Morphometric Analyses and New Taxonomic Circumscription of South American Species of Flourensia (Asteraceae, Heliantheae, Enceliinae)

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Abstract

Flourensia (Asteraceae, Heliantheae, Enceliinae) is an amphitropical genus of resinous subshrubs, shrubs, and small trees with 13 North American, and 20 South American species where disagreement on the species limits of some of its members still exists. To resolve the taxonomic limits among the South American taxa, we carried out a combination of clustering (based on Ward´s method with Gower distance coefficient) and ordination analyses (based on Principal Coordinate Analyses). Thirty-four vegetative and reproductive characters were scored using herbarium material, including types. This study recognizes 12 South American species for the genus Flourensia: F. angustifolia, F. cajabambensis, F. fiebrigii, F. heterolepis, F. hirtissima, F. macrophylla, F. niederleinii; F. peruviana, F. polycephala, F. thurifera, F. tortuosa, and F. suffrutescens. Based upon these results, a number of species are placed in synonymy: Flourensia blakeana and F. hirta, are synonymized under the name F. fiebrigii; Flourensia campestris, F. leptopoda, F. oolepis, and F. riparia, are synonymized under the name F. thurifera; Flourensia macroligulata is synonymized under the name F. tortuosa; Flourensia polyclada is synonymized under the name F. suffrutescens. A taxonomic treatment of four redefined species as well as a key and distribution maps of all South American Flourensia species are provided.

Key words: Compositae, Cluster Analysis, Flourensia, Integrative Taxonomy, PCoA, Systematic.

Introduction

The genus *Flourensia* DC. (Asteraceae, Heliantheae, Enceliinae) consists of 33 species, all resinous subshrubs, shrubs or small trees occurring in arid to semi–arid regions of North and South America. The genus has an amphitropical disjunct distribution with 13 taxa restricted to north-central Mexico and southwestern United States, and 20 species associated with the Andean Cordillera in Peru, Bolivia, Chile, and Argentina (Blake 1921, Dillon 1976, 1981, 1984, 1986, Cabrera 1978, Ariza Espinar 2000, Hind 2011, Beck and Ibáñez 2014, Ariza Espinar and Ospina 2015). As a member of the tribe Heliantheae, *Flourensia* possess sunflowers with mostly radiate capitula, paleaceous receptacles, opposite leaves, yellow corollas (Stuessy 1977, Cabrera 1978, Robinson 1981, Panero 2007), and a base chromosome number of $x = 18$ (Dillon 1984). It is distinguished from the other genera of the subtribe Enceliinae by a combination of characters i.e. shrubs or small trees with resinous or glutinose leaves, disc corollas yellow, and cypselae biconvex with sparsely to densely pubescent faces (Panero 2007).

The *Flourensia* species have been grouped primarily by the comparison of exo-morphologic features, but the efforts to establish species relationships within the genus have been frustrated by the parallel development of various character in both North and South American taxa (Dillon 1984). South American species are distributed from northern Peru to southern Argentina with the highest diversity found in the region between the central Cordillera Real in Bolivia to central Argentina and in the extra-Andean Pampeanas range in central Argentina, where many species are sympatric. South American Flourensia include several taxonomically critical groups of closely related species, as well as polymorphic species with complex intraspecific variation. Extensive morphological

variation, probably including large phenotype plasticity, a broad distribution area and the ecological amplitude of genus *Flourensia* in South America (ranging from lowland habitats in the arid inter-Andean valleys to highland habitats in the Andes), have been the main factors hampering a sound intraspecific concept to date (Dillon 1984). A critical quantitative evaluation of the traditional species concepts, and of the species variation across a large geographic area is still missing.

The purpose of this study is to examine the current circumscription of the South American *Flourensia* taxa to define which species should be recognized based on morphological characters, using statistical as well as diagnostic character analyses for delimiting the species.

Materials and methods

This study is based on herbarium collections from BAA, CORD, LIL, LP, MERL, SI, and digital images from B, BM, CORD, F, G, GH, GOET, HUT, K, LIL, LP, MO, NY, P, S, SI, TEX, UPS, US, and USM available on JSTOR (www.jstor.org). We also conducted fieldwork across the Argentinean portion of the ranges of eight *Flourensia* species (*F. blakeana*, *F. campestris*, *F. hirta*, *F. niederleinii*, *F. suffrutescens*, *F. oolepis*, *F. polyclada* and *F. riparia*) in February 2012 and March 2016.

Taxon Sampling

A total of 138 specimens (including type materials) representing the 20 South American species of *Flourensia* recognized in previous studies, were chosen for the

morphometric analysis: *F. angustifolia* (holotype), *F. blakeana* (15), *F. cajabambensis* (holotype), *F. campestris* (15), *F. fiebrigii* (10), *F. heterolepis* (isoepitype), *F. hirta* (15), *F. hirtissima* (3), *F. leptopoda* (15), *F. macroligulata* (5), *F. macrophylla* (holotype), *F. niederleinii* (10), *F. oolepis* (10), *F. peruviana* (holotype), *F. polycephala* (isotype), *F. polyclada* (5), *F. riparia* (10), *F. suffrutescens* (5), *F. thurifera* (5), and *F. tortuosa* (15). All specimens chosen for the statistical analyses are marked with an asterisk (*) under taxonomic treatment (see below).

Geo-mapping

The herbarium specimens that were included in the morphological analyses were mapped onto a contour map of South America using DIVA GIS v5.2.0.2 (http://www.dive-gis.org). The records with ambiguous locality or with little information on the locality were not taken into account.

Morphological Data

We analysed a total of 34 characters: 10 vegetative and 24 reproductive ones (Appendix 1). All characters used to separate the South American species of *Flourensia* by former authors, as well as new characters that were inferred as useful during the field sampling, were included in our multivariate analyses. All specimens were studied by direct observation and by the stereoscope WILD Heerbrugg M5-26799; measurements were taken using a calibrated ocular micrometer. The leaf-blade observations were limited to the mid-section of flowering branches. Three florets per capitulum at approximately the same stage of anthesis from 3–5 capitula in each specimen were dissected.

Data Set Characteristics

A Kaiser–Meyer–Olkin (KMO) analysis was performed to determine the adequacy of the sampling of the South American *Flourensia* species. Pearson and Spearman correlation coefficients among all characters of the data set were computed in order to reveal highly correlated characters that may potentially distort the multivariate analyses (Michener and Sokal 1957, Conover 1999). The final data matrix does not contain missing data and it was standardized as follow: (1) subtracting the mean of each variable and dividing by the standard derivation for quantitative characters, and (2) semi-quantitative characters were log-transformed. Homogeneity of the data was tested with Bartlett's test. All statistical analyses were carried out using the software NTSYS-pc Ver. 2.21c. (Rohlf 2009).

Multivariate Analyses

We used a combination of clustering and ordination statistical analyses: the (1) cluster analysis employed Ward's method (minimization of the increase of the error sum of squares) with the Gower distance coefficient (Gower 1971), and the (2) principal coordinate analyses (PCoA) were performed to find the phenetic relationships among the specimens in an ordination space (see Marhold 2011, Kapplan and Marhold 2012). The co-phenetic correlation coefficient (*r*) was estimated to measure the distortion between the original matrix and the phenogram (Sneath and Sokal 1973, Sebola and Balkwill 2009, Escobar et al. 2011, Ospina et al. 2016). All analyses were carried out using the software NTSYS-pc Ver. 2.21c. (Rohlf 2009).

Concepts of species delimitation

To delimit the species treated here we have followed a conservative and widely accepted morphological species concept. According to this concept, continuous variation of characters is allowed within the species, while discontinuous variation in more than one character define distinct species (e.g. Davies and Heywood 1967).

Results

The study of data set characteristics revealed that the correlation coefficients among the 34 characters did not exceed 0.85 for any character pair, and thus all of the measured characters were retained for further analyses. The value of the KMO analysis performed for the variation of 20 previously accepted South American species of *Flourensia* was 0.79, indicating an adequate plant sampling and enabled us to perform multivariate analyses. Our data showed a normal distribution.

The Ward's cluster analysis (Fig. 1) of all specimens representing the 20 South American species of *Flourensia* recognized by Dillon (1984) showed that *F. niederleinii* and most of the under-represented species, i.e. *F. angustifolia*, *F. cajabambensis*, *F. peruviana*, *F. heterolepis*, *F. polycephala*, and *F. hirtissima* formed separated clusters (only *F. macrophylla* shows an ambiguous similarity relation with *F. macroligulata* + *F. tortuosa*). The remaining specimens were intermingled in four main groups, each with little metric distance suggesting high similarity between the species of each group. The first group (I) includes *Flourensia blakeana*, *F. fiebrigii*, and *F. hirta*, from north-western Argentina and southern Bolivia, characterized by narrow lanceolate leaves, glabrous to hirsutulose phyllaries, and capitula with 5-10 ray florets. The second group (II) includes

five taxa, i.e. *F. campestris*, *F. leptopoda*, *F. oolepis*, and *F. riparia*, from central-northwestern Argentina and *F. thurifera*, from Central Chile. *Flourensia campestris* was described on the basis of its oblong-lanceolate leaves with entire leaf margins, and capitula ca. 8 mm high with 5-8 ray florets. The identity of *Flourensia leptopoda* was based on its lanceolate to rhombic-ovate leaves with deeply and irregularly repand-dentate leaf margins and capitula ca. 8 mm high with ca. 5 ray floret. *Flourensia oolepis* was differentiated by its elliptic to elliptic-lanceolate leaves with entire (or few acute teeth above) leaf margins, and capitula 10-12 mm high with 12-16 ray florets. *Flourensia riparia* was described on the basis of its lanceolate-oblong to elliptic-oblong leaves with entire leaf margins, and capitula ca. 11 mm high with 7-10 ray florets, and *F. thurifera* on the basis of its oblong-lanceolate leaves with shallowly repand-dentate leaf margins, and capitula 10-15 mm high with ca. 13 ray florets. However, Ward´s and PCoA analyses show these specimens intermingled. A third group (III) includes *F. macroligulata* and *F. tortuosa*, which are morphologically similar. Both are confined to north-western Argentina and are sympatric in part of their distributions. Earlier taxonomic revisions (Dillon 1984, Ariza Espinar 2000, Ariza Espinar and Ospina 2015) have also revealed little differentiation between these taxa, except for sericeous phyllaries in *F. macroligulata* (vs. glabrous or puberulous in *F. tortuosa*); ray florets 13-21 (vs. ca. 10 in *F. tortuosa*); ligules 25-50 mm long (vs. 18-30 in *F. tortuosa*). The forth group (IV), includes *F. suffrutescens* and *F. polyclada*, both are endemic to north-western Argentina and are found together in the province La Rioja. The two species have a small habit with short ascending or procumbent much branched stems, and solitary large capitula, 12-20 mm wide (disk). The UPGMA cluster analysis (diagram not shown) gave similar results. The main clusters were formed equally in both analyses (containing the

same subclusters) and similar relationships were maintained between the subclusters. The only observed differences concerned the positions of some of the species within subclusters, presumably because the distance measures and clustering methods implemented in our two analyses differ in their algorithmic properties.

The PCoA (Fig. 2) recovered 11 clearly discriminated groups when two principal coordinates were plotted. The two groups are in agreement with our cluster results (Fig.1). The first three coordinates accounted for 71.9% of the total variance (35.5%, 24.9%, and 11.5%, respectively; Table 1). Finally, the co-phenetic correlation is high (r= 0.91), indicating a good fit between the Euclidean distance between all specimens in the two dimensional plot and the distance in the original multidimensional space.

The morphological analysis testing species delimitation, based on the 34 characters retained in our analyses (Appendix 1), show that the variables that contribute most to the PCoA are the plant height (PT), abaxial leaf-blade surface (LBAB), petiole length (PL), adaxial paleae surface (PAD), abaxial paleae surface (PAB), and pappus squamae (PSQ); in the PCo2 the contributing characters include, involucre length (IL), involucre diameter (ID), inner phyllaries length (PIL), inner phyllaries width (PIW), ray floret number (RFN), and the ligules venation number (LVN); in the PCo3 analysis the contributing characters include leaf-blade length (LBL) and leaf-blade adaxial surface (LBAD) (Fig. 3, Table 1).

Taxonomic Implications—The Multivariate analysis of the morphological data from 138 specimens of the 20 South American *Flourensia* species indicate that in eight cases (mostly those with one to three specimens of suitable material available) the groupings corresponded to previously described species, i.e. *F. angustifolia*, *F. cajabambensis*, *F.*

heterolepis, *F. hirtissima*, *F. macrophylla*, *F. niederleini*; *F. peruviana*, and *F. polycephala*. However, our results furthermore indicate that only four species should be recognized among the remaining 12 species. These species are: *Flourensia fiebrigii* S. F. Blake, *F. thurifera* (Molina) DC., *F. tortuosa* Griseb., and *F. suffrutescens* (R. E. Fr.) S. F. Blake. Therefore, in agreement with our results *Flourensia* consist of 12 South America species (Fig. 4), and the corresponding synonyms for the four newly circumscribed species are indicated.

Taxonomic treatment

1. *Flourensia fiebrigii* S. F. Blake (1916 p. 47).

Type: Bolivia. Tarija: W of Tarija, summit of pass near Paicho, 3200 m, 5 Feb 1904, *K. Fiebrig 3050* (lectotype: F0050241F!, designated by Dillon (1984 p. 51); isolectotypes: BM 001009697!, G 00223813!, GH 00008161!, K 000497230!, LIL 001728!, LP 002053! Fragment ex F, MO, S-R-2343!, SI 000864!, US 00125310!).

Taxonomic synonyms: *Flourensia hirta* S. F. Blake (1921 p. 402) syn. nov. **Type**: Argentina. La Rioja: en las cercanías de Los Corrales, Sierra Famatina, 7 Feb 1897, *G. Hieronymus & G. Niederlein 635* (lectotype: GH 00008162!, fragment ex B†, designated by Dillon (1984 p. 54); isolectotype, CORD 00004562!). *Flourensia blakeana* M. O. Dillon (1981 p. 108) syn. nov. **Type**: Argentina. Tucumán: [Tafí del Valle], along Ruta 307 at Km 95-105, between Amaicha del Valle and Tafí del Valle, 2900-3000 m s.m., 22 Feb 1973, *M.*

O. Dillon & E. Rodríguez 560 (holotype: LL; isotypes: BM 001009695!, F 0050239F!, HUT, LP, MO, NY 00169385!, USM).

Description

Shrubs 0.50–1.5 m tall; stems ascending, hirsutulose. Leaves narrowly lanceolate, 3–8 × 0.3–2 cm, upper and lower surfaces glabrous or hirsutulose, bases and apices attenuate, margins entire, hispid pilose; petioles 1–6 mm long. Capitula arranged in cymose inflorescences, 2-4-headed; peduncles 1–6 cm long, hispid-pilose. Involucres campanulate, 5–12 × 6–10 mm; phyllaries 2-seriate, subequal, linear-lanceolate to lanceolate, 3–13 × 0.8–2 mm, apices acute to attenuate, herbaceous, glabrous to hirsutulose. Paleae oblanceolate, 5–7 mm long, apices acute to obtuse, glabrous to hirsutulose. Ray florets 5–10, ligules oblong to oblong-ovate, 8–24 × 3–8 mm, tube 3–5 mm long, glabrous to puberulent. Disc florets 10–25, corollas tubulose, 3–5 mm long, tube 0.5–1 mm long, lobes 0.5–0.8 mm long, puberulent or glabrous. Achenes obconical, 4–6 mm long, densely sericeous, sometimes faces glabrescent. Pappus of 2 (rarely 3) awns, 2–4 mm long, persistent.

Distribution and habitat

Mountains of north-western Argentina (Catamarca, Jujuy, La Rioja, Salta, and Tucumán) and southern Bolivia (Potosi). It has been found growing in rocky and sandy soils between (1,200)1,500 and 4,000 m (Fig. 4).

Vernacular name

Viscol (Dillon 1984), Biscol.

Taxonomic Notes

Flourensia blakeana (west-central Argentina, 1500-3000 m) was distinguished from *F. hirta* (also known from west-central Argentina, 1500-2700 m) and *F. fiebrigii* (southern Bolivia to north-western Argentina, 2500-4000 m) by its glabrous phyllaries (vs. strigillose to hirsutulose or glabrescent in *F. hirta*, and *F. fiebrigii*) and leaves less than 3.5 cm long (vs. leaves mostly greater than 3.5 cm long in *F. hirta*, and *F. fiebrigii*). Additionally, *F. hirta* has lanceolate to linear-lanceolate leaves, 5-12 mm wide and 5-8 ray florets (vs. lanceolate leaves, 5-20 mm wide and 7-10 ray florets in *F. fiebrigii*). Our results show these characters as largely overlapping, and that they do not support maintaining these taxa as different species. Therefore, in agreement with our results, we synonymize *Flourensia blakeana* and *F. hirta* under *F. fiebrigii*. A new taxonomic circumscription of *F. fiebrigii*, following a rather broad morphological species concept, is here provided, with leaf blades varying from lanceolate to linear-lanceolate, 3-8 cm long, and phyllaries glabrous to hirsutulose, occurring from southern Bolivia to west-central Argentina, between 1500-4000 m in arid montane sites (Figs. 1, 4, 5A-B).

Additional specimens examined

Argentina. Catamarca: Tinogasta, Ciénaga Redonda, 24 Feb 1950, *J. Hunziker & Caso 4057* (CORD)*; Tinogasta, 19 Mar 1947, *O'Donell & Meyer 5095* (LIL)*; Santa María, Caspinchango, 3 Feb 1949, *Reales 1548* (LIL)*; Tinogasta, Cachiyuyo to Punta Negra, 20 Jan 1930, *Schreiter 6398* (LIL)*; Tinogasta, Las Angosturas, 2550 m a.s.l., 19 Mar 1951, *Vervoorst 3150* (LIL)*. Jujuy: Maimará, 3000 m a.s.l., year 1912, *Budin s.n.* (SI 26701)*;

Maimará, Sierra de Zenta, Mar 1931, *Budin s.n.* (SI 1531); Humahuaca to Palca de Aparzo, 26 Feb 1983, *J. Hunziker et al. 10407* (SI)*; Iturbe to Iruya, 3700 m a.s.l., 11 Feb 1998, *Morrone et al. 2458* (SI)*; Tilcara, Cerro Peña Alta, 2700 m, 8 Feb 1927, *Venturi 4910* (LIL, SI)*; Tilcara to Alfarcito, 2900 m a.s.l., 11 Feb 2007, *Zuloaga et al. 9244* (SI)*. La Rioja: Sierra de Famatina, La Aguadita, 18/20 Feb 1981, *Ambrosetti 31077* (MERL)*; Chilecito, Cuesta de Guanchín, 1800 m a.s.l., 1 Apr 2014, *Barboza et al. 4219.* (CORD)*; Chilecito to Guanchín, 1250 m a.s.l., 1 Apr 2014, *Barboza et al. 4231* (CORD)*; 1250 m a.s.l., 1 Apr 2014, *Barboza et al. 4240* (CORD)*; Vinchina, Quebrada del Río El Peñón, 15 Dec 1996, *Biurrun & Molina 4575* (CORD)*; Gral. Lamadrid, 2900 m a.s.l., 5 Feb 1999, *Biurrun et al. 5494* (SI)*; Vinchina, Jagüel, 12 Dec 1915, 2600 m a.s.l., *Hosseus 1247* (CORD); Vinchina, Valle Hermoso 2700 m a.s.l., 9 Mar 1950, *J. Hunziker & Caso 4260* (CORD); Famatina, 1350 m a.s.l., 26 Mar 1992, *J. Hunziker & Gamerro 11978, 11979* (SI)*; Vinchina, Punta de Agua, 23 May 1949, *Krapovickas & J. Hunziker 5486* (CORD)*; Famatina, Angulos, Rio Blanco, 30 Mar 2016, *Ospina 22, 23*, 24* (SI); Famatina, 8 Jan 2012, *Ratto et al. 47* (SI); Famatina, Campanas, Ismiango, 1850 m a.s.l., Feb 1942, *Rojas Paz s.n.* (LIL 93483); Gral. Lamadrid, Punta del Agua, 2700 m a.s.l., 20 Feb 2010, *Zuloaga et al. 12070* (SI)*. Salta: Cafayate, El Divisadero, 27 Feb 2016, *Correa et al. 009* (SI)*; Cachi, Sierra del Candado, 29 Feb 2016, *Correa et al. 020* (SI)*. Tucumán: Tafí, Amaicha to Infiernillo, 2600 m a.s.l., 9 Mar 1955, *Ahumada de Jerez s.n.* (LIL)*; Tafí, Ampimpa, 2400 m a.s.l., 21 Mar 2010, *Barboza et al. 2477* (CORD)*; Tafí del Valle to Amaicha del Valle, 2850 m a.s.l., 21 Feb 2011, *Barboza et al. 3025* (CORD)*; Tafí, Ampipampa, 2200 m a.s.l., 13 Mar 2015, *Barboza et al. 4390* (CORD); Tafí del Valle, Cuesta del Infiernillo, 25 Feb 1970, *Cabrera & Frangi 20763* (LP)*; Amaicha del Valle, 11 Jan 1980, *Cordo 80-*

A-9 (SI)*; Tafí del Valle, 3 Feb 1990, *Cordo et al. 90-A-62* (SI)*; *Correa et al. 002, 003, 004, 005** (SI); Tafí, El Infiernillo-Amaicha del Valle, 15 Jan 1966, *Legname & Cuezzo 5513* (LIL)*; Tafí, Amaicha del Valle, 2600 m a.s.l., 22 Mar 1947, *O'Donell & Meyer 5309* (LIL)*; Tafí del Valle, El Infiernillo, 10 Feb 2014, *Ratto et al. 177* (BAA)*; Tafí, Amaicha del Valle, 13 Feb 1948, *Reales 907* (LIL)*; Machorastroja, 3000 m a.s.l., 16 Feb 1920, *Schreiter 1311* (LIL)*; Tafí del Valle, La Banda, 2000 m a.s.l., 25 Jan 1959, *Türpe 399* (LIL)*; Tafí, Amaicha del Valle-El Infiernillo, 2700 m a.s.l., 18 Feb 2007, *Zuloaga et al. 9491* (SI)*. Bolivia. Cochabamba: Arani, 29 Nov 1979, *Krach 6938* (SI)*.

2. *Flourensia suffrutescens* (R. E. Fr.) S. F. Blake (1913 p. 376).

Basyonim: *Encelia suffrutescens* R. E. Fr. (1905 p. 83).

Type: Argentina. Jujuy: El Moreno, in declivibus montis saxosis, 3600 m, 16 Dec 1901, *R. E. Fries 926* (holotype: UPS; isotypes: CORD 00004556!, S-R-1912!, US 00125382!).

Taxonomic synonyms: *Flourensia polyclada* S. F. Blake (1921 p. 403) syn. nov. **Type**: Argentina. La Rioja: entre la Cueva de la Mesada y La Encrucijada, Sierra Famatina, 31 Jan 1879, *G. Hieronymus & G. Niederlein 541* (lectotype: GH 00008168! fragment ex B†, designated by Ariza Espinar and Ospina (2015 p. 210); isolectotypes: CORD 00004567!, CORD 00004568!, G 00223809!)

Description

Shrubs to 0.40 m tall; stems decumbent to ascending, pilose. Leaves narrowly lanceolate to oblong, (1.5–)2–8.5 × (0.4–)0.8–1.8 cm, upper and lower surfaces pilose, base cuneate to attenuate, apex acute to attenuate, margins entire; petioles 1–5 mm long. Capitula solitary, terminal; peduncles 2–11 cm long, densely pilose, bracteate. Involucre hemispheric, (8–)10–12(–16) × 10–20 mm; phyllaries 2-seriate, subequal, ovate-lanceolate to oblong-lanceolate, ca. 11 × 2–2.5 mm, apex acute to attenuate, herbaceous, hirsutulose. Paleae oblanceolate, 8–10 mm long, apex obtuse to truncate. Ray florets 9–15, ligules linear-oblong to elliptic, 17–32 × 4–10 mm, tube 5 mm long, sericeous. Disc florets ca. 50, corollas tubulose, ca. 5 mm long, tube ca. 1 mm long, lobes ca. 0.7 mm long. Achenes obconical, ca. 6 mm long, densely sericeous, sometimes faces glabrescent. Pappus of 2 awns, 3–4 mm long, persistent.

Distribution and habitat

Endemic to mountains of north-western Argentina (Jujuy, La Rioja, and Salta). It has been found growing on rocky slopes between 2,500 and 3,500 m (Fig. 4).

Taxonomic Notes

Dillon (1984) considered *Flourensia polyclada*as a dubious species, probably a synonym of *F. fiebrigii*. Ariza Espinar and Ospina (2015) recognized *Flourensia polyclada* as a distinctive species, distinguished from *F. fiebrigii* by being small shrubs to 0.40 m tall (vs. to 1 m tall in *F. fiebrigii*), solitary capitula (vs. solitary or in leafy cimose 2-4-headed in *F. fiebrigii*) involucres 6-9 x 9-11 mm (vs. 5 x 6 mm in *F. fiebrigii*). Additionally, these authors separated *Flourensia polyclada*, endemic of west-central Argentina (Sierra

Famatina, La Rioja) from *F. suffrutescens* from north-western and west-central Argentina by being shrubs to 0.40 m tall (vs. 0.30 m tall in *F. polyclada*), no other distinctive characters were noticed by them. Here, in agreement with our results, we consider *Flourensia polyclada* as a synonym of *F. suffrutescens* (Figs. 1, 4, 6A-B).

Additional specimens examined

Argentina. Jujuy: Maimará, Hualchín, 27 Jan 1906, *Budin 67, 79* (LIL)*; Yavi, La Quiaca, 3450 m a.s.l., 15 Feb 1940, *Meyer s.n.* (LIL 33178); Tumbaya, Ciénaga Grande, 3500 m a.s.l., 19 Feb 1987, *Nicora et al. 8926* (SI); Cochinoca, Abra Pampa, Cerro Huancar, 22 Feb 2011, *Zuloaga et al. 13230* (SI)*. La Rioja: Famatina, Mina San Juan, 2 Mar 1906, *Kurtz* (CORD)*; Río Amarillo, Quebrada de Juan Diaz-Cueva de Juan Diaz, 14 Mar 1906, *Kurtz 13755* (CORD)*. Salta: Rosario de Lerma, Puerta de Tastil, 2700 m a.s.l., 10 Mar 2015, *Barboza et al. 4340* (CORD)*; Cachipampa to Tin-Tin, 27 Mar 1979, *Cabrera et al. 30757* (SI)*; Cachi, Cuesta del Obispo, 3000 m a.s.l., 14 Feb 2002, *Cialdella et al. 252* (SI); Cachi, Recta Tin Tin, 3000 m a.s.l., 24 Jan 1995, *J. Hunziker et al. 13178* (SI)*; Rosario de Lerma, Feb 2014, *Ratto et al. 10* (BAA)*; Rosario de Lerma, Quebrada del Toro, 3400 m a.s.l., 14 Feb 2007, *Zuloaga et al. 9333* (SI)*.

3. *Flourensia thurifera* (Molina) DC. (1836 p. 592).

Basionym: *Helianthus thurifera* Molina (1782 p. 160); based on the same type: *Diomedea thurifera* (Molina) Bertero ex Colla (1835 p. 37, t. 31).

Type: Chile. Valparaiso: sonnige Abhänge, 7 Oct 1895, *O. Buchtien s.n.* (neotype: US!, designated by Dillon (1984 p. 30); isoneotype: GH!).

Taxonomic synonyms: *Helianthus glutinosus* Hook. & Arn. (1830 p. 33). **Type**: Chile: Valparaiso, *T. Bridges s.n.* (holotype: GL). *Flourensia besseriana* Meyen & Walp. (1843 p. 270); based on the same type: *Helianthus besseriana* Benth. & Hook.f. (1873 p. 376), nom. inval. **Type**: Chile. No exact locality: *B. Besser s.n.* (holotype B†; lectotype-fragment: GH, designated by Dillon (1984 p. 30); photo of B† specimen: F!). *Flourensia thurifera* var. *lanceolate* J. Rémy in Gay (1849 p. 288). **Type**: Chile (probably P, not located). *Flourensia campestris* Griseb. (1874 p.184) syn. nov.; based on the same type: *Helianthus campestris* (Griseb.) Kuntze (1898 p. 157). **Type**: Argentina. Córdoba: Sudostlich von Córdoba, 1871, *P. G. Lorentz 245* (lectotype: GOET 001555!, designated by Dillon (1984 p. 56); isolectotypes: CORD 00006330!, GH-fragment 00008159!)**.** *Flourensia riparia* Griseb. (1879 p. 196); based on the same type: *Helianthus riparia* (Griseb.) Kuntze (1898 p. 157) syn. nov. **Type**: Argentina. Salta: pasaje del Rio Juramento, Feb 1873, *P. G. Lorentz & G. Hieronymus 268* (lectotype: GOET 001557!, designated by Dillon (1984 p. 56); isolectotypes: CORD 00006484!, CORD 00006485!, CORD 00006486!, G 00223808!, GH 00008169!, GH 00008170!, GOET 001558!, SI 000866!, US; probable isolectotypes: NY 00169389!, S, *s.n.*). *Flourensia oolepis* S. F. Blake (1921 p. 406) syn. nov. **Type**: Argentina. Córdoba: Cuesta de la Oyada, Sierra Achala, 22 Mar 1876, *G. Hieronymus s.n.* (lectotype-fragment: GH 00008167!, designated by Dillon (1984 p. 48). *Flourensia grindelioides* S. Moore (1926, p. 192). **Type**: Argentina. [San Luis in the protologue]: no exact locality, Feb 1926, *D. Wright s.n.* (holotype: BM 001009696!; isotypes: GH, MO, US). *Flourensia leptopoda* S. F. Blake (1921 p. 406) syn. nov. **Type**: Argentina. La Rioja:

Farrecillas, 5 Mar 1906, *J. S. Urriche s.n*. (lectotype-fragment: GH 00008164!, designated by Dillon (1984 p. 62).

Description

Shrubs to 3 m tall; stems erect or ascending, reddish brown, puberulent to glabrous. Leaves ovate, ovate-rhombic, ovate-elliptic to ovate-lanceolate or lanceolate, 3–14 × 1.2–5 cm, upper and lower surfaces strigillose to glabrous, base attenuate to cuneate, apex acute to acuminate, margins deeply and irregulary dentate with 4–10 pairs of triangular, mucronate teeth to shallowly repand-dentate with 4–6 teeth apically or entire; petioles 2–13 mm long. Capitula (1) 2-3 to arranged in leafy cymose or cymose-paniculate inflorescences, 5-15-headed; peduncles 0.8–6(13) cm long, bracteate. Involucre cylindric-campanulate, campanulate or hemispheric, 3–15 × 4–25; phyllaries 2-seriate, subequal, ovate to ovate-lanceolate or lanceolate, 4–6(17) × 1–4 mm, apex acute to acuminate, herbaceous, sparsely to densely villous. Paleae oblanceolate, 6–10 mm long, apex obtuse to rounded, dorsally puberulent. Ray florets 5–16, ligules oval to oblong-oval or oblong, 7–30 × 3–10 mm, tube 2–5 mm long, glabrous to sericeous or villosulose. Disc florets 15–50, corollas tubulose, 5–6.5 mm long, tube 0.5–2 mm long, lobes 0.5–0.8 mm long, puberulent. Achenes obconical, 5–9 mm long, densely sericeous, sometimes margins sericeous and faces glabrescent to papillose. Pappus of 2 (rarely 3 or 4) awns, 3–5 mm long, persistent.

Distribution and habitat

Endemic to mountains of central-north-western Argentina (Catamarca, Córdoba, Jujuy, La Rioja, Salta, San Juan, San Luis, Santiago del Estero, and Tucumán) and Central Chile

(Aconcagua, Coquimbo, Santiago). It has been found growing in rocky and sandy soils between 500 and 2,500 m (Fig. 4).

Vernacular name

Chilca (Dillon 1984), Maravilla.

Taxonomic Notes

Flourensia campestris, *F. leptopoda*, *F. oolepis*, *F. riparia*, and *F. thurifera* were considered different taxa by several authors, e.g. Dillon (1978, 1984), Ariza Espinar (2000), and Ariza Espinar and Ospina (2015). Delbón et al. (2007a) distinguished *F. oolepis* from *F. campestris* by quantitative leaf epidermal characters (e.g. stomatal index, trichomes frequency). Subsequently, morphological studies (Delbón et al. 2017b) showed that *F. campestris*, *F. oolepis*, and *F. leptopoda*, all occurring in west-central Argentina, have similar caulinar and foliar anatomy. Cytological studies (Delbón et al. 2014) showed differences in the karyotype of these three species. Presence of continuous characters as well as combinations of floral (e.g. number of capitula) and vegetative characters (e.g. leaf margin teeth: 6–8 prominent teeth in *F. leptopoda*, 4–6 slightly prominent teeth in *F. oolepis*, and usually absent in *F. campestris*) have frequently led to misidentification in areas where these species coexist. Our analyses show the specimens of these three species intermingled in a group with *Flourensia. riparia*, from north-western and west-central Argentina, and *F. thurifera* from central Chile, indicating slight morphological differentiation under similar arid environments. Therefore, *Flourensia campestris*, *F. leptopoda*, *F. oolepis*, and *F. riparia* are here treated as synonyms of *F. thurifera.* Our concept of *Flourensia thurifera* is of a polymorphic species, with leaf blades varying from

lanceolate to ovate, acute to acuminate at the apices, with dentate to obscurely dentate or entire margins and capitula solitary to in leafy cymose or cymose-paniculate inflorescences with 5-16 ray florets, occurring in north-western and west-central Argentina, and central Chile, between 500-2500 m (Figs. 1, 4, 5C-D)

Additional specimens examined

Argentina. Catamarca: Capayán, Aimogasta to Chumbicha, 1150 m a.s.l., 22 Feb 2011, *Barboza et al. 3039* (CORD)*; Pomán to Colana, 1400-1500 m a.s.l., 2 Feb 1973, *Cantino 609* (SI); Capital, Lomas de Choya, Mar 1960, *Castillón 11694* (LIL); Sierra Gracián, 10 Jan 1940, *Castillón s.n.* (LIL 33182); 26 km of Catamarca, 1250 m a.s.l.,11 Feb 1973, *J. Hunziker & Andrada 9601* (SI)*; Capayán, Sierra de Ambato, Quebrada de La Cébila, 1250 m a.s.l., 10 Feb 1973, *J. Hunziker & Andrada 9584* (CORD, SI); Valle Viejo, Cuesta del Portezuelo, 1300 m a.s.l., 23 Mar 1960, *A. T. Hunziker et al. 15287* (CORD); Sierra de Ambato, Mutquín, Colana to Rincón, 8 Dec 1965, *A. T. Hunziker et al. 18439* (CORD). Córdoba: Pocho, Feb 2015, *Aagesen s.n.* (SI)*; Colón, Saldán, 4 Feb 1966, *Ariza Espinar 2147* (CORD); Punilla, Villa Carlos Paz to Dique San Roque, 29 Dec 1993, *Ariza Espinar 3192* (CORD)*; La Reducción, *Burkart 7501* (SI); Cruz del Eje, 1 Mar 1957, *Burkart 20423* (SI); Las Lajas, 725 m a.s.l., 17 Dec 2009, *Cantero 5916* (CORD)*; Río Cuarto, Alta Gracia, 10 Dec 2009, *Cantero & Núñez 5819* (CORD); Calamuchita, Valle de los Reartes, without date, *Castellanos 219* (SI); La Cumbre, 30 Jan 1990, *Cordo et al. 17* (SI); Colón, Casabamba, 30 Dec 1949, *A. de la Sota 1417* (LIL); Colón, La Falda, 12 Jan 1950, *A. de la Sota 1550* (LIL); Punilla, Tanti, 13 Jan 1950, *A. de la Sota 1589* (LIL); Santa

María, Las Canteras, 24 Dec 1950, *A. de la Sota 3398* (LIL); Tulumba, Sauce Punco, 27 Jan 1951, *A. de la Sota 3880* (LIL); Río Ceballos, Sierra Chica de Córdoba, 13 Jan 1878, *Galander s.n.* (CORD)*; Falda de la Punilla, 7 Dec 1876, *Hieronymus 623* (CORD, SI)*; Punilla, Dique San Roque, 29 Mar 1942, *Hosseus 639* (CORD)*; Colón, Diquecito, 8 Feb 1951, *J. Hunziker 2747* (SI)*; Santa María, Alta Gracia, Río Anizacate, 17 Jan 1940, *A. T. Hunziker 706* (LIL)*; Río Seco, Villa María-San Miguel, 11 Feb 1955, *A. T. Hunziker 10731* (CORD, SI); Capital, Parque Sarmiento, 6 Feb 1964, *A. T. Hunziker 17362* (CORD); Ischilín, Sierra de Masa, Masa to Las Lajas, 2 May 1958, *A.T. Hunziker 13655* (CORD, SI)*; Colón, Casabamba, 25 Feb 1945, *Krapovickas 1903* (LIL); Siquimán to Ochoa, 26 Feb 1889, *Kurtz 6534* (CORD)*; La Falda, year 1909, *Lizer s.n.* (SI *8864*); without locality and date, *Lorentz 8866* (SI); La Falda, 5 Feb 1965, *Meyer 22457* (LIL); Colón, Río Ceballos, Cerro Ñu-Pora, 700-800 m a.s.l., 14 Jan 1992, *Novara & Bruno 10530* (SI)*; La Oyada, 25/27 Jan 1908, *Puyssegur s.n.* (SI *8862*, *8867*); La Cumbre, Cuchi Corral, 25 Dec 1953, *Rentzell s.n.* (SI 18834); Calamuchita, Embalse de Río Tercero, 20 Feb/5 Mar 1962, *Roig 5008* (CORD, SI)*; Colón, La Falda, 1000 m a.s.l., 15 Dec 1946, *Sparre 1393* (LIL)*; Altos Sud, 16 Dec 1896, *Stuckert 1020* (CORD, SI); Sierra de Córdoba, 10 Mar 1900, *Stuckert 8150* (LIL); Capital, 10 Mar 1900, *Stuckert s.n.* (CORD 8808); Calamuchita, Sierra de San Ignacio, 24 Feb 1908, *Stuckert s.n.* (CORD 18579); Colón, Casa Bamba, 23 Jan 1930, *Stuckert s.n.* (CORD 23526); Río Cuarto, Sierra de Comechingones (E), Alpa Corral, La Unión, 27 Dec 1983, *Subil & Moscone 3291* (CORD)*; Yacanto, without date, *Vattuone 17* (SI). Jujuy: Santa Bárbara, El Fuerte, 21 Apr 1975, *Cabrera et al. 26212* (SI); Valle Grande, Pampichuela toValle Grande, 1600 m a.s.l., 19 Feb 2009, *Zuloaga et al. 10964* (SI)*; Santa Bárbara, Abra de los Morteros to El Fuerte, 1350 m a.s.l., 20 Jan 2012,

Zuloaga et al. 13675 (SI)*; Abra de los Morteros, 1400 m a.s.l., 20 Mar 2013, *Zuloaga et al. 14533* (SI)*; La Rioja: Gral. San Martín, Ulapes, Sierra de Ulapes, 700 m a.s.l., 18 Mar 2010, *Barboza 2438* (CORD)*; Capital, Sierra de Ambato, Quebrada de La Cébila, 7 Feb 1997, *Biurrun & Pagliari 4723* (SI); Chamical, Sierra de los Llanos, Senda de Godoy, 800-1000 m a.s.l., 15 Mar 1993, *Botta & Miconi 670* (SI); Chamical, Sierra de Malanzán, La Aguadita, 10 Apr 1975, *Roig & Méndez 8588* (MERL)*; Gral. Belgrano, Dique Gral. Belgrano, 9 Apr 1957, *Roig 1599 & Ruiz Leal* (MERL); Gral. Belgrano, 29 Feb 1906, *Roig 1613 & Ruiz Leal* (MERL)*; Independencia, Vilgo, 1350 m a.s.l., 26 Mar 2013, *Zapata 8* (CORD). Salta: Rosario de Lerma, Quebrada del Toro, 1800 m a.s.l., 10 Mar 2015, *Barboza et al. 4339* (CORD); La Viña, Cabra Corral, 12 Mar 2015, *Barboza et al. 4388* (CORD)*; Chicoana, Quebrada Escoipe, 2000 m a.s.l., 11 Feb 1972, *Cabrera et al. 21994* (SI); Cafayate, San Isidro, 27 Feb 2016, *Correa et al. 006* (SI)*; Cafayate, El Divisadero, 27 Feb 2016, *Correa et al. 007, 008** (SI); Cachi, Sierra del Candado, Quebrada de Escoipe, 29 Feb 2016, *Correa et al. 019* (SI)*; Coronel Moldes, 1100 m a.s.l., 31 Jan 1941, *Meyer 3535, 3829* (LIL)*; La Candelaria, 17 Feb 1962, *Meyer et al. 2201* (LIL); Guachipas to Pampa Grande, 8 Feb 1961, *Meyer 21858* (LIL)*; La Viña, Osma, 27 Jan 1989, *Novara 8506* (SI); La Viña, 2 km S of Talapampa, 1150 m a.s.l., 22 Feb 1990, *Novara & Bruno 9598* (SI)*; La Viña, Coronel Moldes, 1100-1200 m a.s.l., 1 Mar 1989, *Novara et al. 8619* (SI); Chicoana, near La Viña, 1300 m a.s.l., 25 Jan 2007, *Paula-Souza 7787* (SI); La Viña, Coronel Moldes, 1300 m a.s.l., 25 Jan 2007, *Paula-Souza 7836 et al.* (SI); Guachipas, Cabra Corral, 1000 m a.s.l., 15 Jan 1989, *Saravia Toledo 1822* (SI); La Candelaria, Unquillo, Jan 1933, *Schreiter 9406* (LIL); Quebradas del Toro and Río Blanco, *Vattuone 105* (SI)*; Candelaria, 1000 m a.s.l., 15 Mar 1925, *Venturi 3708* (LIL, SI)*; Chicoana,

Pulares to San Fernando de Escoipe, 1600 m a.s.l., 15 Feb 2007, *Zuloaga et al. 9371* (SI)*; La Viña, N of La Viña, 1200 m a.s.l., 15 Feb 2010, *Zuloaga et al. 11822* (SI)*. San Juan: Sierra de Valle Fértil, 15 Feb 1975, *Ambrosetti 1914* (MERL)*; Campo de Ischigualasto, near Baldecito, Feb 1896, *Bodenbender 9029* (CORD); Chepical, Cerro Loma Negra Chico, 6 Feb 1976, *Contreras s.n.* (MERL 53313); Valle Fértil, 900 m a.s.l., 9 Mar 1998, *Fortunato et al. 5930* (SI); Sierra Pie de Palo, Quebrada del Molle, 1800 m a.s.l., 19/20 Dec 1980, *A. T. Hunziker et al. 23829* (CORD)*; Angaco, Sierra Pie de Palo, Mogote de los Corralitos, 18 Feb 1986, *Kiesling et al. 6310* (SI); Angaco, Sierra Pie de Palo, 6 Feb 2000, *Kiesling et al. 9349* (SI); Jáchal, Quebrada de las Vacas, 12 Feb 2000, *Kiesling et al. 9472* (SI); Valle Fértil, Quebrada de Astica, 28 Mar 2007, *Márquez 416* (MERL)*; Valle Fértil, Usno, 5 Mar 2015, *Márquez 452* (MERL); Valle Fértil, Cerro Pan de Azúcar, 29 Feb 1994, *Márquez & Maldonado 14* (SI); Valle Fértil, 15 Feb 1975, *Roig 8410* (MERL, SI)*; Ischigualasto, Valle de la Luna, 22 Mar 1973, *Roig & Menéndez 7806* (MERL, SI)*. San Luis: Chacabuco, N dique Piscu Yaco, Apr 2010, *Aagesen s.n.* (SI)*; La Capital, los Puquios, Cerro Cuatro Esquinas, 950 m a.s.l., 23 Mar 1972, *Anderson 2387* (CORD); El Volcán to Potreo de los Funes, 29 Jan 1946, *Nicora 4253* (SI); Pringles, Río Quinto, 22 Jan 1969, *Roig 5631* (MERL)*; Quebrada de Gualcamayo, Chepical to El Salto, 13 Dec 1957, *Ruiz Leal 18965 & Roig* (MERL)*. Santiago del Estero: Guasayán, Santa Catalina to Puerta Chiquita, 500 m a.s.l., 6 Mar 1985, *Roig & Villaverde 1124* (SI)*; Ojo de Agua, Ashpa-Puca, 19 Dec 1981, *Ulibarri 1410* (SI). Tucumán: Trancas, Tapia-Vipos, 800 m a.s.l., 9 Mar 2015, *Barboza et al. 4338* (CORD)*; Ojo de Agua, Piedra Blanca, 23 Feb 1980, *Cabrera et al. 31883* (SI); San Pedro de Colalao, 1300 m a.s.l., 2 Mar 1917, *Castillón 221* (LIL)*; Burruyacu, Sierra Nogalito, km 4, 1000 m a.s.l., 2 Feb 1963, *Krapovickas &*

Legname 10897 (LIL)*; Burruyacu, Río Nio to Alto de Medina, 20 Mar 1964, *Legname & Cuezzo 4669* (LIL); Burruyacu, Río del Nio, 12 Feb 1914, *León Monetti 15964* (LIL)*; Tapia, 700 m a.s.l., 26 Dec 1911, *Rodríguez 230* (SI)*; Vipos, 650 m a.s.l., 27 Feb 1921, *Schreiter 1460* (LIL); El Cadillal, Tapia, 21 Jan 1924, *Schreiter s.n.* (LIL 75599); Burruyacu, 1 Apr 1900, *Stuckert 9132* (CORD); Trancas, Tapia, 750 m a.s.l., 9 Feb 1922, *Venturi 1697* (LIL, SI)*; Trancas, Vipos, 800 m a.s.l., 13 Jan 1924, *Venturi 2684* (LIL, SI); Trancas, Monte Bello, 18 Apr 1926, *Venturi 4171* (LIL); Trancas, Tapia, 750 m a.s.l., 1 Jan 1928, *Venturi 5818* (SI)*; Burruyacu, Sierra de Nogalito, Quebrada de las Asperezas, 1600 m a.s.l., 24 Mar 1961, *Vervoorst 6814* (LIL)*. Chile: Aconcagua: Palos Quemados to Zapallar, 9 Oct 1946, *Kausel 2578* (LIL)*. Coquimbo: Fray Jorge, 14 Sep 1947, *Jiles 306* (SI)*; Coquimbo, Ovalle, Fray Jorge, 21 Sep 1952, *Ricardi 2132* (LIL); Coquimbo, Rivadavia, 800 m a.s.l., Nov 1923, *Wedermann 90* (LIL, SI)*. Santiago: Cerro San Cristóbal, 800 m a.s.l., 9 Aug 1950, *Gunckel 18518* (LIL)*; 29 Aug 1946, *Kausel 2277* (LIL); 6 Aug 1925, *Looser 120* (SI)*.

4. *Flourensia tortuosa* Griseb. (1874 p. 184)

Type: Argentina. Catamarca: in Camp von Belén bis Yakutula, 24 Jan 1872, *P. G. Lorentz 659* (lectotype: GOET 001559!, designated by Dillon (1984 p. 47); isolectotypes: CORD 00006331!, CORD 00006332!).

Taxonomic synonyms: *Flourensia macroligulata* Seeligm. (1960 p. 113) syn. nov. **Type**: Argentina. Jujuy: Volcán, Loma de la Laguna, 15 Feb 1924, *R. Schreiter 2663* (holotype: LIL 001729!).

Description

Shrubs 1–2 m tall; stems ascending, sparsely sericeous. Leaves lanceolate to elliptic, 5–14 × 1.5–6 cm, upper and lower surfaces glabrous or sparsely sericeous, base attenuate, apex acute to obtuse, margins entire; petioles 3–17 mm long. Capitula solitary or arranged in cymose inflorescences, 2-3-headed; peduncles 1–15 cm long, puberulent, bracteate. Involucre hemispheric, 10–20 × 15–25 mm; phyllaries 2-seriate, subequal, ovate to ovate-lanceolate, 5–20 × 3–7 mm, apices acute to attenuate, herbaceous, glabrous to sparsely sericeous, ciliolate. Paleae oblanceolate, 10–13 mm long, apices acute to truncate, ciliolate, dorsally sericeous. Ray florets 9–21, ligules oblong to oblong-elliptic, 18–50 × 4–10 mm, tube 5–9 mm long, glabrous to sericeous. Disc florets 30–75, corollas tubulose, 4–6 mm long, tube ca. 1 mm long, lobes 0.7–0.8 mm long, puberulent. Achenes obconical, 5–11 mm long, densely sericeous, sometimes faces glabrescent. Pappus of 2 awns, 3–3.5 mm long, usually persistent.

Distribution and habitat

Endemic to mountains of north-western Argentina (Catamarca, Jujuy, Salta, and Tucumán). It has been found growing on rocky and overgrazed slopes between 1,000 and 4000 m (Fig. 4).

Vernacular name

Maravilla, Viscol.

Taxonomic Notes

Published taxonomic revisions (Dillon 1984, Ariza Espinar 2000, Ariza Espinar and Ospina 2015) have revealed few differences between *Flourensia macroligulata* and *F. tortuosa* (from north-western and west-central Argentina, between 2000-3000 and 2500-3600 m, respectively). The characters that have been used for species delimitation overlap or are continuous and are limited to sericeous phyllaries in *F. macroligulata* (vs. glabrous or puberulus in *F. tortuosa*); ray florets 13-21 (vs. ca. 10 in *F. tortuosa*), and ligules 25-50 mm long (vs. 18-30 in *F. tortuosa*). Our study shows that the specimens of these two species are intermingled in one group. Therefore, we consider *Flourensia macroligulata* as a synonym of *F. tortuosa* (Figs. 1, 4, 6C-D).

***Additional specimens e*xamined**

Argentina. Catamarca: Santa María to Belén, 2300 m a.s.l., 21 Feb 2011, *Barboza et al. 3033* (CORD)*; Belén, Londres, 1250 m a.s.l., 22 Feb 2011; *Barboza et al. 3038* (CORD); Belén, Quebrada de Randolfo, 2850 m a.s.l., 6 Feb 2015, *Barboza et al. 4317* (CORD)*; Belén, Laguna Blanca, Cerro Pabellón, 24 Feb 1981, *Cabrera et al. 32504* (SI); Belén, Las Granadillas, 1850 m a.s.l., 15 Mar 2003, *Cocucci et al. 2594* (CORD); Minas Capillitas, 3200 m a.s.l., 28 Feb 1978, *Cordo 78-A-52* (SI); Andalgalá, Cuesta de la Chilca, 1600 m a.s.l., 24 Mar 1960, *Cristóbal 1477* (LIL)*; Belén, Las Cuevas, 4000 m a.s.l., 2 Apr 1946, *Droghetti s.n.* (LIL); 24 km N of Hualfín, 2150 m a.s.l., 21 Jan 1995, *J. Hunziker et al. 13134* (SI)*; El Candado, 10 Feb 1917, *Jörgensen 1273* (LIL, SI); Andalgalá, Cuesta de la Chilca, 1900 m a.s.l., 24 Mar 1960, *Ledda & Türpe s.n.* (LIL); Yacutula, near Belén, Feb 1872, *Lorentz s.n*. (CORD); Cerrillos, Mar 1944, *Meyer 6877* (LIL)*; Belén, Cuesta de Zapata, 20 Mar 1947, *O'Donell & Meyer 5157* (LIL); Andalgalá, Capillitas, 21 Mar 1947, *O'Donell & Meyer 12594* (LIL); Santa María, Cerro La Calera, 23 Feb 1948, *Reales 988*

(LIL)*; Campo de Yacutula, Mar 1879, *Schickendantz 4* (CORD); Belén, Barranca Larga, 2400 m a.s.l., Feb 1937, *Schreiter 10242* (LIL); Belén, Londres, near Río Huaico, 4 Feb 1973, *Ulibarri 300* (SI)*; Andalgalá, 6 km N of Chuquiago, 1150 m, 30 Mar 2012, *Urdampilleta 692* (CORD); Andalgalá, Cuesta de la Chilca, 1900 m a.s.l., 30 Jan 1950, *Vervoorst 658* (LIL); Santa María, 2400 m a.s.l., 16 Feb 2010, *Zuloaga et al. 11884* (SI); 2200 m a.s.l., 21 Mar 2013, *Zuloaga et al. 14555* (SI)*; Andalgalá, Mina Capillitas to Andalgalá, 1850 m a.s.l., 22 Mar 2013, *Zuloaga et al. 14603* (SI)*; Andalgalá, Cuesta de Chilca, 1800 m a.s.l., 23 Mar 2013, *Zuloaga et al. 14607* (SI); Andalgalá, Buena Vista to Singuil, 21 Mar 2017, *Zuloaga et al. 16028* (SI)*. Jujuy: Tumbaya, Volcán, 13 Mar 2015, *Barboza et al. 4389* (CORD); El Volcán, 2500 m a.s.l., 6 Jan 1923, *Castillón s.n.* (LIL 75609); Tumbaya, Volcán, Laguna, 25 Feb 1983, *J. Hunziker et al. 10385* (SI); Santa Bárbara, Abra de los Morteros, 7 Mar 1983, *J. Hunziker et al. 10657* (SI); Tumbaya, Volcán, 2000 m a.s.l., 8 Feb 1960, *Meyer et al. 21146* (LIL)*; Tumbaya, Laguna de Volcán, 2050 m a.s.l., 9 Dec 1998, *Morrone et al. 3137* (SI)*; Volcán, Loma de la Laguna, 2200 m a.s.l., 15 Feb 1925, *Schreiter 2667* (LIL); Tumbaya, Volcán, Abra de la Laguna, 12 Feb 1927, *Venturi 4901* (LIL, SI); Tumbaya, Laguna de Volcán, 23 Jan 1988, *Zuloaga & Deginani 3744* (SI). Salta: Rosario de Lerma, 2750 m a.s.l., 10 Mar 2015, *Barboza et al. 4341* (CORD)*; Cafayate, Río Lorohuasi, 11 Feb 1951, *Hayward 002055* (LIL)*; La Viña, 1000 m a.s.l., 2 Feb 1941, *A. T. Hunziker 1146* (CORD); Chicoana, San Fernando de Escolpe to Cachi, 2100 m a.s.l., 16 Feb 1992, *J. Hunziker et al. 12330* (SI)*; Molinos, Coloma to Molinos, 2300 m a.s.l., 23 Jan 1995, *J. Hunziker et al. 13167* (SI)*; El Alisal, Cerro del Cajón, 2000 m a.s.l., 10 Jan 1914, *Rodríguez 1341* (SI); Gral. Güemes, Palomitas, 700 m a.s.l., 24 Jan 1984, *Saravia Toledo 811* (SI); Metán, 16 Feb 2008, *Zuloaga et al.*

10067 (SI)*. Tucumán: Valle de Tafí, 24 Dec 1907, *Castillón 53* (LIL)*; Valle de Tafí, La Banda, Dec 1914, *Castillón s.n.* (LIL 25304)*.

Key to the species of *Flourensia* in South America

1. Capitula solitary……..... 2

1'. Capitula arranged in cymose inflorescences, (solitary) 2–20-headed……. 3

2. Subshrubs to 0.20 m tall. Stems erect. Leaves with upper and lower surfaces densely hirsute, 0.2–0.4 cm wide ……*F. hirtissima*

2'. Subshrubs to 0.40 m tall. Stems decumbent to ascending. Leaves with upper and lower surfaces pilose, (0.4)0.8–1.8 cm wide ……. …….. *F. suffrutescens*

3. Inflorescences with (1) 2-4 capitula …….……4

3'. Inflorescences with 5-20 capitula (if few with leaf margin dentate) …….…….…… 8

4. Capitula large, involucre 10–20 × 15–25 mm; petioles to 17 mm long ……..... *F. tortuosa*

4’. Capitula medium, involucre 5–12 × 6–15 mm; petioles to 10 mm long……..…… 5

5. Leaves ovate to lanceolate, base rounded……. *F. niederleinii*

5’. Leaves lanceolate to oblong-lanceolate, base attenuate ……...……..……. 6

6. Entire leaf margins. Leaves narrowly lanceolate, 3–8 × 0.3–2 cm ……... *F. fiebrigii*

6. Shallowly denticulate-cuspidate leaf margins. Leaves lanceolate to oblong-lanceolate 5–13 × 1.5–4 cm ……..…… ……. 7

7. Leaves oval to oblong-oval, apex obtuse to subobtuse ……...… *F. macrophylla*

7’. Leaves lanceolate to narrowly-elliptic, apex acute …… *F. angustifolia*

8. Leaf margins deeply to shallowly repand-dentate (if entire with leaf surfaces glabrous); leaf surfaces glabrous (if strigillose with shallowly repand-dentate leaf margins) ……..…….*F. thurifera*

8’. Leaf margins strictly entire; leaf surfaces strigillose …….. 9

9. Involucre ca. 10 mm long. Phyllaries 2–6 mm long. Inflorescences to 20-headed…… 10

9’. Involucre 15-20 mm long. Phyllaries (5)7–11 mm long. Inflorescences to 8-headed…….. 11

10. Ray florets 8–10 ……

F. peruviana

10’. Ray florets 5 ……..…….…. *F. cajabambensis*

11. Peduncles mostly 3–5 cm long ……..……. *F. polycephala*

11’. Peduncles mostly 5–8 cm long……..……. *F. heterolepis*

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FIGURE LEGENDS

Figure 1: Ward's cluster analysis of the whole set of 138 specimens of the South American species of *Flourensia*, using a matrix calculated from 34 characters (Gower's coefficient of similarity). **I:** *F. blakeana*, *F. fiebrigii*, and *F. hirta*; **II:** *F. campestris*, *F. leptopoda*, *F. oolepis*, *F. riparia*, and *F. thurifera*; **III:** *F. macroligulata* and *F. tortuosa*; **IV:** *F. polyclada* and *F. suffrutescens.*

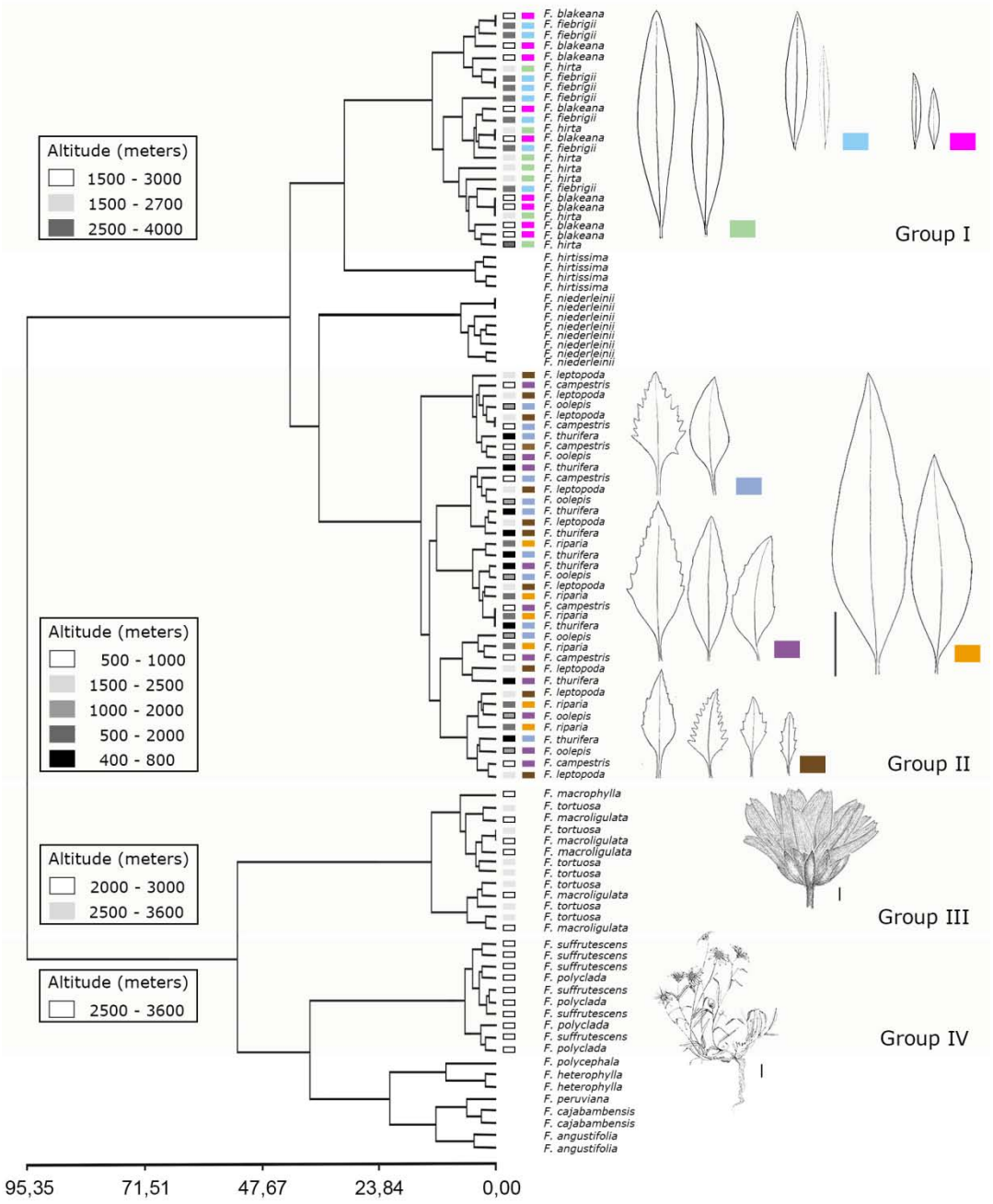

Figure 2: Principal coordinate analysis. Plot of mean value of 138 specimens on the first two principal coordinates. PC1 = 35.5%, PC2 = 24.9%, PC3 = 11.5 %. **I:** white squares represent *F. blakeana*, black squares *F. fiebrigii*, and gray squares *F. hirta*; **II:** white triangles represent *F. campestris*, gray squares *F. leptopoda*, black squares represent *F. oolepis*, white squares *F. riparia*, and black triangles *F. thurifera*; **III:** black squares represent *F. macroligulata*, and white squares *F. tortuosa*; **IV:** white squares represent *F. polyclada* and black squares *F. suffrutescens*; **an**, *F. angustifolia*; **ca**, *F. cajabambensis*; **he**, *F. heterolepis*; **hi**, *F. hirtissima*; **ma**, *F. macrophylla*; **ni**, *F. niederleinii*; **pe**, *F. peruviana*; **po**, *F. polycephala*.

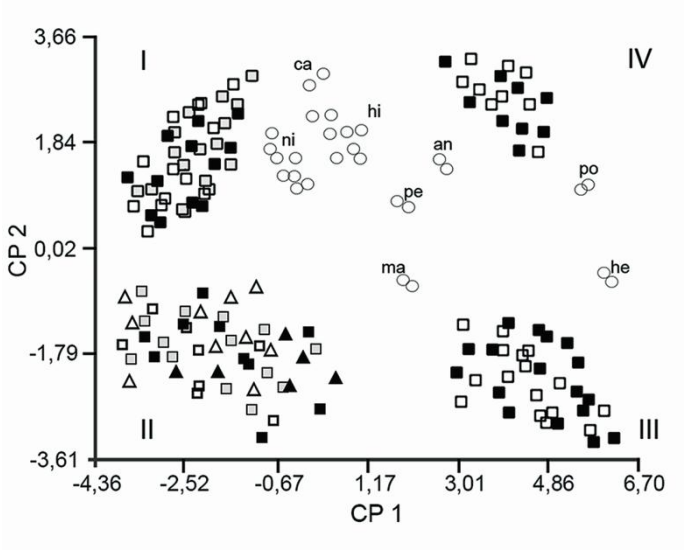

Figure 3: Scatterplot of scores of each variable contribution to each of the factor derived from the PCoA 1 vs. PCoA 2. Produced by saturation of the variables into the factors analysis applied to 34 morphological characters. Crosses represent the variables with their acronyms (see Table 1).

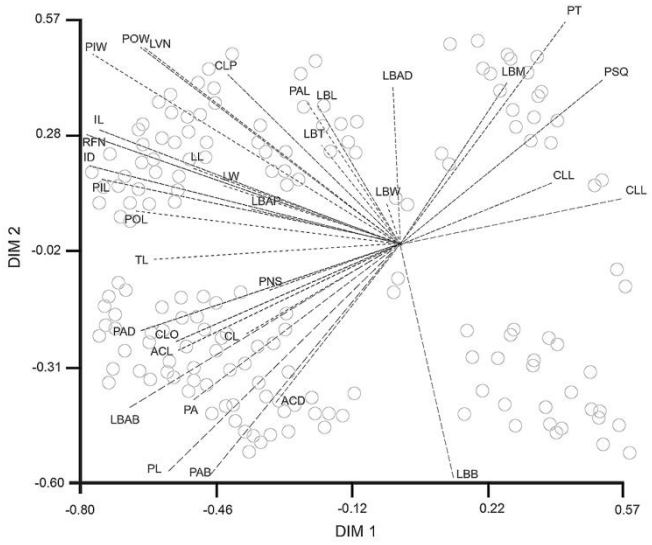

Figure 4: Distribution maps of South American species of *Flourensia*, according to the results of the present study. Dots indicated specimens examined.

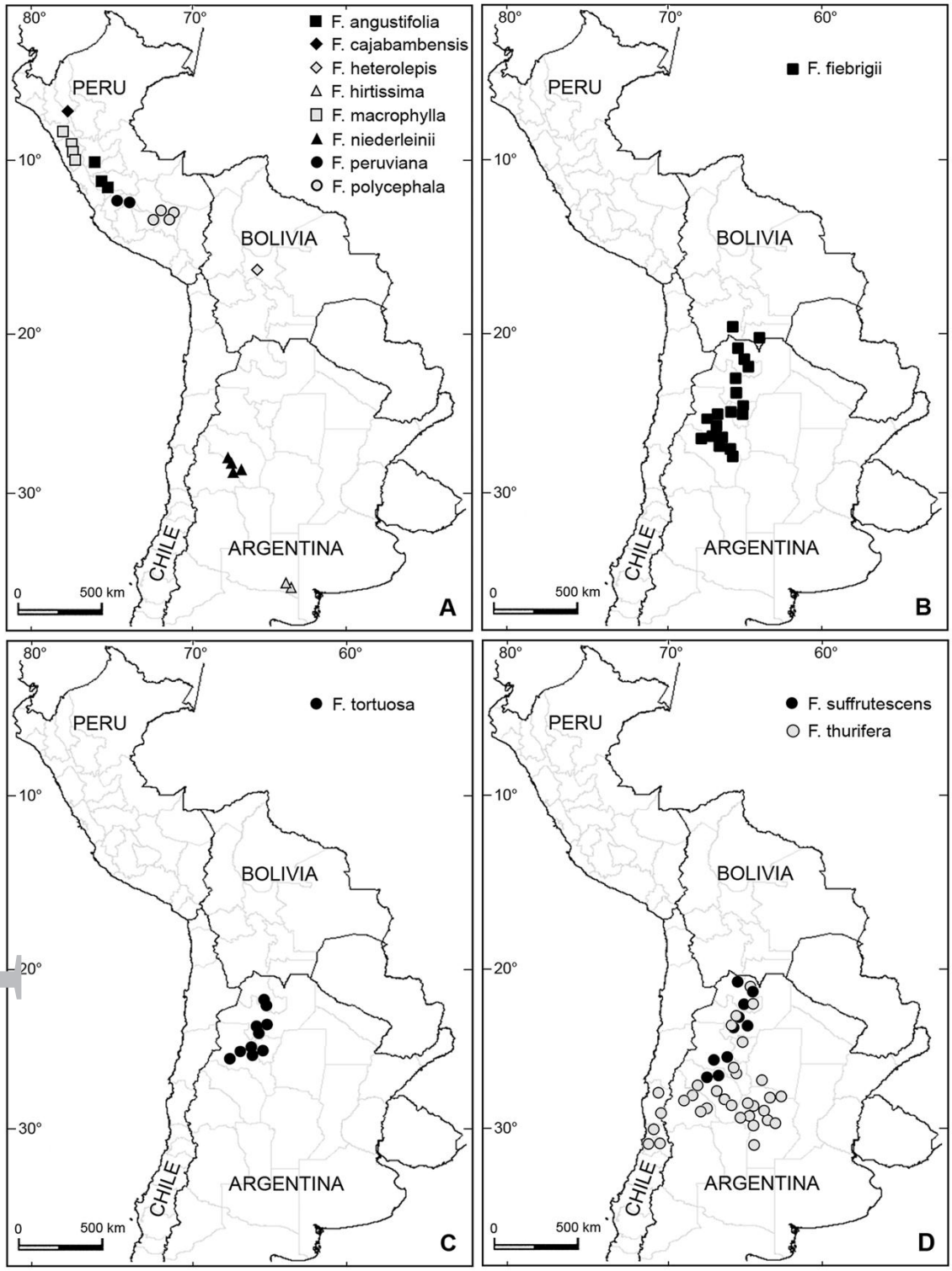

Figure 5: *Flourensia fiebrigii*: A, Shrubs to 1.5 m tall with 2-4 capitula arranged in cymose inflorescence; B, Flowering branch showing narrowly lanceolate leaves.– *Flourensia thurifera*: C, Shrubs to 3 m tall with ovate-lanceolate leaves, entire to shallowly dentate on margins, and capitula arranged in cymose inflorescence; D, Flowering branch showing ovate leaves with leaf margin dentate. A-C: photographs F.O. Zuloaga; D: photograph from http://commons.wikimedia.org

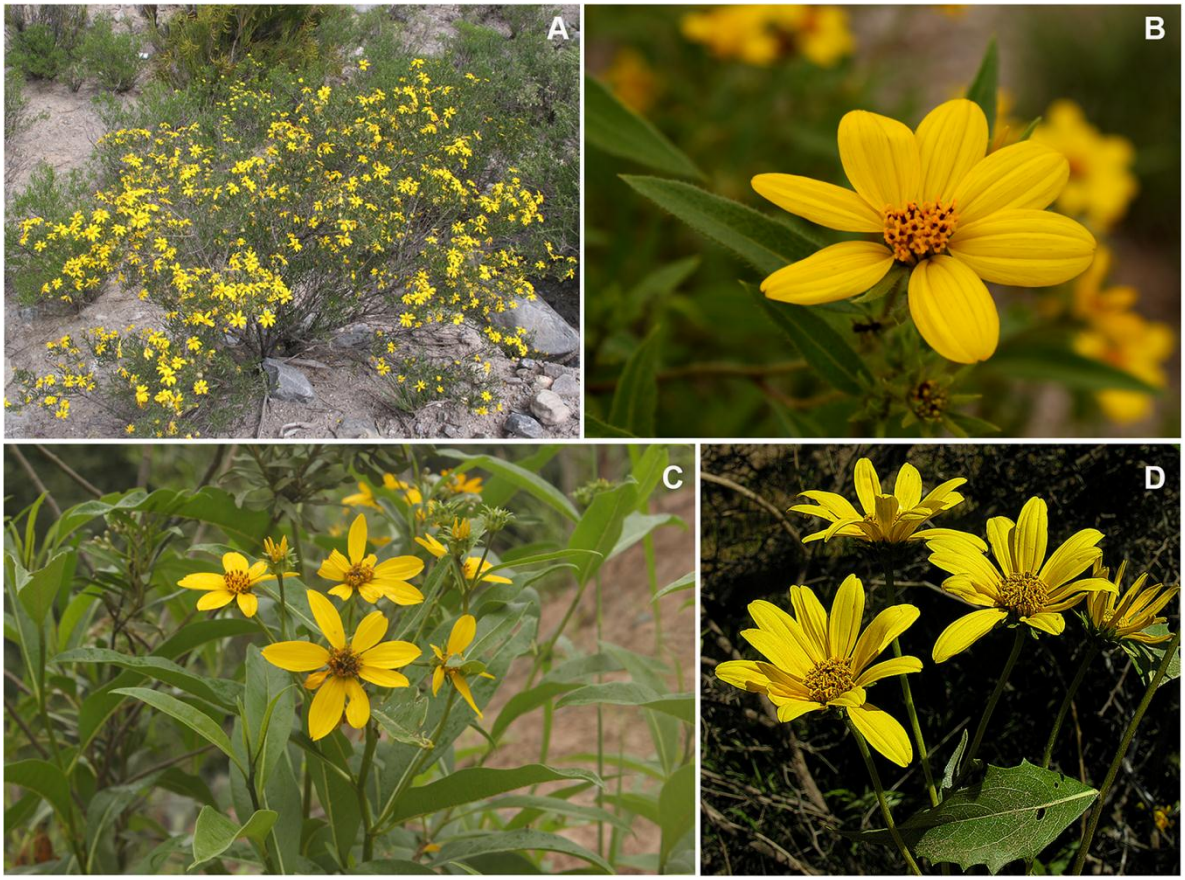

Figure 6: *Flourensia suffrutescens*: A, Shrubs to 40 cm tall with solitary capitula; B, Capitulum. –*Flourensia tortuosa*: C, Shrubs 1-2 m tall; D, Few capitula arranged in cymose inflorescence. A-D: photographs F. O. Zuloaga.

TABLE LEGEND

Table 1: PCoA results. Factor loadings and percentage of variance for the three principal coordinates obtained from the 34 characters analyzed. Numbers in bold font and underlined indicate the higher values.

Variables	**Principal Coordinates** (Variation explained)		
	1 (35.5 %)	**2** (24.9 %)	**3** (11.5 %)
Plant tall (PT)	**-0.67**	-0.01	0.36
Leaf-blade length (LBL)	-0.03	0.15	**0.84**
Leaf-blade width (LBW)	-0.04	-0.05	0.49
Leaf-blade apex (LBAP)	0.26	0.38	-0.06
Leaf-blade base (LBB)	0.22	-0.56	-0.19
Leaf-blade margin (LBM)	-0.45	0.13	0.06
Leaf-blade teeth length (LBT)	0.02	0.31	0.43
Leaf-blade adaxial surface (LBAD)	-0.22	0.07	**0.65**
Leaf-blade abaxial surface (LBAB)	**0.80**	0.15	0.06
Petiole length (PL)	**0.80**	-0.01	-0.02
Capitula number per inflorescence (CNI)	-0.41	-0.32	0.43
Involucre length (IL)	0.47	**0.66**	0.58
Involucre diameter (ID)	0.54	**0.70**	0.21
Phyllaries number of series (PNS)	0.32	-0.05	0.54
Phyllaries outer length (POL)	0.51	**0.60**	0.00
Phyllaries outer width (POW)	0.26	0.83	0.25
Phyllaries inner length (PIL)	0.53	**0.66**	0.19
Phyllaries inner width (PIW)	0.36	**0.83**	0.45

Ray floret number (RFN)	0.50	**0.73**	0.34
Ligule length (LL)	0.32	0.41	0.30
Ligule width (LW)	0.28	0.34	0.42
Ligule venation number (LVN)	0.25	**0.78**	0.37
Tube length (TL)	0.53	0.33	0.30
Paleae adaxial surface (PAD)	**0.65**	0.10	0.59
Paleae abaxial surface (PAB)	**0.73**	-0.18	0.22
Disc floret corolla length (CL)	0.44	-0.00	0.28
Disc floret corolla lobes (CLO)	0.60	0.19	0.15
Corolla lobes length (CLL)	-0.53	-0.25	-0.14
Corolla lobes pubescence (CLP)	0.11	0.54	0.34
Achene length (ACL)	**0.61**	0.10	0.40
Achene diameter (ACD)	0.49	0.01	-0.12
Pappus awns (PA)	**0.64**	-0.01	0.04
Pappus awns length (PAL)	-0.00	0.51	0.14
Pappus squame (PSQ)	**-0.65**	0.048	-0.28