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Towards a stable generic circumscription in Oxypetalinae (Apocynaceae)

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Abstract

Based on phylogenetic studies and morphological evidence, we propose the synonymization of *Morrenia* and *Schistogyne* under *Araujia* and *Oxypetalum* respectively. As a result, eight new combinations are proposed in *Araujia* (*A. brachystephana*, *A. hassleriana*, *A. herzogii*, *A. odorata*, *A. scalae*, *A. stuckertiana*, *A. stuckertiana* subsp. *grandiflora* and *A. variegata*), and eight in *Oxypetalum*, including two new names (*O. fiebrigii*, *O. heptalobum*, *O. karstenianum*, *O. longipedunculatum*, *O. pentaseta*, *O. pubescens*, *O. sylvestre* and *O. tucumanense*). We provide new synonymies and designate lectotypes for *Lagenia megapotamica*, *Morrenia hassleriana*, *M. herzogii*, *M. intermedia*, *Schistogyne boliviensis*, *S. longipedunculata* and *S. sylvestris*. We also clarify the typification of *Tweedia*.

Key words: *Araujia*, classification, *Morrenia*, *Oxypetalum*, *Schistogyne*, *Tweedia*

Introduction

The systematics of Asclepiadoideae (Apocynaceae) has received a great boost from molecular phylogenetics. Relationships in the subfamily are much better understood than ten years ago, and numerous taxonomic changes have been proposed to reflect these advances. Neotropical species of Asclepiadoideae are distributed in just four lineages, the largest including members of the Metastelmatinae, Oxypetalinae and Gonolobinae. Together, these three subtribes form the core group of a clade informally referred as the "MOG" clade (Rapini *et al.* 2003, Liede-Schumann *et al.* 2005).

The plastid phylogenetic framework presented for the neotropical Asclepiadoideae by Rapini *et al.* (2003) and Liede-Schumann *et al.* (2005) provided important evidence to support significant subtribal rearrangements. The Metastelmatinae became restricted to the New World, also including genera previously classified in the Marsdenieae, such as *Barjonia* Decaisne (1844: 512) and *Nephradenia* Decaisne (1844: 604); whereas most Old World species of the subtribe were transferred to the Cynanchinae (Liede & Täuber 2002, Rapini *et al.* 2003). Reducing the Gonolobeae to the rank of subtribe (Liede 1997) improved the classification as the Gonolobinae are nested within the New World Asclepiadeae (Rapini *et al.* 2003). The Oxypetalinae were amplified to include a few genera previously considered in the Metastelmatinae, such as *Philibertia* Kunth in Humboldt & Bonpland (1819: 195) and *Funastrum* Fournier (1882: 388) (Rapini *et al.* 2003, 2006). And finally, the Orthosiinae were created based on the previous Orthosieae, but excluding *Peplonia* Decaisne (1844: 545) and *Macroditassa* Malme (1927: 9), which were shown to belong to the Metastelmatinae (Rapini *et al.* 2004, Liede-Schumann *et al.* 2005).

Internal resolution varies among the three largest subtribes of the MOG core group. In Metastelmatinae, phylogenetic studies supported the fusion of *Gonioanthela* Malme (1927: 6) and the monotypic *Peplonia*

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(Rapini *et al.* 2004) as well as the recognition of *Minaria* T.U.P.Konno & Rapini in Konno *et al.* (2006: 424) to comprise a clearly defined, strongly supported shrubby group that diverged in the initial evolution of the subtribe (Rapini *et al.* 2006). Apart from these advances, few phylogenetic patterns have been detected with confidence in the Metastelmatinae; a situation similar to that found in the Gonolobinae (Krings *et al.* 2008).

In Oxypetalinae, the third of the three largest subtribes of the MOG clade with around 200 species, the generic rearrangements have been marked by the inclusion of several small genera in *Oxypetalum* Brown (1810: 30) (see the list of synonyms below) and *Philibertia* (see Goyder 2004 for a list of synonyms). Phylogenetic studies based on molecular data (Rapini *et al.* 2003, 2006, Liede-Schumann *et al.* 2005) have supported most of these changes and indicated the need for others. Apart from *Funastrum*, which is sister to the rest of the subtribe (Liede-Schumann *et al.* 2005, Rapini *et al.* 2006), the Oxypetalinae is divided into two principal clades, one comprising the large genus *Oxypetalum*, with *Schistogyne* Hooker & Arnott (1834: 291) deeply nested within it, and the other including *Philibertia* and *Tweedia brunonis* Hooker & Arnott (1834: 292) in a trichotomy with a clade composed of *Araujia* Brotero (1817) and *Morrenia* Lindley (1838), the latter nested in the former genus (Liede-Schumann *et al.* 2005).

The taxonomy of Oxypetalinae needs to be rearranged to avoid the recognition of *Araujia* and *Oxypetalum* as paraphyletic genera. Therefore, the aim of this paper is to propose the inclusions of *Morrenia* and *Schistogyne* in the synonymy of *Araujia* and *Oxypetalum*, respectively. Supported by phylogenetic studies and morphological evidences, these are important changes towards a stable generic circumscription in Oxypetalinae. *Tweedia* Hooker & Arnott (1834: 291) has been little sampled, with just *T. brunonis* included in published molecular analyses (Liede-Schumann *et al.* 2005). As a first step towards understanding its position, we clarify the confused typification of the genus. Below, we formalize the taxonomic transfer of accepted species of *Morrenia* and *Schistogyne* to *Araujia* and *Oxypetalum*, respectively, and comment on the typification of *Tweedia*.

According to the classification proposed here, only eight genera of Oxypetalinae are still recognised: *Araujia*, *Funastrum*, *Kerbera* Fournier (1885: 290), *Schistonema* Schlechter (1906: 604), *Oxypetalum*, *Philibertia*, *Tweedia* and *Widgrenia* Malme (1900: 69). The monotypic genera *Kerbera*, *Schistonema* and *Widgrenia* present peculiar morphologies and have not yet been sampled in phylogenetic studies. The former two genera look different from Oxypetalinae; however, any taxonomic proposition would be precipitate without further investigations. Therefore, subsequent work will seek to clarify the positions of *Kerbera eichleri* Fournier (1885: 290), *Schistonema weberbaueri* Schlechter (1906: 604) and *Widgrenia corymbosum* Malme (1900: 69; t. 2, f. 4).

Taxonomic treatment

Araujia Brotero (1817: 62). Type: *A. sericifera* Brotero (1817: 62; t. 4–5).

Physianthus Mart. *in* Martius & Zuccarini (1824: 53). Type: *P. albens* Mart. *in* Martius & Zuccarini (1824: 54; t. 32).

Morrenia Lindley (1838: 71). Type: *M. odorata* (Hooker & Arnott 1834: 294) Lindley (1838: 71). ***Synon. nov.***

Lagenia Fournier (1885: 293). Lectotype (here designated): *L. megapotamica* (Sprengel 1827: 111) Fournier (1885: 293).

Stuckertia Kuntze *in* Post & Kuntze (1902: 541) ≡ *Choristigma* Kurtz *ex* Heger (1897: 443), *hom. post.* [*non* (Baillon 1862: 117) Baillon (1892: 454). Olacaceae]. Type: *C. stuckertianum* Kurtz *ex* Heger (1897: 443). ***Synon. nov.***

Hickenia Lillo (1919: 422). Type: *H. scalae* (Hicken 1918: 306) Lillo (1919: 423). ***Synon. nov.***

Note:—Historically, *Araujia* and *Morrenia* have been considered closely related genera but treated as distinct based on subtle differences such as the thickness and consistency of style-head and the corolla shape (*e.g.*, Goyder 2003, 2004). A hyaline appendage on the corpusculum was also used to recognise *Araujia*, however, similar appendages are found in other genera of Oxypetalinae—for instance, *Oxypetalum appendiculatum* Martius *in* Martius & Zuccarini (1824: 48; t. 30)—and, on the other hand, this character state is not present in *A. plumosa* Schlechter (1895: 449). Curiously, the latter species shares other attributes with species of *Morrenia*, such as the fimbriate anther appendage and contorted anther wings (Goyder 2003) and,

phylogenetically, it is more closely related to *M. odorata* than to *A. sericifera*, a relationship highly supported based on plastid data (Liede-Schumann *et al.* 2005). *Araujia* and *Morrenia* are small genera (with four and eight accepted species, respectively), they are difficult to distinguish as currently defined, and the recognition of *Morrenia* makes *Araujia* paraphyletic. The synonymisation of *Morrenia* under *Araujia* will certainly provide a more stable classification, based on a monophyletic, easily recognisable group of reasonable size and geographic integrity.

Physianthus and *Lagenia* have been treated in the synonymy of *Araujia* since Decaisne (1844) and Schumann (1895), respectively. The monotypic *Hickenia* was transferred to *Morrenia* by Goyder (2001), and *Stuckertia* treated as a synonym of *Morrenia* by Goyder (2003). They are treated here within the expanded concept of *Araujia*. Based on this circumscription, *Araujia* comprises twelve South American species occurring in northern Argentina, southern Bolivia, Paraguay, southern and south-western Brazil, and Uruguay, with a centre of diversity in the Chaco.

Below, we provide the combinations for seven of the eight species (and one subspecies) of *Morrenia* (Goyder 2003) in *Araujia*; *Morrenia stormiana* (Morong 1893: 161) Malme in Chodat & Hassler (1903: 65) was described originally under *Araujia*. We also designate lectotypes for three species and indicate a new synonym.

Araujia brachystephana* (Griseb.) Fontella & Goyder, *comb. nov.

Basionym: *Morrenia brachystephana* Grisebach (1874: 205). Type: ARGENTINA. Córdoba: near San Francisco, February 1871, *P. Lorentz 157* [flowering specimen] (lectotype (designated by Goyder 2003) GOET!, duplicates K! [2 sheets], LIL!).

Araujia hassleriana* (Malme) Fontella & Goyder, *comb. nov.

Basionym: *Morrenia hassleriana* Malme (1909a: 346). Type: PARAGUAY. In saxosis prope Concepción, 14 January 1908, *E. Hassler 10803* (lectotype (here designated) G-barcode G00084459!, duplicate S!).

Note:—Since the species was described in honour of E. Hassler, we opted to choose the material collected by him as the lectotype of this name. In addition, there is some question about the second syntype: it was cited as *Fiebrig 1404* in the protologue, but the specimen at G is clearly labelled as *Fiebrig 1484*.

Araujia herzogii* (Schltr.) Fontella & Goyder, *comb. nov.

Basionym: *Morrenia herzogii* Schlechter (1914: 440). Type: ARGENTINA. Salta: between Embarcación & Miraflores, October 1910, *T. Herzog 1049* (lectotype (here designated) W!, duplicates F!, G!, L!, S!).

Note:—Since the holotype at B was destroyed, we here designate the isotype at W as the lectotype of this name.

Araujia odorata* (Hook. & Arn.) Fontella & Goyder, *comb. nov.

Basionym: *Cynanchum odoratum* Hooker & Arnott (1834: 294). Type: ARGENTINA. 'Old dykes near Buenos Aires', no date, *J. Tweedie s.n.* (holotype K!, possible isotypes BM!, K!).

= *Morrenia intermedia* Meyer (1950: 51). Type: ARGENTINA. San Luis: Pedra Blanca, Departamento Junín, 12 February 1948, *T. Meyer 13845* (lectotype (here designated) LIL-barcode LIL001169!). ***Synon. nov.***

Note:—Goyder (2003: 716) suggested *M. intermedia* might be a hybrid between *M. odorata* and *M. brachystephana*, based on the comments made by Meyer (1950). However, he had at the time not seen the type. Having now examined type material at LIL, we are able to resolve the identity of this plant. There are two sheets with the number *Meyer 13845* housed at LIL, one with a flowering specimen, which matches the description of *M. odorata*, and a fruiting specimen, which does not. We have chosen the sheet with the flowering specimen as lectotype to fix the application of this name.

Araujia scalae* (Hicken) Fontella & Goyder, *comb. nov.

Basionym: *Oxypetalum scalae* Hicken (1918: 306). Type: ARGENTINA. Río Negro: Departamento Adolfo Alsina, Rincón del Palo, January 1916, *A. Scala 10* (holotype SI!, isotypes F!, K!, LIL!, NY!).

Araujia stuckertiana* (Heger) Fontella & Goyder, *comb. nov.

Basionym: *Choristigma stuckertianum* Heger (1897: 443). Type: ARGENTINA. Córdoba: Altos Sur, near Chalet Crysol, 21 December 1896, *F. Kurtz 9267* (lectotype (designated by Goyder 2003) S!, duplicate CORD *n.v.*).

Araujia stuckertiana* subsp. *grandiflora* (Malme) Fontella & Goyder, *comb. nov.

Basionym: *Morrenia grandiflora* Malme (1909b: 21). [*non Araujia grandiflora* (Martius in Martius & Zuccarini 1824: 57) Morong in Morong & Britton (1893: 161)]. Type: BOLIVIA. Tarija: Gran Chaco, Canto del Monte near Pilcomayo, *R. Fries 1581* (holotype S!).

Araujia variegata* (Griseb.) Fontella & Goyder, *comb. nov.

Basionym: *Oxypetalum variegatum* Grisebach (1879: 230). Type: ARGENTINA. Salta: 'ad fl. Juramento', February 1873, *P. Lorentz & G. Hieronymus 320* (holotype GOET!)

Oxypetalum Brown (1810: 30), *nom. cons.* Type: *O. banksii* Schultes (1820: 91).

Gothofreda Ventenat (1808: t. 60), *nom. rej.*
Schistogyne Hooker & Arnott (1834: 291). Type: *S. sylvestris* Hooker & Arnott (1834: 292). ***Synon. nov.***
Calostigma Decaisne (1838: 343). Type: *C. insigne* Decaisne (1838: 344; t. 12, f. H).
Schizostemma Decaisne (1838: 344). Type: *non designatus*.
Pachyglossum Decaisne (1838: 345). Type: *non designatus.*
Bustelma Fournier (1885: 287). Type: *B. warmingii* Fournier (1885: 287).
Dactylostelma Schlechter (1895: 452). Type: *D. boliviense* Schlechter (1895: 452).
Corollonema Schlechter (1914: 441). Type: *C. boliviensis* Schlechter (1914: 441).
Amblyopetalum Malme (1927: 2). Type: *A. coccineum* (Grisebach 1874: 206) Malme (1937: 8).
Metoxypetalum Morillo (1994: 145). Type: *M. retusum* (Markgraf 1933: 787) Morillo (1994: 146).

Note:—*Oxypetalum* is the largest genus of Oxypetalinae, including around 120 species, distributed from Argentina to Mexico, with the centre of diversity in central-eastern South America. Most species are characterised by a combination of flowers with lanceolate corolla lobes, corona lobes gynostegial in origin but displaced onto the base of the corolla, free above and adaxially ornamented, style-head forming a rostrate appendage at the apex of gynostegium simulating a stigma, and caudicles of pollinaria with lateral teeth. *Schistogyne* was created based on the unusual appendage of the style-head with seven linear lobes in *S. sylvestris*: '*Stygma* sub-7-partitum (!), segmentis subulato-filiformis.' (Hooker & Arnott 1834: 292), and with gynostegial corona lobes in a staminal position. Variations of the style-head appendage were used to recognise some genera currently considered synonym of *Oxypetalum* (e.g., *Calostigma*). Nevertheless, this is a polymorphic structure and variations are found even in closely related species. For instance, *O. pilosum* Gardner (1842: 539) exhibits style-head terminating in a rostrate appendage, whereas *O. erostre* Fournier (1885: 265), which is the closest species and was eventually considered synonym of the former (Valente *et al.* 1973), exhibit a conical style-head lacking an appendage.

Besides confirming the inclusion of *Amblyopetalum*, *Bustelma* and *Dactylostelma* in the synonymy of *Oxypetalum*, phylogenetic studies of plastid regions (Rapini *et al.* 2003, Liede-Schumann *et al.* 2005) also showed *Schistogyne* nested in core *Oxypetalum*, closely related to *O. banksii*. To become monophyletic, *Oxypetalum* must include *Schistogyne*. Below, we provide the combinations for the eight accepted species of *Schistogyne* in *Oxypetalum*, designate lectotypes for three species and indicate a new synonym.

Oxypetalum fiebrigii* (Malme) Goyder & Rapini, *comb. nov.

Basionym: *Schistogyne fiebrigii* Malme (1933: 14; f. 1a). Type: BOLIVIA. Tarija: San Luis, 24 January 1904, *K. Fiebrig 2669* (holotype S!, isotypes B destroyed, BM!, K!, US!).

Oxypetalum heptalobum* Goyder & Rapini, *nom. nov.

Basionym: *Schistogyne boliviensis* Schlechter (1914: 442), [*non Oxypetalum boliviense* Schlechter (1906: 602)]. Type: BOLIVIA. "Windend im Gebüsch an der Waldgrenze bei Tres Cruces", February 1911, *T. Herzog 1630* (lectotype (here designated) L!, duplicate F!].

Note:—The lectotype is designated here because the holotype at B was destroyed.

Etymology:—The 7-lobed appendage of the gynostegium was used to recognise *Schistogyne*; however, this is the only Bolivian species that presents this characteristic, which is why we chose this epithet.

Oxypetalum karstenianum* Goyder & Rapini, *nom. nov.

Basionym: *Schistogyne decaisneana* Karsten (1866: 121), (*non Oxypetalum decaisneanum* Meyer 1951: 361). Type: BRAZIL. Rio Grande do Sul: no locality, no date, *A. Isabelle s.n.* (holotype P!).

Etymology:—The new name of this species honours C. W. Herman Karsten who recognised it as distinct from the rest of the material identified by Decaisne (1844) as *Schistogyne sylvestris*.

Oxypetalum longipedunculatum* (Malme) Goyder & Rapini, *comb. nov.

Basionym: *Schistogyne longipedunculata* Malme (1933: 11; f. 1c, 2c). Type: ARGENTINA. Salta: Candelaria, Cerro del Chorrillo, 27 April 1925, *S. Venturi 3780* (Lectotype (here designated) S!, duplicates LIL!, MO!, SI!, US!). Paratype: ARGENTINA. Tucuman: Parque Centenario, 15 January 1928, *S. Venturi 5733* (MO!, S!).

Oxypetalum pentasetum* (Rusby) Goyder & Rapini, *comb. nov.

Basionym: *Schistogyne pentaseta* Rusby (1920: 98). Type: BOLIVIA. La Paz: Yungas, no date, *M. Bang s.n.* (holotype NY!).

= *Schistogyne mandonii* Malme (1933: 12; f. 1e, 2b). Type: BOLIVIA. Larecaja: near Sorata mountain, Cerro Iminapi, February–April 1859, *G. Mandon 358* (holotype S!, isotypes BM!, F!, K!, P!, W!). ***Synon. nov.***

Oxypetalum pubescens* (Malme) Goyder & Rapini, *comb. nov.

Basionym: *Schistogyne pubescens* Malme (1933: 10; f. 1d, 2d). Type: ARGENTINA. Catamarca: Sierra de la Huerte, *F. Schickendantz s.n.* (holotype S!).

Oxypetalum sylvestre* (Hook. & Arn.) Goyder & Rapini, *comb. nov.

Basionym: *Schistogyne sylvestris* Hooker & Arnott (1834: 292). Type: "Banda Orientale", no date, *J. Baird s.n.* (lectotype (here designated) K!). Paratypes: ARGENTINA. Entre Rios: no locality, no date, *J. Tweedie 219* (K!). URUGUAY. Without locality, no date, *J. Tweedie s.n.* (K!).

Oxypetalum tucumanense* (T.Mey.) Goyder & Rapini, *comb. nov.

Basionym: *Schistogyne tucumanensis* Meyer (1941: 278; t. 1). Type: ARGENTINA. Tucumán: Famaillá, Villa Nougués, 27 November 1921, *S. Venturi 1576* (holotype LIL!, isotypes MO!, SI!).

Tweedia Hooker & Arnott (1834: 291). Lectotype: *T. brunonis* Hooker & Arnott (1834: 292).

Turrigera Decaisne (1844: 590). Type: *T. inconspicua* Decaisne (1844: 590).

Note:—Three species of *Tweedia* were listed by Hooker & Arnott (1834), and each of these has subsequently been designated by different authors as the lectotype of the genus. Although Malme (1904) revised the genus *Tweedia* and emended its concept, he did not indicate a type. The first to do so was T. Meyer (1944: 102), who chose *T. brunonis* as his "especie genérica" for *Tweedia*. Hooker & Arnott (1834) questioned the future generic placement of this species when they erected the genus and described the species. They listed two characters for the genus: the form of the corona, and the bifid style-head appendage. As their description of *T. brunonis* notes the stigma to be undivided, a "serious conflict" with the protologue could be argued, leading to a rejection of Meyer´s lectotypification under Art. 9.17 of the Code. But the apex of the style-head appendage is, in fact, shortly bilobed, as shown by Rua (1989). Nomenclaturally, Hooker & Arnott made the combination under *Tweedia*, and the taxonomic opinion expressed subsequently does not negate this.

Bullock (1958: 99) was presumably unaware of Meyer's typification when he designated *T. macrolepis* Hooker & Arnott (1834: 291) as type of the genus. Rua (1989) argued that Bullock's designation was arbitrary and therefore contrary to the code (although this does not stand up to scrutiny, and was a superfluous designation in any case). Rua selected *T. birostrata* (Hooker & Arnott 1830: 35) Hooker & Arnott (1834: 291), which Ezcurra (1999: 75) then followed in Flora Patagonica. The earliest designation is that of Meyer (1944) and must be adopted.

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