Adelphacme (Loganiaceae), a new genus from south-western Australia

Kerry L. Gibbons1,2,3, Barry J. Conn2 and Murray J. Henwood1

1School of Biological Sciences, University of Sydney, NSW 2006, Australia
2National Herbarium of New South Wales, Royal Botanic Gardens and Domain Trust, Mrs Macquaries Road, Sydney NSW 2000, Australia
3corresponding author: kerry.gibbons@sydney.edu.au

Abstract

The new genus Adelphacme (Loganiaceae) is here described. Adelphacme is placed in Loganieae and is distinguished from all other genera in Loganiaceae by the following unique combination of characters: stipules reduced to a persistent, membranous, interfoliar sheath; 5-merous calyx, corolla and androecium; calyx with indistinct tube; corolla glabrous or papillose with valvate aestivation; ovary semi-inferior and capsule two-horned (mitre-shaped) with styles persistent and apically united. The new combination Adelphacme minima (B.J.Conn) K.L.Gibbons, B.J.Conn & M.J.Henwood is here made. A key to the seven genera of Loganieae, recognised here, is provided. The key is modified to include all Australian genera of the family Loganiaceae.

Introduction

Generic and infrageneric boundaries and phylogenetic relationships in Loganieae (Loganiaceae) have recently been evaluated using nucleotide sequence data (Gibbons et al. 2012). In that study, the south-western Australian endemic Mitreola minima B.J.Conn was not placed with other species of Mitreola L. Instead, M. minima was resolved as sister to Mitrasacme Labill., Phyllangium Dunlop and Schizacme Dunlop, thereby rendering Mitreola polyphyletic (Gibbons et al. 2012, Fig. 1). Morphological evidence supports this relationship and the recognition of the taxon ‘Mitreola minima’ as a species of a new, monotypic genus.

In describing the new species Mitreola minima, Conn (1996) placed it in Mitreola based on its incompletely dichasial inflorescences, 5-merous calyx, corolla and androecium, slightly semi-inferior ovary and mitre-shaped capsules. Mitreola is largely distributed in the Americas, Asia and Madagascar, with one widespread species, M. petiolata (J.F.Gmel.) Torr. & A.Gray, also present in Africa, New Guinea and northern Australia. This new species, endemic to south-western Australia, was geographically isolated from the remainder of Mitreola, and its biogeographical history was puzzling. We are now able to evaluate the morphological characters used to support the generic placement of M. minima in a phylogenetic context (Gibbons et al. 2012). It appears that these morphological characters (listed above) are plesiomorphic or homoplastic within Loganiaceae, with incompletely dichasial inflorescences and 5-merous flowers also being widespread throughout the Loganiaceae. This paper formally establishes the new genus Adelphacme K.L.Gibbons, B.J.Conn & M.J.Henwood, with affinities to the Australasian genera Mitrasacme, Phyllangium and Schizacme.
Loganieae is one of four tribes remaining in Loganiaceae after re-circumscription of the family by Backlund et al. (2000). Following that study, Loganieae was expanded to include Mitreola, Mitrasacme and its segregates Phyllangium and Schizacme, previously placed in Spigelieae (Struwe 2004, Heywood et al. 2007). This classification, which placed these genera together with Logania R.Br. and Geniostoma J.R.Forst. & G.Forst. (including Labordia Gaudich.), has received further support in subsequent studies (Frasier 2008, Gibbons et al. 2012).

Loganieae is one of three tribes in Loganiaceae with dehiscent capsular fruits. Antonieae possess winged or spindle-shaped seeds and septicidal capsules (sometimes also splitting loculicidally for a short distance from the apex), and are further distinguished by aspects of their wood anatomy (Leeuwenberg & Leenhouts 1980, Mennega 1980, Backlund et al. 2000, Grant 2009). Spigelieae, now including only Spigelia L., is readily distinguished by its strongly bilobed capsules with persistent style bases (the upper portion of the style being deciduous) and generally cincinnate inflorescences (Leeuwenberg & Leenhouts 1980, Popovkin 2011). Capsule dehiscence in Spigelia is both loculicidal and septicidal, thus producing four deciduous valves from a bicarpellate gynoecium, with a distinctive basal cupula persisting within the calyx following shedding of the valves (Leeuwenberg & Leenhouts 1980). Strychnieae are distinguished by their fleshy indehiscent fruits, although molecular evidence does not support the monophyly of the tribe as currently circumscribed (Backlund et al. 2000, Frasier 2008).

Finding morphological synapomorphies for an expanded Loganieae is somewhat more difficult, but they appear to lack the alkaloids and aluminium accumulation found in the rest of the family (Bisset 1980, Backlund et al. 2000). The tribe contains all genera of Loganiaceae with (variously) imbricate corolla aestivation, but also several genera or species with valvate corolla aestivation. Mitrasacme and Mitreola share mitre-shaped, semi-apocarpous capsules, and a close association between these genera has long been inferred (Bentham 1857, Leenhouts 1962, Leeuwenberg 1974). Backlund et al. (2000) suggested that early basipetal dehiscence found elsewhere in the tribe might be homologous with semi-apocarpy, which might then provide a morphological synapomorphy for the tribe. In the analysis of Gibbons et al. (2012), Mitreola was not placed sister to Mitrasacme and its segregates, but was instead sister to the remainder of Loganieae. It appears, then, that semi-apocarpy is not simply synapomorphic in these genera, but has either evolved in parallel, or has been secondarily lost several times within the tribe.

**Taxonomic treatment**


**Type species:** *Adelphacme minima* (B.J.Conn) K.L.Gibbons, B.J.Conn & M.J.Henwood

Annual herb. Leaves decussate, rarely in whorls of 3, sessile; stipules persistent, membranous, reduced to interfoliar obtriangular sheath. Inflorescence terminal; uniflorescences incompletely dichasial. Flowers with calyx, corolla and androecium 5-merous; corolla lobes valvate; stamens epipetalous; ovary semi-inferior, 2-locular; placentation axile, hemispherical; styles 2, united apically at anthesis and in fruit. Capsule 2-horned.

**Etymology:** the name *Adelphacme* has been formed from the Greek ἀδελφή (adelphe), meaning sister, and ακμή (acme) means highest point, the ‘acme’ is here used in reference to the sister-relationship of *Adelphacme* with Mitrasacme and Schizacme.

**Note:** in the protologue of *Mitrasacme*, Labillardiére (1804) equates ακμή with the Latin flos (flower), and states the etymology is in reference to the flower having the form of a mitre. The gynoecium of the type species, *Mitrasacme pilosa* Labill., is distinctly mitre-shaped and can be easily seen without dissection, the corolla being shallowly campanulate. Later authors have assumed the etymology of *Mitrasacme* refers to the shape of the capsule (Don 1837; Leeuwenberg & Leenhouts 1980; Dunlop 1996a, c). ‘Highest point’ and ‘flower’ are essentially variations of the same meaning of ακμή (which can also include prime and zenith), because the flower may be considered to be the ‘highest point’ in the lifecycle of the plant (Liddell & Scott 1940).


**Basionym:** *Mitreola minima* B.J.Conn Kew Bulletin 51: 169–173, Fig. 1 (1996)

**Type:** Western Australia: Darling (Warren): 1.8 km S along Middle Road from Boronia Road, headwaters of the Bow River, NE of Walpole, T.D. Macfarlane 2297 & A.R. Annels, 2 Nov 1994 (holo: PERTH4179323; iso: DNA, K, NSW366873).

**Informal names:** Mitrasacme sp. South West (G.J. Keighery 343 n.v.); Mitreola sp. Woolbernup Hill (K.R. Newbey
Adelphacme (Loganiaceae)

Distribution: known from the Darling and Eyre regions of the South-West Botanical Province, Western Australia, from Bunbury in the north to Ravensthorpe in the east.


Other specimens examined: Western Australia: Darling: 2.3 km S along Middle Road from Boronia Road, NE of Walpole, Macfarlane 2298 & Annels, 2 Nov 1994 (NSW, PERTH); 1.8 km S along Middle Road from Boronia Road, NE of Walpole, Annels & Hearn s.n., 21 Nov 1994 (CANB, DNA, NSW366874, PERTH); W of South West Highway, Bennett s.n., 9 Nov 2007 (PERTH07980922; photograph!); Eyre: Fitzgerald River National Park: 7 km NNE Woolbernup Hill, Newby 11066, 21 Nov 1985 (DNA, NSW, PERTH).

Key to the genera of Loganiaceae tribe Loganieae

Note: Labordia is not included in the following key. A recent molecular phylogenetic study (Gibbons et al. 2012) found that at least some species of Labordia should be reduced to synonymy of Geniostoma. Sampling was limited to three of the 17 species of Labordia and did not include the type species, L. fagraeoidea Gaud. A more complete phylogenetic evaluation of the status of all species of Labordia is required. Should the continued recognition of a reduced Labordia be warranted, the morphological characters separating Labordia and Geniostoma will require reassessment.

1. Herbs or subshrubs ................................................................. 2
2. Shrubs, trees or woody climbers .............................................. 7
2. Capsule two-horned (horns occasionally adherent along almost their entire length, appearing continuous with base of styles) or bilobed ................................. 3
3. Capsule without horns, not bilobed; Australia (not Tasmania), doubtfully New Zealand (extinct) .............................................. Logania

3. Calyx, corolla and androecium 4-merous, or calyx absent ........................................................................................................ 4
4. Calyx, corolla and androecium 5-merous .......................................................... 6

4. Calyx absent; corolla and capsule enclosed in a two-lobed foliaceous involucre; ovary semi-inferior; southern Australia (including Tasmania) ......................................................... Phyllangium
5. Calyx present, involucre absent; ovary superior .......................................................................................................................... 5
6. Calyx tube indistinct, up to 1 mm long; calyx lobes generally unequal; capsule laterally compressed, appearing broadly cuneiform in lateral view; placenta elongate, seeds few; Australia (Tasmania and alpine Victoria) and New Zealand! ........................................................ Schizacme
7. Calyx tube distinct; calyx lobes equal; capsule generally globular, ovoid or ellipsoid; placenta hemispherical, seeds many; northern and eastern Australia (including Tasmania), New Caledonia, New Guinea, Southeast and East Asia ........................................................ Mitrasacme

6. Leaves <4 mm long; stipules a persistent membranous interfoliar sheath; corolla mouth glabrous or papillose; styles retained in fruit, connate at their apices (sometimes separating post-maturity); south-western Australia ........................................................................................................ Adelphacme
7. Leaves at least 10 mm long (except M. sessilifolia (J.F.Gmel.) G.Don ≥6 mm long and M. petiolatoides P.T.Li ≥5 mm long); stipules well-developed (mostly triangular) or reduced to a stipular line; corolla mouth with penicillate ring of hairs; styles not persisting in fruit or stigmas free, subsessile; Americas, Africa, Madagascar, Southeast and East Asia, New Guinea, northern Australia ........................................................................................................ Mitreola

8. Placenta fleshy, yellow to red, with seeds embedded; Mascarene Islands, Malesia, north-eastern Australia and Pacific ........................................................................................................ Geniostoma
9. Placenta dry, seeds not embedded; Australia (not Tasmania), doubtfully New Zealand (extinct) .............................................. Logania
Species congeneric with Schizacme are currently recognised under the name Mitrasacme in New Zealand.

This key includes an optional modification to include the remaining Australian genus of Loganiaceae, Strychnos (Strychnae), by replacing couplet 7 with the following two couplets:

7. Fruit indehiscent, berry-like; leaves 3–7-plinerved ................................................................. Strychnos
7: Fruit a two-valved capsule; leaves pinninerved .................................................................................. 8

8. Placenta fleshy, yellow to red, with seeds embedded; Mascarene Islands, Malesia, north-eastern Australia and Pacific ................................................................. Geniostoma
8: Placenta dry, seeds not embedded; Australia (not Tasmania), doubtfully New Zealand (extinct) .... Logania

Discussion

Although we are, as yet, unable to identify a morphological synapomorphy for Adelphacme, the genus may be readily identified by a unique combination of morphological characters. In the molecular phylogeny of Gibbons et al. (2012), long branches separate Mitrasacme, Schizacme, Phyllangium and Adelphacme minima, further supporting their recognition as discrete genera, rather than as a more broadly defined Mitrasacme.

Table 1 compares the morphological characteristics of Adelphacme with those of Mitrasacme, Mitreola, Phyllangium and Schizacme.

Adelphacme is distinguished from Mitreola by vegetative, floral and fruit characters. The stature and leaves of Adelphacme are much smaller than those of Mitreola and its stipules are reduced to a membranous, interfoliar sheath (Mitreola with stipules well-developed or reduced to a stipular line). These characters instead support the phylogenetic placement of Adelphacme sister to Mitrasacme, Phyllangium and Schizacme. The incompletely dichasial inflorescences of Adelphacme (refer Conn 1996; Fig. 1) are similar to those of Mitreola but do not extend into a long cincinnate distal portion, as is characteristic of most species of Mitreola. Adelphacme differs from Mitreola in its calyx without a distinct tube (Mitreola calyx lobes and tube ± equal). The corolla of Adelphacme is only slightly urceolate, with rounded lobes (Mitreola corolla distinctly urceolate, lobes generally subacute) and lacks the penicillate or pilose ring of hairs found in the corolla mouth of Mitreola (Leeuwenberg 1974). Corolla aestivation is valvate in Adelphacme but is generally quincuncial in Mitreola, with the exception of the Madagascan endemic M. turgida Jovet (Conn 1996). The stamens of Adelphacme are apiculate (by extension of the connective), as are those of Schizacme and of many species of Mitrasacme and Phyllangium.

In Mitreola petiolata and M. sessilifolia the anthers appear apiculate but this character is uncertain in the remaining species of Mitreola because material was not available for examination. Leeuwenberg (1974, p. 4) states the anthers of Mitreola are “apiculate to retuse” but does not include this character in species descriptions. The gynoecium of Adelphacme is similar to that of Mitreola, except that the styles of Mitreola are generally shorter. However, in fruit, the styles of Adelphacme are persistent and remain united at their apices as the horns of the capsule separate, whereas in Mitreola, the styles separate soon after anthesis, and do not generally persist into fruit. The seeds of Adelphacme are smooth, ellipsoid, with a longitudinal groove on the ventral surface. This type of seed occurs in most species of Mitreola and in some species of Mitrasacme.

The habit, corolla and capsule of Adelphacme bear a strong resemblance to Mitrasacme. However, Adelphacme differs from Mitrasacme in its crowded uniflorescences (Mirasacme uniflorescences generally lax), its almost free calyx lobes and its slightly semi-inferior ovary (Mitrasacme calyx lobes and tube ± equal and ovary superior). Adelphacme further differs from Mitrasacme, Phyllangium and Schizacme by its 5-merous calyx, corolla and androecium (4-merous in Mitrasacme, Phyllangium and Schizacme). Adelphacme resembles Phyllangium in its semi-inferior ovary. Phyllangium is distinguished from all other genera in Loganiaceae by its two-lobed involucral bract surrounding the flower and capsule and absent calyx (Dunlop 1996b). Adelphacme differs from Schizacme in having two styles united at the apex at anthesis and in fruit (Schizacme with styles free). The calyx of Schizacme is generally heteromorphic (Dunlop 1996c), with the exception of S. montana (Hook.f. ex Benth.) Dunlop, which occasionally has equal calyx lobes similar to those of Adelphacme. Schizacme is best distinguished from all other genera in Loganiaceae by its laterally compressed, cupuliform capsules (appearing broadly cuneiform in lateral view) and elongated, few-seeded placentation (Dunlop 1996c).

Capsule dehiscence in Loganiaceae

In Adelphacme, Mitrasacme, Schizacme and Phyllangium, dehiscence occurs along the ventral suture of the horns of the capsule, and not loculicidally as previously stated (Leeuwenberg & Leenhouts 1980; Dunlop 1996a, c, b; Gibbons et al. 2012). Confusion arises from alternative definitions of loculicidal in the literature.
Table 1. Morphological features diagnostic for Adelphacme, Mitrasacme, Mitreola, Phyllangium and Schizacme.

<table>
<thead>
<tr>
<th>Feature</th>
<th>Adelphacme</th>
<th>Mitrasacme</th>
<th>Mitreola</th>
<th>Phyllangium</th>
<th>Schizacme</th>
</tr>
</thead>
<tbody>
<tr>
<td>Leaves</td>
<td>2.7–3.3 mm long, sessile</td>
<td>1–90 mm long, generally sessile</td>
<td>5–150 mm long, generally petiolate</td>
<td>2–13 mm long, sessile</td>
<td>2–14 mm long, sessile or sub sessile</td>
</tr>
<tr>
<td>Stipules</td>
<td>persistent, membranous, interfoliar sheath</td>
<td>persistent, membranous, interfoliar sheath</td>
<td>persistent or reduced to a stipular line, well-developed triangular, ligulate or ochreate</td>
<td>persistent, membranous, interfoliar sheath</td>
<td>persistent, membranous, interfoliar sheath</td>
</tr>
<tr>
<td>Inflorescence</td>
<td>incompletely dichasial, uniflorescences crowded</td>
<td>variously cymose, generally lax, or flowers solitary</td>
<td>incompletely dichasial, generally becoming cinctuate distally, generally crowded</td>
<td>lax cymose, or flowers solitary</td>
<td>flowers solitary</td>
</tr>
<tr>
<td>Flowers</td>
<td>5-merous</td>
<td>4-merous</td>
<td>5-merous</td>
<td>4-merous</td>
<td>4-merous</td>
</tr>
<tr>
<td>Calyx</td>
<td>tube indistinct, lobes equal</td>
<td>tube distinct, lobes equal</td>
<td>tube distinct, lobes equal</td>
<td>absent, replaced by a two-lobed foliaceous involucre</td>
<td>tube indistinct, lobes usually heteromorphic</td>
</tr>
<tr>
<td>Corolla</td>
<td>valvate</td>
<td>valvate</td>
<td>generally quincuncial (valvate in M. turgida)</td>
<td>valvate</td>
<td>valvate or imbricate</td>
</tr>
<tr>
<td>aestivation</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>ornamentation at mouth</td>
<td>glabrous or papillose</td>
<td>penicillate, pilose, papillose or glabrous</td>
<td>penicillate or pilose</td>
<td>glabrous</td>
<td>glabrous, pilose or papillose</td>
</tr>
<tr>
<td>Ovary</td>
<td>semi-inferior</td>
<td>superior</td>
<td>semi-inferior</td>
<td>semi-inferior</td>
<td>superior</td>
</tr>
<tr>
<td>Styles at anthesis</td>
<td>united</td>
<td>generally united (free in M. secedens)</td>
<td>united</td>
<td>united or free</td>
<td>free</td>
</tr>
<tr>
<td>in fruit</td>
<td>persistent, remaining united apically as horns separate</td>
<td>persistent, generally united apically (free in M. secedens)</td>
<td>separating soon after anthesis, not persistent or stigmas subsessile</td>
<td>united or free, sometimes withering in fruit</td>
<td>free, sometimes withering in fruit</td>
</tr>
<tr>
<td>Capsule</td>
<td>± globular, two horned</td>
<td>generally globular, ovoid ellipsoid or obovate, two horned</td>
<td>ellipsoid or ovoid, two-horned or bilobed</td>
<td>ellipsoid to obovate, two-horned (horns not well developed)</td>
<td>laterally flattened, horns widely divergent (appearing broadly cuneiform in lateral view)</td>
</tr>
<tr>
<td>Placentation</td>
<td>axile, hemispherical, seeds many</td>
<td>axile, hemispherical, seeds many</td>
<td>axile, hemispherical, seeds many</td>
<td>axile, hemispherical, seeds many</td>
<td>axile-apical, elongate, seeds 2–3 per locule</td>
</tr>
</tbody>
</table>
In some texts, loculicidal is defined as “longitudinal dehiscence radially aligned with the locules” (Simpson 2006, p. 562). However, loculicidal dehiscence is more accurately described as longitudinal dehiscence along the dorsal rib of the carpels, or (less frequently) between the dorsal rib and the septum (Spjut 1994, Beentje 2010). In completely syncarpous capsules, these definitions are equivalent. In semi-apocarpous capsules, dehiscence along the ventral suture of the horns, although perpendicular to the septum, is most correctly considered a form of septicidal dehiscence, the ventral aspect of the horns being continuous with the septum. In Mitreola, the degree of fusion of the carpels is variable, so that in some species the capsule first dehisces along the septum, although never to the base of the capsule, before dehiscing along the ventral suture. In Logania and Geniostoma, capsules appear completely syncarpous and styles generally appear single. However, in some species of Logania, there appear to be two styles connate along their length, with the stigma bilobed. Additionally, the septicidal capsules of Logania initially dehisce only on their distal half, and although the persistent valves subsequently separate along the septum to the base, dehiscence along the ventral suture remains confined to the distal half of the valves (Conn & Brown 1996). These observations suggest the syncarpous capsules of Logania are secondarily derived, supporting the hypothesis of Backlund et al. (2000) that semi-apocarpy provides a morphological synapomorphy for Loganieae.

Acknowledgments

Kevin Thiele and Skye Coffey (PERTH) kindly provided photographic images of collections of Adelphacme minima held at PERTH. This research was supported by the Hansjörg Eichler Scientific Research Fund (Australasian Systematic Botany Society) and an Australian Postgraduate Award to KLG.

References


Don G (1837) A general history of the dichlamydeous plants, vol 4(1). (Gilbert & Rivington: London)


Frasier CL (2008) Evolution and systematics of the angiosperm order Gentianales with an in-depth focus on Loganiaceae and its species-rich and toxic genus Strychnos. (Unpublished PhD thesis: Rutgers, the State University of New Jersey)


Labillardière JJ (1804) Novae Hollandiae plantarum specimen. (Dominae Hizard: Paris)


Manuscript received 29 August 2012, accepted 08 April 2013