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## ***Brasilianthus* (Melastomataceae), a new monotypic genus endemic to ironstone outcrops in the Brazilian Amazon**

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### **Abstract**

A new monotypic genus, *Brasilianthus carajensis*, is described from Carajás Mineral Province where it is restricted to *campo rupestre* vegetation on ironstone outcrops (*canga*) that form island-like lenses nestled in the Amazon rainforest of southeastern Pará, Brazil. Among neotropical capsular-fruited Melastomataceae, *Brasilianthus* is distinguished by a unique combination of characters: annual habit; haplostemonous, 4-merous flowers; tubulose-subcylindric hypanthia with erect, narrowly obovate deciduous calyx lobes that are widest distally and well-spaced basally; short cupulate-campanulate anthers with a wide truncate apical pore; biaristate ventral staminal appendages; 4-locular ovary with an apex crowned by four persistent  $\pm$  deltoid appendages; absence of placental intrusions in mature capsules; and subcochleate seeds with a costate testa. These morphological characters are congruent with DNA sequence data that show *Brasilianthus* nested within the *Marcetia* alliance of the tribe Melastomeae where it is sister to *Nepsera aquatica*. These two genera are in turn sister to *Ernestia pullei* and *Appendicularia thymifolia*. A comprehensive description of *Brasilianthus* is presented together with diagnostic illustrations, images of plants in the wild, a distribution map, SEM images of seeds, a geospatial conservation assessment based on IUCN criteria, and comparisons with generic relatives in the *Marcetia* alliance.

**Key words:** haplostemony, *Marcetia* alliance, phylogeny, Serra dos Carajás, *canga*

### **Resumo**

Um novo gênero monotípico, *Brasilianthus carajensis*, é descrito da Província Mineral de Carajás, onde é restrito à vegetação de campo rupestre sobre afloramentos ferruginosos (*canga*), que formam ilhas rupestres na floresta amazônica no sudeste do estado do Pará, Brasil. Entre as espécies de Melastomataceae neotropicais com frutos capsulares, *Brasilianthus* distingue-se por uma combinação única de caracteres: hábito anual; flores tetrâmeras haplostêmones; hipanto tubuloso e subcilíndrico com lobos do cálice eretos, decíduos, estreitamente obovais, com a parte distal mais larga e base claramente espessada; anteras curtas, cupulado-campanuladas com um amplo poro apical truncado; apêndices ventrais estaminais biaristados; ovário tetralocular, com um ápice coroado por quatro apêndices  $\pm$  deltóides persistentes; ausência de intrusões da placenta em cápsulas maduras; e sementes subcoceadas com testa costada. Estas características morfológicas são congruentes com os dados de sequência de DNA que mostram *Brasilianthus* inseridos na aliança *Marcetia* da tribo Melastomeae, onde é grupo irmão de *Nepsera aquatica*. Estes dois gêneros são, por sua vez, grupo irmão de *Ernestia pullei* e *Appendicularia thymifolia*. Uma descrição completa de *Brasilianthus* é apresentada, assim como ilustrações diagnósticas, imagens das plantas no habitat, micrografia eletrônica de varredura de sementes, uma avaliação do estado de conservação com base em critérios da IUCN, e comparações com gêneros relacionados na aliança *Marcetia*.

**Palavras chave:** haplostêmones, aliança *Marcetia*, filogenia, Serra dos Carajás, *canga*

### **Introduction**

Melastomataceae, one of the 10 largest and most diverse families of flowering plants, is pantropical with over 65% of described species restricted to the western hemisphere. The melastomes constitute one of the five largest families of

angiosperms in Brazil. With 1,367 species, 894 (65.4 %) of which are endemic, Brazil is a stand-out for melastome diversity and endemism in the neotropics (BFG 2015). Many new species and even new genera of Melastomataceae continue to be described from this biodiversity-rich nation (Goldenberg & Amorim 2006; BFG 2015; Goldenberg *et al.* 2015). The factors that have contributed to Brazil's high biodiversity are many. Extremes of topography and climate have interacted to produce varied landscapes and a complex mosaic of vegetation zones and habitats. Brazil's size, orogenic history, climatic fluctuations, and long history as part of an island continent have also figured prominently in promoting this diversity. For plants, at least, edaphic factors (abiotic influences relating to the physical or chemical composition of the soil) have also been a driving force in the adaptive differentiation of species and in the structure and composition of plant communities (Rajakaruna 2004; Nunes *et al.* 2015).

Globally, metal-rich environments typically harbor floras characterized by high percentages of geographically restricted species (Silveira *et al.* 2015). Plants that grow on ironstone outcrops, in particular, are subjected to a number of stressful environmental factors. These outcrops are compact, hard substrates with shallow and patchy soils that are nutrient poor and highly acidic, and have a low water content. High UV exposure, daily thermal variations, and high levels of heavy metals present additional stress factors for plants of ironstone outcrops (Jacobi *et al.* 2007; Porto & Silva 1989; Giulietti *et al.* 1997; Vincent & Meguro 2008). These stress factors appear to have been important in the origin and limited distribution of the species proposed here.

The unusual capsular-fruited species of Melastomataceae described here was first collected over 45 years ago. It was recollected in the Serra dos Carajás in Pará, Brazil, in the course of an environmental impact study of this mountain range (Golder Associates Brasil 2010) and more recently during the ongoing Rupestral flora project focused on the cangas of the Serra dos Carajás by Museu Paraense Emílio Goeldi and the Instituto Tecnológico Vale. The more complete recent collections confirm the distinctiveness of this species based on a unique combination of morphological characters that include an annual habit; haplostemonous, 4-merous flowers; erect, obovate calyx lobes that are widest distally and constricted basally; short cupulate-campanulate anthers with a wide truncate apical pore; biaristate ventral staminal appendages; and subcochleate seeds with a costate testa. In addition to morphological features, we used DNA sequence data to evaluate the taxonomic status and phylogenetic placement of this enigmatic species. These data clearly dictate placement of this species in the informal grouping that has recently been referred to as the *Marcetia* Candolle (1828: 124) alliance of the tribe Melastomeae (Michelangeli *et al.* 2013; Rocha *et al.* 2016). However, it cannot be assigned to any of the 12 currently recognized genera in that grouping (Rocha *et al.* 2016). Given its distinctive assemblage of diagnostic characters and phylogenetic position within the *Marcetia* alliance we here propose a new monotypic genus, *Brasilianthus carajensis*, that is known only from the Carajás Mineral Province in the southern portion of Pará state, Brazil, where it is restricted to *campo rupestre* vegetation on ironstone outcrops (referred to locally as *canga*) that form island-like lenses nestled within the Amazon rainforest.

## Materials and Methods

In order to ascertain the phylogenetic position of *Brasilianthus*, DNA was extracted from one silica-preserved collection and two herbarium specimens using the Quiagen DNAEasy kit (Valencia, CA), following manufacturer protocols, with the modifications outlined by Martin *et al.* (2008) to provide higher quality DNA for amplification and sequencing in the Melastomataceae. Initially, in order to confirm the phylogenetic position within the *Marcetia* alliance, portions of the *rbcL*, *ndhF* and *rpl16* plastid loci were sequenced for all three accessions using the same primers and protocols outlined by Goldenberg *et al.* (2015). Since all three accessions yielded identical sequences for each of the three loci, one of them was included in the same concatenated matrix from Goldenberg *et al.* (2015) and analyzed under the same conditions outlined in that study. Because the level of variation and number of taxa available in Genbank for these three regions is not enough to ascertain the position of *Brasilianthus* within the *Marcetia* alliance, the nrITS region was amplified following protocols and primers outlined in Michelangeli *et al.* (2013) and Rocha *et al.* (2016). Two of the three accessions were successfully amplified and both yielded identical sequences. One of these nrITS sequences was included in the same concatenated matrix of the Rocha *et al.* (2016) analysis of the *Marcetia* clade. Phylogenetic analyses were run under maximum parsimony and Bayesian inference with identical conditions to those outlined in the Rocha *et al.* (2016) study. Voucher information and GenBank accession data included in this study are listed in Appendix I.

For scanning electron microscope (SEM) studies, seed samples were selected at random from good fruiting specimens and attached to aluminum specimen stubs using electroconductive tape. Seed samples were sputter-coated at



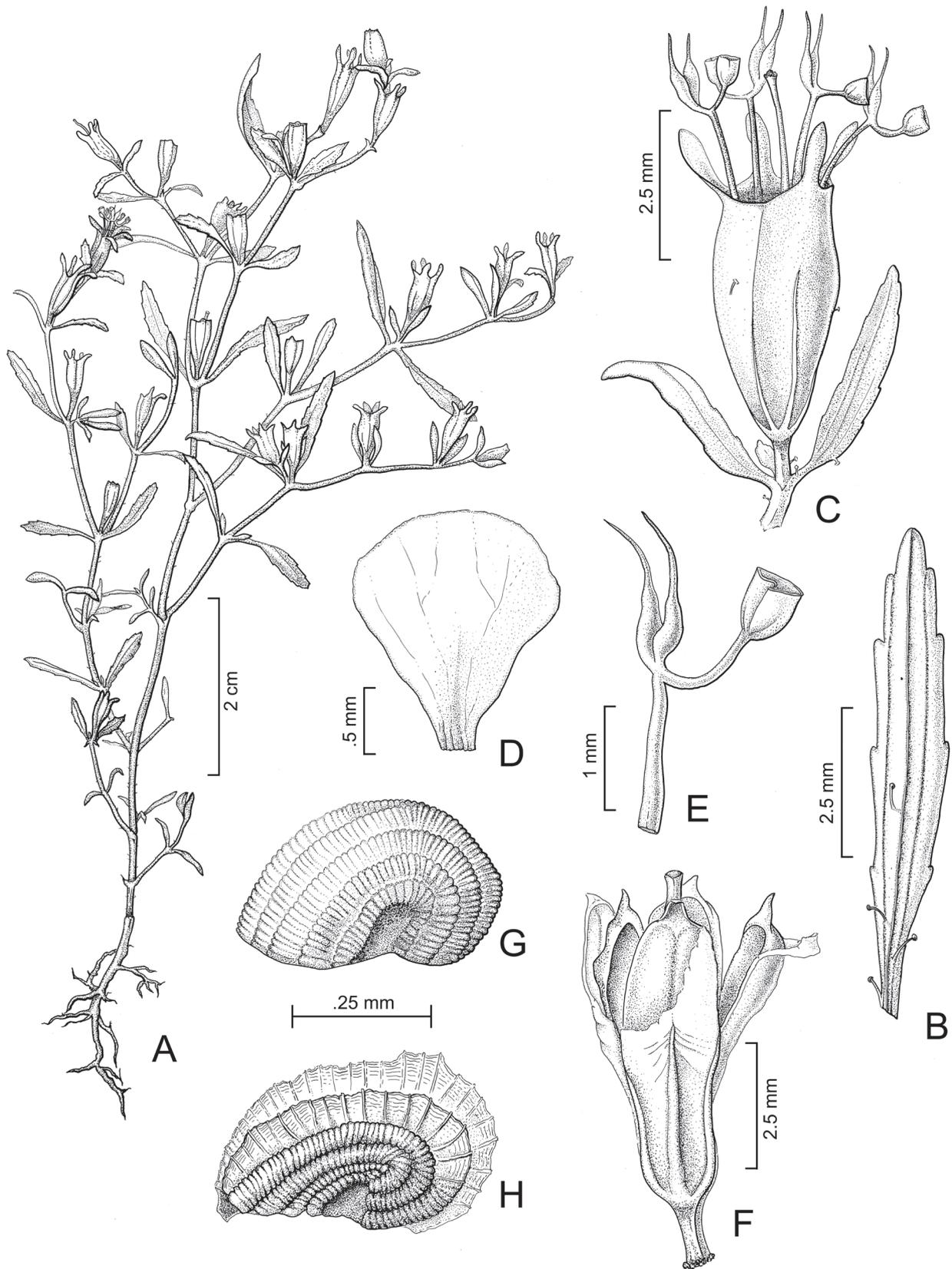
## Taxonomic treatment

### *Brasilianthus carajensis*, Almeda & Michelangeli, *gen. et sp. nov.* (Figures 2–3, 4 A–C)

Distinguished by its annual habit; haplostemonous, 4-merous flowers; tubulose-subcylindric hypanthium with erect, narrowly obovate calyx lobes; short cupulate-campanulate anthers with a wide apical pore; biaristate ventral staminal appendages; ovary apex crowned with four persistent erect  $\pm$  deltoid appendages; 4-locular ovary; absence of placental intrusions; and subcochleate seeds with a prominently costate testa.

Type: Brazil. Pará: Canaã dos Carajás, FLONA de Carajás, Serra dos Carajás, Serra do Tarzan, 6°19'31"S, 50°06'01"W, 702 m, 1 May 2015, P.L. Viana, A. Gil, N.F.O. Mota, A.L. Ilkiu-Borges & C.S. Nunes 5720 (holotype: MG!; isotypes: BHCBI, CAS!, K!, NY!, RB!).

Delicate, wiry annual herbs 4–38 cm tall, mostly sparingly and openly branched distally. Cauline internodes commonly red like the petioles, hypanthia, and some older leaf blades, quadrangular and carinate to narrowly and obscurely winged at least distally, sparsely hirtellous with smooth spreading gland-tipped trichomes 0.2–0.3 mm long. Nodes with a distinct but inconspicuous interpetiolar line, glabrous or with a few gland-tipped trichomes like those on the internodes. Leaves opposite, isomorphic in size and shape in each pair. Basal leaves early deciduous and typically not present on flowering or fruiting plants. Cauline leaves membranaceous to somewhat fleshy when fresh; petioles 1–2.5 mm long, sparingly beset with spreading gland-tipped trichomes 0.1–0.2 mm long; blades green on both surfaces, widely spreading, 4–20  $\times$  0.5–3.2 mm, linear-oblong to narrowly oblanceolate, 1–3-nerved, apex obtuse to bluntly rounded, base acute to attenuate, mostly glabrous on both surfaces but sometimes beset with a few scattered gland-tipped trichomes abaxially and small inconspicuous glandular trichomes mostly less than 0.5 mm long adaxially; the margins bluntly and distantly crenate to crenulate. Inflorescence a modified dichasium with widely spaced flowers that superficially appear solitary and terminal but also appearing lateral with the growth of axillary buds, the ultimate flowering branches elongating and becoming  $\pm$  monochasial or superficially appearing somewhat pseudospiciform in fruit; pedicel 1 mm long at anthesis, the subtending leaves somewhat reduced in size but otherwise like the principal leaves. Flowers 4-merous and haplostemonous. Hypanthium (at anthesis) 3–4  $\times$  1–1.5 mm, tubulose-subcylindric to narrowly obovoid, 8-ribbed, mostly glabrous and appearing alveolate when fresh but drying smooth and thinly papery. Calyx lobes 4, erect, 1.75–2.8 mm long, 0.5–0.75 mm wide distally at the widest point, narrowly obovate, glabrous on both surfaces, crenulate distally, commonly red at the constricted base, green and  $\pm$  foliaceous distally, deciduous (sometimes tardily so) on mature hypanthia, spaced 0.5 mm apart on the torus at the distal end of the hypanthium at anthesis; calyx tube obsolete. Petals 1.9–2.9  $\times$  0.9–2(–2.5) mm, obovate, lilac sometimes fading to a pale lilac or almost white, widely spreading at anthesis, glabrous throughout, entire and eciliate. Stamens 4 (these antesealous), isomorphic; filaments 1.75–2 mm long,  $\pm$  compressed, glabrous, lavender or lilac, declined to one side of the flower opposing the style; anthers 0.5  $\times$  0.5 mm, purple, cupulate-campanulate, the wide  $\pm$  truncate apical pore 0.5 mm across; connective not conspicuously thickened dorsally but prolonged 0.75 mm into an ivory-colored pedoconnective below the thecae, the pedoconnective geniculate with the filament insertion and modified at its juncture with the filament into an erect or incurved biaristate ventral appendage 1–1.5 mm long that is ivory-colored along the dilated base but lavender on the subulate distal lobes; staminodia absent. Ovary (at anthesis) superior, narrowly obovoid. Style 2–2.5 mm long, declined to one side of the flower opposing the stamens, lavender to mauve, stigma capitate and white when fresh but appearing capitellate when dry. Pedicels lengthening to 1.75–2 mm on fruiting hypanthia, glabrous. Mature hypanthia narrowly tubulose-subcylindric to narrowly campanulate, 5–6  $\times$  2 mm, thin, papery, rupturing irregularly and flaking away with age. Mature loculicidal capsules 5–6  $\times$  1.5–2 mm, 4-locular, prominent placental intrusions lacking (the seeds stacked in two vertical columns per locule), glabrous throughout and crowned with four persistent (but sometimes inconspicuous) erect  $\pm$  deltoid appendages 0.5–0.75 mm long and 0.5–0.75 mm wide at the base that are apically acute to bluntly rounded. Seeds subcochleate and prominently costate on the chalazal side, beige to pale brown, 0.49–0.79 mm long and 0.43–0.54 mm high; lateral symmetrical plane elliptic, the highest point toward the chalazal side; antiraphal symmetrical plane elliptic. Raphal zone circular to widely obovate, ca. 50% of the length of the seed. Multicellular sculpture a pattern of longitudinal ridges on both the lateral and antiraphal sides. Cells arranged in an aligned pattern. Individual cells elongated, anticlinal boundaries raised and straight; periclinal walls flat and lacking microrelief. Cells in the areas between the ridges differing in having boundaries with a few clavate appendages or sometimes the boundaries not evident.



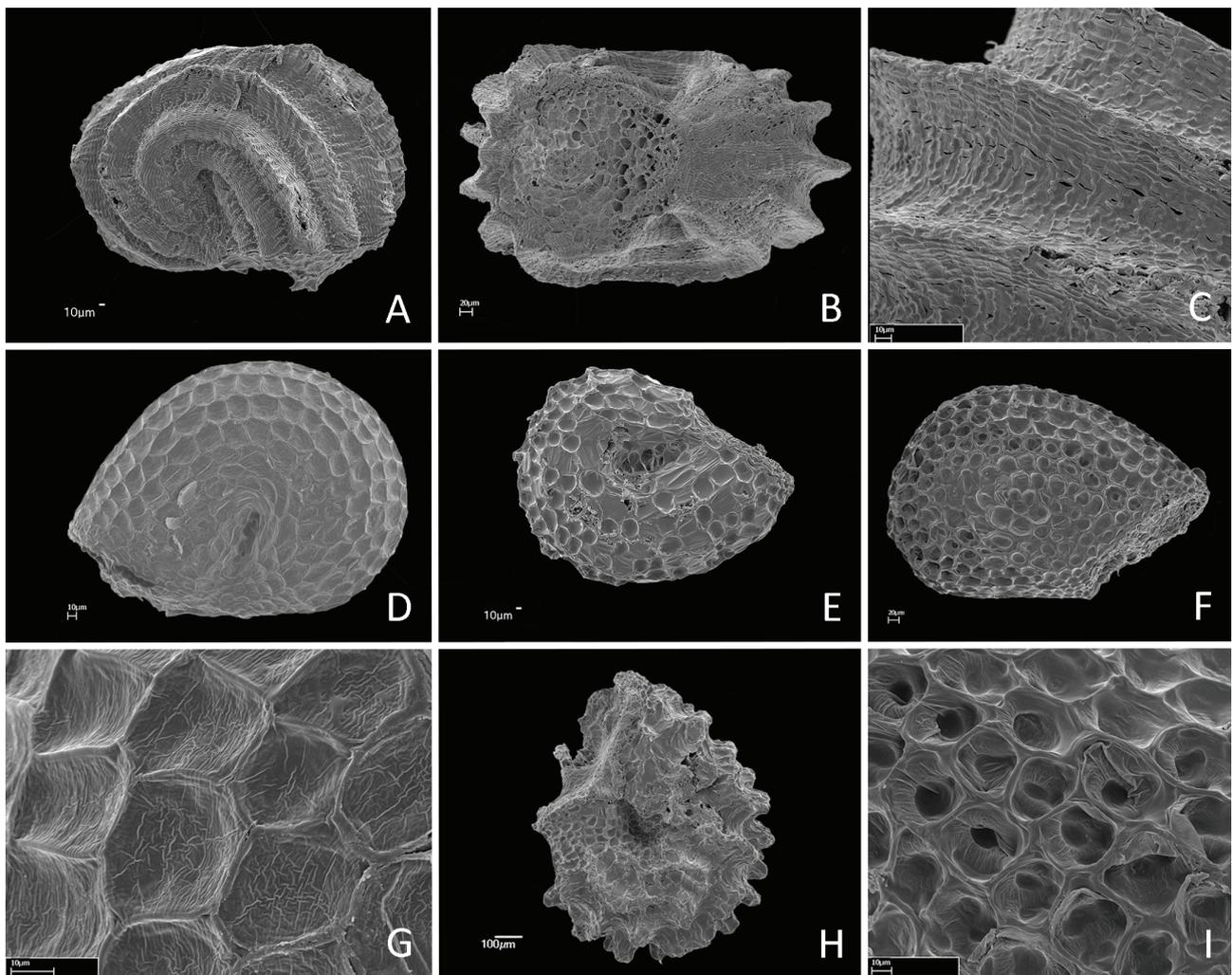
**FIGURE 2.** *Brasilianthus carajensis*. **A.** Habit. **B.** Cauline leaf (abaxial surface). **C.** Flower (at anthesis) with subtending leaves. **D.** Petal. **E.** Stamen (profile view). **F.** Dehiscent loculicidal capsule showing crown of four deltoid appendages and irregularly rupturing hypanthium. **G–H.** Seeds. (A–E, G–H drawn from *Silva et al.* 1760, US; F drawn from *Sperling et al.* 5619, US).



**FIGURE 3.** Images of *Brasilianthus carajensis*. **A.** *Brasilianthus carajensis* on canga substrate. **B.** Habit of mature unpigmented plant. **C.** Habit of mature pigmented plant. **D.** Flowers with pale, nearly white, petals. **E.** Flower (at anthesis) with typical lilac/lavender petals. **F.** Habit showing foliar posture and shape. **G.** Profile view of flower (at anthesis) showing posture of stamens, appendages, style, and stigma. **H.** Mature hypanthium showing alveolate surface (when fresh) and erect calyx lobes with constricted base. **I.** Flower (profile view) with subtending leaves. All photographs by P.L. Viana.

**Phenology:**—Collected in flower and fruit from December through May. This is largely coincident with the rainy season in this part of the eastern Amazon which extends from December to April (Piló *et al.* 2015).

**Distribution and habitat:**—A majority of the 44 collections of *Brasilianthus* are from the easternmost region of the Serra dos Carajás (Figure 5). This serra of pre-Cretaceous age is enclosed by the Araguaia and Itacaiúnas rivers. It is located about 540 km south of Belém in southeastern Pará, Brazil, and has an elevational range of 300 to 800 m (Soubies *et al.* 1991; Silva 1993; Cleef & Silva 1994; Piló *et al.* 2015). On the Serra dos Carajás, this species can be locally common on the ferruginous ironstone upland ridges that are covered with iron breccia generically known as *canga* (Piló *et al.* 2015). The word *canga* describes the open, rocky habitats with a savanna vegetation cover on iron ore outcrops that are nestled within the more widespread rainforest that covers much of the Carajás mountain range. *Brasilianthus* appears to grow only in these non-forest vegetation habitat islands that have been variously described as *canga* vegetation, banded ironstone formations (BIF), ferruginous shrubby or herbaceous *campo rupestre*, and even metallophile savanna (Nunes *et al.* 2015). Virtually all of the known collections come from habitats described as *vegetação rupestre*, *campo graminoso* on *canga*, and lake margins in *canga*. At the beginning of the rainy season it is often first noted along margins of lakes that dot this landscape at 580–760 m elevation.

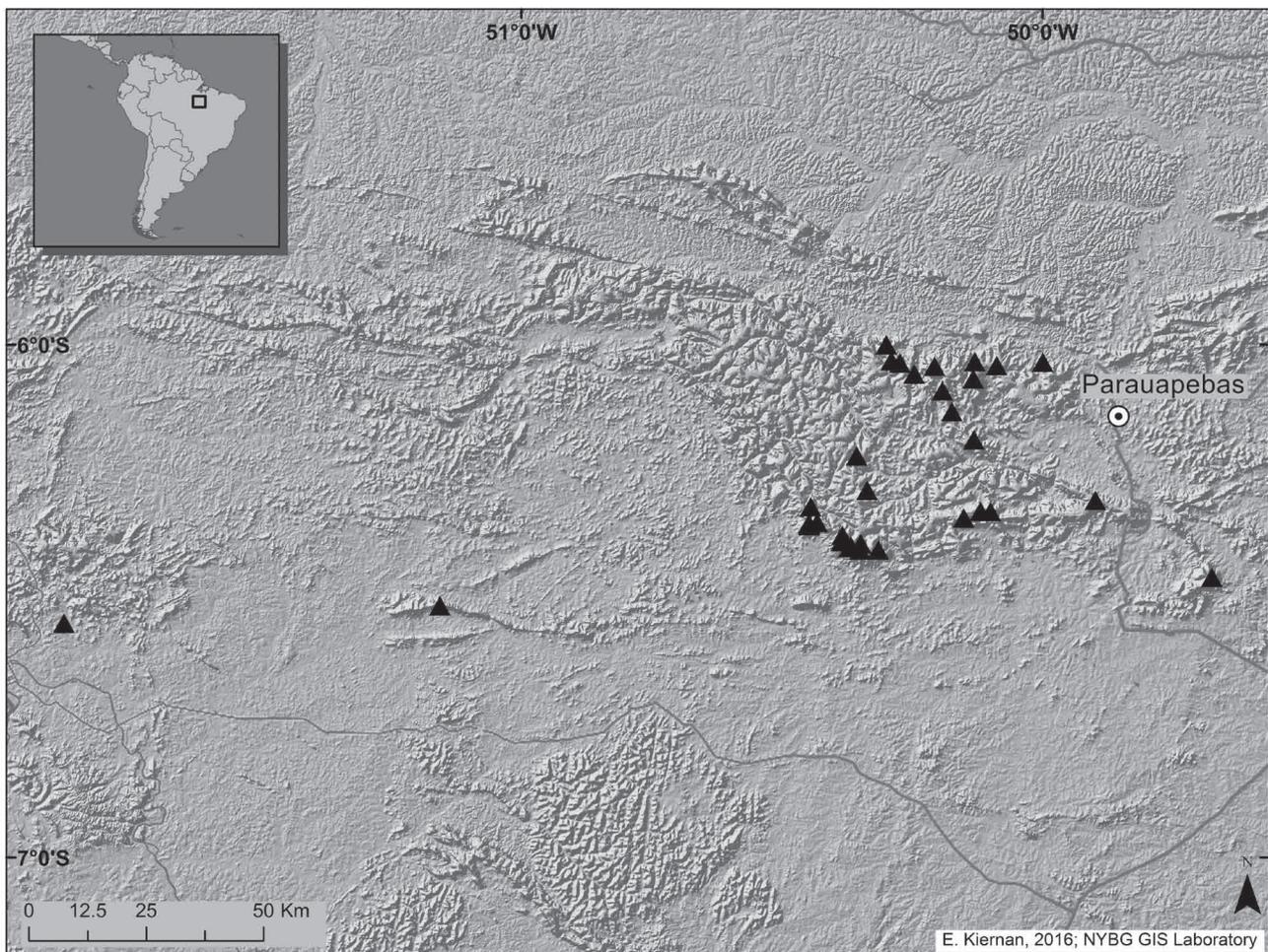


**FIGURE 4.** Scanning electron micrographs of seeds of *Brasilianthus*, *Appendicularia*, *Nepsera*, and *Ernestia*. **A.** *Brasilianthus carajensis* (Viana *et al.* 5261, NY). **B, C.** *Brasilianthus carajensis* (Rosa *et al.* 4607, US). **A.** profile view. **B.** view of raphal zone. **C.** costate ridges and testa. **D, G.** *Appendicularia thymifolia* (Cremers & Hoff 10740, CAS). **D.** profile view. **G.** enlarged portion of testa. **E.** profile view of *Ernestia rubra* (Maguire 54197, NY). **H.** profile view of *Ernestia confertiflora* (Pires 50980, NY). **F, I.** *Nepsera aquatica* (Wilbur & Moore 70136, CAS). **F.** profile view. **I.** enlarged portion of testa. Scale bars: A = 10  $\mu$ m, B = 20  $\mu$ m, C = 10  $\mu$ m, D = 10  $\mu$ m, E = 10  $\mu$ m, F = 20  $\mu$ m, G = 10  $\mu$ m, H = 100  $\mu$ m, I = 10  $\mu$ m.

An initial inventory of the vertebrate fauna of the Carajás National Forest has recently been completed and a plan for environmental diversity conservation has been proposed that addresses the search for compatibility between mineral exploration and biodiversity conservation (Martins *et al.* 2012). Information on the ecology and natural history

of many vertebrate groups is still needed to adequately evaluate their conservation status. The flora of the forest and the *canga* uplands is diverse but it is imperfectly known and still being explored. The *canga* habitats, in particular, represent a unique isolated ecosystem in the Amazon and in Minas Gerais, Brazil, with high biodiversity and notable endemism (Jacobi *et al.* 2007; Vincent & Meguro 2008; Golder Associates Brasil 2010; Oliveira *et al.* 2014; Skirycz *et al.* 2014; Piló *et al.* 2015; Salas *et al.* 2015).

**Conservation status:**—The distribution of *Brasilianthus carajensis* appears to be centered in the easternmost section of the Serra dos Carajás with two outlying populations in mountains somewhat west of this serra (Figure 5). On the Serra dos Carajás, *Brasilianthus* occurs within the limits of a conservation area called the FLONA de Carajás (Carajás National Forest) that was established in early 1998 (Figure 5). The Forest covers 411,949 ha of protected area (Piló *et al.* 2015) but it allows certain types of usage, including mining activities. The open cast mining activities in the region present a major threat to its biodiversity because the iron ore deposits of the Serra are considered to be the largest in the world (Martins *et al.* 2012; Piló *et al.* 2015). Because only 3% of the over 400,000+ ha protected zone is covered by the *canga* habitat, urgent conservation management measures are needed to protect the high alpha and beta diversity of these extraordinary habitat islands (Nunes *et al.* 2015; Piló *et al.* 2015). The few known collection localities for *Brasilianthus* outside of the FLONA de Carajás currently have no protected status. The extent of occurrence (EOO) for *B. carajensis* is 7,210.048 km<sup>2</sup> and the area of occupancy (AOO) is 112 km<sup>2</sup>. Using IUCN guidelines and criteria and considering its archipelago-like distribution and restriction to *canga* islands, annual habit with potential for wide fluctuations in the number of maturing individuals each year, and ongoing threat of expanded mining activities that could drive this species to extinction in a short period of time, we assign this species a conservation assessment of Endangered [EN B2ab(iii)].



**FIGURE 5.** Geographic distribution of *Brasilianthus carajensis* with collection localities represented by triangles.

**Etymology:**—The generic name, *Brasilianthus*, combines the country name, Brasil, and the Greek work for a flower, “anthus.” The specific epithet, *carajensis*, emphasizes the limited geographic distribution of this monotypic genus in the Carajás Mineral Province of southeastern Pará.

**Additional specimens examined:**—BRAZIL. Pará: Canaã dos Carajás, S11D, vegetação rupestre sobre *canga*,

6°23'41"S, 50°19'11"W, 26 January 2012, *A.J. Arruda, L.V. Costa, M.O. Pivari, T.J. Battituci, F.A. de Paula, M.L. Gontijo & B.D. Ranieri* 492 (BHCB!); Parauapebas, Serra Bocaina, 6°18'12"S, 49°53'56"W, 8 March 2012, *A.J. Arruda, L.V.C. Costa & N.F.O. Mota* 642 (BHCB!); Parauapebas, Mirante do Granito, 6°17'02"S, 50°20'13"W, 580 m, 22 March 2012, *A.J. Arruda, P.L. Viana, F.M. Santos, P.B. Meyer, P.J. Battituci* 780 (BHCB!, NY!); Parauapebas, N-6, campo gramíneo sobre canga, 6°07'50"S, 50°10'27"W, 25 March 2012, *A.J. Arruda, P.L. Viana, F.M. Santos, P.B. Meyer, P.J. Battituci & L.J. Arruda* 845 (BHCB!); Parauapebas, N-6, 6°07'50"S, 50°10'27"W, 697 m, 25 March 2012, *A.J. Arruda, P.L. Viana, F.M. Santos, P.B. Meyer, P.J. Battituci & L.J. Arruda* 861 (BHCB!, NY!); Parauapebas, N-3, 6°02'30"S, 50°12'28"W, 694 m, 27 March 2012, *A.J. Arruda, P.L. Viana, F.M. Santos, P.B. Meyer, P.J. Battituci & L.J. Arruda* 902 (BHCB!, NY!); Parauapebas, N-2, 6°03'25"S, 50°14'48"W, 724 m, 19 April 2012, *A.J. Arruda, F.M. Santos, L.J. Arruda & T.J. Battituci* 952 (BHCB!, NY!); Canaã dos Carajás, FLONA de Carajás, Lagoa do Amendoim, Serra Sul, 6°23'44"S, 50°22'17"W, 12 April 2015, *L.M.M. Carreira, T. Guimarães, A. Dias, T. Rodrigues, C. Maurity & D. da Silva* 3350 (MG!); Canaã dos Carajás, FLONA de Carajás, rampa que dá acesso a lagoa Três Irmãs, Serra Sul, 6°20'58"S, 50°26'57"W, 17 April 2015, *L.M.M. Carreira, T. Guimarães, A. Dias, T. Rodrigues, C. Maurity & D. da Silva* 3406 (MG!); Canaã dos Carajás, FLONA de Carajás, encosta de pedras que margeia a lagoa Três Irmãs, Serra Sul, 6°21'09"S, 50°26'54"W, 20 April 2015, *L.M.M. Carreira, T. Guimarães, A. Dias, T. Rodrigues, C. Maurity & D. da Silva* 3448 (MG!); Parauapebas (Marabá), escassa camada de humus, 6°00'S, 50°18'W, 700 m, 21 May 1969, *P.B. Cavalcante* 2091 (MG!); Parauapebas (Marabá), Serra dos Carajás, Platô, rocha de minério de ferro, 6°00'S, 50°18'W, 700 m, 21 May 1969, *P.B. Cavalcante* 2100 (MG!); Parauapebas (Marabá), Norte, 18 April 1970, *P.B. Cavalcante & M. Silva* 2620 (MG!); Parauapebas (Marabá), nas fendas e furos do lagedo, N1, 20 April 1970, *P.B. Cavalcante & M. Silva* 2670 (MG!); Parauapebas, Serra dos Carajás, N5, without date, *P.P. Chaves, L.C.B. Lobato & P. Melo* 23 (MG!); Parauapebas, Floresta Nacional dos Carajás, Serra Norte, N1, 6°02'08"S, 50°16'26"W, 750 m, 11 March 2009, *V.T. Giorni, P.L. Viana, L.V.C. Silva, D.F. Silva* 83 (BHCB!); Canaã dos Carajás, Floresta Nacional dos Carajás, Serra do Tarzan, 6°20'16"S, 50°09'06"W, 750 M, 14 March 2009, *V.T. Giorni, P.L. Viana, L.M. Versieux, L.C. Garcia, L.V.C. Silva & T.S. Silva* 145 (BHCB!); Canaã dos Carajás, Floresta Nacional dos Carajás, Serra Sul, 6°23'01"S, 50°23'10"W, 753 m, 16 March 2009, *V.T. Giorni, P.L. Viana, L.M. Versieux, L.C. Garcia, L.V.C. Silva & D.S. Silva* 179 (BHCB!); Canaã dos Carajás FLONA de Carajás. Serra Sul / S11D Lagoa do Amendoim, 6°23'54"S, 50°22'19"W, 1 December 2015, *R. Goldenberg* 2229, *P.L. Viana, N. Mota, A. Salino, A. Gil, A. Giulietti-Harley* (UPCB); Parauapebas, Serra dos Carajás, Platô N4, 8 January 2010, *L.C.B. Lobato, L.V. Ferreira & P. Prestes* 3764 (MG!); Parauapebas, Platô N4, 6°05'23"S, 50°11'33"W, 13 March 2015, *L.C.B. Lobato, F. Peixoto, L.V. Ferreira & A. Rodrigues* 4311 (MG!); Canaã dos Carajás, Ao longo da Estrada S11 até S11A, 6°22'17"S, 50°23'04"W, 22 March 2015, *L.C.B. Lobato, F. Peixoto, L.V. Ferreira & A. Rodrigues* 4373 (MG!); Canaã dos Carajás, S11D, margem de lagoa Natural, 6°24'S, 50°21'01"W, 20 March 2012, *P.B. Meyer, A.J. Arruda, P.L. Viana, F.M. Santos, T.J. Battituci & L.J. Arruda* 1133 (BHCB!); Parauapebas, N8, campo rupestre sobre canga entremeado campos gramíneos e brejos, 6°11'08"S, 50°07'56"W, 23 March 2012, *P.B. Meyer, A.J. Arruda, P.L. 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*M.G. Silva & R. Bahia 2921* (MG!-pro parte, MO!, NY!, P-pro parte); Serra dos Carajás, 2 km W of AMZA camp N-5, ca. 700 m, 13 May 1982, 6°04'S, 50° 08'W, C.R. Sperling, R.S. Secco, M. Condon, A.L. Mesquita, B.G.S. Ribeiro, & L.R. Marinho 5619 (F!, NY!, US! [2]); Canaã dos Carajás, S11D, 6°23'17"S, 50°20'57"W, 7 December 2007, P.L. Viana, L.V.C. Silva, L.C. Garcia, N.F.O. Mota, G.M. Maciel & D.F. Silva 3359 (BHCB!); Canaã dos Carajás, S11A, 6°18'57"S, 50°26'43"W, 737 m, 21 March 2012, P.L. Viana, F.S. Marino, A.J. Arruda, T.B. Jorge, P.M. Burkowski 5258 (BHCB!, NY!); Canaã dos Carajás, S11A, 6°20'48"S, 50°25'57"W, 711 m, 21 March 2012, P.L. Viana, F.S. Marino, A.J. Arruda, T.B. Jorge, P.M. Burkowski 5261 (BHCB!, NY! [2]); Parauapebas, FLONA de Carajás, Serra dos Carajás, N1, 6°02'03"S, 50°16'14"W, 705 m, 26 March 2015, P.L. Viana, A.M. Giuliatti, R.M. Harley, A. Cardoso & A.P.O. Cruz 5564 (MG!); São Félix do Xingu, Serra de Campos, 6°32'34"S, 51°52'40"W, 660 m, 01 May 2016, P.L. Viana, A.M. Giuliatti, M.T. Watanabe, C.W. Maurity 6132 (MG!); Ourilândia, Serra Arqueada, 6°30'33"S, 51°09'23"W, 633 m, 03 May 2016, P.L. Viana, A.M. Giuliatti, M.T. Watanabe, C.W. Maurity 6213 (MG!); Curionópolis, Serra do Cristalino, 6°27'12"S, 49°40'32"W, 760 m, 04 May 2016, P.L. Viana, A.M. Giuliatti, M.T. Watanabe, C.W. Maurity 6220 (MG!).

**Discussion:**—The suite of diagnostic morphological characters that provides a strong rationale for recognizing *Brasilianthus* as a new genus include its annual habit; haplostemonous, 4-merous flowers; tubulose-subcylindric hypanthium with erect, narrowly obovate deciduous calyx lobes that are widest distally and well-spaced basally; short cupulate-campanulate anthers with a wide truncate apical pore; biaristate ventral staminal appendages; 4-locular ovary with an apex crowned by four persistent, erect  $\pm$  deltoid appendages; absence of placental intrusions in mature capsules; and subcochleate seeds with a prominently costate testa (Figures 2–3, 4 A–C). This combination of characters is not found among any of the 12 genera currently assigned to the *Marcetia* alliance, the grouping to which *Brasilianthus* clearly belongs based on morphological and molecular data. The *Marcetia* alliance has recently been characterized by its 4-merous flowers, number of ovary locules equal to the number of petals (4 or reduced to 2–3 locules), absence of trichomes on the ovary apex, and seeds that are cochleate, ovate, or lacrimiform (Michelangeli *et al.* 2013; Rocha *et al.* 2016). All of these characters are consistent with *Brasilianthus*.

The annual habit of *Brasilianthus* is also notable, but this abbreviated life cycle has evolved in several neotropical genera of Melastomataceae that grow in disturbed or seasonally water-stressed savanna or rocky environments (Wurdack 1963; Almeda & Robinson 2011).

Haplostemony (flowers with petals and stamens that are equal in number), which is clearly a derived character state in the family, is rare among Melastomataceae generally. For genera of the *Marcetia* alliance it is a consistent character state for only five of the 15 species of *Siphanthera* (Almeda & Robinson 2011). Among other capsular-fruited neotropical Melastomataceae it is a characteristic feature of the Cyphostyleae (Michelangeli *et al.* 2011, 2014), one species of *Cambessedesia* (Candolle 1828: 110), one species of *Monochaetum* (Candolle 1828: 138) Naudin (1845: 48–49), one species of *Poteranthera* (Bongard 1838: 137), and one species of *Pterolepis* (Candolle 1828: 140) (Martins 1984; Alvear 2010; Kriebel 2012; Almeda & Martins 2015). In the Cyphostyleae, the capsular fruits are derived from inferior ovaries. *Brasilianthus* is like all the other haplostemonous taxa mentioned above in having capsular fruits derived from superior ovaries.

The short cupulate-campanulate anther thecae (Figures 2E, 3G) of *Brasilianthus* are unique and not known to us in any other neotropical capsular-fruited genus of Melastomataceae. When we first examined specimens with good open flowers we suspected that the anthers had been chewed by pollen-robbing insects but examination of additional specimens, dissections of mature flower buds, and field observations confirmed that this unusual anther morphology is natural and not the result of insect-induced damage. The short anther with a wide-rimmed pore is reminiscent of anthers that have been damaged by the dystrophic feeding behavior of *Trigona* (Apidae: Meliponinae) bees that typically perforate and ultimately sever anthers close to their base in search of pollen (Almeda 1977; Renner 1983). According to Roubik (1989), tropical bees that damage flowers to collect pollen are exclusively meliponines that seek out anthers of nectarless buzz-pollinated flowers visited only by bees. Since the flowers of *Brasilianthus* are nectarless, it is possible that its anther morphology may provide a visual cue that mimics a ravaged anther and thus deceives and discourages dystrophic feeding by *Trigona* bees.

Nothing is known about the pollinator spectrum of *Brasilianthus* or whether the species is self-compatible. The short anthers with wide pores do not seem to lend themselves to the thoracic vibration by bees (sonication or buzz-pollination) that is typical for a majority of species in the family (Buchmann 1983; Renner 1989; Willmer 2011). If the species is self-compatible, these anthers could also conceivably function as splash cups since flowering is coincident with the rainy season and the receptive stigma (Figure 3G) provides a suitably large juxtaposed target for airborne pollen. Field studies are needed to determine exactly how these unusual flowers are pollinated.

Within the *Marcetia* alliance, *Brasilianthus* groups with two other monotypic genera, *Appendicularia thymifolia*

and *Nepsera aquatica*, along with *Acanthella sprucei*, and some species of *Ernestia* (Candolle 1828: 121) to form a well-supported clade informally designated as *Nepsera* and allies (Rocha *et al.* 2016). The relationships within the *Marcetia* alliance are not altered by the inclusion of *Brasilianthus*; our results are identical to those of Rocha *et al.* (2016) except for the addition of this new taxon.

All of the taxa that group with *Brasilianthus* differ by their suffrutescent or woody perennial habit (except *Appendicularia*), diplostemonous 4-merous flowers (vs. haplostemonous), persistent calyx lobes that are widest at the base, slightly to markedly dimorphic linear-subulate stamens, hypanthia that persist and envelop maturing capsules, and unadorned ovary apices. *Acanthella*, the most divergent entity in this assemblage, is readily separated by its petals that are yellow-orange and flushed at the base with red, short or obsolete pedoconnectives, small and inconspicuous bilobed ventral staminal appendages, and prominently winged seeds borne on prominent placental intrusions. *Nepsera* is also distinctive by virtue of its 5–7-nerved ovate to ovate-elliptic leaves, terminal laxly branched multiflorous panicle, subulate stamens that are somewhat dimorphic in size with bluntly acute bilobed ventral appendages, 3-locular globose capsules with conspicuous placental intrusions, and cochleate seeds with a foveolate testa of isodiametric cells (Figures 4F, 4I). *Appendicularia* shares an annual habit and lack of placental intrusions with *Brasilianthus*. The diplostemonous flowers of *Appendicularia* have dimorphic stamens. It also has similar prolonged pedoconnectives and ventrally bilobed appendages that are dilated basally but distinctly aristate distally. It also differs conspicuously from *Brasilianthus* in other features. It has flowers that are borne in subsecund terminal cymes, campanulate hypanthia with oblate calyx lobes, a 3-locular ovary, and cochleate seeds with a foveolate testa of isodiametric cells that have striate microrelief on the periclinal walls (Figures 4D, 4G). *Ernestia pullei* also shares the distinctive staminal morphology of *Appendicularia* and *Brasilianthus* but it differs from the latter in being shrubby with 5-nerved ovate to ovate-elliptic leaves, hypanthia that are suburceolate and distinctly constricted distally in fruit, a 3-locular ovary with placental intrusions, and cochleate seeds with a distinctly tuberculate testa reminiscent of *Ernestia confertiflora* (Figure 4H), a closely related species.

It is important to note that no synapomorphy or unique character combination has been found for the *Nepsera* clade or for the clade recovered here that includes *Brasilianthus*, *Nepsera*, *Appendicularia*, and *Ernestia pullei*. Given the distinctive anther morphology, the unique combination of characters, and the lack of diagnostic characters or character combinations for the more inclusive clades, we believe that the best solution is to recognize this unusual species as a new monotypic genus.

Among the collections cited here, *Silva & Bahia 2921* at MG and P are mixed collections of *Brasilianthus carajensis* and *Cuphea carajasensis* Lourteig (1987: 13), another *canga* endemic in the Lythraceae with superficially similar narrow leaf blades. The sheets of *Silva & Bahia 2921* at MO and NY are entirely *Brasilianthus*.

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**Appendix I:** List of GenBank accession numbers for sequences of *Brasilianthus carajensis* newly generated for this study. Plastid data were added to the concatenated matrix for all Melastomataceae from Goldenberg *et al.* (2015). Nuclear data were added to the concatenated plastid and nuclear matrix for the *Marcetia* alliance from Rocha *et al.* 2016.

	Voucher	Herbarium	Locus	Accession Number
<i>Brasilianthus carajensis</i>	Goldenberg, R., 2229	UPCB	ndhF	KX765168
<i>Brasilianthus carajensis</i>	Silva, L. V. C., 1205	NY	rbcL	KX765169
<i>Brasilianthus carajensis</i>	Silva, L. V. C., 1205	NY	rpl16	KX765170
<i>Brasilianthus carajensis</i>	Goldenberg, R., 2229	UPCB	nrITS	KX765167