

# New species, additions and a key to the Brazilian species of the Geminata clade of *Solanum* L. (Solanaceae) in Brazil

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## Abstract

Two additions and four new species are described from Brazil for the large Geminata clade (*Solanum*: Solanaceae) bringing the total diversity in the group to 149 species, with 44 of these occurring in Brazil. New species are described from Brazil: *S. amorimii* S.Knapp & Giacomin, **sp. nov.** from Bahia and adjacent Minas Gerais states, *S. filirhachis* Giacomin & Stehmann, **sp. nov.** from Espírito Santo, *S. psilophyllum* Stehmann & Giacomin, **sp. nov.** from Minas Gerais and *S. verticillatum* S.Knapp & Stehmann, **sp. nov.** from São Paulo, Rio de Janeiro and Minas Gerais. Modern character-rich descriptions and lectotypifications are provided for *S. apiahense* Witasek and *Solanum lacteum* Vell. All are illustrated, mapped and assessed for conservation status. We also provide a brief analysis of the diversity and endemism of the Geminata clade in Brazil and a key to all 44 Brazilian species.

## Abstract

Duas novas adições e quatro novas espécies ocorrentes no Brasil são apresentadas para o clado Geminata (*Solanum*: Solanaceae), aumentando a diversidade conhecida para grupo para 149 espécies, das quais 44 ocorrem no Brasil. Táxons novos são descritos: *S. amorimii* S.Knapp & Giacomin, **sp. nov.**, conhecido para os estados da Bahia e Espírito Santo, *S. filirhachis* Giacomin & Stehmann, **sp. nov.** conhecido para o

Espirito Santo, *S. psilophyllum* Stehmann & Giacomin, **sp. nov.** conhecido para Minas Gerais e *S. verticillatum* S. Knapp & Stehmann, **sp. nov.** conhecido para São Paulo, Rio de Janeiro and Minas Gerais. Descrições detalhadas e lectotipificações são apresentadas para *Solanum lacteum* Vell. e *S. apiahyense* Witasek. Para todos os táxons são apresentados imagens, mapas e categorias de ameaça. É também apresentada uma breve análise de diversidade e endemismo do clado Geminata no Brasil, além de uma chave dicotômica para as 44 espécies ocorrentes no país.

## Keywords

Atlantic forests, diversity, endemism, assessment of extinction risk

## Palavras chave

Mata Atlântica, diversidade, endemismo, avaliação do risco de extinção

## Introduction

*Solanum* L. is one of the largest of flowering plant genera, and includes *ca.* 1400 species occurring worldwide on all continents except Antarctica. The genus was traditionally divided into the “spiny” and “non-spiny” solanums (e.g., Dunal 1852), based on the presence or absence of leaf and stem prickles. Molecular phylogenetic analysis showed that the “spiny” solanums form a monophyletic group (Bohs 2005; Weese and Bohs 2007; Särkinen et al. 2013), but the “non-spiny” solanums consist of a grade comprising several distinct monophyletic groups. The largest of these monophyletic groups are the potato clade (*ca.* 178 species of potatoes and their relatives), the “M” clade (of Särkinen et al. 2013; *ca.* 110 species of true nightshades and dulcamaroids; see Knapp 2013) and the Geminata clade, whose Brazilian members are treated here.

The Geminata clade as broadly defined contains 149 species, all but one of which occur in the New World tropics (Knapp 2002a, 2008). Members of the group are shrubs and small trees mostly occurring in forest understory habitats; they are often inconspicuous, rare and rarely collected, with only a few widespread and weedy species. The group’s name comes from the morphology of sympodial units in many of the component species where leaves appear to be twinned (geminate) at a node due to concaulescence of shoot generations (Danert 1958). The two leaves are often of markedly different sizes and occasionally even shapes (see Knapp 2002a); plants are then markedly anisophyllous. Knapp (2002a) treated the group as section *Geminata* (G. Don) Walp. and divided the group into several informal species groups based on seed and sympodial morphology. Species later found to belong to the monophyletic group containing members of section *Geminata* (e.g., *S. argentinum* Bitter & Lillo and *S. havanense* Jacq. and its relatives; Weese and Bohs 2007) were added to the group and a list of component species with a key to all taxa was provided (Knapp 2008).

*Solanum trachytrichium* Bitter was included in Geminata by Knapp (2002a, 2008) but recent molecular work in the related *Brevantherum* clade (Giacomin 2015) revealed that it, plus the rare Brazilian species *S. apiahyense* Witasek (Giacomin and

Stehmann 2014) are sister to the Geminata clade as treated by Knapp (2008), but with low support. *Solanum apiahyense* together with *S. trachytrichium* form a strongly supported lineage that is either sister to the Brevantherum or Geminata clade depending on the marker used. We here include these two taxa in the broad circumscription of the Geminata clade for practical reasons of identification and morphological similarity, while recognising that future phylogenetic studies may show *S. apiahyense* and *S. trachytrichium* to be a distinct group (see discussion under *S. apiahyense*). They share trichome types with the Geminata clade, and their possible relationships and similarities are discussed below.

An analysis of species richness and endemism patterns in the Neotropics using a group of species including many members of the Geminata clade (Knapp 2002b) showed peaks of both diversity and endemism in the Andes and south-eastern Brazil, as had been predicted by Gentry (1982) for understory plants in general. Subsequent analysis on a country level (Knapp 2008) showed species richness of the Geminata clade was highest in Colombia, Peru and Brazil with 41 (9 endemic from Colombia, 22%; 11 endemic from Peru, 27%) and 35 (incorrectly recorded as 34; 17 endemic, 50%) species respectively. Concentrated work in Brazil focused on the *Lista de Especies de Flora do Brasil* (Stehmann et al. 2014) has clarified the status of several names of dubious application and brought to light new species of the Geminata clade that are described here. We here record 44 species (43 native) of the group for Brazil, instead of 35 recorded by Knapp (2008). Of these nine additional records for the country, two are range extensions (*S. arboreum* Dunal, *S. diphyllum* L.) and are documented with character-rich descriptions in the literature cited above, while two have not been described over their entire range (*S. apiahyense* and *S. lacteum*) or have been of uncertain application (*S. lacteum*) and we provide descriptions to a modern standard here. Five new species have been discovered since Knapp (2008). We describe four of these new taxa (one is in review elsewhere, see below) and clarify diversity and distribution of the entire clade for Brazil.

## Materials and methods

Descriptions are based on field observations and examination of herbarium specimens from 27 collections in Brazil and abroad (B, BM, BHCB, BR, CEPEC, CORD, ESA, F, FUEL, FURB, G, HUEFS, IAC, JPB, K, LE, MBM, MBML, NY, PMSP, RB, SP, SPF, UEC, UT, VIC, WU). Herbarium acronyms are from Index Herbariorum (<http://sciweb.nybg.org/science2/IndexHerbariorum.asp>) and all specimens are cited in the text. Full data are provided in the supplemental file and on the Solanaceae Source website (<http://www.solanaceaesource.org>). Extent of Occurrence (EOO) and Area of Occupancy (AOO) were calculated using GeoCat (<http://geocat.kew.org>) using the standard 2 km<sup>2</sup> cell width for AOO calculation. Conservation status of each species was assessed using the IUCN (2014) criteria based on the GeoCat analyses (Bachman et al. 2012) combined with field knowledge.

## Results and discussion

The broadly defined Geminata clade has 43 species native to Brazil (Table 1); only *S. diphyllum* (see Knapp 2002a) is known only from cultivation and may be naturalising. The state distribution of each species is given in Table 1, along with endemic status and extra-Brazilian distribution of non-endemic species. Endemism of native Brazilian Geminata species now stands at 65% (28/43 native species, excluding *S. diphyllum*). The south-eastern region (following Brazilian political divisions) is the most species-rich area of the country with 24 species, followed by the southern region (19 species); the northern regions have fewer species, reflecting the circum-Amazonian species richness of *Solanum* in general (Table 2). The distribution in federal units (states) by species is presented in the second column of Table 1 and by state in Table 3. The states of Paraná (19 species), Minas Gerais (17 species) and Santa Catarina (16 species) are the most species-rich, followed by São Paulo (15 species) and Rio de Janeiro (12 species). Six species are endemic to a single state; *S. cordioides* and *S. santosii* in Bahia, *S. filirachis* in Espírito Santo, *S. psilophyllum* in Minas Gerais, *S. gertii* in Paraná, and *S. sp. 1* (a new species based on collections including Giacomini et al. 1789 [BHCB, UFP] being described by M.F. Agra and currently in review) in Pernambuco.

Only seven of the native species occur exclusively outside the Mata Atlântica biome (Atlantic rainforest; as defined by IBGE 2012); all of these are Amazonian (see Table 1). All of the endemic species (28) occur in Mata Atlântica, with 24 of those occurring only in that biome; only *S. caavurana* (Caatinga + Cerrado), *S. intermedium* (Cerrado) and *S. psilophyllum* (Cerrado; in the forested *capões* associated with *Campos Ruprestes*) occur in other vegetation types. *Solanum caavurana* is widespread in secondary habitats and *S. intermedium* and *S. psilophyllum* occur in regions where the Cerrado and Mata Atlântica meet (e.g., Serra do Cipó in Minas Gerais). Few Geminata species are widespread in Brazil; only *S. caavurana*, *S. campaniforme*, *S. leucocarpon*, *S. pseudocapsicum*, *S. pseudoquina* and *S. stipulatum* occur in more than four states.

Because of their biology and occurrence in small populations of scattered individuals, most of the species described here (with the exception of *S. verticillatum*) can be classified as rare and of some conservation concern. Rabinowitz (1981) suggested that species become rare (and by extension subject to extinction risk) by a variety of pathways and if this were so, the ecological and evolutionary consequences of rarity would be diverse. She analysed plant rarity using a scheme that took into account range size, habitat specificity and local abundance (population size); in her classification rare species ranged from ‘common’ to ‘endemics’. The ecological consequences of rarity are likely to differ in rare taxa of the different categories.

Although the south-eastern part of Brazil is the most intensively collected part of the country (Sousa-Baena et al. 2013) all of the new species and additions to the Geminata for the Brazilian flora come from this region. As collecting is intensified in other regions (such as the western edges of the Amazon basin) we expect more of these forest understory solanums for Brazil.

**Table I.** Brazilian species of the Geminata clade (country endemics are in bold face); of 43 native species (is *S. diphyllum* introduced) 28 are endemic to Brazil. Brazilian states are abbreviated following *Lista de Especies de Flora do Brasil* (Stehmann et al. 2014) – see also Table 3.

Species	Brazilian distribution	Extra-Brazilian distribution	Biome distribution in Brazil
<b><i>Solanum alatirameum</i> Bitter</b>	PR; RS; SC		Mata Atlântica
<b><i>Solanum amorinii</i> S.Knapp &amp; Giacomini</b>	BA; MG		Mata Atlântica
<i>Solanum antiochense</i> van Heurck & Mull.-Arg.	AC; AM	Ecuador, Peru	Amazonia
<b><i>Solanum apiahense</i> Witasek</b>	PR; SC; SP		Mata Atlântica
<b><i>Solanum avenarium</i> Sendtn.</b>	RJ; RS		Mata Atlântica
<i>Solanum arboreum</i> Dunal	RR		Amazonia
<b><i>Solanum bahianum</i> S.Knapp</b>	BA; ES; MG		Mata Atlântica
<i>Solanum caavunana</i> Vell.	AL; BA; CE; ES; MA; MG; MS; MT; PB; PE; PI; PR; RJ; RN; SC; SE; SP		Cerrado, Mata Atlântica
<i>Solanum campaniforme</i> Roem. & Schult.	AM; BA; CE; DF; ES; MA; MG; PA; PB; PE; PR; RJ; RR; RS; SC; SP	Venezuela	Amazonia, Caatinga, Cerrado, Mata Atlântica
<b><i>Solanum canosense</i> L.B.Sm. &amp; Downs</b>	PR; SC		Mata Atlântica
<b><i>Solanum cassioides</i> L.B.Sm. &amp; Downs</b>	MG; PR; RS; SC		Mata Atlântica
<i>Solanum compressum</i> L.B.Sm. & Downs	PR; RS; SC	Argentina, Paraguay	Amazonia, Cerrado, Mata Atlântica
<b><i>Solanum cordifolies</i> S.Knapp</b>	BA	Bolivia, Paraguay	Mata Atlântica
<i>Solanum corimbense</i> S.Moore	MS; MT; RO	Argentina, Paraguay	Mata Atlântica
<i>Solanum deliciatum</i> L.B.Sm. & Downs	PR; RS; SC; SP	Introduced from Central America; cultivated and escaped worldwide	Mata Atlântica
<i>Solanum diphyllum</i> L.	MG	Cultivated	Mata Atlântica
<b><i>Solanum evonymoides</i> Sendtn.</b>	BA; ES; MG		Mata Atlântica
<b><i>Solanum filibractis</i> Giacomini &amp; Stehmann</b>	ES		Mata Atlântica
<b><i>Solanum geriti</i> S.Knapp</b>	PR		Mata Atlântica
<b><i>Solanum graphalocarpum</i> Vell.</b>	MG; PR; RJ; SP		Mata Atlântica
<b><i>Solanum intermedium</i> Sendtn.</b>	MG; RJ; SP		Amazonia, Cerrado
<b><i>Solanum kleinii</i> L.B.Sm. &amp; Downs</b>	PR; SC; SP		Mata Atlântica
<b><i>Solanum lacteum</i> Vell.</b>	ES; MG; RJ		Mata Atlântica
<i>Solanum leptopodium</i> van Heurck & Mull.-Arg.	AM	Ecuador, Peru	Amazonia

Species	Brazilian distribution	Extra-Brazilian distribution	Biome distribution in Brazil
<i>Solanum leucocarpum</i> Dunal	AC; AM; GO; MA; MG; MT; PA; RO; RR	Panama, Colombia, Venezuela, Ecuador, Peru	Amazonia, Cerrado, Mata Atlântica
<i>Solanum nudum</i> Dunal	AC; AM	Central and South America	Amazonia
<i>Solanum oppositifolium</i> Ruiz & Pavon	AC; AM; PA; RR	Ecuador, Peru	Amazonia
<i>Solanum pubescens</i> L.B.Sm. & Downs	PR; RS; SC; SP		Mata Atlântica
<i>Solanum pseudocapsicum</i> L.	DF; ES; GO; MG; MS; MT; PR; RJ; RS; SC; SP	Cultivated worldwide	Cerrado, Mata Atlântica
<i>Solanum pseudodaphnopsis</i> L.A.Menzl & Stehmann	PR; SC; SP		Mata Atlântica
<i>Solanum pseudoquina</i> A.St.Hil.	BA; ES; MG; PR; RJ; RS; SC; SP	Argentina, Paraguay	Mata Atlântica
<i>Solanum pilophyllum</i> Stehmann & Giacomin	MG		Mata Atlântica, Cerrado
<i>Solanum reticulatum</i> L.B.Sm. & Downs	PR; RS; SC		Mata Atlântica
<i>Solanum restiniae</i> S.Knapp	BA; ES; RJ		Mata Atlântica
<i>Solanum robustifolius</i> Bitter	AC; AM	Peru, Ecuador, Colombia, Bolivia	Amazonia
<i>Solanum sanctosii</i> S.Knapp	BA		Mata Atlântica
<i>Solanum sessile</i> Ruiz & Pav.	AC; AM	Peru, Ecuador, Colombia, Bolivia	Amazonia
<i>Solanum sp. 1</i>	PE	[in press Agra]	Mata Atlântica
<i>Solanum spissifolium</i> Sendtn.	SP		Mata Atlântica
<i>Solanum stipulatum</i> Vell.	BA; ES; MG; PR; RJ; SC; SP		Mata Atlântica
<i>Solanum symmetricum</i> Rusby	MG; MT; PR	Bolivia	Mata Atlântica
<i>Solanum trachyrrhizum</i> Bitter	PR; RS; SC; SP	Argentina, Paraguay	Mata Atlântica
<i>Solanum verticillatum</i> S.Knapp & Stehmann	MG; RJ; SP		Mata Atlântica
<i>Solanum warningii</i> Hiern	BA; ES; MG; RJ		Mata Atlântica

**Table 2.** Species of the Geminata clade and their distribution in the regions of Brazil (as defined in List of Species of the Brazilian Flora. Rio de Janeiro Botanical Garden. <http://floradobrasil.jbrj.gov.br/> [Accessed on: 08 Nov. 2014]

Region	Species
Central-West (5)	<i>caavurana</i> , <i>campaniforme</i> , <i>corumbense</i> , <i>leucocarpon</i> , <i>pseudocapsicum</i>
North-East (12)	<i>bahianum</i> , <i>caavurana</i> , <i>campaniforme</i> , <i>cordioides</i> , <i>evonymoides</i> , <i>leucocarpon</i> , <i>pseudoquina</i> , <i>restingae</i> , sp. 1, <i>santosii</i> , <i>stipulatum</i> , <i>warmingii</i>
North (10)	<i>anisophyllum</i> , <i>arboreum</i> , <i>campaniforme</i> , <i>corumbense</i> , <i>leptopodium</i> , <i>leucocarpon</i> , <i>nudum</i> , <i>oppositifolium</i> , <i>robustifrons</i> , <i>sessile</i>
South-East (24)	<i>apiahyense</i> , <i>arenarium</i> , <i>bahianum</i> , <i>caavurana</i> , <i>campaniforme</i> , <i>cassioides</i> , <i>delicatulum</i> , <i>evonymoides</i> , <i>gnaphalocarpon</i> , <i>intermedium</i> , <i>kleinii</i> , <i>lacteum</i> , <i>leucocarpon</i> , <i>pabstii</i> , <i>pseudocapsicum</i> , <i>pseudodaphnopsis</i> , <i>pseudoquina</i> , <i>psilophyllum</i> , <i>restingae</i> , <i>spissifolium</i> , <i>stipulatum</i> , <i>symmetricum</i> , <i>trachytrichium</i> , <i>warmingii</i>
South (19)	<i>alatirameum</i> , <i>apiahyense</i> , <i>arenarium</i> , <i>caavurana</i> , <i>campaniforme</i> , <i>canoasense</i> , <i>cassioides</i> , <i>compressum</i> , <i>delicatulum</i> , <i>gertii</i> , <i>gnaphalocarpon</i> , <i>kleinii</i> , <i>pabstii</i> , <i>pseudocapsicum</i> , <i>pseudodaphnopsis</i> , <i>pseudoquina</i> , <i>reitzii</i> , <i>stipulatum</i> , <i>symmetricum</i> , <i>trachytrichium</i>

### Taxonomic treatment of new species

#### *Solanum amorimii* S.Knapp & Giacomin, sp. nov.

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Figures 1A, B, 2

**Diagnosis.** Like *Solanum restingae* S.Knapp but differing in smaller flowers with narrowly deltate to long-triangular calyx lobes, unwinged stems and usually somewhat auriculate leaves.

**Type.** BRAZIL Bahia: Mun. Tancredo Neves, Estrada para os distritos de Água Branca e Julião, ca. 14. 1 km de Tancredo Neves, 554 m, 13°26'36"S, 39°30'40"W, 12 Sep 2005 (fl), A.M. Amorim, J. Jardim, J. Paixão, S. Sant'Ana & E. dos Santos 5210 (holotype: CEPEC [CEPEC-110253]; isotypes: BHCB [BHCB002643, BHCB019062]).

**Description.** Shrub to small treelet 0.5–3 m tall; young stems terete, glabrous or minutely puberulent with simple uniseriate trichomes to 0.5 mm long; new growth glabrous; bark of older stems smooth, greenish brown. Sympodial units difoliate, geminate; leaves of a pair not differing in shape. Leaves simple, the major leaves 8–10(-15) cm long, 2–3(-5) cm wide, elliptic to obovate, usually widest near the middle or in the distal half, glabrous on both surfaces, fleshy in texture; primary veins 8 pairs, usually paler than the lamina; base sessile and more or less auriculate; margins entire; apex attenuate; petiole absent or < 0.1 cm long; minor leaves 3–5 cm long, 1–2 cm wide, differing from the majors only in size. Inflorescence 0.1–0.3 cm long, opposite the leaves, unbranched, with 4–7 flowers, glabrous; peduncle < 0.1 cm long; pedicels ca. 0.8 cm long, 0.5 mm in diameter at the base and apex, filiform, nodding at anthesis, glabrous, articulated at the base; pedicel scars tightly packed and almost overlapping. Buds ellipsoid to rounded, the corolla exserted ca. halfway from

**Table 3.** Species of the Geminata clade occurring in each of the 27 Brazilian states (incl. DF). Species endemic to that state are in boldface type.

State	#	Species
Acre (AC)	6	<i>anisophyllum</i> , <i>leucocarpon</i> , <i>nudum</i> , <i>oppositifolium</i> , <i>robustifrons</i> , <i>sessile</i>
Alagoas (AL)	1	<i>caavurana</i>
Amapá (AP)	1	<i>leucocarpon</i>
Amazonas (AM)	8	<i>anisophyllum</i> , <i>campaniforme</i> , <i>leptopodium</i> , <i>leucocarpon</i> , <i>nudum</i> , <i>oppositifolium</i> , <i>robustifrons</i> , <i>sessile</i>
Bahia (BA)	10	<i>amorimii</i> , <i>caavurana</i> , <i>campaniforme</i> , <b><i>cordioides</i></b> , <i>evonymoides</i> , <i>pseudoquina</i> , <i>restingae</i> , <b><i>santosii</i></b> , <i>stipulatum</i> , <i>warmingii</i>
Ceará (CE)	2	<i>caavurana</i> , <i>campaniforme</i>
Distrito Federal (DF)	2	<i>campaniforme</i> , <i>pseudocapsicum</i>
Espirito Santo (ES)	9	<i>bahianum</i> , <i>caavurana</i> , <i>campaniforme</i> , <i>evonymoides</i> , <b><i>filirbachis</i></b> , <i>lacteum</i> , <i>restingae</i> , <i>pseudoquina</i> , <i>warmingii</i>
Goiás (GO)	3	<i>leucocarpon</i> , <i>pseudocapsicum</i> , <i>stipulatum</i>
Maranhão (MA)	3	<i>caavurana</i> , <i>campaniforme</i> , <i>pseudocapsicum</i>
Mato Grosso (MT)	5	<i>caavurana</i> , <i>corumbense</i> , <i>leucocarpon</i> , <i>pseudocapsicum</i> , <i>symmetricum</i>
Mato Grosso do Sul (MS)	2	<i>caavurana</i> , <i>corumbense</i>
Minas Gerais (MG)	17	<i>amorimii</i> , <i>caavurana</i> , <i>campaniforme</i> , <i>cassioides</i> , <i>diphyllum</i> , <i>evonymoides</i> , <i>gnaphalocarpon</i> , <i>intermedium</i> , <i>lacteum</i> , <i>leucocarpon</i> , <i>pseudocapsicum</i> , <i>pseudoquina</i> , <b><i>psilophyllum</i></b> , <i>stipulatum</i> , <i>symmetricum</i> , <i>verticillatum</i> , <i>warmingii</i>
Pará (PA)	3	<i>caavurana</i> , <i>campaniforme</i> , <i>leucocarpon</i>
Paraíba (PB)	2	<i>caavurana</i> , <i>campaniforme</i>
Paraná (PR)	19	<i>alatirameum</i> , <i>apiabyense</i> , <i>caavurana</i> , <i>campaniforme</i> , <i>canoasense</i> , <i>cassioides</i> , <i>compressum</i> , <i>delicatulum</i> , <b><i>gertii</i></b> , <i>gnaphalocarpon</i> , <i>kleinii</i> , <i>pabstii</i> , <i>pseudocapsicum</i> , <i>pseudodaphnopsis</i> , <i>pseudoquina</i> , <i>reitzii</i> , <i>stipulatum</i> , <i>symmetricum</i> , <i>trachytrichium</i>
Pernambuco (PE)	3	<i>caavurana</i> , <i>campaniforme</i> , <b>sp. 1</b>
Piauí (PI)	1	<i>caavurana</i>
Rio de Janeiro (RJ)	12	<i>arenarium</i> , <i>caavurana</i> , <i>campaniforme</i> , <i>gnaphalocarpon</i> , <i>intermedium</i> , <i>lacteum</i> , <i>pseudocapsicum</i> , <i>pseudoquina</i> , <i>restingae</i> , <i>stipulatum</i> , <i>verticillatum</i> , <i>warmingii</i>
Rio Grande do Norte (RN)	1	<i>caavurana</i>
Rio Grando do Sul (RS)	11	<i>alatirameum</i> , <i>arenarium</i> , <i>campaniforme</i> , <i>cassioides</i> , <i>compressum</i> , <i>delicatulum</i> , <i>pabstii</i> , <i>pseudocapsicum</i> , <i>pseudoquina</i> , <i>reitzii</i> , <i>trachytrichium</i>
Rondônia (RO)	2	<i>corumbense</i> , <i>leucocarpon</i>
Roraima (RR)	3	<i>arboreum</i> , <i>campaniforme</i> , <i>leucocarpon</i>
Santa Catarina (SC)	16	<i>alatirameum</i> , <i>apiabyense</i> , <i>caavurana</i> , <i>campaniforme</i> , <i>canoasense</i> , <i>cassioides</i> , <i>compressum</i> , <i>delicatulum</i> , <i>kleinii</i> , <i>pabstii</i> , <i>pseudocapsicum</i> , <i>pseudodaphnopsis</i> , <i>pseudoquina</i> , <i>reitzii</i> , <i>stipulatum</i> , <i>trachytrichium</i>
São Paulo (SP)	15	<i>apiabyense</i> , <i>caavurana</i> , <i>campaniforme</i> , <i>delicatulum</i> , <i>gnaphalocarpon</i> , <i>intermedium</i> , <i>kleinii</i> , <i>pabstii</i> , <i>pseudocapsicum</i> , <i>pseudodaphnopsis</i> , <i>pseudoquina</i> , <i>spissifolium</i> , <i>stipulatum</i> , <i>trachytrichium</i> , <i>verticillatum</i>
Sergipe (SE)	1	<i>caavurana</i>
Tocantins (TO)	0	---

the calyx tube just before anthesis. Flowers 5-merous, perfect. Calyx tube 1.5–2 mm long, conical, the lobes 2–3 mm long, *ca.* 1 mm wide, narrowly deltate to long-triangular with a 1–1.5 mm long projection that in live plants is a fleshy knob, glabrous. Corolla 0.8–1 cm in diameter, white, stellate, lobed  $\frac{1}{2}$  to  $\frac{2}{3}$  of the way to the base, the lobes *ca.* 0.4 cm long, 0.2 cm wide, planar at anthesis, minutely puberulent at the tips and along margins. Stamens 3–4 mm long; filament tube *ca.* 0.5 mm long, the free portion of the filaments <0.5 mm long, glabrous; anthers 2.5–3.5 mm long, *ca.* 1 mm wide, ellipsoid, yellow, poricidal at the tips, the pores elongating to longitudinal slits with age. Ovary glabrous; style 4–5 mm long, glabrous; stigma minutely capitate, the surface minutely papillose. Fruit a globose or depressed globose berry, *ca.* 1 cm in diameter, green or pale whitish green, glabrous, the pericarp thick, not markedly shiny; fruiting pedicels *ca.* 1.5 cm long, *ca.* 3 mm in diameter at the apex, woody, deflexed; calyx lobes in fruit persistent and slightly elongating, occasionally breaking off but always with > 1 mm remnants. Seeds *ca.* 30 per berry, not known from mature fruit.

**Distribution.** Endemic to eastern Brazil in the states of Minas Gerais and Bahia, known from northernmost Minas Gerais and southern Bahia (Figure 3).

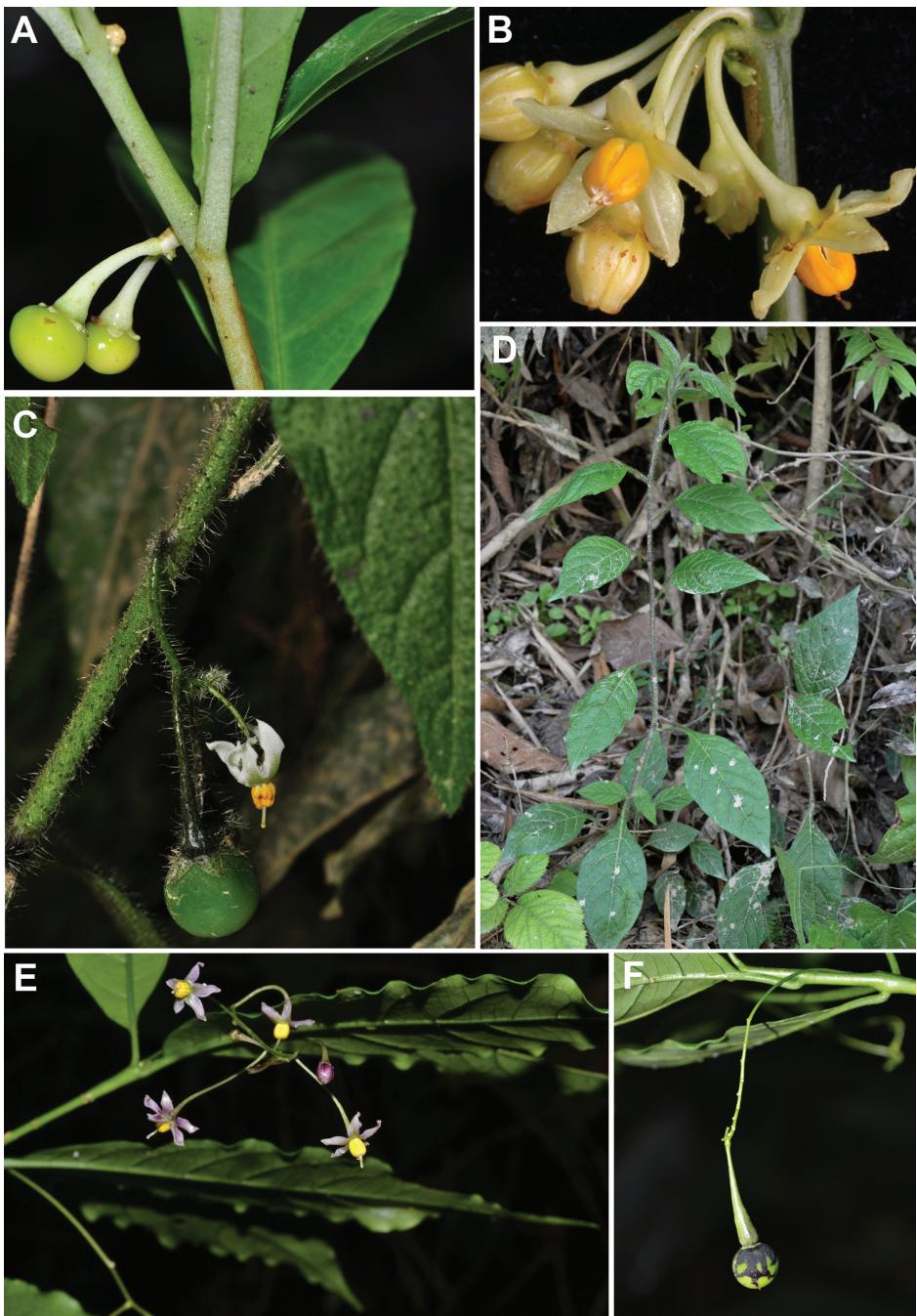
**Ecology.** *Solanum amorimii* is found in the understory of wet Atlantic forests (*Floresta Ombrófila Densa*, Mata Atlântica; IBGE 2012) from 50–1000 m, most commonly found at around 500–900 m elevation in very preserved sites.

**Phenology.** Flowering specimens have been collected from July to October but appears to peak in August; fruiting specimens have been collected from September to April.

**Etymology.** The species epithet honours André M. Amorim, curator of the herbarium at CEPEC in Ilhéus, Bahia, and collector of the type specimen, whose knowledge of the flora of Bahia has helped many botanists in the region and beyond.

**Preliminary conservation status (IUCN 2014).** Near-threatened (NT) B1, 2a, b (ii, iii); EOO 20,663 km<sup>2</sup> (NT); AOO 40 km<sup>2</sup> (EN). Although the large extent of occurrence (> 20,000 km<sup>2</sup>) places *S. amorimii* out of the vulnerable category, the small number of locations (5–10) and the fragmentation of its forest habitat mean it is of some conservation concern. Populations occur within several private protected areas (in Minas Gerais the only population is within a private reserve) so the species is afforded some protection. On the other hand, the known collections suggest the species is restricted to pristine sites, which are becoming increasingly rare. As with all *Geminata* species, it is possible that more populations remain to be collected; these plants are inconspicuous in the deep forest understory and usually occur in small, sparsely distributed populations.

**Notes.** *Solanum amorimii* is morphologically very similar to the sympatric *S. restingae*, but can be distinguished by its much smaller flowers with long-triangular calyx lobes and by its unwinged stem. Both species grow in the understory of mostly undisturbed forests and can be small shrubs or treelets. *Solanum restingae* has markedly cucullate corolla lobes, and the calyx lobes are so small as to be almost non-existent, especially in fruit. Bud shape also differs between the two species, with those of *S. amorimii* being globose to somewhat ellipsoid and those of *S. restingae* more elongate



**Figure 1.** Photograph of living plants of *S. amorimii*, *S. apiahyense* and *S. filirhachis*. **A** Immature fruit of *S. amorimii* (Giacomin et al. 1962) **B** Flowers of *S. amorimii* (Amorim et al. 5210) **C** Inflorescence with flower and fruit of *S. apiahyense* (Giacomin et al. 1086) **D** Habit of *S. apiahyense* (Giacomin et al. 1086) **E** Inflorescence, flower and leaves of *S. filirhachis* (Giacomin et al. 1854) **F** Fruit (immature) of *S. filirhachis* (Giacomin et al. 1854). Photographs: **A** (S. Knapp), **B** (A.M. Amorim), **C-F** (L.L. Giacomin).

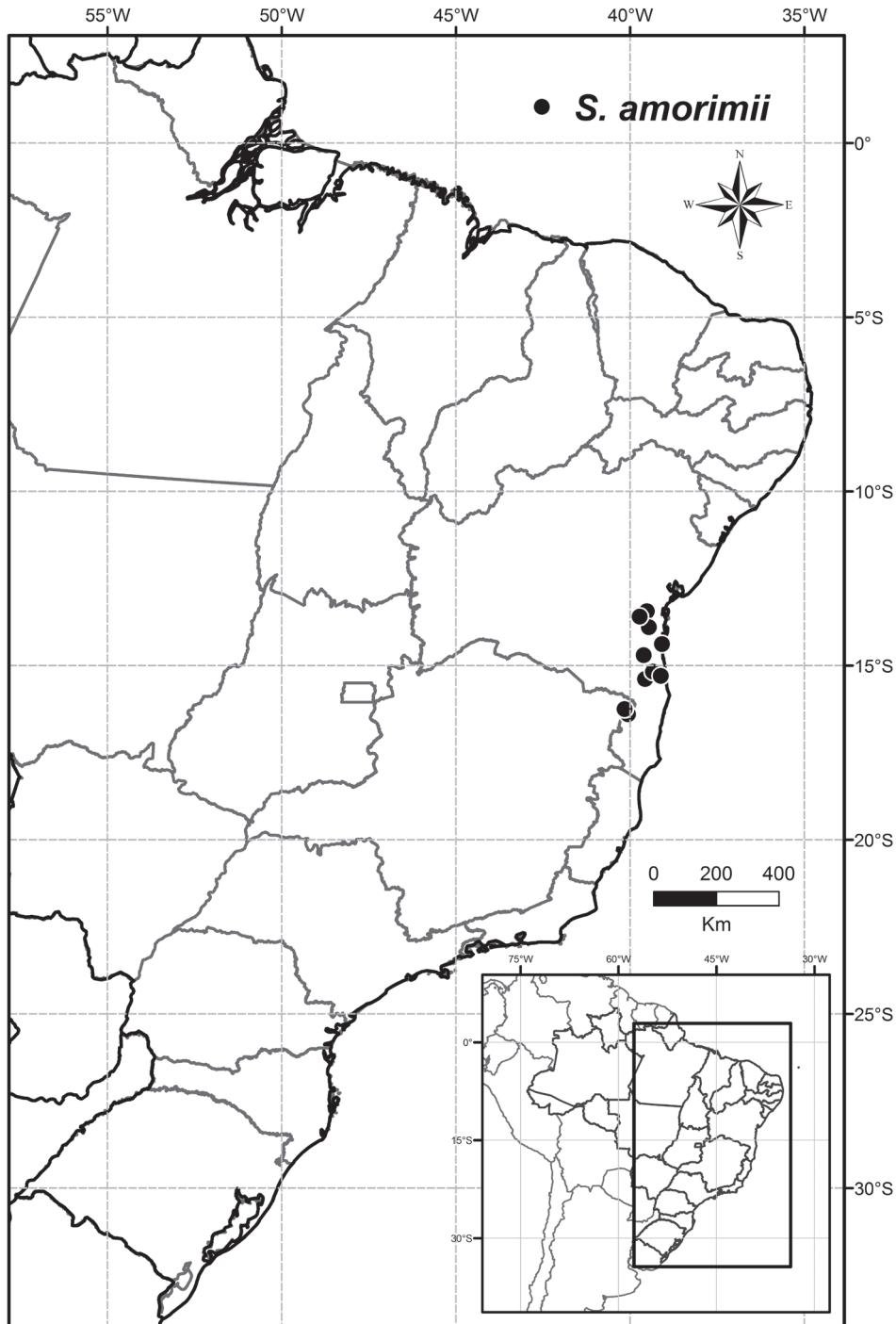


**Figure 2.** Isotype specimen of *S. amorimii* (Amorim et al. 5210, BHCB).

with a distinct “nipple” from the cucullate corolla tips. In fruit the two species can be difficult to distinguish, but the winged stems of *S. restingae* and the presence of calyx lobes in *S. amorimii* should enable identification.

Leaves of *S. amorimii* are usually somewhat auriculate at the base, with the base not surrounding the stem but enlarged to a very short petiole. Plants grow in forest understory, sometimes in open places such as treefall gaps. From overall morphology this species would belong to the *S. arboreum* species group of Knapp (2002a), but its relationships have not been tested using molecular sequences.

**Specimens examined.** BRAZIL. BAHIA: Mun. Arataca, RPPN Caminho das Pedras, Serra do Peito-de-Moça, entrada a 9.5 km no Assent. Santo Antonio, mais 8.9 km ate a sede da RPPN, trilha de acesso ao topo da serra, após a Mormaço, 15°10'27"S, 38°20'22"W, 900–936 m, 26 Nov 2006 (fr), A.M. Amorim et al. 6608 (CEPEC); Mun. Arataca, Serra do Peito-de Moça, estrada que liga Arataca a Una, ramal ca 22.4 km de Arataca com entrada do Assentimento Santo Antonio, RPPN Caminho das Pedras, 15°10'25"S, 39°20'30"W, 1000 m, 20 Jan 2007 (fr), A.M. Amorim et al. 6730 (CEPEC); Mun. Arataca, Serra do Peito-de Moça, RPPN do IESB, rodovia Arataca/Una, entrada a 9.5 km de cidade, mais 8.9 km de entrada, trilha do mormaço, 15°10'27"S, 39°20'22"W, 700–900 m, 12 Aug 2009 (fl), L. Daneu et al. 81 (CEPEC); Mun. Arataca, Serra Novo Javi, RPPN do IESB, rodovia Arataca/Una, entrada a 9.5 km N, mais 8.9 km até a sede da RPPN, trilha da Serra, acesso ca. 1.5 km NE da sede, Topo da Serra, 15°10'42"S, 39°20'09"W, 12 Sep 2009 (fl), L. Daneu et al. 96 (CEPEC); Mun. Arataca, Serra Novo Javi, RPPN do IESB, rod. Una/Arataca, entrada 9.5 km N, mais 8.9 km até a sede da RPPN, trilha da serra, acesso ca. 1.5 km NE da sede, topo da serra, 15°10'42"S, 39°20'09"W, 759 m, 12 Sep 2009 (fl), L. Daneu et al. 121 (CEPEC); Mun. Camacan, RPPN Serra Bonita, trilha da pousada, 15°23'26"S, 39°33'55"W, 835–1000 m, 25 Aug 2007 (fl), F.M. Ferreira et al. 1326 (CEPEC); Mun. Arataca, Serra do Peito-de Moça, Serra do Peito-de Moça-Serra das Lontras, estrada Arataca-Una, ramal 22.4 km de Arataca, assentamento Sto. Antonio, RPPN Caminho das Pedras, 15°10'25"S, 39°20'30"W, 1000 m, 23 Sep 2007 (fl), F.M. Ferreira et al. 1452 (CEPEC); Reserva Pratigi, 28 km de Itamarati, 6 km no ramal a direita, sentido Gandu, 13°53'52"S, 39°27'26"W, 670 m, 22 Oct 2007 (fl), F.M. Ferreira et al. 1563 (CEPEC); Mun. Uruçuca, estrada de Itacaré para Serra grande, pouco após km 43, ramal à direta após acesso para a cachoeira do Tijuipe, área explorada do plano de manejo, 14°23'12"S, 39°04'45"W, 4 Apr 2004 (fr), P. Fiaschi et al. 2249 (CEPEC); Mun. Arataca, Serra Novo Javi, RPPN do IESB, Rod. Una/Arataca, entrada 9.5 km N, mais 8.9 km até a sede da RPPN, trilha da Serra acesso ca. 1.5 km NE do sede, Topo da Serra, 15°10'42"S, 39°20'09"W, 759 m, 12 Oct 2008 (fr), J.G. Jardim et al. 5408 (CEPEC); Mun. Una, Rodovia BA-265, a 23 km de Una, 50–75 m, 26 Feb 1978 (fr), S.A. Mori et al. 9299 (CEPEC, MO, NY); Mun. Almadina, Serra do Concavado, Rod. Almadina/Coaraci, ca. 5 km, 14°42'13"S, 39°36'09"W, 300 m, 19 Mar 2006 (fr), J.L. Paixão et al. 838 (CEPEC); Mun. Wenceslau Guimarães, ca. 3 km W of Nova Esperança, W edge of Reserva Wenceslau Guimarães, 13°36' S, 39°43' W, 500–600 m, 14 May 1992 (fr), W.W. Thomas et al. 9244 (CEPEC, MO, NY, RB); Mun. Camacan,



**Figure 3.** Distribution of *S. amorimii*.

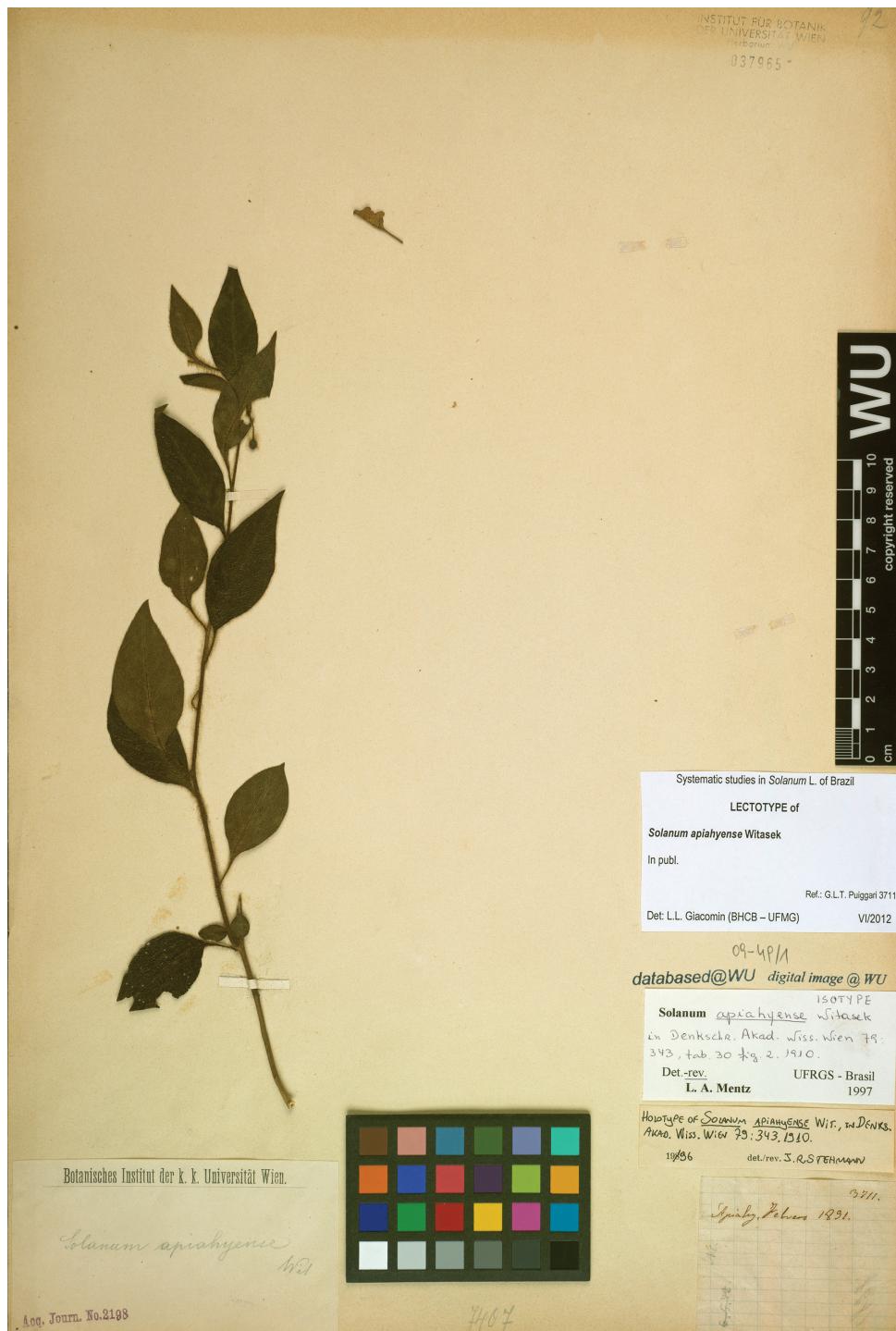
RPPN Serra Bonita, 9.6 km NNW of Camacan on road to Jacaraci and Jussari, then 6 km up road to Serra Bonita, 820 m, 21 Sep 2004 (fr), W.W. Thomas et al. 14224 (NY). **MINAS GERAIS:** Mun. Santa Maria do Salto, Distrito de Talismã, RPPN Loredano Aleixo (Fazenda Duas Barras), 16°24'01"S, 40°03'24"W, 873 m, 31 Oct 2013 (fl, fr), L.L. Giacomin et al. 1962 (BHCB, BM, UT); Mun. Santa Maria do Salto, RPPN Duas Barras, ca. 27 km do distrito de Talismã, trilha em direção a divisa com a Bahia, 16°14'56"S, 40°08'58"W, 8 Sep 2008 (fl), R.P. Oliveira et al. 1636 (HUEFS).

***Solanum apiabyense* Witasek, Denkschr. Kaiserl. Akad. Wiss., Wien Math.-Naturwiss. Kl. 79: 343. 1910.**

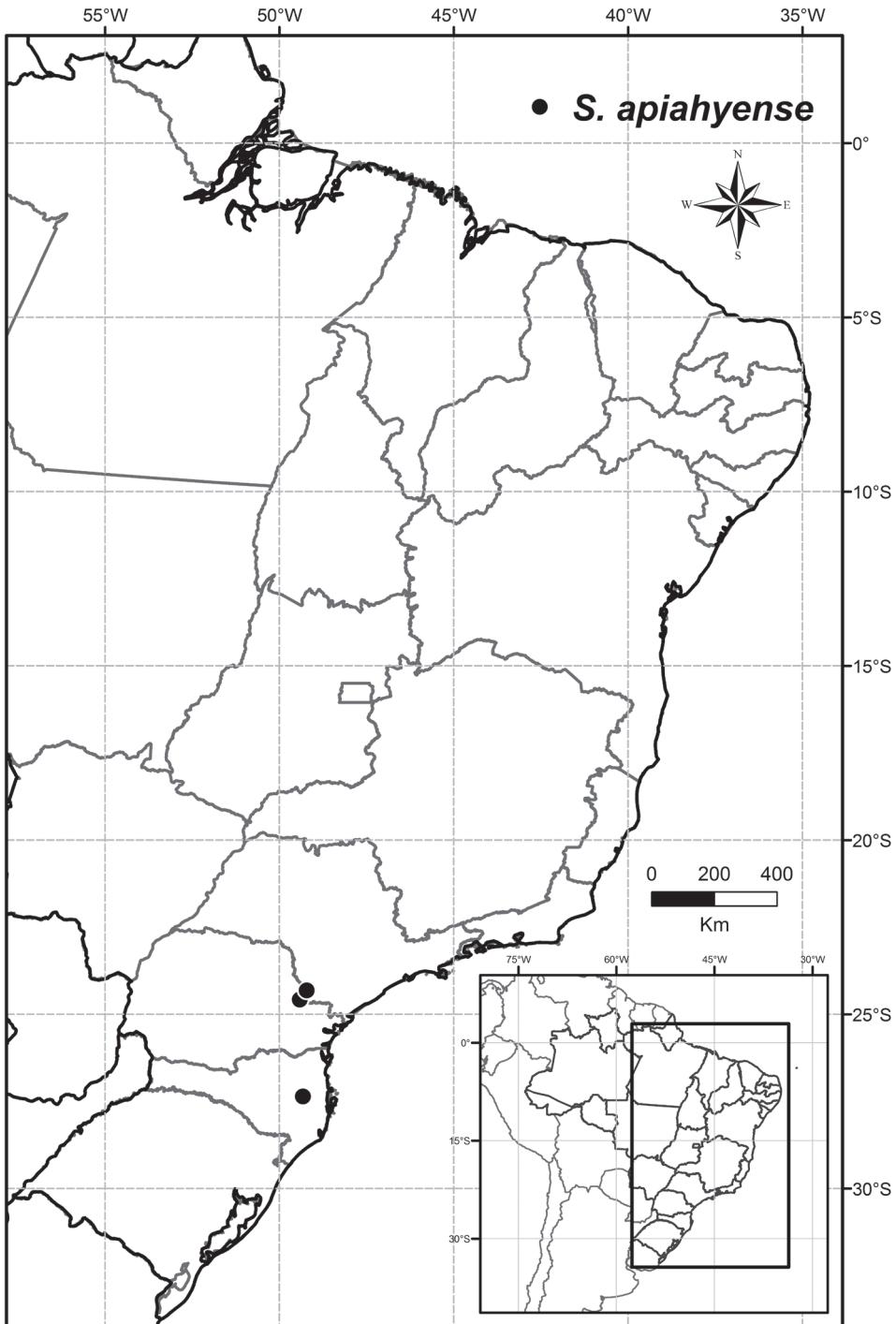
Figures 1C, D, 4

**Type.** BRAZIL. São Paulo. Apiahý, Feb 1891(f), J.I. Puiggari 3711 (lectotype, designated here: WU [WU0037965]).

**Description.** Small erect shrubs, to 50 cm tall, often rhizomatous with a horizontal woody branch bearing several adventitious roots; young stems moderate to densely pubescent, with 4–8-celled hyaline trichomes to 2 mm long; new growth drying dark, densely pubescent; bark of older stems pale gray, glabrescent, not exfoliating. Sympodial units 3-plurifoliate, normally not geminate, if geminate, with leaves differing only in size. Leaves simple, 3.4–11 × 0.8–4 cm, elliptic to narrowly elliptic, membranous, slightly discolored, shiny green adaxially when fresh, drying pale green beneath, dark above, not shiny, both surfaces moderate to densely pubescent with hyaline simple uniseriate trichomes 1–2 mm long with up to 5 cells, sometimes with a multicellular base (but see comments); primary veins 5–7 pairs, the midrib and primary veins darker abaxially, raised; base attenuate to acute, slightly decurrent onto the petiole, mostly symmetric; margins entire, not revolute, ciliate with antrorse hyaline trichomes; apex attenuate to acuminate; petioles 2.5–15 mm long, densely pubescent, with trichomes like those of the stems and leaves. Inflorescences 1.7 to 3.3 cm long, mostly lateral or less often strictly opposite the leaves, unbranched, with 3–5 flowers, moderate to densely pubescent, with hyaline trichomes like those of the stems and leaves; peduncle 4–15 mm long; pedicels 5 to 11 mm long, articulated at base; pedicel scars closely spaced ca. 1 mm apart. Buds globose to slightly elongate, the corolla mostly included in the calyx tube, exserted only just before anthesis. Flowers all perfect, 5-merous. Calyx tube up to 1 mm long, conical, getting reflexed, the lobes up to 0.9 mm long in flower, to 1.7 mm long in fruit, approximately 1.6 mm wide, acuminate and discretely keeled, adaxially, glabrous or papillose, covered with tiny 1–2-celled glandular trichomes, abaxially densely pubescent, with trichomes as those of the stem, or sometimes even longer, with 2.5 mm, and normally 5–6 cells. Corolla 1.5–1.7 cm in diameter, white, stellate, membranous, lobed from 2/3 to 3/4 of the way to the base, the lobes 7.5–9 mm long, 3–3.5 mm wide, reflexed at anthesis, deltate to lanceolate, glabrescent adaxially, abaxially sparsely pubescent, with 3–4-celled delicate simple trichomes of ca. 0.5 mm along



**Figure 4.** Lectotype specimen of *S. apiiphyense* (Puiggari s.n., WU). Reproduced with permission of the University of Vienna.



**Figure 5.** Distribution of *S. apiahyense*.

the midvein, with tufts of few celled tiny trichomes less than 0.1 mm long on the tips and margins. Stamens 3.2–3.6 mm long; filament tube *ca.* 0.5 mm long, the free portion of the filaments up to 0.6 mm long equal in length or slightly unequal, and when so, one filament slightly longer (barely visible in dried material), glabrous; anthers 2.6–2.8 mm long, 1.6–1.8 mm wide, ellipsoid, slightly connivent, yellow, slightly sagittate at the base, the pores directed introrsely, opening into longitudinal slits at maturity. Ovary glabrous; style 4.2–5 mm long, white, straight, glabrous; stigma capitate, light green. Fruit a globose berry 0.7–1.4 cm in diameter (immature?), dull green, drying dark, the pericarp glabrous and not markedly shiny; fruiting pedicels 1.2–2 cm long, *ca.* 0.7 mm in diam. at the base, to 1.1 mm at the apex, with a slight constriction at the receptacle; calyx lobes in fruit somewhat enlarged. Seeds approximately 70 per fruit, known only from very young fruits, possibly flattened and with a marginal wing when fully developed.

**Distribution.** In the Serra do Mar mountain range in the Brazilian states of Paraná, Santa Catarina and São Paulo (Figure 5).

**Ecology.** *Solanum apiahyense* is a rare and inconspicuous shrub of the understory and edges of well preserved and secondary fragments of the montane Brazilian Atlantic rainforest (*Floresta Ombrófila Densa* of IBGE 2012; Mata Atlântica), from 600 to 900 m. Although most collections are from well preserved sites, *S. apiahyense* is not exclusively associated with shaded environments. The species is also found along unpaved roadsides close to the type locality.

**Phenology.** Fertile specimens are known from September to February. Mature fruits were observed only in October.

**Etymology.** The epithet refers to the type locality, the city of Apiaí in southern São Paulo state.

**Preliminary conservation status (IUCN 2014).** Endangered (EN) B1; B2 ab (ii, iii, iv). EOO 3,208 km<sup>2</sup> (EN); AOO 16 km<sup>2</sup> (EN). Although the species occurs in a wide latitudinal range, it is locally rare, and is known from only six localities. None of the known populations are from within protected areas.

**Notes.** *Solanum apiahyense*, described more than a century ago (Witasek 1910), has not been assigned to any infraspecific group of *Solanum* so far. Recent phylogenetic analysis using molecular data (Giacomin 2015) has shown it to be closely related to *S. trachytrichium*, which was previously assigned to the Geminata clade (Knapp 2002a, 2008) and to its own subsection when originally described (subsect. *Silicosolanum* Bitter; Bitter 1919). Bitter (1919) based this on the unusual trichome morphology of hooked cells arising from a flattened multicellular base that give the leaves a feeling of sandpaper in herbarium specimens. Although molecular data support a close relationship between *S. apiahyense* and *S. trachytrichium*, the affinities of this clade are not clear-cut. Data from combined markers place it as sister to all other Geminata clade species, but with low support. In analyses of individual markers, it emerges as sister to either the Brevantherum or Geminata clades depending upon the marker used (Giacomin 2015).

Morphologically both taxa are easy to distinguish from most other Geminata species, and have the following assemblage of characters: both are small shrubs with leaves mostly not geminate, they have leaf trichomes with an expanded multicellular base and relatively large flowers (>1.5 cm in diameter). Among them, *Solanum apiahyense* and *S. trachytrichium* are easy to distinguish: *S. trachytrichium* has a unique scabrous indumentum on the leaf surfaces and stems, composed of short unicellular hooked trichomes on a mound-like multicellular base, while in *S. apiahyense* the surface is not rough to the touch, and although some trichomes with multicellular bases can be seen on leaves, these are translucent, very long (*ca.* 2 mm) and mostly 5-7-celled. These long trichomes of *S. apiahyense* are easily seen on the new growth, while *S. trachytrichium* trichomes are not visible to the naked eye. In addition, the flowers of *S. apiahyense* are slightly smaller, 1.5–1.7 cm in diameter versus 1.6–2.2 cm in *S. trachytrichium*.

In the past, the epithet *S. apiahyense* has been applied to more than one species of the *S. inornatum* group (part of the Brevantherum clade; Giacomin and Stehmann 2014) by various *Solanum* taxonomists, although they are now known to not be closely related. Although members of the *S. inornatum* group (e.g., *S. inornatum* Witasek, *S. bradei* Giacomin & Stehmann and relatives) and *S. apiahyense* are similar in habit and in having pubescence of long, translucent trichomes, they can be readily distinguished by close examination of the trichomes; those of *S. apiahyense* are multicellular with 5-7(8) cells while those of members of the *S. inornatum* group are mostly 3-celled (probably representing modified stellate hairs, Giacomin and Stehmann 2014). Fruiting specimens of *S. apiahyense* have peduncles longer than 1 cm and the pedicels are strongly apically expanded and constricted just beneath the calyx lobes (see Figure 1C), while in the species of the *S. inornatum* group species, the peduncles do not exceed 1 cm and the pedicels are never apically expanded with a distal constriction. Examination of trichomes with a 10× hand lens will allow easy identification of both flowering and fruiting material.

The type material found at WU (*Puiggari 3711*) consists of a single sheet, and does not match the photograph of a dried specimen in the original publication (Witasek 1910: tab. 30, fig. 2). It should therefore be treated as an isotype (Mentz and Oliveira 2004). As no further material could be found in other possible herbaria where J.I. Puiggari deposited his collections, the specimen at WU is here designated as a lectotype.

**Specimens examined.** **BRAZIL.** PARANÁ: Mun. Cerro Azul, Serra Paranapiacaba, 20 Nov 1970 (fl), *G. Hatschbach & O. Guimarães* 25528 (MBM, RB); Mun. Doutor Ulysses, Barra do Teixeira, 16 Sep 2006 (fl, fr), *J.M. Silva* (HUFU, MBM, RB). SANTA CATARINA: Mun. Vidal Ramos, Mina Bugre, 27°21'35"S, 49°19'12"W, 598 m, 22 Sep 2009 (fl, fr), *A. Korte & A. Kniess* 243 (BHCB, FURB). SÃO PAULO: Mun. Bom Sucesso de Itararé, Estrada de terra para Bom Suceso de Itararé, Próximo a Mineração de ouro São Judas (3 km após), 24°19'13.19"S, 49°12'49.49"W, 891 m, 11 Oct 2009 (fl, fr), *L.L. Giacomin et al.* 1097 (BHCB, BM, NY, RB); Mun. Bom Sucesso de Itararé, Estrada Bom Sucesso de Itararé, 2 km antes da Mineração São Judas, 24°19'13"S, 49°13'04"W, 15 Dec 1997 (fr), *J.M. Torenzan et al.* 647 (IAC, ESA, FUEL, SPSF, UEC).

***Solanum filirhachis* Giacomin & Stehmann, sp. nov.**

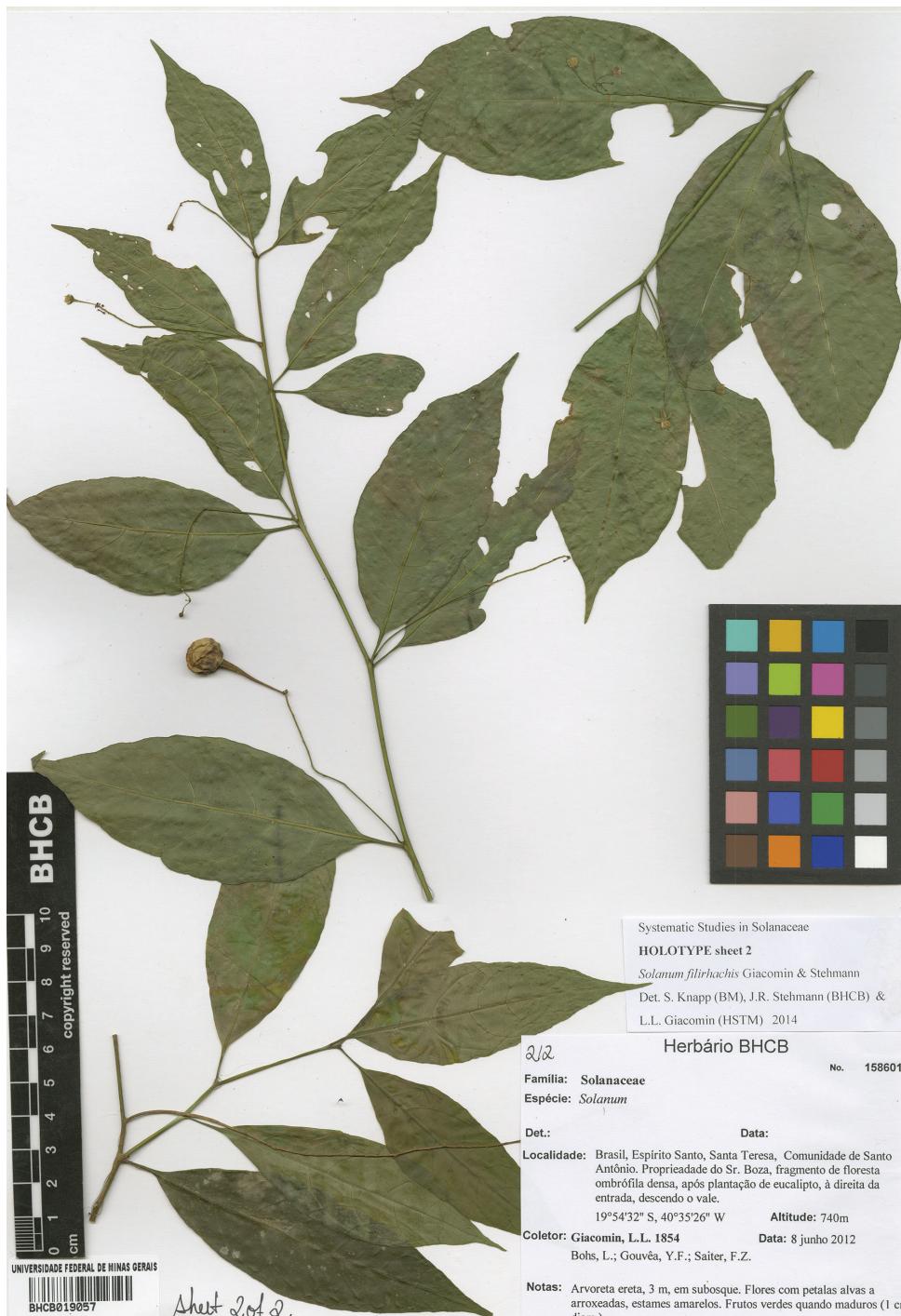
urn:lsid:ipni.org:names:77145588-1

Figures 1E, F, 6

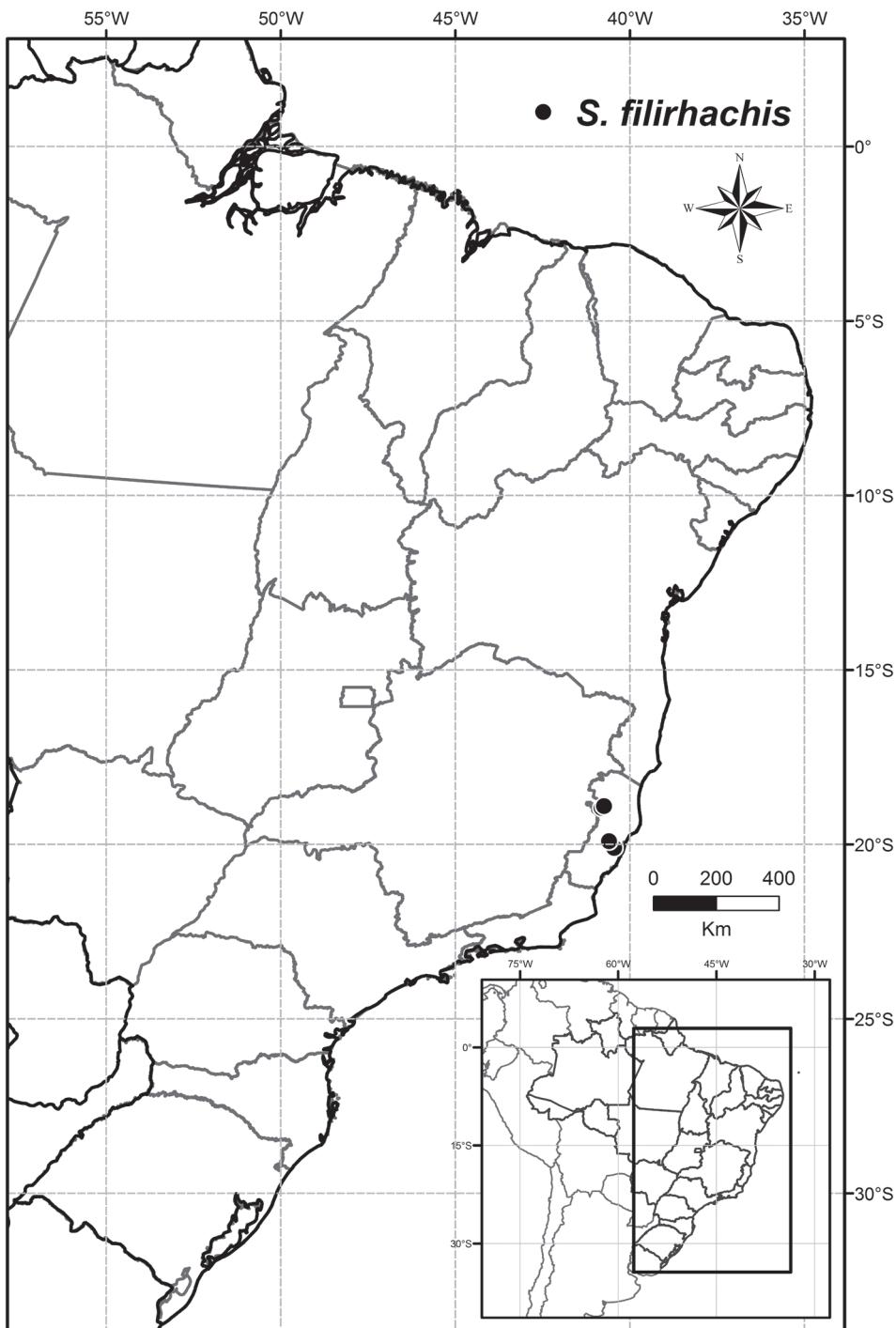
**Diagnosis.** Differs from the sympatric *S. campaniforme* Roem. & Schultes in its deep forest habitat, leaves with ruffled margins, flowers less than 1 cm in diameter, pedicels with a constriction at the distal end that are swollen in fruit, and few seeds.

**Type.** BRAZIL. Espírito Santo: Mun. Santa Teresa, Comunidade de Santo Antônio, Propriedade do Sr. Boza, fragmento de floresta ombrófila densa após plantação de eucalipto, à direita da entrada, descendo o vale, 19°54'32"S, 40°35'26"W, 740 m, 8 Jun 2012 (fl, fr), L.L. Giacomin, L. Bohs, Y.F. Gouvêa & F.Z. Saiter 1854 (holotype: BHCB [2 sheet holotype: sheet 1 (fl) BHCB019056; sheet 2 (fr) BHCB019057]; isotypes: BM, MBML, NY, RB).

**Description.** Erect shrubs to small trees, up to 3 m tall, normally branching close to the apex, the upper stems ascendant; young stems terete, glabrous; new growth brownish, glabrous. Bark of older stems turning pale greyish brown, glabrous, not exfoliating. Sympodial units difoliate, mostly geminate, with leaves not differing in shape or size. Leaves simple, 4.6–15.9 cm long, 1.3–4.9 cm wide, narrowly elliptic, membranous to chartaceous, slightly discolored when dry, the adaxial surface glabrous, dark green and somewhat shiny in live plants, the abaxial surface sparsely pubescent with simple uniseriate 7–12-celled trichomes to 1 mm long in tufts in the primary vein axils, occasionally extending to the midrib; primary veins 5–9 pairs, yellowish green, discretely raised above, raised beneath; base attenuate to acute, slightly decurrent onto the petiole, sometimes asymmetric; margins entire, slightly undulate (ruffled) and revolute, apex long-attenuate to acuminate; petioles 1–9 mm long, glabrous. Inflorescences 3.5 to 26 cm long, opposite the leaves or internodal, unbranched, slender and very delicate, with 18–60 flowers, but bearing normally with 4–10 flowers at a time, glabrous; peduncle 1.8–3.8 cm long; pedicels 7–18 mm long, ca. 0.4 mm in diam. at the base, ca. 0.9 mm in diameter at the apex, with a constriction at the receptacle, articulated at base, unevenly spaced 1.7 to 10 mm apart. Buds globose, the corolla completely exserted from the calyx tube before anthesis. Flowers all perfect, 5-merous. Calyx tube to 1 mm long, conical, the lobes ca. 0.2 mm long, ca. 1.5 mm wide, acuminate and somewhat keeled, papillose adaxially, glabrous abaxially. Corolla 6–8 mm in diameter, normally whitish purple adaxially, light purple abaxially, stellate, membranous, lobed more than ¾ the way to the base, the lobes 4–5 mm long, 1–1.7 mm wide, spreading at anthesis and becoming reflexed in older flowers, deltate to lanceolate, glabrous on both surfaces, minutely papillose at tips and margins. Stamens 2.5–3 mm long; filament tube ca. 0.3 mm long, the free portion of the filaments up to 0.2 mm long, equal in length or slightly unequal, and when so, two filaments slightly longer (barely visible in dried material), glabrous; anthers 2–2.5 mm long, 1.2–1.5 mm wide, ellipsoid, slightly connivent, yellow, poricidal at the tips the pores directed introrsely, elongating to longitudinal slits with age. Ovary glabrous; style 4–6 mm long, white, straight, glabrous, the stigma light grayish green, capitate. Fruit a globose berry 1–1.5 cm in diameter, dull green at maturity, with irregular black spots (Figure



**Figure 6.** Holotype specimen (sheet two) of *S. filirhachis* (Giacomin et al. 1854, BHCB019057). Reproduced with permission of the Universidade Federal de Minas de Gerais.



**Figure 7.** Distribution of *S. filirhachis*.

1F) drying grayish brown, the pericarp glabrous, not shiny; fruiting pedicels 2.0–2.4 cm long, clearly obconical, *ca.* 0.5 mm in diam. at the base, widening markedly towards the apex to *ca.* 2.5 mm in diam.; calyx lobes in fruit *ca.* 1.5 mm long, commonly broken off in dried fruiting material. Seeds 20–25 per berry, 2.5–4.5 mm long, 2–3.3 mm wide, ovoid-reniform to somewhat flattened towards the margins, light to dark brown, the surface irregularly pitted, the testal cells undulate.

**Distribution.** Restricted to the state of Espírito Santo (Figure 7), in south-eastern Brazil. Collections are known from the central and northern parts of the state, from both sides of the Rio Doce.

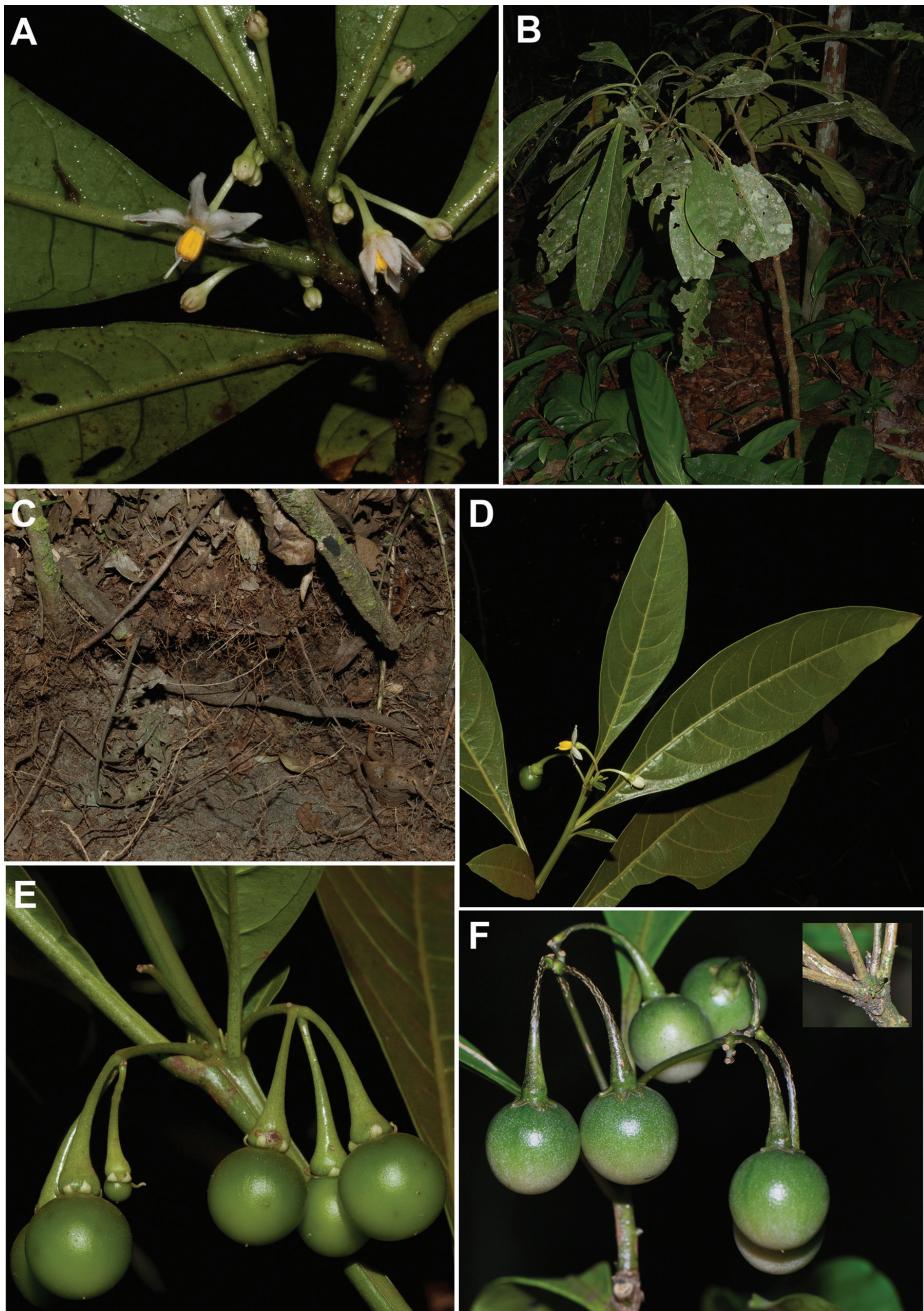
**Ecology.** Rare in the understory of well-preserved fragments of the sub-montane and montane Brazilian Atlantic coastal rainforest (*Floresta Ombrófila Densa*; IBGE 2012), normally in formations where granitic outcrops are present or close by, in elevations ranging from 200 to 750 m.

**Phenology.** Fertile specimens of *Solanum filirhachis* are known mostly from the rainy season (from November to March), but the type collection from June indicates that the species might be fertile for a longer period. Mature fruits were observed in specimens from November and June.

**Etymology.** The epithet refers to the long and slender inflorescence rachis, which is not observed in any of the Brazilian sympatric species, although a common feature in some species of the *S. confine* group from Colombia, Ecuador and Venezuela (Knapp 2002a).

**Preliminary conservation status (IUCN 2013).** Endangered (EN) B1, B2 ab (ii, iii, iv); EOO 1,136 km<sup>2</sup> (EN); AOO 20 km<sup>2</sup> (EN). *Solanum filirhachis* is currently known from only five localities, and all collections are from within private properties, where agriculture (both large and small scale) is known to occur. Despite the fact that it inhabits higher elevations that are usually harder to access and not always suitable for agriculture, we strongly recommend that further efforts to map new populations of the species should be undertaken, mainly within protected areas with similar forest types. Although the type locality of Santa Teresa in central Espírito Santo has several well preserved fragments of forest, the landscape has been rapidly transformed in the last few decades to *Eucalyptus* and coffee plantations, and summer vacation homes (cottages).

**Notes.** *Solanum filirhachis* is remarkably similar to a suite of species of the *Geminata* clade with ruffled leaf margins (see Figure 1E) and long filiform inflorescences (*S. leptorrhachis* Bitter and *S. nematorrhachis* S.Knapp from the W Andean slopes in Colombia and Ecuador and *S. tenuiflagellatum* S.Knapp of Venezuela). Knapp (2002a, 2008) treated these as members of her *S. confine* species group, all of whose members have a thin inflorescence rhachis, small flowers and leaves with ruffled (undulate) margins, although this latter character is impossible to see in herbarium specimens. *Solanum filirhachis* differs from those species in its distribution and in the tufts of trichomes in the abaxial leaf vein axils (domatia); other members of this morphologically similar set of species are glabrous or have fine, golden pubescence. The only Brazilian species Knapp (2002) placed in this group was *S. stipulatum* which can be easily distinguished from *S. filirhachis* by its shorter inflorescences, flowers with reflexed corolla lobes and winged stems with anisophyllous difoliate, geminate sympodial units. *Solanum stipulatum* is



**Figure 8.** Photograph of living plants of *S. lacteum*, *S. psilophyllum* and *S. verticillatum*. **A** Inflorescence and flower of *S. lacteum* (Agra et al. 7284) **B** Habit of *S. lacteum* (from Linhares, ES; no voucher) **C** Habit of *S. psilophyllum* showing rhizomatous growth (Giacomin et al. 186) **D** Flowers and young stems of *S. psilophyllum* (Giacomin et al. 186) **E** Fruit of *S. psilophyllum* (Giacomin et al. 186) **F** Immature fruit of *S. verticillatum*, inset shows pseudo-vorticillate branching pattern (Giacomin et al. 2016). Photographs: **A–E** (J.R. Stehmann), **F** (S. Knapp).

usually a shrub of watercourses, and often grows amongst rocks and is submerged in floods, while *S. filirhachis* is a slender treelet of forest understory. The relationships of the *S. confine* group have not yet been tested using molecular markers.

Another Brazilian species with which *S. filirhachis* could be confused is *S. campaniforme* that has similar (but somewhat stouter) elongate inflorescences and tufts of uniseriate trichomes in the abaxial leaf vein axils. *Solanum filirhachis* has leaves with ruffled margins that normally dry pale green and smaller flowers (0.6–0.8 cm in diameter) that (at least in the type specimen) are tinged purple; *S. campaniforme* has leaves with entire, non-ruffled margins that normally dry black or brownish black and larger flowers (1.2–1.8 cm in diameter) with strongly cucullate corolla lobes.

We have designated a two sheet holotype for *S. filirhachis* in order to represent both flower and fruit in the type sheets.

**Specimens examined.** BRAZIL. ESPÍRITO SANTO: Mun. Águia Branca, Assentamento 16 de Abril, 18°54'25"S, 40°44'05"W, 150–200 m, 15 Mar 2006 (fl), V. Demuner et al. 1919 (MBML, BHCB); Mun. Santa Leopoldina, Colina Verde (Morro do Agudo), prop. Israel Elias Ramos (trilha da casa), 20°06'12"S, 40°26'30"W, 250–370 m, 29 Nov 2007 (fl, fr), V. Demuner et al. 4628 (MBML, BHCB); Mun. Santa Leopoldina, Pedra Branca, mata na Serra Santa Lucia, prop. Cristiano Bremencampi, 20°01'36"S, 40°29'32"W, 300–600 m, 30 Nov 2007 (fr), V. Demuner et al. 4655 (MBML, BHCB). Mun. Águia Branca, Rochedo, Trilha do Córrego, prop. Ailton Corteleti, 18°57'21"S, 40°48'05"W, 300–400 m, 19 Dec 2007 (fl, fr), V. Demuner et al. 4817 (MBML, BHCB).

### *Solanum lacteum* Vell., Fl. Flumin. 82. 1829 [“1825”].

Figures 8A, B, 9, 10

### *Solanum cormanthum* Vell., Fl. Flumin. 86. 1829 [1825].

Type. Brazil Rio de Janeiro: “Praedii S. Crucis” (no specimens located; lectotype, designated here: Vellozo, Flora fluminensis icones 2: tab. 113. 1831).

### *Solanum glomuliflorum* Sendtn., Fl. Bras. [Martius] 10: 24, tab 3, fig. 11–15. 1846.

Type. BRAZIL. Rio de Janeiro: “Serra d’Estrella” [Serra de Estrela] (fr), H.W. Schott [5412] s.n. (lectotype, designated here: F [F-874710]).

**Type.** BRAZIL. Sin loc. [probably Rio de Janeiro] “Silvis nondum cultis ad rivulae, vel stagna crescit” (no specimens located; lectotype, designated here: Vellozo, Flora fluminensis icones 2: tab. 93. 1831; epitype, designated here: BRAZIL. Rio de Janeiro: Mun. Nova Friburgo, RPPN Bacchus, Macaé da Cima, near Nova Friburgo, owned by David and Isabel Miller, Trilha da Aguada, 22°23'34.4"S, 42°30'03.4"W, 1470 m, 29 Oct 2012 (fl, fr), M.F. Agra, L. Bohs & L.L. Giacomin 7298 (RB [RB00718282, accession number 551172]; duplicates in BHCB, JPB, UT).

**Description.** Shrub or small treelet 1–3 m (occasionally as small as 25–30 cm or as tall as 5 m); young stems terete, glabrous; new growth glabrous or minutely papillate;

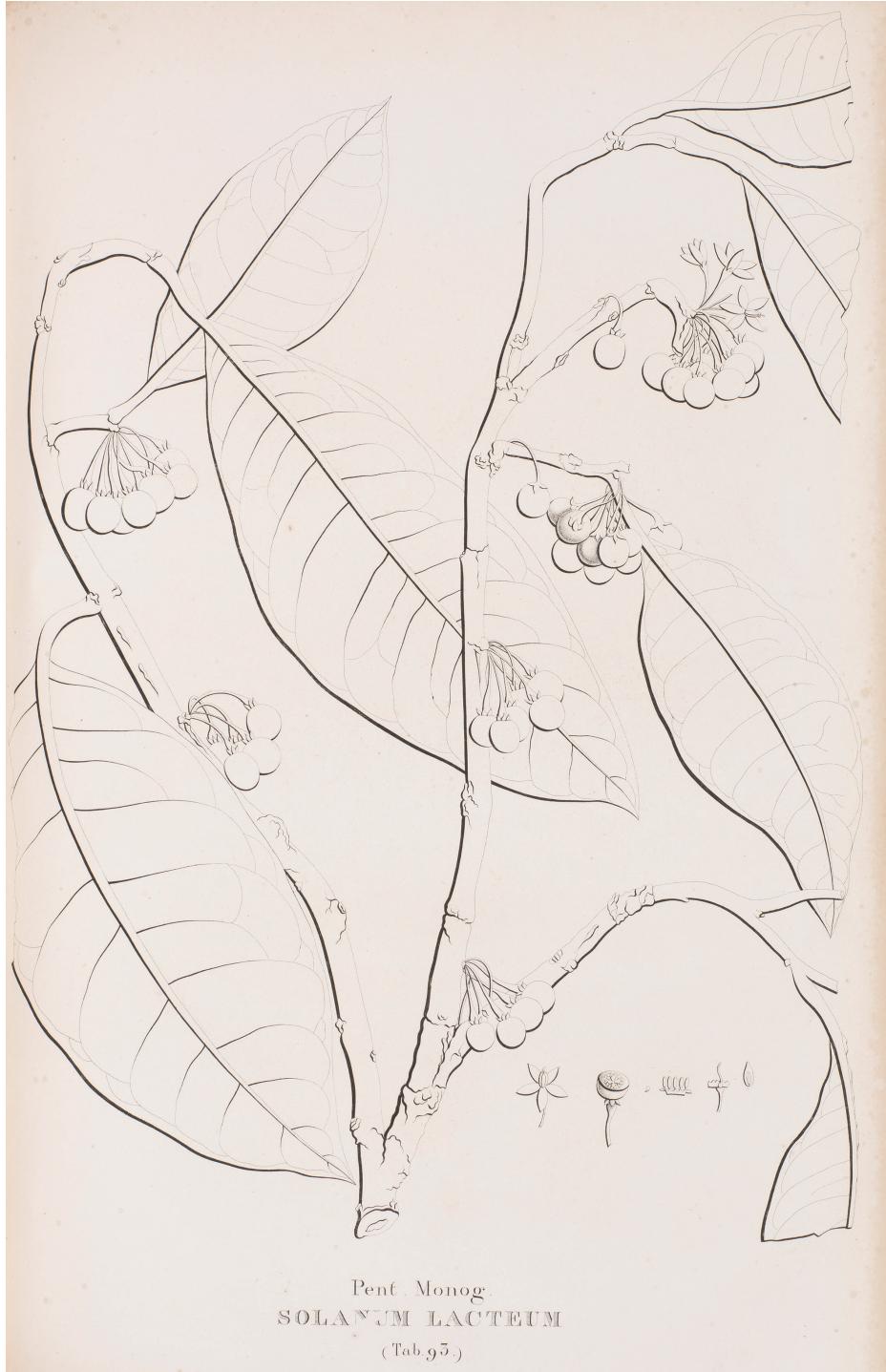
bark of older stems pale brown, with prominent paler lenticels. Sympodial units difoliate, geminate or more usually not geminate; leaves of a pair usually differing in size but not in shape. Leaves simple, 9.5–25 cm long, 3.5–9 cm wide, narrowly obovate, widest in the distal half, membranous, glabrous on both surfaces, the abaxial surface paler in dry specimens; primary veins 6–10 pairs, drying dark abaxially; base attenuate; margins entire; apex bluntly acute to attenuate; petiole 1–3 cm long, glabrous; minor leaves, if present, differing only in size from the majors. Inflorescences 0.1–0.5 cm long, terminal, more or less leaf-opposed or internodal and appearing pseudoaxillary, unbranched or occasionally furcate, with 5–10 flowers, glabrous; peduncle 0.1–0.5 cm long, the flowers in an apical clump; pedicels 0.9–1.1 cm long, < 0.5 mm in diameter at the base and apex, filiform, spreading at anthesis, glabrous, articulated at the base, with a constriction at the apex just below the calyx lobes, this becoming more pronounced in fruit; pedicel scars congested and overlapping at the tip of the very short inflorescence. Buds ovoid, the corolla strongly exserted from the calyx tube before anthesis. Flowers 5-merous, perfect. Calyx tube ca. 0.5 mm long, conical, the lobes 0.5–0.75 mm long, ca. 0.5 mm wide, deltate, with scarious margins and rounded tips, glabrous. Corolla 0.9–1 cm in diameter, white, stellate, lobed ca. 2/3 of the way to the base, the lobes 3–4.5 mm long, 1.5–3 mm wide, spreading or somewhat reflexed at anthesis, the tips and margins minutely papillose. Stamens 2.5–3 mm long; filament tube ca. 0.5 mm long, the free portion of the filaments < 0.5 mm long, glabrous; anthers 1.5–2 mm long, ca. 1 mm wide, ellipsoid to almost globose, yellow, poricidal at the tips, the pores lengthening to longitudinal slits with age. Ovary glabrous; style ca. 4 mm long, glabrous; stigma minutely capitate, the surface papillose. Fruit a globose to somewhat ellipsoidal berry, 0.5–1 cm in diameter, greenish white, occasionally pointed at the apex, the pericarp thin, shiny, brittle when dry; calyx lobes in fruit not markedly enlarging; fruiting pedicels 1–1.3 cm long, 0.5–1 mm in diameter at the base, enlarging gradually to 1.5–2 mm in diameter at the apex, with a slight constriction just below the calyx lobes, not markedly woody, pendant; calyx lobes in fruit not markedly enlarged. Seeds 10–20 per berry, 3–4 mm long, 2–3 mm wide, somewhat flattened-reniform (perhaps immature?), dark to blackish brown, the surfaces minutely pitted, the margins paler and thickened; testal cells pentagonal in outline.

**Distribution.** South-eastern Brazil in the states of Espírito Santo, Minas Gerais and Rio de Janeiro (Figure 11).

**Ecology.** *Solanum lacteum* grows in wet Atlantic forests (*Mata Atlântica, Floresta Ombrófila Densa*) in forest understory of well preserved sites, from 600 to 1500 m elevation.

**Phenology.** No apparent pattern in flowering or fruiting; specimens are often collected with only inflorescences, each plant is very few-flowered.

**Etymology.** The species epithet was coined by Vellozo (1829) to refer to the whitish colour of the plant – “Color albescens totius plantae nomen triviale dedit” (the white color of the entire plant gives it its trivial name [epithet]). We have not observed entire plants that are white in colour, but suspect Vellozo (1829) was referring to the congested inflorescence that is completely white.



**Figure 9.** Lectotype of *S. lacteum*. Vellozo (1831) Volume 2, plate 93. Reproduced with permission of the Natural History Museum Library.



**Figure 10.** Epitype specimen of *S. lacteum* (Agra et al. 7298, RB). Reproduced with permission of the Jardim Botânico do Rio de Janeiro.

**Preliminary conservation status (IUCN 2014).** Near Threatened (NT) B1, 2 a, b(ii, iii); EOO 32,466 km<sup>2</sup> (NT); AOO 28 km<sup>2</sup> (EN). In spite of its large extent of occurrence, *S. lacteum* is only known from six locations and we consider it to be at risk due to the fragmentation and loss of its primary forest habitat. Populations in all three states of occurrence, however, are from within protected areas. It is possible that it is more common than it appears, considering that the flowers are so small and inconspicuous that it is easily overlooked.

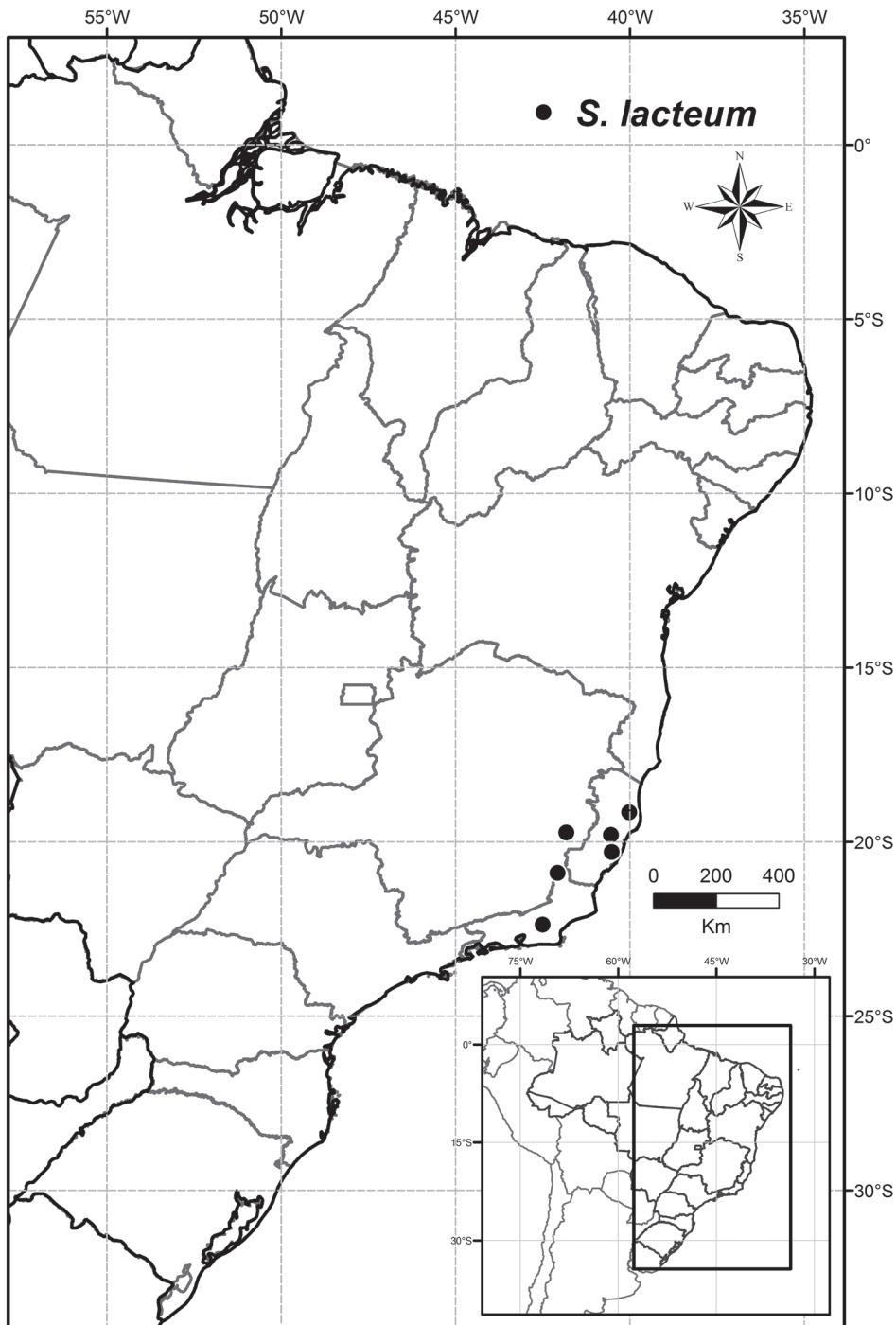
**Notes.** *Solanum lacteum* is characterized by its tiny inflorescences with tightly packed flowers and the difoliate sympodia that are usually not conspicuously geminate. The leaves are narrowly obovate and widest in the distal third. They dry a characteristic blackish brown above and paler brown beneath. The inflorescences often occur internodally and are completely white, including the peduncle and pedicels. The colour of the leaves on herbarium specimens is similar to that of *S. caavurana* and *S. campaniforme*, but those species always have leaf pubescence on the lower leaf surfaces and more elongate inflorescences. The highly congested inflorescences of *S. lacteum* are distinctive and the species is not easily confused with any other growing sympatrically. It is somewhat similar to *S. psilophyllum*, which is similarly glabrous; differences between these two species are noted in the discussion of *S. psilophyllum*.

*Solanum lacteum* grows in the understory of undisturbed forest and can vary from being a tiny subshrub (see Figure 8B) to a small treelet *ca.* 5 m tall. This variation in height is common in members of the Geminata clade and may have to do with plant age and maturity.

Vellozo's (1831) illustration (Figure 9) is not particularly clear, but the congested inflorescences and swollen fruiting pedicels with a slight distal constriction are clearly depicted. In addition, *S. lacteum* usually has prominent lenticels on the stems; these are also depicted in Vellozo's plate. We have selected an epitype from Rio de Janeiro State to support this suboptimal plate with material that is fertile and shows the key characters (*Agra et al. 7298*).

We have recognised *S. cormanthum* here as a synonym of *S. lacteum*; after detailed study we consider the plate of *S. cormanthum* (t. 113) to represent flowering material of the same taxon as that shown in fruit in Vellozo's plate of *S. lacteum* (t. 93). *Solanum cormanthum* was used by both Sendtner (1846) and more recently in the *Lista de Especies de Flora do Brasil* (Stehmann et al. 2014) to refer to a different taxon we here recognise as a narrow endemic from Minas Gerais (see *S. psilophyllum* below). Both these authors expressed reservations about the correct application of this name. As is the case with the plate of *S. lacteum*, the depiction of the plant is not particularly clear, but the small flowers, small anthers and inflorescences that appear axillary (although they are not) are characteristic of *S. lacteum*. The locality cited for *S. cormanthum* ("silvis maritimis Regii Praedii S. Crucis"; Vellozo 1829: 86) is well within the geographic range and habitat of *S. lacteum*, although today it is part of the city of greater Rio de Janeiro.

Sendtner's (1846) plate of *S. glomuliflorum* (f. 11–15) clearly shows the scarious-margined calyx with rounded lobes and very plump anthers characteristic of *S. lacteum*. In his protologue Sendtner (1846) cited two collections of *S. glomuliflorum*; a flower-



**Figure 11.** Distribution of *S. lacteum*.

ing specimen of Schott from “Serra d’Estrella” (Serra de Estrela, in Rio de Janeiro State) and a fruiting specimen of Sellow’s from an unspecified locality in Brazil (F neg. 2823; presumably from Berlin]. We select here the Schott specimen at F (accession number 874710; barcode F0073278F) as the lectotype of *S. glomuliflorum*, as it bears a label with the locality and collector in J.F. MacBride’s handwriting and presumably comes from Berlin where the original is now destroyed. The collection number 5412 noted on this sheet was not mentioned by Sendtner (1846), but he rarely mentioned collection numbers in his citations.

**Specimens examined.** **BRAZIL.** Sin. loc., *Herb. Miers* 2724 (BM). **ESPÍRITO SANTO:** Mun. Cariacica, Reserva Biológica Duas Bocas, Alegre, trilha do Pau Oco, 20°17'29"S, 40°31'10"W, 600 m, 4 May 2008 (fr), *A.M. Amorim et al.* 7324 (BHCB); Mun. Cariacica, Reserva Biológica de Duas Bocas, localidade de Alegre, trilha do Pau-Oco, 20°17'29"S, 40°31'10"W, 600 m, 20 Jul 2008 (fr), *A.M. Amorim et al.* 7563 (BHCB, CEPEC, MBML, RB, UPCB); Mun. Santa Teresa, São Lourenco, Mata do Martinelli, trilha subindo o rio lado direito, 11 Apr 2000 (infl), *V. Demuner et al.* 885 (BHCB); Mun. Linhares, Reserva Florestal Linhares, km 0, 23 Jun 1999, *D.A. Folli* 3441 (BHCB); Mun. Santa Teresa, Nova Lombardia, terreno de Sr. Furlani, 19°48'14"S, 40°32'17"W, 813 m, 3 Feb 2011 (infl), *L.L. Giacomini et al.* 1200 (BHCB); Mun. Santa Teresa, Santo Henrique, terreno Waldecir Frey, 15 Apr 2005 (fr), *L. Kollmann & A.P. Fontana* 7642 (BHCB); Mun. Santa Teresa, Nova Lombardia, Reserva Biológica Augusto Ruschi, corrego entre os marcos 130 e 131, 2 Apr 2003 (fl), *R.R. Vervloet & E. Bausen* 2110 (BHCB). **MINAS GERAIS:** Mun. Matão, Estação Biológica de Caratinga, 23 Sep 1984 (fl, fr), *P.M. Andrade & M.A. Lopes* 346 (BHCB); Mun. Coronel Pacheco, Estação Experimental de Café Coronel Pacheco, 12 Aug 1941 (fl), *E.P. Heringer et al.* 702 (VIC); Mun. Caratinga, Fazenda Montes Claros, Estação Biológica de Caratinga, mata do Rafael, 19°43'53"S, 41°49'02"W, 5 Sep 1998 (fr), *J.A. Lombardi et al.* 2334 (BHCB); Mun. Caratinga, Fazenda Montes Claros, 10 Jan 1991 (st), *J.R. Stehmann & C.V. Mendonça s.n.* (BHCB); Mun. Tombos, Fazenda de Cachoeira, 12 Jul 1935 (fl), *Mello Barreto* 1577 (BHCB); Mun. Tombos, Mata do Banco, 13 Jul 2007 (fl), *L. Leoni* 6947 (BHCB). **RIO DE JANEIRO:** Mun. Nova Friburgo, RPPN Bacchus, Macaé da Cima, near Nova Friburgo, owned by David and Isabel Miller. Trilha da Antena, 22°22'31"S, 42°29'47"W, 1420 m, 29 Apr 2010 (fl, fr), *M.F. Agra et al.* 7296 (JPB, UT); Mun. Rio de Janeiro, Caminho do Macaco, 8 Aug 1878, *A.F.M. Glaziou* 9549 (B); Mun. Nova Friburgo, 1883, *A.F.M. Glaziou* 14177 (G).

***Solanum psilophyllum* Stehmann & Giacomini, sp. nov.**

urn:lsid:ipni.org:names:77145589-1

Figure 8C, D, E, 12

**Diagnosis.** Like *Solanum evonymoides* Sendtn. but differing in smaller flowers, inflorescences that are unbranched or branch only once near the base, pedicels with a constriction at the apex just below the calyx lobes and ovoid-reniform seeds.

**Type.** BRAZIL. Minas Gerais: Mun. Mariana, Mina de Fazendão, em mata, próximo à ferrovia, 20°08'43.7"S, 43°24'48.4"W, 875 m, 29 Jul 2008 (fl, fr), L.L. Giacomin, J.R. Stehmann, S.G. Resende & F. Pena 186 (holotype: BHCB [BHCB019054]; isotypes: BHCB [BHCB019055], BM, NY, RB).

**Description.** Treelet to 4 m, rhizomatous with underground stems; young stems terete, glabrous; new growth completely glabrous, occasionally minutely papillate; bark of older stems greenish brown, slightly winged from the leaf bases. Sympodial units di- foliate, geminate; leaves of a pair differing in size but not usually in shape. Leaves simple, the major leaves 10–15(-25) cm long, 4–13 cm wide, elliptic to narrowly elliptic, occasionally wider in the distal third and narrowly obovate, membranous, glabrous on both surfaces, the abaxial surface often drying paler than the adaxial surface; primary veins 8–11 pairs, drying somewhat lighter than the lamina; base attenuate, somewhat oblique; margins entire; apex acute, the tip somewhat blunt; petiole 1.5–2 cm long, glabrous; minor leaves 6–8 cm long, 2–3 cm wide, differing from the majors only in size and sometimes not present in dried specimens. Inflorescences 0.2–2 cm long, opposite the leaves or appearing to arise from the leaf axils, unbranched, but apparently sometimes with 2 inflorescences from one axil and appearing branched (*Giacomin et al. 186*), with 5–8 flowers, glabrous; peduncle 0.1–2 cm; pedicles 1.2–1.5 cm long, ca. 0.5 mm in diameter at the base, ca. 1.5 mm in diameter at the swollen apex with a marked constriction just below the calyx lobes, slender and expanding distally, spreading or pendant at anthesis, glabrous, articulated at the base; pedicel scars 0.5 -1 mm apart, more congested in the distal part of the inflorescence. Buds obovoid, the corolla strongly exserted from the calyx tube before anthesis. Flowers 5-merous, perfect. Calyx with the tube 0.5–1 mm long, broadly conical, the lobes 1–1.5 mm long, deltate to triangular, reflexed at anthesis, glabrous. Corolla 1.2–1.4 cm in diameter, white, stellate, lobed 1/2 to 2/3 of the way to the base, the lobes ca. 5 mm long, 2.5 mm wide, spread at anthesis, glabrous with the tips minutely papillate. Stamens 3.5–4 mm long; filament tube ca. 0.5 mm long, the free portion of the filaments ca. 0.5 mm long, glabrous; anthers 2.5–3 mm long, ca. 1 mm wide, ellipsoid, yellow, poricidal at the tips, the pores lengthening to slits with age. Ovary glabrous; style 5–6 mm long, glabrous; stigma not expanded, blunt, the surface minutely papillate. Fruit a globose berry, 1–1.3 cm in diameter, green, the pericarp not markedly shiny, thick; fruiting pedicels 1.5–1.7 cm long, ca. 1 mm in diameter at the base, 2.5–3 mm and expanded at the apex, woody and pendant; calyx lobes in fruit not markedly expanding, but distinctly differentiated from the enlarged pedicel apex. Seeds not known.

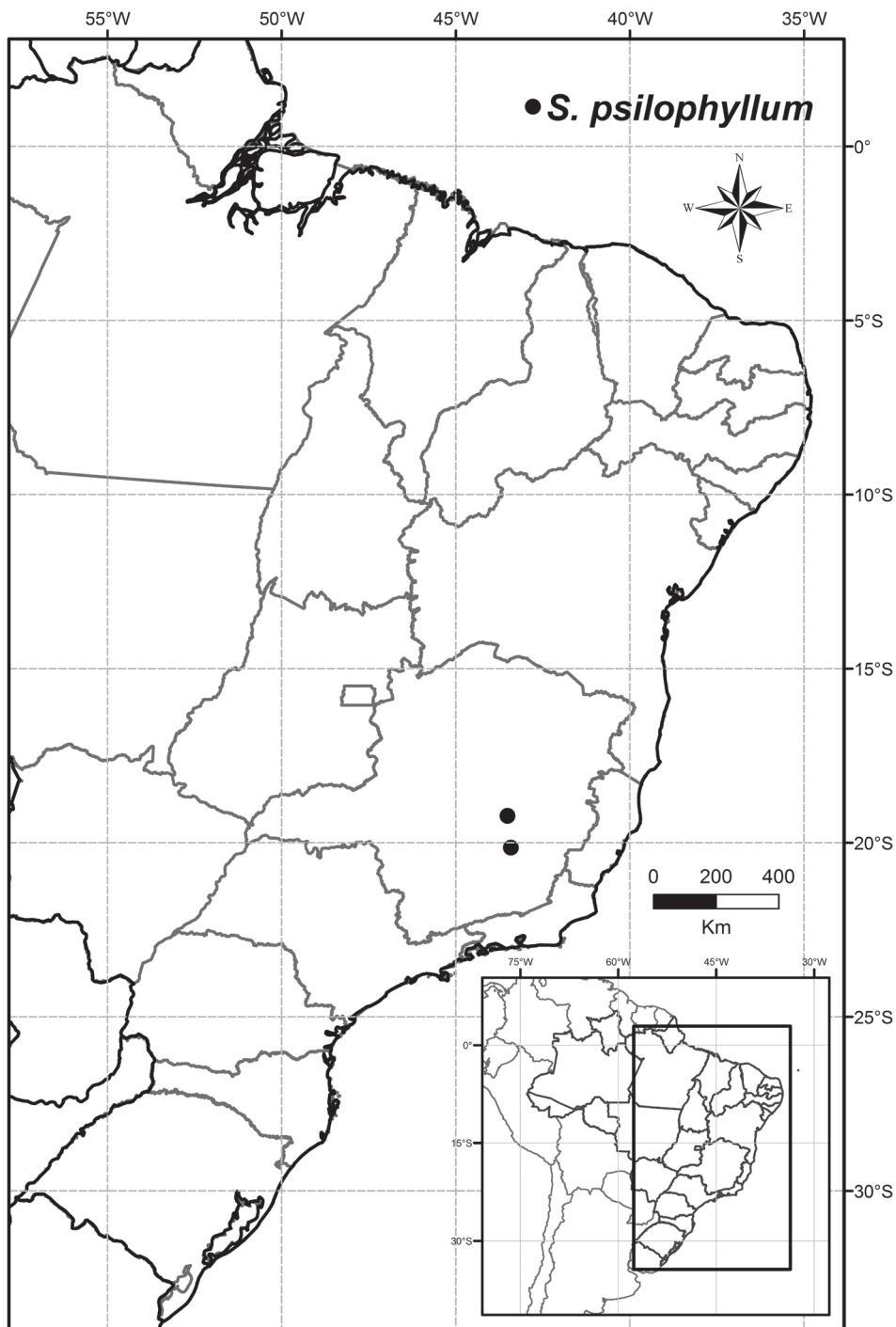
**Distribution.** In the south-eastern part of the state of Minas Gerais, in islands of forest (*capões*) associated with iron or quartzite formations in the Iron Quadrangle and Serra do Cipó regions, in the southern limit of Espinhaço mountain range (Figure 13).

**Ecology.** *Solanum psilophyllum* grows in the forest understory on thin soils associated with iron-rich or quartzite formations, at elevations from 800–900 m.

**Phenology.** Flowering specimens have been collected throughout the year; fruits have only been seen on the type specimen, collected in July. It is probable that this species flowers and fruits sporadically throughout the year.



**Figure 12.** Holotype specimen of *S. psilosphyllum* (Giacomin et al. 186, BHCB019054). Reproduced with permission of the Universidade Federal de Minas Gerais.



**Figure 13.** Distribution of *S. psilosphyllum*.

**Etymology.** Named for its completely glabrous leaves (from the Greek *psilos* smooth or bare, *phyllos* leaf).

**Preliminary conservation status (IUCN 2014).** Critically Endangered (CR) B1, 2 a, b(ii, iii, iv); EOO 26 km<sup>2</sup> (CR); AOO 16 km<sup>2</sup> (EN). *Solanum psilophyllum* is known from only two localities and its habitat is under severe pressure from mining and frequent forest fires (see Notes). The population from which the type specimen was collected, close to a private railroad, has already been destroyed. Although the area of occupancy would suggest a status of Endangered we consider the extreme threats to these populations coupled with the habitat specificity of members of the Geminata clade (see above) warrant a status of Critically Endangered. One of the known collections might be from a protected area (PARNA Serra do Cipó), although not stated on the specimen label (*Campos & Belisário CFSC-13505*) but appears to be from a roadside, subject to occasional fire.

**Notes.** *Solanum psilophyllum* is the species previously called *Solanum cormanthum* Vell. in *Lista de Especies de Flora do Brasil* (Stehmann et al. 2014). That name, however, has been of uncertain application since Sendtner (1846) listed a collection from Minas Gerais (“Caxoeira do Campo”) as belonging to *S. cormanthum*, but with reservations.

Three sheets of labelled as “*Solanum cormanthum* Vell.” in Martius’s hand in Brussels belong to this species as do presumed duplicates of this collection in F (F-680206) and G (G00016950) cited by Knapp (2008) as belonging to *S. evonymoides* Sendtn., a species now considered to only occur from coastal Bahia to northeastern Minas Gerais (see discussion of *S. verticillatum* below). Sendtner (1846) cites a collection in Martius’s herbarium from “Caxoeira do Campo, prov. Minarum, Martio floret: Martius”; this was probably collected by Claussen. One of the three of the sheets in BR (BR00000825373) is from Martius’s herbarium and is labelled “Mart. 1839.” Another sheet is definitely attributed to Claussen and collected in 1835, while the third is attributed (“comm. Schüch fil. 1850”) to Guilherme Schüch, the Baron of Capanema (Minas Gerais, currently the active iron mine of Capanema), who sent plants to Martius.

The Vellozo illustration of *S. cormanthum* (tab. 113, Vellozo 1831) has distinctly axillary inflorescences and is said to come from what is now the city of Rio de Janeiro (“Praedii S. Crucis”), an area of very different vegetation and soils than the iron or quartzite rich formations of Minas Gerais. We recognise *S. cormanthum* here as a synonym of *S. lacteum*, both on morphological and distributional grounds. Members of the Geminata clade are very similar morphologically and Vellozo’s plates are often distinctly suboptimal for secure identification. In view of the restricted distribution and habitat of these plants (see below) we prefer to describe this as new here rather than use *S. cormanthum* for these distinct and endangered populations.

*Solanum psilophyllum* has a very narrow distribution restricted to the Iron quadrangle, within areas that are today active mines, and to the Serra do Cipó region, where it was collected more than ten years ago, in forest fragments close to roadsides. The fact that no collections are known from northern areas of the Espinhaço range

likely indicates that the distribution is extremely restricted to the region around Serra do Cipó and the Iron Quadrangle. Efforts to locate new populations of this species are urgent, especially considering that most areas where it might occur are currently owned by mining companies and are subject to an intensive land use.

*Solanum psilophyllum* is morphologically similar to *S. verticillatum* (described here below), another completely glabrous species of the Geminata clade occurring in the states of São Paulo and Rio de Janeiro. It can be distinguished from that species by its longer calyx lobes and by the swollen distal portions of the pedicels that are markedly constricted just below the calyx lobes. In addition, the leaf texture of *S. psilophyllum* is somewhat fleshy, while leaves of *S. verticillatum* are brittle and chartaceous.

*Solanum psilophyllum* is also morphologically similar to *S. lacteum* from Atlantic forests in Rio de Janeiro, Espírito Santo and Minas Gerais states. It differs from that species in its larger flowers (>1 cm in diameter), longer inflorescences, elliptic rather than obelliptic leaves that do not dry a blackish brown colour and in the non-lenticellate stem. Like *S. lacteum*, *S. psilophyllum* is completely glabrous. *Solanum psilophyllum* has an underground stem (Figure 8C), like *S. arboreum* Dunal of northern South America and Central America (see Knapp 2002a); this characteristic may be more common in the Geminata clade than currently thought, as it is rare that the underground parts of these small shrubs are collected or even observed.

**Specimens examined.** BRAZIL. MINAS GERAIS: Mun. Santana do Riacho, Serra do Cipó, Rodovia MG-010, Belo Horizonte a Conceição do Mato Dentro, ca. de 1.5 km antes da bifurcação para Morro do Pilar, pequeno capão da mata a direita, próximo a rodovia, 19 Nov 1993 (fl), M.T.V.A. Campos & A.J.M. Belisário CFSC-13505 (BHCB); sin. loc., 1835 (infl), *P. Claussen s.n.* (BR); sin. loc., 1839 (infl), *P. Claussen s.n.* (F); Caxoeira do Campo, Mar 1839 (infl), *P. Claussen 200* (BR, G); Mun. Santana do Riacho, Serra do Cipó, ca. 400 m antes da bifurcação Morro do Pilar-Conceição do Mato Dentro, ca. 1.8 km da estrada, 2 Mar 2001 (fl), M. Groppo et al. 640 (BHCB); Mun. Catas Altas, Mina de Fazendão, próximo à área da cava, 20°07'38"S, 43°24'48"W, 970 m, 27 May 2008 (fl), S.G. Rezende et al. 2749 (BHCB); sin. loc., 1850 (infl), *G. Schüch s.n.* (BR).

### *Solanum verticillatum* S.Knapp & Stehmann, sp. nov.

urn:lsid:ipni.org:names:77145590-1

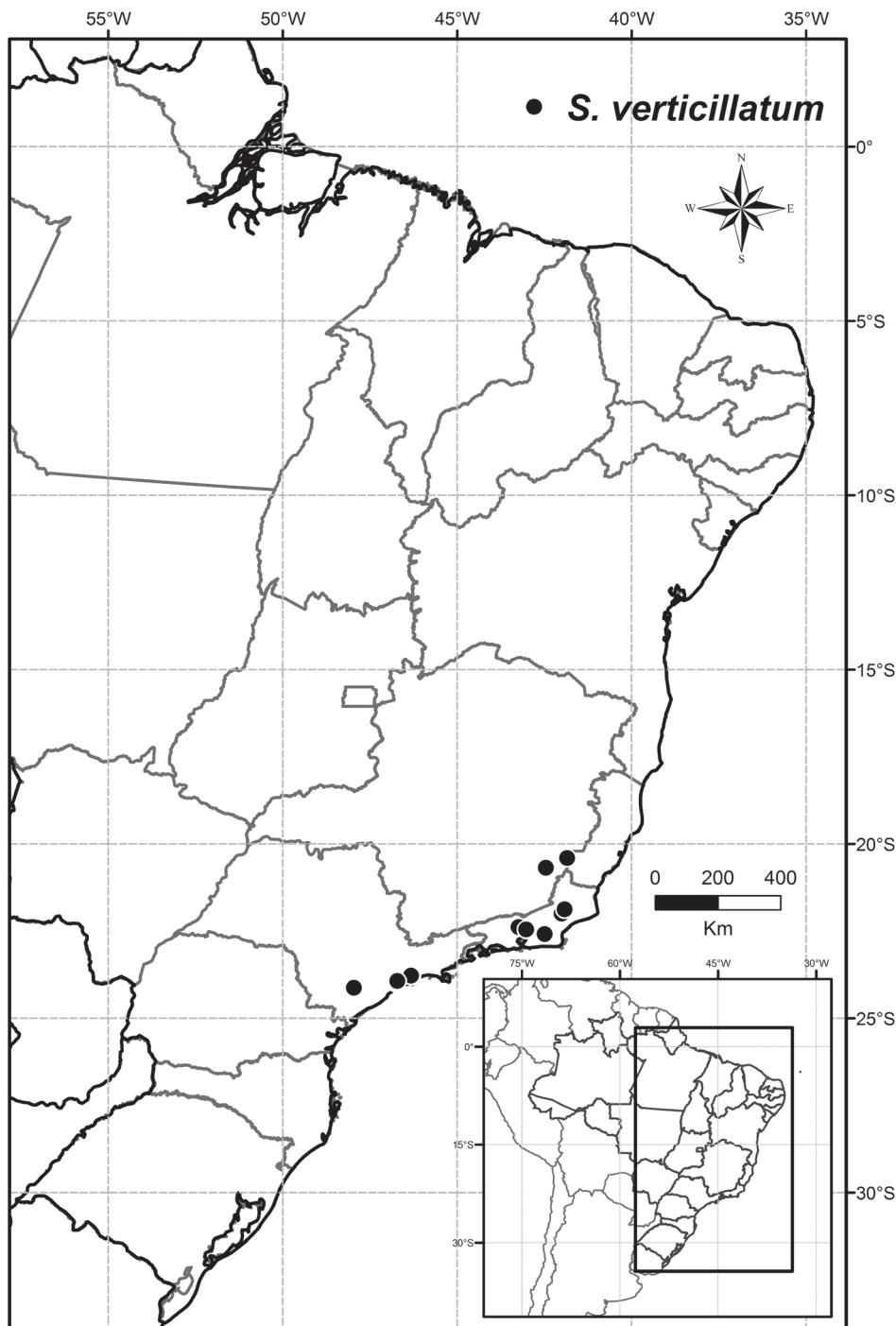
Figures 8F, 14

**Diagnosis.** Like *S. evonymoides* Sendtn. but differing in being a large tree with pseudoverticillate very shiny chartaceous leaves, smaller, sweet-smelling flowers and orange berries with large seeds.

**Type.** BRAZIL. São Paulo: Mun. Santo André, Paranapiacaba, Estação Biológica, 23°46'-23°48"S, 46°21'-46°17"W, 800 m, 30 Jul 1980. A. Custodio Filho & A.C. Dias 305 (holotype: SP [SP002705]; isotypes: BHCB [BHCB019061], BM [BM001120381]).



**Figure 14.** Holotype specimen of *S. verticillatum* (Custodio Filho & Dias 305, SP002705). Reproduced with permission of Instituto de Botânica, São Paulo.



**Figure 15.** Distribution of *S. verticillatum*.

**Description.** Tree to 8 m, the branching appearing somewhat verticillate with branches in congested groups; young stems terete, completely glabrous, usually shiny; new growth completely glabrous and shiny, in live plants sometimes purplish green; bark of older stems pale yellow when dry, in live plants greyish brown. Sympodial units plurifoliate, the leaves clustered along the stems. Leaves simple, 4.5–16 cm long, 2–5 cm wide, elliptic to obelliptic, usually narrowly so, chartaceous and somewhat brittle, both surfaces glabrous and shiny, drying a golden brown; primary veins 6–10 pairs, drying yellowish brown, not looping in a submarginal vein; base acute to acuminate; margins entire, sometimes revolute; apex abruptly acute to attenuate; petiole (0.5-)1–2 cm long, glabrous, drying pale yellowish brown. Inflorescences 2–5 cm long, terminal, appearing axillary but this due to short internodes and congested leaves, branching 1–2 times, with 30–40 flowers, completely glabrous; peduncle 0.5–2.5 cm long; pedicels 1.5–1.7 cm long, *ca.* 0.5 mm in diameter at the base, *ca.* 1 mm in diameter at the apex, filiform, spreading at anthesis, glabrous, articulated at the base; pedicel scars unevenly spaced 1–2 mm apart, usually clustered at the tips of the inflorescence branches. Buds ellipsoid, the corolla completely enclosed in the calyx when young, exserted 2/3 to 3/4 of the way just before anthesis. Flowers 5-merous, all perfect, intensely sweet-smelling (*Custodio Filho* 305). Calyx tube 1–1.5 mm long, conical, the lobes 0.9–1 mm long, *ca.* 1 mm wide, broadly deltate, with scarious margins and a central thickened keel ending in a rounded point, glabrous or the tips with a few papillae. Corolla (1.4-)1.6–1.8 cm in diameter, white, stellate, lobed nearly to the base, the lobes 6–8 mm long, 2.5–3.5(-4) mm wide, spreading at anthesis, densely papillate on the cucullate tips, otherwise completely glabrous. Stamens 4.5–6 mm long; filament tube 1 mm long or less, the free portion of the filaments minute, <0.5 mm long, glabrous; anthers (3-)4–4.5 mm long, 1–1.2 mm wide, obellipsoid with the base narrower than the distal portion, yellow, poricidal at the tips, the pores lengthening to slits with age. Ovary glabrous; style 5–7 mm long, glabrous; stigma minutely capitate, the surface papillose. Fruit a globose berry, 1–1.2 cm in diameter, pale green and white speckled (immature) becoming yellow or orange when ripe, the pericarp shiny and leathery, shattering when pressed and dried; fruiting pedicels 2–2.5 cm long, *ca.* 1 mm in diameter at the base, expanding gradually to *ca.* 2 mm in diameter at the apex, more or less woody, hanging; calyx lobes in fruit not markedly lengthening. Seeds 10–20 per berry, 5–5.5 mm long, 3–4 mm wide, reniform and somewhat flattened, dark brown with paler margins, the surfaces minutely pitted and usually quite thin the embryo easily visible, the testal cells with sinuate margins.

**Distribution and ecology.** Endemic to south-eastern Brazil, in the states of Minas Gerais, Rio de Janeiro and São Paulo; in the Serra do Mar and Mantiqueira mountain chains (Figure 15).

**Ecology.** *Solanum verticillatum* grows on the montane coastal forests (Mata Atlântica) as a small tree in forests and secondary growth from 700 to almost 2000 m elevation. Plants can be as large as 10 cm in diameter, and form part of the low canopy of these forests.

**Phenology.** Most flowering specimens collected in the months of June and July; fruiting in November–January. Sporadic flowering and fruiting apparently occurs

throughout the year, but a flowering peak occurs in the austral winter (May-August), which is also the drier season.

**Etymology.** Named for the pseudo-vorticillate nature of the stems, where many branches appear to arise from a set of closely spaced nodes (Figure 8F inset).

**Preliminary conservation status (IUCN 2014).** Least Concern (LC); EOO 75, 516 km<sup>2</sup> (LC); AOO 60 km<sup>2</sup> (EN). Although only described here, *S. verticillatum* is known from many localities along the Serra do Mar, many of which are from within protected areas (e.g., Reserva Biológica do Alto da Serra de Paranapiacaba in São Paulo state and Reserva Ecológica de Macaé de Cima, in Nova Friburgo, Rio de Janeiro state). Where it occurs, *S. verticillatum* is relatively common.

**Notes.** *Solanum verticillatum* was considered a montane form of *S. evonymoides* by Knapp (2008); field collections in 2013 confirmed the distinctness of this species. *Solanum evonymoides* is known from coastal forests in Bahia and adjacent Espírito Santo, and eastern Minas Gerais and although morphologically similar to *S. verticillatum* is distinct in both habitat and in several morphological features. *Solanum verticillatum* differs from *S. evonymoides* in its tree habit, branches that appear vorticillate due to short internodes (Figure 8F inset), smaller sweet-smelling flowers (< 2 cm in diameter), shiny chartaceous leaves, and orange berries.

*Solanum verticillatum* also resembles *S. psilophyllum* (another set of specimens previously recognised as *S. evonymoides* by Knapp 2008) in its glabrous shiny leaves. It differs from that species in its more broadly deltate calyx lobes, its distinctly pedunculate inflorescences (versus inflorescences that branch only very near the base in *S. psilophyllum*), its berry that is orange or yellow-orange when ripe, and in its flattened rather than ovoid seeds. These two species can be very difficult to distinguish, but the marked constriction just below the calyx lobes at the distal end of the swollen pedicel occurs only in *S. psilophyllum*.

This species was commonly collected until approximately the 1980s and populations from the Paranapiacaba reserve are well represented in SP. It is strange that more recent collections do not seem to have been made; this may be due to the tree habit of *S. verticillatum* and to its similarity to the more common species *S. campaniforme* and *S. pseudoquina* A.St.Hil. It can be distinguished from *S. campaniforme* by its shiny, completely glabrous leaves (the leaves of *S. campaniforme* have tufts of trichomes in the vein axils abaxially) and from *S. pseudoquina* by its equal anthers (those of *S. pseudoquina* are markedly unequal). It differs from both species in its yellow or orange berries and pseudoverticillate branching. Most specimens of *S. verticillatum* at SP were previously identified as *S. pseudoquina*.

**Specimens examined. BRAZIL. MINAS GERAIS:** Mun. Alto Caparaó, Serra do Caparaó, Rancho da Casa Queimada, 2200m, 10 Jul 1941 (fl, fr), *J. de Castro s.n.* (VIC); Mun. Araponga, Parque Estadual da Serra do Brigadeiro, trilha para o Pico do Boné, 26 May 2000 (fr), *A. Salino 5485* (BHCB). **RIO DE JANEIRO:** Mun. Nova Friburgo, Reserva Macaé de Cima, estrada de terra do Hotel São João para o Sítio dos Miller, 19 Jan 1999 (fr), *L.O. Anderson et al. 99/33* (RB); Macaé, Distrito de Frade, trilha para o Pico, 1250 m, 19 Nov 2002 (fr), *M.G. Bovini et al. 2228* (RB); Serra dos Órgãos, 21 Apr 1941 (fl).

fr), *A.C. Brade* 16776 (RB); Mun. Teresópolis, Teresópolis do Parnaso, excursão a trilha do Rancho Frio, 23K (0704594/7514750), 22°27'16"S, 42°59'19"W, 15 Sep 2010 (fr), *C. Cronemberger et al.* 5 (NY, RB); près Theresopolis [no date], *A.F.M. Glaziou* 8199 (P); Serra dos Órgãos, près Theresopolis, 1886 (fl), *A.F.M. Glaziou* 8856 (G, K); Mun. Nova Iguaçu, Pico do Tinguá, REBIO Tinguá, estrada do Trilha do Rala, Sapé, 22°35'22"S, 42°29'03"W 1600 m (fr), *H.C. de Lima et al.* 6006 (RB); Mun. Petrópolis, Araras, 22°23'23"S, 43°13'57"W, 1100 m, 16 Jun 1974 (fl), *G. Martinelli* 330 (RB); Mun. Nova Friburgo, Morro da Caledonia, 1400-1600 m, 8 Jun 1977 (fl), *G. Martinelli et al.* 2440 (K); Mun. Nova Friburgo, Reserva Macaé de Cima, nascente do Rio das Flores, 1000 m, 25 May 1987 (fl, fr), *G. Martinelli et al.* 12067 (RB); Mun. Santa Maria Magdalena, Parque Estadual do Desengano, Pedra do Desengano, 21°53'00"S, 41°55'00"W, 1700-1800 m, 21 Dec 1988 (fr), *G. Martinelli et al.* 13274 (F, RB); Mun. Santa Maria Magdalena, Parque Estadual do Desengano, Pedra do Desengano, 21°53'00"S, 41°55'00"W, 1800-1850 m, 28 Jun 1989 (fl, fr), *G. Martinelli et al.* 13360 (F, RB); Mun. Petrópolis, Serra da Maria Comprida, Distrito de Araras, APA de Petrópolis, João Grande, 22°24'01"S, 43°12'18"W, 1500m, 25 Apr 2006 (fl), *M.A. Moraes & B. Benevenuto RB-* 477309 (BHCB); Mun. Nova Friburgo, Reserva Macaé de Cima, trilha em direção ao cume, atrás da casa de Bel e David Muller, 22°00' S, 42°00' W, 2 May 2007 (fr), *M.M. Saavedra & M. Bocayuva* 381 (BHCB, RB); Mun. Teresópolis, Parque Nacional da Serra dos Órgãos, upper part of the Rancho Frio trail, 22°27'50"S, 43°00'48"W, 1625 m, 8 Mar 2005 (fr), *C. Seele* 1004 (RB); Mun. Teresópolis, Parque Nacional da Serra dos Órgãos, vale do Rio Beija-Flor, proximo a trilha da Pedra do Sino, 22°26'53"S, 43°00'20"W, 1265m, 24 Apr 2004 (st), *J.W. Wesenberg* 1037 (BHCB); Mun. Teresópolis, Parque Nacional da Serra dos Órgãos, Vale das Orquídeas, 22°27'27"S, 43°01'11"W, 1985 m, 21 Jul 2010 (fr), *J.W. Wesenberg et al.* 1046 (RB). **SÃO PAULO:** Mun. São Paulo, desde Parelheiros rumbo a Eng. Marsilac, a 300 m de la Estrada Ponte Seca, 15 Apr 2008, *G.E. Barboza et al.* 2025 (CORD); Mun. São Paulo, Marsilac, Parque Estadual Serra do Mar, nucleo Curucutu, caminho para o Mirante, 14 May 1997 (fr), *N.S. Chukr et al.* 536 (PMSP); Mun. Itanhaém, Parque Estadual Serra do Mar, núcleo de Curucutu, trilha do Rio Camburi, 799m, 15 Mar 2005 (fr), *R. Cielo-Filho et al.* 410 (BHCB); Mun. Santo André, Estação Biológica do Alto da Serra de Paranapiacaba, picada 1, 3 Aug 1979 (fl), *A. Custodio Filho et al.* 91 (BM, SP); Cunha, Reserva Florestal [44.50-45.50 W, 23.10-23.20S], 1000 m, 11 Jul 1980 (fl), *A. Custodio Filho* 265 (BHCB, NY); Mun. São Paulo, Rio Capivari, Distrito de Engo. Marsilac, 23°56'03"S, 46°42'36"W, 800 m, 17 Jun 1992 (fl), *C. Farney et al.* 3143 (RB); Mun. São Paulo, Marsilac, Parque Estadual Serra do Mar, nucleo Curucutu, trilha do mirante, 18 Jan 1996 (fr), *G.M.P. Ferreira et al.* 35 (BHCB, BM, SP, UEC); Mun. Santo André, Estação Biológica do Alto da Serra de Paranapiacaba [46 21S-46 17S;23 46W-23 28W, DM], 750-790 m, 27 Aug 1980 (fl), *E. Forero et al.* 7656 (BM, SP); Mun. Cunha, Parque Estadual Serra do Mar, picada do Rio Bonito, 17 Aug 1994 (fl), *G.A.D.C. Franco & M.L. Kawasaki* 1241 (BHCB); Mun. São Paulo, Marsilac, Parque Estadual Serra do Mar, nucleo Curucutu, trilha do Mirante, topo do morro, limite de municipio com Itanhaém, 872m, 13 Apr 1997 (fr), *R.J.F. García & M. Gomes*

*Neto 1161* (PMSP); Mun. Santo André, Paranapiacaba, Parque Municipal das Nascentes de Paranapiacaba, trilha do caminho da Bela Vista, 23°47'21"S, 46°18'11"W, 1056m, 13 Oct 2009 (fr), *L.L. Giacomin et al. 1110* (BHCB, BM); Mun. Santo André, Reserva Biológica do Alto da Serra de Paranapiacaba, 23°46'41"S, 46°18'44"W, 809 m, 19 Nov 2013 (fr), *L.L. Giacomin et al. 2016* (BHCB, BM, UT); Mun. São Paulo, Marsilac, Parque Estadual Serra do Mar, Curucutu, subida para o Mirante, 23°59'28"S, 46°44'36"W, 16 Aug 1995 (fl), *S.A.P. Godoy et al. 755* (BHCB, SP); Mun. Santo André, Alto da Serra (fl), *F.C. Hoehne s.n.* (SP); Mun. Santo André, Alto da Serra, 31 Jul 1918 (fl), *F.C. Hoehne SP-2336* (BM, SP); Mun. Santo André, Alto da Serra, 28 Jan 1919, *F.C. Hoehne 3042* (US); Mun. Santo André, Reserva Biológica do Alto da Serra de Paranapiacaba, área de Campo Grande, 6 Apr 1995 (fr), *M. Kirizawa & E.A. Lopes 2972* (BM, SP); Mun. Santo André, trilha construída pela CESP, estrada da Torre, caminho para o Vale do Quilombo, próximo a Vila de Paranapiacaba, 31 Jan 1996 (fr), *C.Y. Kiyama et al. 103* (SP, UEC); Mun. Santo André, Paranapiacaba, Estação Biológica, 23 May 1946 (fr), *M. Kuhlmann 3420* (BM, SP); Mun. Santo André, Alto da Serra, Estação Biológica, 2 Aug 1928, *D. Lemos s.n.* (BM, SP); Cunha-Res., Est. de Cunha, 11 Jul 1980 (fl), *F.R. Martins et al. 12361* (NY); Mun. Santo André, E.B. Alto da Serra de Paranapiacaba, (via férrea São Paulo-Santos), 28 Oct 1965 (fr), *J. Mattos & C. Moura 12790* (SP); Mun. Santo André, Paranapiacaba, Estação Biológica, via férrea São Paulo-Santos, 30 Sep 1966 (fr), *J. Mattos 13888* (BM, SP); Mun. Santo André, E.B. Alto da Serra de Paranapiacaba, (via férrea São Paulo-Santos), 27 Dec 1966 (fr), *J. Mattos & N. Mattos 14394* (SP); Mun. Santo André, E.B. Alto da Serra de Paranapiacaba, (via férrea São Paulo-Santos), 27 Jul 1967 (fl), *J. Mattos & N. Mattos 14844* (SP); Mun. São Miguel Arcanjo, Parque Estadual Carlos Botelho, estrada de serviço, próximo a Mirante, 2 Sep 2011 (fl, fr), *P.L.R. de Moraes et al. 3327* (BHCB); Mun. Santo André, Alto da Serra, Aug-Sep 1917 (fl), *E. Schwebel 79* (SP); Mun. São Paulo, Parque Estadual Serra do Mar, núcleo Curucutu, trilha do Campo, 23°59'00"S, 46°44'00"W, 800m, 11 Apr 2001 (fr), *F.M. Souza et al. 63* (BHCB); Mun. Santo André, trilha construída pela CESP, estrada da Torre, caminho para o Vale do Quilombo, próximo a Vila de Paranapiacaba, 31 Jan 1996 (fr), *M. Sugiyama et al. 1403* (BHCB, SP); Mun. Santo André, Paranapiacaba, Estação Biológica, 23°47' S, 46°19' W, 750-900 m, 28 Jul 1983 (fl), *C.B. Toledo & A. Custodio Filho 29* (BM, SP).

#### Artificial key to the Brazilian species of the Geminata clade

**Note:** Each species' occurrence in Brazilian states is in square brackets where it keys out. Abbreviations of states follow Table 3.

- |   |   |    |
|---|---|----|
| 1 | Mature leaves completely glabrous, with no trichomes > 1 cell long (Note: new growth can have some pubescence in these species) ..... | 2  |
| - | Mature leaves with at least some trichomes > 1 cell long.....   | 28 |
| 2 | Sympodial units plurifoliate, difoliate or unifoliate, not geminate.....  | 3  |

- Sympodial units difoliate and geminate ..... 14
- 3 Sympodial units unifoliate; new growth with minute branched trichomes [BA; ES; MG] ..... *Solanum bahianum*
- Sympodial units with more than one leaf; new growth glabrous or with arachnoid (tangled like spider's webs) or scurfy pubescence ..... 4
- 4 Stems winged [PR; RS; SC] ..... *Solanum alatirameum*
- Stems not strongly winged ..... 5
- 5 Inflorescence many times branched ..... 6
- Inflorescence simple or at most once-branched (often near the base) ..... 11
- 6 Leaves with conspicuous domatia like small pits in the vein axils abaxially [PR; RS; SC; SP] ..... *Solanum pabstii*
- Leaves without domatia abaxially ..... 7
- 7 Corolla < 1 cm in diameter; leaf bases acute or cuneate; plants often drying black or dark brown [BA] ..... *Solanum cordioides*
- Corolla > 1 cm in diameter; leaf bases attenuate; plants not drying black or dark brown ..... 8
- 8 Inflorescences stout, the pedicel scars closely spaced and usually overlapping; leaves large and repand with parallel venation; new growth with brown scurfy pubescence [AC; AM] ..... *Solanum robustifrons*
- Inflorescences not stout, the pedicel scars not overlapping; leaves not repand with parallel venation; new growth glabrous or with minute golden pubescence, not scurfy and reddish brown when dry ..... 9
- 9 New growth and inflorescence axes with minute golden pubescence; leaves matte, sessile or very short petiolate; buds completely enclosed in the calyx when young [AC; AM] ..... *Solanum sessile*
- New growth and inflorescence axes glabrous and shiny; leaves shiny, petiolate; buds not completely enclosed in calyx ..... 10
- 10 Leaves chartaceous, apparently whorled, wider in the distal third; flowers sweet-smelling; mature fruit orange or yellow; montane areas [MG; RJ; SP] .. ..... *Solanum verticillatum*
- Leaves membranous to fleshy, not whorled, widest in the middle; flowers not sweet-smelling; mature fruit green; coastal [BA; ES; MG; RJ] ..... *Solanum evonymoides*
- 11 New growth with arachnoid or scurfy pubescence ..... 12
- New growth completely glabrous ..... 13
- 12 New growth with matted arachnoid pubescence; sympodial units plurifoliate; inflorescences simple [PR; SC] ..... *Solanum canoaense*
- New growth with scurfy papillate pubescence; sympodial units difoliate; inflorescences simple or furcate [AC; AM] ..... *Solanum robustifrons*
- 13 Flowers > 1 cm in diameter; inflorescence > 1 cm long; leaves elliptic [MG]... ..... *Solanum psilophyllum*
- Flowers < 1 cm in diameter; inflorescence < 1 cm long; leaves obelliptic [ES; MG; RJ] ..... *Solanum lacteum*

- 14 Leaves of a geminate pair not differing markedly in shape (but can differ in size) ..... 15
- Leaves of a geminate pair differing markedly in shape (usually also in size) .... 20
- 15 New growth finely golden pubescent; plants of the Amazon [AC; AM; PA; RR]..... *Solanum oppositifolium*
- New growth glabrous; plants of SE Brazil ..... 16
- 16 Stems strongly winged inflorescence branched [PR; RS; SC] .....  
..... *Solanum alatirameum*
- Stems terete, not winged; inflorescence unbranched or at most furcate ..... 17
- 17 Inflorescences elongate (> 2 cm long), the pedicel scars not overlapping; pedicels strongly winged [BA; ES; MG; RJ]..... *Solanum warmingii*
- Inflorescence minute (< 0.5 cm long), the pedicel scars overlapping; pedicels terete..... 18
- 18 Stems strongly winged [BA; ES; RJ] ..... *Solanum restingae*
- Stems terete ..... 19
- 19 Calyx lobes narrowly triangular, 1–1.5 mm long; corolla with the lobes reflexed; stem not lenticellate; leaves not drying black or dark brown [BA; MG] ..... *Solanum amorimii*
- Calyx lobes deltate, < 1 mm long; corolla with the lobes spreading; stem strongly lenticellate; leaves drying black or dark brown [ES; MG; RJ] .....  
..... *Solanum lacteum*
- 20 Fruits red or orange; fruiting pedicels erect ..... 21
- Fruits green or yellowish green; fruiting pedicels deflexed ..... 22
- 21 Flowers > 1 cm in diameter, the corolla lobes spreading; fruit dark orange or red [cultivated] ..... *Solanum pseudocapsicum*
- Flowers < 1 cm in diameter, the corolla lobes strongly reflexed; fruit pale orange [cultivated] ..... *Solanum diphyllum*
- 22 Stems winged..... 23
- Stems terete ..... 24
- 23 Bark of older stems white and peeling; internodes crowded; inflorescences filiform and pedicel scars spaced; flowers < 1 cm in diameter; plants of river courses [BA; ES; MG; PR; RJ; SC; SP] ..... *Solanum stipulatum*
- Bark of older stems not markedly peeling; internodes not crowded; inflorescences very short and thick and pedicel scars congested; flowers > 1 cm in diameter; plants of forest understory [BA; ES; RJ] ..... *Solanum restingae*
- 24 Buds ellipsoid or turbinate; corolla > 1.5 cm in diameter, the lobes cucullate, spreading; minor leaves usually heart-shaped ..... 25
- Buds globose; corolla < 1 cm in diameter, the lobes not cucullate, reflexed; minor leaves not usually heart-shaped ..... 26
- 25 Buds turbinate; calyx lobes deltate or broadly deltate; fruiting pedicels swollen at distal end just below the calyx; new growth finely pubescent with whitish trichomes [AC; AM; GO; MA; MG; MT; PA; RO; RR] .....  
..... *Solanum leucocarpon*

- Buds ellipsoid; calyx lobes long-acuminate; fruiting pedicels gradually tapering to apex; new growth glabrous [AC; AM]..... *Solanum anisophyllum*
- 26 Inflorescence stout; pedicel scars closely spaced; fruiting pedicels erect [RR]...  
..... *Solanum arboreum*
- Inflorescence filiform; pedicel scars evenly but not tightly spaces; fruiting pedicels deflexed ..... 27
- 27 Minor leaves very small and appearing stipulate; new growth and calyx lobes with fine golden pubescence (this occasionally extending to the midrib); plants of the Amazon [AM] ..... *Solanum leptopodum*
- Minor leaves not stipulate; new growth and calyx lobes glabrous; plants of Mata Atlântica [PE] ..... *Solanum* sp. 1
- 28 Trichomes variously branched ..... 29
- Trichomes simple or at most a few furcate ..... 41
- 29 Upper leaf surfaces glabrous and shiny; if trichomes present then the upper surface very sparsely pubescent ..... 30
- Upper leaf surfaces not markedly shiny; variously pubescent ..... 33
- 30 Trichomes lax and dendritic ..... 31
- Trichomes with more densely congested branches (or echinoid) ..... 32
- 31 Leaves sessile or the base strongly attenuate; trichomes sparse on lower leaf surface [PR; SC; SP] ..... *Solanum pseudodaphnopsis*
- Leaves petiolate; trichomes dense on lower leaf surface, obscuring the lamina [RJ; RS] ..... *Solanum arenarium*
- 32 Trichomes in axillary tufts; stems glabrous or only sparsely pubescent with mostly uniseriate trichomes on new growth; plants of the Amazon [AC; AM]..... *Solanum nudum*
- Trichomes distributed over entire abaxial lamina; stems densely to moderately pubescent with dendritic trichomes; plants of south-eastern Brazil ...33
- 33 Inflorescence simple; sympodial units difoliate, geminate or not geminate [BA; ES; MG; RJ] ..... *Solanum kleinii*
- Inflorescence several to many times branched sympodial units plurifoliate [PR; RS; SC] ..... *Solanum compressum*
- 34 Pedicels distinctly swollen at the distal end; flowers fleshy, the corolla lobes spreading [AC; AM; GO; MA; MG; MT; PA; RO; RR] .....  
..... *Solanum leucocarpon*
- Pedicels tapering to the distal end; flowers not markedly fleshy, corolla lobes spreading or reflexed ..... 35
- 35 Mature fruit green or yellowish green; flowering and fruiting pedicels nodding or spreading ..... 36
- Mature fruit red or orange; fruiting pedicels erect; flowering pedicels nodding ..... 38
- 36 Inflorescence many times branched; sympodial units plurifoliate [PR; RS; SC] ..... *Solanum compressum*
- Inflorescence simple; sympodial units defoliate ..... 37

- 37 Leaf trichomes whitish in colour; sympodial units difoliate, not geminate; flowers fleshy; fruit glabrous [MG; PR; RS; SC] ..... *Solanum cassoides*
- Leaf trichomes beige or brownish in colour; sympodial units difoliate, geminate and anisophyllous; flowers membranous; fruit densely pubescent [MG; PR; RJ; SP] ..... *Solanum gnaphalocarpon*
- 38 Sympodial units di-or trifoliate; pubescence a mixture of simple and dendritic trichomes [PR; RS; SC; SP] ..... *Solanum delicatulum*
- Sympodial units defoliate; pubescence of only dendritic trichomes ..... 39
- 39 Leaves narrowly linear [SP] ..... *Solanum spissifolium*
- Leaves elliptic ..... 40
- 40 Trichomes reddish brown, 1–2 mm long, evenly distributed on both leaf surfaces [PR; SC; SP] ..... *Solanum kleinii*
- Trichomes whitish cream, 0.25–0.5 mm long, denser abaxially [plants from natural habitats, not cultivated; DF; ES; GO; MG; MS; MT; PR; RJ; RS; SC; SP] ..... *Solanum pseudocapsicum*
- 41 Leaf trichomes evenly distributed on both surfaces, always extending to the lamina abaxially ..... 42
- Leaf trichomes confined to the abaxial surfaces; often in tufts in the vein axils (if pubescence on upper surface then this very sparse and only along the midrib) ..... 44
- 42 Trichomes < 1 mm long, 1–2-celled, from broad multicellular bases, hooked; leaves scabrous [PR; RS; SC; SP] ..... *Solanum trachytrichium*
- Trichomes > 1 mm long, if less than 1 mm long then multi-celled, not hooked; leaves not scabrous ..... 43
- 43 Leaves only sparsely pubescent above; trichomes white, minute; pedicel with an expanded distal end; flowers fleshy, the corolla lobes spreading [MS; MT; RO] ..... *Solanum corumbense*
- Leaves evenly pubescent on both surfaces; trichomes translucent, to 2 mm long; pedicel filiform; flowers membranous, the corolla lobes reflexed [PR; SC; SP] ..... *Solanum apiahyense*
- 44 Pubescence evenly distributed over entire lower leaf surface ..... 45
- Pubescence confined to tufts in leaf vein axils or along the midrib ..... 46
- 45 Anthers unequal; pores never lengthening to slits [PR; RS; SC] ..... *Solanum reitzii*
- Anthers of equal size; pores lengthening to slits with age [MG; RJ; SP] ..... *Solanum intermedium*
- 46 Flowers > 1.5 cm in diameter, somewhat fleshy; corolla lobes spreading ..... 47
- Flowers < 1.5 cm in diameter, not markedly fleshy; corolla lobes reflexed or spreading ..... 50
- 47 Calyx lobes expanded and petaloid; pedicels tapering evenly from base to tip ..... 48
- Calyx lobes variously deltate or triangular, not petaloid or markedly expanded; pedicels with a swollen distal end ..... 49
- 48 Pedicels strongly winged, green [BA; ES; MG; RJ] ..... *Solanum warmingii*

- Pedicels terete, white [AL; BA; CE; ES; MA; MG; MS; MT; PB; PE; PI; PR; RJ; RN; SC; SE; SP] ..... *Solanum caavurana*
- 49 Leaf base abruptly attenuate [MS; MT; RO] ..... *Solanum corumbense*
- Leaf base acute [AC; AM; GO; MA; MG; MT; PA; RO; RR] ..... *Solanum leucocarpon*
- 50 Bark of older stems (not very new growth) pale white or yellowish green (especially when dry) ..... 51
- Bark of older stems (not very new growth) brown or grey, not yellowish green ..... 52
- 51 Stems with long multicellular trichomes; flowers with equal anthers and filaments; anther pores opening to slits [PR] ..... *Solanum gertii*
- Stems glabrous; flowers with unequal anthers and filaments; anther pores round [BA; ES; MG; PR; RJ; RS; SC; SP] ..... *Solanum pseudoquina*
- 52 Inflorescences elongate and filiform, with widely spaced pedicel scars ..... 53
- Inflorescences not elongate or filiform, the pedicel scars closely spaced or overlapping ..... 54
- 53 Leaf margins undulate (ruffled); flowers < 1 cm in diameter, the corolla lobes not markedly cucullate [ES] ..... *Solanum filirhachis*
- Leaf margins plane; flowers > 1 cm in diameter, the corolla lobes cucullate [AM; BA; CE; DF; ES; MA; MG; PA; PB; PE; PR; RJ; RR; RS; SC; SP] ..... *Solanum campaniforme*
- 54 Flowers congested at apex of inflorescence; pedicel scars overlapping; calyx lobes long triangular [MG; MT; PR] ..... *Solanum symmetricum*
- Flowers spaced along the inflorescence axis; pedicel scars closely spaced, but not markedly overlapping; calyx lobes deltate or spatulate ..... 55
- 55 Stems winged; calyx lobes spatulate; plants of south-eastern Brazil [BA] ..... *Solanum santosii*
- Stems terete; calyx lobes deltate; plants of the Amazon [AC; AM] ..... *Solanum nudum*

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# ***Heliotropium* (Boraginaceae) in the Marquesas Islands (French Polynesia) with description of a new species**

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## **Abstract**

During the preparation of the Vascular Flora of the Marquesas Islands a new endemic species of *Heliotropium* L. (Boraginaceae) has come to light and is described herein: *Heliotropium perlmanii* Lorence & W. L. Wagner. It is known only from the island of Eiao and appears most closely related to *H. marchionicum* Decne., also endemic to the Marquesas and known from Nuku Hiva. An amended description of *H. marchionicum* and key to separate the Marquesan species are given and their differences discussed.

## **Keywords**

*Heliotropium*, Boraginaceae, Marquesas Islands, French Polynesia

## **Introduction**

The Flora of the Marquesas Islands project is a collaborative program primarily between the Smithsonian Institution and the National Tropical Botanical Garden intended to further knowledge of the flora of this remote archipelago. In 1997 the first publications of new species and revisions of genera with at least one endemic species were initiated (Florence and Lorence 1997; Wagner and Lorence 1997). Since that time a series of publications has enumerated and revised a number of genera (for summary see Lorence and Wagner 2011). This treatment of the Marquesas species of *Heliotropium* L. is one

of the last precursor publications before finalizing the data in the online Flora of the Marquesas Islands website (Wagner and Lorence 2002–).

A number of recent studies utilizing both molecular and morphological analyses suggest that the traditional Boraginaceae s.l. should be split into a number of families (see Refulio-Rodriguez and Olmstead 2014 and other papers cited therein). One of the primary reasons for this is that the overall clade is comparable to other nearby clades in the phylogeny that are treated as orders in the classification (Gentianales, Lamiales, and Solanales). Therefore, the group is being restructured to be a series of families within an order Boraginales. This classification would elevate former subfamilies of Boraginaceae to the rank of family (i.e., Boraginaceae, Cordiaceae, Ehretiaceae, and Heliotropiaceae); keep Hydrophyllaceae at the rank of family, but it may need to be split into two families); and recognize two small families, Wellstediacae (formerly Boraginaceae) and Codonaceae (formerly Hydrophyllaceae). Refulio-Rodriguez and Olmstead (2014) point out that there are still a number of issues to resolve in the phylogeny of Boraginales that will affect the final classification of the clade. One issue is that one of the monophyletic groups, tribe Nameae of the Hydrophyllaceae, has no currently available family name. Since the overall new classification of the Boraginales requires further study to fully resolve, including proposal of at least one additional family, it seems premature to adopt it yet. For this reason we here use Boraginaceae in the broad sense for purposes of this contribution to the Flora of the Marquesas Islands project.

*Heliotropium* (Boraginaceae subfam. Heliotropoideae, or Heliotropiaceae of many authors) consists of 280 to 350 species of herbs, shrubs, lianas and small trees from the temperate and warm regions of the world, mostly in arid zones, with the greatest diversity in the New World (Diane et al. 2002; Luebert et al. 2011; Mabberley 2008; Wagner and Lorence 2002–). Molecular results using ITS1 demonstrated strong support for the Old World species of *Heliotropium* s. str., but there are no clear morphological characters separating them from their New World sister clade (Diane et al. 2002). The systematics of this group remains highly controversial due to the scarcity of informative reproductive characters, i.e. floral and fruit morphology, and variability in leaf morphology. Since Pacific species were not included in analyses by either Diane et al. (2002) or Luebert et al. (2011), putative origin and affinities of the Marquesan species are unclear and further investigations are necessary to demonstrate their precise relationships.

In the Marquesas Islands (SE Polynesia) only a single native species, *Heliotropium marchionicum* Decne. has been previously recorded (Brown 1935, Drake del Castillo 1893), the type of which was collected at an unknown locality on Nuku Hiva island by Le Bastard. Study of *Heliotropium* collections for preparation of the Vascular Flora of the Marquesas Islands has revealed that the collections from Eiao differ from *H. marchionicum* in a number of significant, non-overlapping morphological features including branching of the stems, indument, phyllotaxis, characters of the flowers, including the annular stigma overtopped by a sterile, conically elongated stigmatic column, and fruits (see key below). For this reason we recognize the collections from Eiao as a new species, *Heliotropium perlmanii*. Risk evaluation for determination of conservation sta-

tus was inferred using IUCN criteria for endangerment (IUCN 2001) based on best available information on suitable habitat and threats, primarily from personal observations by Jean-François Butaud (pers. comm. 2014).

## Systematics

### Key to Marquesas species of *Heliotropium*

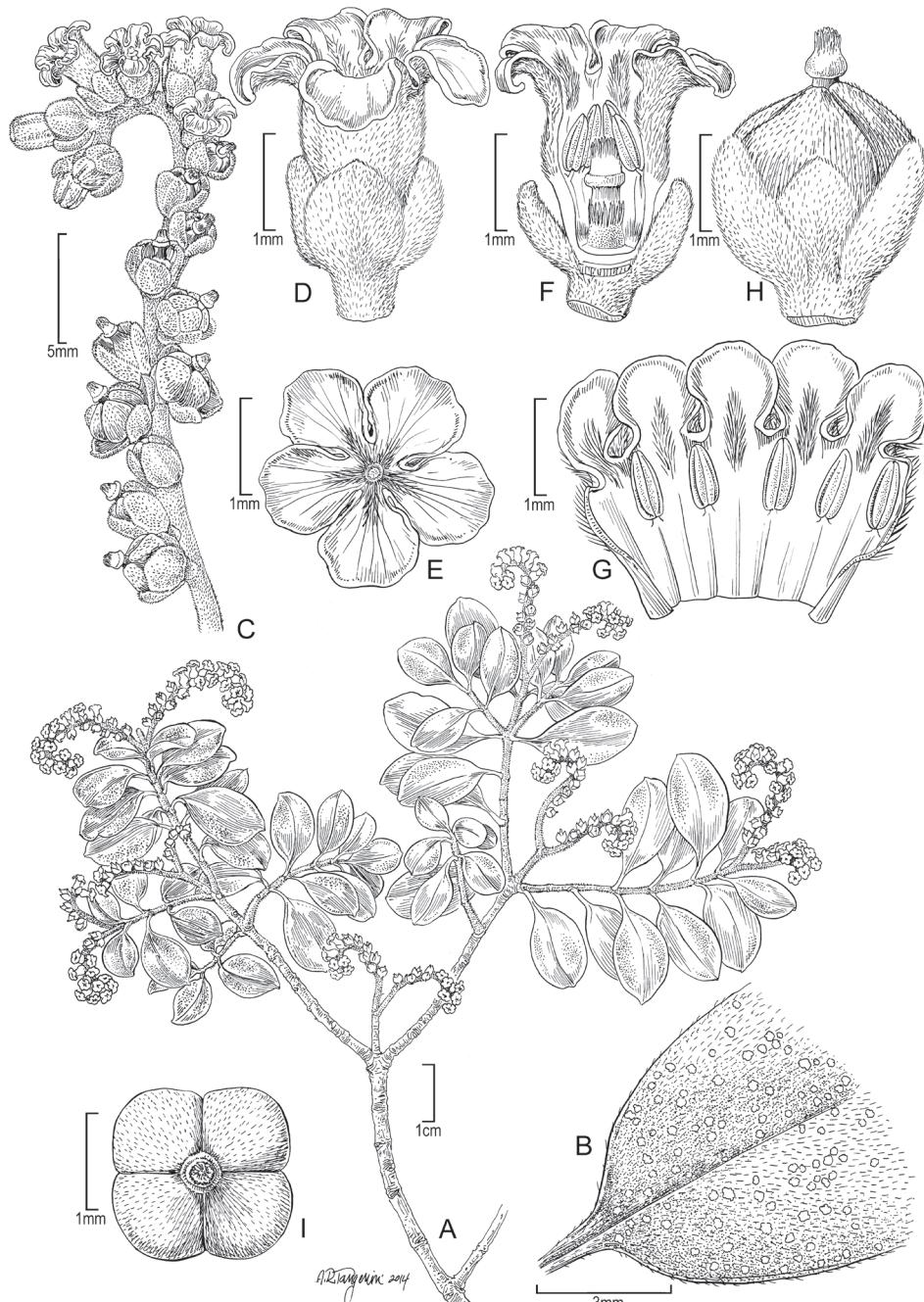
- 1 Stems virgately branched, with two subequal lateral branches developing adjacent to inflorescence; indument of trichomes 0.1–0.2 mm long; leaves opposite, blade with secondary veins obscure; calyx lobes unequal, 1–2 larger, ovate, 1–1.5 × 0.6–1 mm, 3–43 smaller, narrowly ovate to oblong, 1 × 0.3–0.4 mm; corolla 2 mm, tube 1–1.5 mm, lobes 0.5–0.7 × 0.5–0.7 mm; ovary glabrous except for ring of trichomes 0.2–0.3 mm long surrounding base of style; fruits 1 × 1.6 mm.....*H. perlmanii*
- Stems sympodially branched, with usually only a single lateral branch developing adjacent to inflorescence; indument of trichomes 0.2–0.5 mm long; leaves subopposite to alternate, blade with secondary veins visible; calyx lobes subequal, 1.7–2.2 × 0.7–1.2 mm; corolla 2.6–3.2 mm, tube 2.0–2.2 mm, lobes 1.2–1.7 × 0.8–1.3 mm mm; ovary densely strigillose; fruits 1.5–2 × 2 mm .....*H. marchionicum*

### *Heliotropium perlmanii* Lorence & W. L. Wagner, sp. nov.

urn:lsid:ipni.org:names:77145753-1

**Type.** Marquesas Islands. Eiao, north side of large valley which is south of Vaituha Valley, Opituha Valley. Sea cliffs, with *Heliotropium*, *Dodonaea*, *Cordia lutea*. Shrubs 1–2 ft. tall; flower; leaves smaller than Nuku Hiva plants; not silvery, 1050 ft [320 m], 7 Jul 1988, S. Perlman & J. Florence 10052 (Holotype PTBG 009229; Isotypes BISH, F, MO, P, PAP, US). Figure 1.

**Description.** **Shrubs** 30–60 cm tall, stems decumbent, virgately branched, with two subequal lateral branches developing adjacent to inflorescence; leafy stems 0.8–1.5 mm in diam., terete, brown, moderately shortly strigillose-canescens with white ascendant trichomes 0.1–0.2 mm long; older stems with peeling brown bark. **Leaves** opposite, blade elliptic to broadly elliptic or obovate-elliptic, 0.8–1.8 × 0.3–1.0 cm, apex obtuse to rounded, or occasionally truncate, usually apiculate, base acutely cuneate, sides slightly attenuate and decurrent, subcoriaceous to coriaceous and brown when dry, bright green when fresh, both surfaces moderately shortly strigillose with appressed trichomes 0.1–0.2 mm, pustular, venation obscure, 1–2 (–3) pairs secondary veins arising near base, petiole 2–4 mm long, 0.4–0.5 mm in diam., shortly strigillose. **Inflorescences** terminal, scorpioid-cymose, forked 1(–2) times, axes densely



**Figure 1.** *Heliotropium perlmanii* Lorence & WL Wagner **A** Habit **B** Upper leaf surface, **C** Inflorescence **D** Flower, lateral view **E** Corolla, face view **F** Flower, longitudinal section showing stamens and gynoecium **G** Corolla, sectioned to show stamens and indument, **H** Fruit and calyx, lateral view **I** Fruit showing 4 carpels. All figures drawn from Perlman & Florence 10052 (US) and photos from Falaise Est Eiao, 11 March 2007 courtesy of J-F Butaud.

shortly strigillose-canescens like the stems, 2–4 cm long, peduncle 0.5–0.8 cm long, primary axes 1.5–3 cm long. **Flowers** sessile to subsessile, 18–23 per axis, calyx lobes 5, unequal, 1–2 larger, ovate, 1–1.5 × 0.6–1 mm, 3–4 smaller, narrowly ovate to oblong, 1 × 0.3–0.4 mm, densely strigillose toward base, corolla shortly funnelform, 2 mm long, tube 1–1.5 mm long, externally densely villose-strigillose, internally slightly villosulous in throat, lobes 5, subcircular, 0.5–0.7 × 0.5–0.7 mm, margin crisped, stamens 5, attached midway in tube, basifixed, anthers ellipsoid, 0.5–0.6 mm long, apiculate; ovary cylindric-ovoid, glabrous except for ring of trichomes 0.2–0.3 mm long surrounding base of style, style terminal, 0.3 mm long, stigmatic column 0.3–0.4 mm long, cylindrical-conical, apex strigillose, base annular. **Fruit** broadly ovoid, 1 × 1.6 mm, shortly strigillose, shallowly 4-lobed, dry, splitting into 4 wedge-shaped nutlets. **Nutlets** 1.3–1.5 × 1–1.1 mm, dorsally strigillose, ventrally glabrous, brown.

**Distribution.** Marquesas Islands, known only from three collections made on Eiao.

**Habitat.** Grows on windward sea cliffs, with *Dodonaea viscosa* Jacq., *Cordia lutea* Lam., and *Bidens beckiana* (F. Br.) Sheriff.

**Conservation status.** Endangered (EN): B1ab (i, ii, iii) + 2ab (i, ii, iii): B2: total area of occupancy less than 500 km<sup>2</sup> (ca. 47 km<sup>2</sup>). B1a, severely fragmented; B1b (1–iii), habitat quality continuing decline inferred. The suitable habitat for *Heliotropium perlmanii* on Eiao (40 km<sup>2</sup>) is indicated as an endangered environment, threatened by feral animals and invasive plants, thus reducing the extent of the suitable habitat. Eiao has populations of feral sheep, pigs, cats, and rats (J.-F. Butaud, pers. comm. 2013).

**Etymology.** We are pleased to name this new species in recognition of rough-terrain botanist Steven P. Perlman (National Tropical Botanical Garden) in recognition of his contributions to our knowledge of the flora of the Pacific region. Steve collected the type specimen and in his label data noted several differences from *H. marchionicum*.

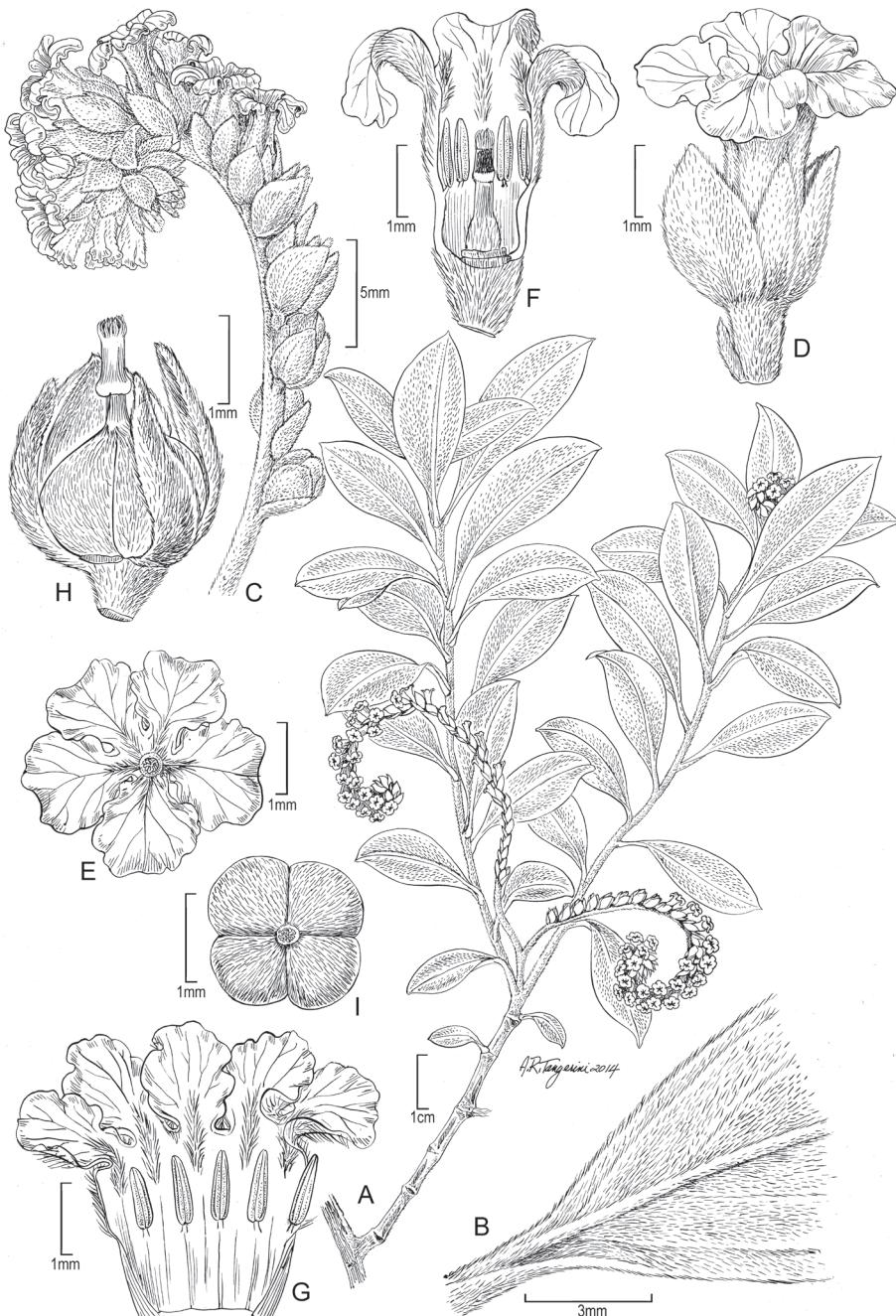
**Discussion.** Collections of this species were previously distributed as *H. marchionicum*, which differs by its non-virgate sympodial branching, more densely strigillose indument, larger leaves, and flowers about twice as large with corollas 2.6–3.2 mm long.

**Specimens examined.** Marquesas Islands. Eiao: 20 September 1922, R.H. Beck & W.B. Jones 1537 (A, BISH); NW side of island, Vaituha Bay and summit ridge of island 400 m elevation, 1 August 1977, B.H. Gagné 1295 (BISH).

### *Heliotropium marchionicum* Decne., Voy. Venus, Bot. [Alt.] 21. 1864.

**Type.** Iles Marquises [Marquesas Islands], Noukahiva [Nuku Hiva], “toutemanou”, pl. herbacee sur le sommet du montagne, Le Bastard 76 (Holotype P, digital image!). Figure 2.

**Description.** **Shrubs or suffrutescent perennials** 1–2 m tall, stems erect or decumbent, sympodially branched, with usually only a single lateral branch 30–120 cm long developing adjacent to inflorescence, terete, 1.5–3 mm diam., most parts densely silvery white strigillose with ascending white trichomes 0.2–0.5 mm long. **Leaves** subopposite to alternate, blade elliptic to narrowly elliptic or obovate-elliptic, 1–5 ×



**Figure 2.** *Heliotropium marchionicum* Decne. **A** Habit **B** Upper Leaf surface **C** Inflorescence **D** Flower, lateral view **E** Corolla, face view **F** Flower, longitudinal section showing stamens and gynoecium **G** Corolla, sectioned to show stamens and indument **H** Fruit and calyx, lateral view **I** Fruit showing 4 carpels. Drawn from Perlman 10005 (US) and photos from Nuku Hiva, 24 February 2007 [A], Mercier 1847 (US) and photos from Nuku Hiva, 24 February 2007 courtesy of J-F Butaud [B–I].

0.5–1.5 cm, apex acute, obtuse or rounded, often apiculate, base acute to narrowly cuneate, sometimes attenuate, chartaceous to subcoriaceous, both surfaces strigillose to densely white strigillose with appressed white trichomes 0.2–0.4 mm long, smooth or sometimes pustular, secondary veins 2–3 pairs arising in basal half of lamina; petiole 3–15 mm. **Inflorescences** terminal and later displaced by growth of one axillary bud, or sometimes leaf-opposed, scorpioid-cymose, densely white strigillose as for stems and leaves, 4–7 cm long, forked once, peduncle 1–2 cm long, primary branches 2.5–7 cm long, each with 17–35 flowers. **Flowers** sessile or subsessile, calyx lobes 5, densely white strigillose, free to the base, subequal, ovate to lanceolate, 1.7–2.2 × 0.7–1.2 mm, acute to acuminate; corolla shortly funneliform, 2.6–3.2 mm, tube 2.0–2.2 mm, externally strigillose except at base, internally with pubescent lines below the lobes, lobes 5, subcircular, 1.2–1.7 × 0.8–1.3 mm × 0.8 mm, margins crisped, dorsally strigillose medially; stamens 5, attached below middle of tube, basifixated, anthers linear-oblong, 0.6–0.7 mm long, glabrous, not connate; ovary ovoid, densely strigillose, 0.5 mm long, style terminal, 0.3–0.6 mm long, glabrous, stigmatic column 0.4–0.5 mm, cylindrical-conical, papillose, apex strigillose, base annular. **Fruit** broadly ovoid, 1.5–2.0 × 2.0 mm, shallowly 4-lobed, externally strigillose, dry, splitting into 4 wedge-shaped nutlets. **Nutlets** 1.4–1.6 × 0.8–1.0 mm, apiculate, dorsally densely strigillose, ventrally glabrous, dark brown.

**Distribution.** Marquesas Islands, known only from Nuku Hiva.

**Habitat.** This species usually occurs inland on basaltic cliffs and dry ridges, sometimes near waterfalls, in dry land forest with *Sapindus saponaria* L., *Cerbera manghas* L., and introduced invasive species including *Tecoma stans* (L.) Kunth and *Leucaena leucocephala* (Lam.) De Wit. The label on one collection notes it is a low elevation littoral plant (Brown 542, BISH).

**Conservation status.** Proposed IUCN Red List Category Endangered (EN): B1ab (i, ii, iii) + 2ab (i, ii, iii): B2: total area of occupancy less than 500 km<sup>2</sup> (ca. 50 km<sup>2</sup>). B1a, severely fragmented; B1b (1–iii), habitat quality continuing decline inferred. The suitable habitat for *Heliotropium marchionicum* on Nuku Hiva (ca. 340 km<sup>2</sup>) is indicated as an endangered environment, threatened by human activity (deforestation), feral animals, and invasive plants, thus reducing the extent of the suitable habitat.

**Discussion.** *Heliotropium marchionicum* is apparently closely related to *H. pernambucum* but differs by the characters noted above. A single collection from Taiohae, Nuku Hiva (Florence 8394, BISH, CHR, K, NY, P, US) resembles *H. marchionicum* superficially but differs in having stems and petioles pilose with hairs to 1 mm long, inflorescence axis pilose, very small flowers (calyx lobes 1–1.1 mm long, corolla 1.1–1.3 mm long) and ribbed fruits 1.1–1.2 × 1.8 mm, covered with bulbous-tuberculate scales, splitting into 4 nutlets. Further collections are needed to determine whether it represents an undescribed taxon or alternatively a naturalized species. It closely resembles *H. angiospermum* Murr., native to North America and the Caribbean and was identified by M. Strong (US) as this species.

**Specimens examined.** Marquesas Islands. Nuku Hiva: Hakaui, 20 July 1921, F.B.H. Brown 542 (BISH); Moyenne vallée de Hakaui, flanc droit, 125 m, latitude

08°54'S, longitude 140°10'W, 18 May 1984, J. Florence 6695 (BISH, P); Hakaui Valley, 107 m elevation, 26 June 1988, S. P. Perlman 10005 (AD, BISH, F, MO, MU, NY, OS, P, PAP, PTBG, US); Matatekouaehi Valley, about 2 miles in from coast, by 100 ft. waterfall, 1 July 1988, S. P. Perlman 10026 (BISH, PTBG, US); Taiohae, flanc gauche de la baie, S du CJA, 150 m, latitude 08°56'S, longitude 140°05'W, 26 Jul 1987, J. Florence 8394 (BISH, CHR, K, NY, P, US), W shore, 200 m elevation, 20 Oct 1922, W.B. Jones 1591 (BKL); slope on ridge, 18 Oct 1922, E.H. Quayle 1591 (A, BISH); without precise locality, 1841, R. Hinds s.n. (P), Mathias 96 (GH), 1847, M.P. Mercier s.n. (P, US).

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# Plant endemism in the Sierras of Córdoba and San Luis (Argentina): understanding links between phylogeny and regional biogeographical patterns<sup>1</sup>

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## Abstract

We compiled a checklist with all known endemic plants occurring in the Sierras of Córdoba and San Luis, an isolated mountainous range located in central Argentina. In order to obtain a better understanding of the evolutionary history, relationships and age of the regional flora, we gathered basic information on the biogeographical and floristic affinities of the endemics, and documented the inclusion of each taxon in molecular phylogenies. We listed 89 taxa (including 69 species and 20 infraspecific taxa) belonging to 53 genera and 29 families. The endemics are not distributed evenly, being more abundant in the lower than in the middle and upper vegetation belts. Thirty-two genera (60.3%) have been included in phylogenetic analyses, but only ten (18.8%) included local endemic taxa. A total of 28 endemic taxa of the Sierras CSL have a clear relationship with a widespread species of the same genus, or with one found close to the area. Available phylogenies for some taxa show divergence times between 7.0 – 1.8 Ma; all endemic taxa are most probably neoendemics *sensu* Stebbins and Major. Our analysis was specifically aimed at a particular geographic area, but the approach of analyzing phylogenetic patterns together with floristic or biogeographical relationships of the endemic taxa of an area, delimited by clear geomorphological features, could reveal evolutionary trends shaping the area.

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<sup>1</sup> Dedicated to Dr. Luis Ariza Espinar, Emeritus Curator of the Museo Botánico de Córdoba (CORD), connoisseur and expert on the flora of Central Argentina.

## Resumen

Se presenta una lista comentada de todas las especies endémicas conocidas de las Sierras de Córdoba y San Luis, una región montañosa aislada del centro de Argentina. A fin de obtener una mejor comprensión de la historia evolutiva, relaciones y edad de la flora regional, recopilamos información básica sobre afinidades florísticas y biogeográficas de las endémicas, y relevamos su inclusión en estudios filogenéticos moleculares. El listado incluye 89 taxones (69 species y 20 taxones infraespecíficos), pertenecientes a 53 géneros y 29 familias. La distribución altitudinal de los endemismos no es uniforme, ya que el piso de vegetación inferior tiene más taxones endémicos que los pisos intermedio y superior. Treinta y dos géneros (60.3%) han sido incluidos en algún análisis filogenético, pero sólo 10 de ellos (18.8%) incluyeron taxones locales. Un total de 28 taxones endémicos de las Sierras CSL tienen una clara relación con una especie de amplia distribución del mismo género, o con una de distribución cercana al área. Las filogenias disponibles para algunos taxones muestran tiempos de divergencia entre 7.0 – 1.8 Ma; todos los endemismos del área son probablemente neoendemismos *sensu* Stebbins y Major. Aunque nuestro análisis estaba dirigido específicamente a un área geográfica particular, el enfoque de analizar patrones filogenéticos junto con relaciones florísticas y biogeográficas de los endemismos de un área delimitada por características geomorfológicas, podría revelar las tendencias evolutivas que modelaron el área.

## Keywords

Argentina, Sierras of Córdoba and San Luis, endemics, phylogenies

## Palabras clave

Argentina, Sierras de Córdoba y San Luis, endemismos, filogenias

## Introduction

### Why are endemic taxa important?

‘*The study and precise interpretation of the endemism of a territory constitute the supreme criterion, indispensable for arriving at any conclusions regarding the origin and age of its plant population. It enables us better to understand the past and the transformations that have taken place. It also provides us with a means of evaluating the extent of these transformations, the approximate epoch when they occurred, and the effects which they produced on the development of the flora and the vegetation*’ (Braun-Blanquet 1923: 223). Although many studies have dealt with the origin, classification and biology of endemism (e.g. Stebbins and Major 1965, Kruckeberg and Rabinowitz 1985, Hobhom 2013), this simple sentence by Josias Braun-Blanquet (1884–1980) illustrates well how some basic good definitions last through time. The study of plant endemism is important because it could improve our knowledge of the flora of a region in at least two different respects, which are briefly discussed below.

### Biogeography and evolution

The first aspect, perhaps the most traditional, has to do with biogeography and evolution of plants. The work of Stebbins and Major (1965) on the endemics of California outlined

the basic elements to analyze when dealing with the endemic flora of a region: a) the floristic affinities and distribution of the endemics; b) the relationships of the endemic species with congeners (particularly for widely distributed taxa); c) the availability of a fossil record; and d) the use of genetic data to differentiate *paleo-* from *neo-endemism*.

These two concepts, paleo and neoendemic (Stebbins and Major 1965) apply to: a) ancient vestiges of taxa that were once more widespread, with their present distribution being a relict resulting of the reduction of their original habitats over time (paleoendemics); and b) relatively young species have only recently diverged from a parental entity, usually a widespread species (neoendemics).

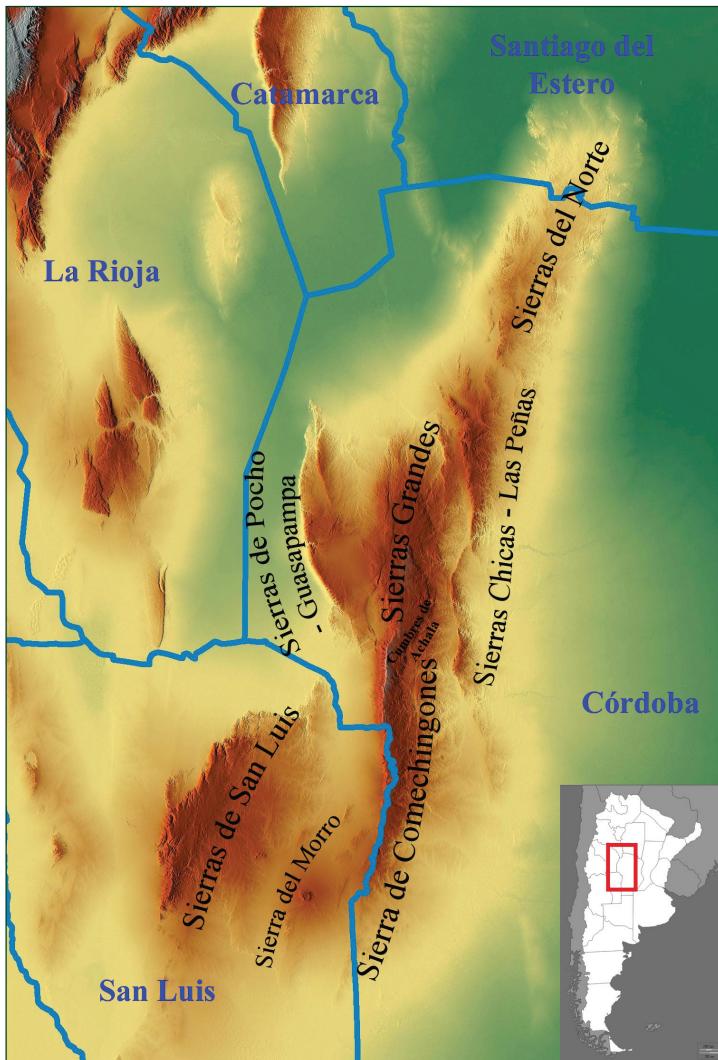
The concepts of floristic affinities and fossil record availability have still more or less the same meaning as in the 1960's, but today genetic data often provides a phylogenetic or phylogeographic context; these disciplines have matured into essential tools to understand evolutionary processes.

Biogeography counts the study of endemics and its distribution as one of its main subjects, since the existence of endemic taxa is related to geographic areas (Crisp et al. 2001). Both endemic taxa and restricted geographic areas are part of the same concept – i.e. taxa are considered endemic when they occur in a restricted area (Anderson 1994). Many studies have focused on the detection of areas of endemism (e.g. Myers et al. 2000, Crisp et al. 2001, Murray-Smith et al. 2009); a substantial number of endemic species in a geographical region often correlates with age and isolation of the area as these factors influence both the evolution (the formation and development of new taxa) and survival (the permanence of endemic relicts) (Lesica et al. 2006).

## Conservation

How should policy makers set priorities for conservation? Narrow endemic taxa often have priority in setting conservation policies (Chaplin et al. 2000) because narrow endemic plants are by definition rare, and in consequence face higher extinction risk due to environmental change (Crisp et al. 2001). Although there is controversy about what should be conserved, areas with high numbers of endemic species (hot spots) are often a preferred object of conservation policies and strategies because they offer the best reward for investment in conservation (Myers et al. 2000, Lamoreux et al. 2006, Ferreira and Boldrini 2011). But while Myers et al. (2000) defined 25 major biodiversity hotspots, and some have been well studied, e.g. the Brazilian Atlantic forest (Tabarelli et al. 1999, Morellato and Haddad 2000), there is still very little information on areas other than these 25 'major' biodiversity hotspots, even though these are areas with fewer, but still a substantial number of, endemic species.

Among all biotas, mountainous regions are especially rich in plant endemic species with restricted distribution, since those areas represent discontinuities in soil conditions and topography that promote differentiation in plant populations (Kruckeberg and Rabinowitz 1985; Lesica et al. 2006). The Sierras of Córdoba and San Luis ("Sierras CSL") represents such an area, extending ca. 550 km in NE-SW length and about



**Figure 1.** Map of the Sierras of Córdoba and San Luis (Sierras CSL).

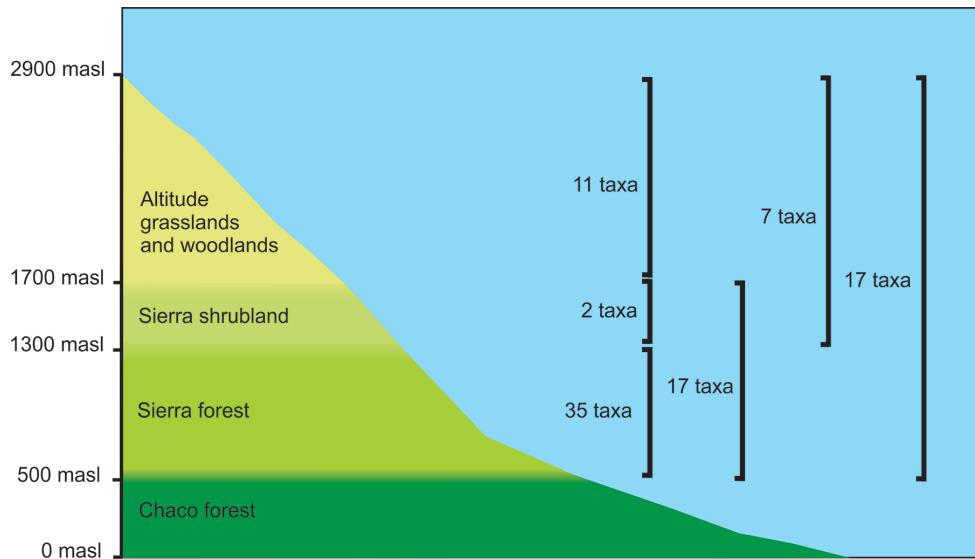
110 km width, with the highest point represented by the Cerro Champaquí (2790 m). Sierras CSL are located in the center of Argentina, between 29° and 33°S, mostly in Córdoba and San Luis Provinces, except for a small northern portion extending into the neighboring province of Santiago del Estero (Fig. 1). With an overall northeast-southwest orientation and composition of Precambrian metamorphic blocks, the Sierras CSL are older than the Andes; they rise above Pampa plains of Quaternary origin (Baldo et al. 1996), and comprise six main sections (from north to south): *Sierras del Norte*, *Sierras Chicas-Las Peñas*, *Sierras Grandes-Sierra de Comechingones*, *Sierras de Pocho-Guasapampa*, *Sierra de San Luis* and *Sierra del Morro* (Fig. 1) (Carignano 1999).

Biogeographically, the flora of the Sierras CSL belongs to the Chaco Province of the Chacoan subregion (Morrone 2006); this is mainly xerophytic forest with shrubs and trees up to 15 m high (Cabrera and Willink 1980; Prado 1993a, b; Giorgis et al. 2011). Luti et al. (1979) described three main altitudinal vegetation belts for the Sierras CSL: the sierra forest, between 500 and 1300 meters above sea level; the sierra shrubland, between 1300 and 1700 meters; and finally, the altitude grasslands and woodlands, from 1700 meters upwards (Fig. 2). The upper belt is floristically different from the other two and shows affinities with Andean and Patagonian floristic elements (Cabido et al. 1998; Prado 1993a) and contains several endemics restricted to this altitude (Cabido et al. 1998). Of the three vegetation belts, the lower is the most exposed to anthropogenic threats because it lies close to the second largest city of Argentina (Córdoba); the attractive landscapes of the Sierras are also a preferred holiday destination in the country. Additional anthropogenic disturbances include fires and livestock grazing (Cingolani et al. 2013).

The implementation of conservation strategies needs in the first case basic information on the taxa object of potential conservation. Since previous works hinted at many endemic taxa present in the Sierras CSL (Cabido et al. 1998, Cantero et al. 2011, Oggero and Arana 2012), but specific evaluation of the endemic taxon richness of the Sierras CSL has not been done, we compiled a critical list of all species and infraspecific taxa endemic to the region. We then assessed the inclusion of the listed endemic taxa in molecular phylogenetic studies, as a means to estimate the evolutionary history of each studied taxon, specifically verifying relationships and divergence times (when available).

## Methods

We compiled a list using online resources, in particular Zuloaga et al. (2008) (updated to December 2014; <http://www2.darwin.edu.ar/Proyectos/FloraArgentina/FA.asp>) and the database of endemic plants of Argentina (<http://www.lista-planear.org>). We verified both the endemic status and the distribution of each taxon restricted to the Sierras CSL as defined by a cut-off altitude limit of 200 m. (i.e. endemic taxa from Córdoba and/or San Luis provinces found below this elevational limit were excluded from the list). Verification of taxa also included checking the validity of names and common synonyms; since estimates of biodiversity relies upon counting species names, including synonyms or *nomina dubia* would affect estimates of endemism (Alroy 2002). After this validation, we searched for information for each taxon regarding: 1) distribution, including altitudinal range; 2) life-form; 3) number of species in the genus; 5) inclusion in a molecular phylogenetic study; and 6) relationship to a widespread taxon of the same genus.



**Figure 2.** Vegetation belts in Sierras CSL.

## Results

Of the relevant elements for studying endemism recognized by Stebbins and Major (1965), only the floristics of the Sierras CSL has been well studied (Cabido et al. 1987, 1998; Giorgis et al. 2011 and references therein), while the currently known fossil record is too sparse to be useful for studies of current vegetation (Leguizamón 1972, Balarino and Gutiérrez 2006). We list 89 taxa (69 species and 20 infraspecific taxa, belonging to 53 genera and 29 families), which are found only in the provinces of Córdoba and San Luis at elevations above 200 m. Distribution, elevation and life form of each taxon are summarized in Table 1. The genus with the most endemics is *Gymnocalycium*, with 16 taxa. *Aristida*, *Gomphrena*, *Hieracium*, *Nassella*, *Portulaca*, *Siphocampylus*, *Senecio* and *Solanum* have 3 endemic taxa; *Grindelia*, *Hysterionica*, *Nothoscordum*, *Poa*, and *Valeriana* have 2 endemic taxa and the remaining genera each have one taxon.

### Checklist of the endemic taxa of the Sierras of Córdoba and San Luis

All vouchers listed are from Argentina. Province (Córdoba, San Luis or Santiago de Estero) and Departamento (Dept.) are detailed for each where data are available.

#### ALLIACEAE

***Nothoscordum achalense*** Ravenna, Onira 3: 1. 1990.

Voucher: Hunziker, A. T. 12919, Prov. Córdoba, Depto. San Alberto, Sierra Grande, Pampa de Achala, en las inmediaciones de Monolito, 31°41'29"S, 65°6'5"W, (CORD)



**Figure 3.** Representative endemic taxa of the Sierras CSL. (Clockwise) *Aa achalensis*, *Poa stuckertii*, *Acanthocalycium spiniflorum*, *Gymnocalycium monvillei*, *Gymnocalycium andreae*, *Valeriana ferax*, *Escallonia cordobensis*, *Siphocampylus foliosus* var. *glabratius*.

**Table 1.** List of endemic species and infraspecific taxa of the Sierras of Córdoba and San Luis. *Distribution by Province D:* Córdoba: 1; San Luis: 2; Santiago del Estero: 3. *Life Form LF:* A-annual herb; P-perennial herb; S-shrub; SL-shrublet; V-perennial vine; SU-succulent, E-epiphytic.

	<b>Family</b>	<b>Species</b>	<b>D</b>	<b>Elevation</b>	<b>LF</b>
1	Alliaceae	<i>Nothoscordum achalense</i> Ravenna	1	1000–1800	P
2	Amaranthaceae	<i>Alternanthera pumila</i> O Stützer	1	1000–2000	P
3	Amaranthaceae	<i>Gomphrena colosacana</i> Hunz. & Subils var. <i>andersonii</i> Subils & Hunz.	2	500–1000	SL
4	Amaranthaceae	<i>Gomphrena pulchella</i> Mart. subsp. <i>rosea</i> (Griseb.) Pedersen	1,2	500–1000	P
5	Amaranthaceae	<i>Gomphrena pulchella</i> Mart. var. <i>bonariensis</i> (Moq.) Pedersen	2	0–500	P
6	Amaryllidaceae	<i>Habranthus sanavirone</i> Roitman, A. Castillo, G. Tourn. & Uria	1	700–900	P
7	Amaryllidaceae	<i>Zephyranthes longistyla</i> Pax	1, 2, 3	1000–1500	P
8	Apiaceae	<i>Eryngium agavifolium</i> Griseb.	1, 2, 3	500–1000	P
9	Asteraceae	<i>Grindelia cabrerae</i> Ariza var. <i>alatocarpa</i> Ariza	1	0–500	SL
10	Asteraceae	<i>Grindelia globularifolia</i> Griseb.	1	2000–2200	SL
11	Asteraceae	<i>Helenium argentinum</i> Ariza	1, 2, 3	200–1000	P
12	Asteraceae	<i>Hieracium achalense</i> Sleumer	1, 2	1000–2200	P
13	Asteraceae	<i>Hieracium cordobense</i> Sleumer	1, 2	1000–2000	P
14	Asteraceae	<i>Hieracium criniceps</i> Sleumer	1	1500–3000	P
15	Asteraceae	<i>Hypochaeris caespitosa</i> Cabrera	1, 2	1000–2500	P
16	Asteraceae	<i>Hysterionica dianthifolia</i> (Griseb.) Cabrera var. <i>dianthifolia</i>	1	2000–3000	SL
17	Asteraceae	<i>Hysterionica dianthifolia</i> (Griseb.) Cabrera var. <i>pulvinata</i> (Cabrera) Ariza	1	2000–2500	SL
18	Asteraceae	<i>Isostigma cordobense</i> Cabrera	1	500–1000	SL
19	Asteraceae	<i>Mutisia castellanossii</i> Cabrera var. <i>comechingoana</i> Ariza	1	0–500	V
20	Asteraceae	<i>Senecio achalensis</i> Cabrera	1	1700–2800	SL
21	Asteraceae	<i>Senecio fragantissimus</i> Tortosa & A.Bartoli	2	800	S
22	Asteraceae	<i>Senecio retamensis</i> Cabrera	1, 2	2200–2800	SL
23	Asteraceae	<i>Soliva trinifolia</i> Griseb.	1		A
24	Asteraceae	<i>Trichocline plicata</i> Hook. & Arn.	1, 2	1000–3000	P
25	Berberidaceae	<i>Berberis hieronymi</i> C.K.Schneid	1	1000–2000	S
26	Brassicaceae	<i>Mostacillastrum carolinense</i> (Scappini, C.A.Bianco & Prina) Al-Shehbaz	2	1500–1700	SL
27	Bromeliaceae	<i>Tillandsia xiphoides</i> Ker Gawl. var. <i>minor</i> L.Hrom.	1, 2	1000–1500	E
28	Cactaceae	<i>Acanthocalycium spiniflorum</i> (K Schum) Backeb.	1, 2	1000–1500	SU
29	Cactaceae	<i>Gymnocalycium achirasense</i> H.Till & Schatzl ex H.Till	1, 2	500–1000	SU
30	Cactaceae	<i>Gymnocalycium andreae</i> (Boed) Backeb	1	1500–2500	SU
31	Cactaceae	<i>Gymnocalycium bruchii</i> (Speg) Hosseus	1, 2	1000–2000	SU
32	Cactaceae	<i>Gymnocalycium calochlorum</i> (Boed) Y.Itô	1	500–1500	SU
33	Cactaceae	<i>Gymnocalycium capillense</i> (Schick) Hosseus	1	500–1500	SU
34	Cactaceae	<i>Gymnocalycium carolinense</i> (Neuhuber) Neuhuber	2	1500–2000	SU
35	Cactaceae	<i>Gymnocalycium castellanosii</i> Backeb. subsp. <i>ferocius</i> (H.Till & Amerhauser) Charles	1	500–700	SU
36	Cactaceae	<i>Gymnocalycium erinaceum</i> J.G.Lamb.	1	500–1500	SU
37	Cactaceae	<i>Gymnocalycium gibbosum</i> (Haworth) Pfeiffer ex Mittler subsp. <i>borthii</i> (Koop ex H.Till) Charles	2	500–800	SU
38	Cactaceae	<i>Gymnocalycium horridispinum</i> Frank ex H.Till	1	500–700	SU

	<b>Family</b>	<b>Species</b>	<b>D</b>	<b>Elevation</b>	<b>LF</b>
39	Cactaceae	<i>Gymnocalycium monvillei</i> (Lem) Britton & Rose	1, 2	500–2000	SU
40	Cactaceae	<i>Gymnocalycium mostii</i> (Gürke) Britton & Rose subsp. <i>mostii</i>	1	500–1000	SU
41	Cactaceae	<i>Gymnocalycium mostii</i> (Gürke) Britton & Rose subsp. <i>valnicekianum</i> (Jajó) Meregalli & Charles	1	500–1000	SU
42	Cactaceae	<i>Gymnocalycium neuhuberi</i> H.Till & W.Till	2	500–1500	SU
43	Cactaceae	<i>Gymnocalycium quehlianum</i> (F Haage ex Quehl) Vaupel ex Hosseus	1	500–1000	SU
44	Cactaceae	<i>Gymnocalycium robustum</i> R Kiesling, O.Ferrari & Metzing	1	0–500	SU
45	Campanulaceae	<i>Siphocampylus foliosus</i> Griseb. var. <i>glabratus</i> E.Wimm	1	1000–1500	SL
46	Campanulaceae	<i>Siphocampylus foliosus</i> Griseb. var. <i>minor</i> Zahlbr.	1	500–1500	SL
47	Campanulaceae	<i>Siphocampylus lorentzii</i> E.Wimm.	1	500–1500	SL
48	Caryophyllaceae	<i>Cerastium argentinum</i> (Pax) F.N.Williams	1		P
49	Cyperaceae	<i>Carex monodynema</i> (Griseb.) G.A.Wheeler	1	2600–2900	P
50	Escalloniaceae	<i>Escallonia cordobensis</i> (Kuntze) Hosseus	1, 2	1000–2500	S
51	Fabaceae	<i>Adesmia cordobensis</i> var. <i>appendiculata</i> Ulibarri & Burkart	2	900–1100	SL
52	Fabaceae	<i>Apurimacia dolichocarpa</i> (Griseb.) Burkart	1	1800–3000	S
53	Fabaceae	<i>Astragalus parodii</i> I.M.Johnst.	1	1000–2500	P
54	Fabaceae	<i>Mimosa cordobensis</i> Ariza	1	0–500	S
55	Fabaceae	<i>Prosopis campestris</i> Griseb.	1, 2	500–2000	S
56	Fabaceae	<i>Sophora linearifolia</i> Griseb.	1, 2	1000–1500	SL
57	Gencianaceae	<i>Gentianella parviflora</i> (Griseb) T.N.Ho	1	1500–2500	A
58	Geraniaceae	<i>Geranium parodii</i> I.M.Johnst.	1, 2	1800–2600	P
59	Iridaceae	<i>Calydorea undulata</i> Ravenna	1	800–1000	P
60	Loasaceae	<i>Blumenbachia hieronymi</i> Urb.	1, 2	1900–2500	A
61	Malvaceae	<i>Sphaeralcea cordobensis</i> Krapov.	1, 2, 3	500–1000	SL
62	Orchidaceae	<i>Aa achalensis</i> Schltr.	1, 2	1500–2500	P
63	Plantaginaceae	<i>Plantago densa</i> (Pilg.) Rahn	1, 2	100–1800	P
64	Poaceae	<i>Aristida minutiflora</i> Caro var. <i>glabriflora</i> Caro	1, 2	500–1000	P
65	Poaceae	<i>Aristida multiramea</i> Hack.	1, 2	0–1000	P
66	Poaceae	<i>Aristida sayapensis</i> Caro	2	500–1000	P
67	Poaceae	<i>Cenchrus rigidus</i> (Griseb.) Morrone	1, 2	100–800	P
68	Poaceae	<i>Danthonia melanathera</i> (Hack.) Bernardello	1, 2	1200	P
69	Poaceae	<i>Melica decipiens</i> Caro	1, 2	1500–200	P
70	Poaceae	<i>Nassella hunzikeri</i> (Caro) Barkworth	1, 2	900–1500	P
71	Poaceae	<i>Nassella nidulans</i> (Mez.) Barkworth	1, 2	500–1500	P
72	Poaceae	<i>Nassella stuckertii</i> (Hack.) Barkworth	1	500–1500	P
73	Poaceae	<i>Poa hubbardiana</i> Parodi	1, 2	1400–2100	P
74	Poaceae	<i>Poa stuckertii</i> (Hack.) Parodi	1, 2	500–1500	P
75	Poaceae	<i>Trichloris pluriflora</i> E.Fourn. f. <i>macra</i> Hack.	1	500–1100	P
76	Poaceae	<i>Tridens nicorae</i> Anton	1, 2	1500	P
77	Portulacaceae	<i>Portulaca confertifolia</i> Hauman var. <i>cordobensis</i> D.Legrand	1, 2	500–1000	P
78	Portulacaceae	<i>Portulaca obtusifolia</i> D.Legrand var. <i>obtusifolia</i>	1	0–500	P
79	Portulacaceae	<i>Portulaca ragonesei</i> D.Legrand	1	200–400	P
80	Rosaceae	<i>Geum brevicarpellatum</i> F.Bolle	1	500–1500	P

	<b>Family</b>	<b>Species</b>	<b>D</b>	<b>Elevation</b>	<b>LF</b>
81	Rubiaceae	<i>Borreria eryngioides</i> Cham & Schlecht. var. <i>ostenii</i> (Standl.) E.L.Cabral & Bacigalupo	1, 2	500–1000	P-SL
82	Rubiaceae	<i>Richardia coldenioides</i> Rusby	1	2700	P
83	Solanaceae	<i>Solanum concarense</i> Hunz.	2	500–1000	P
84	Solanaceae	<i>Solanum natum</i> C.V.Morton	1	0–1000	P
85	Solanaceae	<i>Solanum restrictum</i> C.V.Morton	1	500–1500	P
86	Valerianaceae	<i>Valeriana ferax</i> (Griseb) Höck	1	2100–2300	P
87	Valerianaceae	<i>Valeriana stuckertii</i> Briq.	1, 2	1000–2500	P
88	Verbenaceae	<i>Junellia bisulcata</i> (Hayek) Moldenke var. <i>campestris</i> (Griseb.) Botta	1, 3	1000–2000	S
89	Verbenaceae	<i>Parodianthus capillaris</i> Tronc.	1	0–500	S

## AMARANTHACEAE

***Alternanthera pumila*** O. Stützer, Repert. Spec. Nov. Regni Veg. Beih. 88: 45. 1935.

Syn.: *Alternanthera pumila* O. Stützer var. *coarctata* O. Stützer.

Voucher: *Cantero, J. J. 6315*, Prov. Córdoba, Depto. Río Cuarto, Achiras (Monte Guazú), 33°2'36"S, 64°59'25"W, (CORD)

***Gomphrena colosacana*** Hunz. & Subils var. ***andersonii*** Subils & Hunz., Hickenia 1: 71, fig. 1A, B. 1977.

Voucher: *Chiapella, J. 1486*, Prov. San Luis, Depto. Belgrano, camino de acceso al Parque Nacional Sierra de Las Quijadas, a 3 km de la Ruta n° 147, antes de Huatarán, 32°29'S, 67°0'60"W, (CORD)

***Gomphrena pulchella*** Mart var. ***bonariensis*** (Moq.) Pedersen, Darwiniana 20 (1–2): 292. 1976.

Voucher: *Vignati, M. A. 143*, Prov. San Luis, Depto. La Capital, (LP)

***Gomphrena pulchella*** Mart subsp. ***rosea*** (Griseb.) Pedersen, Darwiniana 20 (1–2): 292. 1976.

Syn.: *Gomphrena perennis* L. var. *rosea* Griseb.; *Gomphrena rosea* Griseb.

Voucher: *Nicora, E. G. 1858*, Prov. Córdoba, Depto. Colón, (SI)

## AMARYLLIDACEAE

***Habranthus sanavirone*** Roitman, J. A. Castillo, G. M. Tourn & Uria, Novon 17(3): 393, fig. 1. 2007.

Voucher: *Roitman, G. s.n*, Prov. Córdoba, Depto. Cruz del Eje, San Marcos Sierras, (BAA)

***Zephyranthes longistyla*** Pax, Bot. Jahrb. Syst. 11: 323. 1891.

Voucher: Romanutti, A. 198, Prov. Córdoba, Depto. Punilla, Quebrada del Condorito, en el sendero hacia la Quebrada, 31°37'34"S, 64°42'22"W, (CORD)

## APIACEAE

***Eryngium agavifolium*** Griseb., Abh. Königl. Ges. Wiss. Göttingen 19: 155. 1874.  
Voucher: *Ariza Espinar, L.* 3222, Prov. Córdoba, Depto. Punilla, camino a las Altas Cumbres, yendo hacia El Cóndor, unos 6 km después de Puesto Pedernera, (CORD)

## ASTERACEAE

***Grindelia cabreræ*** Ariza var. ***alatocarpa*** Ariza, Kurtziana 20: 170. 1989.  
Voucher: *Chiarini, F.* 1049, Córdoba, Depto., San Justo, 30°56'22"S, 62°53'1"W, (CORD)

***Grindelia globularifolia*** Griseb., Symb. Fl. Argent. 178. 1879.  
Voucher: *Cerana, M. M.* 1806, Prov. Córdoba, Depto. Punilla, Los Gigantes, 31°11'55"S, 64°35'1"W, (CORD)

***Helenium argentinum*** Ariza, Phytochemistry 31(5): 1626. 1992.  
Voucher: *Cantero, J. J.* 5618, Córdoba, Depto. Río Cuarto, El Cóndor, 31°7'55"S, 64°46'47"W, (CORD)

***Hieracium achalense*** Sleumer, Bot. Jahrb. Syst. 77(1): 121. 1956.  
Voucher: *Cerana, M. M.* 1660, Prov. Córdoba, Depto. Punilla, Cerro Uritorco, 31°11'55"S, 64° 35'1"W, (CORD)

***Hieracium cordobense*** Sleumer, Bot. Jahrb. Syst. 77(1): 120. 1956.  
Syn.: *Hieracium cordobense* Sleumer var. *mollisetum* Sleumer.  
Voucher: *Cerana, M. M.* 1662, Prov. Córdoba, Depto. Punilla, Cerro Uritorco, Cima, 31°11'55"S, 64°35'1"W, (CORD)

***Hieracium criniceps*** Sleumer, Bot. Jahrb. Syst. 77(1): 116. 1956.  
Syn.: *Hieracium petrophytes* Sleumer.  
Voucher: *Hunziker, A. T.* 11446, Prov. Córdoba, Depto. Punilla, Sierra Grande (falda este), cuesta de Copina, entre Copina y Pampa de Achala, 31°34'31"S, 64°39'45"W, (CORD)

***Hypochaeris caespitosa*** Cabrera, Darwiniana 9: 376. 1951.  
Voucher: *Cantero, J. J.* 5596, Prov. Córdoba, Depto. Río Cuarto, El Pantano (mármoles), 31°12'4"S, 64°48'20"W, (CORD)

***Hysterionica dianthifolia*** (Griseb.) Cabrera var. ***dianthifolia***, Notas Mus. La Plata, Bot. 11(53): 352. 1946.  
Voucher: *Hunziker, A. T.* 9649, Prov. Córdoba, Depto. Calamuchita, Sierra de Co-mechingones (falda este), Cumbre de Cerro Champaquí, 31°59'15"S, 64°56'14"W, (CORD)

***Hysterionica dianthifolia*** (Griseb.) Cabrera var. ***pulvinata*** (Cabrera) Ariza, Darwiniana 22(4): 540. 1980.

Syn.: *Hysterionica pulvinata* Cabrera; *Neja pulvinata* (Cabrera) G.L.Nesom.

Voucher: *Ariza Espinar, L. 3461*, Prov. Córdoba, Depto. San Alberto, Pampa de Achala, entre camino Altas Cumbres y el Colegio del Padre Liqueno, (CORD)

***Isostigma cordobense*** Cabrera, Notas Mus. La Plata, Bot. 19(22): 202, f. 5. 1959.

Syn.: *Isostigma crithmifolium* Less. var. *nanum* Sherff.

Voucher: *Cantero, J. J. 5488*, Prov. Córdoba, Depto. Río Cuarto, Árbol Seco (serpentitas), 32°12'26"S, 64°41'40"W, (CORD)

***Mutisia castellanosii*** Cabrera var. ***comechingoniana*** Ariza, Bol. Soc. Argent. Bot. 35: 173. 2000.

Voucher: *Ariza Espinar, L. 3217*, Prov. Córdoba, Depto. Punilla, Sierra Chica (falda oeste), Los Terrones, 31°11'55"S, 64°35'01"W, (CORD)

***Senecio achalensis*** Cabrera, Notas Mus. La Plata, Bot. 1(4): 92. 1935.

Voucher: *Hunziker, A. T. 18048*, Prov. Córdoba, Depto. Punilla, Sierra Chica, Cerro Uritorco, falda occidental, 30°50'45"S, 64°28'12"W, (CORD)

***Senecio fragantissimus*** Tortosa & A.Bartoli, Novon 15(4): 646. 2005.

Voucher: *Covas, G. 1337*, Prov. San Luis, (LP)

***Senecio retanensis*** Cabrera, Notas Mus. La Plata, Bot. 4(21): 100. 1939.

Syn.: *Senecio sectilis* Griseb. var. *radiatus* Griseb.

Voucher: *Hunziker, A. T. 9641*, Prov. Córdoba, Depto. Calamuchita, Sierra de Comechingones (Falda este): En la falda oriental del Cerro Champaquí, 32°11'4"S, 64°37'1"W, (CORD)

***Soliva triniifolia*** Griseb., Abh. Königl. Ges. Wiss. Göttingen 24: 202. 1879.

Voucher: *Cabido, M. 6865*, Prov. Córdoba, Depto. San Alberto, Sierra Grande, Pampa de Achala, en la Estancia San Alejo, (CORD)

***Trichocline plicata*** D. Don ex Hook. & Arn., Comp. Bot. Mag. 1: 103. 1835.

Voucher: *Cantero, J. J. 5903*, Prov. Córdoba, Depto. Colón, Candonga, 31°4'30"S, 64°20'16"W, (CORD)

## BERBERIDACEAE

***Berberis hieronymi*** C.K.Schneid., Bull. Herb. Boissier, sér. 2, 5: 394. 1905.

Syn.: *Berberis ruscifolia* Lam. var. *subintegrifolia* Kurtz.

Voucher: *Romanutti, A. 212*, Prov. Córdoba, Depto. Punilla, Quebrada del Condorito, en el sendero hacia la Quebrada, 31°37'34"S, 64°42'22"W, (CORD)

## BRASSICACEAE

***Mostacillastrum carolinense*** (Scappini, C.A.Bianco & Prina) Al-Shehbaz, Darwiniana 44(2): 346. 2006.

Syn.: *Sysimbrium carolinense* Scappini, C.A. Bianco & Prina.

Voucher: Scappini, E. G. 5316, Prov. San Luis, (RIOC)

## BROMELIACEAE

***Tillandsia xiphiooides*** Ker Gawl. var. ***minor*** L.Hrom., Die Bromelie 3:61–65. 1989.

Voucher: Zavala-Gallo, L. s.n. (SI 96882), Prov. San Luis, Depto. Belgrano, Sierra de Las Quijadas, 32°45'9"S, 66°44'49"W, (SI)

## CACTACEAE

***Acanthocalycium spiniflorum*** (K.Schum.) Backeb., Kaktus-ABC [Backeb. & Knuth] 226. 1936.

Syn.: *Echinopsis spiniflora* K.Schum., *Lobivia spiniflora* (K.Schum) Britton & Rose

Voucher: Schlumpberger, B. O. 323, Prov. Córdoba, Depto. Minas, Agua de Ramón, (CORD)

***Gymnocalycium achirasense*** H.Till & Schatzl ex H.Till, Kakteen Sukk. 38(8): 191. 1987.

Syn.: *G. monvillei* (Lem.) Britton & Rose subsp. *achirasense* (H.Till & Schatzl ex H.Till) H.Till; *G. horridispinum* Frank ex H.Till var. *achirasense* (H.Till & Schatzl ex H. Till) Lodé; *G. horridispinum* subsp. *achirasense* (H.Till & Schatzl ex H.Till) Charles

Voucher: Demaio, P. 489, Prov. Córdoba, Depto. Río Cuarto, Alpa Corral (CORD)

***Gymnocalycium andreae*** (Boed.) Backeb. Kaktus-ABC [Backeb. & Knuth]: 285. 1935.

Syn.: *G. andreae* (Boed.) Backeb. f. *svecianum* Pazout ex H.Till; *G. andreae* (Bödeker) Backeb. subsp. *maznetteri* Rausch; *G. andreae* (Boed.) Backeb. var. *fechseri* H.Till.

Voucher: Demaio, P. 480, Prov. San Luis, Depto. Junín, cuesta de Merlo, (CORD)

***Gymnocalycium bruchii*** (Speg.) Hosseus, Revista Centro Estud. Farm. Córdoba 2(6): 22. 1926.,

Syn.: *G. lafaldense* Vaupel; *G. albispinum* Backeb.; *G. andreae* (Boed.) Backeb. var. *grandiflorum* Krainz & Andreeae; *G. bruchii* (Speg.) Hosseus var. *brigittae* Piltz; *G. bruchii* (Speg.) Hosseus var. *niveum* Rausch.

Voucher: Demaio, P. 111, Prov. Córdoba, Depto. Colón, Ruta Provincial E-66 (Camino del Pungo), 30°56'36"S, 64°23'16"W, (CORD)

***Gymnocalycium calochlorum*** (Boed.) Y.Itô, Cacti 1952: 90. 1952.

Syn.: *G. proliferum* (Backeb.) Backeb.; *G. amoenum* (H.Till) Lambert.

Voucher: Kiesling, R. 9069, Prov. Córdoba, Depto. San Alberto, Mina Clavero, (SI)

**Gymnocalycium capillaense** (Schick) Hosseus, Revista Centro Estud. Farm. Córdoba 2(6): 16. 1926.

Syn.: *G. sigelianum* (Schick) Hosseus; *G. sutterianum* (Schick) Hosseus; *G. deeszianum* Dölz; *G. poeschlii* Neuhuber; *G. fischeri* Halda, Kupcák, Lukasik & Sladkovsky; *G. miltii* Halda, Kupcák, Lukasik & Sladkovsky; *G. fischerii* subsp. *suyuquense* Berger; *G. nataliae* Neuhuber.

Voucher: *Leuenberger, B. E.4389*, Córdoba, Depto. Punilla, 2 Km N of Capilla del Monte towards Charbonier , 30°51'S, 64°32'W, (CORD)

**Gymnocalycium carolinense** (Neuhuber) Neuhuber, *Gymnocalycium* 18(4): 639–640.

2005.

Voucher: *Demaio, P. 475*, Prov. San Luis, Depto. Coronel Pringles, La Carolina, (CORD)

**Gymnocalycium castellanosii** Backeb. subsp. *ferocius* (H.Till & Amerhauser) Charles, Cactaceae Systematics Initiatives 20: 18. 2005.

Syn.: *G. mostii* subsp. *ferocior* H.Till & Amerhauser.

Voucher: *Borth, H. s.n.*, Prov. Córdoba, Depto. Minas, Agua de Ramón, (CORD)

**Gymnocalycium erinaceum** Lambert, Succulenta 64: 64–66. 1985.

Syn.: *G. amerhauseri* H.Till; *G. lukasikii* Halda & Kupcak; *G. papschii* H.Till; *G. gaponii* Neuhuber; *G. walteri* H.Till.

Voucher: *Demaio, P. 108*, Prov. Córdoba, Depto. Colón, Ruta Provincial E-66 (Camino del Pungo), pasando Tres Cascadas, 30°56'58"S, 64°19'57"W, (CORD)

**Gymnocalycium gibbosum** (Haw.) Pfeiff. ex Mittler subsp. *borthii* (Koop ex H.Till) Charles, Cactaceae Systematics Initiatives 20: 18. 2005.

Syn.: *G. berthii* Neuhuber; *G. borthii* Koop ex H.Till subsp. *nogolense* Neuhuber.

Voucher: *Demaio, P. H. 479*, Prov. San Luis, Junín, Los Chañares, (CORD)

**Gymnocalycium horridispinum** Frank ex H.Till, Kakteen And. Sukk. 38(8): 191. 1987.

Syn.: *G. monvillei* (Lem.) Britton & Rose subsp. *horridispinum* (Frank ex H.Till) H.Till.

Voucher: *Fechser, H. s.n.*, Prov. Córdoba, SW Salsacate, (WU)

**Gymnocalycium monvillei** (Lem.) Britton & Rose, Cactaceae [Britton & Rose] 3: 161. 1922.

Syn.: *G. multiflorum* (Hook.) Britton & Rose; *G. brachyanthum* (Gürke) Britton & Rose; *G. grandiflorum* Backeb.; *G. schuetzianum* H.Till & Schatzl.

Voucher: *Demaio, P. 112*, Prov. Córdoba, Depto. Colón, Ruta Provincial E-66 (Camino del Pungo), 30°56'34"S, 64°23'53"W, (CORD)

***Gymnocalycium mostii*** (Gürke) Britton & Rose subsp. ***mostii***, Addisonia 3: 5. 1918.  
 Syn.: *G. kurtzianum* (Gürke) Britton & Rose.  
 Voucher: *Leuenberger, B. E. 4490*, Prov. Córdoba, Depto. Colón, 15–16 km W of Ascochinga on road to La Cumbre, (CORD)

***Gymnocalycium mostii*** (Gürke) Britton & Rose subsp. ***valnicekianum*** (Jajó) Meregalli & Charles, Cactaceae Systematics Initiatives 24. 2008.  
 Syn.: *G. inmemoratum* A. Castellanos & Lelong; *G. tobuschianum* Schick.; *G. prochazkianum* Sorma  
 Voucher: *Kiesling, R. 9069*, Prov. Córdoba, Depto. Punilla, Capilla del Monte, (SI)

***Gymnocalycium neuhuberi*** H.Till & W.Till, *Gymnocalycium* 5(1):59–60. 1992.  
 Voucher: *Demaio, P. H. 470*, Prov. San Luis, Depto. Belgrano, Suyuque, (CORD)

***Gymnocalycium quehlianum*** (F.Haage ex Quehl) Vaupel ex Hosseus, Revista Centro Estud. Farm. Córdoba 2(6): 22. 1926.  
 Syn.: *G. quehlianum* (F.Haage ex Quehl) Vaupel ex Hosseus var. *rolfianum* Schick.; *G. quehlianum* (F.Haage ex Quehl) Vaupel ex Hosseus var. *zantnerianum* Schick.; *G. stellatum* Speg.; *G. stellatum* Speg. var. *flavispinum* Bozsing ex H.Till & W.Till; *G. stellatum* Speg. var. *kleinianum* Rausch ex H.Till & W.Till.  
 Voucher: *Schlumpberger, B. O. 320*, Prov. Córdoba, Depto. Punilla, Capilla del Monte, El Cajón, (CORD)

***Gymnocalycium robustum*** R.Kiesling, O.Ferrari & Metzing, Cactus and Succulent Journal (US) 74(1): 4–8. 2002.  
 Syn.: *G. kuehhasii* Neuhuber & Sperling  
 Voucher: *Kiesling, R. 9883*, Prov. Córdoba, Depto. Ischilín, Quilino, 30°22'18"S, 64°39'31"W, (SI)

#### CAMPANULACEAE

***Siphocampylus foliosus*** Griseb. var. ***glabratus*** E.Wimm., Revista Sudamer. Bot. 2: 93. 1935.  
 Voucher: *Stuckert, T. J. V. 10536*, Prov. Córdoba, Depto. San Alberto, Mina Clavero, 31°41'29"S, 65°6'5"W, (CORD)

***Siphocampylus foliosus*** Griseb. var. ***minor*** Zahlbr., Revis. Gen. Pl. 3[3]: 189. 1898.  
 Voucher: *Stuckert, T. J. V. 10816*, Prov. Córdoba, (G)

***Siphocampylus lorentzii*** E.Wimm., Repert. Spec. Nov. Regni Veg. 29: 85. 1931.  
 Voucher: Lorentz, P. G. 697, Prov. Córdoba, (B)

## CARYOPHYLLACEAE

***Cerastium argentinum*** (Pax) F.N.Williams, J. Bot. 36: 387. 1898.

Syn.: *Cerastium nutans* Raf. var. *argentinum* Pax

Voucher: *Hunziker, A. T.* 6412, Prov. Córdoba, Depto. San Alberto, Sierra Grande, Pampa de Achala, al costado del monolito (Ruta Prov. 14), 31°40'42"S, 64°50'11"W, (CORD)

## CYPERACEAE

***Carex monodynema*** (Griseb.) G.A.Wheeler, Syst. Bot. 15: 656. 1990.

Syn.: *Carex atropicta* Steud. var. *monodynema* Griseb.; *Carex atropicta* Steud. var. *pallens* Kurtz ex Kük.; *Carex atropicta* Steud. f. *monodynema* (Griseb.) Kük.; *Carex atropicta* Steud. f. *pallescens*(Kurtz ex Kük.) Kük.

Voucher: *Kurtz, F.* 3080h, Prov. Córdoba, Depto. Calamuchita, (CORD)

## ESCALLONIACEAE

***Escallonia cordobensis*** (Kuntze) Hosseus, Bol. Acad. Nac. Ci. 26: 120–121, f. 18. 1921.

Syn.: *Escallonia rubra* (Ruiz & Pav.) Pers. var. *cordobensis* Kuntze; *Escallonia montana* auct. non Phil.

Voucher: *Ariza Espinar, L.* 3494, Prov. Córdoba, Depto. Punilla, Copina, 31°11'55"S, 64°35'1"W, (CORD)

## FABACEAE

***Adesmia cordobensis*** Burkart var. *appendiculata* Ulibarri & Burkart, Darwiniana 38(1–2): 84. 2000.

Voucher: *Anderson, D. L.* 1921, Prov. San Luis, Depto. Pedernera, Cerro El Morro, Ea. La Guardia, (SI)

***Apurimacia dolichocarpa*** (Griseb.) Burkart, Physis (Buenos Aires) 20(58): 286. 1951.

Syn.: *Tephrosia dolichocarpa* Griseb.

Voucher: *Cabrera, A. L.* 29655, Prov. Córdoba, Depto. Pocho, Subida de Taninga, 31°21'30"S, 64°58'W, (SI)

***Astragalus parodii*** I.M.Johnst., J. Arnold Arbor. 28: 371. 1947.

Voucher: *Hieronymus, G. H. E. W. s.n.*, Prov. Córdoba, Sierra de Achala, Cuesta del Gaucho, (CORD)

***Mimosa cordobensis*** Ariza, Lorentzia 6: 7–10, f. 1. 1986.

Voucher: *Ariza Espinar, L.* 3014, Prov. Córdoba, Depto. Totoral, El Sauce, 30°40'51"S, 63°55'25"W, (CORD)

***Prosopis campestris*** Griseb., Abh. Königl. Ges. Wiss. Göttingen 19: 132–133. 1874.  
 Voucher: *Lorentz, P. G. 2*, Prov. Córdoba, “Umgebung von Chañar, wenige Leguas nach Süd und Nord verschwindend”, (CORD)

***Sophora linearifolia*** Griseb., Symb. Fl. Argent. 110. 1879.

Voucher: *Hieronymus, G. H. E. W. 135*, Prov. Córdoba, orillas del río cerca del Molino de Ducas, (CORD)

#### GENTIANACEAE

***Gentianella parviflora*** (Griseb) T.N.Ho, Bull. Brit. Mus. (Nat. Hist.), Bot. 23(2): 63. 1993.

Voucher: *Ariza Espinar, L. 1390*, Prov. Córdoba, Depto. San Alberto, Pampa de Achala: Cerca de La Posta, 31°41'29"S, 65°6'5"W, (CORD)

#### GERANIACEAE

***Geranium parodii*** I.M.Johnst., Contr. Gray Herb. 81: 92. 1928.

Voucher: *Stuckert, T. 26029*, Prov. Córdoba, Depto. Cruz del Eje, Sierra de Achala, entre Tanti y Pampa de San Luis, 31°19'S, 64°35'W, (CORD)

#### IRIDACEAE

***Calydorea undulata*** Ravenna, Onira 6(1): 14. 2001.

Voucher: *Maldonado-Bruzzone, R. 1037*, Prov. Córdoba, Depto. Río Seco, Cerro Colorado, (LP)

#### MALVACEAE

***Sphaeralcea cordobensis*** Krapov., Lilloa 17: 214. 1949.

Voucher: *Cantero, J. J. 5388*, Prov. Córdoba, Depto. Calamuchita, Cañada de Alvarez, 32°22'1"S, 64°32'4"W, (CORD)

#### LOASACEAE

***Blumenbachia hieronymi*** Urb., Jahrb. Königl. Bot. Gart. Berlin 3: 249. 1884.

Voucher: *Hieronymus, G. H. E. W. 790*, Prov. Córdoba, Sierra de Achala, al pie del Cerro Champaquí, (CORD)

#### ORCHIDACEAE

***Aa achalensis*** Schltr., Repert. Spec. Nov. Regni Veg. 16: 358. 1920.

Voucher: *Ariza Espinar, L. 428*, Prov. Córdoba, Depto. Punilla, entre Cosquín y Parque Siquiman 31°11'55"S, 64°35'1"W, (CORD)

#### PLANTAGINACEAE

***Plantago densa*** (Pilg.) Rahn, Nord. J. Bot. 3(3): 336. 1983.

Voucher: *Hieronymus, G. H. E. W. 603*, Prov. Córdoba, (CORD, F)

## POACEAE

***Aristida minutiflora*** Caro var. ***glabriflora*** Caro, Kurtziana 1: 154. 1961.

Voucher: *Hunziker, A. T.* 22472, Prov. Córdoba, Depto. Pocho, Sierra de Pocho: entre Arroyo Piedras Rosadas y Arroyo de las Águilas, 31°25'57"S, 65° 25'38"W, (CORD)

***Aristida multiramea*** Hack., Anales Mus. Nac. Buenos Aires 21: 67. 1911.

Syn.: *Aristida adscensionis* L. var. *laevis* Hack.

Voucher: *Hunziker, A. T.* 14026, Prov. Córdoba, Depto. Pocho, Sierra de Pocho (falsa oeste): Ruta 20, cerca de los Túneles, 31°25'57"S, 65°25'38"W, (CORD)

***Aristida sayapensis*** Caro, Kurtziana 1: 159. 1961.

Voucher: *Anderson, D. L.* 2202, Prov. San Luis, Depto. General Pedernera, Ruta 148, 13 km al norte de Villa Mercedes, 34°1'20"S, 65°34'39"W, (CORD)

***Cenchrus rigidus*** (Griseb.) Morrone, Ann. Bot. (Oxford) 106: 129. 2010.

Syn.: *Pennisetum rigidum* (Griseb.) Hack., *Gymnotrix rigida* Griseb.

Voucher: *Stuckert, T. J. V.* 18737, Prov. Córdoba, Depto. Río Primero, Estancia San Teodoro, 31°1'24"S, 63°27'21"W, (CORD)

***Danthonia melanathera*** (Hack.) Bernardello, Kurtziana 10: 249. 1977.

Syn.: *Danthonia cirtata* Hack. & Arechav. var. *melanathera* Hack.

Voucher: *Krapovickas, A.* 7414, Prov. Córdoba, Depto. Punilla, entre Copina y la Pampa de Achala, 31°11'55"S, 64°35'1"W, (CORD)

***Melica decipiens*** Caro, Kurtziana 5: 288, fig. 5. 1969.

Syn.: *Melica violacea* Cav. var. *glabrior* Papp; *Melica violacea* Cav. f. *mucronata* Papp.

Voucher: *Hunziker, A. T.* 9687, Prov. Córdoba, Depto. San Javier, Sierra Grande, bajando del cerro Champaquí, 32°5'3"S, 65°6'5"W, (CORD)

***Nassella hunzikeri*** (Caro) Barkworth, Taxon 39(4): 610. 1990.

Syn.: *Stipa hunzikeri* Caro

Voucher: *Cantero, J. J.* 5539, Prov. Córdoba, Depto. Río Cuarto, Iguazú, 31°3'51"S, 64° 47'39"W, (CORD)

***Nassella nidulans*** (Mez.) Barkworth, Taxon 39(4): 611. 1990.

Syn.: *Stipa nidulans* Mez.

Voucher: *Hunziker, A. T.* 18052, Prov. Córdoba, Depto. Punilla, Sierra Chica, Falda Oeste del Cerro Uritorco, 31°11'55"S, 64°35'1"W, (CORD)

***Nassella stuckertii*** (Hack.) Barkworth, Taxon 39(4): 612. 1990.

Syn.: *Stipa stuckertii* Hack.

Voucher: *Hunziker, A. T.* 8646, Prov. Córdoba, Depto. Punilla, camino a Los Gigantes, El Vallecito, 31°11'55"S, 64°35'1"W, (CORD)

**Poa hubbardiana** Parodi, Notas Mus. La Plata, Bot. 2: 10–13, f.4. 1937.

Voucher: Hunziker, A. T. 8682, Prov. Córdoba, Depto. Punilla, Sierra Grande, Cerro de La Cruz, al este de Los Gigantes, 31°11'55"S, 64°35'1"W, (CORD)

**Poa stuckertii** (Hack.) Parodi, Physis (Buenos Aires) 11: 137. 1932.

Syn.: *Poa lanigera* Nees var. *stuckertii* Hack.

Voucher: Hunziker, A. T. 9657, Prov. Córdoba, Depto. Calamuchita, Sierra Grande, Cumbre del Cerro Champaquí, 32°11'4"S, 64° 37'1"W, (CORD)

**Trichloris pluriflora** E. Fourn. f. **macra** Hack., Anales Mus. Nac. Buenos Aires ser.

3, 4: 116. 1904.

Voucher: Hunziker, A. T. 14868, Prov. San Luis, Depto. Junín, Sierra de San Luis, Quebrada del Tigre, entre Santa Rosa y Bañado de Cautana, 32°18'45"S, 65°16'39"W, (CORD)

**Tridens nicorae** Anton, Kurtziana 10: 51, fig. 1977.

Syn.: *Antonella nicorae* (Anton) Caro.

Voucher: Anderson, D. L. 1686, Prov. San Luis, Depto. La Capital, Cerro El Lince, faldeo oriental, 33°43'47"S, 66°30'47"W, (CORD)

#### PURTULACACEAE

**Portulaca confertifolia** Hauman var. **cordobensis** D. Legrand, Lilloa 17: 360, fig. 19. 1949.

Voucher: Soriano, A. 791, Prov. Córdoba, Salinas Grandes, km 907, (SI)

**Portulaca obtusifolia** D. Legrand var. **obtusifolia**, Comun. Bot. Mus. Hist. Nat. Montevideo 3(32): [1], tab. 1. 1959.

Voucher: Sayago, M. 2311, Prov. Córdoba, Depto. Río Seco, en el centro de Saladillo, Villa Candelaria, 29°58'45"S, 63°15'49"W, (CORD)

**Portulaca ragonesei** D. Legrand, Lilloa 17: 333, tab. 2. 1949.

Voucher: Ragonesi, A. E. s.n., Prov. Córdoba, (BAB)

#### ROSACEAE

**Geum brevicarpellatum** F. Bolle, Repert. Spec. Nov. Regni Veg. Beih. 72: 54. 1933.

Voucher: Hieronymus, G. H. E. W. 35, Prov. Córdoba, Depto. San Alberto, Sierra Achala, Quebrada del Chorro, al Este de Los Gigantes, (CORD)

#### RUBIACEAE

**Borreria eryngioides** Cham. & Schltl. var. **ostenii** (Standl.) E.L.Cabral & Bacigalupo, Opera Bot. Belg. 7: 317. 1996.

Syn.: *Borreria ostenii* Standl.

Voucher: Ariza Espinar, L. 1260, Prov. Córdoba, Depto. Capital, Barrio San Martín, 31°23'27"S, 64°11'27"W, (CORD)

***Richardia coldenioides*** Rusby, Mem. Torrey Bot. Club 4: 208. 1895.

Syn.: *Richardsonia coldenioides* (Rusby) Buchtien

Voucher: Burkart, A. 10443, Prov. Córdoba, Depto. Calamuchita, Río Tercero, 32°11'4"S, 64°37'1"W, (SI)

#### SOLANACEAE

***Solanum concarens*** Hunz., Kurtziana 20: 190, fig. 2. 1989.

Voucher: Hunziker, A. T. 14547, Prov. San Luis, Depto. Chacabuco, cerca de Concarán, Santa Rosa, 32°42'38"S, 65°12'6"W, (CORD)

***Solanum ratum*** C.V.Morton, Revis. Argentine Sp. Solanum 130 (-132), figs. 121-L, 15. 1976.

Voucher: Chiarini, F. 818, Prov. Córdoba, Depto. Punilla, entre Cerro Blanco y La Ollada, El Durazno, 31°11'55"S, 64°35'1"W, (CORD)

***Solanum restrictum*** C.V.Morton, Revis. Argentine Sp. Solanum 128 (-130), figs. 12E-N, 14. 1976.

Voucher: Chiarini, F. 794, Prov. Córdoba, Depto. Punilla, La Cumbre, alrededores de la Estancia El Rosario, 31°59'2"S, 64°28'13"W, (CORD)

#### VALERIANACEAE

***Valeriana ferax*** (Griseb.) Höck, Bot. Jahrb. Syst. 3(1): 55. 1882.

Syn.: *Phyllactis ferax* Griseb.

Voucher: Hunziker, A. T. 9683, Prov. Córdoba, Depto. San Javier, Sierra Grande, Cerro Champaquí, 32°5'3"S, 65°6'5"W, (CORD)

***Valeriana stuckertii*** Briq., Annuaire Conserv. Jard. Bot. Genève 20: 442. 1919.

Voucher: Stuckert, T. J. V. 12063, Prov. Córdoba, Depto. Santa María, Sierra Chica, 31°38'59"S, 64°15'28"W, (CORD)

#### VERBENACEAE

***Junellia bisulcata*** (Hayek) Moldenke var. ***campestris*** (Griseb.) Botta, Hickenia 2: 127. 1995.

Syn.: *Junellia juniperina* (Lag.) Moldenke var. *campestris* (Griseb.) Moldenke; *Verbena juniperina* Lag. var. *campestris* Griseb.

Voucher: Krapovickas, A. 7751, Prov. Córdoba, Depto. Pocho, Taninga, 31°25'57"S, 65°25'38"W, (SI)

***Parodianthus capillaris*** Tronc., Darwiniana 18: 21. 1973.

Voucher: Hunziker, A. T. 24987, Prov. Córdoba, Depto. Sobremonte, Sierra del Norte, 6 km al oeste de San Francisco del Chañar, hacia Lucio V. Mansilla, 29°44'12"S, 64°7'57"W, (CORD)

**Table 2.** Summary of altitudinal distribution of endemic taxa in the Sierras CSL. Taxa identification numbers as in Table 1.

Vegetation belt or combination	lower	middle	upper	lower/middle	middle/upper	lower/middle/upper
taxa	35	2	11	17	7	17
percentage	39.32	2.29	12.35	19.54	8.04	19.54
taxa ID	3, 4, 5, 7, 8, 17, 18, 20, 28, 34, 36, 37, 39, 40, 41, 42, 47, 49, 52, 57, 61, 64, 65, 66, 67, 68, 75, 77, 78, 79, 81, 82, 83, 84, 89	25, 76	9, 15, 16, 19, 21, 22, 47, 50, 56, 60, 86	6, 10, 26, 27, 31, 32, 35, 43, 44, 45, 54, 70, 71, 72, 74, 80, 85	13, 29, 33, 55, 62, 69, 73	1, 2, 11, 12, 14, 23, 24, 30, 38, 48, 51, 53, 58, 59, 63, 87, 88

### Distribution of the endemic taxa

The altitudinal distribution of the endemic taxa in the Sierras CSL is shown in Table 2 and Fig. 2. There are *exclusive* taxa (i.e., present *only* in a single altitudinal belt) and also *shared* taxa (present in more than one altitudinal belt). Among the exclusive taxa, the lower Sierra forest belt has 35 taxa, the intermediate Sierra shrubland belt has 2 taxa and the upper grasslands and woodlands belt has 11 taxa. The presence of taxa in more than one belt is depicted in the last three columns of Table 2, that shows which taxa are present in which combination of belts; among the taxa which are present in two belts, the combination of lower and middle belts has 17 taxa and the combination of middle and upper belts has 7 taxa. Finally there are 17 taxa that are present in all the three belts.

### Phylogenetic knowledge of the endemic taxa of the CSL Sierras

The inclusion of the endemic taxa of the Sierras CSL in phylogenetic studies has been minimal; from a total of 53 genera with endemic taxa present in the area, 32 (60.3%) have been included in at least one molecular phylogenetic analysis, but only 10 studies (18.8%) have a species endemic to the Sierras CSL: *Acanthocalycium*, *Blumenbachia*, *Eryngium*, *Escallonia*, *Grindelia*, *Gymnocalycium*, *Portulaca*, *Prosopis*, *Sphaeralcea* and *Tillandsia* (Table 3).

### Assessment of the phylogenetic knowledge of the genera with endemic taxa of the Sierras CSL.

**Aa.** South American genus with around 25 species, mostly in the Central and Northern Andes, and 5 species in Argentina (Luer 2008). The phylogeny by Álvarez-Molina

**Table 3.** Phylogenetic knowledge of the endemic taxa of the CSL Sierras.

Family	Genus	Phylogeny of the genus including endemic species of CSL Sierras
Amaranthaceae	<i>Gomphrena</i>	Moore et al. 2012
Apiaceae	<i>Eryngium</i>	Calviño et al. 2008
Bromeliaceae	<i>Tillandsia</i>	Barfuss et al. 2005
Cactaceae	<i>Acanthocalycium</i>	Schlumpberger and Renner 2012
Cactaceae	<i>Gymnocalycium</i>	Demaio et al. 2011
Escalloniaceae	<i>Escallonia</i>	Sede et al. 2013
Fabaceae	<i>Prosopis</i>	Catalano et al. 2007
Loasaceae	<i>Blumenbachia</i>	Hufford et al. 2005; Ackerman et al. 2006
Malvaceae	<i>Sphaeralcea</i>	Tate and Simpson 2003
Portulacaceae	<i>Portulaca</i>	Ocampo and Columbus 2012

and Cameron (2009) included some species of the genus *Aa*, but not the Sierras CSL endemic *A. achaleensis*. The genus was placed in the Altensteinia clade of the sub tribe Prescottiinae.

***Acanthocalycium*.** Endemic genus of the mountain ranges of Central Argentina, with 5 species (Kiesling 2008). Hunt (2006) synonymized this genus with *Echinopsis*. *Acanthocalycium spiniflorum* has been included in a molecular phylogeny (Schlumpberger and Renner 2012), which shows the genus as paraphyletic, embedded in *Echinopsis* sensu lato, in agreement with Hunt (2006). Regardless of the delimitation of the genus, *A. spiniflorum* is a long branch in the phylogram of Schlumpberger and Renner (2012). Arakaki et al. (2011) dated the diversification of the clade Trichocereinae (including *Acanthocalycium*) between 7.5–6.5 Ma. Hernández-Hernández et al. (2014) dated the divergence time of *A. spiniflorum* to ca. 2.5 Ma.

***Adesmia*.** This genus has ca. 240 species in South America, most of which are found in the Andes (Burkart 1967). In Argentina there are 198 species (Ulibarri 2008), and the Sierras CSL endemic *Adesmia cordobensis* var. *appendiculata* has not been included in a molecular phylogeny.

***Alternanthera*.** Cosmopolitan genus with ca. 100 species, mostly in tropical and warm regions of America. There are 36 species in Argentina (Borsch 2008a). A recent molecular study by Sanchez del Pino et al. (2012) included other Argentinean species, such as *A. pungens*, but not the morphologically related endemic species of the CSL Sierra *A. pumila*.

***Apurimacia*.** South American genus with 5 species. The endemic of the Sierras CSL *A. dolichocarpa* is the only species in Argentina. A molecular phylogeny of the tribe Millettiae (da Silva et al. 2012), where *Apurimacia* belongs, has dated the clade including the genus to ca. 1.1 Ma.

***Aristida*.** Widespread genus with ca. 300 spp. of tropical and subtropical regions of both hemispheres (Watson and Dallwitz 1992), with ca. 30 species in Argentina (Caro 1961, Sulekic 2003). The Sierras CSL endemics *A. minutiflora* var. *glabri-flora*, *A. multiramea* and *A. sayapensis* have not been included in the phylogeny

of *Aristida* by Cerros-Tlatilpa et al. (2011), that dated species included in a core South America clade to 2.37 (3.77–1.15) Ma, the most recent in the genus.

***Astragalus*.** Cosmopolitan genus with ca. 2500 species inhabiting Mediterranean arid and semiarid environments, with 61 species in Argentina (Zuloaga and Morrone 1999). Although the Sierras CSL endemic *A. parodii* has not been included in molecular phylogenies, Scherson et al. (2008) showed that South American species belong to one of two clades, dated to ca. 1.89 Ma and ca. 0.98 Ma and proposed at least two migration events from North America, with a recent radiation of species in both South American clades.

***Berberis*.** Estimates of species numbers in the cosmopolitan genus *Berberis* vary between 20 (Landrum 1990) and ca. 450 (Kim et al. 2004). Thirty four species are found in Argentina (Ulloa Ulloa 2008) and the Sierras CSL endemic *Berberis hieronymi* has never been included in molecular phylogenetic studies.

***Blumenbachia*.** South American genus with ca. 12 species, 6 of them in Argentina (Zuloaga and Belgrano 2008). The Sierras CSL endemics *B. hieronymi* has been included in a molecular phylogeny (Hufford et al. 2005, Ackermann et al. 2006) and is a member of a clade with *B. insignis*, widely distributed in southern South America.

***Borreria*.** Sometimes included in *Spermacoce* L. (150 spp.), this genus comprises 18 species in Argentina. Besides the different type of fruit of *Borreria* and *Spermacoce*, the study by Groeninck et al. (2009) shows clearly that *Borreria* should be maintained as a separate genus. The Sierras CSL endemic *Borreria eryngioides* var. *ostenii* has never been included in a molecular phylogeny.

***Calydorea*.** This South American genus comprises ca. 10 species from temperate regions. There are 5 spp. in Argentina, including the Sierras CSL endemic *C. undulata*. This taxon was described by Ravenna (2001) from Córdoba populations of *C. pallens*; the identity of the species was verified by De Tullio et al. (2008) based on cytological and morphological evidence, but the taxon has never been included in a phylogeny.

***Carex*.** This cosmopolitan genus comprises 1500–2000 species in both Northern and Southern hemispheres (Wheeler 1990); 107 species are found in Argentina (Zuloaga et al. 2008). The Sierras CSL endemic *C. monodynema* is found in an isolated location at the summit of the Sierra de Achala, but has not been included in molecular phylogenies.

***Cenchrus*.** Grass genus with ca. 100 species of tropical and temperate regions of both hemispheres; 14 species are found in Argentina (Gutiérrez 2012). The Sierras CSL endemic *C. rigidus* has not been included in a molecular phylogeny.

***Cerastium*.** The nearly cosmopolitan genus *Cerastium* comprises ca. 100 species with a diversity center in Eurasia and has preference for cold-temperate regions (Pedersen 1984); two migration events to North and South America have been suggested (Scheen et al. 2004). In Argentina there are 17 spp., from which the Sierras CSL endemic *C. argentinum* has never been included in a molecular phylogenetic study.

***Danthonia*.** 30 species mainly from mountainous regions of the Southern Hemisphere; 7 species in Argentina (Romanutti and Anton 2012). The Sierras CSL endemic *D. melanathera* has not been included in any molecular phylogeny.

**Eryngium.** The largest genus in the Apiaceae, with about 250 species of temperate regions of all continents; 29 species are found in Argentina (Zuloaga and Morrone 1999). The Sierras CSL endemic *E. agavifolium* was included in the molecular phylogeny by Calviño et al. (2008), forming a clade with *E. elegans*, a widely distributed species in southern South America.

**Escallonia.** The South American genus *Escallonia* comprises ca. 40 species of shrubs, especially in the Andes. In Argentina there are 16 species (Zuloaga et al. 2008) and the Sierras CSL endemic *E. cordobensis* has been included in the phylogenetic study of Sede et al. (2013), forming a polytomy with *E. petrophila*, *E. ledifolia*, *E. farinacea*, *E. bifida* and *E. laevis*, which are taxa distributed in northeastern Argentina, Brazil, Paraguay and Uruguay.

**Gentianella.** This mostly alpine-arctic genus occurs in South America in the Andes, where is represented by ca. 150 species (von Hagen and Kadereit 2001), with about 28 species in Argentina (Zuloaga and Morrone 1999). *Gentianella* entered in South America probably more than one time, and has in the region a high rate of speciation, probably linked with the availability of suitable habitats (von Hagen and Kadereit 2001). The Sierras CSL endemic annual *G. parviflora* has not been included in a molecular phylogeny.

**Geranium.** Genus with ca. 400 species of temperate areas and tropical mountains throughout most of the world, and 18 species in Argentina (Zuloaga and Morrone 1999). There is no molecular phylogenetic study of the whole genus. Aedo et al. (2005) revised section *Andina* of the genus, to which the endemic of CSL Sierras *G. parodii* belongs. Aedo et al. (2005) note that *G. parodii* was first described as a variety of the wider distributed *G. sessiliflorum*, which is found in the Andes from Perú to southern Argentina and Chile.

**Geum.** This mostly Northern Hemisphere (Smedmark and Eriksson 2002) genus comprises ca. 40 species of cold-temperate regions. In Argentina it includes 6 species, commonly found in the Andes and Patagonia. The Sierras CSL endemic *Geum brevicarpellatum* has not been included in a phylogeny.

**Gomphrena.** This genus includes ca. 120 spp. of tropical regions, with 38 species in Argentina (Borsch 2008b). *G. pulchella* subsp. *rosea* and *G. pulchella* var. *bonariensis* are restricted to the Sierras CSL, but *G. pulchella* is widely distributed in southern South America. There is no molecular phylogenies including these taxa.

**Grindelia.** A New World temperate genus with 73 species in western North America and southern South America (Sancho and Ariza Espinar 2003); 19 species in Argentina (Freire 2008). There are two endemic taxa in the Sierras CSL, *G. cabrerae* var. *alatocarpa* and *G. globularifolia*. The latter was included in the phylogeny by Moore et al. (2012), and resolved within the South American clade.

**Gymnocalycium.** South American genus of ca. 50 species, mostly in mountain ranges of Argentina; with 16 endemic species and subspecies in the Sierras CSL, is the genus with largest number of endemic species in the region (Demaio 2012). The phylogeny of the genus by Demaio et al. (2011) recovered three clades (subgenera) living sympatrically in the Sierras CSL: *Scabrosemineum* (6

endemic taxa); *Gymnocalycium* (9 endemic taxa); and *Trichomosemineum* (1 taxon). Divergence times in Cactaceae (Arakaki et al. 2011) showed that the differentiation of the genus might have occurred between the Miocene and Pliocene (7.5–6.5 Ma); Hernández-Hernández et al. (2014) gave a younger date of 5.08 (3.09–7.55) Ma.

**Habranthus.** American genus of ca. 30 species, mostly South American but with five species in North America, probably introduced (Roitman et al. 2007). Twenty three species grow in Argentina (Zuloaga et al. 2008). The Sierras CSL endemic *H. sanavironae* is similar in flowers size to *Habranthus robustus* (=*Zephyranthes robusta*) (Roitman et al. 2007), which is widespread in Central Argentina and Southern Brazil. *H. sanavironae* has never been included in a phylogeny.

**Helenium.** American genus of ca. 40 species, mostly southern USA and Mexico (Bremer 1994); in Argentina three species (Novara and Petenatti 2000). The Sierras CSL endemic *H. argentinum* has never been included in a molecular phylogeny.

**Hieracium.** Nearly cosmopolitan genus with ca. 1000 species (Bremer 1994); 45 species in Argentina (Cerana and Ariza Espinar 2003). Presence of polyploidy, mixed breeding systems and apomixis (Chrtek et al. 2009) complicate its systematics and make estimation of taxon numbers highly variable. None of the Sierras CSL endemics (*H. achalense*, *H. cordobense* and *H. criniceps*) have been included in molecular phylogenetic studies.

**Hypochaeris.** This genus with ca. 60 species occurs in Europe, Asia and North Africa, and South America, while the greatest number of species is found in the latter (Bremer 1994); 30 species are found in Argentina (Bortiri 1999). Studies by Samuel et al. (2003) and Tremetsberger et al. (2005) did not include the Sierras CSL endemic *H. caespitosa*.

**Hysterionica.** South American genus with 12 species in Brazil, Uruguay and Argentina; 9 species are found in Argentina (Freire 2008). The Sierras CSL endemics *H. dianthifolia* var. *dianthifolia* and *H. dianthifolia* var. *pulvinata* have not been included in molecular phylogenies; Noyes and Rieseberg (1999) related this genus with *Conyza* and *Erigeron*, both of the Northern hemisphere.

**Isostigma.** Small South American genus with 11 species from subtropical areas; 5 species are found in Argentina (Peter 2009). The Sierras CSL endemic *I. cordobense* has not been included in a molecular phylogeny.

**Junellia.** South American genus with 36 species distributed in Perú, Bolivia, Chile and the most in Argentina. The molecular phylogeny of O’Leary et al. (2009) did not include *J. bisulcata*, whose variety *campestris* is endemic of the Sierras CSL. *Junellia bisulcata* has a wide geographical distribution in Andean and sub-Andean ranges of northern Argentina, northern Chile and southern Bolivia.

**Melica.** Grass genus with 80 species from temperate regions of both hemispheres; 17 species in Argentina (Morrone and Zuloaga 2012). The Sierras CSL endemic *M. decipiens* has not been included in any phylogenetic study.

**Mimosa.** This genus comprises ca. 480 spp. of tropical and warm zones of the American continent; in Argentina there are 55 species (Zuloaga and Morrone 2012). The

genus is rich in narrow endemics (Simon et al. 2011). *Mimosa cordobensis* has not been included in a phylogenetic study.

**Mostacillastrum.** This South American genus comprises 17 species distributed from southern Peru and Bolivia to northern Patagonia (Al-Shehbaz 2006); *Mostacillastrum carolinense* was described originally as a *Sisymbrium* (Scappini et al. 2004). The phylogeny by Warwick et al. (2009) included other *Mostacillastrum* species but not *M. carolinense*; the tribe Thelypodieae where *Mostacillastrum* belongs shows low molecular differentiation.

**Mutisia.** Excepting for a few species growing in southern Brazil and adjacent regions of Paraguay and Uruguay, most of the 59 species of this genus are found in the Andes (Cabrera 1971). Argentina has 35 species (Freire 2008) and the Sierras CSL endemic *M. castellanosii* var. *comechingoniana* has never been included in a phylogenetic study.

**Nassella.** Grass genus with ca. 80 species distributed in the American continent, especially in the Andes (Mabberley 1997). Due to different generic concepts, the species number in Argentina varies between 16 (Rosa et al. 2005) and 70 (Cialdella 2012). The Sierras CSL endemic *N. stuckertii*, related to the widespread *N. tenuissima*, has not been included in molecular phylogenies.

**Nothoscordum.** This mostly South American genus comprises more than 70 species, with 39 in Argentina and a single species, *N. gracile*, distributed through the Americas (Zuloaga et al. 2008; Rodrigues Souza et al. 2012). The Sierras CSL endemic *N. achalense* has not been included in a phylogenetic study.

**Parodianthus.** Small genus with only two known species, restricted to central Argentina. *Pardianthus capillaris* grows only in the northern extreme of the Sierras CSL. Marx et al. (2010) showed *Parodianthus* formed a clade with *Casselia* and *Tamonea* in agreement with previous morphological studies (Martínez and de Romero 2003), but did not include the Sierras CSL endemic *P. capillaris*. *Casselia* is distributed in Brazil, Bolivia, and Paraguay, while *Tamonea* is widespread from Mexico and the Caribbean to Brazil and Paraguay.

**Plantago.** The ca. 260 species of *Plantago* are distributed worldwide (Dunbar-Co et al. 2008); in Argentina there are 34 species (Zuloaga et al. 2008). The Sierras CSL endemic *P. densa* has never been included in a molecular phylogeny.

**Poa.** The largest genus of the Poaceae, with a number varying between 500–575 species distributed in all temperate-cold regions of the world (Gillespie and Soreng 2005; Gillespie et al. 2007). There are 62 species in Argentina (Giussani et al. 2012), and from the two Sierras CSL endemics, *P. hubbardiana* and *P. stuckertii*, only the latter has been included in a phylogeny (Gillespie et al. 2007), where it was placed together with the North American *P. arachnifera*.

**Portulaca.** Distributed worldwide, this genus comprises ca. 100 species, mainly in the tropics and subtropics, with centers of diversity in South America and Africa. There are 29 taxa in Argentina, including the Sierras CSL endemic *P. confertifolia* var. *cordobensis* (Zuloaga et al. 2008). A recent molecular phylogeny included *P. confertifolia* (Ocampo and Columbus 2011) and showed the node including this species is dated to 3 Ma.

***Prosopis***. This genus comprises 45 species of warmer regions of America, Southeast Asia and Africa. There are 28 spp. in Argentina (Zuloaga and Morrone 1999), and the Sierras CSL endemic *P. campestris* has been included in the phylogenetic study by Catalano et al. (2008). The study shows a probable divergence time during the late Pliocene (1.8 Ma).

***Senecio***. One of the most species-rich genera of the Asteraceae, *Senecio* has ca. 3000 species distributed all over the world. In Argentina there are 423 species (Freire 2008), with regions of highest diversity the Andes and Patagonia (Cabrera 1971). The two Sierras CSL endemics, *S. achalensis* and *S. retanensis* have never been included in any phylogenetic study.

***Siphocampylus***. South American genus with ca. 220 species, 16 growing in mountainous regions of Argentina. Neither endemic variety of *S. foliosus* endemic to the Sierras CSL has been included in any phylogenetic study.

***Solanum***. Sub-cosmopolitan genus with around 1400 species of warm regions of the world. In Argentina there are 115 species and three hybrids (Barboza 2013). The three Sierras CSL endemics, *S. concarens*, *S. ratum* and *S. restrictum* have not been included in phylogenetic studies; *S. concarens* has been accepted by Barboza (2013), but *S. restrictum* and *S. ratum* were treated as synonyms of *S. salicifolium*, an extremely variable species distributed in western Argentina and Bolivia.

***Soliva***. Small and mostly South American genus, it also has widespread species that occur in both Australia and North America. 5 species grow in Argentina (Zuloaga et al. 2008). The molecular phylogeny of the tribe Anthemideae by Watson et al. (2000) did not include the Sierras CSL endemic *S. triniifolia* but *S. anthemifolia*, a widespread species occurring in adjacent areas.

***Sophora***. Cosmopolitan genus with ca. 45 species; 2 species in Argentina. *Sophora linearifolia* is endemic to the Sierras CSL, but has not been included in the phylogeny by Mitchell and Heenan (2002), although it was mentioned as closely related to coastal Chilean species belonging to Sect. Edwardasia that also includes species from the Pacific islands and New Zealand (Crowder 1982; Peña et al. 2000).

***Sphaeralcea***. This genus has ca. 40 herbaceous and shrubby species occurring in temperate parts of the Americas (Krapovickas 1965, 1970). The Sierras CSL endemic small shrub *S. cordobensis* has been included in the phylogeny of *Tarassa* by Tate and Simpson (2003). *Sphaeralcea cordobensis* is a diploid included in a polyphyletic assemblage with *Tarassa* and *Nototrichie*; however the unique morphology and geographic distribution suggest the three genera are different lineages (Tate and Simpson 2003).

***Tillandsia***. Pan-American genus with ca. 550 species (Barfuss et al. 2005). *Tillandsia xiphiooides* is widely distributed in southern South America, and was included in the analysis of Barfuss et al. (2005); it joined an Andean clade forming a polytomy and characterized by its rapid evolution (Barfuss et al. 2005: 347).

***Trichloris***. Grass genus with 2 disjunct species distributed in north-central Argentina and Bolivia and Mexico and southern USA (Rúgolo and Molina 2012). The endemic *T. pluriflora* f. *macra* has not been included in a molecular phylogeny.

**Trichocline.** Genus of 22 species, most of them in South America from southern Peru to central Argentina and Chile (Katinas et al. 2008), with 13 species in Argentina (Zuloaga et al. 2008). *Trichocline plicata*, endemic to the Sierras CSL, has not been included in molecular phylogenies; a widespread and related species, *T. reptans*, grows in sympatry.

**Tridens.** Grass genus with 14 species distributed in tropical and temperate regions of the Americas; 3 species in Argentina (Romanutti and Anton 2012). The Sierras CSL endemic *T. nicorae* has not been studied in molecular phylogenetic studies.

**Valeriana.** This genus comprises ca. 350 species usually found in mountainous regions (Bell and Donoghue 2005), while 81 are found in Argentina (Kutschker 2008). The roughly 175 South American species form a clade suggesting the existence of a modern center of diversification in the Andes (Bell and Donoghue 2005, Bell et al. 2012). Neither of these works has included the Sierras CSL endemics *V. ferox* and *V. stuckertii*.

**Zephyranthes.** This genus comprises about 65 Neotropical species. The molecular phylogeny of American Amaryllidaceae by Meerow et al. (2000) showed the genus as polyphyletic, with two well differentiated clades including South American taxa. *Zephyranthes longystila*, the endemic species of Sierras CSL, was not included in this work.

### Endemic taxa of Sierras CSL and widespread related taxa

A total of 28 taxa of the endemics of the Sierras CSL is sympatric with a widespread congener, or with one found close to the area (Table 4).

## Discussion

### Recent origins of endemism in the Sierras CSL

Two main sources of evidence suggest that 46 taxa (ca 40.4%) of the endemics of the Sierras CSL are neoendemic taxa *sensu* Stebbins and Major (1965). The first evidence arises from available molecular phylogenetic studies (Table 3), which show 10 taxa (11.24 %) included in clades with divergence times of ca. 5 Ma or less. The second source is the existence of sympatry between an endemic taxon of the Sierras and a widespread taxon of the same genus (Table 4). *Acanthocalycium spiniflorum* was included in the study by Hernandez-Hernandez et al. (2014), showing a divergence time of ca. 2.5 Ma. Ackerman et al. (2006) included *Blumenbachia hieronymii* in their phylogeny and it was resolved in a clade with *B. insignis*, which is widely distributed in southern South America. *Eryngium agavifolium*, included in the phylogeny by Calviño et al. (2008) joined in a well-supported clade with *E. elegans*, which is widely distributed in southern South America. *Escallonia cordobensis* was included in the phylogeny

**Table 4.** Sympatry/parapatry of endemic taxa of Sierra CSL and widespread congeners.

Endemic taxa Sierra CSL	Widespread related taxa	Source
<i>Adesmia cordobensis</i> var. <i>appendiculata</i>	<i>A. cordobensis</i> Burkart	Zuloaga and Morrone 1999
<i>Alternanthera pumila</i>	<i>A. pungens</i> Kunth	Zuloaga and Morrone 1999
<i>Aristida minutiflora</i> var. <i>glabriflora</i>	<i>A. minutiflora</i> Caro	Zuloaga and Morrone 1999
<i>Blumenbachia hieronymi</i>	<i>B. insignis</i> Schrad.	Hufford et al. 2005, Ackerman et al. 2006
<i>Borreria eryngioides</i> var. <i>ostenii</i>	<i>B. eryngioides</i> Cham. & Schltdl.	Zuloaga and Morrone 1999
<i>Calydorea undulata</i>	<i>C. pallens</i> Briseb.	Zuloaga and Morrone 1999
<i>Eryngium agavifolium</i>	<i>E. elegans</i> Cham. & Schltdl.	Calviño et al. 2008
<i>Escallonia cordobensis</i>	<i>E. petrophila</i> Rambo & Sleumer, <i>E. ledifolia</i> Sleumer, <i>E. farinacea</i> A. St.-Hil., <i>E. bifida</i> Link & Otto, <i>E. laevis</i> (Vell.) Sleumer, <i>E. hypoglauca</i> Herzog and <i>E. tucumanensis</i> Hosseus	Sede et al. 2013
<i>Geranium parodii</i>	<i>G. sessiliflorum</i> Cav.	Aedo et al. 2005
<i>Gomphrena pulchella</i> subsp. <i>rosea</i>	<i>G. pulchella</i> Mart.	Borsch 2008
<i>Grindelia cabrerae</i> var. <i>alatocarpa</i>	<i>G. cabrerae</i> Ariza	Zuloaga and Morrone 1999
<i>Grindelia globularifolia</i>	<i>G. pulchella</i> Mart.	Moore et al. 2012
<i>Habranthus sanavironae</i>	<i>H. robustus</i> Herb. ex Sweet	Roitman et al. 2007
<i>Junellia bisulcata</i> var. <i>campestris</i>	<i>J. bisulcata</i> (Hayek) Moldenke	O'Leary 2009
<i>Mutisia castellanensis</i> var. <i>comechingoana</i>	<i>M. castellanensis</i> Cabrera	Zuloaga and Morrone 1999
<i>Nassella stuckertii</i>	<i>N. tenuissima</i> (Trin.) Barkworth	Cialdella 2012
<i>Parodianthus capillaris</i>	<i>P. illicifolium</i> (Moldenke) Tronc.	Marx et al. 2010
<i>Portulaca confertifolia</i>	<i>P. eruca</i> Hauman, <i>P. perennis</i> R.E. Fr., <i>P. mucronulata</i> D. Legrand, <i>P. obtusa</i> Poelln. and <i>P. gilliesii</i> Hook.	Ocampo and Columbus 2011
<i>Prosopis campestris</i>	<i>P. chilensis</i> (Molina) Stuntz emend. Burkart	Catalano et al. 2008
<i>Siphocampylus foliosus</i> var. <i>glabratus</i> , <i>S. foliosus</i> var. <i>minor</i>	<i>S. foliosus</i> Griseb.	Zuloaga and Morrone 1999
<i>Solanum concarense</i> , <i>S. ratum</i> , <i>S. restrictum</i>	<i>S. salicifolium</i> Phil.	Knapp 2013
<i>Soliva trinifolia</i>	<i>S. anthemifolia</i> (Juss.) Sweet	Zuloaga and Belgrano 2008
<i>Sphaeralcea cordobensis</i>	<i>S. crispa</i> Baker f.	Tate and Simpson 2003
<i>Tillandsia xiphioidea</i> var. <i>minor</i>	<i>T. xiphioidea</i> Ker Gawl.	Zuloaga and Morrone 1999
<i>Trichloris pluriflora</i> fo. <i>macra</i>	<i>T. pluriflora</i> E. Fourn.	Rúgolo and Molina 2012
<i>Trichocline plicata</i>	<i>T. reptans</i> (Wedd.) Hieron.	Zuloaga and Belgrano 2008

by Sede et al. (2013), forming an unresolved clade with *E. petrophila*, *E. ledifolia*, *E. farinacea*, *E. bifida* and *E. laevis*, *E. hypoglauca* and *E. tucumanensis*. All these species are barely differentiated (Sede et al. 2013: 173), which suggests that the group evolved relatively recently. *Grindelia globularifolia* shows a similar pattern in the phylogeny by Moore et al. (2012), grouped in a large polytomy with several widespread species. The phylogram of *Gymnocalycium* by Demaio et al. (2011) showed that *G. saglionis* is the first branching taxon in the genus. Hernández-Hernández et al. (2014) showed that *G. saglionis* diverged ca. 5 Ma, and the clade including a species of the subgenus

*Scabrosemineum* (*G. guanchinense*) - where many species of the Sierras CSL belong - diverged ca. 2.5 Ma. In *Portulaca*, the phylogeny by Ocampo and Columbus (2011) set a divergence time for *P. confertifolia* of ca. 3 Ma. *Prosopis campestris* was included in the chronogram of Catalano et al. (2008), with a divergence time of ca. 1.8 Ma. *Sphaeralcea cordobensis* was included in the phylogeny by Tate and Simpson (2003), forming a clade with the widely distributed *S. crispa*. *Tillandsia xiphiooides* has been included in the molecular phylogeny of Barfuss et al. (2005), who suggested all taxa of *Tillandsia* to be phylogenetically young, as inferred by the low genetic divergence. *Tillandsia xiphiooides* var. *minor* was a member of a polytomy in their phylogenetic reconstruction, suggesting that it had not time to undergo a complete differentiation.

The second source of supporting evidence is the existence of pairs of taxa with the endemic species of Sierras CSL occurring in sympatry or parapatry with a widespread congeneric species. Walck et al. (2001) compared *Solidago shortii* Torr. & A. Gray, a narrow endemic species of eastern North America, with *S. altissima* L., a widespread species, and found that *S. altissima* is a better competitor than *S. shortii* because of its greater height, larger leaf area and more extensive clonal growth. On the other hand, *S. shortii* tolerates drought stress better than *S. altissima* because the allocation of a higher percentage of biomass to roots, higher root/shoot ratio and greater capacity to maintain leaf turgor under xeric conditions. As a consequence of the differences in these traits, and although the lack of a molecular phylogenetic framework precludes conclusive classification, Walck et al. (2001) suggested the endemic taxon to be probably derived from the widespread one.

These aspects of the endemics of the Sierras (inclusion in clades and sympatry with a widespread congeneric taxon) are congruent with the geological and biological history of the region. The Sierras CSL system is the result of a ca. 520 Ma (Paleozoic) orogenic process that around 399 Ma was subject to an intrusion of magmatic batholiths (Baldo et al. 1996). The current arrangement, with blocks of basement tilted eastwards, is the result of the Andean orogeny, which rejuvenated the whole region in the Miocene-Pliocene, starting at ca. 5.3 Ma (Baldo et al. 1996). The actual composition of the vegetation of the Sierras CSL would have been assembled during this later interval, and has probably been preceded by times of major interchange with neighboring areas (Prado 1993a).

### Altitudinal distribution of endemic taxa

The distribution of endemic taxa varied among the altitudinal belts. In a chorological study on 20 selected sites of the Sierras CSL, Cabido et al. (1998) emphasized that the upper vegetation belt in the Sierras CSL is distinct not only because its richness in Andean phytogeographic elements, but also due to the occurrence of highly restricted endemics. The data presented here show that the altitudinal belt with highest number of endemic taxa is the lowest (the sierra forest belt) with 35 endemic taxa, while the upper (the high-altitude grasslands and woodlands) has 11 endemic taxa (Fig. 2, Table 2). The cumulative number of endemic taxa in the two lower belts suggests that

differentiation and establishment of neoendemic taxa occurred most probably in the lower vegetation belts of the Sierras CSL, which have clear floristic affinities with surrounding Chaco vegetation (Prado et al. 1993a, 1993b; Cabido et al. 1998).

## Conclusion

### Why more studies on local endemics are needed

Our data suggests that many endemic taxa of the Sierras de Córdoba and San Luis have developed as consequence of differentiation processes occurred during the last approximately 7 Ma. Likewise, the whole flora of the Sierras has been only partially isolated from surrounding Chaco vegetation. The overall lower presence of endemic taxa of the Sierras in phylogenetic studies emphasizes the need for their inclusion in such studies as a mean to achieve a better understanding of the evolutionary and biogeographical history of this area. Lastly, the present work also suggests that, although extracting information on speciation from phylogenies is not straightforward (Barraclough and Nee 2001), including endemic taxa in phylogenetic studies could provide useful insights on evolution of endemism and areas of endemism. Although our analysis is specifically aimed at a defined geographic area, the concept of analyzing all the endemic taxa of a particular zone could reveal patterns of biodiversity, since endemic taxa richness is a product of the interaction between historical processes as speciation or migration and contemporary factors as ecology or landscape use.

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## Two new non-spiny *Solanum* species from the Bolivian Andes (Morelloid Clade)

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### Abstract

Two new Bolivian species are described from the Morelloid clade of *Solanum* (section *Solanum* in the traditional sense). *Solanum alliariifolium* M.Nee & Särkinen, **sp. nov.** is found in montane forests between 1,900 and 3,200 m and is morphologically most similar to *S. leptocaulon* Van Heurck & Müll.Arg., also from montane forests in southern Peru and Bolivia. *Solanum rhizomatum* Särkinen & M.Nee, **sp. nov.** is found in seasonally dry forests and matorral vegetation in lower elevations between 1,300 and 2,900 m and is most similar to *S. pygmaeum* Cav., a species native to sub-tropical Argentina but introduced in subtropical and temperate areas worldwide.

### Resumen

Se describen dos nuevas especies bolivianas del clado Morelloid de *Solanum* (sección *Solanum* en sentido tradicional). *Solanum alliariifolium* M.Nee & Särkinen, **sp. nov.** se encuentra en bosques montanos entre 1,900 y 3,200 metros y es morfológicamente muy similar a *S. leptocaulon* Van Heurck & Müll.Arg., también presente en bosques montanos en el sur de Perú y Bolivia. *Solanum rhizomatum* Särkinen y M.Nee, **sp. nov.** se encuentra en bosques tropicales estacionalmente secos y en vegetación de matorral a elevaciones más bajas entre 1,300 y 2,900 m, y es más similar a *S. pygmaeum* Cav., una especie nativa para Argentina subtropical pero introducida en las zonas subtropicales y templadas del mundo.

**Keywords**

Bolivia, endemism, Morellloid Clade, tropical Andes, Solanaceae, *Solanum* section *Solanum*

**Palabras clave**

Andes tropicales, Bolivia, Clado Morellloid, endemismo, Solanaceae, *Solanum* sección *Solanum*

## Introduction

*Solanum* is one of the most species-rich vascular plant genera in the tropical Andes (Jørgensen et al. 2011), where many new species continue to be described (e.g., Anderson et al. 2006; Stern and Bohs 2010; Knapp 2010a,b; Farrugia and Bohs 2010; Tepe et al. 2012; Särkinen et al. 2013a; Särkinen et al. 2015). Here we describe two new *Solanum* species from Bolivia that belong to the Morellloid clade, one of major clades of non-spiny solanums (Weese and Bohs 2007; Särkinen et al. 2013b).

The Morellloid clade is a group of ca. 75 species, most of which are endemic to the tropical Andes (Bohs 2005; Särkinen et al. in review). The clade includes five major groups (traditionally recognised as sections *Solanum*, *Campanulisolanium* Bitter, *Parasolanum* A. Child, *Chamasarachidium* Bitter, and *Episarcophyllum* Bitter), which are in the process of re-circumscription based on molecular results (Särkinen et al. in review). Section *Solanum* is the largest of these with ca. 52 species and ca. 580 published names and is the only group to occur outside of the Americas. The Morellloid clade is distinguished by its herbaceous or sub-shrubby habit, usually internodal inflorescences, small flowers and fruits, and the usual possession of stone cells in the fruits (Bitter 1911). These are sclerified structures that are usually white and spherical rather than flattened and brown or yellowish brown like the seeds. Although some studies have examined the taxonomy of the Old World and North American species of this group (Edmonds 1977, 1978; Schilling 1981), monographic treatment is needed to aid species identification and to clarify synonymy in South America, where most of the species diversity is found (Edmonds 1972; Barboza et al. 2013).

Recent taxonomic work focusing on producing a monographic treatment of the Morellloid clade has resulted in the description of various new species from Peru, Bolivia and Ecuador (Särkinen et al. 2013a; Särkinen et al. 2015). Two additional new species are described here from Bolivia. Descriptions are based on field work and examination of herbarium specimens from 20 herbaria (BH, BM, COL, CORD, CPUN, DUKE, E, F, GH, GOET, HUSA, HUT, K, LPB, MO, MOL, NY, S, UDBC, US, USM, USZ). Extent of Occurrence (EOO) and Area of Occupancy (AOO) were calculated using GeoCat ([www.geocat.kew.org](http://www.geocat.kew.org)) with a 2 km<sup>2</sup> cell size for AOO calculation. Conservation status of each species was assessed using the IUCN (2014) criteria based on the GeoCat analyses (Bachman et al. 2011) combined with field knowledge. All specimens are cited in the text, and full data is provided in the Suppl. material 1 and on Solanaceae Source ([www.solanaceaesource.org](http://www.solanaceaesource.org)).

## Taxonomic treatment

### *Solanum alliariifolium* M.Nee & Särkinen, sp. nov.

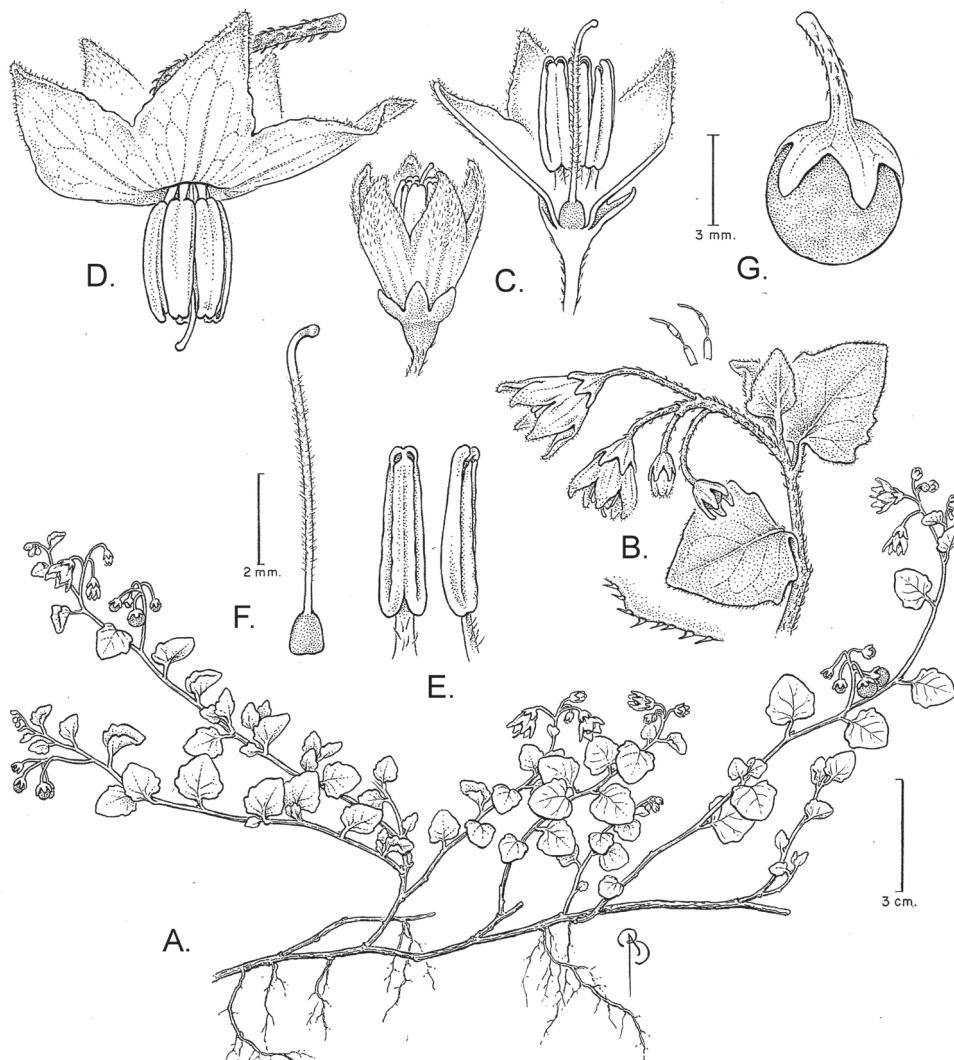
urn:lsid:ipni.org:names:77145835-1

Figs 1–2

**Diagnosis.** Similar to *Solanum leptocaulon* Van Heurck & Müll.Arg., but differing in its slender creeping habit with stems rooting along nodes, broadly ovate to orbicular leaves with mostly undulate to shallowly lobed margins, and a stellate corollas lobed to the middle with lobes reflexed at anthesis.

**Type.** BOLIVIA. Santa Cruz. Prov. Vallegrande: 6.5 km by air SW of Guadalupe on rd to Pucará, at turnoff to Santa Ana, 18°36'S, 64°07'W, 2675 m, 15 Dec 1990 (fl,fr), M. Nee 40315 (holotype: LPB; isotypes: MO [MO-2537105], NY [NY00852828], USZ).

**Description.** Slender herb to 20–30 cm high, with multiple long, creeping stems arising from a central taproot. Stems rooting at nodes, 1–2 mm in diameter, up to 50 cm long, glabrous or sparsely pubescent with spreading translucent 4–6-celled simple uniseriate trichomes ca. 0.2 mm long. Sympodial units difoliate, not geminate. Leaves simple, 1.5–3.6 cm long, 0.9–2.3 cm wide, broadly ovate to orbicular; adaxial surface glabrous; abaxial surface glabrous or sparsely pubescent with appressed 1–3-celled simple uniseriate trichomes along veins and leaf margins; primary veins 3–4 pairs; base rounded to attenuate, occasionally decurrent; margins entire, undulate, or shallowly lobed; apex acute; petiole 0.7–1.5 cm long, sparsely pubescent with simple 1–3-celled uniseriate trichomes like those of the stems, especially on young leaves. Inflorescences 1.5–3.0 cm long, simple, lateral, leaf-opposing or internodal, with 2–6 flowers, sparsely pubescent with simple uniseriate 4–6-celled spreading trichomes; peduncle 1.0–3.0 cm long, 0.4–0.5 mm in diameter at the apex and 0.6 mm in diameter at the base; pedicels 0.6–0.9 cm long, ca. 0.4 mm in diameter at the base and ca. 0.5 mm in diameter at the apex, straight and spreading at anthesis, articulated at the base; pedicel scars spaced 0.2–1.5 mm apart. Buds globose, white or purple-tinged. Flowers 5-merous, all perfect, nodding; calyx tube ca. 1.4–1.5 mm long, the lobes 1.6–2.0 mm long, rectangular-deltate in outline with rounded to acute apices, somewhat spreading at anthesis, sparsely pubescent with simple 1–4-celled uniseriate trichomes; corolla 1.4–1.6 cm in diameter, white to pale or deep violet-blue, with a dark purple ring and yellow-green central star at the base, stellate, lobed to the middle, the lobes ca. 4.0–5.0 mm long, 2.0–2.5 mm wide, reflexed at anthesis, densely pubescent abaxially with 1–2-celled simple uniseriate trichomes, these usually shorter than the trichomes of stems and leaves, glabrous adaxially; filament tube 1.3–1.5 mm long; free portion of the filaments ca. 1.1–1.6 mm long, pubescent with 4–7-celled uniseriate trichomes at the base adaxially; anthers 3.5–4.0 mm long, 0.8–1.0 mm wide, ellipsoid to rectangular in outline, yellow, poricidal at the tips, the pores lengthening to slits with age; ovary globose, glabrous; style 5–6 mm long, exerted 1.0–1.7 mm beyond the anther cone, densely pubescent with 2–3-celled simple uniseriate trichomes in the basal 2/3;



**Figure 1.** Illustration of *Solanum alliariifolium*. **A** Habit **B** Inflorescence with details of indumentum of simple, multi-cellular hairs along the stem, and short ciliate hairs along leaf margins **C** Flower just before anthesis, with and without corolla lobes removed **D** Flower at anthesis **E** Stamens **F** Gynoecium **G** Fruit (**A–C, E–G** Nee 40315, **D** Vargas 787). Illustration by Bobbi Angell.

stigma clavate, minutely papillate. Fruit a globose berry, 4–5 mm in diameter, green when developing, the colour when mature unknown, with a few stone cell aggregates in each berry; fruiting pedicels 1.1–3.2 cm long, ca. 0.4 mm in diameter at the base, ca. 0.6 mm in diameter at the apex, spreading, becoming somewhat woody; fruiting calyx lobes 2.8–3.2 mm long, spreading. Seeds 15–20 per berry, ca. 1.5–1.7 mm long, ca. 1.2–1.3 mm wide, flattened, reniform, pale-brown, the sub-lateral hilum positioned close to the middle, the testal cells pentagonal in outline.

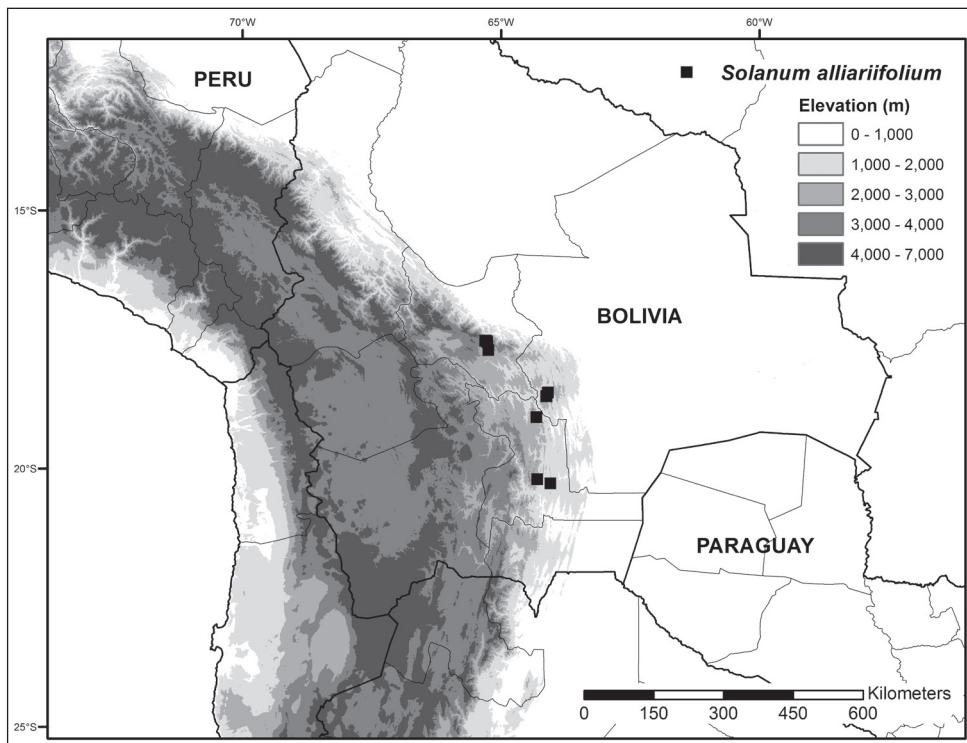
**Distribution.** Endemic to montane forests of the Eastern Bolivian Andes in the Departments of Chuquisaca, Cochabamba, and Santa Cruz, in open areas close to water sources, near rivers and moist depressions, and marshy meadows on sandy or rocky substrates, associated with *Podocarpus parlatorei* Pilg., *Alnus acuminata* Kunth, *Hesperomeles ferruginea* (Pers.) Benth., *Alchemilla pinnata* Ruiz & Pav., *Azorella biloba* (Schltdl.) Wedd., *Weinmannia fagaroides* Kunth, *Baccharis genistelloides* (Lam.) Pers., *Clethra scabra* Pers., *Myrsine coriacea* (Sw.) Roem. & Schult., *Symplocos nana* Brand, *Eleocharis* spp., *Chusquea* spp., *Morella pubescens* (Willd.) Wilbur, ferns, grasses and Apiaceae herbs; between 1,900 and 3,200 m elevation.

**Ecology.** Flowering and fruiting during the wet season, generally from October–March, with a single record known from August.

**Etymology.** The epithet refers to the leaf shape, which struck the collector of the type (MN) as like that of *Alliaria petiolata* (M.Bieb.) Cavara & Grande (Brassicaceae), a European species invasively adventive in the eastern USA and other temperate areas of the world.

**Conservation status.** We assign a preliminary IUCN threat status of Vulnerable (VU, B1) to *S. alliariifolium* based on the small extent of occurrence (EOO=16,136 km<sup>2</sup>). The area of occupancy is even smaller (AOO=40 km<sup>2</sup>) and would merit status as endangered (EN), but knowing that collection densities in the tropical Andes remain extremely low and that the collections are mainly along the sparse road network, we prefer basing our assessment on the extent rather than area of occurrence. No occurrences are known within the protected area network in Bolivia thus far, but collection data indicates that the species endures grazing pressures relatively well.

**Specimens examined.** BOLIVIA. CHUQUISACA: Prov. Belisario Boeto: ca. 5 km S of Nuevo Mundo at summit of rd to Villa Serrano, 2,300 m, 18 Oct 1997, J.R.I. Wood 12710 (K). Prov. Hernando Siles: Primera Sección Monteagudo, Cantón Fernández, Comunidad Vallecito, 20°12'43"S, 64°18'03"W, 2,314 m, 11 Aug 2007, M. Jiménez 603 (NY); Laguna Milagros, 20°17'16"S, 64°02'56"W, 1,993 m, 26 Dec 2005, R. Lozano & M. Serrano 1787 (MO, NY); Primera Sección Monteagudo, Cantón Fernández, Comunidad Vallecito, 20°12'18"S, 64°17'58"W, 2,456 m, 9 Nov 2007, J. Villalobos 927 (MO). COCHABAMBA: Prov. Carrasco: Siberia, 17°49'87"S 64°44'07"W, 2,940 m, 20 Feb 2005, S. Altamirano & M. Alcázar 3075 (MO); Se-huenka-Totora, 2,800 m, Nov 1959, M. Cárdenas 5716 (US); Jatum Pino, 3200 m, Jan 1961, M. Cárdenas 5942 (K); near Lagunillas (Totora), 2,700 m, Jan 1951, M. Cárdenas 4663 (US); narrow canyon of Rio Monte Puncu, 5 km NE of Monte Puncu, 10 km by air NW of Epizana, 17°33'S, 65°16'W, 2,700–2,750 m, 10 Mar 1988, M. Nee 36631 (NY); de Episana a Sehuancas via Montepunca, 2,500 m, 25 Mar 1978, C.M. Ochoa 12022 (US); 5 km above Sehuancas towards Monte Puncu, 2,500 m, 4 Feb 1995, J.R.I. Wood 9317 (K). SANTA CRUZ: Prov Caballero: 5.5 km (by rd) E of town of El Churro at pond along Pojo–Comarapa highway, 17°50'15"S 64°44'00"W, 2,940 m, 22 Jan 2006, M. Nee & Jun Wen 53903 (MO, USZ). Prov. Vallegrande: Huasacañada, 5 km al S de la ciudad de Vallegrande, 18°31'30"S 64°05'42"W, 2,050 m, 3 Nov 1990, I. Vargas C. 787 (MO, NY, USZ); carretera



**Figure 2.** Distribution map of *Solanum alliariifolium*.

entre Vallegrande y Pucará, 18°35'49"S 64°07'34"W, 2,673 m, 5 Mar 2005, J.R.I. Wood 21774 (K, USZ).

**Discussion.** *Solanum alliariifolium* is distinct within the Morelloids in being a slender creeping herb rooting at the nodes, with broadly ovate to orbicular leaves with undulate to shallowly lobed margins. It is morphologically most similar to *S. leptocaulon* Van Heurck & Müll.Arg., which occurs in similar montane habitats in Bolivia and in southern Peru, but the latter species is a small scrambling shrublet with ovate-lanceolate leaves with entire margins. *Solanum leptocaulon* further differs from *S. alliariifolium* in having a campanulate corolla lobed only 1/3 of the way to the base, rather than a stellate corolla lobed to 2/3 to the base with the lobes clearly reflexed at anthesis.

***Solanum rhizomatum* Särkinen & M.Nee, sp. nov.**

urn:lsid:ipni.org:names:77145836-1

Figs 3–4

**Diagnosis.** Like *Solanum pygmaeum* Cav., but differing in having mostly 1-branched inflorescences with 6–15 flowers, anthers < 3.5 mm long, strongly recurving fruiting pedicels, and berries < 1 cm in diameter with fewer than 30 seeds.

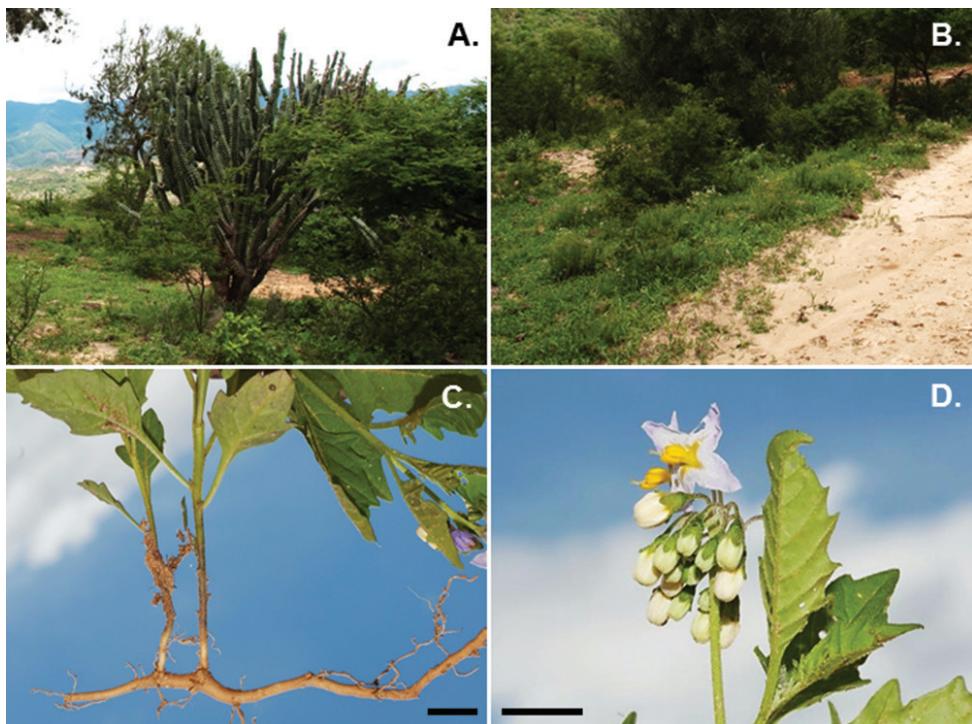


**Figure 3.** Paratype of *Solanum rhizomatatum* (Wood 11974, K).

**Type.** **BOLIVIA. Santa Cruz:** Prov. Vallegrande, 10 km (by air) NNW of Vallegrande, 18°23'S, 64°08'W, 1850 m, 1 Feb 1987, *M. Nee & G. Coimbra S.* 33947 (holotype: LPB; isotypes: G, MO [MO-5894880], NY [NY00824501]).

**Description.** Rhizomatous herb with erect stems up to 15–50 cm tall arising from an underground rhizome. Stems 1.5–4.0 mm in diameter at base, slightly flexuose, terete to ridged, often slightly winged, often purple-coloured, glabrous to sparsely pubescent with appressed 1–4-celled simple uniseriate trichomes ca. 0.5 mm long. Sympodial units difoliate, not geminate. Leaves simple, 2.3–8.0 cm long, 1.2–4.3 cm wide, ovate-lanceolate; adaxial surface glabrous or sparsely pubescent with 1–2-celled spreading hairs along lamina and veins; abaxial surface pubescent only along veins; primary veins 4–6 pairs; base attenuate to decurrent; margins lobed to entire, often purple-tinged, pubescent with short, 1-celled simple uniseriate trichomes, if present lobes present throughout or most commonly only in the basal 1/3 of the blade; apex acute to acuminate; petiole 0.5–1.2 cm long, sparsely pubescent with spreading, simple uniseriate trichomes like those of the stems and leaves. Inflorescences 1.5–3.1 cm long, lateral and internodal, simple to 1-branched, with 6–15 flowers, sparsely pubescent with simple 1–4-celled uniseriate appressed trichomes; peduncle 1.0–2.4 cm long, and if branched, each branch with a rachis 3–4 mm long; pedicels 4–6 mm long, ca. 0.3 mm in diameter at the base and ca. 0.4 mm in diameter at the apex, straight and spreading at anthesis, articulated at the base; pedicel scars spaced 1–2 mm apart. Buds ovoid, white or purple-tinged. Flowers 5-merous, all perfect; calyx tube ca. 2.0–2.5 mm long, the lobes 1.0–1.5 mm long, triangular with acute apices, sparsely pubescent with simple 1–3-celled appressed uniseriate trichomes; corolla 1.2–1.5 cm in diameter, white or flushed with blue, with a yellow-green basal star, stellate, lobed 1/2 to 2/3 of the way to the base, the lobes 4.0–5.0 mm long, 2.5–3.0 mm wide, reflexed at anthesis, later spreading, densely pubescent abaxially with 1–2-celled simple uniseriate trichomes, these usually shorter than the trichomes of stems and leaves, glabrous adaxially; filament tube 1.2–1.5 mm long; free portion of the filaments 1.0–1.2 mm long, pubescent along internal side with spreading hairs like those of the stems and leaves; anthers 3.2–3.5 mm long, 0.9–1.0 mm wide, ellipsoid or rectangular in outline, yellow; ovary globose, glabrous; style 6–7 mm long, exerted 2.5–3.0 mm beyond the anther cone, densely pubescent with 4-celled simple uniseriate trichomes in the basal 2/3; stigma globose, minutely papillate. Fruit a globose berry, 6–7 mm in diameter, pale green (mature ?), with a few stone cell aggregates; fruiting pedicels 1.2–1.4 mm long, ca. 0.6 mm in diameter at the base, ca. 0.8 mm in diameter at the apex, strongly recurving; fruiting calyx lobes 2.5–3.5 mm long, appressed to the berry with the tips slightly reflexed. Seeds 15–25 per berry, 1.7–1.8 mm long, 1.4–1.5 mm wide, concave-reniform, pale brown, the hilum positioned towards the narrower end of the seed, the testal cells pentagonal in outline.

**Distribution.** Endemic to the arid interior valleys of the Bolivian Andes in the Departments of Cochabamba, Potosí, Santa Cruz, and probably Chuquisaca, growing in seasonally dry tropical forests and dry matorral vegetation, along slopes and on rocky and sandy soils, often found growing in moist depressions under the shade of



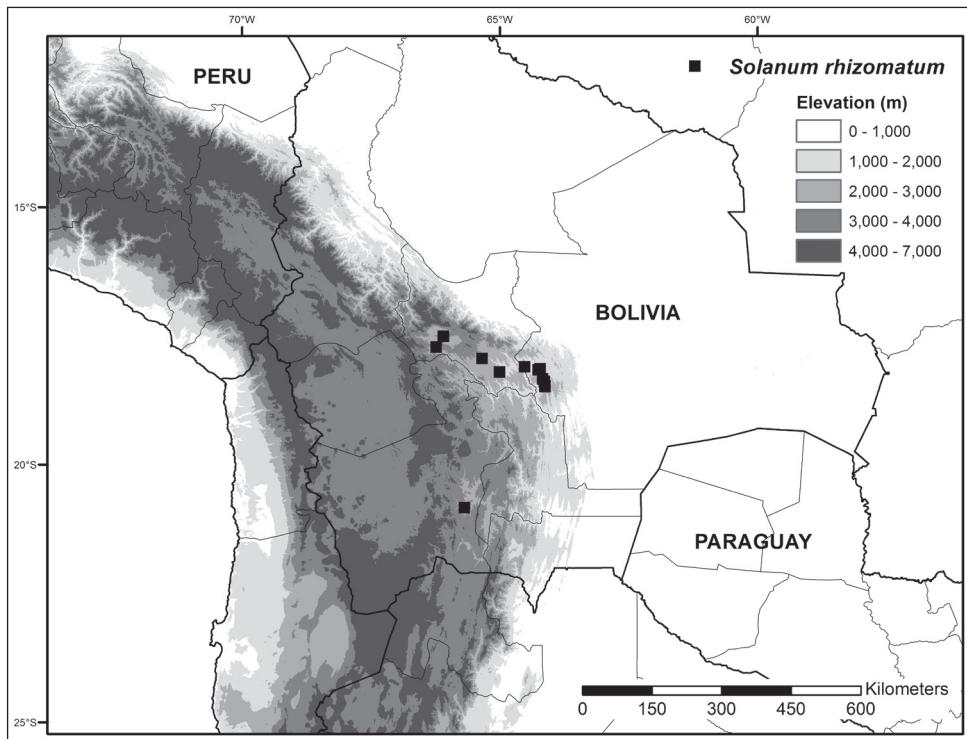
**Figure 4.** *Solanum rhizomatum*. **A** Habitat in seasonally dry forests, eastern Bolivian Andes, Vallegrande, Dept. Santa Cruz **B** Habit amongst low herbs in partial shade **C** Rhizome **D** Inflorescence (**A–D** Nee & Mendoza 57594). Photos by M. Nee, scale bars = 1 cm.

larger trees and thickets, associated with *Prosopis kuntzei* Harms ex Kuntze, *Jodina rhombifolia* (Hook. & Arn.) Reissek, legumes, grasses, columnar cacti, and Asteraceae herbs; between 1,300 and 2,900 m elevation.

**Ecology.** Flowering and fruiting during the wet season from Jan. to March.

**Etymology.** *Solanum rhizomatum* is named for its rhizomatous underground stem.

**Conservation status.** We assign a preliminary IUCN threat status of Least Concern (LC) to *S. rhizomatum* based on the known extent of the species occurrence (EOO=43,101 km<sup>2</sup>). The extremely small observed area of occupancy (AOO=48 km<sup>2</sup>) could merit endangered status (EN), but knowing that collection densities in the tropical Andes remain extremely low and considering that current collections are from >10 different localities, we prefer basing our threat status assessment on the extent rather than area of occurrence. It is not known whether *S. rhizomatum* is similar in its biology and vegetative spread to *S. pygmaeum*, and further studies may clarify this aspect of potential conservation assessments in the future. No populations are known thus far from the protected area network in Bolivia. The growth form that allows effective vegetative spreading would indicate that the species can withstand grazing pressures moderately well.



**Figure 5.** Distribution map of *Solanum rhizomatatum*.

**Specimens examined.** **BOLIVIA.** **COCHABAMBA:** **Prov. Campero:** Mizque, 2,020 m, 20 Feb 1967, R.F. Steinbach 721 (US); ca. 5 km de Villa Granada hacia Peña Colorada, 18°12'10"S, 65°00'09"W, 2,201 m, 25 Feb 2004, J.R.I. Wood 20266 (K, LPB). **Prov. Cercado:** en la salida de Cochabamba hacia el Valle Alto pasando La Tranca y ca. 2 km antes de la Angostura, 17°30'24"S 66°05'35"W, 2,676 m, 10 Feb 2005, J.R.I. Wood 21590 (K). **POTOSI:** **Prov. Nor Chichas:** 4 km N of Cotagaita on road to Potosí, 20°50'S, 65°41'W, 2,900 m, 30 Mar 1997, J.R.I. Wood 11974 (K, LPB). **SANTA CRUZ:** **Prov. Caballero:** carretera de Pulquina a Saipina a 0.5 km al oeste de la cumbre, 18°05'58"S, 64°30'56"W, 1,788 m, 20 Feb 2003, J.R.I. Wood 19134 (BOLV, K). **Prov. Florida:** 3 km S of Mataral, 18°08'S, 64°13'W, 1,425 m, 6 Feb 1988, M. Nee 36252 (MO, NY, USZ); 4 km by road W of Mataral, 18°09'21"S, 64°15'17"W, 1,300 m, 22 Feb 1984, G. Schmitt 27A (MO). **Prov. Vallegrande:** Pueblo de Vallegrande, Cerro los Tres Pilares, 100–150 m antes de llegar a la cima sobre el sendero hacia el pueblo, 18°29'21"S, 64°07'13"W, 2,236 m, 19 Jan 2003, M. Mendoza 449 (K); Choroquetal, ca. 5 km de Vallegrande sobre la carretera a Mataral, entrando ca. 500 m, sobre la senda hacia Chacateal, 18°28'07"S, 64°07'25"W, 1,932 m, 17 Mar 2003, M. Mendoza 529 (K); 4 km SW El Trigal, 18°20'S, 64°10'W, 1,600 m, 8 Mar 1988, M. Nee 36536 (MO, NY, USZ); Las Cañas, 2500 m, 28 Feb 1984, C.M. Ochoa 15548 (US); 6.5 km (by air) NE of airport in Vallegrande, along bad dirt road down

into the Río San Blas valley, 18°26'33"S 64°03'12"W 1,795 m, 3 Jan 2011, *M. Nee & M. Mendoza 57594* (USZ).

**Discussion.** *Solanum rhizomatum* is most closely related to *S. pygmaeum* from central and coastal Argentina (see Barboza et al. 2013), another rhizomatous species of *Solanum* section *Solanum*. *Solanum rhizomatum* differs from *S. pygmaeum* in having mostly 1-branched inflorescences with 6–15 flowers, anthers 3.2–3.5 mm long, strongly recurving fruiting pedicels, and berries with 15–25 seeds, while *S. pygmaeum* always has simple (unbranched) inflorescences with 2–6 flowers, anthers usually >3.5 mm long, fruiting pedicels that are broadly spreading, and berries with >50 seeds. Although these sets of characters overlap to some extent, *S. pygmaeum* individuals are generally smaller than those of *S. rhizomatum* (10–20 cm tall), with smaller leaves 1–5 cm long and 0.5–2.2 cm wide, while *S. rhizomatum* grows 15–50 cm tall, with larger leaves 2.3–8.0 cm long and 1.2–4.3 cm wide. *Solanum pygmaeum* forms dense colonies in secondary habitats such as railroad sidings, and has been introduced and naturalised in Europe and North America, presumably in boats carrying wool from eastern coastal Argentina (Barboza et al. 2013).

As in many species of *Solanum*, variation in corolla colour occurs in *S. rhizomatum*, where corollas vary from white to pale lilac even within single individuals. Label information from *Nee & Mendoza 57594* notes changes in the corolla colour during development, where the corolla is white in bud, violet in anthesis, and darker after wilting.

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## Supplementary material I

### Occurrence records of *Solanum alliariifolium* and *Solanum rhizomatum*

Authors: Tiina Särkinen, Sandra Knapp, Michael Nee

Data type: occurrence

Explanation note: Occurrence records of the two new *Solanum* species.

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