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Calceolaria flavida (Calceolariaceae) a new endemic species to central Chile

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1 *Calceolaria flavida* (Calceolariaceae) a new endemic species to central Chile.

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13 **Abstract**

14 A new species of *Calceolaria* endemic to central Chile is described. A comparison with
15 morphologically similar species is made, and a key as well as detailed images to differentiate
16 them is provided. The species is only known from the Natural Sanctuary Cerro El Roble,
17 which is part of the coastal mountain range of central Chile and can be considered as
18 Critically Endangered (CR) under the IUCN categories and criteria.

19 **Keywords:** Chilean Mediterranean hotspot, Cerro el Roble, endemism, montane flora, South
20 America, taxonomy.

21 **Introduction**

22 *Calceolaria* Linnaeus is the largest genus within Calceolariaceae with approx. 250 species
23 distributed from Mexico to Southern Chile and Argentina. The centre of diversity of the
24 genus is found in Peru (Molau 1988). The genus includes herbs and shrubs characterised by
25 opposite leaves and bilabiate corollas with a saccate lower lip with an infolded lobe normally
26 bearing the elaiophore, a highly specialised, oil-producing structure involved in pollination.
27 The latest revision of *Calceolaria* for Chile, published by Ehrhart (2000), was followed by
28 the publication of new species segregated from the *C. integrifolia* complex (Ehrhart 2005),
29 the revision of *Calceolaria* section *Calceolaria* (Puppo and Novoa 2012) and by *Calceolaria*
30 *philippii* Eyzaguirre (2014). In Chile are currently recognised 61 species, ten of which are
31 further separated in a total of 30 subspecies (Rodríguez et al. 2018). Of a total of 81 taxa, 60
32 taxa (74%) are endemic to Chile. *Calceolaria* in Chile presents a wide distribution, from the
33 latitudes of Arica y Parinacota region (18°35'S), to Magallanes region (54°50'S), and from
34 the coast to the high elevations of the Andes (0-4300 m). Unsurprisingly, the area of most
35 diversity is central Chile, from the Coquimbo region to the Araucania region (Ehrhart 2000).
36 High levels of endemism in plants are common in the biogeographic area of central Chile
37 which is recognized as a biodiversity hotspot (Myers et al. 2000; Arroyo et al. 2004).

38
39 The aim of this work is to describe a new species of *Calceolaria*, endemic to central Chile,
40 assess its conservation status and provide a key for correct identification.

42 **Methods**

43

44 Between the austral spring of 2018-2020, several botanical explorations were carried out in
45 the coastal mountain range of central Chile, between the limits of Valparaiso region and the
46 Metropolitan region, in the Natural Sanctuary “Cerro El Roble” 75 km northeast of Santiago
47 urban area (Fig. 1). Specimens of *Calceolaria* that could not be assigned to any of the
48 described species of the genus were found flowering in two sites close to the summit (1722-
49 1729 m and 1766 m). The climate of the study site is classified as Mediterranean type with a
50 rainfall regime characterized by an annual mean precipitation of 656mm, a water deficit of
51 897mm, and a 7-month dry season (Donoso et al. 2010). The soil is mainly composed of
52 weathered granitic rocks (Brüggen 1950). The vegetation of this area is characterized by a
53 relict deciduous forest dominated by *Nothofagus macrocarpa*, and surrounded by
54 sclerophyllous forest and scrub of *Quillaja saponaria* and *Lithraea caustica* (Latorre-Beltrán
55 2012). At lower elevations, on the bottom of creeks with permanent flooding by groundwater,
56 dense swamp forests of *Drimys winteri* and *Luma chequen* can be found. In the summit, a
57 relict sclerophyllous andean scrub dominated by *Chuquiraga oppositifolia* and *Azorella*
58 *prolifera* is found (Ministerio del Medio Ambiente 2018).

59
60 Specialised literature on systematics and taxonomy of *Calceolaria* was consulted (Witasek
61 1905; Valenzuela 1969; Ehrhart 2000; Ehrhart 2005). Herbarium specimens were collected
62 and deposited at SGO (Lavandero 372, Lavandero & Santilli, 201027). A systematic
63 examination of selected specimens of *Calceolaria* found at SGO, as well as online digital
64 images of specimens available on E was carried out to search for more collections that could
65 be morphologically coincident with the species. Herbarium specimens with similar
66 morphology were found at SGO identified as *Calceolaria asperula* and *Calceolaria aff.*
67 *asperula*. A thorough examination and dissection of the type specimen of *Calceolaria*
68 *asperula* Phil. (SGO 055831) was performed, due to discrepancies with the drawing and the
69 description of the species by Ehrhart (2000) and to confirm the identity of the new species.
70 The description and key were prepared after examining all available specimens. Description
71 was made based on terminology following Ehrhart (2000) and Ehrhart (2005).
72 The assessment of the conservation status of the species was made using the International
73 Union for Conservation of Nature (IUCN 2017) criteria. The extent of occurrence (EOO) and
74 area of occupancy (AOO) were calculated using GeoCat (Bachman et al. 2011).

75 Results

76
77 Following the morphological comparison of the plant collected with the specimens found in
78 the consulted herbaria, we reached the conclusion that the individuals found in Cerro el Roble
79 represent a new species. The new species is vegetatively similar to *Calceolaria asperula*
80 Philippi and to *Calceolaria petiolaris* Cavanilles in being perennial herbs with woody base,
81 ovate leaves and serrate margins, covered in glandular hairs. Nevertheless, both leaf texture
82 and indumentum and flower morphology differ considerably (Figs. 2–4). The secondary and
83 tertiary venation of the new species is visibly impressed on the adaxial side and prominent on
84 the abaxial side of the lamina (Fig. 2C-D). The leaf indumentum is formed by long and
85 densely arranged glandular and eglandular trichomes, which gives a glutinous and sticky
86 texture. Freshly collected material can hardly be separated from the paper in which it is dried.
87 The leaf texture and indumentum is similar to *Calceolaria asperula* (Fig. 2A–B), but the
88 latter has a deeply impressed venation on the upper surface, forming deep cavities, giving the
89 most rugose aspect of the three species. *Calceolaria petiolaris*, has a venation slightly
90 impressed on the adaxial side and slightly prominent on the abaxial side, with leaf
91 indumentum composed of short glandular and eglandular trichomes, which give a less

92 glutinous and sticky texture, freshly collected material can easily be separated from the paper
 93 in which it is dried (Fig 2E–F). The flower lips of the new species are rounded in shape,
 94 saccate, and the upper lip is narrower and shorter than the lower lip (Fig. 3C–D), while the
 95 flower lips of *C. petioalaris* are squared, flat and almost equal in size (Fig. 3E–F). The length
 96 of the stamens of the new plant and *C. petioalaris* is similar, while *C. asperula* presents much
 97 shorter filaments (Fig. 4A, C, E). The new species shows an elaiophore similar to *C.*
 98 *petioalaris* and different from the one of *C. asperula* which has an elaiophore made of
 99 dispersed oil producing trichomes (Fig. 4B, D, F), a character that is unique among
 100 *Calceolaria* found in Chile (Ehrhart 2000).

101
 102 The dissection of the type specimen of *Calceolaria asperula* (SGO 055831) showed that the
 103 lips differ in size, being the upper lip less than half the size of the lower lip (Fig. S1). This
 104 contrasts with the schematic drawing of the flower of *Calceolaria asperula* found in Ehrhart
 105 (2000). The dissection also confirms that the elaiophore of *Calceolaria asperula*, is formed by
 106 dispersed oil producing trichomes (Fig. S1D–E).

107 Taxonomic treatment

108 *Calceolaria flavida* N. Lavandero & L. Santilli, *sp. nov.*

109 Figures 2C–D, 3C–D, 4C–D, 5, 6

110 **Diagnosis.** *C. flavida* is most similar to *C. asperula* and *C. petioalaris* in growth habit and in
 111 having leaves of similar shape covered in glandular hairs. *C. flavida* can easily be
 112 distinguished from *C. asperula* in having pale yellow corolla (vs. bright yellow), the upper lip
 113 longer than half the length of the lower lip (vs. upper lip shorter than half the length of the
 114 lower lip), anthers much shorter than filaments and opening towards the distal part of the
 115 upper lip (vs. anthers as long as filaments and opening toward the style) and an elaiophore
 116 with densely arranged oil-producing trichomes (vs. dispersed oil producing trichomes). It can
 117 be distinguished from *C. petioalaris* by its reddish stems (vs. green), secondary and tertiary
 118 veins of the adaxial side of leaf lamina clearly impressed (vs. secondary and tertiary veins of
 119 the adaxial side of leaf lamina slightly impressed), pale yellow corolla (vs. bright yellow),
 120 upper lip narrower than lower lip seen from above (vs. upper lip as wide as lower lip), lips
 121 rounded in shape (vs. squared), saccate upper lip (vs. flat), and style inserted in corolla (vs.
 122 exerted).

123 **Type.** CHILE. Región Metropolitana, Cerro el Roble, 1674 m, 32°59'54'' S - 71°01'27'' W,
 124 17-12-2006, N. García & M. Muñoz 3836 (holotype SGO157641!)

125 **Description.** *Perennial* herb up to 60 cm; base lignified. *Stems* green to red, densely covered
 126 in glandular hairs accompanied by much longer regular hairs; internodia progressively longer
 127 towards the apex; stems renewing from the lignified base every season. *Leaves* opposite,
 128 green; lower leaves lanceolate, petiolate, base cuneate, apex acute; upper leaves ovate, sessile
 129 to partially amplexicaul, base subcordate, apex acute; (1.7–)2–7(–8.5) × (1.2–)2.5–3.5(–4)
 130 cm, margins serrate or slightly biserrate, lamina hirsute, trichomes glandular; venation
 131 impressed in the upper surface and prominent in the lower surface, secondary and tertiary
 132 veins of the adaxial side of leaf lamina slightly impressed. *Synflorescence* not conspicuously
 133 elevated from the vegetative part, up to 32 cm tall including the basal internode of the main
 134 florescence; basal internode 46–85 mm and as long as the internodes between the leaves at
 135 most; main inflorescence composed of 1–3 pairs of 15–19-flowered cymes; hypopodia 3.4–

136 6.4 cm; pedicels 6.5–10.2(–20) mm; cyme bracts sessile, 14–30 × 8–25 mm, subordinate
 137 bracts sessile, 5–9 × 3–6 mm. **Sepals** green, ovate, 6.5–7.3 × 3.7–4.2 mm, densely covered in
 138 glandular hairs on both sides. **Corolla** pale yellow, evenly covered in glandular hairs,
 139 longitudinal axes of the lips parallel to each other, lower and upper lips subequal in length
 140 and keep close to one another; lower lip saccate, rounded and lobed, 9.0–10.5 × 9.2 × 6.0–6.2
 141 mm; aperture narrow and oval, facing the upper lip, depression of the upper side almost
 142 absent; upper lip saccate, rounded to truncate seen from above, 6.8–9.3 mm long 8.0–9.2 mm
 143 wide 4.0–4.1 mm height; aperture wide and almost reaching the sides of the lip. **Elaiophore**
 144 type 1 (sensu Ehrhart 2000), same length as the opening of the lower lip, 7.6 × 2.4 mm,
 145 folded inside the lower lip and covering the end of the lobe; oil-producing trichomes 190–
 146 245(–270) µm long, generally with (3–)4–6(–7) stalk-cells and a 38–44-celled glandular head,
 147 densely arranged, forming a well-defined and compact cushion. **Stamens** 2, filaments 5.1–5.4
 148 mm, anthers 2.7–3.3 × 1.2–1.4 mm, included in the upper lip; anthers dithecal, basifixed, with
 149 line of dehiscence opening towards the distal part of the upper lip; stamens and style almost
 150 parallel, forming an acute angle. **Gynoecium** (ovary + style) 6.0 mm; ovary densely covered
 151 in glandular hairs; style inserted in upper lip, 4.3 mm; stigma simple. **Capsule** conic,
 152 acuminate, 5.3–5.6 × 3.4–3.7 mm, with sparse glandular hairs. **Seeds** globose, 520–600 ×
 153 280–340 µm, seed surface type 3 (sensu Ehrhart 2000).

154 **Habitat and distribution.** *C. flavida* seems to be endemic to the Natural Sanctuary Cerro El
 155 Roble (33°00' S 71°01' W), which is part of the coastal mountain range of central Chile (Fig.
 156 1). It can be found on slopes with N–NW orientation at elevations of 1450–2200 m.
 157 *Calceolaria flavida* grows on soils of granitic origin, between rocks in open areas within
 158 sclerophyllous scrub dominated by *Puya coerulea* Lindl. var. *coerulea*, *Lithraea caustica*
 159 (Molina) Hook. & Arn. and *Gochnatia foliolosa* (D. Don) D. Don ex Hook. & Arn (Fig. 6A).

160 **Phenology.** The species was found flowering between October and January.

161 **Etymology.** The specific epithet is the singular, feminine, nominative of the latin adjective
 162 “flavidus” which means “pale yellow”. It makes reference to the colour of the corolla.

163 **Conservation status.** *C. flavida* can be considered as Critically Endangered (CR) under the
 164 IUCN categories and criteria B1ab(iii). The criterion B1 was selected because its extent of
 165 occurrence is <100 km² (0.995 km²). The criterion “a” was selected because it is known to
 166 exist at only one location (=1). The criterion “b(iii)” was selected because there is a projected
 167 decline in the area, extent and quality of habitat. Climate change and the persistent drought
 168 that has been affecting Central Chile represent a threat to plants that grow in the region.
 169 Starting in 2010, the Chilean territory between the Coquimbo and Araucanía Regions has
 170 experienced a rise in temperature and a precipitation deficit of approximately 30% causing
 171 visible deterioration of non-irrigated vegetation as well as increasing the likeability of forest
 172 fires (Garreaud, 2015). The species grows within the Natural Sanctuary Cerro El Roble.

173 **Additional specimens examined. CHILE. Región Metropolitana:** Provincia de
 174 Chacabuco: Cerro El Roble, km 5 camino a la cumbre, 1 January 2003, A. Moreira 863
 175 (SGO); Subida a Cerro El Roble, poco más abajo Portezuelo Rauco, 27 October 2005, M.
 176 Muñoz 4741 (SGO); Caleu, camino a El Roble, 1 km más abajo del corral, 17 December
 177 2006, N. García & M. Muñoz 3839 (SGO); Cerro El Roble, arriba del refugio a 3.5 km desde
 178 la entrada, 29 November 2019, N. Lavandero 372 (SGO); Cerro el Roble, 27 October 2020,
 179 Lavandero & Santilli 201027 (SGO).

181 **Key of herbaceous *Calceolaria* with a woody base and glandular indumentum, taller**
182 **than 20 cm, with leaves along the stem, not arranged in a rosette, entire with tendency**
183 **to be sessile, less than five times longer than wide, longer than 25 mm (replace couplet**
184 **17 of Ehrhart's key to *Calceolaria* of Chile (2000)).**

185 1 Secondary and tertiary veins of the adaxial side of leaf lamina deeply impressed; glandular
186 hairs dark, scattered along the corolla; upper lip less than half the length of the lower lip,
187 anthers as long as filaments, and opening toward the style, elaiophore with scattered oil-
188 producing hairs... *C. asperula*

189 - Secondary and tertiary veins of the adaxial side of leaf lamina slightly or not impressed;
190 glandular hairs clear, densely arranged along the corolla; upper lip more than half the length
191 of the lower lip, anthers much shorter than filaments and opening towards the distal part of
192 the upper lip, elaiophore with densely arranged oil-producing hairs.....2

193 2 Stems green; leaf margin dentate with sharp teeth, indumentum made of short glandular
194 hairs; secondary and tertiary veins of the adaxial side of leaf lamina slightly or not impressed;
195 corolla bright yellow, upper lip as wide as lower lip seen from above, lips squared in shape,
196 bright yellow, flat; style exserted from corolla.....*C. petioalaris*

197 - Stems reddish; leaf margin dentate, with smooth teeth, indumentum made of long glandular
198 hairs; secondary and tertiary veins of the adaxial side of leaf lamina clearly impressed;
199 corolla pale yellow, upper lip narrower than lower lip seen from above, lips rounded in shape,
200 pale yellow, saccate; style inserted in corolla.....*C. flavida*

201 Discussion

202
203 Initial confusion existed regarding the identity of *Calceolaria asperula*. In the protologue of
204 *C. asperula*, Philippi (1895) only gives the diameter of the inferior lip in a short description
205 without mentioning the upper lip. Ehrhart (2000) illustrates the taxon with a schematic
206 drawing showing lips of almost equal size, being the upper lip slightly smaller than the lower,
207 and only gives the size of the upper lip seen from above, being 5.5 mm in diameter
208 approximately. Ehrhart (2000) describes it as a species with a unique combination of
209 characters such as the anthers opening towards the style and an elaiophore made of dispersed
210 oil-producing hairs. The dissection of a flower from the type material of *C. asperula*
211 (SGO055831) (Fig. S1) shows Ehrhart's (2000) description to be mostly accurate regarding
212 vegetative morphology and elaiophore structure, but the upper and lower lip description is
213 incomplete and imprecise, making the schematic drawing doubtful. This imprecision in
214 Ehrhart's drawing might explain why specimens of *Calceolaria flavida* found in SGO were
215 formerly identified as *C. asperula* or, in some cases, as *Calceolaria* aff. *asperula*.

216
217 The most useful characters to differentiate the new species from the morphologically most
218 similar species *C. asperula* and *C. petioalaris*, proved to be flower related, showing the
219 importance of these stable characters for the taxonomy of *Calceolaria*. From the ecological
220 and geographical perspective, these three species can be clearly distinguished. *Calceolaria*
221 *petioalaris* is the only among the three species that associates with meso-hydrophytic
222 conditions, growing most of the time near water courses such as small streams or ravines
223 from the coast up to mid-elevations of the Andean cordillera (50-1800 m), between the
224 Coquimbo and Maule regions (Ehrhart 2000). *Calceolaria asperula* can be found in more
225 xeric conditions at elevations between 800-2000 m, in both Coastal and Andean Cordilleras,

226 in open and rocky areas among the sclerophyllous montane vegetation, between the
 227 Metropolitan and O'Higgins regions. *Calceolaria flavida* is more similar to *C. asperula* in
 228 terms of its ecology. It can also be found in xeric conditions associated with sclerophyllous
 229 vegetation at mid-elevations (1450-2200 m), but only grows on soils of granitic origin with
 230 N-NW orientation of Cerro El Roble, the tallest peak of the Coastal Cordillera of Central
 231 Chile.

232

233 Out of 81 taxa recognized for Chile, 61 are endemic (Rodríguez et al. 2018; RBG Edinburgh
 234 2021). Most of the endemism is located around Coquimbo and Maule Regions (29°02' S –
 235 36°32' S), being Valparaíso and the Metropolitan Region (32°01' S – 34°17' S) the most
 236 species-rich regions (Rodríguez et al. 2018; RBG Edinburgh 2021). The Coastal cordillera of
 237 central Chile is already known to host several species of *Calceolaria* endemic to Chile
 238 (Ehrhart 2000; Ehrhart 2005; García 2010; Flores-Toro and Amigo 2013). Moreover, Cerro
 239 El Roble hosts two narrow-endemic (Sensu Molau 1988) species of the genus: *Calceolaria*
 240 *caleuana* Muñoz-Schick & Moreira, found in the summit of Cerro El Roble and another
 241 locality in the limits of Valparaíso and Coquimbo Regions (Muñoz-Schick and Moreira-
 242 Muñoz 2008; Muñoz-Schick and Moreira-Muñoz 2009), and *Calceolaria ascendens* Lindl.
 243 subsp. *exigua* (Witasek) Nic. García, a rupicolous taxa found only in rocky outcrops of the
 244 coastal Cordillera between 32°42' S – 33°12' S at elevations of 1600-2100 m (García 2010).
 245 La Campana National Park, adjacent to Natural Sanctuary Cerro El Roble, is also home to the
 246 narrow endemic *Calceolaria campanae* Phillipi, that grows between the rock crevices near
 247 the summit of Cerro La Campana. This pattern of diversity found in *Calceolaria* is not
 248 unusual for the Chilean flora. Several genera share the same pattern of high diversity and
 249 endemism in Central Chile, such as *Senecio* L., *Chaetanthera* Ruiz & Pav., *Haplopappus*
 250 Cassini, *Leucheria* Lagascae, *Oxalis* L. and *Adesmia* D.C. (Arroyo et al. 1995; Fuentes et al.
 251 1995). A combination of high climatic heterogeneity due to latitudinal and altitudinal
 252 gradients (Armesto et al. 2007), plus the climatic history of the Quaternary, particularly
 253 glaciations and the presence of coastal refugia, are the probable drivers for the higher
 254 diversity and endemism in this region (Arroyo et al. 1995; Villagrán 1995; Hinojosa and
 255 Villagrán 1997; Villagrán and Hinojosa 1997).

256

257 The origin and present distribution of *C. flavida* could be related to the series of
 258 expansions/contractions and isolation of the vegetation belts in the coastal cordillera due to
 259 the glacial/interglacial cycles. Since there is no updated phylogeny of *Calceolaria*, no
 260 relationships could be inferred for *C. flavida*. Based on its morphology and following the
 261 preliminary phylogenetic studies (Cosacov et al. 2009), it could be hypothesized that it
 262 belongs to the subgenus *Cheiloncos* along with the most morphologically similar species
 263 *Calceolaria asperula* and *Calceolaria petioalaris*, all endemics to central Chile. A well-
 264 resolved phylogeny of the genus could help clarify the relationships among these species and
 265 establish a better understanding of the complex evolutionary history of *Calceolaria* in central
 266 Chile.

267

268 Since *Calceolaria flavida* appears to be a narrow-endemic and our preliminary assessment
 269 classifies it as Critically Endangered (CR), further surveys in the coastal Cordillera of central
 270 Chile are needed in order to fully understand its distribution and population size.

271 **Additional specimens examined**

272 *Calceolaria asperula*. **CHILE. Región Metropolitana:** Provincia de Melipilla: Reserva
 273 Nacional Roblería del Cobre de Loncha, 18 November 2004, P. Baxter, F. Bustos, M.F.

274 *Gardner, P. Hechenleitner V. & P.I. Thomas 1439* (SGO!, E[photo!]); Reserva Natural Altos
 275 de Cantillana, sendero desde refugio el alto a Horcón de Piedra, 28 December 2019, *N.*
 276 *Lavandero 191228* (SGO!); Reserva Natural Altos de Cantillana, sendero desde refugio el
 277 alto a Horcón de Piedra, 20 November 2020, *N. Lavandero 201120* (SGO!); Provincia
 278 Cordillera: Pirque, Reserva Nacional Río Clarillo, Sendero Quebrada Jorquera, 29 January
 279 2013, *T. Christian, M.F. Gardner & V. Morales 343* (E [photo!]); Reserva Nacional Río
 280 Clarillo, Cajón de los Cipreses, 13 December 2019, *N. Lavandero 409* (SGO!); **Región de**
 281 **O'Higgins**: Cajón de los Cipreses, March 1875, *R.A. Philippi s.n.* (SGO 055831!,
 282 PH[photo!]), Provincia del Cachapoal: Rancagua, road from Coya to Mina La Juanita, ca. 8.3
 283 km above retén de Carabineros, 18 January 1995, *L.R. Landrum & J. Martínez 8486* (SGO!);
 284 Machalí, Road from Coya to Machalí, 3 January 2009, *M.F. Gardner & S.G. Knees 8453* (E
 285 [photo!]); Copada, open rocky slope, 25 January 1925, *F.W. Pennell 12272* (US [photo!])

286 *Calceolaria petioalaris*. **CHILE. Región de Coquimbo**: Provincia de Limarí: Camino a
 287 Mina Lapislazuli, 14 January 2009, *Fundación Philippi 349* (SGO); Provincia Choapa:
 288 Camino Tilama - cuesta Las Palmas, 18 November 2002, *A. Moreira 784* (SGO); Provincia
 289 de Elqui: Illapel, Cuzcuz, 5 November 1985, *M. A. Trivelli s.n* (SGO). **Región de**
 290 **Valparaíso**: Provincia de Petorca: Catemu al N entre las Majadas y Campamento Cerro
 291 Negro, 28 December 2001, *A. Moreira 643* (SGO); Provincia Los Andes: Camino a Portillo,
 292 11 December 2001, *M. Chamy & M. Piovano 15* (SGO); camino a Portillo, 11 December
 293 2001, *M. Chamy & M. Piovano 16* (SGO); Provincia de Quillota: Olmué, Parque Nacional La
 294 Campana, sector Granizo, 1 February 1998, *Baxter et al. s.n* (SGO); Parque Nacional la
 295 Campana, sector Granizo, Mina Pronosticada, 6 January 2001, *A. moreira 510* (SGO); Parque
 296 Nacional la Campana, sector Granizo, Mina Pronosticada, March 2001, *A. moreira 533*
 297 (SGO). **Región Metropolitana**: Provincia de Santiago: Hacienda Rinconada de Cerda,
 298 Maipú, Quebrada de la Plata, 1 October 1936, *C. Muñoz s.n* (SGO); Cajón del Estero La
 299 Leonera, ladera al NO, 27 February 2000, *Arroyo et al. 201380* (SGO); Provincia Cordillera:
 300 Lo Valdés, 28 December 2000, *A. Moreira 498* (SGO); camino al Embalse del Yeso, 21
 301 January 1995, *M. Muñoz & A. Moreira 3704* (SGO); Provincia de Melipilla: Alhué, Reserva
 302 Nacional Roblería del Cobre de Loncha, 18 November 2004, *Baxter et al. s.n* (SGO); Cuesta
 303 Zapata, 7 October 1988, *von Bohlen 512* (SGO), Cuesta Zapata, 4 July 1989, *von Bohlen 581*
 304 (SGO); Cuesta Zapata, 18 December 2001, *M. Chamy & M. Piovano 2* (SGO), Cuesta
 305 Zapata, 18 December 2001, *M. Chamy & M. Piovano 8* (SGO); Provincia de Chacabuco:
 306 Cuesta la Dormida, entre Cruce Caleu y Portezuelo, 4 May 2003, *A. Moreira 958* (SGO).
 307 **Región Libertador Bernardo O'Higgins**: Provincia de Colchagua, San Fernando, Sector La
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449 **Figure 1.** Distribution map of *Calceolaria flavida* (triangles) in Chile. Roman numbers
450 represent administrative regions (IV Coquimbo, V Valparaiso, RM Metropolitan Region, VI
451 O'Higgins, VII Maule). Green polygons represent protected areas (La Campana National
452 Park and Natural Sanctuary Cerro El Roble).

453

454 **Figure 2.** Indumentum type in leaves of *Calceolaria*. A, C, E: upper leaf surface; B, D, F:
455 lower leaf surface. A, B: *Calceolaria asperula* (Lavandero 409 (SGO)). C, D. *Calceolaria*
456 *flavida* (Lavandero & Santilli 201027 (SGO)). E, F. *Calceolaria petiolaris* (B. Rosende s/n).
457 Scale bar: 1 mm.

458

459 **Figure 3.** Lateral and frontal view of flowers (from left to right) of *Calceolaria*. A, B.
460 *Calceolaria asperula* (Lavandero 409 (SGO)). C, D. *Calceolaria flavida* (Lavandero &
461 Santilli 201027 (SGO)). E, F. *Calceolaria petiolaris* (B. Rosende s/n).

462

463 **Figure 4.** Lateral cross-section view of flowers of *Calceolaria* and detail of elaiophores. A,
464 B. *Calceolaria asperula* (Lavandero 409 (SGO)). C, D. *Calceolaria flavida* (Lavandero &
465 Santilli 201027 (SGO)). E, F. *Calceolaria petiolaris* (B. Rosende s/n).

466

467 **Figure 5.** *Calceolaria flavida*. A. Habit. B upper side view of flower. C. Lateral view of
468 flower. D. frontal view of flower with upper lip open. E. Frontal view of flower. F. Detail of
469 abaxial side of leaf. G. Detail of adaxial side of leaf. H. Detail of stems. I. Detail of early-
470 flowering inflorescence.

471

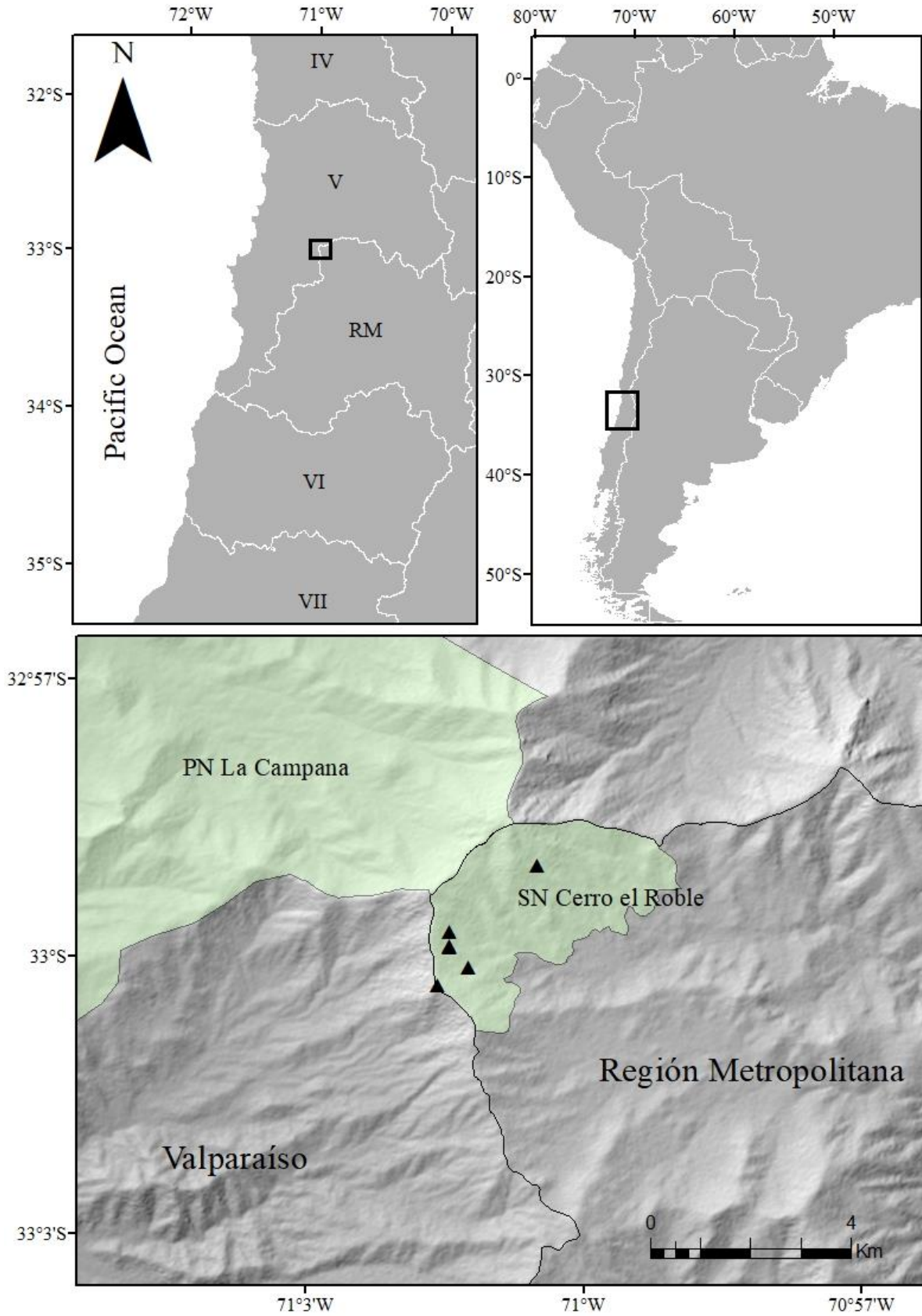
472 **Figure 6.** Habitat of *Calceolaria flavida*. A. NW-facing slopes dominated by *Puya coerulea*
473 *var. coerulea*, *Lithraea caustica* and *Gochnatia foliolosa* (Natural Sanctuary Cerro El Roble,
474 Región Metropolitana, Chile). B, C. Habit of *Calceolaria flavida*.

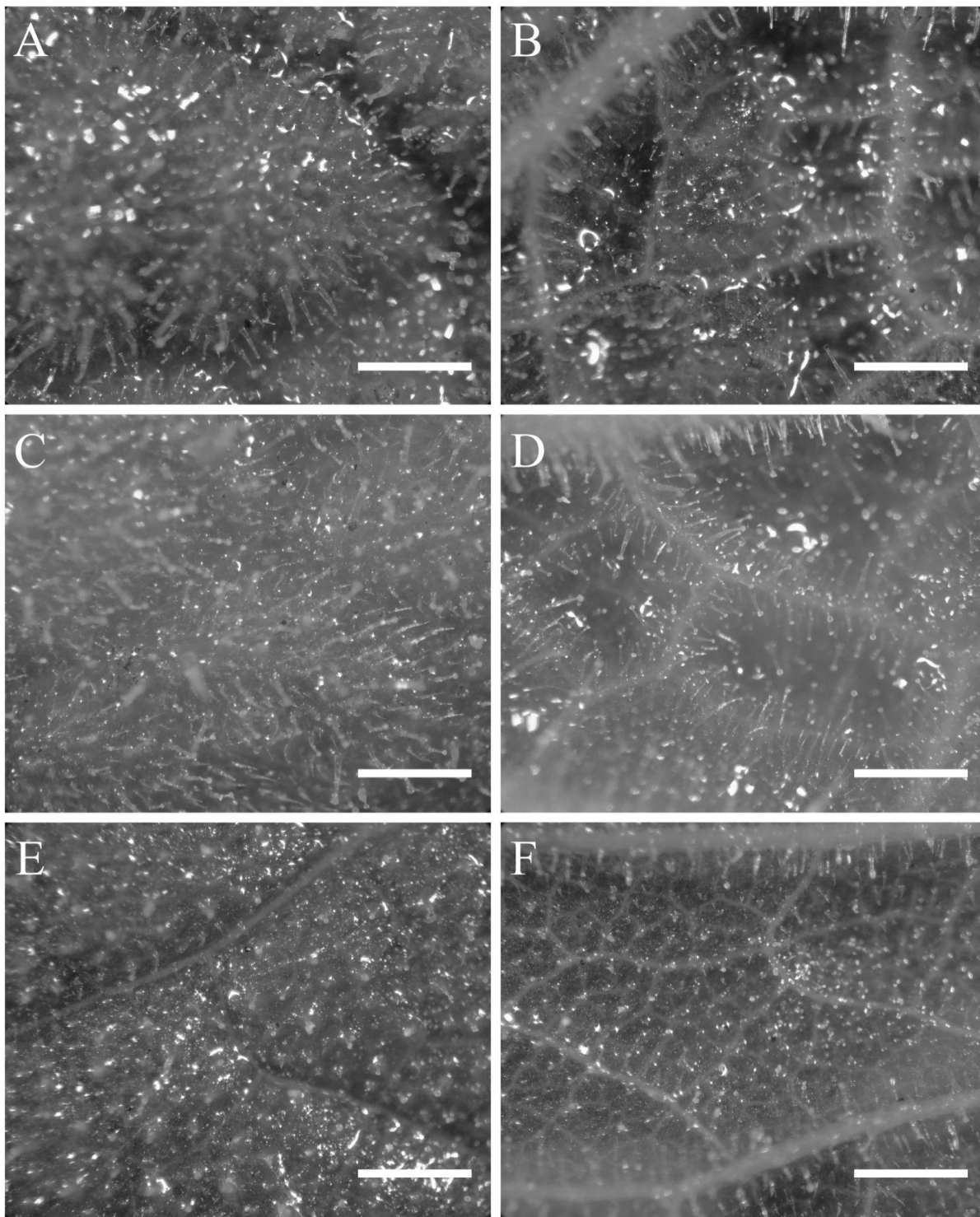
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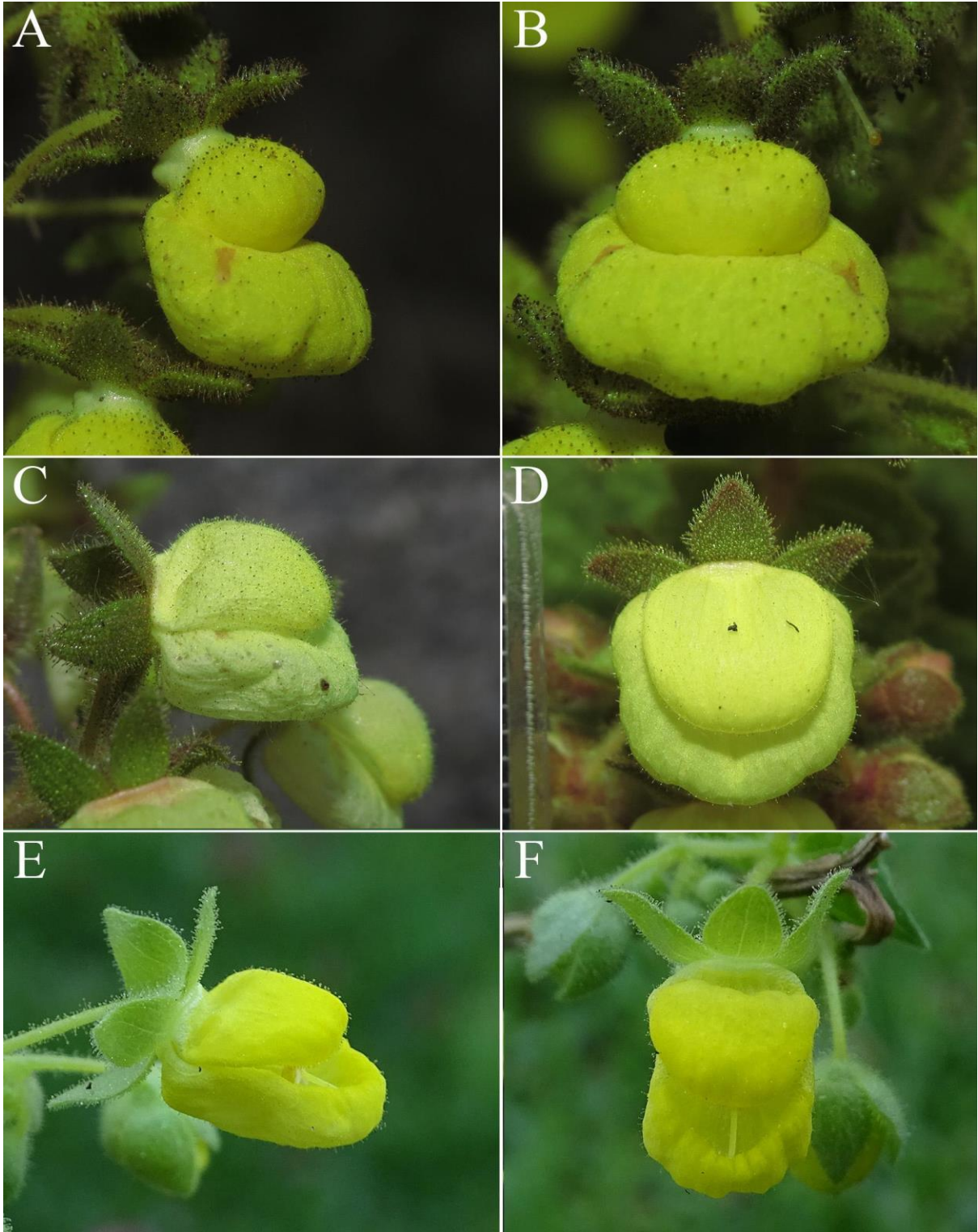
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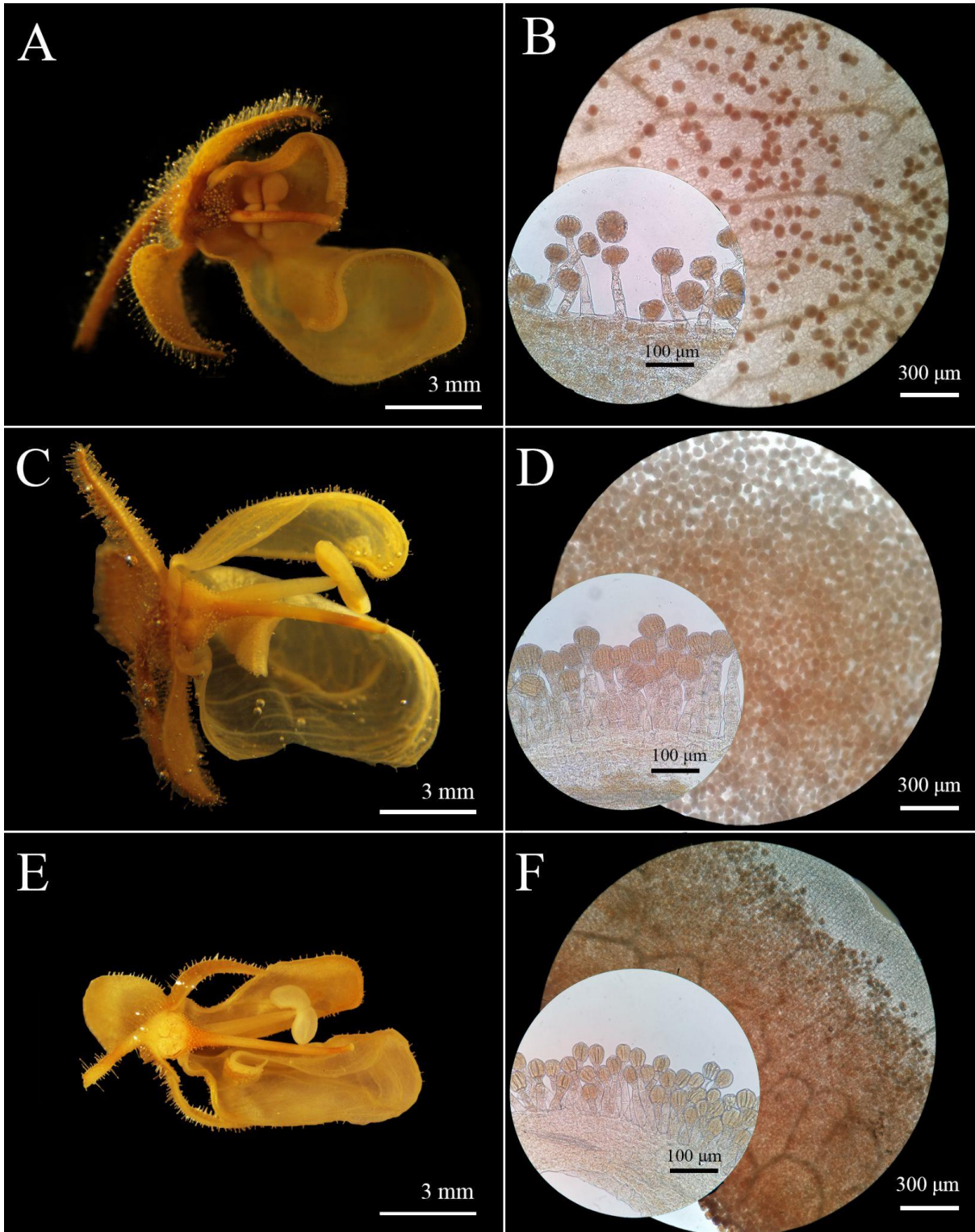


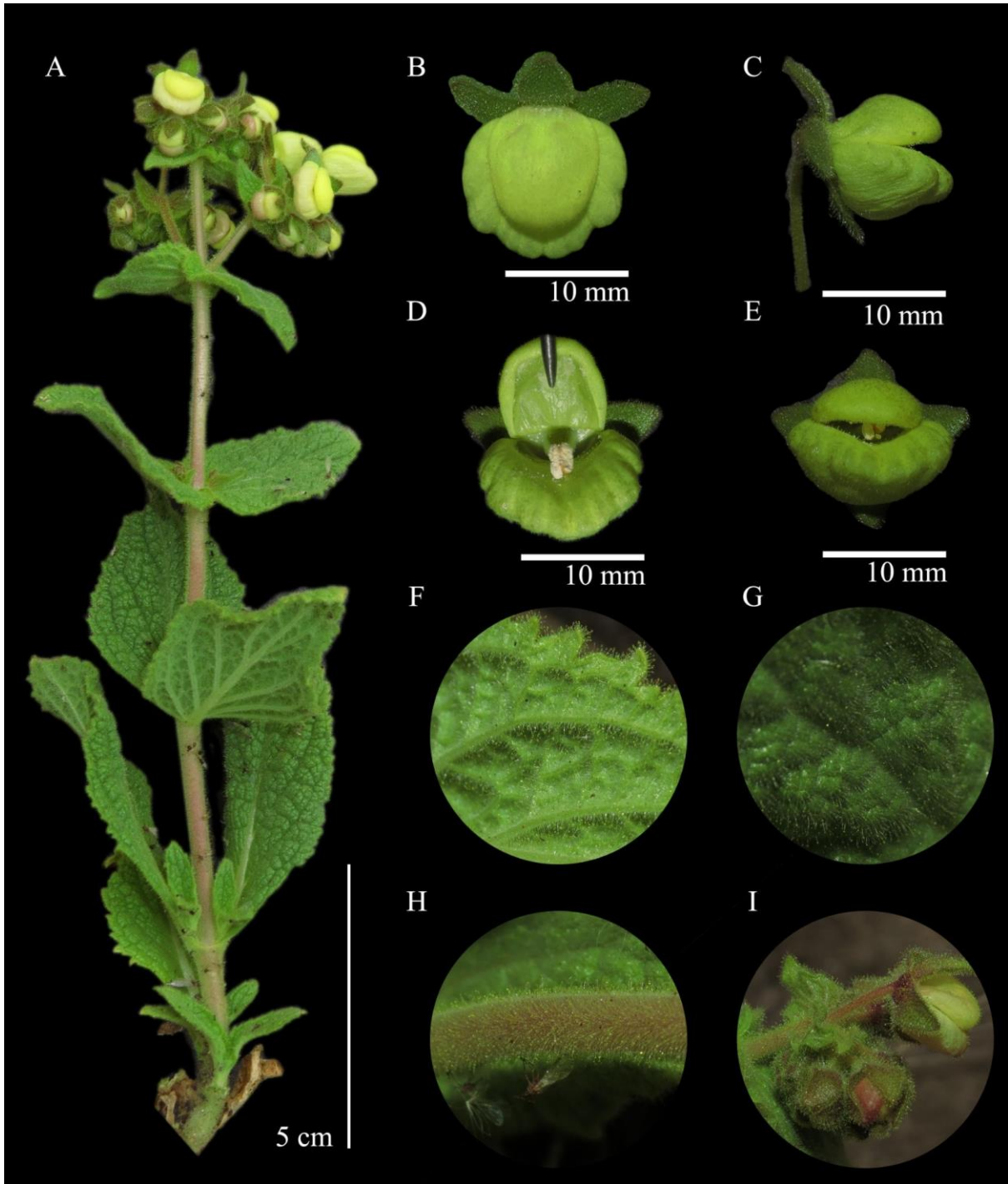


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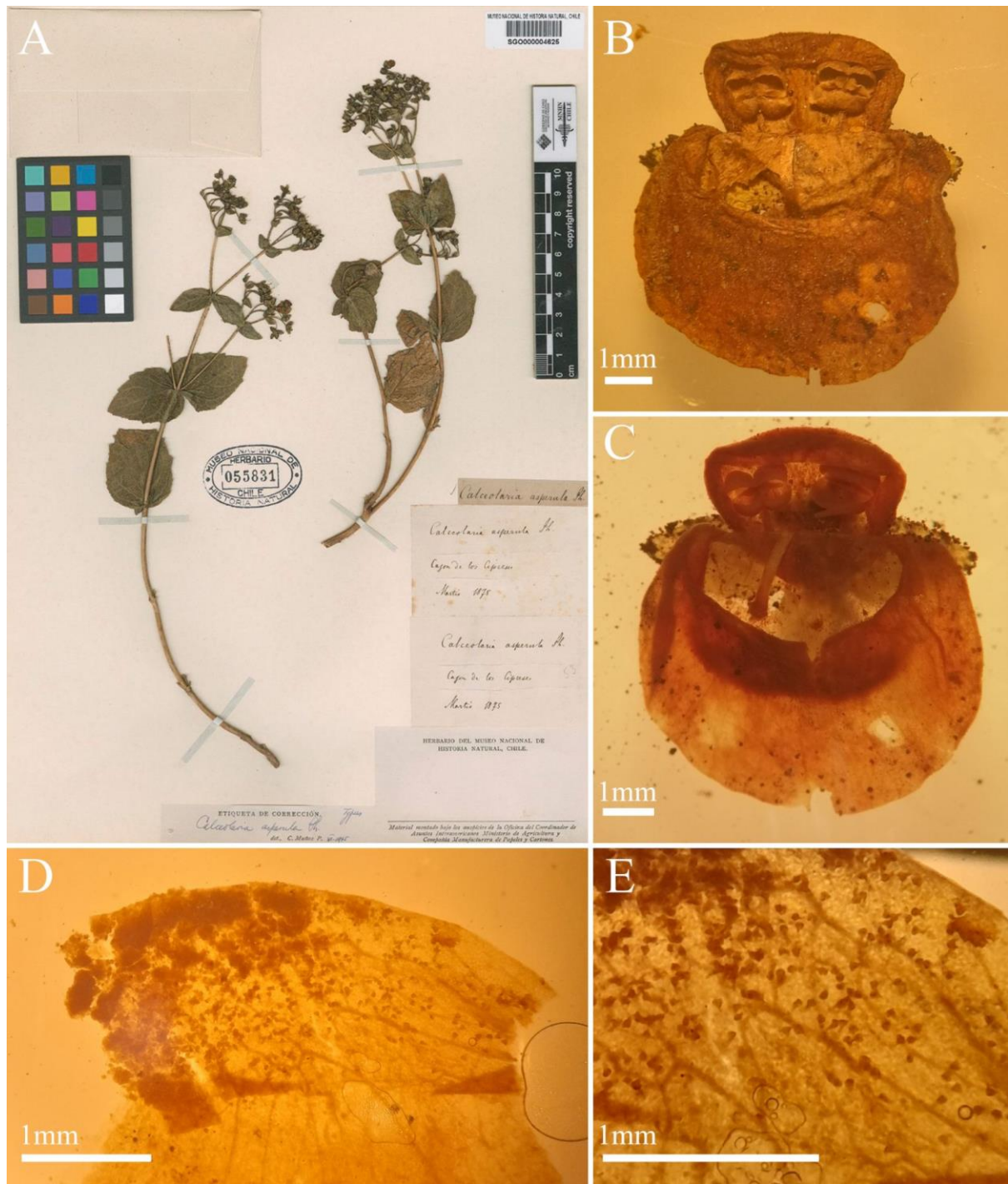
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490 **Supplementary material:**

491 **Figure S1.** Type specimen of *Calceolaria asperula* Phil. (SGO 055831). A. complete
492 specimen. B. Detail of dried flower. C. Detail of rehydrated flower. D. Detail of the
493 elaiophore. E. Detail of the scattered oil-producing glands of the elaiophore.



494