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THE GENERIC AFFINITY OF *CAIOPHORA PULCHELLA* (LOASACEAE, LOASOIDEAE)

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Abstract. Acuña, R. & M. Weigend. 2018. The generic affinity of *Caiophora pulchella* (Loasaceae, Loasoideae). *Darwiniana*, nueva serie 6(1): 94-98.

The history of the nomenclatural changes and past hypotheses on the relationships of *Caiophora pulchella* are presented. The identity of voucher specimens, identified as *C. nivalis* in previous phylogenetic studies, is reassessed based on fruit morphology. The validity of *C. pulchella* is reconsidered and can be confirmed as a member of the genus *Caiophora* based on both morphological and molecular data. Alternative generic placements are rejected.

Keywords. Argentina; *Caiophora*; *Loasa*; Mendoza; morphology; phylogeny; San Juan.

Resumen. Acuña, R. & M. Weigend. 2018. La afinidad genérica de *Caiophora pulchella* (Loasaceae, Loasoideae). *Darwiniana*, nueva serie 6(1): 94-98.

Se presentan la historia nomenclatural e hipótesis previas acerca de las relaciones de *Caiophora pulchella* (Loasaceae, Loasoideae). La identidad de especímenes "voucher", identificados como *C. nivalis* en estudios filogenéticos previos, es reevaluada de acuerdo a la morfología de los frutos. La validez de *C. pulchella* es reconsiderada y se confirma como una especie de *Caiophora* de acuerdo a evidencias morfológicas y moleculares. Su vinculación alternativa en otros géneros es rechazada.

Palabras clave. Argentina; *Caiophora*; filogenia; *Loasa*; Mendoza; morfología; San Juan.

INTRODUCTION

Caiophora pulchella Urb. & Gilg is a very distinctive species of *Caiophora* C.Presl., endemic to the Provinces of San Juan and Mendoza in west-central Argentina (Pérez-Moreau & Crespo, 2003). Although considered part of *Caiophora* even before its valid description (Urban & Gilg in Kurtz, 1893; Urban & Gilg, 1900; Sleumer, 1955), its placement in this genus was called into doubt by Pérez-Moreau & Crespo (1992), the first botanists to describe and study this species' unusual fruits. The new combination *Loasa pulchella* (Urb. & Gilg) R.L.Pérez-Mor. & Crespo was created and the species reconsidered as probably related to *Loasa* Adans. ser. Loasa (≡ Acanthifoliae Urb. & Gilg). The same authors used this new name in posterior works (Pérez-Moreau & Crespo, 2003). In their excellent recent revision of the Argentinean species of *Caiophora*, Slanis et al. (2016) excluded *C. pulchella*, following the same recommendation, considering it as part of *Loasa*. Conversely, Weigend (1997), Weigend & Ackermann (2003), and Weigend et al. (2008) retain this species in *Caiophora*, considering it as a close ally of *C. nivalis* Lillo.

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Recent molecular analyses of the "South Andean Loasas" (defined as the group that includes the genera *Blumenbachia* Schrad. *Caiophora*, *Loasa* and *Scyphanthus* Sweet, as well as recently segregated *Grausa* Weigend & R.H.Acuña and *Pinnasa* Weigend & R.H.Acuña) identified the major clades within this speciose group, mostly restricted to temperate South America and the High Andes (Strelin et al., 2017; Acuña et al., 2017). However, the affinities of *Caiophora pulchella* were not discussed in these works. The goal of this study is to evaluate and clarify the affinities of *C. pulchella* based on both morphological and molecular evidence.

MATERIALS AND METHODS

Detailed examination of preserved specimens of *Caiophora pulchella* and *C. nivalis* (including extant type material) was carried out on specimens or photographs of specimens deposited at the herbaria BM, CORD, F, L, LIL, P and SI (Thiers, 2017).

RESULTS

A re-examination of herbarium specimens of *Caiophora* from the Provinces of San Juan and Mendoza revealed that the vouchers *Cocucci et al. 2219* (CORD) and *Cocucci & Sérsic 4840* (CORD), were incorrectly determined as *C. nivalis* in previous molecular studies (Weigend et al., 2004, as *Cocucci s.n. = Cocucci et al. 2219*; Strelin et al., 2017; Acuña et al., 2017). The capsules in these specimens (Fig. 1), even if still mostly immature, are clearly diagnostic and typical of *Caiophora pulchella* (Pérez-Moreau & Crespo 1992, Weigend 1997). In *C. pulchella*, the capsules are mostly superior and dehiscent above the sepals (Fig. 1), something unique in *Caiophora*, while in the morphologically similar *C. nivalis*, as in the rest of the genus, these are mostly inferior and dehiscent below the sepals (Slanis et al., 2016: Figs. 24E, 25F). The collection locality of these specimens is likewise in agreement with the known geographic range of *C. pulchella*, not with *C. nivalis* (known only from the Provinces of Jujuy, Salta, Catamarca and Tucumán), which has not been recorded from the more southerly Province of Mendoza. (Weigend et al., 2008; Slanis et al., 2016).

Weigend et al. (2004), Strelin et al. (2017) and Acuña et al. (2017) all reach similar conclusions in their analyses: *Cocucci et al. 2219* and *Cocucci & Sérsic 4840*, and by extension *Caiophora pulchella*, are retrieved unequivocally as part of a monophyletic and highly supported *Caiophora*, both based on plastid and nuclear markers. Although the relationships within the genus are not fully resolved, trees from both Strelin et al. (2017) and Acuña et al. (2017) indicate that *C. pulchella* may represent an early diverging branch in the genus, agreeing with the interpretation of the morphological evidence by Weigend et al. (2005) mostly regarding the characteristic seeds of the species.

There are a range of similarities shared between *Caiophora pulchella* and *C. nivalis*, such as habitat (from areas above the tree line usually at altitudes well above 2000 m a.s.), growth habit (rosulate herbs < 10 cm in height, with well-developed rhizomes), leaf morphology (leaves < 10 cm long, with pinnatifid to pinnate blades) and floral morphology (flowers axillary, erect and solitary; sepals reduced and inconspicuous; corollas white, half to full spreading; nectar scales contrastingly coloured yellow to orange, with three dorsoventrally flattened dorsal threads, attached to the distal-most third of the scale's back). On the other hand, other putative, close relatives to *C. pulchella* such as *Loasa* series Loasa (Pérez-Moreau & Crespo, 1992) are not just only distantly related to *C. pulchella* based on molecular evidence (Strelin et al., 2017; Acuña et al., 2017), but also differ in ecology and morphology, as both *L. acanthifolia* Lam. and *L. sclareifolia* Juss. inhabit forested (or formerly forested) habitats at lower elevations (usually below 2000 m), and are very robust biennial or perennial herbs often well over 1 m tall, with pinnately lobed, large (up to ca. 30 cm) simple leaves, deflexed flowers with conspicuous and well developed sepals, yellow to red corollas, mostly red nectar scales with flag shaped (laterally expanded and obovoid in shape) dorsal threads and large, globose seeds with shallowly reticulate testas (instead of deeply pitted as in *Caiophora*, Weigend et al., 2004, 2005; Acuña et al. 2017). Another group formerly included in *Loasa* that bears a superficial resemblance to *C. pulchella* (and often sharing similar habitat and habit), is the genus *Pinnasa* (≡ *Loasa* ser. Pinnatae Urb. & Gilg). However, no

author has suggested a close relationship between both taxa and the phylogenetic data retrieve them as only distantly related (Weigend et al., 2004; Strelin et al., 2017; Acuña et al., 2017): *C. pulchella* is more closely related to other *Caiophora* than to *Pinnasa*. Morphologically, *Pinnasa* differs from *C. pulchella* in the virtual abscence of stinging trichomes, deeply serrate to laciniate petal margins (entire in *C. pulchella* and *C. nivalis*) and mostly inferior capsules opening solely with apical valves (a combination not found in any *Caiophora*, Urban & Gilg, 1900; Weigend et al., 2004; Acuña et al., 2017). Though not suggested in the literature, the only other plant that could be reasonably confused with *C. pulchella* due to habitat and morphology is *Grausa lateritia* (Gillies ex Arn.) Weigend & R.H.Acuña, in particular the white flowered plants called *Loasa acaulis* (Phil.) Urb. & Gilg. *Grausa lateritia,* however, also lacks stinging trichomes, its sepals are conspicuous, ca. half the length of the petals, its floral scales are the same colour as the petals with dorsal threads that are apically expanded (instead of being linear), its apically dehiscent capsules are mostly inferior and its seeds often have a conspicuous hilar cone that is found only in *Grausa* (Weigend et al., 2004, 2005; Acuña et al., 2017).

Based on the evidence presented here, both molecular and morphological data clearly underscore that *Caiophora pulchella* is indeed part of *Caiophora*. Its closest relative is likely *C. nivalis*, but future molecular studies should investigate these relationships in more detail. Clades included in the traditional concept of *Loasa* are only distantly related to this species.

Representative specimens examined

Caiophora pulchella Urb. & Gilg, Nova Acta Acad. Caes. Leop.-Carol. German. Nat. Cur. 76: 272-273. 1900. TYPE: Argentina, Mendoza, Depto. Malargüe, Cumbre entre el Valle Hermoso y el del Río Salado. Oben am Schnee, 18-I-1888, *F. Kurtz 5865* (Lectotype, here designated: CORD 00003381!; B† [photo F Neg. No.10163!]).

ARGENTINA. **San Juan.** Depto. Calingasta, de La Invernada a Las Minitas, 2950-3100 m s.m., 21-II-1988, *Kiesling et al. 6981* (SI); Reserva Estricta El Leoncito: Quebrada de las Vaquitas Muertas (Arroyo y zona de influencia), 25-I-1995, *Apochian et al. 220* (SI); Sierra del Tontal, 3500 m s.m., 22-I-1987, *Kiesling & Meglioli 6538* (SI); Sierra del Tontal al N de Barreal camino a la antena, 3550-3750 m s.m., 5-II-1989, *Kiesling et al. 7350* (SI);del Observatorio El Leoncito al Portezuelo del Tontal, 3300 m s.m., 1-III-1984, *Kiesling 4677* (SI); El Leoncito, Ciénaga de las Cabeceras, 3300 m s.m., 24-II-1999, *Kiesling et al. 9289* (SI); Reserva natural estricta El Leoncito, Quebrada del arroyo Portezuelo, 3730 m s.m., 9-IV-1999, *Haene 1994* (SI). **Mendoza**. Depto. San Carlos, Tres Esquinas, 2200 m s.m., I-1921, *Carette 278* (SI); Depto. Las Heras, Cordillera del Tigre, 3000 m s.m., 15-XII-1927, *King 328* (BM). Depto. Luján de Cuyo, Vallecitos cerca del refugio Club de Regatas Mendoza, 3020 m s.m., 11-I-2003, *Cocucci et al. 2219* (CORD); dentro del Centro de Esquí Vallecitos, 3074 m s.m., 20-I-1998, *Herrera & Jiménez 477* (SI). Depto. Las Heras, Vallecitos, 18-I-2012, *Cocucci & Sérsic 4840* (CORD). Depto. San Carlos, Quebrada del Paso de La Cruz de Piedra, 15-I-1949, *Ruiz Leal 11692* (P); camino a Laguna del Diamante, 3000 m s.m., 27-I-1950, *Araque 1390* (L); camino a la Laguna Diamante, afluente del Arroyo Papagallos, 3-II-1950, *Soriano 4125* (SI); Los Paramillos, camino a Lag. Diamante, 23-I-1989, *Gómez-Sosa 343* (SI).

Caiophora nivalis Lillo, Prim. Reun. Nac. Soc. Argent. Cien. Nat. [Tucuman, 1916] Secc. 3, Bot.: 229. 1919. TYPE: Argentina, Tucumán, Depto. Tafí del Valle, Cumbres Calchaquíes, lagunas, campo en la cima, 4700 m s. m., 4-II-1903, *M. Lillo 3090* (Holotype LIL-78055 [000993]!).

ARGENTINA. **Jujuy.** Depto. Tilcara, Omgeving van Tilcara, 2500 m s.m., 1953, *Sleumer s.n.* (L). **Salta.** Depto. Cafayate (?), La Laguna, Cerro del Cajón, 2900 m s.m., 25-I-1914, *Rodríguez 1314* (SI). **Tucumán.** Depto. Tafí del Valle, El Pelado, habita faldas y peñas, 4000 m s.m., 19-III-1912, *Rodríguez 579* (SI); Quebrada Honda, 3800 m s.m., 28-I-1952, *Sparre et al. 9395* (L); Cumbres Calchaquíes, Huaca Huasi, alrededores laguna Nostra, suelo arenoso, 4300 m s.m., 13-III-1984, *Gómez-Sosa & Múlgura 179* (SI).

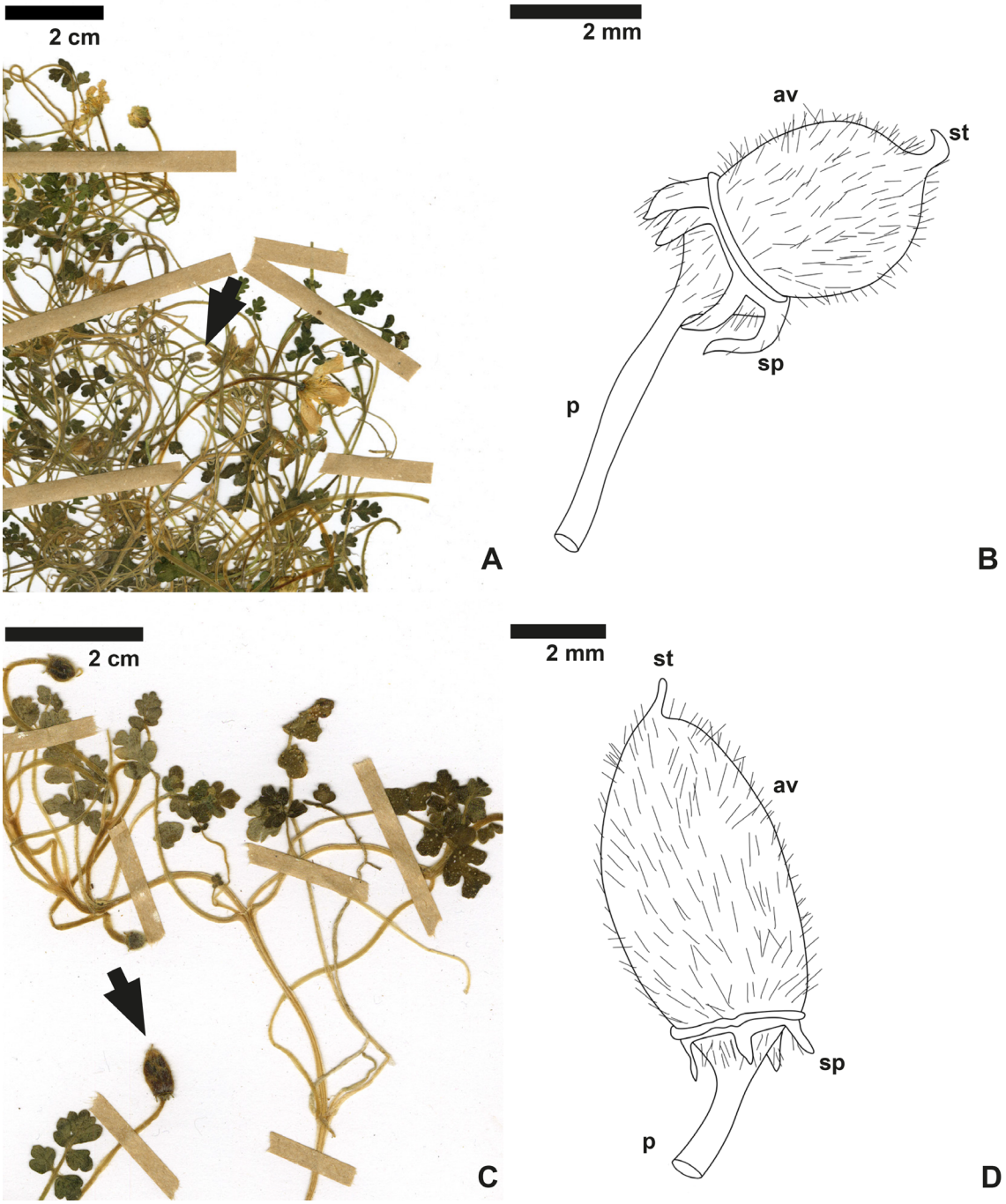

Fig. 1. Voucher specimens of *Caiophora pulchella* used in the molecular studies of Weigend et al. (2004), Strelin et al. (2017) and Acuña et al. (2017). **A,** *Cocucci & Sérsic 4840* (CORD), overview. **B,** detail of an immature capsule. **C,** *Cocucci et al. 2219* (CORD), overview. **D,** detail of an immature capsule. Abbreviations: **av**, apical valve region; **p**, pedicel; **sp**, sepal; **st**, persistent style. Color version at http://www.ojs.darwin.edu.ar/index.php/darwiniana/article/view/780/755

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BIBLIOGRAPHY

Acuña, R.; S. Fließwasser; M. Ackermann; T. Henning; F. Luebert & Weigend, M. 2017. Phylogenetic relationships and generic re-arrangements in "South Andean Loasas" (Loasaceae).*Taxon* 66: 365-378. DOI: 10.12705/662.5

Kurtz, F. 1893. Dos viajes botánicos al Río Salado superior (Cordillera de Mendoza). *Boletín de la Academia Nacional de Ciencias en Córdoba (República Argentina)* 13: 171-210

Pérez-Moreau, R. L. & S. Crespo. 1992. Notas sobre Loasaceae IV. *Loasa pulchella* nueva combinación. *Hickenia* 2(14): 67-68.

Pérez-Moreau, R. L. & S. Crespo. 2003. Loasaceae, in R. Kiesling (ed.), *Flora de San Juan Volumen 2,* pp. 152–160. Buenos Aires: Estudios Sigma.

Slanis, A. C.; M. C. Perea & A. Grau. 2016. Revisión taxonómica del género *Caiophora* (Loasaceae) para Argentina: *C. sleumerii* una nueva especie. *Darwiniana*, nueva serie 4(2): 138-191. DOI: 10.14522/darwiniana.2016.42.685

Sleumer, H. 1955. Die Loasaceen Argentiniens. *Botanische Jahrbücher für Systematik, Pflanzengeschichte und Pflanzengeographie* 76: 411-462.

Strelin, M.; J. Arroyo; S. Fließwasser & M. Ackermann. 2017. Diversification of *Caiophora* (Loasaceae subfam. Loasoideae) during the uplift of the Central Andes. *Organisms Diversity and Evolution* 17: 29-41. DOI: 10.1007/s13127-016-0312-4

Thiers, B. [continuously updated, accessed 2017]. Index Herbariorum: a global directory of public herbaria and associated staff. New York Botanical Garden's Virtual Herbarium; available from: http://sweetgum.nybg.org/ih/ (accessed Nov 2017).

Urban, I & E. Gilg. 1900. Monographia Loasacearum. *Nova Acta Academiae Caesareae Leopoldino-Carolinae Germanicae Naturae Curosiorum* 76: 1-368.

Weigend, M. 1997. Names and types in *Caiophora* K.Presl.s.str. (Loasaceae). *Sendtnera* 4: 221-242.

Weigend, M. & M. Ackermann. 2003. Los nombres antiguos en el género *Caiophora* (Loasáceas subfam. Loasoídeas) y una clasificación infragenérica preliminar. *Arnaldoa* 10: 75-94.

Weigend, M.; M. Gottschling; S. Hoot & M. Ackermann. 2004. A preliminary phylogeny of Loasaceae subfam. Loasoideae (Angiospermae: Cornales) based on trnL (UAA) sequence data, with consequences for systematics and historical biogeography. *Organisms Diversity and Evolution* 4: 73-90. DOI: 10.1016/j.ode.2003.12.001

Weigend, M.; J. Grau & M. Ackermann. 2008. Loasaceae, in: F. O. Zuloaga, O. Morrone & M. J. Belgrano (eds.), Catálogo de las Plantas Vasculares del Cono Sur (Argentina, Sur de Brasil, Chile, Paraguay y Uruguay) *Monographs in Systematic Botany from the Missouri Botanical Garden* 107(3): 2413-2424.

Weigend, M.; A. Gröger; & M. Ackermann. 2005. The seeds of Loasaceae subfam. Loasoideae (Cornales) II: Seed morphology of 'South Andean Loasas' (*Loasa*, *Caiophora*, *Scyphanthus* and *Blumenbachia*). *Flora* 200: 569-591. DOI: 10.1016/j.flora.2005.06.009