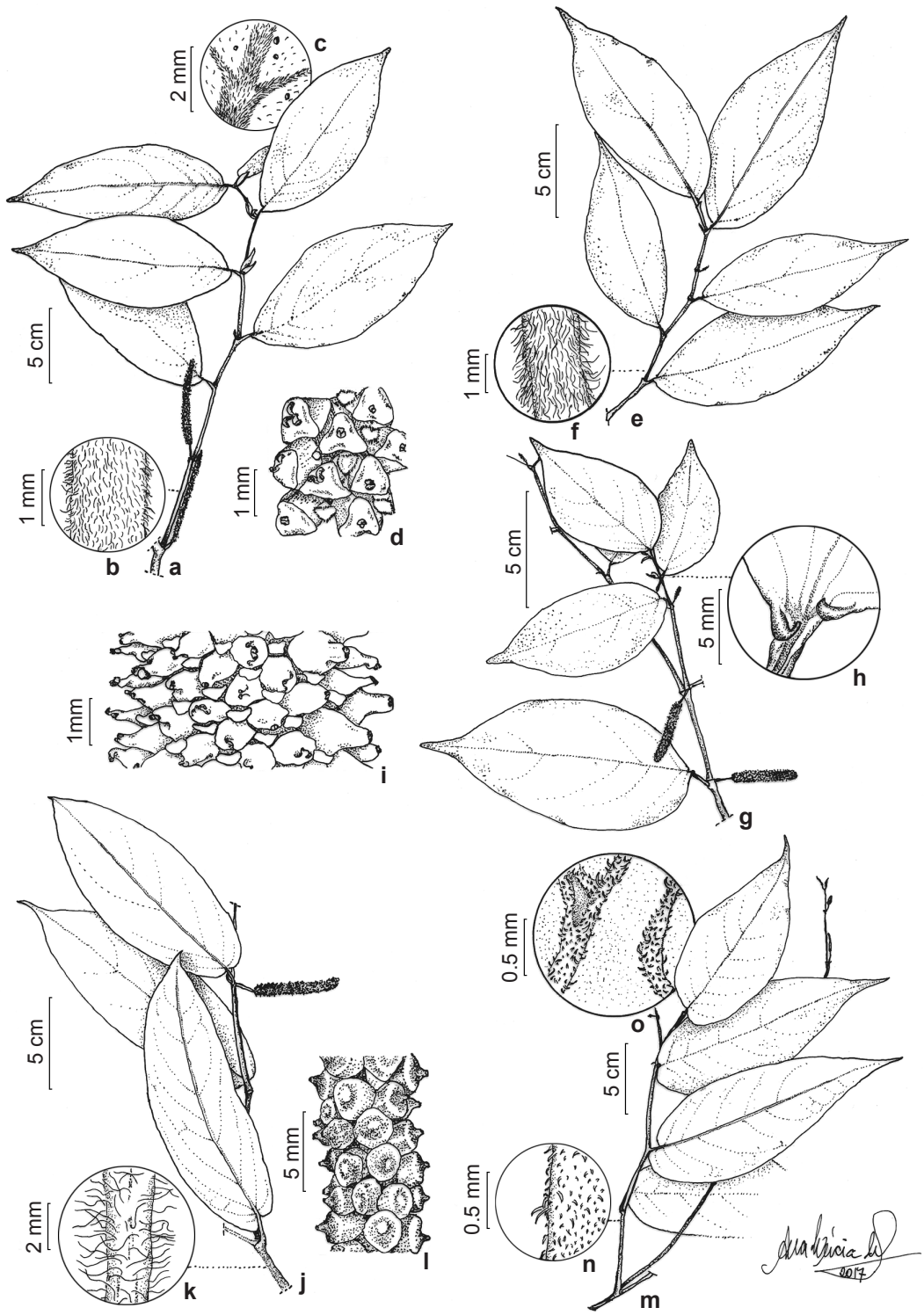

Figure 2 – a-d. *Piper aleyreanum* – a. habit; b. trichomes of the branch; c. trichomes of abaxial surface of the lamina; d. detail of the spike. e-f. *Piper belterraense* – e. habit; f. trichomes of the branch. g-i. *Piper callosum* – g. habit; h. basal callosity of the lamina; i. detail of the spike. j-l. *Piper cyrtopodon* – j. habit; k. trichomes of the branch; l. detail of the spike. m-o. *Piper goeldii* – m. habit; n. trichomes of the branch; o. trichomes of abaxial surface of the lamina (a-d. *Carreira et al. 2869*; e-f. *Sperling et al. 6356*; g-i. *de Paula et al. 495*; j-l. *Rosário 1366*; m-o. *Daly et al. 1848*).

glabrous, abaxial dense to moderately pubescent along the veins; margin flat, pubescent toward the apex; venation brochidodromous, with 5–7 pairs of secondary veins arranged above the middle, generally reaching the leaf apex. Spikes 3.5–4.5(–7) × 0.4 cm, pendulous, apiculate; peduncle 0.5–1 cm long, densely pubescent; rachis glabrous; floral bract triangular, subpeltate, fringed throughout the margin, more densely in the upper margin. Fruits ca. 1.5 mm long, globose-obovoid, glabrous, truncate at apex, depressed; stigmas 3, sessile.

Material selected: Parauapebas, Serra dos Carajás, estrada onde termina a mina N4 e se destina a mina N1, 6°5'24"S, 50°9'14"W, 4.IV.2007, fl., *L. Carreira et al. 2773* (MG); mina N5, 19.II.2008, fr., *L. Carreira et al. 2842* (MG, RB); km 10 da estrada que vai da Serra Sul a Serra Norte, 21.II.2008, fr., *L. Carreira et al. 2868* (MG, RB); km 50 da estrada que vai da portaria do projeto Bahia para a sede/GABAM, 22.II.2008, fr., *L. Carreira et al. 2886* (MG, RB); "Azul", near camp at Serra Norte, 22 km NW, then 10-15 km SW, 5°59'S, 50°28'W, 8.XII.1981, fr., *D.C. Daly 1921* (MG, NY); 3 km SE of AMZA mining camp 3-Alfa, 5°48' S, 50°32' W, 175–200 m, 13.VI.1982, fl., C.*R. Sperling et al. 6141* (MG, NY); 7 km west of camp ECB on the ferrovia, ca. 52 km west of road BR 150, 5°35' S, 490°15' W, ca. 150 m, 26.VI.1982, fl., *C.R. Sperling et al. 6363* (MG, NY).

Piper carniconnectivum is difficult to identify due to variations in the indumentum of the branches (densely pubescent to glabrescent) and the shape of leaf base (acute to obtuse on both sides, occasionally rounded in the longer side, or as described by Yuncker (1973), sometimes cordulate). It is endemic to the Brazilian Amazon, occurring in Amazonas, Amapá and Pará states (Flora do Brasil 2020). At the Serra dos Carajás it was collected in the Serra Norte: N4 and N5. Found in transition forest with occasional rock outcrops, low forest seasonally flooded, and occasionally on disturbed area, between altitudes of 150 and 200 m.

2.9. *Piper crassinervium* Kunth, Nov. gen. sp. 1: 48. 1815.

Erect shrub, 2–5 m tall; branches sparsely hirtellous to glabrescent, trichomes ca. 0.2 mm long. Leaves with petiole 1–2 cm long, canaliculate with short basal sheath, sparsely hirtellous to glabrescent; lamina 14–21 × 7–11 cm, ovate-elliptic, base obtuse to rounded, slightly asymmetric, one side ca. 3 mm shorter than the other, without callus, apex acuminate, discolor, chartaceous, translucent, adaxial surface glabrous, abaxial hirtellous along the veins and brown-glandular, smooth to the touch on both sides; margin flat, glabrous; venation eucamptodromous, with 4–5 pairs of secondary veins arranged below the middle, not reaching the leaf apex, prominent in the adaxial surface. Spikes ca. 6.5 × 0.6 cm, erect, apiculate; peduncle ca. 1 cm long, moderately hirtellous, trichomes most conspicuous near the rachis; rachis glabrous; floral bract rounded to triangular, subpeltate, densely fringed throughout the margin, conspicuous in fruiting. Fruits ca. 3 mm long, ovate, glabrous, acute-apiculate at apex; stigmas 3, on a long style, 1.5–2 mm long.

Material examined: Parauapebas, FLONA de Carajás, Rodovia Raimundo Mascarenhas, km 11, cachoeira da Bica, 24.II.2008, st., *L. Carreira et al. 2906* (RB); Igarapé Baia, Projeto Alemão, área industrial, 18.XI.2013, fl., *L.C.B. Lobato & L. Ferreira 4237* (MG).

Material additional examined: BRAZIL. PARÁ: Itaituba, Serra do Cachimbo, margem direita do rio Braço Norte, cerca de 100m da beira da estrada, 9°22'S, 54°54'W, 433 m, 17.VIII.1979, fl. and fr., *A.S. Silva 334* (MG, RB).

Piper crassinervium is easily diagnosed by its ovate-elliptic leaves with venation reaching below the middle, erect and apiculate spikes, floral bract rounded to triangular, densely fringed and ovate fruits, with a long style, as illustrated in Steyermark (1984) and Guimarães & Monteiro (2006). It occurs in Honduras (Bornstein & Coe 2007), Costa Rica, Panama (Steyermark 1984), French Guiana (Callejas *et al.* 2007), Venezuela (Steyermark 1984), Colombia, Ecuador, Peru (Trelease & Yuncker 1950) and Bolivia (Callejas *et al.* 2015). In Brazil it is recorded in Acre, Amazonas, Pará, Ceará, Bahia, Sergipe, Goiás, Distrito Federal, Mato Grosso do Sul, Paraná, Santa Catarina and all states of Southeast region (Flora do Brasil 2020). In Carajás it was collected in disturbed and transition forests, flowering in November.

2.10. *Piper cyrtopodon* C.DC., Prodr. 16(1): 337. 1869. Fig. 2j-l

Erect shrub, ca. 2 m tall; branches moderately villous, trichomes ca. 2 mm long. Leaves with petiole ca. 1 cm long, with basal sheath or winged throughout, moderately villous; lamina 15 × 5.5 cm, oblong-elliptic, base asymmetric, cordate, one side ca. 5 mm shorter than the other, apex acuminate, concolor, chartaceous, adaxial surface glabrous, abaxial moderately to sparsely villous along the veins; margin flat, sparsely pilose; venation eucamptodromous, with 4–5 pairs of secondary veins arranged above the middle, generally reaching the leaf apex. Spikes 4.5 × 0.7 cm, pendulous, bisexual; peduncle ca. 1 cm

long, moderately villous; rachis glabrous; floral bract triangular to lunate, subpeltate, fimbriated throughout the margin, diminute mainly in fruiting. Fruits ca. 2.5 mm long, globose, glabrous, acute-apiculate at apex; stigmas 3, on a short style, ca. 1 mm long.

Material examined: Parauapebas [Marabá], Serra dos Carajás, Salobo, 1.VIII.1990, fr., *C. Rosário 1366* (MG).

Piper cyrtopodon can be recognized by the presence of villous trichomes along the branches and the veins of abaxial surface, oblong-elliptic leaves with asymmetrically cordate base and globose fruits, with a short style. It occurs in the Guianas (Callejas *et al.* 2007) and Peru (Brako *et al.* 1993). In Brazil it is occasionally found in the states of Amazonas, Amapá, Pará, Roraima, Tocantins and Mato Grosso (Flora do Brasil 2020) and should have its conservation status evaluated. In the Serra dos Carajás it was recorded in the 1990s, growing on *terra firme* forest with rocky outcrops, fruiting in August.

2.11 *Piper demeraranum* (Miq.) C.DC., Prodr. 16(1): 298. 1869.

Erect shrub, 0.5–1.5 m tall; branches moderate to densely pilose-pubescent, trichomes up to 0.5 mm long, erect or retrorse, sometimes up to 1 mm long. Leaves with petiole 0,3–1 cm long, with short basal sheath, densely pilose-pubescent; lamina 12–16(–19) × 4–5.3(–7.5) cm, oblong to elliptic-obovate, base cordate-auriculate, asymmetric, one side 3–7 mm shorter than the other, sometimes with the longer lobe overlapping with the petiole, apex acute, concolor, chartaceous, adaxial surface glabrous, abaxial pilose-pubescent along the veins; margin flat, pilose to glabrescent; venation brochidodromous, with 10–12 pairs of secondary veins reaching the leaf apex. Spikes 2.5–3.5 × 0.2–0.3 cm, erect, bisexual; peduncle 0.5–1 cm long, sparsely pilose-pubescent; rachis fimbriate; floral bract narrow-lunate to triangular slightly winged, glabrous or papillose in the lower margin, mainly when young. Fruits 2 × 1.5 mm, oblong, densely pilose-puberulent, truncate at apex, depressed; stigmas 3, sessile.

Material selected: Canaã dos Carajás, Serra Sul, S11A, 6°19’43”S, 50°27’17”W, 741 m, 14.II.2010, fr., *F.D. Gontijo 53* (BHCB, RB); S11B, 6°21’18”S, 50°23’16”W, 650–750 m, 6.X.2009, fl., *P.L. Viana et al. 4406* (BHCB, MG). Parauapebas, Serra Norte, near water fall, near AMZA Exploration camp, 6°S, 50°15’W, 14.X.1977, fl., *C.C. Berg & A.J. Henderson BG 530* (INPA, MG, MO, NY, RB); “Azul”, near camp at Serra Norte, 22 km NW then 10–15 km SW, 5°59’S, 50°28’W, 8.XII.1981, fl. and fr., *D.C. Daly et al. 1869* (MG, NY).

Piper demeraranum, illustrated in relatively recent studies (Steyermark 1984; Steyermark & Callejas 2003; Melo *et al.* 2014), is characterized by the presence of pilose-pubescent trichomes in the branches and veins of the abaxial surface of the leaves, erect or retrorse in the branches, with oblong to elliptic-obovate leaves, asymmetrically cordate-auriculate at base, erect spikes with floral bract narrow-lunate to triangular, slightly winged and by oblong, densely pilose-puberulent fruits. It occurs in the Guianas, Venezuela (Steyermark & Callejas 2003), Colombia (Lleras & Cruz 2005), Ecuador (Callejas & Burger 1999), Peru (Brako *et al.* 2003), Bolivia (Callejas *et al.* 2015) and Brazil, in Acre, Amazonas, Pará, Rondônia, Roraima and Mato Grosso states (Flora do Brasil 2020). In the flora area it was recorded in the Serra Sul: S11A, S11B, between altitudes of 650 and 820 m. Found in forest over *canga* substrate and transition forest.

2.12. *Piper dilatatum* Rich., Actes Soc. Hist. Nat. Paris 1: 105, tab. 84. 1792.

Erect shrub, 1–3 m tall; branches glabrescent, sparsely to densely pubescent or subvillous, trichomes 0.2–0.5 mm long. Leaves with petiole 0.7–1(–1.5) cm long, sparsely to densely subvillous to pubescent, canaliculate, with short basal sheath; lamina (11.5–)14–20 × (5–)7.5–9.5 cm, elliptic to rhombic-elliptic, base asymmetric, one side 3–5 mm shorter than the other, longer side rounded to cordate, the other obtuse to rounded or occasionally acute, apex acuminate, membranous, translucent, discolor, subappressed-pubescent on both sides, mainly along the veins, slightly rough to the touch on both sides, abaxial sometimes glandular; margin flat, ciliate; venation eucamptodromous, with 4–6 pairs of secondary veins arranged up to the middle, not reaching the leaf apex. Spikes 6.5–9.5 × 0.2–0.3 cm, erect or curve, apiculate; peduncle 1–2.5 cm long, pilose-pubescent; rachis glabrous; floral bract rounded to triangular, subpeltate, densely fringed throughout the margin. Fruits ca. 1 mm long, obpyramidal, trigonous at apex, truncate, pubescent; stigmas 3, sessile.

Material selected: Canaã dos Carajás, Racha placa, ADA Usina S11, 6°24’51”S, 50°14’47”W, 275 m, 30.I.2012, fl. and fr., *L.F.A. de Paula et al. 512* (BHCB); S11D, 6°27’11”S, 50°20’17”W, 10.XII.2012, fl., *M.O. Pivari et al. 1703* (BHCB, MG). Parauapebas, FLONA de Carajás, estrada para a Serra Sul, 20.II.2008, fl. and fr., *L. Carreira et al. 2852* (MG, RB); km 18 da estrada que vai da Serra Sul à Serra Norte, 21.II.2008, fr., *L. Carreira et al. 2871* (MG, RB); Rodovia Raimundo

Mascarenhas - vai de Parauapebas ao núcleo urbano km 11, Serra Norte, 23.II.2008, fr., *L. Carreira et al. 2899* (MG, RB).

Illustrated in Tebbs (1993), *Piper dilatatum* can be identified by pubescent or subvillous to glabrescent branches, elliptic to rhombic-elliptic lamina with asymmetric base, secondary veins arranged up to the middle, subappressed-pubescent on both sides, slightly rough to the touch on both sides and by obpyramidal and pubescent fruits. The type of trichomes of the branches, shape of the leaf blade, its spikes sustained by a long peduncle, the pubescence and shape of the fruits differentiate it from *P. aduncum*. It has wide Neotropical distribution, occurring in Mexico, El Salvador, Honduras (Tebbs 1993), Costa Rica, Panama, the Guianas, Venezuela, Colombia (Steyermark & Callejas 2003), Ecuador (Callejas & Burger 1999), Peru (Brako *et al.* 1993), Bolivia (Callejas *et al.* 2015) and Paraguay (Zuloaga *et al.* 2008). In Brazil is recorded from Acre to Rio Grande do Sul (BFG 2015). In Carajás it was collected in the Serra Sul: S11D, growing on forest over *canga* substrate. Found in transition and disturbed forests, at an altitude of ca. 275 m.

2.13 *Piper goeldii* C.DC., Notizbl. Königl. Bot. Gart. Berlin 6: 434. 1917. Fig. 2m-o

Scandent shrub; branches moderate to densely pubescent, trichomes ca. 0.2 mm long, slightly recurved. Leaves with petiole 0.5–0.8 mm long, canaliculate, with basal sheath, moderately pubescent; lamina 15.5–19 × 6.5 cm, elliptic, base asymmetric, round-cordate on both sides, one side ca. 3 mm shorter than the other, apex acuminate, discolor, membranaceous, translucent, adaxial surface sparsely pilose to glabrescent, trichomes up to 0.3 mm long, abaxial obscurely brown-glandular, moderately pubescent along the veins and sparsely pilose in the veins near the margin, opaque and smooth to the touch on both sides; margin flat, glabrous; venation brochidodromous, with ca. 6 pairs of secondary veins arranged above the middle, not reaching the leaf apex.

Material examined: Serra dos Carajás, "Azul", near camp at Serra Norte, 22 km NW, then 10–15 km SW, 5°59'S, 50°28'W, 8.XII.1981, fl., *D.C. Daly et al. 1848* (MG).

Piper goeldii is a very rare scandent shrub that deserves to be considered for the red list of endangered species. It can be recognized by the indumentum in various parts of the plant and the broadly elliptic leaves, asymmetrically round-cordate at base. The spikes have been described as erect, with 0.5–2.7 cm long and 0.2–0.6 cm thick, sustained by a peduncle up to 1 cm long, pubescent; the rachis are glabrous, the floral bract triangular, subpeltate, equally short-fringed throughout the margin and the fruits are glabrous, globose-ellipsoidal, ca. 2 mm long, slightly pointed at apex and with 3 sessile stigmas (Yuncker 1973; Melo *et al.* 2014). It occurs only in Brazil, in the states of Amazonas and Roraima (Flora do Brasil 2020), to where the distribution was recently expanded by Melo *et al*. (2014). The specimen from the Serra dos Carajás is the first record for Pará state, and was collected in the 1980s, in hilly transition forest.

2.14. *Piper hispidum* Sw., Prodr. 15. 1788.

Erect shrub, 1.5–2.5 m tall; branches densely hispid-scabrous, trichomes up to 5 mm long, generally directed to the apex. Leaves with petiole 3–10 mm long, canaliculate with basal sheath, densely hispid-scabrous; lamina 11–20 × 4–7 cm, elliptic, base asymmetric, one side 2–4 mm shorter than the other, obtuse to rounded on both sides or occasionally acute on smaller side, apex acuminate, discolor, chartaceous, obviously rough to the touch on both sides, adaxial surface hispid-scabrous, mainly along the veins, adaxial surface moderate to densely appressed hispid-scabrous along the veins; margin flat, scabrous; venation eucamptodromous, with 4–5 pairs of secondary veins arranged below or up to the middle, not reaching the leaf apex. Spikes 7–11 × 0.2–0.3 cm, erect; peduncle 0.8–1(–1.5) cm long, sparsely hispid-scabrous; rachis glabrous; floral bract triangular, subpeltate, densely fringed throughout the margin. Fruits 1.5–2 mm long, oblong, truncate at apex, densely puberulent; stigmas 3, sessile.

Material examined: Canaã dos Carajás, subida da cachoeira, Racha Placa, 6°24'32"S, 50°14'50"W, 282 m, 27.IV.2010, fl., *F.D. Gontijo et al. 188* (BHCB). Parauapebas, Serra dos Carajás, captação de água do Parque Botânico, 8.IX.1987, fl., *J.P. Silva 70* (MG); mina de cobre 4 ALFA, FLONA, 19.VII.1990, fl. and fr., *N.A. Rosa & M.F.F. da Silva 5300* (MG); Igarapé Baia, Projeto Alemão, estrada do Pojuca, 23.VI.2013, fl., *L.C.B. Lobato & L. Ferreira 4190* (MG); AMZA camp 3-Alfa, 5°48'S, 50°32'W, 200 m, 10.VI.1982, fl. and fr., *C.R. Sperling et al. 6049* (MG, NY); AMZA camp 4-Alfa, ca. 25 km by road northwest of Rio Itacaiúnas, 5°46'S, 50°36'W, 225 m, 6.VI.1982, fl., *C.R. Sperling et al. 5935* (MG, MO, NY).

Illustrated by Tebbs (1993), Carvalho-Silva & Guimarães (2009) and Melo *et al*. (2013), *Piper hispidum* is a hispid-scabrous shrub, with elliptic leaves that are harshly rough to the touch on both sides, asymmetric at base with secondary

veins arranged below or up to the middle, erect spikes and oblong and densely puberulent fruits. These characters differentiate it from *P. aduncum*, to which it resembles morphologically. With a Neotropical distribution, it is found in Mexico (Tebbs 1993), Antilles, Central and South American (Steyermark 1984). It is widely distributed in Brazil, occurring in almost all Brazilian states (BFG 2015). In Carajás it was found in transition forests and disturbed areas, in altitudes between 200 and 280 m.

2.15. *Piper hoffmannseggianum* Schult., Mant. 1: 242. 1822. Fig. 3a-c

Erect shrub, 1.5–3 m tall; branches glabrous. Leaves with petiole (0.3–)0.5–1.2 cm long, canaliculate, glabrous, when young sometimes hirtellous in the top, near the base of the lamina, without keel of pilose trichomes in the dorsal region; lamina 12.5–16 × 4–6.5 cm, oblong-elliptic to oblong-lanceolate, base symmetric, acute to obtuse, commonly with two small callus, apex acuminate, discolor, chartaceous, glabrous on both sides, submarginally dense to sparsely hirtellous to pilose in the abaxial surface; margin revolute, glabrous; venation brochidodromous, with ca. 8 pairs of secondary veins arranged up to the leaf apex. Spikes 5.5–7 × 0.15–0.3 cm, erect, not apiculate; peduncle 3–6 mm long, glabrous; rachis pilose; floral bract saccate-galeate, glabrous, with pilose pedicel. Fruits 1.5 × 1 mm, oblong and 4-angled, subturbinate at apex, acute or truncate, papillate or smooth; stigmas 4, sessile.

Material examined: Canaã dos Carajás, S11C, 6°24'17"S, 50°23'59"W, 414 m, 28.I.2012, fr., *L.V.C. Silva et al. 1143* (BHCB); S11D, 6°27'38"S, 50°19'41"W, 9.XII.2012, fr., *M.O. Pivari et al. 1674* (BHCB). Parauapebas, FLONA de Carajás, km 29 da estrada que vai da Serra Sul à Serra Norte, 21.II.2008, fr., *L. Carreira et al. 2876* (MG, RB); Serra Norte, ca. 15 km W of AMZA exploration camp, 6°S, 50°15'W, 400 m, 12.X.1977, fl., *C.C. Berg & A.J. Henderson BG 478* (MG, RB).

Piper hoffmannseggianum is a glabrous shrub recognized by its oblong-elliptic to oblong-lanceolate leaves that are submarginally hirtellous to pilose, erect spikes with pilose rachis, floral bracts saccate-galeate and fruits oblong or 4–angled, subturbinate, acute or truncate in the apex, all characters which differentiate it from *P. anonifolium*. It occurs only in Brazil, where it is likely to have a disjunct distribution, occurring in the Amazon and Atlantic Rainforest, in the states of Acre, Pará, Rondônia, Mato Grosso, Bahia, Distrito Federal, Paraná and in all states of the Southeast region (Flora do Brasil 2020). At the Serra dos Carajás it was recorded in the Serra Sul: S11C, S11D. Found in forests over *canga* substrate and transition forest slopes, at an altitude of ca. 400 m.

2.16. *Piper hostmannianum* (Miq.) C.DC., Prodr. 16(1): 287. 1869.

Erect shrub, ca. 2 m tall; branches moderately pubescent to glabrescent, trichomes up to 0.5 mm long., erect or slightly retrorse. Leaves with petiole 0.7–1.5 cm long., with basal sheath, pubescent to glabrescent; lamina 12.5–22 × 5.5–8.5 cm, ovate-elliptic to lanceolate, base obtuse to rounded, slightly asymmetric, one side 3–5 mm shorter than the other, apex acuminate, discolor, chartaceous, adaxial surface glabrous and glossy, abaxial pubescent, mainly along the main vein with trichomes appressed to suberect, smooth to the touch on both sides; margin narrowly revolute, glabrous; venation eucamptodromous or brochidodromous, with 3–5 pairs of secondary veins arranged below or up to just above the middle, not reaching the leaf apex, impressed on the adaxial surface. Spikes 5–7.5(–9) × 0.2–0.3 cm, erect, apiculate; peduncle 5–8(–17) mm long, pubescent; rachis glabrous; floral bract rounded to triangular, subpeltate, dense and equally fringed throughout the margin. Fruits ca. 1 mm long, oblong or 3–4-angled, truncate-concave at apex, slightly papillose to glabrescent; stigmas 3, sessile.

Material selected: Parauapebas, FLONA de Carajás, km 50 da estrada que vai da portaria do projeto Bahia para a sede/GABAM, 22.II.2008, fl., *L. Carreira et al. 2885* (MG, RB); Rodovia Raimundo Mascarenhas - vai de Parauapebas ao núcleo urbano km 30, Serra Norte, 23.II.2008, fl., *L. Carreira et al. 2898* (MG, RB); Igarapé Baia, Projeto Alemão, estrada do Pojuca, 23.VI.2013, fl., *L.C.B. Lobato & L. Ferreira 4188* (MG).

Material additional examined: BRAZIL. PARÁ: Oriximiná, rio Trombetas, margem direita, Porto Trombetas, estrada da mineração Rio-Norte km 60, atrás da mina de bauxita, 30.VIII.1980, fl. and fr., *C.A. Cid et al. 1915* (INPA, RB).

Piper hostmannianum, illustrated in several papers (Steyermark 1984; Tebbs 1993; Melo *et al.* 2013), can be diagnosed by pubescent trichomes along the branches and abaxial surface of the lamina, leaves broadly ovate-elliptic to lanceolate, glossy and with impressed veins in the adaxial surface, arranged below or up to just above the middle, and by erect spikes with oblong or 3–4-angled, slightly papillose to glabrescent fruits. It occurs in the Guianas (Görts-van Rijn 1997),

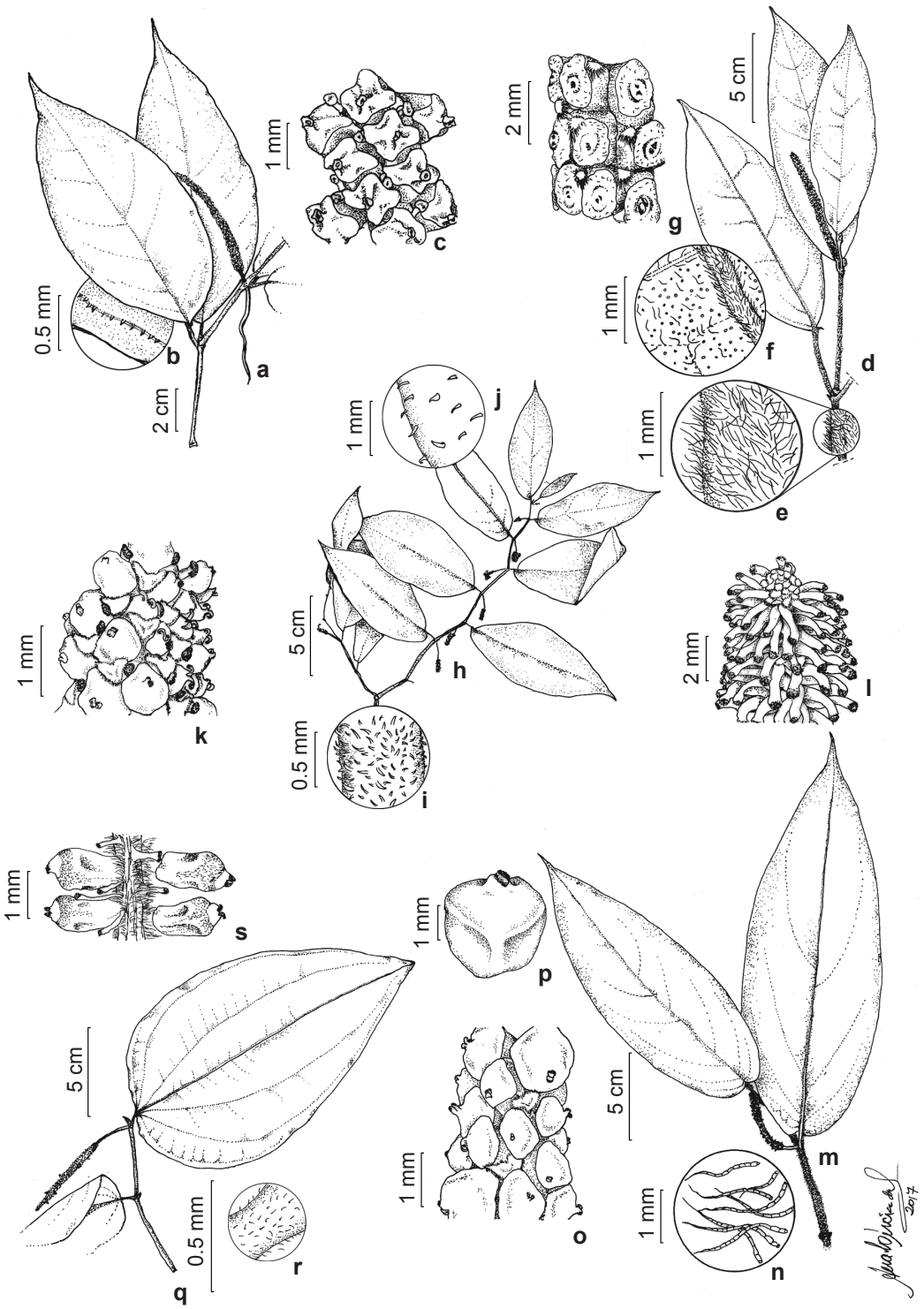

Figure 3 – a-c. *Piper hoffmannseggianum* – a. habit; b. submarginal trichomes of abaxial surface of the lamina; c. detail of the spike. d-g. *Piper kegelianum* – d. habit; e. trichomes of the branch; f. trichomes of abaxial surface of the lamina; g. detail of the spike. h-l. *Piper nematanthera* – h. habit; i. trichomes of the branch; j. trichomes of adaxial surface of the lamina; k. detail of the female spike; l. detail of the male spike. m-p. *Piper pellitum* – m. habit; n. trichomes of the branch; o. detail of the spike; p. fruit. q-s. *Piper reticulatum* – q. habit; r. trichomes of abaxial surface of the lamina; s. detail of the spike (a-c. *Carreira et al. 2876*; d-g. *Arruda et al. 1230*; h-l. *Nascimento & Bahia 1136*; m-p. *Viana et al. 4169*; q-s. *Harley et al. 57400*).

Venezuela (Steyermark 1984), Colombia (Lleras & Cruz 2005), Ecuador (Callejas & Burger 1999), Peru (Brako *et al.* 1993) and Bolivia (Callejas *et al.* 2015). In Brazil is recorded in the states of Acre, Amazonas, Amapá, Pará, Rondônia, Roraima, Mato Grosso, Maranhão, Pernambuco, Alagoas, Minas Gerais and Rio de Janeiro (Flora do Brasil 2020). In the Serra dos Carajás, where it is popularly known as "rajado" (L. Carreira *et al.* 2896, 2897 - MG, RB), was collected on transition and anthropized forests, flowering in February and June.

2.17. *Piper kegelianum* (Miq.) C.DC., Prodr. 16(1): 372. 1869. Fig. 3d-g

Erect shrub; branches densely hirsute, trichomes 0.5–1 mm long, erect. Leaves with petiole 0.5–1 cm long., canaliculate with short basal sheath, densely hirsute; lamina 13–17 × 5–5.5 cm, lanceolate, base acute to sub-obtuse, symmetric to slightly asymmetric, one side ca. 2 mm shorter than the other, apex acuminate, discolor, chartaceous, adaxial surface glabrous, abaxial densely glandular and hirsute, with trichomes erect to subappressed mainly along the main vein, smooth to the touch on both sides; margin revolute, glabrous; venation brochidodromous with ca. 6 pairs of secondary veins arranged above the middle or up to the leaf apex, prominent on the abaxial surface. Spikes ca. 7 × 0.3 cm; peduncle ca. 5 mm long, densely hirsute; rachis glabrous; floral bract triangular to broadly lunate, subpeltate, densely fringed throughout the margin. Fruits ca. 1.5 mm long, oblong, truncate at apex, concave, densely glandular and pilose-pubescent; stigmas 3, sessile.

Material examined: Parauapebas, Serra Norte, N1, 6°2'27"S, 50°173'40"W, 533 m, 24.VII.2012, fr., *A.J. Arruda et al. 1230* (BHCB).

Piper kegelianum occurs in the Guianas (Steyermark & Callejas 2003) and Venezuela (Steyermark 1984). In Brazil it occurs occasionally in the states of Amazonas, Amapá, Pará and Maranhão (Flora do Brasil 2020) and should have its conservation status evaluated. It resembles morphologically *P. hostmannianum*, differing by its hirsute trichomes, smaller leaves with acute to sub-obtuse base and veins reaching above the middle or up to the leaf apex, oblong and densely pilose-pubescent fruits. In the flora area it was recorded only in the Serra Norte: N1, growing on forest over *canga* substrate, at an altitude of ca. 530 m.

2.18. *Piper krukoffii* Yunck., Bol. Inst. Bot. (São Paulo) 3: 24. 1966.

Erect shrub, 2–3 m tall; branches moderate to densely tomentose-villous, trichomes brown, 1–1.5 mm long. Leaves with petiole 3–4 cm long., canaliculate, with winged sheath throughout, tomentose-villous; lamina 23–35 × 14–21 cm, ovate-elliptic, base asymmetric, rounded-auriculate, forming lobes, one side ca. 3 cm shorter than the other, apex acute to obtuse, discolor, chartaceous, adaxial surface glabrous, abaxial tomentose along the veins; margin flat, glabrous; venation brochidodromous, with ca. 8 pairs of secondary veins arranged up to the leaf apex. Spikes (23–)35–40 × 0.3–0.5 cm, pendulous, bisexual; peduncle 3–3.5 cm long, tomentose-villous; rachis glabrous; floral bract triangular, subpeltate, densely fringed throughout the margin. Fruits ca. 2 mm long., oblong, glabrous, concave at apex; stigmas 3, sessile.

Material selected: Canaã dos Carajás, Serra Sul, Corpo A/B, 6°20'31"S, 50°24'33"W, 650 m, 8.X.2009, fl., *V.T. Giorni et al. 330* (BHCB); S11B, 6°21'23"S, 50°23'22"W, 750 m, 19.III.2009, fr., *P.L. Viana et al. 4170* (MG). Parauapebas [Marabá], Serra Norte, mina de cobre do Pojuca, 12.I.1985, fl. and fr., *C.S. Rosario et al. 678* (MG); FLONA de Carajás, Projeto Bahia até a portaria principal, distante da sede 52 km, 22.II.2008, st., *L. Carreira et al. 2879* (MG, RB); Rodovia Raimundo Mascarenhas, km 11, cachoeira da Bica, 24.II.2008, fr., *L. Carreira et al. 2904* (MG, RB).

Piper krukoffii is endemic to Brazil, where it occurs in the states of Acre, Amazonas, Amapá, Pará and Rondônia (Flora do Brasil 2020). Tebbs (1989) placed this taxon as a synonym of *P. obliquum* Ruiz & Pav. It is considered here that the much more tomentose-villous branches of *P. krukoffii* are enough to grant it specific recognition. In the Serra dos Carajás it was collected in the Serra Norte and Serra Sul: S11A, S11B, between altitudes of 650 and 750 m. Found in forest over *canga* substrate and transition forest with occasional rock outcrops.

2.19. *Piper marginatum* Jacq., Collectanea 4: 128. 1790.

Erect shrub, 2–3 m tall; branches glabrous. Leaves with petiole 3.5–6 cm long, canaliculate, with winged sheath throughout, glabrous; lamina 12–22 × 9.5–15 cm, ovate-cordate, base symmetric, cordate, apex acuminate, chartaceous to translucent-membranous, discolor, adaxial surface hirtellous-pubescent along the veins, mainly near the base to glabrescent, abaxial sparse to moderately hirtellous-pubescent along the veins; margin flat, ciliate; venation campilodromous, with 9–11 veins starting from the base arcuate towards the leaf apex. Spikes 10–15 × 0.2 cm, curve; peduncle ca. 3 mm long, glabrous; rachis glabrous; floral bract triangular, subpeltate, densely fringed throughout the margin. Fruits ca. 1 mm long, obovoid, glabrous, truncate at apex, concave; stigmas 3, sessile, without a dilated base.

Material selected: Canaã dos Carajás, S11, Racha Placa, 6°24'19"S, 50°14'52"W, 345 m, 27.IV.2010, fl. and fr., *F.D. Gontijo et al. 189* (BHCB, MG). Parauapebas FLONA de Carajás, Núcleo urbano, 19.II.2008, fl., *L. Carreira et al. 2849* (MG, RB).

Piper marginatum, illustrated in several papers (Steyermark 1984; Tebbs 1993; Guimarães & Giordano 2004; Melo *et al*. 2013), is easily recognized by the ovate-cordate, hirtellous-pubescent leaves with campilodromous veins and by the long, curved spikes. It has a Neotropical distribution, with records in Mexico, Antilles, Guatemala, Belize, El Salvador, Honduras, Nicaragua, Costa Rica, Panama, Venezuela, Colombia, Ecuador (Tebbs 1993), and the Guianas (Görts-van Rijn 1997). In Brazil it occurs in almost all states (BFG 2015), and the Paraná state seems to be its Southern limit. In the flora area it was recorded at an altitude of ca. 340 m, in transition and anthropized forests.

2.20. *Piper nematanthera* C.DC., Prodr. 16(1): 367. 1869. Fig. 3h-l

Scandent shrub; branches hirtous to minutely pubescent, trichomes up to 0.2 mm long, slightly retrorse. Leaves with petiole 0.3–1 cm long, canaliculate; lamina 6–12.5 × 2.5–5.5 cm, elliptic, base asymmetric, one side ca. 3 mm shorter than the other, obtuse to cordate on both sides, apex acuminate, discolor, chartaceous to membranaceous, translucent, adaxial surface sparse to moderately pilose, trichomes up to 0.5 mm long, more concentrated near the margin, abaxial surface hirtous to minutely appressed-pubescent along the veins, pilose-pubescent in the veins near the margin; margin flat, glabrous; venation brochidodromous, with 4–7 pairs of secondary veins arranged up to near the leaf apex. Spikes erect, unisexual (♂ and ♀) or bisexual (with diclinous flowers, upper portion ♂, lower ♀), plant monoecious; peduncle 1–2(–2.5) long, hirtous to pubescent; rachis papillose; floral bract triangular to lunate, subpeltate, densely fringed throughout the margin; male spike 0.8 × 0.6 cm, in the uppermost, each flower with 1 stamen, with long filamentous anthers, ca. 3 mm long; lower female spike 0.7–1.7 × 0.3–0.4 cm. Fruits ca. 1 mm long, globose-ovoid, glabrous, convex at apex; stigmas 3, recurved, sessile.

Material selected: Canaã dos Carajás, S11D, 6°27'47"S, 50°19'27"W, 9.XII.2012, fl. (spikes ♂), *I.M.C. Rodrigues et al. 568* (BHCB, MG). [Marabá], Serra dos Carajás, estrada do Pojuca, 2.II.1985, fl. (spikes ♂, ♀ and ♂♀), fr., *O.C. Nascimento & R.P. Bahia 1136* (MG). Parauapebas, FLONA de Carajás, Rodovia Raimundo Mascarenhas, vai de Parauapebas ao núcleo urbano km 33, na encosta da Serra Norte, 23.II.2008, fl. (spikes ♂), *L. Carreira et al. 2895* (MG, RB); "Azul", near camp at Serra Norte, 22 km NW then 10–15 km SW, 5°59'S, 50°28'W, 8.XII.1981, fl. (spikes ♂), *D.C. Daly et al. 1946* (INPA, MG, MO).

Piper nematanthera is a rare scandent, monoecious shrub that grows to 5 m high up the trees. It deserves to have its conservation status evaluated. While it is easily recognized by its scandent habit, elliptic and asymmetrically basally obtuse to cordate leaves and unisexual spikes, the small leaf blade, hirtous to minutely pubescent branches, long filamentous anthers and the globose-ovoid fruits also characterize the species and differentiate it from *P. goeldii*, which resembles it morphologically. *Piper acreanum* C.DC. is here considered a synonym of this taxon, following Callejas *et al.* (2015). A rudimentar lateral structure, like a staminode, was observed in each pistil of the female spike.

Piper nematanthera occurs in Bolivia (Callejas *et al.* 2015), the Guianas (Callejas *et al.* 2007), Peru (Trelease 1936), and Brazil, occasionally found in the states of Amazonas, Amapá, Pará and Tocantins (Flora do Brasil 2020). In the Serra dos Carajás it was collected in the Serra Sul: S11D, growing on hilly forest and disturbed area.

2.21. *Piper obliquum* Ruiz & Pav., Fl. peruv. 1: 37, pl. 63, fig. a. 1798.

Erect shrub, 2–5 m tall; branches sparsely tomentose-villous to glabrescent, trichomes up to 1.5 mm long, brown. Leaves with petiole 3–4.5(–8) cm long, canaliculate, with winged sheath throughout, sparsely tomentose-villous to glabrescent; lamina 25–30(–40) × 11–15(–20) cm, ovate-elliptic, base asymmetric, rounded-auriculate, forming lobes, one side 2–3(–6) cm shorter than the other, apex acute to obtuse, discolor, chartaceous, adaxial surface glabrous, abaxial tomentose along the veins; margin flat, glabrous; venation brochidodromous, with ca. 8 pairs of secondary veins arranged up to the leaf apex. Spikes 22–32 × 0.3–0.7 cm, pendulous, bisexual; peduncle 2.5–4.5 cm long, sparsely villous-tomentose to glabrescent; rachis glabrous; floral bract triangular, subpeltate, densely fringed throughout the margin. Fruits ca. 2 mm long, oblong, glabrous, concave at apex; stigmas 3, sessile.

Material selected: Canaã dos Carajás, Serra Sul, Corpo A, 6°19'14"S, 50°27'17"W, 741 m, 14.II.2010, fl. and fr., *F.D. Contijo 44* (BHCB, RB). Parauapebas [Marabá], Serra dos Carajás, mina de ferro N1, despenhadeiros

do igarapé da bomba d´água, 28.IV.1985, fr., *N.A. Rosa & M.F.F. da Silva 4721* (MG); FLONA de Carajás, Rodovia Raimundo Mascarenhas, km 11, Cachoeira da Bica, 24.II.2008, fr., *L. Carreira et al. 2905* (MG, RB); N4, 6°4'21"S, 50°11'45"W, 470 m, 20.IV.2012, fr., *A.J. Arruda et al. 987* (BHCB); Igarapé Baia, Projeto Alemão, 20.IX.2013, fl., *L.C.B. Lobato & L. Ferreira 4212* (MG); Serra Norte, near water fall, near AMZA Exploration Camp, 14.X.1977, fr., *C.C. Berg & A.J. Henderson BG 523* (MG, MO, NY, RB).

Illustrated in Tebbs (1989) and Steyermark (1984), *Piper obliquum* is characterized by the sparsely tomentose-villous to glabrescent branches, leaves strongly asymmetric forming lobes, and pendulous spikes, as long as the leaves, with oblong and glabrous fruits. It occurs in Mexico, Guatemala, Belize, Honduras, Nicaragua, Costa Rica, Panama, French Guiana, Venezuela, Colombia, Equador, Peru and Bolivia (Tebbs 1989). In Brazil it is recorded in Acre, Amazonas, Pará, Amapá, Rondônia, Tocantins, Mato Grosso, Bahia, Minas Gerais, Rio de Janeiro and São Paulo states (Flora do Brasil 2020), where it seems to reach its Southern limit. In the Serra dos Carajás it occurs in the Serra Norte: N1, N4 and Serra Sul: S11A. Found between altitudes of 250 and 740 m, growing on forest over *canga* substrate and transition forest.

2.22. *Piper pellitum* C.DC., Verh. Bot. Vereins Prov. Brandenburg 47: 114. 1905. Fig. 3m-p

Erect shrub, 1.8–5 m tall, villous, trichomes ca. 2 mm long; branches moderate to densely villous. Leaves with petiole 0.5–1 cm long, with short basal sheath, densely villous; lamina 12–22 × 4–7.5 cm, oblong-elliptic, base asymmetric, one side 3–5 mm shorter than the other, rounded-cordate on both sides, apex acuminate, membranous, translucent, villous on both sides, more densely along the veins, adaxial surface rough to the touch; margin flat, villous; venation eucamptodromous, with 4–5 pairs of secondary veins arranged up to or just above the middle, not reaching the leaf apex. Spikes 2.5–3 × 0.3–0.4 cm, pendulous; peduncle 0.8–1 cm long, moderate to densely villous; rachis glabrous; floral bract triangular, subpeltate, densely fringed throughout the margin. Fruits ca. 2 mm long, ovate, glabrous, acute-apiculate at apex; stigmas 3, on a short style, ca. 0.5 mm long.

Material selected: Canaã dos Carajás, Serra Sul, Corpo B, 6°21'23"S, 50°23'22"W, 700 m, 19.III.2009, fl. and fr., *P.L. Viana et al. 4169* (BHCB). Parauapebas, Serra dos Carajás, mina de cobre 4 Alfa, FLONA, 19.VII.1990, st., *N.A. Rosa & M.F.F. da Silva* (MG 134876); FLONA de Carajás, Serra Norte, mina N5, 19.II.2008, st., *L. Carreira et al. 2840* (MG, RB); Projeto Bahia, até a portaria principal, distante da sede 52 km, 22.II.2008, st., *L. Carreira et al. 2881* (MG, RB).

The characters that help in the recognition of *Piper pellitum*, and differentiate it from *P. cyrtopodon* to which it resembles morphologically, are the villous trichomes throughout the plant and broadly oblong-elliptic leaves, adaxially rough to the touch. The ovate and glabrous fruits with a short style are described here for the first time. *Piper pellitum* is a rare shrub that should have its status of conservation evaluated. It occurs in Ecuador (Callejas & Burger 1999), Bolivia (Callejas *et al.* 2015) and Brazil, where it is occasionally found in the states of Acre, Amazonas, Pará, Rondônia, Roraima, Tocantins and Mato Grosso (Flora do Brasil 2020). In the flora area it is popularly known as "peludinho" or "peluda" (L. Carreira *et al.* 2840, 2881, 2907) and was recorded in the Serra Norte: N5 and Serra Sul: S11B, at an altitude of ca. 700 m. Found in forest over *canga* substrate and transition forest.

2.23. *Piper reticulatum* L., Sp. pl. 1: 29. 1753. Fig. 3q-s

Erect shrub, 4–5 m tall; branches sparsely papillose-hirtellous to glabrescent. Leaves with petiole 1–1.5 cm long, canaliculate, with short basal sheath, moderately papilose-hirtellous; lamina 18–24 × 10–13 cm, ovate-elliptic, base symmetric, rounded, apex acuminate, concolor, chartaceous, adaxial surface glabrous, sometimes papillose-hirtellous on the veins near the base, abaxial papillose-hirtellous along the veins; margin revolute, glabrous; venation acrodromous, with 5–7 veins starting from the base towards the leaf apex. Spikes 4.5–5 × 0,3 cm, erect; peduncle 1–2 cm long, papillose-hirtellous; rachis pilose; floral bract inconspicuous, rounded, subpeltate, glabrous. Fruits ca. 1.5 mm long, oblong-obovoid, 4–angled, truncate at apex, densely papillose; stigmas 3–4, sessile, on a dilated base.

Material examined: Canaã dos Carajás, Serra de Carajás, caminho na base da Serra do Tarzan, 6°23'24"S, 50°6'33"W, 242 m, 25.II.2016, fr., *R.M. Harley et al. 57400* (MG). Parauapebas, FLONA de Carajás, estrada para a Serra Sul, 20.II.2008, st, *L. Carreira et al. 2850* (MG, RB); [Marabá], mina de cobre do Solôbo, 15.III.1988, st., *J.G.S. Maia et al. 5* (MG); AMZA camp 3-Alfa, 5°48'S, 50°32'W, 200 m, 10.VI.1982, st., *C.R. Sperling et al. 6046* (MG, NY, RB).

Piper reticulatum is easily recognized by the papillose-hirtellous trichomes throughout the various parts of the plant, broadly ovate-elliptic leaves with acrodromous venation, erect spikes

with pilose rachis and oblong-obovoid, 4–angled fruits, with densely papillose apex, with stigmas on a dilated base. The name *P. reticulatum* Vell. is illegitimate and synonymous to *P. amalago* L. (Yuncker 1950; Zuloaga *et al.* 2008). This species occurs in the Antilles, Nicaragua, Panama, Venezuela, Colombia, Ecuador, Peru (Steyermark 1984), the Guianas (Callejas *et al.* 2007), Honduras (Bornstein & Coe 2007), Costa Rica (Burger 1971) and Bolivia (Callejas *et al.* 2015). In Brazil it is occasionally found in Acre, Amazonas, Pará, Rondônia, Roraima and Mato Grosso states (Flora do Brasil 2020). In the Serra dos Carajás it was collected at an altitude of ca. 200 m, in anthropized and transition forests.

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List of exsiccates

Almeida TE 2413 (1.3), 2501 (2.3), 2493 (2.5.1), 2421 (2.21). **Arruda AJ** 728, 1116, 1163, 1178 (1.1), 1186 (1.1), 1265 (1.2), 1276 (1.3), 784, 811, 1136 (1.6), 965 (1.6), 515 (2.5.2), 1230 (2.17), 497 (1.19), 987 (2.21). **Berg CC** 452 (1.7), 531 (1.7), 477, 528 (2.3), 529 (2.3), 476 (2.4), 530 (2.11), 478 (2.15), 523 (2.21), 611 (1.3). **Cardoso A** 2016 (1.1), 2029 (1.4). **Carreira L** 2837, 2892 (1.3), 2838, 2848, 2866, 2908 (2.1), 2841, 2883, 2900 (2.2), 2846, 2847, 2865, 2869, 2874, 2882, 2891 (2.3), 2903 (2.4), 2880 (2.5.1), 2773 (2.8), 2842, 2868, 2870, 2886 (2.8), 2906 (2.9), 2852, 2871, 2873, 2899 (2.12), 2876 (2.15), 2885, 2896, 2897, 2898 (2.16), 2879, 2904 (2.18), 2849 (2.19), 2895 (2.20), 2905 (2.21), 2840, 2881, 2907 (2.22), 2850 (2.23). **Cavalcante P** 2103 (1.4). Cid CA 1915 (2.16). **Costa LV** 898 (1.1), 1004 (2.3). **Daly DC** 1951 (1.3), 1860 (2.2), 1868 (2.3), 1764 (2.5.1), 1921 (2.8), 1967 (2.8), 1967b (2.8), 1869 (2.11), 1967a (2.11), 1848 (2.13), 1946 (2.20). **Dias CSP** 10 (1.5). **Giacomin LL** 1174 (1.1). **Gil A** 542 (1.3). **Giorni VT** 174 (1.4), 283 (1.3), 330 (2.18). **Gontijo FD** 91, 187 (1.1), 190 (1.4), 32 (1.7), 54 (2.2), 46 (2.3.), 43, 69 (2.3), 53 (2.11), 188 (2.14), 189 (1.19), 44 (2.21). **Harley RM** 57400 (2.23). **Lobato LCB** 3901(1.5), 4122 (1.3), 4190 (2.1), 4235 (2.3), 4189 (2.5.1), 4237 (2.9), 4190 (2.14), 4188 (2.16), 4212 (2.21), 4271 (1.5). **Maciel UN** 722 (2.5.1). **Maia JGS** 5(2.23). **Meyer PB** 1130 (1.1), 1145, 1199 (1.1), 1162 (1.1), 1128 (1.4). **Mota NFO** 1951 (1.3). **Nascimento OC** 1065 (2.1), 1136 (2.20). **de Paula LFA** 472 (1.7), 495 (2.7), 512 (2.12). **Pivari MO** 1653 (2.4), 1639 (2.5.1), 1672 (2.5.2), 1640 (2.11), 1703 (2.12), 1674 (2.15), 1669 (1.19). **Reis AS** 25 (1.5). **Rodrigues IMC** 568 (2.20). **Rosa NA** 4721 (2.21), 5288 (2.5.1), 5297a (2.3), 5300 (2.14), 5313 (1.3), 5314 (2.4), s.n. 134876 (2.22). **Rosário C** 1366 (2.10), 1358 (2.18). **Rosário CS** 678 (2.18). **Sales J** 65 (1.3). **Santos RS** 131 (1.7). **Saraiva DP** 298 (1.2). **Secco R** 302 (1.4), 401 (1.3), 468 (2.2), 467 (2.5.1). **Silva AS** 334 (2.9). **Silva ASL** 1771 (1.7). **Silva DF** 904 (1.5). **Silva JP** 70 (2.14). **Silva LVC** 1309, 1332 (1.1), 985 (1.3), 1143 (2.15). **Silva MFF** 1458 (2.21). **Sperling CR** 5849 (1.3), 5882 (2.1), 5748, 5778, 6007 (2.5.1), 6356 (2.6), 6141, 6363(2.8), 5935 (2.14), 6049 (2.14), 5779 (2.21), 6046 (2.23). **Souza DT** 1151 (1.2), 1162 (2.2). **Viana PL** 6169 (1.1), 3394 (1.4), 4104 (1.6), 4393 (1.7), 4167 (2.3), 4173 (2.5.1), 4168 (2.11), 4406 (2.11), 4170 (2.18), 4169 (2.22). **Vidal CV** 716 (2.5.1).

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