

1 Three new species of *Bertolonia* (Melastomataceae) from Espírito Santo, Brazil

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18 **ABSTRACT**

19 We describe and illustrate three new species of *Bertolonia*, all endemic to the state of Espírito
20 Santo, Brazil. *Bertolonia duasbocaensis* and *B. macrocalyx* occur close to each other, in the
21 municipalities of Cariacica and Viana. *Bertolonia ruschiana* has a wider distribution, occurring
22 in the municipalities of Santa Leopoldina, Santa Maria de Jetibá and Santa Teresa. The first two
23 species are respectively classified as endangered (EN) and critically endangered (CR), and the
24 latter as lower risk (LR). We also present an identification key for the species of *Bertolonia* that
25 occur in Espírito Santo.

Keywords. Atlantic Forest; Bertoloniaeae; endemism; taxonomy.

INTRODUCTION

Bertolonia Raddi is a Neotropical genus of Melastomataceae endemic to the Atlantic Forest biome (Baumgratz, 1990; Bacci et al., 2016). The genus was previously classified as a member of tribe Bertoloniaeae, together with other genera of Melastomataceae that are also herbs with ~~obtriquetrous~~ ~~obtriquetrous~~-capsular fruits, like *Monolena* Triana ex Bent. & Hook. f., *Salpinga* Mart. ex DC. and *Triolena* Naudin (Clausing & Renner, 2001). Nevertheless, the tribe is not monophyletic, and *Monolena*, *Salpinga* and *Triolena* actually belong to a different evolutionary lineage (Goldenberg et al., 2012). Inside the Atlantic Forest Biome, the species of *Bertolonia* occur mostly in the Atlantic Rainforest (“Floresta Ombrófila Densa Submontana/Montana”, following the official Brazilian system – Veloso et al., 1991). It has 22 taxa, including *Bertolonia margaritacea* Naudin [until recently recognized as *Salpinga margaritacea* (Naudin) DC.; see Bacci et al., 2016 and Goldenberg et al., 2016]. *Bertolonia* species are small, perennial herbs that inhabit moist and shaded areas. They grow on forest litter, directly on rocks or on shallow soils, on decaying logs or as epiphytes on the base of tree trunks (frequently tree ferns). The plants are usually glandulose-punctate or also with other types of trichomes, rarely glabrous (Baumgratz, 1990). The inflorescences are scorpioid cymes and the fruits are obtriquetrous (Baumgratz, 1990), bertolonidium-type capsules (following Baumgratz, 1983–1985).

Four new species of *Bertolonia* have been described in the last five years (Baumgratz et al., 2011; Bacci et al., 2016; Silva-Gonçalves et al., 2016), three from the state of Bahia and one from Rio de Janeiro. According to “Flora do Brasil” (Baumgratz, 2016), there should be only five species of *Bertolonia* occurring in the state of Espírito Santo: *Bertolonia formosa* Brade, *B. foveolata* Brade, *B. maculata* DC., *B. sanguinea* Saldanha ex Cogn. and *B. wurdackiana* Baumgratz. Since the specimens that have been mentioned as *B. sanguinea* actually belong to one of the three new species described here, the total number for *Bertolonia* in Espírito Santo should rise to seven species, which makes this state the second richest, after Rio de Janeiro (8 species), but before Bahia (6 species; Baumgratz, 2016). Espírito Santo was originally and almost entirely covered by the Atlantic Forest Biome (Fundação SOS Mata Atlântica & INPE, 1993). Nowadays only about 10% of the original vegetation remains preserved (Fundação SOS Mata Atlântica & INPE, 2014). Despite of the small remaining forested area and the relatively

homogenous vegetation, Espírito Santo has several rare, endemic and threatened species of both fauna and flora, and can be considered a biodiversity hotspot (Dutra et al., 2015).

We describe here three new species of *Bertolonia* that are endemic to Espírito Santo, Brazil. We also provide an identification key for the species that occur in Espírito Santo, comparisons with closely related species, information about distribution and conservation status, and illustrations of living and dry specimens.

MATERIAL AND METHODS

The authors have been collecting *Bertolonia* in Espírito Santo since 2008. Specimens were collected and processed following the usual ~~precedures~~procedures for botanical specimens (Mori et al., 1989). Morphological descriptions follow Radford (1974), Baumgratz (1985-1987) and Baumgratz (1990). The study was based on literature (Baumgratz, 1990, Baumgratz et al., 2011, Bacci et al., 2016) and the analysis of specimens at CEPEC, MBM, MBML, NY, RB, UPCB, VIES (acronyms according to Thiers, 2016). Ecological and geographic distribution data were also obtained from herbarium labels. Conservation status assessments were based on range size (criterion B), according to IUCN (2014). The Extension of Occurrence (EOO) and Area of Occupancy (AOO) were calculated through GeoCAT (Bachman et al., 2011). Collection permits were issued by the “Instituto Estadual do Meio Ambiente” (IEMA/Espírito Santo: 14489/07) for the plants inside “Reserva Biológica de Duas Bocas” and by the “Instituto Chico Mendes de Conservação e Biodiversidade (ICMBio: 49043-2) for the plants inside the “Reserva Biológica Augusto Ruschi”.

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84 "<http://ipni.org/>". The online version of this work is archived and available from the following
85 digital repositories: PeerJ, PubMed Central, and CLOCKSS.

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87 RESULTS

88 Key to the species of *Bertolonia* from the state of Espírito Santo, Brazil.

- 89 1. Leaves with bullate/foveolate surfaces 2
90 1'. Leaves with flat surfaces 3
91 2. Petioles villose; sepals with entire margins; petals 5.5–7 mm long *B. foveolata*
92 2'. Petioles hirsute; sepals with long-laciniate margins; petals 7.8–8.3 mm long
93 *B. wurdackiana*
94 3. Abaxial and/or adaxial surfaces of the leaf blade permanently covered with sessile and short
95 stalked glands and also long unbranched trichomes. 4
96 3'. Both surfaces of the leaf blade covered with only sessile and short stalked glands 5
97 4. Petioles hirsute at the apex; flowers 17–22 mm long; sepals fleshy, with short-laciniate
98 margins; petals with eciliate margins; anther connective with a dorsal appendage *B. formosa*
99 4'. Petioles glandulose-pilose or glandulose-villose; flowers 11–13 mm long; sepals
100 membranaceous, with entire margins; petals with the margins ciliate at the apex; anther
101 connective unnapendaged *B. maculata*
102 5. Hypanthium covered with only sessile or short stalked glands; sepals with an acute apex;
103 petals 6–6.5 mm long, widely obovate *B. ruschiana*
104 5'. Hypanthium covered with sessile or short stalked glands and also with unbranched trichomes;
105 sepals truncate; petals 7–12 mm, irregularly elliptic 6
106 6. Flowers 13.3–14.7 mm long; calyx external teeth ca. 1 mm long, triangular, covered with only
107 sessile and short stalked glands; petals long-apiculate (ca. 1 mm long), the apiculus without an
108 unbranched trichome its tip *B. duasbocaensis*

109 6'. Flowers 9.5–11.2 mm long; calyx external teeth ca. 2 mm long, ovate, covered with sessile
110 and short stalked glands and also long-stalked glands (0.6–0.8 mm long); petals short-apiculate
111 (ca. 0.5 mm long), the apiculus with an unbranched trichome its tip *B. macrocalyx*

113 ***Bertolonia duasbocaensis*** Bacci & R.Goldenb. *sp. nov.*

114 ▲ (Figs 1, 2)

115 **Type.** Brazil. Espírito Santo: Mun. Cariacica, Reserva Biológica Duas Bocas. Localidade de
116 Alegre, trilha do Pau-Oco. Floresta Ombrófila Densa Montana 20°16'4"S 40°31'30"W 525 m, 18
117 January 2009, fl., *R. Goldenberg, C.N. Fraga, P.H. Labiak, R.C. Forzza, A.P. Fontana, L.C.*
118 *Kollmann* and *P.B. Schwartzburd* 1249 (holotype: UPCB!; isotypes: CEPEC!, MBML!).

119 **Diagnosis.** *Bertolonia duasbocaensis* is similar to *B. formosa*. The new species has petioles and
120 leaves covered only with sessile or short-stalked glands (vs. petioles hirsute and leaves also
121 covered with unbranched trichomes in *B. formosa*), smaller flowers (13.3–14.7 mm long vs. 17–
122 22 mm long in *B. formosa*), inconspicuous and truncate sepals with triangular external teeth (vs.
123 conspicuous, 3.2–3.7 mm long ~~sepals~~sepals, these rounded and lacking external teeth) and by the
124 petals with the apex covered with sessile or short-stalked glands (vs. petals glabrous).

125 **Description.** Herbs 10–35 cm tall, terrestrial, reptant; adventitious roots branched, growing from
126 several points along the stem, but larger next to its base; stem 3–5 mm thick, terete and slightly
127 costate, the older portions plagiotropic and aphyllous, the young ones erect and bearing leaves.
128 Branches, leaves, inflorescences and bracts with sparse to dense, sessile or short-stalked (then
129 less than 0.1 mm long) glands, young branches also with sparse unbranched trichomes. Leaves
130 opposite, occasionally subopposite; petioles 3–9.5 cm long, quadrangular, slightly costate,
131 covered with the same trichomes as the branches; blade 7.8–11.7 × 4.5–9 cm, flat, ovate to
132 elliptic, chartaceous, base rounded to slightly cordate, apex rounded to slightly acute, margins
133 entire to slightly crenulate and ciliate, adaxial surface dark-green, whitish along the primary
134 vein, sparsely covered with sessile glands, otherwise glabrescent, abaxial surface light-green or
135 lilac, sparsely covered with sessile glands, veins three to five, plus a shorter marginal pair that do
136 not reach the leaf apex, basal, main veins at the abaxial surface with pocket domatia at their
137 bases. Thyrsoids 4.5–10.7 cm long, terminal (but pseudo-lateral in older, fruiting specimens),

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138 with one pair of paraclades, these cymose, scorpioid, the branches greenish to light-pink;
139 bracteoles 0.5–0.8 mm long, narrow-lanceolate, apex acuminate, both surfaces covered only with
140 sessile glands. Flowers 5-merous, 13.3–14.7 mm long, on pedicels ca. 2 mm long, light green,
141 densely covered with sessile and short-stalked glands. Hypanthium light green, $2.5\text{--}2.7 \times 2$ mm,
142 widely campanulate, 10-costate, with the same indument as the pedicel, seldom with scattered
143 unbranched trichomes in its the upper half. Calyx caducous on fruits, tube ca. 0.7 mm long,
144 sepals truncate, external teeth ca. 1 mm long, green to slightly vinaceous, triangular, apex acute,
145 margins entire, eciliate, both surfaces with the same indument as the pedicels. Petals white, with
146 light-pink or light-purple apex, $10.8\text{--}12 \times 4.5\text{--}5$ mm, irregularly elliptic, base slightly attenuate,
147 apex acute and apiculate (ca. 1 mm long), the apiculus bending outwards (to the abaxial surface
148 of the petal), lacking trichomes at its tip, margins entire, both surfaces papillose, adaxial surface
149 apex sparsely covered with sessile or short-stalked glands. Stamens 10, 6–7 mm long,
150 isomorphic; filaments 3.5–4 mm long, slightly widened at the base; thecae yellow, 2–3 mm long,
151 oblong-subulate, slightly undulate, pore apical, introrse; connective prolonged ca. 1 mm below
152 the thecae, dorsally thickened [appendage](#). Ovary free, apex glabrous, 3-locular, placentation
153 axillary; style ca. 5 mm long, curved at the apex, glabrous; stigma slightly capitate, papillose.
154 Capsules bertolonidium-type, $4\text{--}5 \times 4.5\text{--}6$ mm, obtriquetrous; seeds 0.4–0.5 mm long, triangular,
155 tuberculate on the dorsal angles and apex.

156 **Distribution and conservation status.**—*Bertolonia duasbocaensis* has been collected a few
157 times since 2008, mostly along the same trail (“Pau-Oco”) inside Duas Bocas Biological
158 Reserve, but with one specimen occurring in a private property near the Reserve. The Biological
159 Reserve is a fully protected area, kept by the state government (IEMA/ES). It is located in the
160 municipality of Cariacica, in central Espírito Santo, between $20^{\circ}14'40''\text{S} - 20^{\circ}18'30''\text{S}$ and
161 $40^{\circ}28'01''\text{W} - 40^{\circ}32'07''\text{W}$. Its 2910 ha are covered with well-preserved Atlantic Rainforest that
162 protects threatened species of both fauna and flora (Novelli, 2010). In the last five years, three
163 new plant species were described from Duas Bocas: *Eugenia amorimii* Fraga & Giaretta
164 (Giaretta & Fraga, 2014), *Leandra magnipetala* R. Goldenb. & E. Camargo (Camargo &
165 Goldenberg 2011), and *Ouratea cauliflora* Fraga & Saavedra (Fraga & Saavedra, 2014). The
166 plants occur in shaded and moist slopes at 500–600 m elev. *Bertolonia duasbocaensis* was
167 collected with flowers in January and February and with fruits in January, February and July.
168 According to IUCN (2014) criteria B1ab(ii) + B2ab(ii), with EOO (Extent of Occurrence) = 2.235

169 km² and AOO (Area of Occupancy) = 12.000 km², this species should be classified as
170 “endangered” (EN). It was collected only in two locations, one of them in a private property.

171 **Paratypes.** Brazil. Espírito Santo: Mun. Cariacica, 10 January 2007, fl. and fr., *A.P. Fontana* et
172 al. 2584 (MBML!, RB!, UPCB!); 10 January 2007, fl., *L. Kollmann* et al. 9457 (MBML!); 20
173 July 2008, fr., *A.M.A. Amorim* et al. 7571 (CEPEC!, RB!, UPCB!); 22 July 2008, fr., *R.*
174 *Goldenberg* 1210 (CEPEC!, MBML!, RB!, UPCB!); 15 February 2008, fl. and fr., *R.C. Forzza*.
175 et al. 5035 (CEPEC!, MBML!, RB!, UPCB!). Mun. Viana, Arredores da Reserva
176 Biológica Duas Bocas, São Paulo de Viana, prop. do Valtinho, 700 m, 19 January 2009, fl. and
177 fr., *R. Goldenberg* et al. 1257 (MBML!, RB!, UPCB!).

178 **Etymology**— The epithet “*duasbocaensis*” refers to the Duas Bocas Biological Reserve, the type
179 locality of the new species.

180 **Remarks.** *Bertonia duasbocaensis* is characterized by the ovate to elliptic leaves with rounded
181 to slightly cordate bases, ciliate margins, 3–5 main veins, and covered only with sessile and
182 short-stalked glands, the widely campanulate hypanthium, truncate sepals, triangular external
183 calyx teeth, apiculate petals with the apex of the adaxial surface covered with sessile or short-
184 stalked glands, and oblong-subulate stamens with a dorsally thickened appendage. The new
185 species closely resembles *B. formosa*, also endemic of the state of Espírito Santo. For more
186 details on the distinction between the two of them, see the diagnosis above.

187 *Bertonia hoehneana* Brade, *B. nymphaeifolia* Raddi and *B. sanguinea* share with the new
188 species the leaves with cordate bases and also the branches and adaxial surface of the leaves
189 covered only with sessile or short stalked glands. The first is a rare species, endemic to the state
190 of São Paulo (Baumgratz, 1990; Baumgratz, 2016) and differs by the leaves with a cordate-
191 lobate base (vs. rounded to slightly cordate in *B. duasbocaensis*), eciliate margins (vs. ciliate
192 margins) and an acute, attenuate, or sometimes acuminate apex (vs. rounded to slightly acute),
193 by the smaller flowers (10–13 mm long vs. 13.5–15 mm long) with the hypanthium covered only
194 with sessile or short-stalked glands (vs. covered also with scattered unbranched trichomes,
195 mostly on its upper half) and sepals widely ovate, lacking external teeth (vs. sepals truncate, with
196 external teeth). Both *Bertonia nymphaeifolia* and *B. sanguinea* are endemic to the state of Rio
197 de Janeiro and differ from the new species by the bigger leaves, with 7–9 and 5–7 acrodromous
198 veins, respectively (vs. 3–5 in *B. duasbocaensis*), petioles hirsute at the base or seldom on the

Comentado [PJFG1]: The variation is greater in the description: “margins entire to slightly crenulate and ciliate”

Comentado [PJFG2]: “short-stalked glands” Not present in the description of the leaf blade.

whole petiole (vs. petioles covered with sessile or stalked glands, the young ones sometimes with caducous, unbranched trichomes), longer flowers, 18–23 mm long in *B. sanguinea* (vs. shorter ones, 13.3–14.7 mm long in *B. duasbocaensis*) and by the long subulate stamens with an acute extension at the apex, forming a tube below the apical pore (vs. oblong-subulate stamen, without the extension at the apex). The morphology of the calyx is also different: *B. nymphaeifolia* has widely ovate, membranaceous sepals with fleshy, rounded external teeth, this forming a concave cavity on the sepals and *B. sanguinea* has fleshy, widely ovate sepals lacking external teeth (Baumgratz 1990), while *B. duasbocaensis* has truncate sepals with a triangular external teeth.

Bertolonia duasbocaensis closely resembles *B. macrocalyx*; both are endemic of Espírito Santo and occur very close to each other. The differences between both species are listed in the diagnosis of *B. macrocalyx* (see below).

210

211 ***Bertolonia macrocalyx*** Bacci & R.Goldenb. *sp. nov.*

212 (Figs. 3, 4)

213 **Type.** Brazil. Espírito Santo: Mun. Viana, Arredores da Reserva Biológica Duas Bocas. São
214 Paulo de Viana, beira da estrada. Floresta Ombrófila Densa Montana 20°18'3"S 40°32'48"W 575
215 m, 17 January 2009, fl., *R. Goldenberg, C.N. Fraga, P.H. Labiak, R.C. Forzza, A.P. Fontana,*
216 *and P.B. Schwartzburd* 1235 (Holotype: UPCB; Isotypes: CEPEC, MBML).

217 **Diagnosis.** *Bertolonia macrocalyx* is similar to *B. duasbocaensis*. Both species have similar
218 vegetative morphology, but *B. macrocalyx* has the calyx with longer (ca. 2 mm long), ovate and
219 ciliate external teeth (vs. shorter, ca. 1 mm long, triangular and eciliate in *B. duasbocaensis*),
220 short-terete hypanthium (vs. widely campanulate hypanthium), smaller, 7–8.5 × 3–3.5 mm petals
221 with the upper half of the adaxial surface densely covered with sessile and short-stalked glands
222 (vs. bigger 10.8–12 × 4.5–5 mm petals, with only the apex of the adaxial surface sparsely
223 covered with sessile and short-stalked glands).

224 **Description.** Herbs ca. 20 cm tall, terrestrial or rupicolous, reptant; adventitious roots branched,
225 growing from several points along the stem, but larger next to its base; stem ca. 3 mm thick,
226 quadrangular and slightly costate, the older portions plagiotropic and aphyllous, the young ones

227 erect and bearing leaves. Branches, leaves, inflorescences and bracts with sparse to dense, sessile
228 or short stalked (then less than 0.1 mm long) glands. Leaves opposite, occasionally subopposite;
229 petioles 1.5–5.3 cm long, quadrangular, slightly costate, covered with the same trichomes as the
230 branches, also with unbranched trichomes, denser at the apex; blade 10–13.5 × 4.7–6.3 cm, flat,
231 ovate, narrowly elliptic to lanceolate, chartaceous, base slightly cordate, apex rounded to slightly
232 acute, margins entire to slightly crenulate and ciliate, adaxial surface dark-green, sometimes light
233 green along the primary vein, abaxial surface light-green or lilac, veins three to five, plus a
234 shorter marginal pair that do not reach the leaf apex, basal, main veins at the abaxial surface with
235 pocket domatia at their bases. Thyrsoids 11.3–16.2 cm long, terminal (but pseudo-lateral in
236 older, fruiting specimens), with one pair of paraclades, these cymose, scorpioid, the branches
237 greenish to light-pink; bracteoles ca. 0.5 mm long, linear to narrow-lanceolate, apex aristate and
238 tipped with one glandular trichome ca. 0.5 mm long, both surfaces covered only with sessile
239 glands. Flowers 5-merous, 9.5–11.2 mm long, on pedicels 1.5–2 mm long, light pink, densely
240 covered with sessile and short stalk glands. Hypanthium light green, 2.5–2.7 × 2 mm, short-
241 terete, 10-costate, ridges pink, the ones between the external teeth ending in one trichome, with
242 the same indument as the pedicel, also with unbranched trichomes, on the ridges at the apex of
243 the hypanthium. Calyx caducous on fruits, tube ca. 0.8 mm long, sepals truncate, external teeth
244 ca. 2 mm long, with the abaxial surface pinkish, abaxial light green, covered with the same
245 trichomes as the pedicels and also with unbranched trichomes (0.6–0.8 mm long) on the adaxial
246 surface, ovate, apex rounded, margins entire, ciliate at the apex. Petals white, with light-pink
247 apices, 7–8.5 × 3–3.5 mm, irregularly elliptic, base slightly attenuate, apex acute and apiculate
248 (ca. 0.5 mm long), the apiculus bending outwards (to the abaxial surface of the petal), ending in a
249 long unbranched trichome, margins entire, both surfaces papillose, upper half of the adaxial
250 surface densely covered with sessile and short stalked glands. Stamens ten, 6–6.5 mm long,
251 isomorphic; filaments 3.5–4 mm long, slightly widened at the base; thecae yellow, 2–2.5 mm
252 long, oblong-subulate, slightly undulate, pore apical, introrse; connective prolonged ca. 1.5 mm
253 below the thecae, with a dorsal calcar, ca. 0.3 mm long. Ovary free, apex glabrous, 3-locular,
254 placentation axillary; style ca. 5 mm long, curved at the apex, glabrous; stigma slightly capitate,
255 papillose. Capsules bertolonidium-type (following Baumgratz 1983–1985), 3.5–5 × 4.5–5.3 mm,
256 obtriquetrous; seeds unknown.

257 **Distribution and conservation status.** *Bertolonia macrocalyx* is endemic to the state of Espírito
258 Santo. It had been collected only twice, both in 2008. The species occurs just outside the limits
259 of the Duas Bocas Biological Reserve, in the municipality of Viana, (Fig. 7). The area is covered
260 with well-preserved Atlantic Rainforest. *Bertolonia macrocalyx* was collected near a local
261 roadside and in a private property. It occurs in shaded and moisty slopes, with flowers in January
262 and with old fruits in January, May and June. According to IUCN (2014) criteria B2ab(iii), AOO
263 (Area of Occupancy) = 8.000 km², this species should be classified as “critically endangered”
264 (CR). It has been collected only two times, one of them inside a protected area.

265 **Paratypes.** Brazil. Espírito Santo: Mun. Cariacica, Reserva Biológica Duas Bocas, São Paulo
266 Viana, beira da estrada 575 m, 06 May 2008, fr., C.N. Fraga et al. 2049 (CEPEC!, MBML!,
267 UPCB!).

268 **Etymology.** The epithet “*macrocalyx*” refers to the calyx with long external teeth, one of the
269 diagnostic features of the new species.

270 **Remarks.** *Bertolonia macrocalyx* is characterized by the short petioles (1.5–5.3 cm long)
271 covered with sessile and short stalked glands and also with unbranched trichomes at the apex,
272 leaves with 3 main veins, both surfaces covered with sessile and short stalked glands,
273 hypanthium short-terete, light green with pinkish ridges, calyx with truncate sepals and external
274 teeth light green on the abaxial surface, ovate and ciliate (trichomes mostly at the apex), petals
275 with the upper half densely covered with sessile and short-stalked glands, short-apiculate, with
276 the apiculus ending in an unbranched trichome, and stamens oblong-subulate, with a dorsally
277 thickened connective appendage.

278 *Bertolonia duasbocaensis* also has petals with the apex covered with sessile and short stalked
279 glands, but they are concentrated at the apex of the adaxial surface and are much more sparsely
280 distributed when compared with *B. macrocalyx*. Another diagnostic feature of *B. macrocalyx* is
281 the morphology of the calyx. The sepals are truncate (like *B. duasbocaensis*), but with a long (ca.
282 2 mm), ovate and ciliate external teeth. For more details, see the comments above on *Bertolonia*
283 *duasbocaensis*

285 ***Bertolonia ruschiana*** Bacci & R.Goldenb. *sp. nov.*

Comentado [PJFG3]: The variation is greater in the description “veins three to five”

Comentado [PJFG4]: It makes no sense because these differences are described here only. “The differences between both species are listed in the diagnosis of *B. macrocalyx* (see below).”

286 (Figs. 5, 6)

287 **Type.** Brazil. Espírito Santo: Mun. Santa Teresa, Reserva Biológica Augusto Ruschi. Beira da
288 estrada para Goiapaba-Açu, após a entrada da Reserva. Floresta Ombrófila Densa Montana
289 19°52'38"S 40°32'20"W 800 m, 14 January 2016, fl. and fr., *L.F. Bacci*, *T. Bochner* and *M.*
290 *Bolson* 321 (Holotype: UEC!; Isotypes: CEPEC!, MBML!, NY!, UPCB!).

291 **Diagnosis.** *Bertolonia ruschiana* is similar to *B. nymphaeifolia*. Both have branches, adaxial
292 surface of the leaves, pedicels and hypanthium covered only with sessile or short stalked glands,
293 white petals with a pinkish apex, hypanthium widely campanulate and a fleshy calyx with widely
294 ovate sepals. The new species differs by the leaves with 5 main acrodromous veins (vs. 7–9 main
295 acrodromous veins in *B. nymphaeifolia*) and with ciliate margins (vs. eciliate margins), petioles
296 covered with sessile and short-stalked glands, seldom with unbranched trichomes (vs. petioles
297 covered with sessile and short-stalked glands, and also hirsute), shorter flowers (8–9 mm long vs.
298 12–15 mm long), petals apex covered with sessile and short stalked glands on the adaxial surface
299 (vs. petals apex glabrous) and ovary apex glabrous (vs. ovary apex covered with glands).

300 **Description.** Herbs 10–40 cm tall, terrestrial, seldom rupicolous, reptant; adventitious roots
301 branched, growing from several points along the stem, but larger next to its base; stem 4–7 mm
302 thick, terete and slightly costate, the older portions plagiotropic, aphyllous, the young ones erect
303 and bearing leaves. Branches, leaves, inflorescences and bracts with sparse to dense, sessile or
304 short stalked (then less than 0.1 mm long) glands. Leaves opposite, occasionally subopposite;
305 petioles 1.5–6.4 cm long, quadrangular, costate, covered with the same trichomes as the
306 branches, seldom with scattered unbranched trichomes at the apex; blade 9–18.5 × 4.5–10.5 cm,
307 flat, ovate, elliptic to wide elliptic, chartaceous, base slightly cordate, apex rounded to slightly
308 acute, sometimes mucronulate, margins crenulate and ciliate, adaxial surface dark-green or with
309 a whitish stripe along the primary vein, covered with sessile glands, abaxial surface light-green
310 or lilac, covered with sessile or short stalked glands, seldom with small unbranched trichomes on
311 the marginal veins, veins five, plus a shorter marginal pair that do not reach the leaf apex, basal,
312 main veins at the abaxial surface strongly marked. Thyrsoids 3.2–9.5 cm long, terminal (but
313 pseudo-lateral in older, fruiting specimens), with one pair of paraclades, these cymose, scorpioid,
314 the branches greenish to light-brownish; bracteoles 0.5–0.6 mm long, narrow-triangular, apex
315 acuminate, both surfaces covered only with sessile glands. Flowers 5-merous, 8–9 mm long, on

316 pedicels 1.5–2 mm long, densely covered with sessile and short-stalked glands. Hypanthium
317 light green, 2–2.5 × 2 mm, widely campanulate, 10-costate, with the same trichomes as in the
318 pedicel. Calyx caducous, tube ca. 1 mm long, sepals ca. 1.5 mm long, widely ovate, margins
319 entire, both surfaces covered with the same trichomes as in the pedicels, seldom with an
320 unbranched trichome on the tip of the ridges between the sepals, external teeth 0.5–0.7 mm long,
321 light pink, fleshy, triangular, slightly concave, sometimes forming a small cavity, with an apex
322 ending in a small trichome, caducous. Petals white, with a light-pink apex, 6–6.5 × 5.7–6 mm,
323 widely obovate, slightly convex, fleshy, base slightly attenuate, apex rounded to obcordate,
324 margins entire, both surfaces papillose, adaxial surface apex covered sparsely with sessile or
325 short stalked glands. Stamens ten, 6–7.5 mm long, isomorphic; filaments 3.5–4.5 mm long,
326 papillose, slightly widened at the base; thecae yellow, 2.5–3 mm long, oblong-subulate, slightly
327 undulate, pore apical, introrse; connective prolonged 0.7–0.9 mm below the thecae, dorsally
328 thickened (0.3–0.5 mm long). Ovary free, apex glabrous, 3-locular, placentation axillary; style
329 ca. 6 mm long, curved at the apex, glabrous; stigma slightly capitate, papillose. Capsules
330 bertolonidium-type, 5.5–7 × 6–7.5 mm; seeds 0.5–0.7 mm long, triangular, tuberculate at the
331 apex.

332 **Distribution and conservation status.** *Bertolonia ruschiana* occurs in the central region of the
333 state of Espírito Santo, in three neighboring municipalities: Santa Leopoldina, Santa Maria de
334 Jetibá and Santa Teresa (Fig. 7). Most populations were found in Santa Teresa, within three
335 different conservation units and in several private properties. Two populations with several
336 individuals were found inside the Augusto Ruschi Biological Reserve, a Brazilian Federal
337 Conservation Unit with 3598 ha (IBAMA, 2000). A few specimens of *B. ruschiana* were
338 collected in some trails ~~inside the~~inside the Santa Lúcia Ecological Station and the São
339 Lourenço Municipal Natural Monument (also called “Caixa D’água”) are kept by the Museu de
340 Biologia Professor Mello Leitão (MBML). The first has 400 ha and the second has 363 ha, both
341 covered ~~with~~with Atlantic Rainforest (Mendes & Padovan, 2000). Specimens of *B. ruschiana*
342 usually are terrestrial or rupicolous herbs that inhabit moist and shaded slopes or rocks with
343 shallow soil near water, but sometimes they ~~epiphyse~~epithets growing on lower portions of tree
344 trunks. It was collected with flowers from January to March and with fruits all year. According
345 to IUCN (2014) this species should be classified as “Lower Risk” (LR), subcategory Near
346 Threatened (nt). It has been collected more than 30 times, inside three conservation units and

several private properties. Nevertheless, its habitat is fragmented and the conservation of the species depends on the maintenance of these units.

Paratypes. Brazil. Espírito Santo: Mun. Santa Leopoldina: Santo Antônio, 24 October 1988, fr., *V. Krause s.n.* (MBML 5295!); Bragança, Mata do Tyrol, prop.: Assunta Salvador, 31 October 2006, fr., *L.F.S. Magnago* 1523 (MBML!); Califórnia, prop. de Albertino Kringer, 16 March 2007, fr., *A.P. Fontana* et al. 3050 (MBML!, RB!, UPCB!). Mun. Santa Maria de Jetibá: São José do Rio Claro, terreno de L. Butke, 06 May 2001, fr., *L. Kollmann* et al. 3650 (MBML!). Mun. Santa Teresa: Estação Biológica da Caixa D'água, 11 April 1985, fr., *W. Boone* 333 (MBML!); Penha, 01 October 1985, fr., *H.Q.B. Fernandes* 1527 (MBML!); Cabeceira do Rio Salinho, 03 July 1986, fr., *H.Q.B. Fernandes* 2003 (MBML!); Valão de São Lourenço, Estação Ecológica da Caixa D'água, 23 December 1993, fr., *E. Bausen* 53 (MBML!, SPF!, UPCB!); Valão de São Lourenço, Estação Ecológica da Caixa D'água, 07 January 1994, fl. and fr., *E. Bausen* 54 (MBML!, UPCB!, SPF!); Estação Biológica de Santa Lúcia, 17 January 1995, fr., *C.C. Chamas* and *R.R. Santos* 375 (MBML!); Estação Biológica de Santa Lúcia, 24 January 1995, fl., *C.C. Chamas* 380 (MBML!); 05 March 1999, fl. and fr., *L. Kollmann* et al. 2039 (MBML!); Estação Biológica de Santa Lúcia, 19 April 2000, fr., *L. Kollmann* et al. 2869 (MBML!); Valsugana Velha, Prop. Dr. Pedro, 06 June 2001, fr., *L. Kollmann* 3816 (MBML!); Valsugana Velha, 23 June 2001, fr., *A.P. Fontana* et al. 132 (MBML!); Valsugana Velha, Estação Biológica de Santa Lúcia, 14 September 2001, fr., *L. Kollmann* and *E. Bausen* 4553 (MBML!); Reserva Biológica de Nova Lombardia, 05 February 2002, fl. and fr., *L. Kollmann* et al. 5499 (MBML!, UPCB!); Reserva Biológica Augusto Ruschi, 22 January 2003, fl., *R.R. Vervloet* et al. 1718 (MBML!); Nova Lombardia, Reserva Biológica Augusto Ruschi, estrada Marlene, 05 February 2003, fl., *R.R. Vervloet* et al. 1777 (MBML!, RB!, UPCB!); APP São Lourenço, Trilha Boa, 29 March 2003, fr., *A.P. Fontana* et al. 545 (MBML!, UPCB!); Nova Lombardia, Reserva Biológica Augusto Ruschi, trilha seguindo o córrego, 01 April 2003, fr., *R.R. Vervloet* and *E. Bausen* 2095 (MBML!); Reserva Biológica Augusto Ruschi, trilha da Cachoeira, 20 January 2005, fl., *H.Q.H. Fernandes* and *R. Goldenberg* 3373 (MBML!, UPCB!); Santo Henrique, 26 January 2005, fl., *L. Kollmann* 7308 (MBML!); Santo Henrique, beira da estrada, 26 January 2005, fl., *L. Kollmann* and *A.P. Fontana* 7328 (MBML!, UPCB!); Penha, prop. sr. Tabajara Ribeiro de Oliveira, 22 May 2005, fr., *R.C. Britto* 58 (MBML!); Santo Anselmo, terreno do M. Nandolfo, 830 m, 24 February 2006, fr., *L. Kollmann* et al. 8675

(MBML!); Julião, prop. Sr. João Luiz Rodrigues de Souza, 23 February 2007, fr., *A.P. Fontana* 2980 (MBML!); Nova Lombardia, Terreno do Furlani, 13 July 2007, fr., *R. Goldenberg* et al. 891 (MBML!, NY!, UPCB!); Lombardia, prop. de João Furlane, 19°48'9"S 40°32'14"W, 800 m, 4 May 2009, fr., *A.P. Fontana* et al. 5982 (MBML!, WAG); Nova Lombardia, terreno do Furlani, 7 February 2011, fr. and fl., *F.A. Michelangeli* et al. 1604 (NY!, UPCB!); Nova Lombardia, terreno do Furlani, 7 February 2011, fl., *F.A. Michelangeli* et al. 1606 (NY!, UPCB!); Reserva Biológica Augusto Ruschi, 10 December 2012, fr., *J.A. Lombardi* 9819 (UPCB!); Reserva Biológica Augusto Ruschi, 27 November 2013, fr., *L.F. Bacci* and *D.F. Lima* 108 (UPCB!); Reserva Biológica Augusto Ruschi, trilha da Roda D'água, 14 January 2016, fl. and fr., *L.F. Bacci* et al. 317 (MBML!, NY!, UEC!, UPCB!).

Etymology. The epithet "*ruschiana*" honors the Brazilian naturalist Augusto Ruschi (1915-1986), who fought against the deforestation of the Atlantic Forest, mainly in the state of Espírito Santo. In addition, the type locality of the species is in the Augusto Ruschi Biological Reserve.

Remarks. *Bertolonia ruschiana* is characterized by the adaxial surface of the leaves, pedicels and hypanthium covered only with sessile or short stalked glands, the leaves with 5 main acrodromous veins and ciliate margins, hypanthium widely campanulate, sepals widely ovate and fleshy, with triangular, slightly concave external teeth. The widely depressed obovate, slightly convex and fleshy petals with the apex of the adaxial surface covered sparsely with sessile or short stalked glands are also important for the recognition of the new species. *Bertolonia ruschiana* closely resembles *B. nymphaeifolia*. (for more details, see the diagnosis above).

Several specimens of *Bertolonia ruschiana* had been determined as *Bertolonia sanguinea*, due to the similar vegetative morphology. Both species share the big leaves with cordate bases, and both surfaces of the leaf covered only with sessile or short stalked glands, but *B. sanguinea* has hirsute petioles and eciliate leaf margins (Baumgratz, 1990). The morphology of the flowers is also different. *Bertolonia sanguinea* has sepals lacking external teeth (vs. sepals with a triangular, concave external teeth in *B. ruschiana*), longer flowers (18-23 mm vs. 8-9 mm), glabrous petals (vs. adaxial surface apex covered with sessile and short stalked glands), longer stamens (18-19 mm long vs. 6-7.5 mm), these with an extension at the apex, forming a tube (vs. stamens without an extension at the apex).

408

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421 permit in Reserva Biológica Augusto Ruschi (ICMBio nº49043-2).

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423 **REFERENCES**

- 424 **Bacci LF, Amorim AM, Michelangeli FA, Goldenberg R. 2016.** A new species of *Bertolonia*
425 (Melastomataceae) from southern Bahia, Brazil. *Phytotaxa* **265** (3): 251–258.
- 426 **Bachman S, Moat J, Hill AW, de la Torre J, Scott B. 2011.** Supporting Red List threat
427 assessments with GeoCAT: geospatial consevation assessment tool. *Zookeys* **150**: 117–
428 126.
- 429 **Baumgratz JFA. 1983–1985.** Morfologia dos frutos e sementes de Melastomataceas brasileiras.
430 *Arquivos do Jardim Botânico do Rio de Janeiro* **27**: 113–155.
- 431 **Baumgratz JFA. 1990.** O gênero *Bertolonia* Raddi (Melastomataceae): revisão taxonômica e
432 considerações anatômicas. *Arquivos do Jardim Botânico do Rio de Janeiro* **30**: 69–213.

Comentado [PJFG5]: DOI (when it's available for all references).

433 **Baumgratz JFA. 2016.** *Bertolonia* in Flora do Brasil 2020 em construção. Jardim Botânico do
 434 Rio de Janeiro. Disponível em:
 435 <<http://floradobrasil.jbrj.gov.br/reflora/floradobrasil/FB9413>>. Acesso em: 28 Jul. 2016

436 **Baumgratz JFA, Amorim AM, Jardim AB. 2011.** Two new species of *Bertolonia*
 437 (Melastomataceae) from the Brazilian Atlantic Forest. *Kew Bulletin* **66**: 273–279.

438 **Camargo AC, Goldenberg R. 2011.** Two new species of *Leandra* from Espírito Santo, Brazil.
 439 *Brittonia* **63**(2): 220–226.

440 **Clausing G, Renner SS. 2001.** Molecular phylogenetics of Melastomataceae and
 441 Memecylaceae: Implications for character evolution. *American Journal of Botany* **88**: 486–
 442 498.

443 **Dutra VF, Alves-Araújo A, Carrijo TT. 2015.** Angiosperm checklist of Espírito Santo: using
 444 eletronic tools to improve the knowledge of an Atlantic Forest biodiversity hotspot.
 445 *Rodriguesia* **66**: 1145–1152.

446 **Fraga CN, Saavedra MM. 2014.** A new cauliflorous white-flowered species of *Ouratea*
 447 (Ochnaceae) from the Brazilian Atlantic Forest. *Phytotaxa* **167**(1): 119–126.

448 **Fundação SOS Mata Atlântica & INPE 1993.** *Atlas da evolução dos remanescentes florestais*
 449 *da Mata Atlântica e ecossistemas associados no período de 1985-1990*. São Paulo: Fundação
 450 SOS Mata Atlântica/INPE.

451 **Fundação SOS Mata Atlântica & INPE 2014.** *Atlas da evolução dos remanescentes florestais*
 452 *da Mata Atlântica e ecossistemas associados no período de 2005-2008*. São Paulo: Fundação
 453 SOS Mata Atlântica/INPE/Instituto Sócio-ambiental (ISA).

454 **Giaretta A, Fraga CN. 2014.** Two new *Eugenia* species (Myrtaceae) from the Brazilian Atlantic
 455 Forest. *Phytotaxa* **163**(2): 113–120.

456 **Goldenberg R, Bacci LF, and Bochorny T. 2016.** *Behuria*, *Bertolonia*, *Cambessedesia*,
 457 *Huberia* e *Mouriri*, e chave de identificação de gêneros de Melastomataceae no estado do
 458 Paraná. *Rodriguesia* **67**(2): 445–454.

459 **Goldenberg R, Fraga CN, Fontana AP, Nicolas AN, Michelangeli FA. 2012.** Taxonomy and
 460 phylogeny of *Merianthera* (Melastomataceae). *Taxon* **61**: 1040–1056.

461 **IBAMA – Instituto Brasileiro do Meio Ambiente e Recursos Renováveis 2000.** *Plano de*
 462 *Manejo da Reserva Biológica Augusto Ruschi*. Vitória: Diretoria de Ecossistemas, 280 pp.

463 **IUCN Standards and Petitions Subcommittee 2014.** *Guidelines for Using the IUCN Red List*
 464 *Categories and Criteria*. Version 11 (February). Prepared by the IUCN species survival
 465 commission. IUCN Council, Gland, Switzerland and Cambridge, UK, 87 pp. Available
 466 from: <http://www.iucnredlist.org/documents/RedListGuidelines.pdf> (accessed 19 July
 467 2016)

468 **Mendes LS, Padovan MP. 2000.** A Estação Ecológica de Santa Teresa, Espírito Santo. *Bol.*
 469 *Mus. Biol. Mello Leitão* **11/12**: 7–34.

470 **Mori AS, Silva LAM, Lisboa G, Coradin L. 1989.** *Manual de manejo de herbário*
 471 *fanerogâmico*. Ilhéus: Centro de Pesquisas do Cacau.

472 **Novelli FZ. 2010.** A Reserva Biológica de Duas Bocas e seus vínculos com a história da
 473 conservação no Espírito Santo. *Natureza on line* **8(2)**: 57–59.

474 **Radford AE, Dickison WC, Massey JR, Bell CR. 1974.** *Vascular Plant Systematics*. New
 475 York: Harper & Row Publishers.

476 **Silva-Gonçalves KC, Baumgratz, JFA, Nunes-Freitas, AF. 2016.** A new species of *Bertolonia*
 477 (Melastomataceae) from the Southeastern Brazilian Atlantic Forest. *Phytotaxa* **273(2)**:
 478 115–121.

479 **Thiers B. 2015.** *Index herbariorum: a global directory of public herbaria and associated staff*.
 480 *New York Botanical Garden's Virtual Herbarium*. Available from:
 481 <http://sciweb.nybg.org/science2/IndexHerbariorum.asp> (accessed 26 April 2016)

482 **Veloso HP, Rangel-Filho ALR, Lima JCA. 1991.** *Classificação da vegetação brasileira,*
 483 *adaptada a um sistema universal*. Rio de Janeiro: IBGE.

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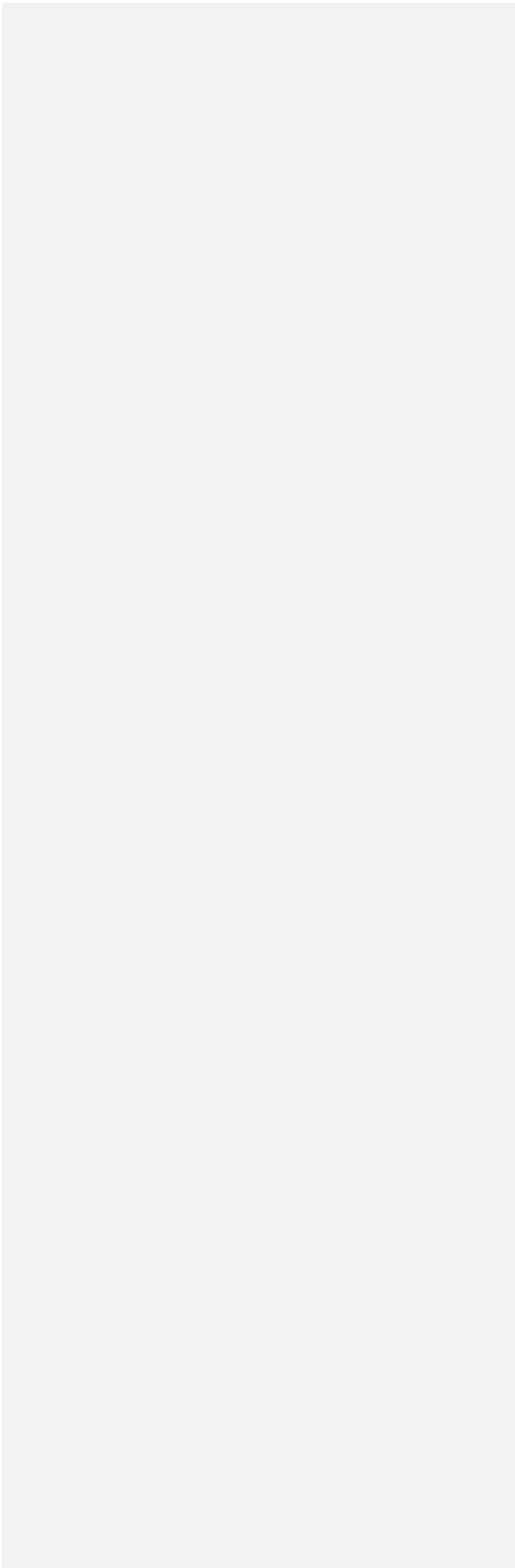
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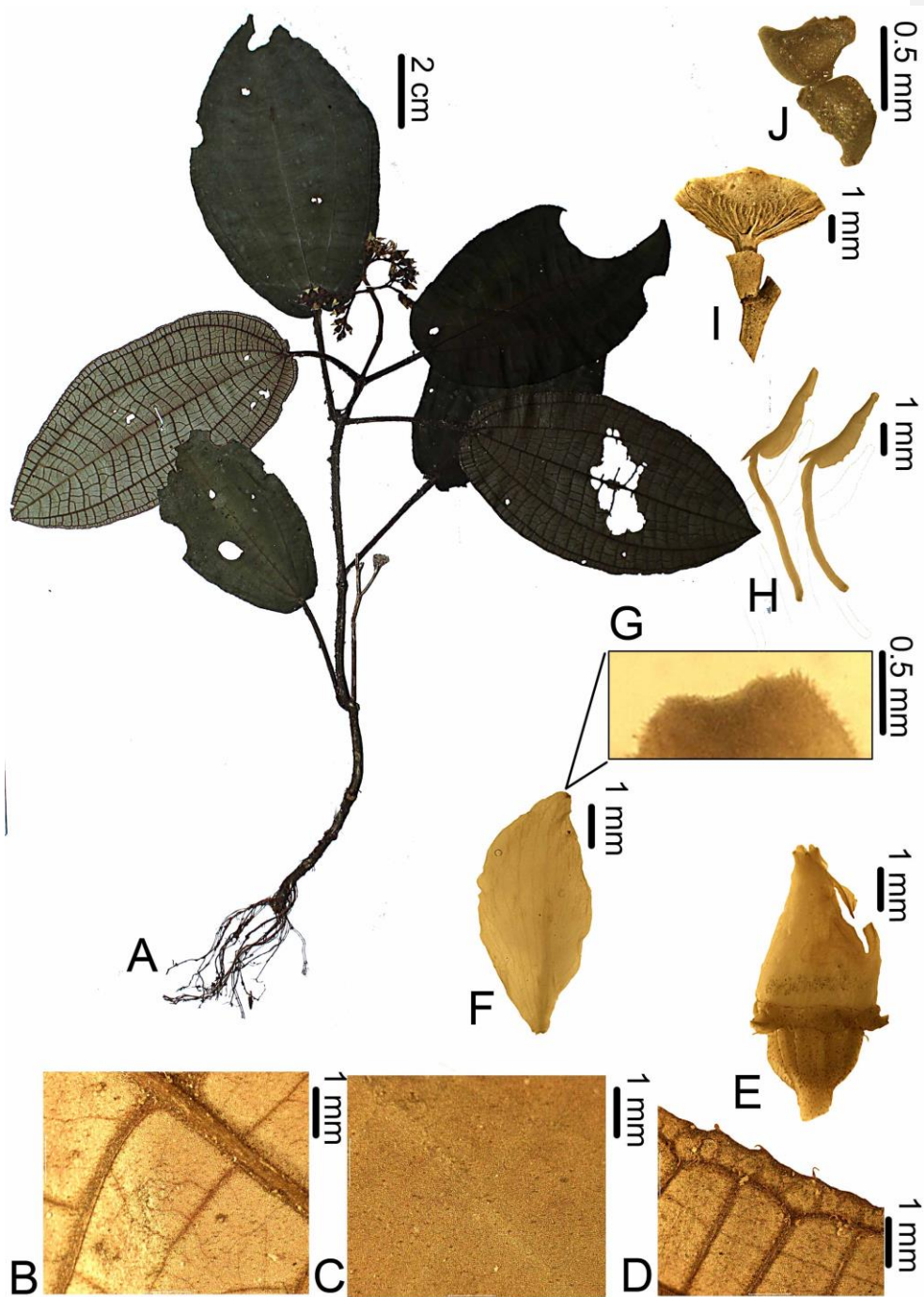
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492 Figure 1. *Bertolonia duasbocaensis*. A. Habit. B. Detail of the abaxial surface of the leaf. C.
493 Detail of the adaxial surface of the leaf. D. Abaxial surface of the leaf showing the ciliate
494 margin. E. Flower bud. F. Adaxial view of the petal. G. Detail of the petal apex covered with
495 sessile and short stalked glands. H. Lateral view of the stamens. I. Fruit. J. Seeds. (A-D from
496 R.C. Forzza et al. 5035; E-H from R. Goldenberg et al. 1249; I and J from R. Goldenberg et al.
497 1210).

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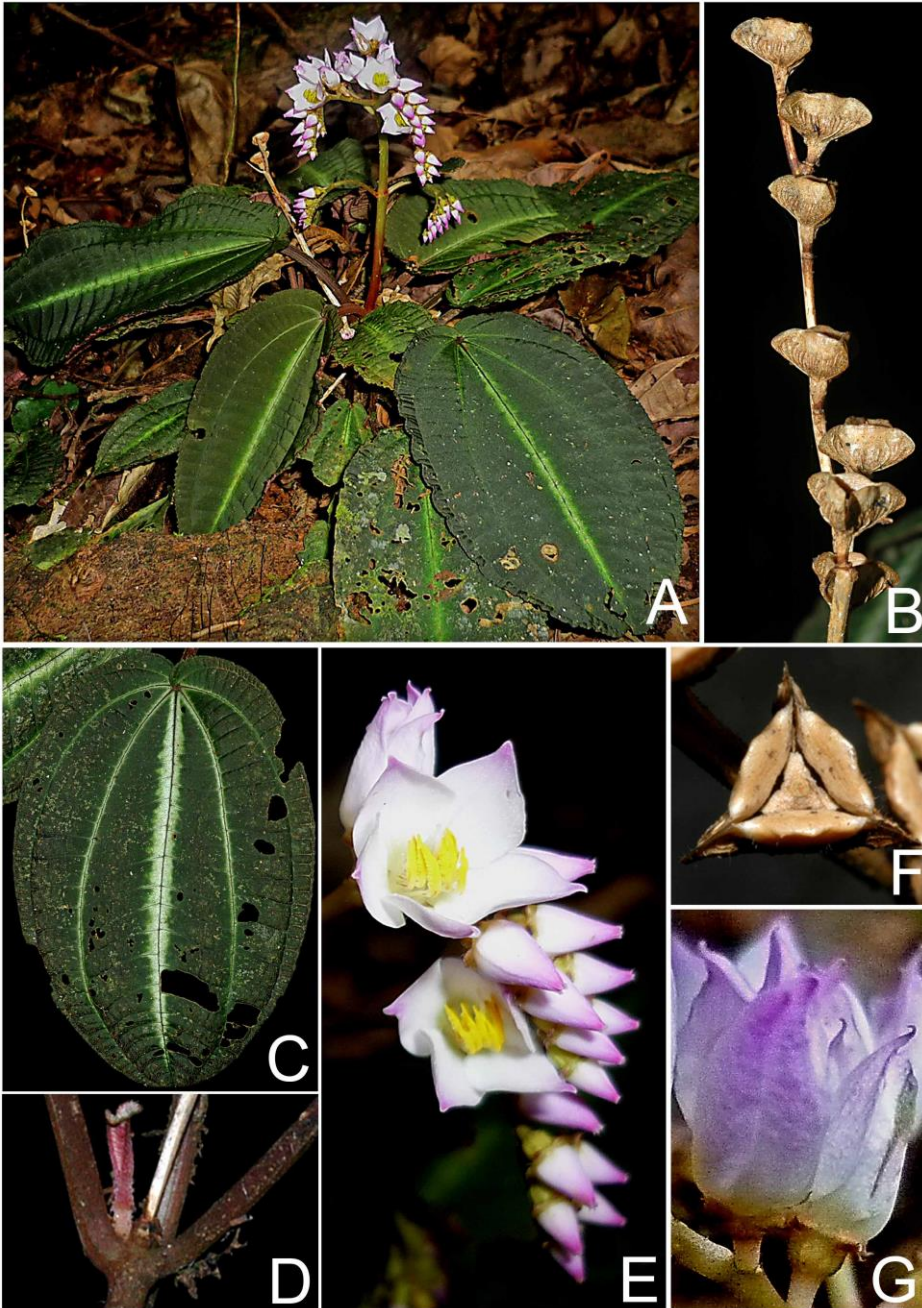
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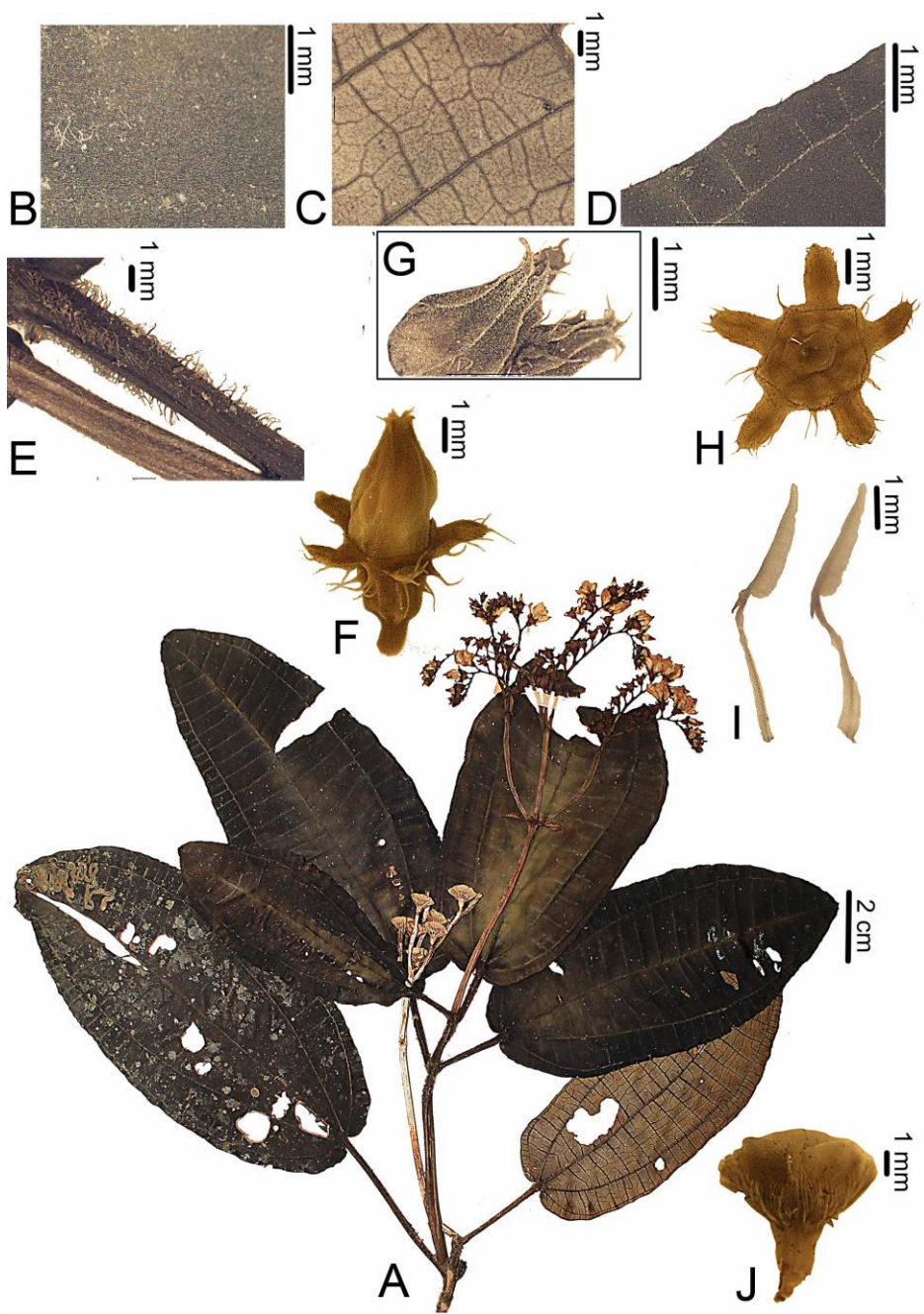
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517 Figure 2. *Bertolonia duasbocaensis*. A. Habit. B. Infructescence. C. Adaxial surface of the leaf.
518 D. Stem and petioles. E) Inflorescence. F. Fruit. G. Flowers on lateral view. (Photos by R.
519 Goldenberg).

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541 Figure 3. *Bertolonia macrocalyx*. A. Habit. B. Detail of the adaxial surface of the leaf. C. Detail
542 of the abaxial surface of the leaf. D. Adaxial surface of the leaf showing the ciliate margin. E.
543 Petioles. F. Flower. G. Petals of a flower bud showing the sessile and short stalked glands on the
544 upper half. H. Frontal view of the calyx. I. Lateral view of the stamens. J. Fruit. (A-I from *R.*
545 *Goldenberg et al.* 1235; J from *C.N. Fraga et al.* 2049).

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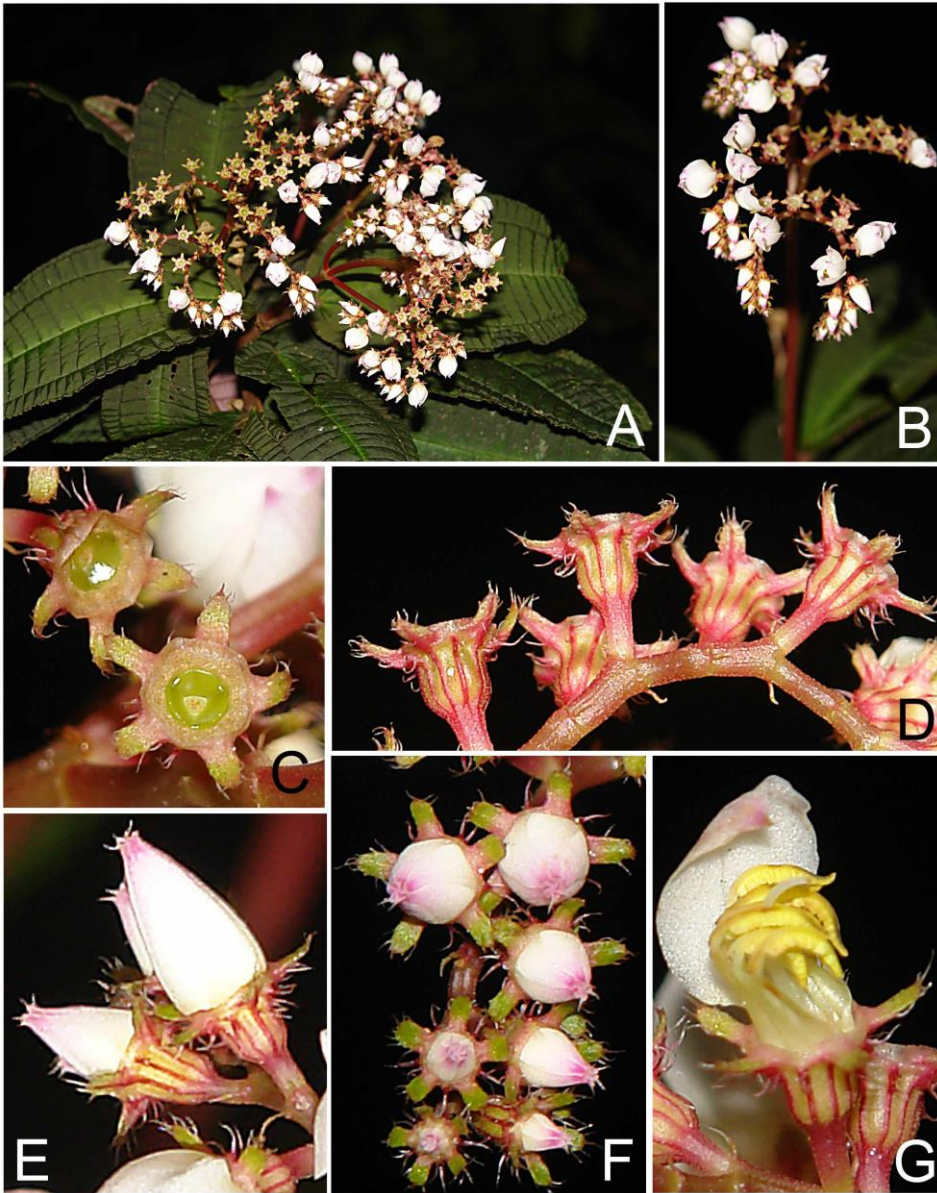
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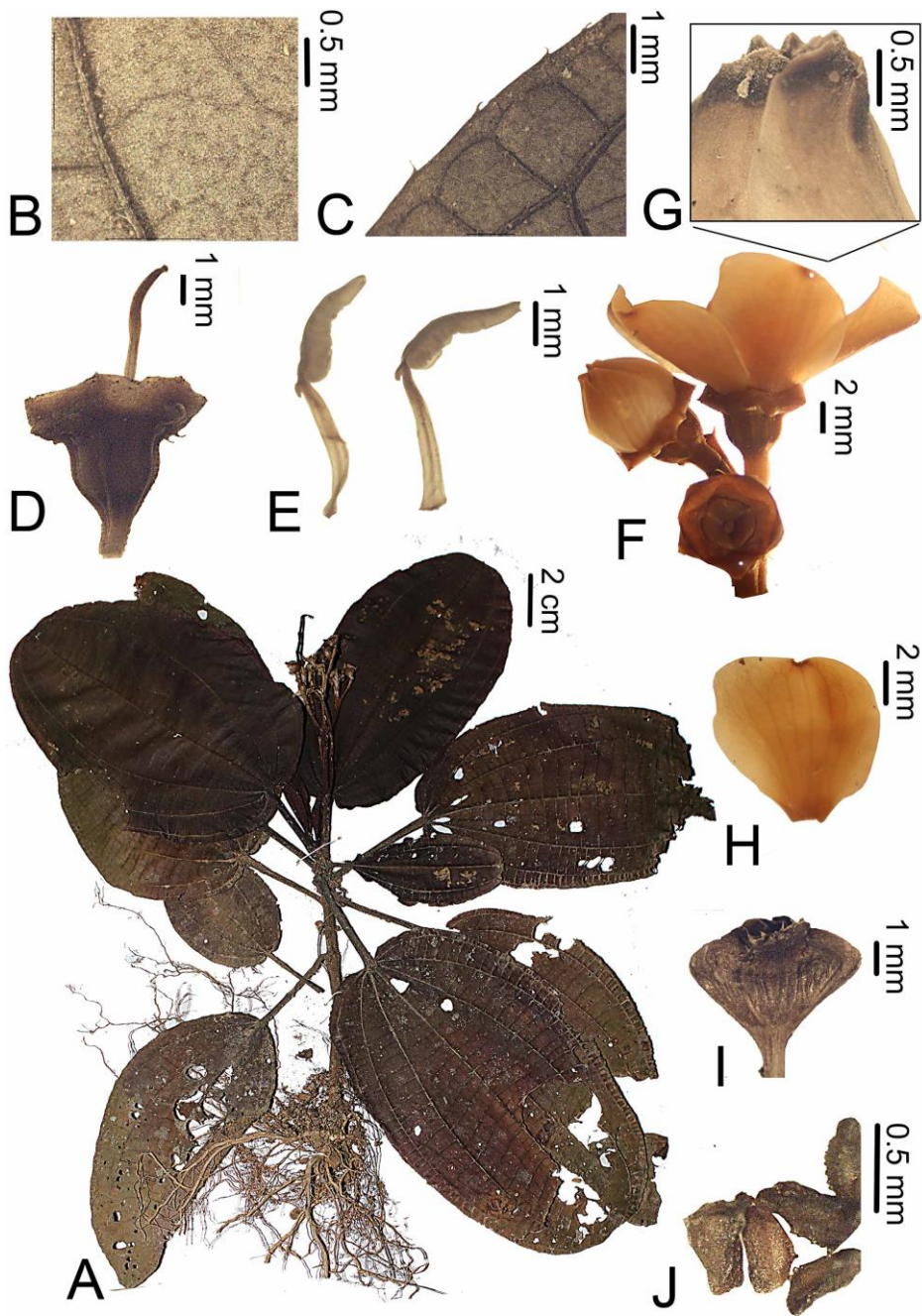
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566 Figure 4. *Bertolonia macrocalyx*. A. Habit. B. Inflorescence. C. Frontal view of the calyx and
567 ovary apex. D. Lateral view of old flowers. E. Lateral view of the flowers. F. Frontal view of the
568 flowers. G. Stamens (Photos by C.N. Fraga).

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590 Figure 5. *Bertolonia ruschiana*. A. Habit. B. Detail of the abaxial surface of the leaf. C. Detail of
591 the abaxial surface of the leaf showing the ciliate margin. D. Hypanthium, calyx and style. E.
592 Lateral view of the stamens. F. Flowers and flower bud. G. Detail of the petals apex covered
593 with sessile and short stalked glands. H. Adaxial view of the petal. I. Fruit. J. Seeds. (A, I and J
594 from *L. Kollmann* and *E. Bausen* 4553; B-H from *L.F. Bacci* et al. 321).

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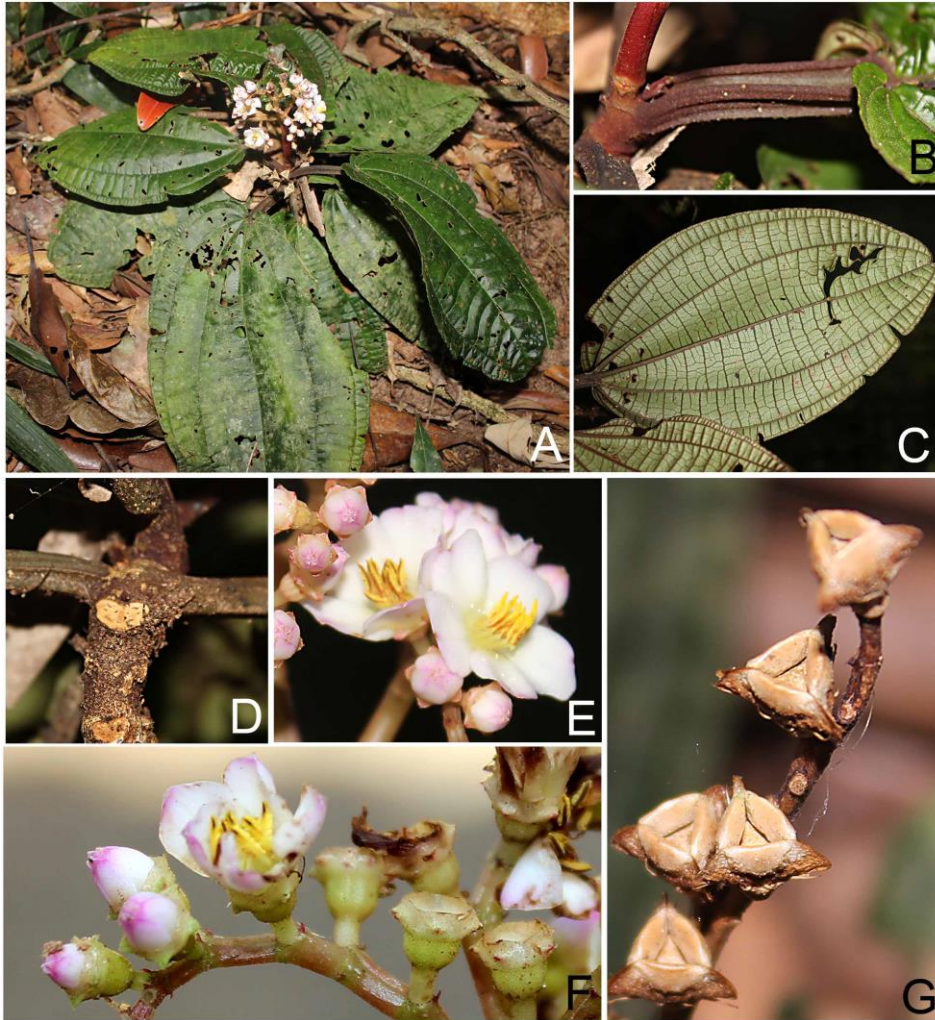
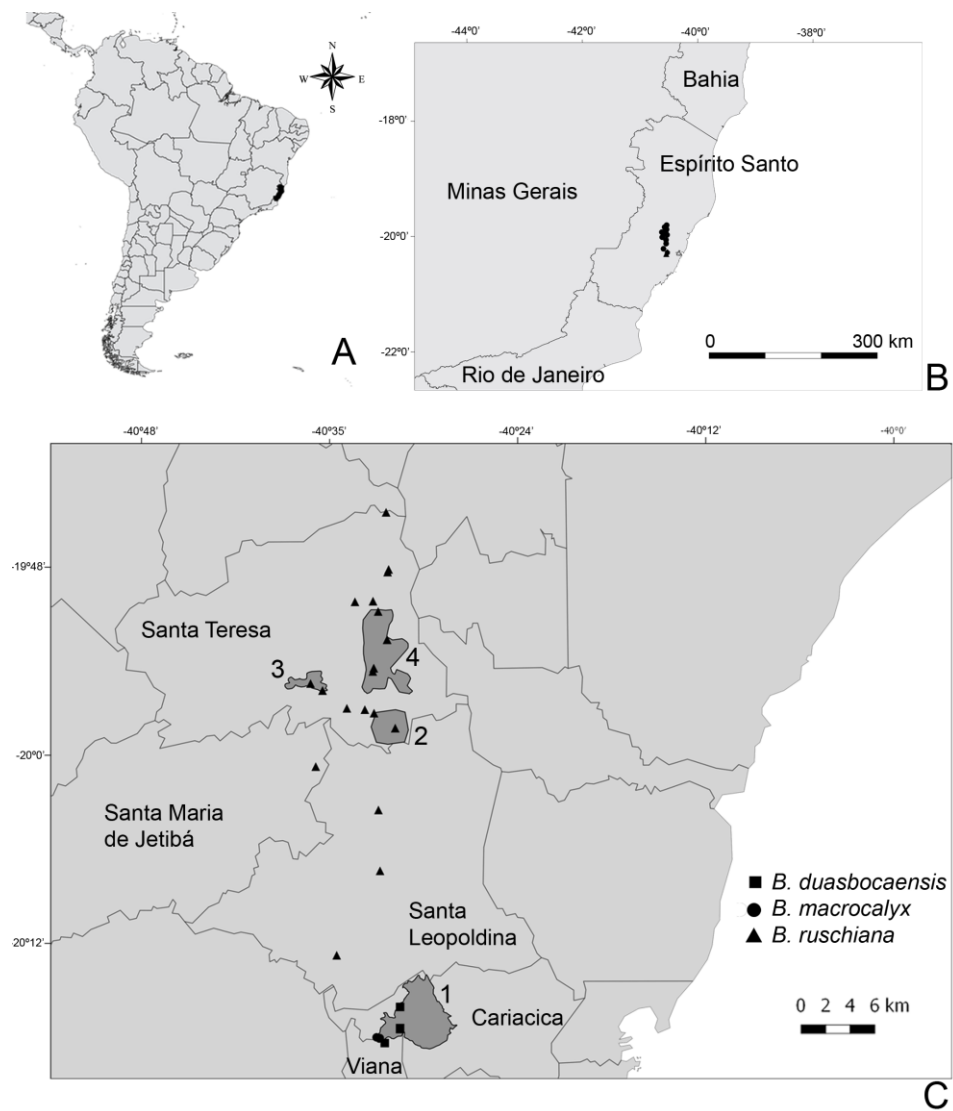


Figure 6. *Bertolonia ruschiana*. A. Habit. B. Petiole. C. Abaxial surface of the leaf blade. D. Stem. E. Flowers and flower buds. F. Inflorescence. G. Infructescence. (Photos by L.F. Bacci).



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623 Figure 7. Map with the collection localities of the new species: A) South America, the state of
624 Espírito Santo in black; B) Detail of the state of Espírito Santo and the neighboring states, the
625 collection points in black; C) Collection points. Conservation Units: 1- Duas Bocas Biological
626 Reserve, 2- Santa Lúcia Ecological Reserve, 3- São Lourenço Natural Municipal Reserve, 4-
627 Augusto Ruschi Biological Reserve.

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