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Notes on Hibbertia (Dilleniaceae) 10. *Hibbertia hirsuta* (subgen. *Hemistemma*: *H. vestita* group) does occur in South Australia and Tasmania

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Abstract

A review of *Hibbertia hirsuta* (Hook.) Benth., which is prompted by its recent rediscovery in South Australia, includes a full description and a discussion of the importance of an understanding of the position and number of stamens in a flower to place the species with allied ones. Its affinities to *H. dispar* Toelken and *H. basaltica* A.M.Buchanan & Schah. are assessed and its possible cleistogamy discussed.

Keywords: Dilleniaceae, *Hibbertia*, taxonomy, cleistogamy, South Australia, Tasmania.

Introduction

When Joe Quarmby consulted Bob Bates about a plant from the Meadows Creek tributary that he could not identify, the latter immediately recognised it as a new species for the South Australian flora. He soon confirmed its natural occurrence in the area by finding a second population of the species a few kilometres away along the creek. This new evidence was needed particularly as the species, *Hibbertia hirsuta* (Hook.) Benth., as it was identified, has lately been described as a Tasmanian endemic (Curtis 1956, Stone & Curtis 1971, Curtis & Morris 1975, Gray 2010). However, a closer examination of the literature shows that Mueller (1882, 1889) and Tate (1883, 1889, 1890) had already recorded its existence in South Australia, although all recent literature including three editions of the *Flora of South Australia* (Black 1926, 1952, Jessop 1986), have ignored it in spite of Tate (1883) citing details of a specimen(s) by J.G.O. Tepper and R. Tate. The only herbarium material found to date is a specimen collected by J.G.O. Tepper in 1881 (MEL119774), which has been overlooked for more than one hundred years, although it was correctly identified at the time. It is significant that Tepper also collected his specimen along Meadows Creek "on temporarily inundated flat", while Quarmby (*J.Quarmby 189*) describes it as "seasonally wet depression". *Hibbertia hirsuta* is extremely localised in South Australia, while it is more widespread in Tasmania, but it has not been recorded from Victoria, which is geographically closer to and more similar in climate to Tasmania.

One reason for overlooking the species for so long may be its very small flowers, as reported by Joe Quarmby (pers. comm.). *Hibbertia pallidiflora* Toelken has similar small flowers, which also gradually open (Toelken 1995, 2000), but as plants of that species are larger and more common they are better represented in herbaria.

Floral biology

Field observations in South Australia did not yield the envisaged breakthrough in the understanding of the breeding system of the species, except that it showed a very high percentage of seed set. An examination of the morphology of the flower together with different possible scenarios of the pollination biology are explored below. It is hoped that these will stimulate further interest, new observations and research into the problem.

Particularly important in *H. hirsuta* is the reduction of the number of petals and stamens to usually one, rarely few. Similar to specimens from Tasmania, South Australian plants examined displayed short styles bearing slightly incurved stigmas, which are at the upper level of the anther(s). This flower arrangement differs from that of *H. pallidiflora* and the vegetatively similar *H. sessiliflora* Toelken.

The small flowers, "which often remain unopened" as Curtis (in Stones & Curtis 1971) described it, cause difficulties in interpreting the breeding system of the species. The evidence that flowers never open, Bob Bates (pers. comm.) reported them to be cleistogamous, is at present incomplete. They might only open for a short time or at hours not coinciding with visits by collectors, particularly as they grow in not easily accessible localities in South Australia.

The specimens show, though not clearly, the petal(s) protruding above the apex of the clasping calyx lobes, as also illustrated by Stones & Curtis (1971, pl. 92). These authors also reported a reduction of petals, but never the absence thereof. The photo in Wapstra et al. (2010, p. 107) shows one flower with the calyx partially opened.

Table 1. Morphological comparison of *Hibbertia hirsuta*, *H. basaltica* and *H. dispar* to show similarities and differences.

Characters	*H. hirsuta*	*H. basaltica*	*H. dispar*
Hairs on branches	scattered larger and smaller fascicled hairs, rarely few simple hairs	dense larger and smaller fascicled hairs and few longer simple hairs	dense larger simple over smaller simple and/or fascicled hairs
Leaf lamina	(2.2–) 3.5–5 (–6.4) × (0.7–) 0.9–1.3 (–1.6) mm	(2.4–) 3.5–6 (–7.4) × 1–1.4 mm	(1.8–) 2.5–6.5 (–10.4) × (0.8–) 1–1.3 mm
Hairs on leaves, upper surface	scattered longer and shorter simple hairs	scattered simple, rarely forked hairs	scattered simple hairs
Hairs on leaves, lower surface	scarcely raised central vein and undersurface with ± dense fascicled hairs	recessed central vein and undersurface with few simple over short fascicled hairs	flush/recessed central vein with mainly long over shorter simple hairs
Outer calyx lobes	4–4.4 × 1.2–1.4 mm	4.5–4.7 (–5.1) × 2.3–2.5 mm	(5.2–) 5.4–5.8 (–6.1) × 1.8–2.6 mm
Outer calyx outside hairs	strigose, coarse simple over fascicled hairs	± strigose, few simple over mainly fascicled hairs	± strigose, few simple over mainly fascicled hairs
Inner calyx lobes	3.8–4 × 1.6–1.8 mm	4.3–4.7 (–4.8) × 2.5–2.8 mm	(5–) 5.2–5.6 (–6) × 2.6–3.2 mm
Stamen number and position around ovary	1 (2) on one side	(3–) 4 or 5 (–7) on one and 1 on other side	(2–) 4–6 (7) on one and (0) 1 or 2 on other side
Anthers	0.8–1 mm long	1–1.2 mm long	(1–) 1.1–1.4 mm long
Seeds	1.8–2 ×1.5–1.6 mm	1.6–2 × 1.2–1.5 mm	1.7–2 × 1.4–1.6 mm
Habit	prostrate to scrambling	prostrate to procumbent	prostrate to decumbent

A flower of the South Australian plants examined displayed only one petal clasping a dehisced anther with some pollen in it and a cluster of pollen grains on each of the adjoining stigmas.

Plants of *H. hirsuta* show a very high degree of seed development, which could indicate selfing and, in fact, cleistogamous flowers, if the flowers can be demonstrated to remain closed. More field work is needed, as it is, for instance, not clear whether a pollinating agent is still needed to burst the anthers by vibration in order to spread the pollen, as usual in *Hibbertia* species (Bernhardt 1986). The stigmas of flowers of the South Australian *H. hirsuta* examined were covered with pollen although not, or perhaps no longer, in contact with the anther. One could speculate on the continued presence of petal(s) inviting pollinating vectors to visit the flowers. Even though they are closed or partially closed (see Wapstra et al. 2010), visiting insects might provide the thoracic vibration required to dehisce the anther(s) to cause selfing/cleistogamy by violently distributing the pollen onto the adjacent stigmas. It is unlikely that such a visitor will forcefully open the flower, as pollen, the only reward in hibbertias, is sparse and was still found scattered in some flowers with developing seed.

In a detailed study of the floral ontogeny in 12 species of *Hibbertia* from different groups in the genus, Tucker & Bernhardt (2003) discussed the possible importance of the reduction of the number of stamens in specialisation and speciation in *Hibbertia*, with particular reference to a form of *H. fasciculata* R.Br. ex DC., which has its anthers reduced to three (Tucker & Bernhardt 2000). While this form of *H. fasciculata* differs only in the reduced number of stamens and flowers open normally, *H. hirsuta* displays also a reduction in the number of petals and, apparently, the flowers are not opening fully. This changes not only the floral biology, but has also obscured its affinity to the two related species (below) with anthers on both sides of the ovary. The specialisation of the breeding system of *H. hirsuta* needs further examination, as discussed above. The possibility that this is an inbreeding species, makes the disjunct, but morphologically indistinguishable populations of *H. hirsuta* in Tasmania and South Australia even more remarkable.

Relationships

A number of smaller species of *Hibbertia*, e.g. *H. humifusa* F.Muell. and *H. sessiliflora*, with a superficially similar habit and morphology, occur throughout the genus. Raheem (2013, pp. 3-9, 3-10) placed *H. hirsuta* next to *H. dispar* Toelken in his molecular cladogram (ITS data) of the eastern Australian species. *Hibbertia basaltica* A.M.Buchanan & Schah, a very similar species to *H. dispar* (cf. Toelken 2013), was not included in his study. This close affinity of the three species is not only reflected in their very similar morphology (Table 1), but also in a progressive loss of stamens, especially of the anterior ones closest to the bract. Furthermore, the number of petals in *H. hirsuta* is also reduced to one, rarely two. Toelken (2013) had for that reason not included *H. hirsuta* in his treatment of the *H. vestita* group, because it did not conform to the criterion of the group, i.e. stamens on both sides of

the ovary. He, however, discussed the wide range of variation, particularly in the number of stamens found in *H. dispar*.

Hibbertia basaltica and *H. dispar* are found in eastern Victoria and Tasmania, *H. hirsuta* in South Australian and Tasmania. Herbarium specimen data indicate that South Australian plants of *H. hirsuta* have been recorded only from temporarily wet areas in forest, while Tasmanian plants occur in drier habitats, such as, "amongst rocks in open sclerophyll forest" (*R.D. Hoogland 11748*), or, as Gray (2010) describes it, "in dry grassy places, open heath and woodlands". The very similar *H. basaltica*, as well as *H. dispar*, is also mainly recorded from rocky or gravelly outcrops; Toelken (2013) cited a number of different habitats for different populations of *H. dispar*, among them there are forms from Flinders and Clark Island in Bass Strait, "recorded from wet areas near a lagoon" and "in sedgeland on marshy flats".

Taxonomy

***Hibbertia hirsuta* (Hook.) Benth.**

Fl. Austral. 1: 26 (1863); Spicer, Handb. Pl. Tasmania 100 (1878); F.Muell., Census Pl. Tasmania 3 (1880); F.Muell., Syst. Census 1: 1, 141 (1882), includes S.A.; Tate, Trans. Proc. Rep. Roy. Soc. S. Austral. 6: 111 (1883), incl. S.A.; F.Muell., Second Syst. Census 1: 1 (1889), incl. S.A.; Tate, Fl. Extratrop. S. Austral. 14, 205 (1890), incl. S.A.; Tate, Trans. Proc. Rep. Roy. Soc. S. Austral. 12: 70 (1889), incl. S.A.; Rodway, Tasmanian Fl. 4 (1903); W.M.Curtis, Student Fl. Tasmania 1: 21 (1956); M.Stones & W.M.Curtis, Endemic Fl. Tasmania 3: 172, t. 92 (1971); W.M.Curtis & D.I.Morris, Student Fl. Tasmania edn 2, 1: 22 (1975); M.Wapstra et al., Tasmanian Pl. Names Unravelled 107, fig. (2010); A.M.Gray in M.Duretto (ed.), Fl. Tasmania Online: Dilleniaceae (2010). — *Pleurandra hirsuta* Hook., Companion Bot. Mag 1: 273 (1836); Hook.f., J. Bot. (Hook.) 2: 42 (1840); Walpers, Repert. Bot. Syst. 1: 64 (1842); Hook.f., Fl. Tasmania 1: 17 (1855). — **Type citation:** "Mr. Gunn (n. 445) – Gathered on dry hills, near Hobart Town, by Mr. Backhouse". **Lectotype (designated here):** Tasmania, Hobart Town, dry hills, *J.Backhouse sub Gunn 445* (K000687477!). **Remaining syntype:** V[an] D[iemen's] Land, [Tamar River, Whirlpool Reach, Sep. 1835,] *R.C.Gunn 445* (K000687476!).

Suffrutex up to 0.15 m tall, prostrate to scrambling, moderately branched; branches thin-wiry, with leaf bases scarcely raised and scarcely decurrent, pilose but soon glabrescent. *Vestiture* on many parts persistent, sparse, consisting of fascicled and/or longer simple hairs; *on branches* sparse but denser below the inflorescence, a range of larger and smaller erect-spreading fascicled hairs (5–10 often unequally long arms) overtopped by scattered and on some branches very few porrect simple hairs, usually wearing off soon; *on leaves above* sparse, with scattered long and short erect hairs and rarely with a few forked hairs on the flanks of the revolute margins; *on leaves below* sparse with few fascicled hairs under scattered erect long and short simple hairs on the revolute margins and with dense spreading fascicled hairs (8–12 often unequal arms on the central vein but ± similar on the undersurface) and usually without simple hairs; *on bracts* moderately dense, above and below with few small fascicled hairs overtopped by longer antrorse simple hairs; *on outer calyx lobes* moderately dense, outside with short fascicled hairs (2–4 usually unequal arms) overtopped by coarse antrorse simple hairs, inside moderately dense with finer forked hairs overtopped by coarser antrorse simple ones; *on inner calyx lobes* outside sparse, with scattered coarser simple hairs mainly along the central ridge over more widespread finer forked hairs, but glabrous membranous margins, inside glabrous. *Leaves* with pronounced intrapetiolar tuft of hairs up to 1 mm long and often ± decurrent on both sides of the petiole; *petiole* 0–0.4 mm long; *lamina* narrowly elliptic to rarely linear, (2.2–) 3.5–5 (–6.4) × (0.7–) 0.9–1.3 (–1.6) mm, gradually tapering into petiole, acute, rarely obtuse, above grooved to incurved and pilose, below exposing a tomentose undersurface between the slightly revolute margins and a narrow central vein, which is often visible to the leaf apex. *Flowers* sessile, single, terminal on terminal and axillary short shoots on distal branches; *buds* ellipsoidal; *bracts* lanceolate to almost triangular, 2–2.3 × 0.5–0.6 mm, bluntly acute, pubescent. *Calyx* unequally long and accrescent; *outer calyx lobes* 3, lanceolate, 4–4.4 × 1.2–1.4 mm, slightly longer than inner ones, acute, without ridge or recurved distal margins, outside strigose, inside strigose on upper half; *inner calyx lobes* broadly elliptic to obovate, 3.8–4 × 1.6–1.8 mm, obtuse, with ± broad membranous margins, outside pubescent, inside glabrous. *Petal* apparently only one, linear, with incurved apex, 3.2–3.7 mm long, shielding stamen. *Stamens* 1, rarely 2; *filaments* stiffly erect; *anthers* narrowly obloid and scarcely broader than and ± continuous with filament, 0.8–1 mm long and positioned with apex between the stigmas. *Pistils* 2; *ovaries* obovoid, with 2 ovules per ovary and attached above one another, pubescent; erect *styles* attached to the apex and curved inwards (sideway) to place stigmas next to anther. *Seeds* obloid to obovoid, 1.8–2 × 1.5–1.6 mm, brown; *aril* scarcely fleshy, with slightly lobed margins of the membranous cup covering the lower half of the seed.

Distribution and ecology. Known in South Australia (Southern Lofty region) from "clay soils on flats near creek line with *Eucalyptus viminalis* subsp. *cygnetensis*, *E. obliqua*, *E. camaldulensis* over *Acacia melanoxylon*, *A. verticillata*, *Exocarpus cupressiformis*, *Leptospermum continentale*, *Microlaena stipoides*, *Goodenia ovata*, *Hibbertia crinita*, *Haloragis heterophylla*" (*J.Quarmby 189*) and from "heavy grey clay with seasonal wet depressions with *Eucalyptus ovata* over *Leptospermum continentale*, *Banksia marginata*, *Gahnia sieberiana*, *Pteridium esculentum*, *Chorizandra enodis*, *Haloragis heterophylla* and *Gonocarpus tetragynus*" (*J.Quarmby 188*), while Gray (2010) recorded that south-eastern Tasmanian (TSE region) plants were growing "in dry grassy places, open heath and woodlands".

Fig. 1. Type sheet of ***Hibbertia hirsuta***: **Lectotype** indicated in red (K000687477: *J.Backhouse sub Gunn 445*). The **remaining syntype**, indicated in yellow (K000687476: *R.C. Gunn 445*), is accompanied with a note by Gunn: "Sent in 1835 as received from Mr. Backhouse / which he collected at Hobart Town. – Those now sent / are not in flower, but were gathered by myself / at Whirlpool-reach on the Tamar early in Sept.r / 1835 – growing on a dry hill-side, – the habit / evidently dwarf and procumbent, – or prostrate. –". — Reproduced with kind permission of the Board of Trustees of the Royal Botanic Gardens, Kew.

Conservation status. Very rare in South Australia; "scattered but not common" in Tasmania (Gray 2010).

Diagnostic features. Although the vegetative organs are similar to several small species of *Hibbertia*, the flowers are easily distinguished by the reduction of the number of petals and stamens to one or two.

Variation. Except for some range of variation in the denseness of the vestiture in local forms, as for instance in north-eastern Tasmania, where it is much denser, *H. hirsuta* shows remarkably little variation for a suspected inbreeding species.

Typification. A number of early specimens of this species have been accumulated on two sheets at K. On sheet A (Fig. 1), the specimen collected by J. Backhouse (left centre; inscribed "445. Dry Hills. Hobart Town"; K000687477), which is cited in the protologue of *Pleurandra hirsuta* Hook., is here selected as lectotype, as it is flowering. The specimen gathered by R.C. Gunn (right centre; K000687476) is a syntype. It was collected at Whirlpool Reach near Launceston in Sep. 1835 and was sent to W.J. Hooker some time after the Backhouse specimen (see note by Gunn; Fig. 1), but both specimens were presumably available to W.J. Hooker when describing the species in Apr. 1836. Collections by J.D. Hooker on the type sheet, and three collections of Gunn collected in the 1840s, mounted on sheet B, are irrelevant to the typification.

Specimens examined

South Australia: *R.Bates 84343*, Kuitpo Forest, 5.x.2011 (AD, HO, MEL); *J.Quarmby 188*, Meadows Creek tributary, 27.x.2011 (AD); *J.Quarmby 189*, Kuitpo, 27.x.2011 (AD); *J.G.O.Tepper MEL1197774*, Meadows Creek, 10.xii.1881 (MEL).

Tasmania: *M.Allen HO75847*, Stringy Bark Gully, Warrane, 12.x.1975 (HO); *M.Allen HO76346*, Proctors Road, 25.ix.1975 (HO); *A.M.Buchanan 560*, Finger Post Hill, 7.x.1981 (HO); *J.Bufton MEL695427*, Port Arthur, 1894 (MEL); *P.Collier 134*, S Blackmans Bay, 26.xi.1984 (HO); *P.Collier 1770*, near Molesworth, 23.x.1986 (HO); *P.Collier 4308*, 6 km SW Tooms Lake, 14.x.1989 (HO); *W.M.Curtis HO3114*, Conara, Tunbridge, 20.xi.1952 (HO); *A.V.Giblin HO3120*, Mt Nelson Road, 15.x.1929 (HO); *Gunn 445/1841,* Grass Tree Hill, Hobart, 12.x.1840 (K); *Gunn 445/1842,* Hobart Town, i.1839 (K); *Gunn 445/23.x.1844*, George Town (K, NSW); *M.Hart HO29331*, Sandy Bay, 17.xi.1947 (HO); *R.D.Hoogland 11748*, summit of Mt Nelson, 14.i.1970 (CANB, K); *I.Murfet HO3115*, c. 300m SE Mt Nelson Signal Station, 30.x.1957 (HO); *L.Rodway 13*, Queens Domain, Hobart, 15.xi.1897 (HO); *L.Rodway HO3119*, Mt Nelson Range, x.1917 (HO); *L.Rodway NSW243046*, Bellevive, 5.ix. 1892 (NSW).

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References

Bentham, G. (1863). Dilleniaceae. In: *Flora Australiensis, a description of plants of the Australian territory* 1: 26. (Reeves: London).

Bernhardt, P. (1986). Bee-pollination in *Hibbertia fasciculata* (Dilleniaceae). *Plant Systematics and Evolution* 152: 231–241.

Black, J.M. (1926). Dilleniaceae. In: *Flora of South Australia* 3: 386–389. (Government Printer: Adelaide).

Black, J.M. (1952). Dilleniaceae. In: *Flora of South Australia* edn 2, 3: 574–577. (Government Printer: Adelaide).

Curtis, W.M. (1956). *The student's flora of Tasmania* 1: 21. (Tasmanian Government Printer: Hobart).

Curtis, W.M. & Morris, D.I. (1975). *The student's flora of Tasmania* edn 2, 1: 22. (Tasmanian Gov. Printer: Hobart).

Gray, A.M. (2010). Dilleniaceae. In: Duretto. M.F. (ed.). Flora Tasmania Online. (Tasmanian Herbarium, Tasmanian Museum & Art Gallery: Hobart). www.tmag.tas.gov.au/floratasmania [accessed 28 July 2014].

Jessop, J.P. (1986). Dilleniaceae. In: Jessop, J.P. & Toelken, H.R. (eds), *Flora of South Australia* edn 4, 1: 354–358. (Government Printer: Adelaide).

Mueller, F. (1882). *Systematic Census of Australian Plants* 1: 1, 141. (Victorian Government: Melbourne).

Mueller, F. (1889). *Second systematic Census of Australian Plants* 1: 1. (Victorian Government: Melbourne).

Raheem, I.A.A.A. (2012). Phylogeny of the SE Australian clade of *Hibbertia* subg. *Hemistemma* (Dilleniaceae). Unpublished Ph.D. Thesis. (The University of Adelaide: Adelaide).

Stones, M. & Curtis, W.M. (1971). *The endemic flora of Tasmania* 3: 172, pl. 92. (The Ariel Press: London).

Tate, R. (1883). Additions to the flora of South Australia. *Transactions & Proceedings of the Royal Society of South Australia* 6: 111.

Tate, R. (1889). A census of the indigenous flowering plants and vascular cryptogams of Extra Tropical South Australia. *Transaction & Proceedings of the Royal Society of South Australia* 12: 70.

Tate, R. (1890). *Flora of Extratropical South Australia*, pp. 14, 205. (Education Department: Adelaide).

Toelken, H.R. (1995). Notes on *Hibbertia* (Dilleniaceae). 1. New taxa from south-eastern Australia. *Journal of the Adelaide Botanic Gardens* 16: 59–72.

Toelken, H.R. (1998). Notes on *Hibbertia* (Dilleniaceae). 2. The *Hibbertia aspera-empetrifolia* complex. *Journal of the Adelaide Botanic Gardens* 18: 107–160.

Toelken, H.R. (2000). Notes on *Hibbertia* (Dilleniaceae). 3. *H. sericea* and associated species. *Journal of the Adelaide Botanic Gardens* 19: 1–54.

Toelken, H.R. (2013). Notes on *Hibbertia* subgen. *Hemistemma* (Dilleniaceae) 9. The eastern Australian *H. vestita* group, including *H. pedunculata* and *H. serpyllifolia*. *Journal of the Adelaide Botanic Gardens* 26: 31–69.

Tucker, S.C. & Bernhardt, P. (2000). Floral ontogeny, pattern formation, and evolution in *Hibbertia* and *Adrastaea* (Dilleniaceae). *American Journal Botany* 87 (12): 1915–1936.

Tucker, S.C. & Bernhardt, P. (2003). Developmental evidence for stamen number reduction in populations of *Hibbertia fascicularis* (Dilleniaceae). *Plant Systematics and Evolution* 240: 107–114.

Wapstra, M., Wapstra, A. & Wapstra, H. (2010). *Tasmanian plant names unravelled*, p. 107. (Fullers Bookshop: Launceston).