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Research

Passiflora carajasensis (Passifloraceae), a new species of subgenus *Passiflora*, series *Quadrangulares*, from the Brazilian Amazon

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A new species of *Passiflora* series *Quadrangulares* is described and illustrated from National Forest of Carajás in the Brazilian state of Pará, viz *Passiflora carajasensis*. This new species is recognized by linear-lanceolate stipules, long-ovate to oblong leaf blades, bracts 3–3.5 × 1.5–2.5 cm, erect sepals and petals, and corona with 6 series. It resembles *P. longifilamentosa* and *P. trialata* in having 3-angular winged stems, and 3-angular petioles and peduncles and a comparison of morphological characteristics between these species is provided, as well as a key for all species of *Passiflora* series Quadrangulares.

Keywords: Canga, Carajás, mining areas

Introduction

In Brazil, *Passiflora* Linnaeus (1753, p. 955) is represented by 153 species, of which 76 occur in the Amazonia domain (BFG 2015, 2018). In the last decade, taxonomic studies of *Passiflora* from the Brazilian Amazon have demonstrated the expressive importance of this genus, and seven new taxa have been described: *Passiflora kikiana* Cervi and Linsingen (2010, p. 1062), *P. cristalina* Vanderplank and Zappi (2011, p. 149), *P. fissurosa* Souza and Hopkins (2011, p. 449), *P. longifilamentosa* Koch et al. (2013, p. 43), *P. echinasteris* Koch et al. (2015, p. 171), *P. lorenziana* Mezzonato-Pires et al. (2016, p. 78), *P. bernaccii* Mezzonato-Pires (2018, p. 230) and *P. garckei* subsp. *pentaloba* Engels & A.K.Koch (2019, p. 17).

During the preparation of the treatment of Passifloraceae for the Flora of the cangas of the Serra dos Carajás (Koch and Ilkiu-Borges 2016), we detected herbarium and fresh material of a species that could not be identified. It proved to be a new species of subgenus *Passiflora*, series *Quadrangulares* Feuillet and MacDougal (2003, p. 38), which is described and illustrated here.

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Material and methods

The new species was collected in four areas in Carajás National Forest, Pará State, in Brazilian Amazon. The region of the Carajás mountain range consists of a mosaic of vegetation that includes Amazon rainforest and canga vegetation (STCP 2016). The area of collection is situated at 500–700 m a.s.l., with humidity varying from 76.8 to 88.5% (Viana et al. 2016). The collection was carried out according to Fidalgo and Bononi (1984). The description and illustrations are based on fertile material, with the descriptive terminology based on Killip (1938), Cervi (1997) and Ulmer and MacDougal (2004). Types were deposited at herbarium MG.

Passiflora carajasensis **A.K.Koch & Ilk.-Borg. sp. nov. (Fig. 1A–H)**

A species closely related to *P. longifilamentosa*, but differing in stipules linear-lanceolate, 1.3–1.5 × 0.2–0.3 cm, ellipsoid petiole glands, long-ovate to oblong leaf blades, sepals and petal erect at anthesis, absence of throchlea, styles with stigmas 1.2–1.3 cm long, and corona with six series of filaments.

Type: Brazil, Pará: Parauapebas, Serra dos Carajás, urban nucleus of Vale, 6°03′53″S, 50°04′02″W, 04.09.2015, fl, A. Gil & A.L. Ilkiu-Borges 547 (holotype MG216046).

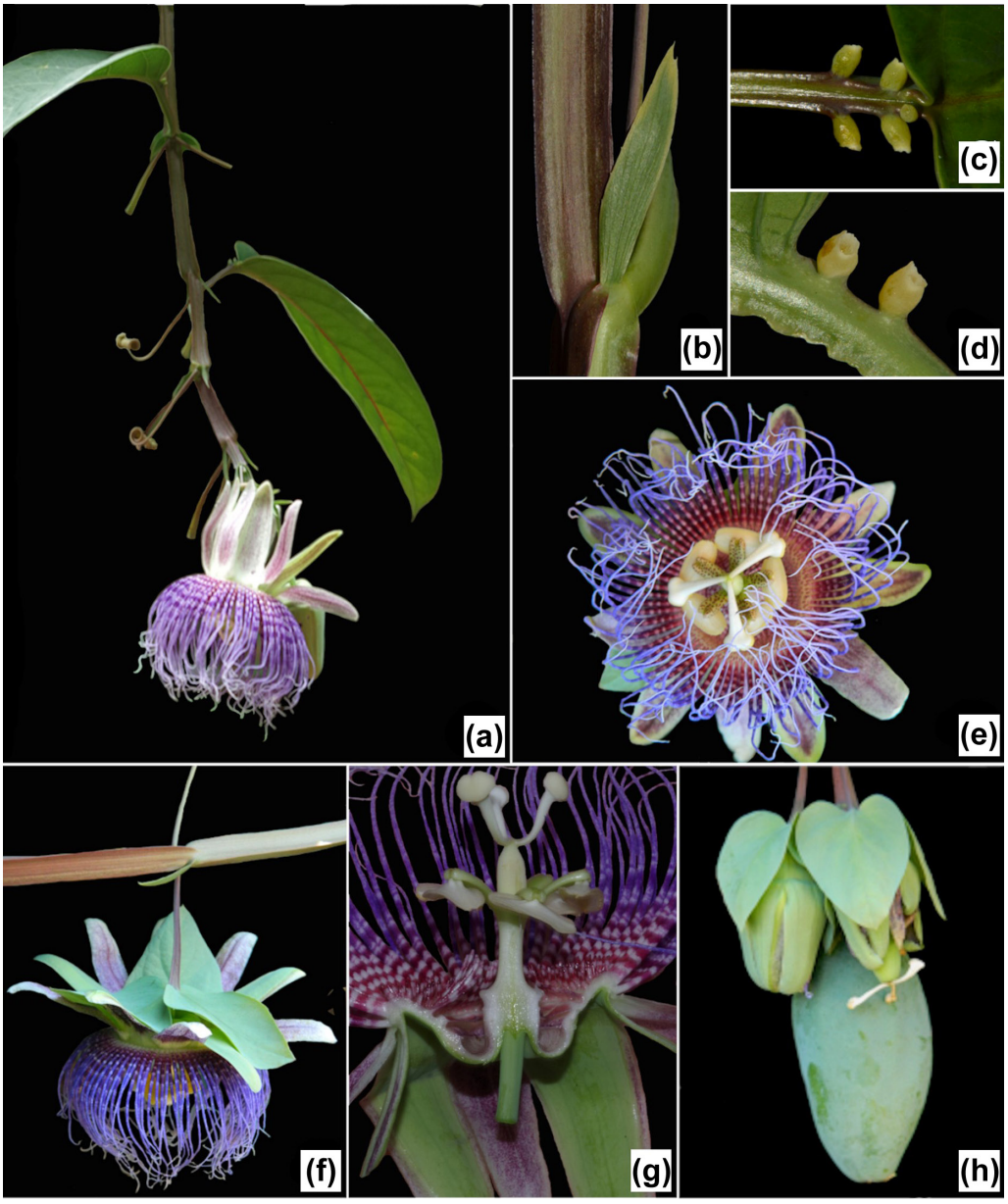

Figure 1. *Passiflora carajasensis* A.K.Koch & Ilk.-Borg sp. nov. (a) Habit, (b) stipule, (c–d) petiole glands, (e) flower in frontal view, (f) flower in lateral view, (g) longitudinal section of flower with detail of corona filaments, (h) immature fruits. (Photos: (a and g) by N. F. O. Mota – MG216046; (b–d) by A. K. Koch; (e, f and h) by M. Pastore – MG238755.)

Etymology

The epithet refers to the site of occurrence, the Carajás mountain range.

Description

Woody scandent vine, glabrous. Stem sharply 3-angular, greenish brown. Stipules linear-lanceolate, 1.5–1.8 × 0.3–0.5 cm, green with a yellow border, their margin dentate; glands absent. Petioles sharply 3-angular, 2.5–3.5 cm long, greenish brown; glands 4–6, ellipsoid, green, less than 1 mm diam., 1.0–1.5 cm from the petiole base. Leaf blade long-ovate to oblong, 16.0–21.5 × 7.2–10.8 cm, with entire margin, rounded at base, cuspidate at pex, pinnately veined, coriaceous, olive-green at both surfaces; nectaries absent. Tendrils weakly to well-developed, greenish brown. Flowers solitary, from older parts of the plant, pendant; peduncles 3-angular, 2.5–3.0 cm long, greenish brown; bracts verticillate, ovate to lanceolate, 3.0–3.5 × 1.5–2.5 cm, greenish, their margin obscurely dentate, without glands, free from the hypanthium; pedicels terete, 0.8–1.0 cm long; hypanthium campanulate, 1.0–1.5 cm long, glabrous, greenish. Sepals erect at anthesis, oblong-lanceolate to triangular, 3.4–3.8 × 1.5–1.8 cm, obtuse at base, rounded at apex, their adaxial surface greenish, abaxial surface white with purple spots; awn absent. Petals erect at anthesis, oblong-lanceolate, 3.0–4.0 × 0.8–1.0 cm, obtuse at base, rounded at apex, white with purple spots; corona with 6 series of filaments, the two outer series linear-hairy, slender, 6–7 cm long, inclined, slightly wavy at apex, 13–15 banded, red and white banded from the base to middle, whitish and purple banded, becoming white toward the apex, the third, fourth and fifth series equal. Filaments stout, tubicular, 2–3 mm long, inclined to erect, red and white banded, the sixth series of filaments stout, filiform, subulate, 8–9 mm long, inclined, red and white banded; operculum membranaceous, straight, with denticulate margin, purplish; trochlea absent; androgynophore 2.3–2.5 cm long, whitish; staminal filaments 7–8 mm long, greenish and slightly mottled with red-purple spots. Ovary glabrous, yellowish, 8–9 mm long, 2–3 mm diam.; styles with stigmas 1.2–1.3 cm long, yellowish. Fruits obovoid, ca 10 cm long, 6 cm diam., green.

Distribution and habitat

Passiflora carajasensis is only known from four areas in the National Forest of Carajás (FLONA of Carajás), as follows: Serra Norte N7, Salobo, road Serra Norte N3, and at the urban nucleus of Vale. In this region the altitudes vary between 500 and 700 m, with slightly flattened summits and less frequent occurrence of hilly mounds and sharp ranges (Viana et al. 2016). The species grows as a scandent vine at the border of ombrophilous forests or forests on canga, blooming in July, September and December and fruiting in February, March and July.

Conservation status

Passiflora carajasensis may be classified as endangered [EN B1ab(ii, iii) + B2ab(ii, iii)] (IUCN 2020). It is known from only four localities in the Carajás mountain range. Older collections (e.g. O.C. Nascimento & R.P. Bahia 1148, N.A. Rosa & M.F.F. da Silva 5296 and N.A. Rosa & M.F. Ferreira 5077) deposited in herbarium MG indicate that their localities in the FLONA of Carajás were destroyed or cleared by mining activities. The most recent collections were carried out in an ombrophilous forest reserve in the urban centre of Vale. The species habitat is fragmented and its EOO < 5000 km^2 and AOO < 500 km^2.

Similar species

Passiflora carajasensis belongs to the subgenus *Passiflora*, supersection *Laurifoliae* Killip ex Cervi (1997, p. 22), Feuillet and MacDougal (2003, p. 38), series *Quadrangulares* Feuillet and MacDougal (2003, p. 38), which constitutes a small complex of large-flowered and large-fruited passionflowers with 3–4-angulate-winged stems (Feuillet and MacDougal 1996). Actually this series is comprised of five species: *Passiflora alata* Curtis (1788, p. 66), *P. quadrangularis* Linnaeus (1759, p. 1248) and *P. phoenicea* Lindley (1833, p. 1603) with 4-angulate stem; *P. trialata* Feuillet and MacDougal (1996, p. 351) and *P. longifilamentosa* Koch et al. (2013, p. 43) with 3-angulate stem (Koch et al. 2013).

Additional specimens examined (paratypes)

Brazil, PARÁ: Parauapebas, [Marabá]: Serra Norte N7, 04 Feb 1985, fr, O.C. Nascimento & R.P. Bahia 1148 (MG115786); Salobo, 3-Alfa, Copper mine, 18 Jul 1990, fr, N.A. Rosa & M.F.F. da Silva 5296 (MG134953); Road for N3, 13 Mar 1988, fr, N.A. Rosa & M.F. Ferreira 5077 (MG134894); Urban nucleus of Vale, Karajá Avenue, 17 Jul 2019, fl., fr., M. Pastore & M.T.C. Watanabe 1059 (MG238755).

Key to species of *Passiflora* series Quadrangulares adapted from Koch et al. (2013)

1. Stems 4-angular; bracts ovate; corona with 4–6 series of filaments..... 2
   – Stems 3-angular; bracts ovate-triangular; corona with 6–12 series of filaments..... 4
2. Petioles with 2–8 glands..... 3
   – Petioles with 2 glands ..... *P. phoenicea*
3. Stipules ovate or ovate-lanceolate more than 1 cm wide; sepals not aristate..... *P. quadrangularis*
   – Stipules linear-lanceolate less than 1 cm wide; sepal aristate..... *P. alata*
4. Petioles with 2 glands; corona with 10–12 series..... *P. trialata*
   – Petioles with 4–6 glands; corona with 6–7 series..... 5
5. Stipules oblanceolate; leaf blades elliptic to obovate; bracts 4.3–5.0 × 2.0–3.1 cm; sepals and petals declined at anthesis; corona with 7 series..... *P. longifilamentosa*
   – Stipules linear-lanceolate; leaf blades long-ovate to oblong; bracts 3.0–3.5 × 1.5–2.5 cm; sepals and petals erect at anthesis; corona with 6 series..... *P. carajasensis*

Table 1. Comparison of morphological characteristics of of *Passiflora* species with 3-angular stems in the series *Quadrangulares*.

Characteristics	*P. carajasensis*	*P. longifilamentosa* (Koch et al. 2013)	*P. trialata* (Feuillet and MacDougal 1996)
Stipules			
Size	1.5–1.8 × 0.3–0.5 cm	1.3–1.5 × 0.2–0.3 cm	2.3–3.2 × 0.8–1.3 cm
Shape	linear-lanceolate	oblanceolate	narrowly ovate to narrowly oblong ovate
Leaves			
Petiole length	2.5–3.5 cm	2.0–2.5 cm	2.8–5.0 cm
Number of petiole gland	4–6	4	2
Petiole gland shape	ellipsoid	tubicular	narrowly ovoid
Leaf blade size	16.0–21.5 × 7.2–10.8 cm	13.0–14.0 × 6.4–6.6 cm	15.0–26.5 × 8.5–16.0 cm
Leaf blade shape	long-ovate to oblong	elliptic to obovate	ovate
Flower			
Peduncle length	2.5–3.0 cm	2.5–4.0 cm	4–7 cm
Bracts size	3.0–3.5 × 1.5–2.5 cm	4.3–5.0 × 2.0–3.1 cm	7.0–8.5 × 4.4–6.5 cm
Bracts shape	ovate to lanceolate	ovate to ovate-triangular	ovate-triangular
Hypanthium size	1.0–1.5 cm	1.0–1.5 cm	1.5–2.0 cm
Hypanthium shape	campanulate	campanulate	campanulate funnelform
Sepals size	3.4–3.8 × 1.5–1.8 cm	2.0–4.5 × 1.0–2.0 cm	4.4–6.0 × 1.8–2.5 cm
Sepals shape	oblong-lanceolate to triangular	oblong-lanceolate to triangular	ovate-triangular
Petals size	3.0–4.0 × 0.8–1.0 cm	2.0–4.0 × 0.8–1.2 cm	4.5–6.1 × 1.3–1.7 cm
Petals shape	oblong-lanceolate	oblong-lanceolate to triangular	oblong-lanceolate to narrowly triangular-oblong
Number of corona series	6	7	10–12
Outer series length	6–7 cm	6.5–8.0 cm	5.5–8.0 cm
Throchlea	absent	present	absent
Ovary size	8–9 × 2–3 mm	6–8 × 2–3 mm	11–13 × 5–6 mm
Staminal filaments length	7–8 mm	4–7 mm	2.8–3.2 mm
Style with stigmas length	1.2–1.3 mm	6–8 mm	8–9 mm

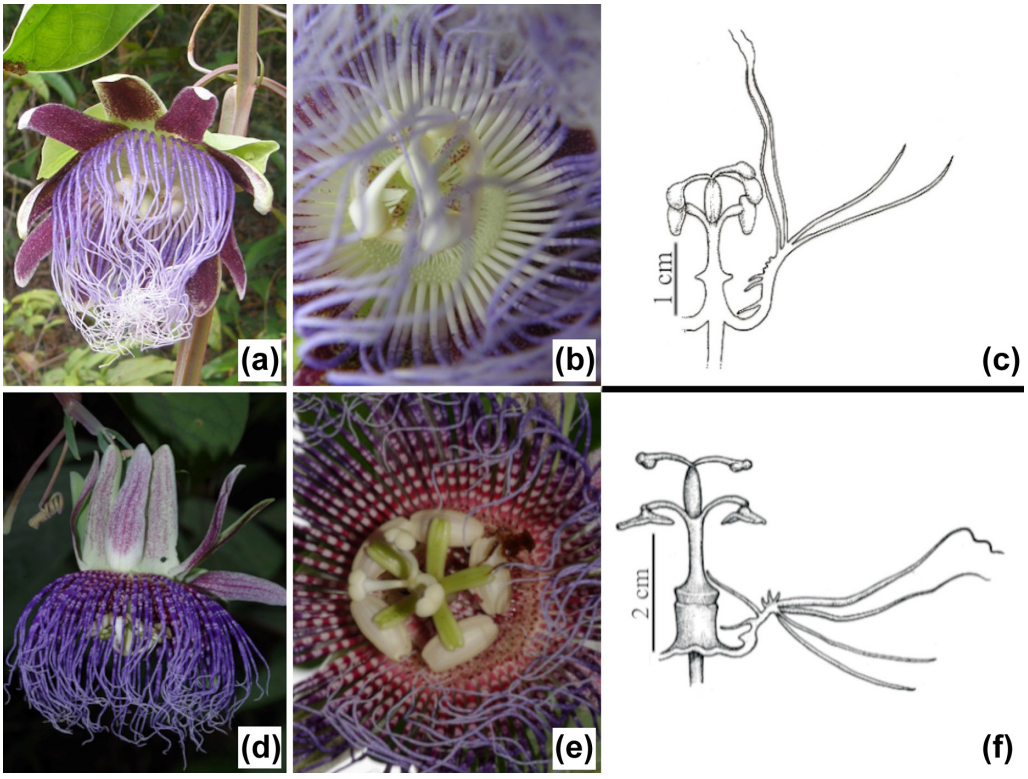

Figure 2. Comparison between *Passiflora carajasensis* and *P. longifilamentosa*. (Photos: (a–b) by J. B. F. da Silva; (d–e) by N. F. O. Mota; illustrations (c–f) by J. Silveira from type specimens.)

The new species is closely related to *P. longifilamentosa* and *P. trialata* as indicated by the 3-angular winged stems, 3-angular petioles and peduncles. A comparison of morphological characteristics of *Passiflora carajasensis* with *P. longifilamentosa* and *P. trialata* is provided in Table 1.

From *P. longifilamentosa*, the new species differ in stipule shape and size, petiole glands, leaf blade, size of bracts, absence of throchlea, length of staminal filaments and styles with stigmas, and number of corona series. Further differences are 1) the erect position of the sepals and petals at anthesis of *P. carajasensis* (versus declined position) and 2) the color of petals and outer series of filaments. In *P. carajasensis*, petals are white with purple spots, and the outer series of filaments are red and white banded from the base to middle, turning whitish and purple banded, and becoming white toward the apex. *Passiflora longifilamentosa*, instead, presents whitish green with marginally purple spotted petals, and outer series of filaments whitish and purple banded, becoming white toward the apex (Koch et al. 2013). The two species are illustrated in Fig. 2A–F.

Passiflora carajasensis is readily separated from *P. trialata* by the petioles with 2 glands and corona with 10–12 series, besides all other differences presented in Table 1. In *P. trialata*, petals are medium light purple to reddish purple, with fine reddish spots proximally in the center, and outer series of filaments white and purple banded, the bands purplish red basally, becoming violet toward the apex (Feuillet and MacDougal 1996).

Thitherto, *P. carajasensis* is known from the Carajás range in southeastern Pará (Brazil), while *P. longifilamentosa* was collected in a reforested area in Pará, ca 850 km away from the type locality of *P. carajasensis*, and in lowland rainforest in Saül, in central French Guiana (Koch et al. 2013). *Passiflora trialata* is only known from two localities of rainforest nearby Monts Tortue, in French Guiana (Feuillet and MacDougal 1996).

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Author contributions

Ana K. Koch: Conceptualization (equal); Data curation (equal); Formal analysis (equal); Funding acquisition (equal); Investigation (equal); Methodology (equal); Project administration (equal); Resources (equal); Supervision (equal); Validation (equal); Visualization (equal); Writing – original draft (equal); Writing – review and editing (equal). **Anna L. Ilkiu-Borges**: Conceptualization (equal); Data curation (equal); Formal analysis (equal); Funding acquisition (equal); Investigation (equal); Methodology (equal); Project administration (equal); Resources (equal); Supervision (equal); Validation (equal); Visualization (equal); Writing – original draft (equal); Writing – review and editing (equal).

References

BFG (The Brazil Flora Group) 2015. Growing knowledge: an overview of seed plants diversity in Brazil. – Rodriguésia 66: 1085–1113.
BFG (The Brazil Flora Group) 2018. Brazilian Flora 2020: innovation and collaboration to meet target 1 of the global strategy for plant conservation (GSPC). – Rodriguésia 69: 1513–1527.
Cervi, A. C. 1997. Passifloraceae do Brasil. Estudos do gênero *Passiflora* L., subgênero *Passiflora*. – Fontqueria 45: 1–92.
Cervi, A. C. and Linsingen, L. V. 2010. *Passiflora kikiana* a new species of Passifloraceae from the Brazilian Amazon. – Acta Bot. Bras. 24: 1062–1064.
Curtis, W. 1788. *Passiflora alata*. – The botanical magazine; or, flower-garden diplayed. – Sherwood, Neely, & Jones, London.
Feuillet, C. and MacDougal, J. M. 1996. *Passiflora trialata* (Passifloraceae), a new species of Granadilla (*Passiflora* subg. *Passiflora*) from French Guiana. – Novon 6: 351–355.
Feuillet, C. and MacDougal, J. M. 2003. A new infrageneric classification of *Passiflora* L. (Passifloraceae). – Studia Geomorphol. Carpatho-Balcanica 13: 34–38.
Fidalgo, O. and Bononi, V. L. R. 1984. Técnicas de coleta, preservação e herborização do material botânico. – Inst. de Botânica (Manual), São Paulo.
IUCN 2020. The IUCN red list of threatened species, ver. 2020/2. – IUCN Red List Unit, Cambridge, UK, <www.iucnredlist.org/>, accessed 20 Jul 2020.
Killip, E. P. 1938. The American species of Passifloraceae. – Field Mus. Nat. Hist. Bot. Ser. 19: 1–613.
Koch, A. K. and Ilkiu-Borges, A. L. 2016. Flora das cangas da Serra dos Carajás: Passifloraceae. – Rodriguésia 67: 1431–1436.
Koch, A. K. et al. 2013. A new species of *Passiflora* subgenus *Passiflora* series *Quadrangulares* (Passifloraceae) from the Brazilian Amazon. – Phytotaxa 104: 43–48.
Koch, A. K. et al. 2015. *Passiflora echinasteris*: a new species of subgenus *Passiflora*, series *Serratifoliae* (Passifloraceae) from the Brazilian Amazon. – Phytotaxa 208: 170–174.
Koch, A. K. et al. 2019. A new subspecies and taxonomic notes on *Passiflora* L. (Passifloraceae) in the Brazilian Amazon, Mato Grosso, Brazil. – Phytotaxa 402: 13–20.
Lindley, J. 1833. *Passiflora phoenicia*. – Edward's Botanical Register, London 19: 1603.
Linnaeus, C. 1753. Species Plantarum. – Imprensis Laurentii Salvii, Stockholm.
Linnaeus, C. 1759. Systema Naturae ed. 10, 2. – Impressis Laurentii Salvii, Stockholm, pp. 825–1384.
Mezzonato-Pires, A. C. 2018. *Passiflora bernaccii* (Passifloraceae *s.s.*), a new species from Acre, Brazil. – Phytotaxa 372: 229–235.
Mezzonato-Pires, A. C. et al. 2016. A new species of *Passiflora* subgenus *Astrophea* (Passifloraceae) from the Brazilian Amazon. – Phytotaxa 288: 77–84.
Souza, M. A. D. and Hopkins, M. J. G. 2011. *Passiflora fissurosa*: a new species of Passifloraceae from Amazon, Brazil. – Acta Amaz. 41: 449–452.
STCP Engenharia de Projetos Ltda. 2016. Plano de manejo da Floresta Nacional de Carajás. Vol. 1. Diagnóstico. – Engenharia de Projetos Ltda., Curitiba.
Ulmer, T. and MacDougal, J. M. 2004. *Passiflora*: passionflowers of the world. – Timber Press, Cambridge.
Vanderplank, J. and Zappi, D. 2011. *Passiflora cristalina*, a striking new species of *Passiflora* (Passifloraceae) from Mato Grosso, Brazil. – Kew Bull. 66: 149–153.
Viana, P. L. et al. 2016. Flora das cangas da Serra dos Carajás, Pará, Brasil: história, área de estudos e metodologia. – Rodriguésia 67: 1107–1124.