Acta Botanica Brasilica, 2023, 37: e20220313
doi: https://doi.org/10.1590/1677-941X-ABB-2022-0313

Original article

A taxonomic headache due to a 'Frankenstein type': solving the identity and typification of a *Mimosa* species

Fernanda Schmidt Silveira[1] and **Silvia Teresinha Sfoggia Miotto**[1]

Received: December 30, 2022
Accepted: May 30, 2023

ABSTRACT

A nomenclatural type is the element to which a name is permanently linked and must consist of a gathering, or part of a gathering, of a single species or infraspecific taxon. However, sometimes more than one species may be mounted on a single herbarium sheet ('Frankenstein type'), causing a nomenclatural confusion (admixture) in the use of a name, which creates difficulties on the delimitation of the species and application of its name ('taxonomic headache'). This is the case of the assigned holotype to *Mimosa asperoides* Izag. & Beyhaut that is composed also of other *Mimosa* species. To solve the 'Frankenstein type' of *Mimosa asperoides*, we analyzed the original material, the protologue, and performed a morphological comparative analysis to distinguish the species involved in the admixture. These analyses allowed us to identify which of the fragments of the 'Frankenstein type' correspond to *M. asperoides*, enabling its lectotypification and providing new diagnostic features to amend its description. Finally, we reported the first citation of *M. asperoides* for Brazil and discussed the link between nomenclature and taxonomy to solve a taxonomic headache due to admixture.

Keywords: admixture, lectotypification, *Mimosa asperoides*, morphology, nomenclature.

Introduction

Names are what we use to communicate about organisms and by extension the rest of their biology (Knapp *et al.* 2004), thereby any change is disruptive to an enormous community outside of taxonomy (McNeill 2000). Regarding this, the nomenclature regulates how names are used to communicate taxonomic hypotheses and also establishes the rules (Codes) to ensure the least degree of ambiguity in their application (Thomson *et al.* 2018), avoiding scientific confusion (Turland *et al.* 2018). For example, the International Code of Nomenclature for algae, fungi, and plants (ICN) governs the scientific naming of all organisms traditionally treated as algae, fungi, or plants (Turland *et al.* 2018), being composed of a number of principles, rules and recommendations arranged in articles.

In the ICN, the application of names of taxa at the rank of family and below is determined by means of nomenclatural types, a process known as typification (Art. 7.1, Turland *et al.* 2018). A nomenclatural type is the physical element to which the name of a taxon is permanently linked, whether

1 Programa de Pós-Graduação em Botânica, Universidade Federal do Rio Grande do Sul, Av. Bento Gonçalves, 9500, Porto Alegre, Rio Grande do Sul, 91501-970, Brazil.

* Corresponding author: blumenfss@gmail.com

as the correct name or as a synonym (Art. 7.2, Turland *et al.* 2018). Furthermore, the type is usually a single specimen (Art. 8.1) mounted on a single herbarium sheet or in an equivalent preparation (Art. 8.2). However, sometimes the type material contains parts belonging to more than one taxon (admixture), which may be considered a 'Frankenstein type' in allusion to Mary Shelley's horror romance (Shelley 1831), generating difficulties for applying names and delimiting species, a real "taxonomic headache".

This is the case of the designated holotype of *Mimosa asperoides* Izag. & Beyhaut that has been based on taxonomically discordant elements. This species was described in 2009, being considered endemic to Uruguay (Izaguirre & Beyhaut 2009). During the review of its original material to describe a probably new species from Brazil, very similar to *M. asperoides*, we noticed that some fragments of the designated holotype of this species correspond to *M. axillarioides* Izag. & Beyhaut. Probably, these species were confused because both are prostrate with globose inflorescences, discolor leaflets, and paleaceous calyx, differing mainly by the type of fruit, which was absent in the fragments related to *M. axillarioides*. Finally, these findings highlighted to us that instead of a new *Mimosa* species, we were dealing with the first citation of *Mimosa asperoides* for Brazil; a discovery that contributed to detecting the admixture ('the Frankenstein type') and to fix it (Box 1).

Here, we aimed to report and solve the nomenclatural and taxonomic admixture in *M. asperoides*. Our specific goals were: (1) to provide additional taxonomic support in the morphological delimitation of *M. asperoides*, searching for other diagnostic features that may distinguish it from *M. axillarioides* when fruit is missing; (2) to lectotypify *M. asperoides* for the correct application of this name; and (3) to report its first occurrence in Brazil.

Materials and methods

To solve the 'Frankenstein type' of *Mimosa asperoides*, we analyzed the original material, the protologue, and conducted a morphological comparative analysis to distinguish the species involved in the admixture. Considering these analyses, we chose the fragment that represents *M. asperoides*, performing its lectotypification. We also proposed an amended description and reported the first citation of *Mimosa asperoides* for Brazil.

We consulted the original material of *Mimosa asperoides* by physical review or image analysis of specimens deposited in the Uruguayan herbaria, MVFA and MVM (acronyms according to Thiers 2023; Tab.1). From the MVM, we analyzed by image two paratypes; one of them lacks the diagnostic feature of this species, the fruit. The designated paratype collected by Osorio 688 (MVM No.13297) does not correspond to *Mimosa asperoides* due to the size and venation of leaflets and indumentum of branches; features that match with the description of *Mimosa riverensis* Izag. & Beyhaut. The exsiccate collected by Legrand 4990 (MVM s/n) corresponds to *Mimosa asperoides*. From the MVFA, we reviewed and photographed all the original material of *M. asperoides* (three exsiccates). This analysis showed that the designated paratype collected by Berro 5528 is free of admixture. Nevertheless, the designated holotype (MVFA barcode 0000095) and the isotype (MVFA barcode 0000096) consist in two different species mounted on the same sheet, *M. asperoides* and *M. axillarioides*.

To identify other potential diagnostic features of *M. asperoides* beyond the fruit shape, we analyzed separately 17 features related to leaf, flower and fruit that were available in the original material deposited on MVFA herbarium. We also examined specimens available from Brazilian collections (HUCS, ICN, MBM, MPUC, and PACA, herbaria acronyms according to Thiers 2023). These features were: arrangement of leaves on secondary branches; leaf length; leaflet number, indumentum, margin, nervures, shape, and size; indumentum and length of peduncles; calyx and corolla length; calyx proportion to corolla; calyx and corolla shape; corolla and fruit indumentum. We also consulted the protologue of *M. axillarioides* (in Izaguirre & Beyhaut 2009) and analyzed its original material deposited in the MVFA (MVFA barcode 26745 holotype!, Rosengurt B-1028 paratype!), photographing its leaflets, flower, indumentum of peduncles and fruits. Then, we summarized the data of

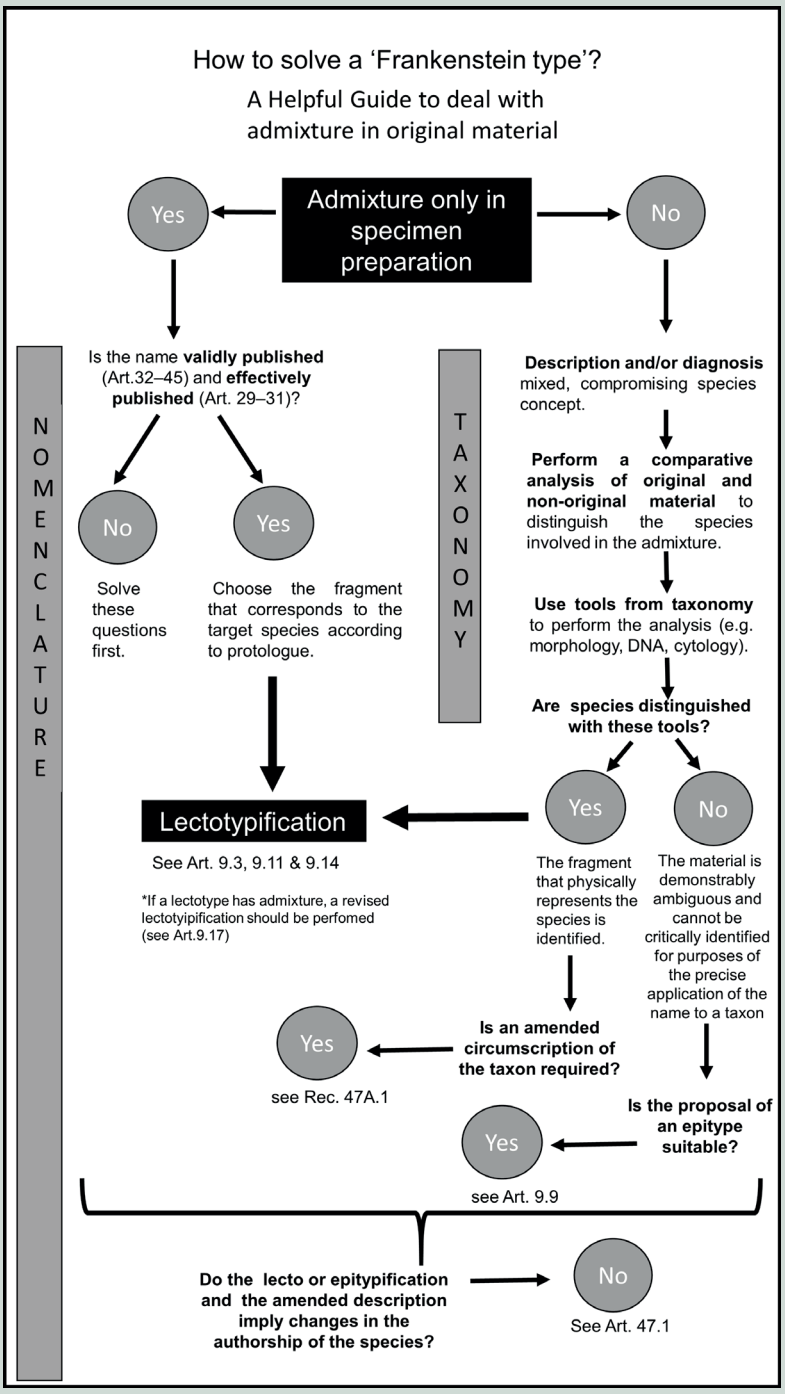
Table 1. Review of original material of *Mimosa asperoides* and *M. axillarioides* highlighting which of them is composed of admixture.

Species analyzed	Type status	Herbarium	Kind of review	Collectors name /number, and/or herbarium barcodes	Admixture
M. asperoides	Holotype	MVFA	Physical	Berro 836, 0000095	Present
	Isotype	MVFA	Physical	Berro 836, 0000096	Present
	Paratype	MVFA	Physical	Berro 5528	Absent
	Paratype	MVM	Image	Legrand 4990	Absent
	Paratype	MVM	Image	Osorio 688	Absent *
M. axillarioides	Holotype	MVFA	Physical	Izaguirre *et al.* s.n., 26745	Absent
	Paratype	MVFA	Physical	Rosengurt B-1028	Absent

* This exsiccate does not correspond to *M. asperoides*.

Box 1. Solving a 'Frankenstein type': nomenclatural and taxonomic approaches to deal with admixture.

Typification is the main nomenclatural act to solve a nomenclatural admixture. According to Shenzhen Code (Turland *et al.* 2018), if a type is found to belong to more than one taxon, the name must remain attached to the part (specimen as defined in Art. 8.2) that corresponds most nearly to the original description or diagnosis (Art. 9.14) by the designation of a lectotype (Art. 9.3 and Art. 9.11). When the original description/diagnosis is itself taxonomically mixed, as in the case of *Mimosa asperoides*, the use of the protologue to guide the lectotypification may be compromised. A solution would be to conduct a comparative taxonomically analysis of the fragments to find features that underline the differences among the species involved in the admixture. This analysis may result in an amended circumscription (emend., Rec. 47A.1), in which it is possible to perform the corrections and to include relevant information previously not cited in the description, such as new diagnostic features. If after this analysis, the original material is demonstrably ambiguous and cannot be critically identified for purposes of the precise application of the name to a taxon, an epitype should be proposed under the Art. 9.9 to help the interpretation of that name; considering at least if the specimen has a similar locality, habitat, and morphological details to those mentioned in the protologue (Turland 2019; Lendemer 2020). On the other hand, if the lectotype is unambiguous, but incomplete, it is not appropriate to designate an epitype (see **Box 1**, scheme below).



diagnostic and overlapping morphological features between *M. asperoides* and *M. axillarioides* in a comparative table and in three illustrative figures with morphological details.

Afterwards, these data and analyses were used to support which fragments correspond to *M. asperoides*, allowing its lectotypification based on the Articles 9.11 and 9.14 of the Shenzhen Code (Turland *et al.* 2018). Furthermore, these data also supported the amended circumscription of *M. asperoides*. The terminology of the description was adapted from Barneby (1991), Beentje (2010) and, for the trichomes, from Jordão *et al.* (2020). Finally, we reported the first citation of *M. asperoides* in Brazil by the analysis of recent collections and the review of national and international herbaria (BHCB, BLA, BOTU, CESJ, CORD, CRI, CTES, E, ESA, F, FURB, HAS, HDCF, HPBR, HUCS, HUEM, HURG, HVAT, IAC, ICN, JOI, K, MBM, MO, MPUC, MVM, NY, P, PACA, PEL, R, RB, SJRP, SMDB, SPSF, and USZ, acronyms according to Thiers 2023). We provided a distribution map, first field images of the species, and a comparative analysis between Brazilian and Uruguayan populations regarding their habitat and flowering phenology.

Results

Identification tags highlighted the historical nomenclatural and taxonomic confusion

The analysis of identification tags on the original material of *M. asperoides* illustrates the taxonomic confusion involving its type specimens, indicating the presence of admixture (Fig. 1). The designated holotype of *M. asperoides* was collected by Mariano B. Berro in 1899 in Uruguay and firstly identified as *Mimosa marginata* Lindl., one of the synonyms of *M. schleidenii* Herter. In 1948, Arturo Burkart suggested that this specimen was a putative hybrid between *M. axillaris* Benth. and *M. lindleyi* Burkart, this last one being another synonym of *M. schleidenii*. Thus, annotations made by Burkart on the original material in 1948 provided the historical evidence that these exsiccates contain two distinct morphotypes related to two *Mimosa* species, helping us to detect and fix the admixture problem.

However, these two morphotypes identified in the original material of *M. asperoides* do not correspond to any of the species highlighted by Burkart in 1948, *M. axillaris* and *M. schleidenii*. In fact, they correspond to the two new species described by Izaguirre and Beyhaut (2009), *M. asperoides* and *M. axillarioides*. Both species suggested by Burkart to compose the admixture are morphologically distinct from *M. asperoides*, mainly by the articulate fruits, and from *M. axillarioides* by indumentum or flower features. For example, *M. axillaris* differs from both species of the admixture by its subglobose to ellipsoid inflorescences, antrorse-strigose indumentum of branches and peduncles, and longer leaves and petioles. While *M. schleidenii* differs by having a pappiform calyx, leaflets glabrous on both faces, and a corolla completely sericeous.

Looking for new diagnostic features to solve the admixture

The morphological analysis of the original material and the discovery of Brazilian populations (Tab. 2) helped us to support which fragment corresponds to *M. asperoides* and which corresponds to *M. axillarioides*, enabling the lectotypification of *M. asperoides*. In addition, the comparative analysis highlighted other five diagnostic features to better circumscribe *M. asperoides*. These features were: the shape and size of leaflets (Fig. 2D, E, F, Tab. 2); the arrangement of leaves on the secondary branches (Fig. 3F); the indumentum of peduncles (Fig. 3H) and indumentum of fruits (Fig. 3 J, K). However, we noticed that most of the features analyzed overlapped with *M. axillarioides* (71%), hampering their distinction due to high variance among *M. asperoides* populations or by sharing similar morphology (Tab. 2).

For example, the shape and length of calyx were highly variable between Brazilian (BRA) and Uruguayan (URY) populations of *M. asperoides*, which has compromised their use as diagnostic features. While *M. axillarioides* has a laciniate calyx covering half of corolla length (Fig. 3A),

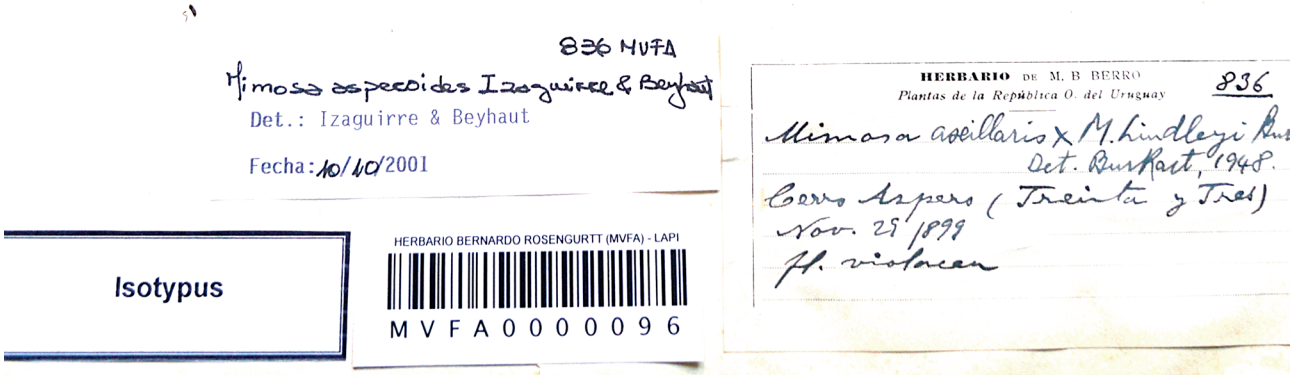


Figure 1. Detail of the identification tag of *M. asperoides* Izag. & Beyhaut isotype, illustrating the historical evidence of taxonomic confusion caused by specimen admixture; which was highlighted by Burkart in 1948, when he considered this specimen as a putative hybrid (Photo from F. Schmidt-Silveira).

in *M. asperoides* it covers the half (URY, Fig. 3B, C) or more than half of corolla's length (BRA, Fig. 3D, E), being more laciniate (URY, Fig. 4B, C) or less laciniate (BRA), so the rim is fimbriate (BRA, Fig. 3E). Furthermore, this variation was also noticed regarding the phenological state and age of the specimens analyzed. The calyx is less laciniate and longer in flower buds and young inflorescences (Fig. 3D, E), while it is more laciniate and shorter in old inflorescences (Fig. 3B, C). Nevertheless, the relationship between calyx shape and inflorescence age merits further investigations beyond of the goals of the present study.

Another example of morphological overlap between the species is the indumentum of flowers. Both species have two types of indumentum in corolla, one antrorse in the apex of lobes and other retrorse covering the lobes besides tubular corolla and paleaceous-laciniate calyx (Fig. 3A–E, Tab. 2). Moreover, both species are covered by setiform-barbellate trichomes, mainly in peduncles and fruits (Fig. 3. I–K). However, despite being classified as the same type of trichome, this structure seems to differ regarding robustness, width, and length. Those micromorphological differences remarked for the trichomes should be

Table 2. Comparative morphological analysis between *Mimosa axillarioides* and *M. asperoides*, indicating the diagnostic features of *M. asperoides* and overlapping features with *M. axillarioides*.

Feature	*M. axillarioides* *	*M. asperoides* §	Taxonomic value of the feature
Arrangement of leaves on secondary branches	Few and lax leaves per branch	Several and congested leaves per branch	Diagnostic
Pinnae length	(20) 30–55 mm long	7–32 (40) mm long	Overlap
Leaflet number	15–25 pairs	(9) 15–38 (43) pairs	Overlap
Leaflet venation	1–3 subcentric veins, conspicuous on both faces, being the lateral veins incomplete	1–2 subcentric veins, usually conspicuous on the abaxial face, lateral veins inconspicuous	Overlap
Leaflet shape	Oblong with asymmetric base and acute apex	Narrowly oblong with asymmetric base and obtuse apex	Diagnostic
Leaflet size	6–7.5 × 1.5–2 mm	2–5 × 0.5–0.9 (1.3) mm	Diagnostic
Leaflet indumentum	Abaxial face pubescent (filiform trichomes); Adaxial face usually glabrous	Abaxial face pubescent (filiform trichomes); Adaxial face partly pubescent	Overlap
Leaflet margin	Corneus-setose	Corneus-setose	Overlap
Peduncles length	55–100 (120) mm	12–60 (70) mm	Overlap
Peduncle indumentum	Hispid with patent setiform-barbellate trichomes	Retrorse-strigose with setiform-barbellate trichomes	Diagnostic
Calyx type	Paleaceous-laciniate, tube deeply laciniate	Paleaceous-laciniate, tube deep to shortly laciniate, then rim fimbriate	Overlap
Calyx length (long)	1.4–1.6 (2) mm	1.2–1.8 mm	Overlap
Calyx proportion to corolla	Up to 1/3 of corolla length	1/3 to ½ of corolla length	Overlap
Corolla shape	Tubular	Subtubular to tubular	Overlap
Corolla length (long)	2–2.5 mm	1.9–2.6 mm	Overlap
Corolla indumentum	Lobes retrorse-sericeous, Apex of lobes antrorse	Lobes retrorse-sericeous, Apex of lobes antrorse	Overlap
Fruit shape *	Craspedium 2–3 (4) articulate, oblong, flattened	Craspedium non articulate, oblong, inflated	Diagnostic
Fruit dehiscence #	transversal	valvar	Diagnostic
Fruit indumentum	Hispid with setiform-barbellate trichomes	Retrorse-strigose with setiform-barbellate trichomes	Diagnostic

* Features based on description of Izaguirre & Behyaut (2009) and the holotype of *M. axillarioides*.

Diagnostic feature highlighted in the protologue.

§ Data from the analysis of herbaria exsiccates (holotype and paratype of MVFA) and Brazilian collections (see Materials and methods for more details).

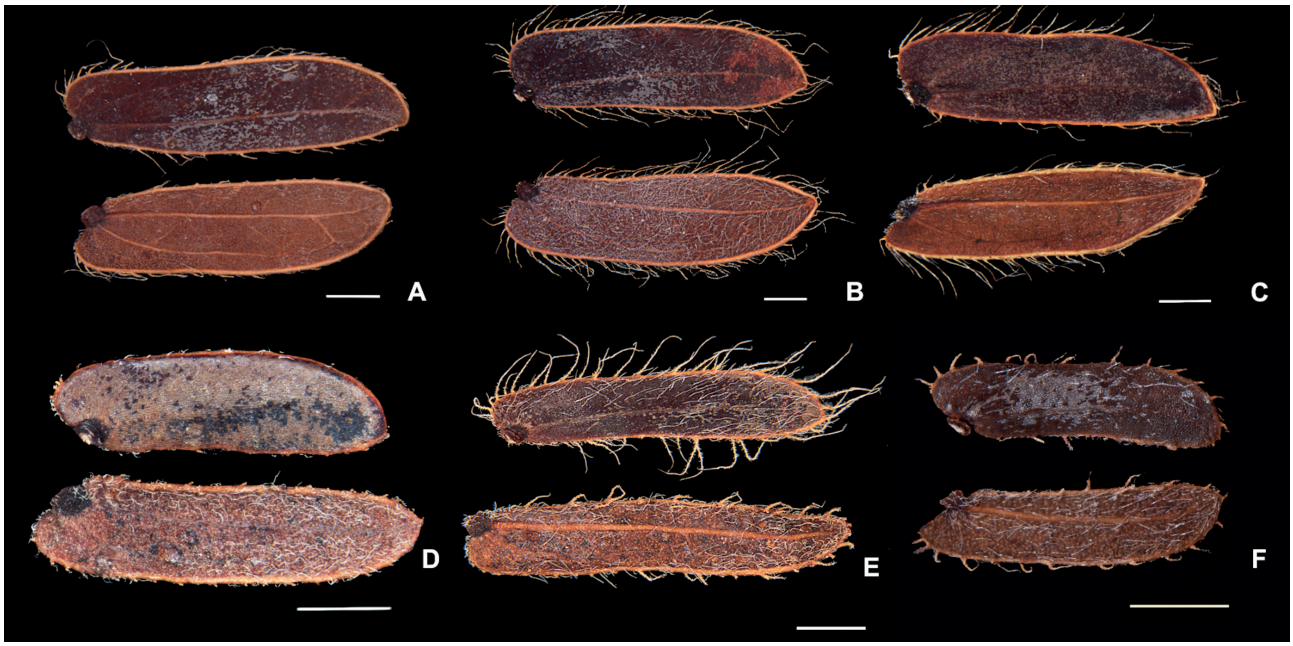


Figure 2. Comparative morphological analysis of *Mimosa asperoides* and *M. axillarioides* leaflets, showing that some leaflets from the fragments of the designated holotype and isotype of *M. asperoides* (A, B) have consistent morphology with *M. axillarioides* (C); while other leaflets are indeed from *M. asperoides* (D) when comparing its morphology with non-mixed material from the *M. asperoides* paratype (E) and the Brazilian collections (F). **A**. Leaflets from a fragment of the designated holotype of *M. asperoides* (MVFA barcode 0000095), whose morphology corresponds to *M. axillarioides*. **B.** Leaflets from a fragment of *M. asperoides* isotype (MVFA barcode 0000096) that correspond to *M. axillarioides*. **C.** Leaflets from the holotype of *M. axillarioides* (MVFA barcode 26745). **D**. Leaflets from a fragment of *M. asperoides* holotype (MVFA barcode 0000095), whose morphology corresponds to *M. asperoides*. **E.** Leaflets of *M. asperoides* paratype (Berro 5528). **F**. Leaflets of *M. asperoides* from Brazil (F. Schmidt-Silveira, 1094). Upper leaflets are from adaxial face, being usually nerveless and brighter. Lower leaflets are from abaxial face, usually 1–3 nerved and non-brighter. Scale bars of 1 mm.

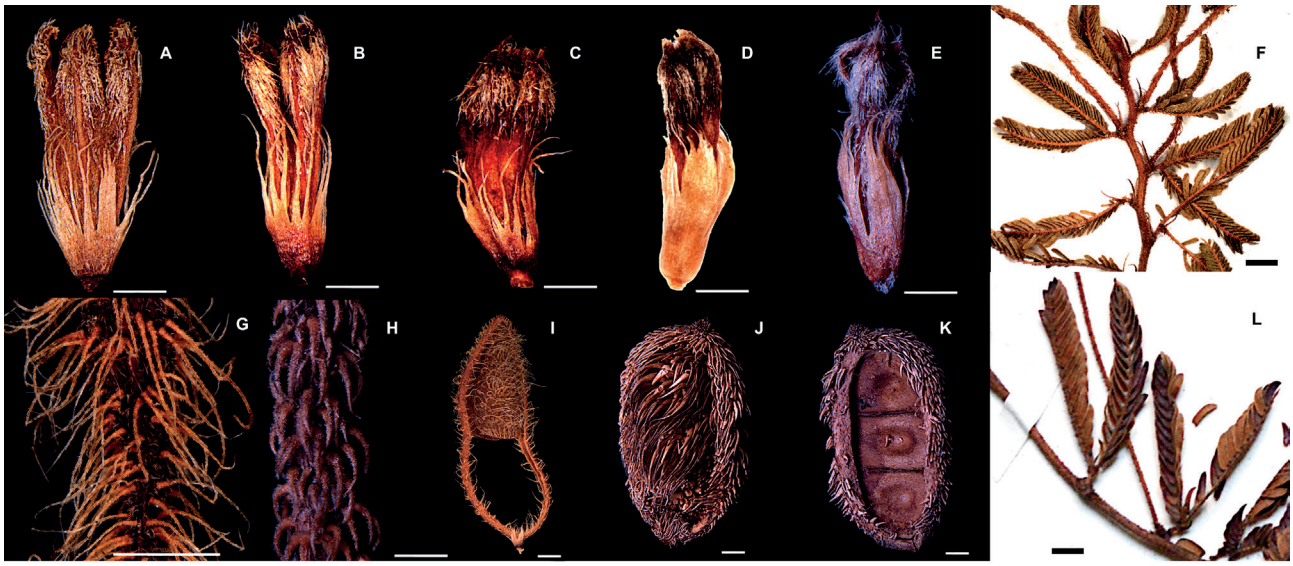


Figure 3. Comparative morphological details between *Mimosa asperoides* and *M. axillarioides*, showing that the morphology and indumentum of calyx and corolla are similar in both species **(A, B, C, D, E**). However, they differ by the indumentum of peduncles (**G, H**); the arrangement of leaves on branches (**F, L**), by fruit type, and indumentum (I, J, K). ***M. asperoides***: B, C, D, E, F, H, J, K, ***M. axillarioides***: A, G, I, L. (Photos A, G, I, L from *M. axillarioides* holotype; Photo B from a fragment of *M. asperoides* holotype; Photo C from *M. asperoides* paratype; Photos D, E, F, H, I, J, K from F. Schmidt-Silveira, 1094). Scale bars of 0.5 mm (A–E & H) and 1mm (F, G, I–L).

investigated concerning an anatomical approach to allow a better delimitation of the species based on trichomes. In addition, features such as the leaf length and the number of leaflets may be of interest to delimit *M. asperoides* despite the overlapping measures (in Tab. 2), if more material would be available, and if analyzed considering a morphometric framework.

Lectotypification and the amended description

Mimosa asperoides Izag. & Beyhaut, Bol. Soc. Argent. Bot. 44(3–4): 354–355, 352, fig. 1C. 2009, *emend.* Schmidt-Silveira & Miotto. – **Lectotype** (designated here): URUGUAY. Treinta y Tres, Cerro Áspero, Yerbal, flor violácea, 29 Nov 1899, Berro 836 pro parte (MVFA barcode 0000095! [three stems on half right side of the sheet with fruits and flowers]; isolectotype: pro parte (MVFA barcode 0000096! [two stems on lower left side of the sheet with fruits or vegetative]). Fig. 4

Mimosa asperoides differs from *M. axillarioides* by the arrangement of leaves on secondary branches with several congested leaves per branch; the shape and size of the leaflets, which are narrowly oblong from asymmetric base and obtuse apex with 2–5 × 0.5–0.9 (1.3) mm; peduncles covered by a retrorse-strigose setiform-barbellate trichomes, and a craspedium non-articulate, oblong, inflated, with valvar dehiscence, covered by retrorse-strigose and setiform-barbellate trichomes.

Herbs prostrate ascendant or trailing, stoloniform, unarmed, without xylopodium, roots with nodules. **Branches** cylindrical with variable indumentum, from glabrescent (principal branch) to puberulent and hispid with setiform-barbellate trichomes (secondary branches). Principal branch prostrate; secondary branches usually ascending with divaricate nodes and several congested alternate leaves. **Stipules** linear-lanceolate, 1.9–3.0 × 0.23–0.33 mm, one main vein quite visible due to trichomes, margin pubescent. **Leaves** bipinnate, 1-jugate; non sensitive to touch; **petioles** diminute, (0.95) 1–2.5 mm long, covered with setiform-barbellate trichomes; interpinnal segment 1–3 mm long; spiculate; **paraphyllidia** subulate, small, 0.40–0.53 × 0.11–0.21 mm, pubescent; **pinnae** 7–32 (40) mm long, (11) 15–38 (43) pairs of leaflets per pinnae, rachis puberulent and usually quadrangular; **leaflets** narrowly oblong, base asymmetric and apex obtuse, 2–5 × 0.5–0.9 (1.3) mm, discolor, 1–2 subcentric veins outstanding, usually only on abaxial face; adaxial face brighter and scarcely pubescent than abaxial face, which is completely pubescent, margin corneus and setose. **Synflorescence** axillar, alternate. **Inflorescence** capituliform, globose; **peduncle** 12–60 (70) mm long, retrorse-strigose covered by setiform-barbellate trichomes. **Floral bracts** narrowly elliptic, 1.4–2.2 × 0.3–0.6 mm, dorsally pubescent, margin hispid. **Flowers** 4-merous, 4-androus, apparently all bisexual; **calyx** paleaceous-laciniate, tube deep to shortly laciniate, then rim fimbriate, 1.2–1.8 mm long, glabrous; **corolla** subtubular to tubular, 1.9–2.6 × 0.5–0.8 mm, half tube and lobes covered with thinly retrorse filiform trichomes (densely sericeous), but apex lobes with antrorse filiform trichomes; **ovary** oblong, reniform, 0.50–0.90 × 0.19–0.32 mm, glabrous to pubescent, substipitate, stipe 0.5–0.7 mm long; **stamens** shortly monadelphous at base of ovary, exserted 2.5–5 mm long, filaments pink-purple, anthers elliptic and dorsifix. **Fruit** a non-articulate craspedium, oblong, inflated, only internally segmented; (1) 4–10 (12) fruits per inflorescence; short-pedicellate 0.40–1.15 mm long; 7.4–13.0 × 5.30–7.44 mm; valves and replum densely retrorse-strigose, covered by setiform-barbellate trichomes, replum enlarged with 0.6–1.3 mm width and apex shortly apiculate; dehiscence valvar. **Seeds** ovoid, dark brown to black, 1–3 (4) seeds, 2.4–3.0 × 2.0–2.8 mm.

Examined Material — BRAZIL. **Rio Grande do Sul,** Mostardas, Bacopari, 17 Nov. 2006 (fr), *E. Pasini 2253* (MBM 63244, MBM 407888, HUCS 32183); ibidem, Lagoa Azul, Jun. 2013 (fl), *F. Gonzatti 886* (ICN); ibidem, Lagoa do Bacopari, 07 Nov. 2015 (fl, fr), *F. Schmidt-Silveira 1094* (ICN); Osório, Faz. do Arroio para Osório, Sept. 1957 (fl), *B. Rambo s.n.* (PACA 61455); ibidem, Fazenda do Arroio- Lagoa da Emboaba, 2 Sept. 2015 (fl), *F. Gonzatti 2110* (HUCS 52015); ibidem, RS 030-Jasida, 9 Apr. 2015 (fl), *F. Gonzatti 1806* (HUCS 42751); ibidem, 21 Sept. 1972 (fl), *N. Bolsin s.n.* (MPUC2536); Palmares do Sul, estrada para Lagoa da Porteira, 24 Aug. 2017 (fl), *F. Schmidt-Silveira 1095* (ICN); Tramandaí, Parque General Osório, 8 Sept. 1987 (fl), *s.c. s.n.* (ICN674, MVFA 000117); ibidem, beira da estrada RS-030, 24 Aug. 2017 (fl), *F. Schmidt-Silveira 1092* (ICN); ibidem, Campus Litoral Norte da UFRGS, 03 Jan. 2019 (fr), *F. Schmidt-Silveira 1093* (ICN). —URUGUAY**. Lavalleja**, Cerro Penitente (Minas), 11 Jan. 1909 (fr), *Berro 5528* (MVFA). **Treinta y Tres**, Cerro Áspero, Yerbal, flor violácea, 29 Nov. 1899 (fr, fl), *Berro 836* (MVFA 0000095).

Notes— *Mimosa asperoides* is a singular species among other Southern American *Mimosa* L. section *Mimosa* due to its inflated and non-articulated fruit with valvar dehiscence, similar to some species of *M.* sect. *Batocaulon* ser. *Pachycarpae* Benth. and *M.* ser. *Stipellares* Benth. Among the species of *Mimosa* sect. *Mimosa*, only two species of *M.* subser. *Obstrigosae* (Benth.) Barneby have non-articulated fruits with valvar dehiscence (*M. sprengelii* DC. and *M. australis* Izag. & Beyhaut). *Mimosa asperoides* seems to be morphologically more similar to *M. pedersenii* Barneby and *M. excendentis* Izag. & Beyhaut regarding the shape and indumentum of leaflets, peduncles, corolla indumentum and calyx type besides having spiculate leaves, features that match with *Mimosa* sect. *Mimosa* subser. *Macrocalycinae* Barneby, instead of *M.* sect. *M.* subser. *Axillares* Barneby as proposed by Izaguirre and Beyhaut (2009).

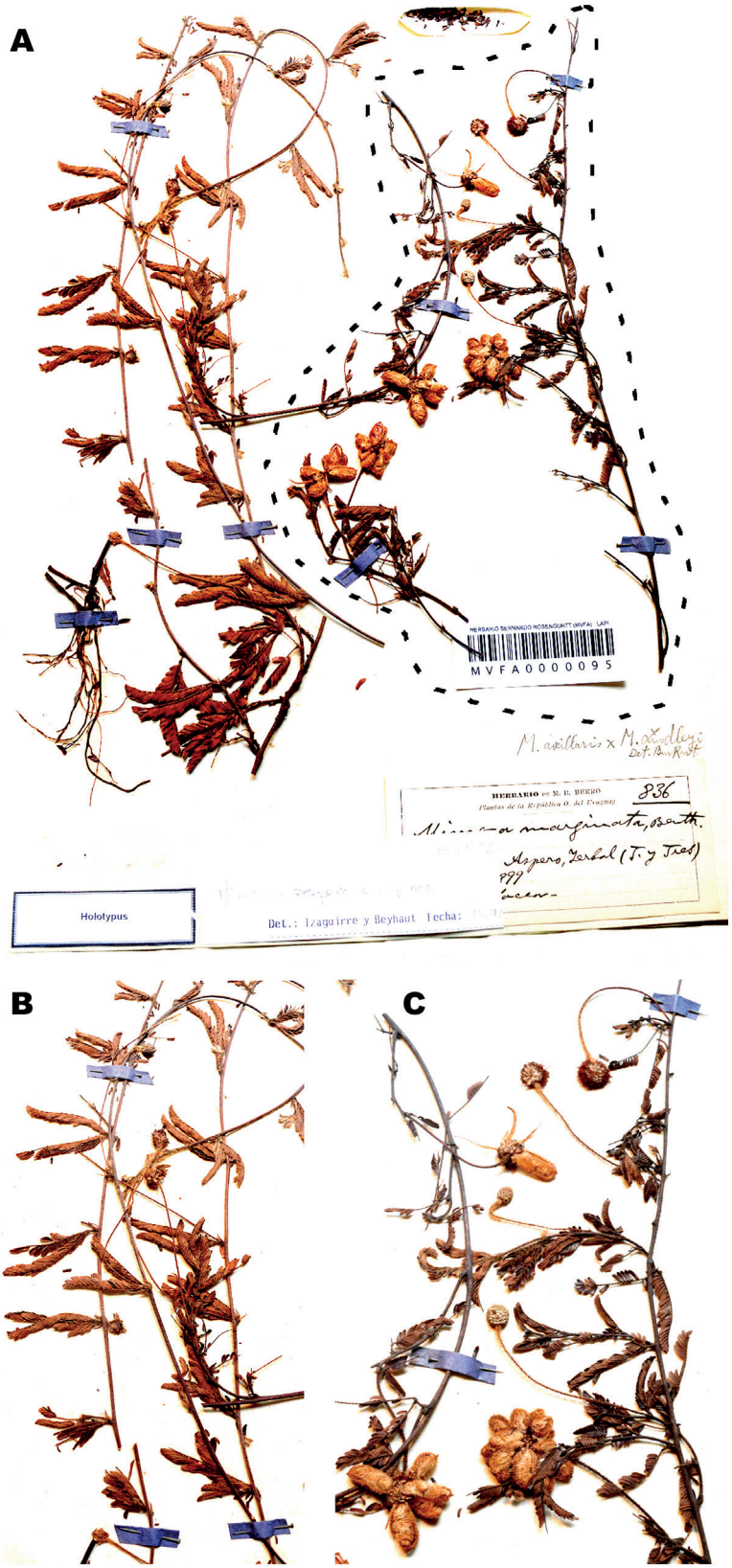


Figure 4. Designated holotype of *Mimosa asperoides* Izag. & Beyhaut and details of admixture (mixed collection): the 'Frankenstein type'. This original material is composed of fragments of *M. asperoides* (**A** dotted & **C**, here lectotypified) that presents its mainly diagnostic feature, the fruit; and *M. axillarioides* Izag. & Beyhaut (**A** not dotted & **B**), which does not present this feature. (Photos from F. Schmidt-Silveira).

*The first record of **M. asperoides** for Brazil highlighted the admixture and improved its description*

The nomenclatural admixture was only detectable due to the discovery of Brazilian populations of *M. asperoides*. Firstly, the Brazilian collections were considered a probably new species morphologically similar to *M. asperoides*. However, the analysis of MFVA herbarium allowed us to confirm its occurrence in Brazil and to detect the admixture in the original material, enlightening the circumscription of *M. asperoides*. For example, beyond the new diagnostic features, we noticed that this species has: (1) nodules on the roots; (2) paraphyllidia; (3) spicule; (4) substipited ovary; (5) shortly monadelphous stamens at base of ovary; (6) variable flower features according to development stage; (7) two flowering periods.

In Brazil, *M. asperoides* is found in the remaining native vegetation of four localities of the coastal plain of Rio Grande do Sul (RS) State (32°S 1' 60", 52°W 5' 55"), growing on sandy soils and wet grasslands (Fig. 5 and 6). Most recent records were only reported from Brazil, because this species has not been collected in Uruguay for almost 70 years. Brazilian populations of this species showed differences mainly regarding its phenology and habitat beyond disjoint distribution. For example, Brazilian populations habit sandy soils in coastal plain, and they bloom twice (during April–June and August–September), having fruits at November–January. While Uruguayan populations occur on hills and prairies slopes, having only one and shorter period of flowering and fructification (November to March). Furthermore, Brazilian populations occur in areas of intense land conversion (e.g. urban expansion, agriculture and silviculture), being limited to a few individuals and small patches. Regarding this, urgent efforts are required to: (1) map all its populations, (2) evaluate its conservation status, and (3) elaborate a conservation plan to avoid its extinction in the field.

Discussion

Nomenclature rules are independent from taxonomic methods (Turland 2019). However, these disciplines are subordinated to each other regarding the typification of a name. While taxonomy provides the methods and concepts to delimit a taxon, nomenclature determines the rules that fix and link a taxon to a name. A taxonomic confusion in species delimitation will imply in instability on naming a species, and on nomenclatural problems. For example, a delimitation based only on a unique or high variable feature or mixed material can difficult the identification of a taxon, and prompt a taxonomic

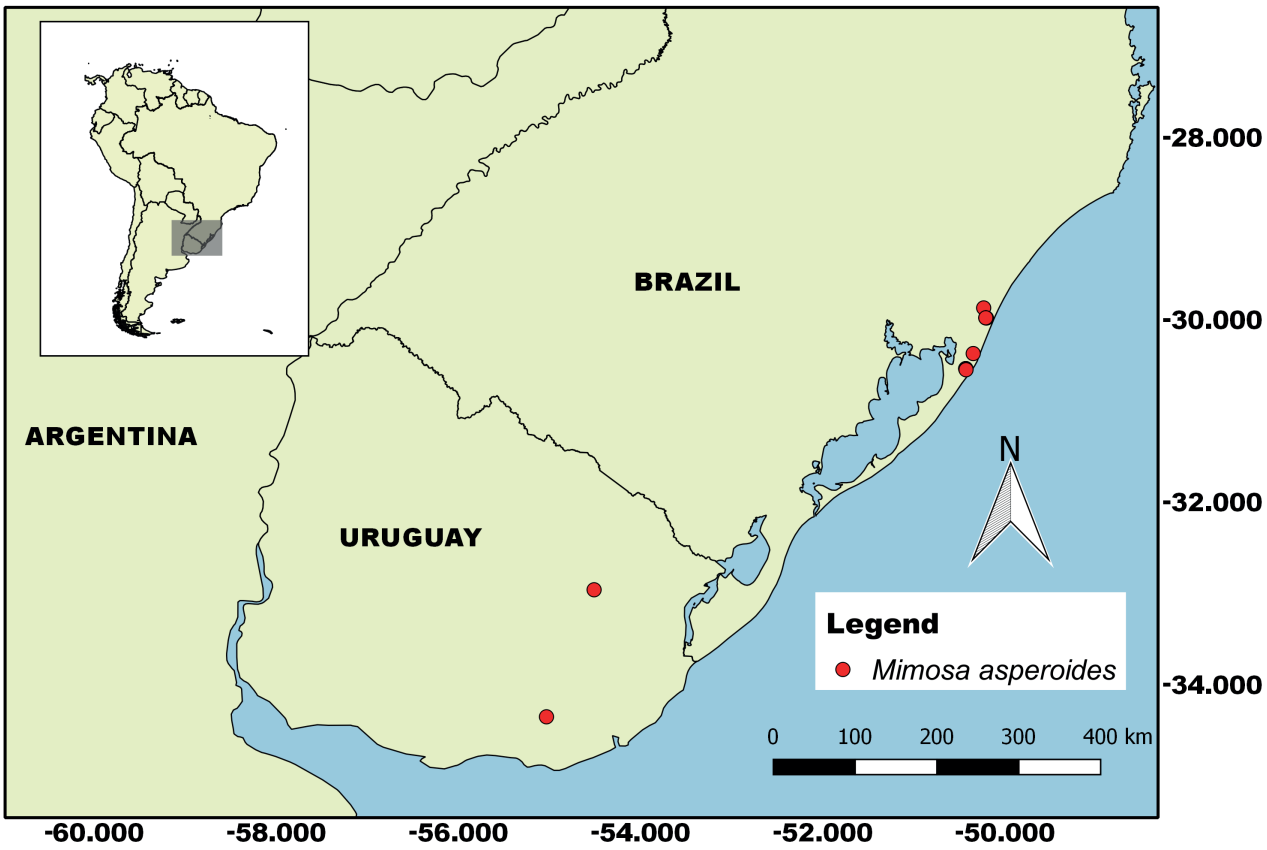


Figure 5. Current distribution of *Mimosa asperoides* in South America, considering the new records for Brazil, in Rio Grande do Sul State.

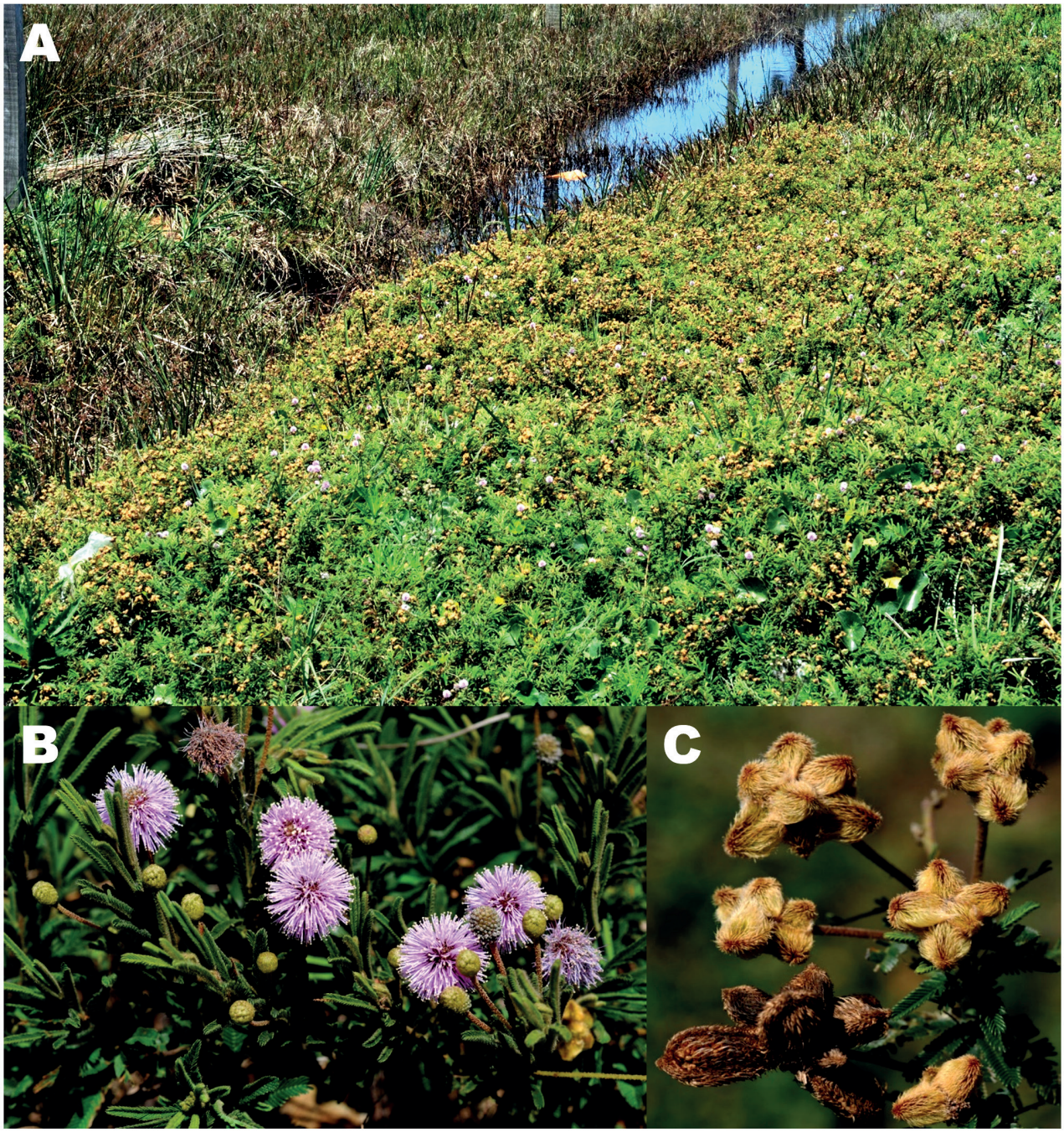


Figure 6. *Mimosa asperoides* details. **A**. In sandy soils of Coastal Plain in Rio Grande do Sul State, Brazil. **B**. Inflorescences. **C**. Fruits. (Photos from S. Bordignon).

confusion when this feature is not available or; when used to distinguish species morphologically similar, to result in misidentification. Thereafter, if not solved, the taxonomic confusion will generate, such as a domino effect, difficulties in the species identification and application of a name in taxonomy and outside of taxonomy (McNeill 2000), such as in the biomedical research (e.g. Bennett & Balick 2014); nourishment (e.g. Nesbitt *et al.* 2010); conservation (e.g. Mace 2004; Vogel-Ely *et al.* 2017), and in the managing of biological invasions (Pyšek *et al.* 2013).

A nomenclatural admixture ('Frankenstein type') is an example of a taxonomic confusion in species delimitation that may be generated by the superficial similarity between the taxa, the little progress in a particular taxonomic group (Sennikov & Tikhomirov 2019), besides the simultaneous collection of a species in sympatry and the absence of field notes to distinguish them (Brummitt *et al.* 2004). In the case of the 'Frankenstein type' of *M. asperoides*, the phenological stages among the fragments contributed to the mixed material, because while *M. asperoides* presented

very distinctive fruits, *M. axillarioides* was in flowering or with immature fruits that have similar trichomes, thereby being confused with *M. asperoides*. The lack of the fruit may also explain why Izaguirre and Beyhaut (2009) did not consider the exsiccate from Brazil deposited in MVFA herbarium (MVFA 0000117) belong to this species. We also hypothesize that the morphological similarities, availability of only herbaria material instead of recent collections and fieldwork may have contributed to the admixture because if the authors had have observed this species in field, they may have highlighted previously the fragments of *M. axillarioides*, avoiding admixture in the original material of *M. asperoides*.

A 'Frankenstein type' is not restricted to *Mimosa asperoides*, it has been reported for different groups of plants and fungi, mainly for the Linnean species (Sennikov & Tikhomirov 2019). For example, the revised lectotypifications of *Lycopus europaeus* L. (Lamiaceae) and *Daucus mauritanicus* L. (Apiaceae) were needed due to their current lectotypes consisting of plant fragments representing two different species (Sennikov & Melnikov 2018; Martínez-Flores & Crespo 2019). These examples show that admixture seems to be a common taxonomic headache, although it has been underestimated and reported, being an interesting topic to be investigated regarding its causes and consequences. Other cases of 'Frankenstein types' are more complex and involve mixed material in the protologue and/or illustrations (e.g. Wu *et al.* 2012; Crespo *et al.* 2019), requiring sometimes amended descriptions (e.g. McPherson & White 1999), epitypes (e.g. Malekmohammadi *et al.* 2017) or demanding morphological and molecular analyses to clarify the identity of the species (e.g. Link-Pérez *et al.* 2016).

In the case of *Mimosa asperoides*, we perfomed a morphological comparative analysis to find differences among the species involved in the admixture, highlighting new morphological diagnostic features to this species. Most of these new diagnostic features helped to distinguish *M. asperoides* when the fruit was lacking, such as the leaflets shape and the kind of indumentum of peduncles, features that have been successfully used to delimit other species in the *Mimosa* genus. For example, leaf morphology was a good feature to distinguish species from *Mimosa* subser. *Dolentes–Brevipedes* (Morales *et al.* 2020) and *M.* ser. *Quadrivalves* (Flores-Cruz *et al.* 2004). Furthermore, the indumentum has been considered a relevant feature to describe new species in *Mimosa* (e.g. Atahuachi & Hughes 2006; Santos-Silva & Tozzi 2012; Dutra & Garcia 2013; Jordão *et al.* 2014; Schmidt-Silveira *et al.* 2019). We would also benefit from other source of evidence such as DNA, morphometry, and cytogenetic data to support the species hypothesis in the perspective of the integrative taxonomy (Dayrat 2005; Pante *et al.* 2015) to solve a 'Frankenstein type'. However, in the case of the *Mimosa asperoides*, we had limited data, being the morphological approach fundamental to detect and to solve the admixture.

Here, we have illustrated that a nomenclatural problem can be a raw material to develop and improve our understanding of plant taxonomy. We exemplified the 'taxonomic headache' due to a 'Frankenstein type' and solved the admixture on the original material of *Mimosa asperoides*. Firstly, the discovery of new records in Brazil, the review of original material and the protologue, besides the identification tags, helped us to detect the admixture. Secondly, we found more diagnostic features to distinguish the species involved on the admixture by a careful morphological analysis that allowed the lectotypification of *Mimosa asperoides* and its amended circumscription. Thirdly, we extended the occurrence of *Mimosa asperoides* in South America, reporting its first citation for Brazil and ecological differences among the populations. Finally, we discussed the implications of a taxonomic confusion for naming and delimiting species, probably reasons that may prompt a 'Frankenstein type' and the role of morphology to clarify the *M. asperoides* identity.

Acknowledgements

We are very grateful to Nicholas Turland for his help in understanding the nomenclatural problem and for the prompt answer to our doubts. We also want to thank Primavera Izaguirre and Rosario Beyhaut (MVFA) for their help with the types and protologue of *M. asperoides*. We also thank curators of Uruguayan herbaria that assisted us during the herbarium revision, especially Eduardo Marchesi and José M. Bonifacino (MVFA) and Manuel García in memorian (MVM). We gratefully acknowledge Sérgio Bordignon for the field photographs of *M. asperoides*; Cleusa V. Ely and Henrique M. Büneker for discussions, Felipe Gonzatti for collections; Gustavo Hassemer, Gustavo Heiden and João Iganci for comments. This work was supported by the Conselho Nacional de Desenvolvimento Científico e Tecnológico (CNPq).

References

Atahuachi MB, Hughes CE. 2006. Two new species of *Mimosa* (Fabaceae) endemic to Bolivia. Brittonia 58: 59–65.

Barneby RC. 1991. *Sensitivae censitae*: A description of the genus *Mimosa* Linnaeus, (Mimosoideae) in the New World. Memoirs of the New York Botanical Garden 65: 1–835.

Beentje H. 2010. The Kew Plant Glossary. London, Royal Botanic Gardens, Kew.

Bennett BC, Balick MJ. 2014. Does the name really matter? The importance of botanical nomenclature and plant taxonomy in biomedical research. Journal of Ethnopharmacology 152: 387–392.

Brummitt RK, Mill RR, Farjon A. 2004. The significance of 'it' in the nomenclature of three Tasmanian conifers: *Microcachrys tetragona* and *Microstrobos niphophilus* (Podocarpaceae), and *Diselma archeri* (Cupressaceae). Taxon 53: 529–539.

Crespo MB, Martínez-Azorín M, Alonso-Vargas AM. 2019. Lectotype designation for *Scilla undulata* Desf. (Asparagaceae) from among the mixed original material. Phytotaxa 411: 089–092.

Dayrat B. 2005. Toward integrative taxonomy. Biological Journal of the Linnean Society 85: 407–415.
Dutra VF, Garcia CP. 2013. Three new species of *Mimosa* (Leguminosae) from Minas Gerais, Brazil. Systematic Botany 38: 398–405.
Flores-Cruz M, Santana-Lira HD, Koch SD, Grether R. 2004. Taxonomic significance of leaflet anatomy in *Mimosa* series *Quadrivalves* (Leguminosae, Mimosoideae). Systematic Botany 29: 892–902.
Izaguirre P, Beyhaut R. 2009. Nuevas espécies del género *Mimosa* de las subséries axillares y reptantes (mimosoideae-leguminosae) em el distrito uruguayense de La región neotropical. Boletín de la Sociedad Argentina 44: 351–359.
Jordão LSB, Morim MP, Baumgratz JFA. 2014. A new species of *Mimosa* (Leguminosae) from Brazil. Phytotaxa 184: 131–138.
Jordão LSB, Morim MP, Baumgratz JFA. 2020. Trichomes in *Mimosa* (Leguminosae): Towards a characterization and a terminology standardization. Flora 272: 151702.
Knapp S, Lamas G, Lughadha NE, Novarino G. 2004. Stability or stasis in the names of organisms: the evolving codes of nomenclature. Philosophical Transactions of the Royal Society B 359: 611–622.
Lendemer JC. 2020. Epitypes are forever: Best practices for an increasingly misused nomenclatural action. Taxon 69: 849–850.
Link-Pérez MA, Ludwig TG, Ledford CJ, Seabolt MH, Sessa EB. 2016. Lectotypification of *Adiantopsis alata* (Pteridaceae) and Descriptions of New Palmate Species in the Guiana Shield. Systematic Botany 41: 906–918.
Mace GM. 2004. The role of taxonomy in species conservation. Philosophical Transactions of the Royal Society B 359: 711–719.
Malekmohammadi M, Lack HW, Lomonosova M, Akhani H. 2017. The discovery, naming and typification of *Limonium gmelini* (Plumbaginaceae). Willdenowia 47: 99–106.
Martínez-Flores F, Crespo MB. 2019. Revisiting the lectotype of *Daucus mauritanicus* L. (Apiaceae). Taxon 68: 1359–1362.
McNeill J. 2000. Naming the groups: developing a stable and efficient nomenclature. Taxon 49: 705–720.
McPherson G, White LJT. 1999. A New Combination in Gabonese *Synsepalum* (Sapotaceae). Novon 9: 534–535.
Morales M, Giannoni F, Inza MV *et al*. 2020. Genetic and morphological diversity and population structure of a polyploid complex of *Mimosa* (Leguminosae). Systematics and Biodiversity 18: 236–254.
Nesbitt M, McBurney RPH, Broin M, Beentje HJ. 2010. Linking biodiversity, food and nutrition: The importance of plant identification and nomenclature. Journal of Food Composition and Analysis 23: 487–499.
Pante E, Schoelinck C, Puillandre N. 2015. From integrative taxonomy to species description: One step beyond. Systematic Biology 64: 152–160.
Pyšek P, Hulme PE, Meyerson LA *et al*. 2013. Hitting the right target: Taxonomic challenges for, and of, plant invasions. AOB Plants 5: plt042.
Santos-Silva J, Tozzi AMGA. 2012. *Mimosa foreroana* (Leguminosae, Mimosoideae), a new species from Nariño, Colombia. Systematic Botany 37: 437–441.
Schmidt-Silveira FS, Vargas W, Fortuna-Perez AP, Miotto STS. 2019. A new glandular *Mimosa* species from Southern Brazil and insights about its glandular trichomes micromorphology. Acta Botanica Brasilica 33: 716–723.
Sennikov AN, Melnikov DG. 2018. Revised lectotypification of *Lycopus europaeus* (Lamiaceae). Taxon 67: 1199–1201.
Sennikov AN, Tikhomirov VN. 2019. Revised typification of *Campanula sibirica* (Campanulaceae). Taxon 68: 152–155.
Shelley MW. 1831. Frankenstein, or, The Modern Prometheus: The 1818 text. New York, Oxford University Press.
Thiers B. 2023 [continuously updated]. Index Herbariorum: A global directory of public herbaria and associated staff. New York Botanical Garden's Virtual Herbarium. http://sweetgum.nybg.org/science/ih/. 20 Dec. 2022.
Thomson SA, Pyle RL, Ahyong ST *et al*. 2018. Taxonomy based on science is necessary for global conservation. PLOS Biology 16: e2005075.
Turland NJ, Wiersema JH, Barrie FR *et al*. (eds). 2018. International Code of Nomenclature for algae, fungi, and plants (Shenzhen Code) adopted by the Nineteenth International Botanical Congress Shenzhen, China, July 2017. Königstein, Koeltz Botanical Books.
Turland T. 2019. The Code Decoded A user's guide to the International Code of Nomenclature for algae, fungi, and plants. Bulgaria, Pensoft.
Vogel-Ely C, Bordignon SAL, Trevisan L, Boldrini II. 2017. Implications of poor taxonomy in conservation. Journal for Nature Conservation 36: 10–13.
Wu SH, Kirk PM, Redhead SA *et al*. 2012. Resolution of the nomenclature for niu-chang-chih (*Taiwanofungus camphoratus*), an important medicinal polypore. Taxon 61: 1305–1310.