

## The rediscovery of *Dischidia hirsuta* (Apocynaceae, Asclepiadoideae) in Singapore

M. Rodda<sup>1,3</sup>, H.D. Tran<sup>1</sup>, P.T. Chiew<sup>2</sup>,  
D. Liew<sup>2</sup> and J. Leong-Škorničková<sup>1</sup>

<sup>1</sup>Singapore Botanic Gardens, 1 Cluny Road, 259569 Singapore

<sup>2</sup>Conservation Division, Central Nature Reserve,  
National Parks Board, 1 Cluny Road, 259569 Singapore

<sup>3</sup>rodda.michele@gmail.com

**ABSTRACT.** This paper seeks to document the rediscovery of *Dischidia hirsuta* (Bl.) Decne. in Singapore. The taxon was last collected from Singapore in 1903 and later considered nationally extinct. Botanical investigation of Nee Soon Swamp Forest in May 2011 resulted in the rediscovery of a single specimen of *D. hirsuta*, now considered critically endangered.

**Keywords.** *Dischidia*, IUCN Red Lists, Nee Soon Swamp Forest, Singapore

### Introduction

The genus *Dischidia* R.Br. occurs from India, across SE Asia, to the east Pacific region and Australia. The genus has not been recently revised but it has been the subject of modern floristic treatments (Rintz 1980; Li et al. 1995; Forster et al. 1996; Jagtap & Singh 1999; Livshultz et al. 2005). *Dischidia* species are epiphytic and lithophytic climbers with long and slender stems rooting at the nodes and along internodes. The leaves are usually opposite, entire, ovate to elliptic but can alternatively develop into three distinct types: shell-like leaves, usually tightly appressed to the host plant bark, pitchers, and terete leaves (observed in *Dischidia bengalensis* Colebr. only). Shell-like leaves and pitcher leaves accommodate ants that establish a symbiotic interaction with the plant (Janzen 1974).

Inflorescences are spirally-elongating racemes producing flowers more-or-less regularly over a variable amount of time, sometimes up to years. The flowers are pentamerous, with a small calyx and a typically urceolate corolla more-or-less pubescent internally. All species have a staminal corona composed of five hyaline anchor-shaped appendages alternating with the stamens. In some species, a corolline corona also occurs together with the staminal corona and is formed by five lobes attached to the inner surface of the corolla. The pollen is carried in pollinia lacking sterile edges, attached to a central retinaculum by two often broad and cristate caudicles. Fruit follicles are variable, from terete to reniform or triangular in cross section (Rintz 1980). The phylogenetic position of *Dischidia* with respect to *Hoya* is unresolved (Wanntorp et al. 2006a, b; Wanntorp et al. 2011) but they are considered to be separate on a morphological basis (Wanntorp & Kunze 2009).

In Singapore, Ridley (1900) recognised seven species at first, but later eight (Ridley 1923). Rintz (1980) made a critical revision of *Dischidia* for the Malay Peninsula (now including Peninsular Malaysia and Singapore) and recognised seven species occurring in Singapore. Currently nine species are listed as native in the Checklist of Singapore Flora (Chong et al. 2009) but five of these are considered nationally extinct. Among these, *D. singaporensis* Ridl., is considered a globally extinct species.

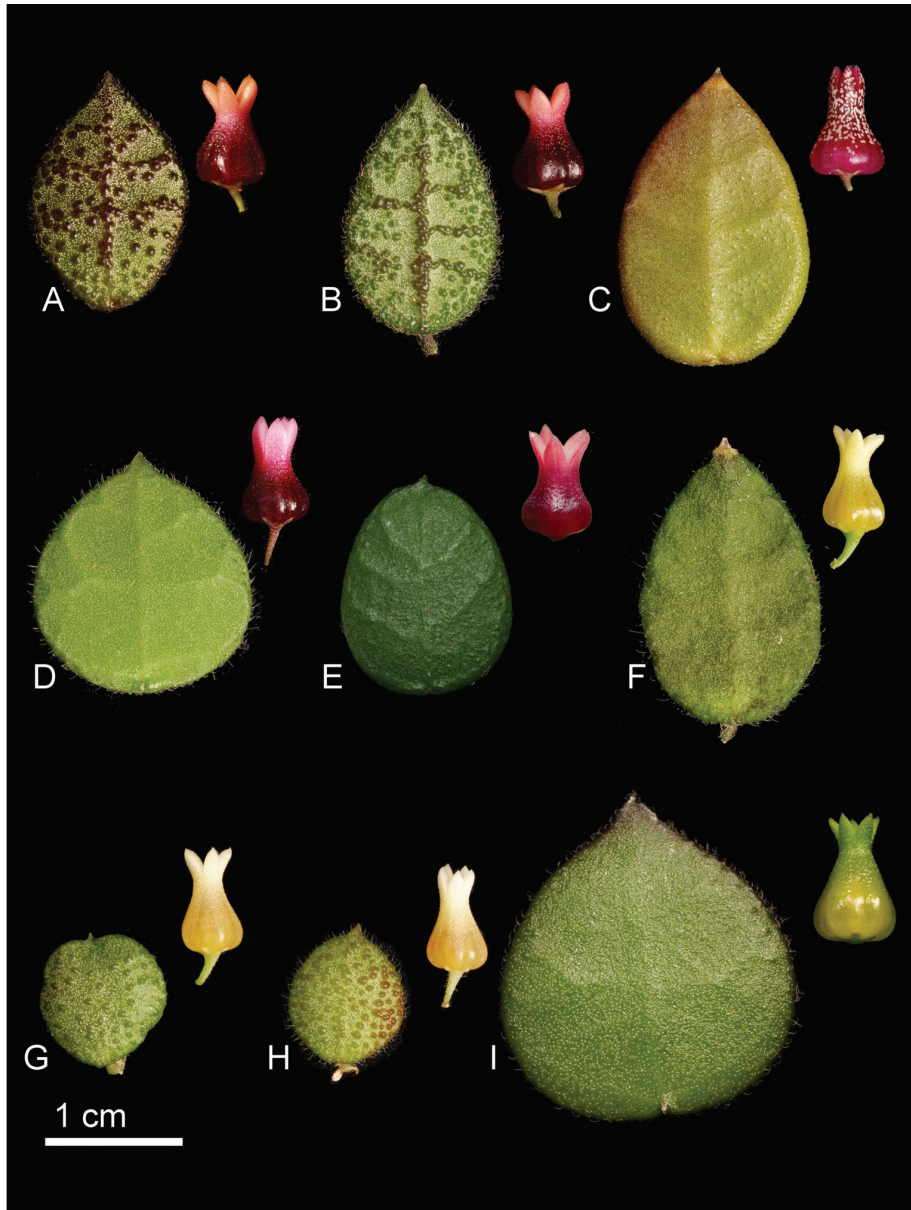
### Distribution and variability of *D. hirsuta*

*Dischidia hirsuta* derived its specific epithet from the characteristic pubescence of the young leaves and stems. It was first described as *Leptostemma hirsuta* Bl. (1826) and transferred to the genus *Dischidia* by Decaisne (1844). It is a rather common species occurring continuously from Burma across to New Guinea (Rintz 1980). It occupies a narrow altitudinal range and can be found growing from lowland to hill forests below 100 m asl. (Rintz 1980). It is usually found on small branches high in the tree canopy where it is exposed to nearly full sun. For this reason, despite its showy flowers, it is difficult to notice unless it is found on recently fallen branches, for example, after storms.

The species is very variable in vegetative and flower morphology depending on the provenance and on the growing condition. Flower colour can range from pale yellow with white corolla lobes to burgundy red, and corolla shape can be from broadly urceolate with a nearly flat base to narrowly ovoid (Fig. 1). Leaf shape can vary from lanceolate to orbicular, flat with visible veins or thick, succulent, with an obscure venation, and leaf size ranges from  $0.5 \times 0.5$  cm to  $2.5 \times 1.5$  cm. Leaf colour varies from dark green to light green-yellow with red or maroon spots (Fig. 1). Lighter-coloured, thicker leaves are typical of specimens growing in direct sunlight but even this may vary from one locality to another (Rodda, pers. obs.). In mature parts of the plant the pubescence typical of juvenile leaves is less conspicuous and often completely absent. While different collections have been described under different names over the years, *D. hirsuta* is currently considered a single species with a large intraspecific variation. Such a high morphological variation has not yet been studied in detail and future studies could lead to resurrection of some of the six species names that are currently considered to be synonymous with *D. hirsuta* (Rintz 1980).

### *Dischidia hirsuta* in Singapore

From herbarium records it appears that *D. hirsuta* was rather widespread in Singapore at the end of the 19th century. It was recorded from natural areas such as Kranji and Seletar, but also along the more populated Nassim Road. The last collection (in Woodlands) dates back to 1903 and therefore the species had been considered presumably extinct (Tan et al. 2008; Davison 2008) until a recent botanical survey of Nee Soon Swamp Forest we conducted in May 2011. It was found growing on



**Fig. 1.** Morphological variation of *Dischidia hirsuta* across its distribution area. For each accession a leaf (adaxial surface) and a flower (side view) is presented. **A.** Borneo, Sabah, 1989, *Ridsdale s.n.* (Hortus Botanicus Leiden number 910235). **B.** Thailand, 24 Aug 2000, *de Wilde* 143909 (20031259). **C.** Indonesia, Irian Jaya, Feb 1998, *Yumte s.n.* (981096). **D.** s. loc, s. coll., (970839). **E.** Singapore, Upper Seletar track, 3 May 2011, *Rodda, Leong-Škorničková, Tran, Liew & Chew* MR11-008 (SING). **F.** Philippines, 21 Jan 1993, *Ridsdale & Pancho s.n.* (930049). **G.** Borneo, Sarawak, 1998, *Vogel, Schuiteman & Roelfsema s.n.* (980056). **H.** s. loc, 21 Jan 1993, *Ridsdale s.n.* (930045). **I.** Indonesia, Sulawesi, *Tauecchio* ETS94031 (20000247). All pictures from living specimens cultivated in the Hortus Botanicus Leiden unless otherwise stated. (Photos: M. Rodda)

fallen branches on the forest floor in deep shade in secondary forest, but the branches had grown in the canopy where they were exposed to nearly full sun. We could not locate any additional specimen on neighbouring trees. The species can be observed in similar habitats in Johore, Malaysia, where *D. hirsuta* is a common epiphyte in lowland freshwater swamps (Rodda, pers. obs.).

### **Conservation considerations**

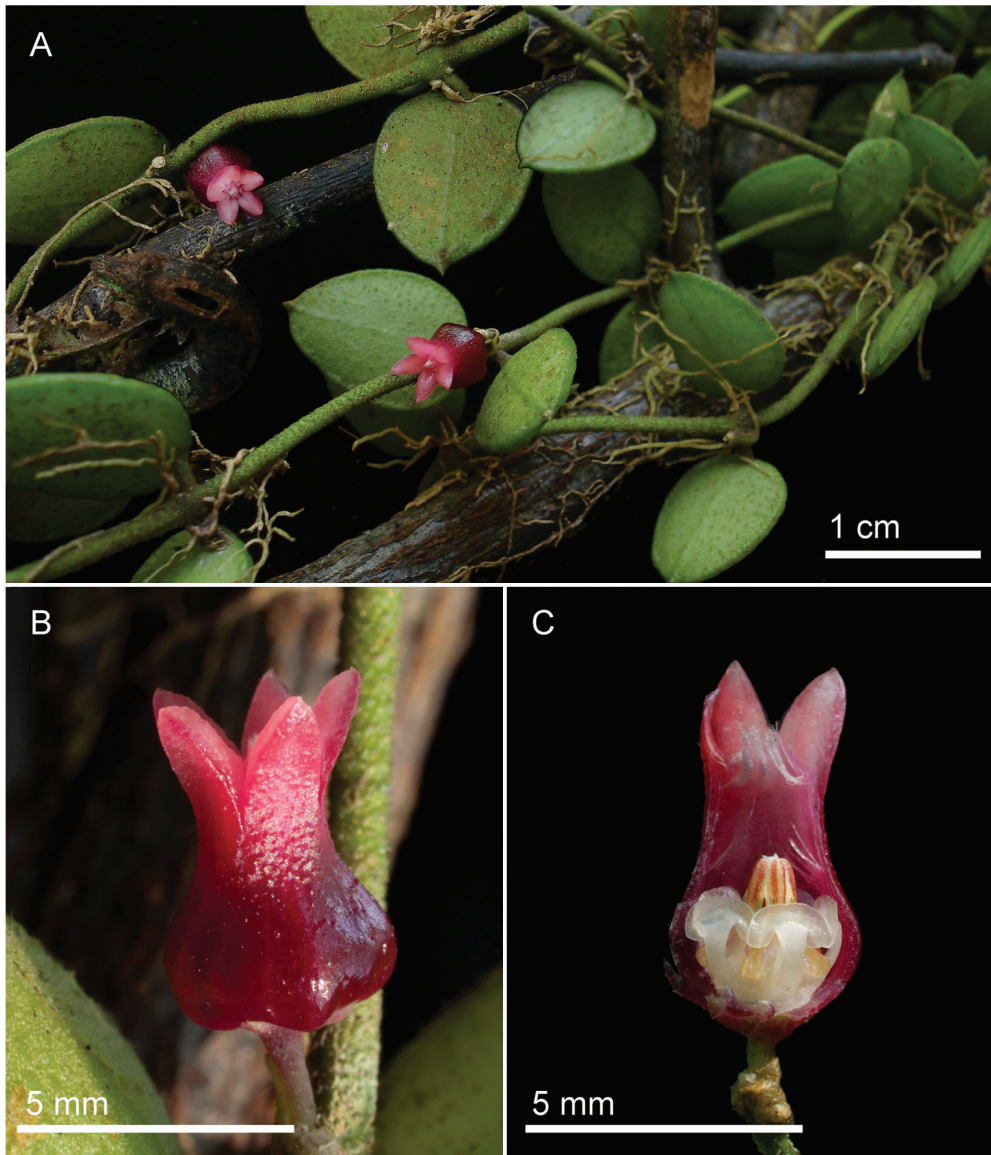
Since the discovery of a single specimen of *D. hirsuta* and its precarious state, the species is more suitably considered Critically Endangered in Singapore, according to guidelines given in *The Singapore Red Data Book* (Davison 2008). It is plausible that further specimens of *D. hirsuta* and other nationally extinct epiphytic species could still persist in the canopy of suitable trees in the relatively under-collected Nee Soon Swamp Forest. This habitat should therefore be further explored and preserved. Cuttings for propagation were taken from the specimen of *D. hirsuta* in Nee Soon Swamp Forest. Currently about 50 plants have been raised at the Singapore Botanic Gardens (SBG Acc. No. 20111110) to create enough stock for conservation work, including possible re-introduction trial planting.

Further collections and detailed studies both at the population level and across the distribution range are needed to verify the extent of morphological as well as genetic variation in order to understand whether *D. hirsuta* is a species complex, which may then require to be recognised as different taxonomic units. From a conservation perspective, the geographic and genetic origin of propagation materials to be potentially used for reintroduction is therefore of essential importance to understand together with its taxonomy. This then helps to avoid genetic contamination of the natural populations of the taxon, in particular in Singapore, where natural populations could be highly restricted and ecological repercussions potentially impactful.

### **Description of the Singapore taxon**

The following morphological description is based on specimens collected in Singapore (Fig. 2):

**Plants** succulent, herbaceous; epiphytic vines growing tightly appressed to the host tree stems, clinging by adventitious roots, rarely pendulous, usually preferring to colonise small canopy branches up to 5 cm diameter. Latex white. **Roots** on mature plants adventitious, produced just below each node and along the internodes. **Leafy stems** terete, up to 2.5 mm diameter, dark green, hirsute when young; internodes 1–2 cm long. **Leaves** opposite, petiolate; petiole cylindrical, 1.5–2.5 mm long, c. 1 mm in diameter, sparsely pubescent; lamina dark green, underneath lighter green with darker spots, coriaceous, fleshy, (orbicular) broadly ovate (lanceolate), 1–2.5 × 0.6–1.5 cm, hirsute on both surfaces when young; apex acute-apiculate, base round-truncate (shortly attenuate), margin entire, main vein evident on adaxial surface, marked by a dark green line on abaxial surface, secondary veins 3–4 pairs, branching at 60–80(–90)° from main vein. **Inflorescences** usually bearing a single open flower at a time; peduncle extra-axillary, perennial, bearing scars of previous flowerings 2–5 mm long, c. 1 mm in diameter, pubescent; pedicels 2–3 mm long, c. 0.7 mm in diameter, glabrous



**Fig. 2.** *Dischidia hirsuta* in Singapore. **A.** Flowering branches bearing single-flowered inflorescences. **B.** Single-flowered inflorescence. **C.** Dissected flower. The double ring of hairs lining the corolla tube, the hyaline appendages surrounding the staminal corona and the central anther appendages can be observed. Based on Rodda, Leong-Škorničková, Tran, Liew & Chew MR11-008 (SING). (Photos: M. Rodda (A, C) and J. Leong-Škorničková (B)).

(sparsely hirsute). **Calyx** c. 3 mm in diameter, red-purple, lobes ovate 1–1.5 × 0.6–1 mm, apex acute to round, glabrous. **Corolla** succulent, urceolate, c. 7 × 4 mm, basally dark red, progressively fading into light pink at the lobe apices, externally glabrous,

corolla throat with two rings of hairs, the first just below the corolla lobe sinus, the second at the same high as the anther appendages; lobes nearly entirely fused, glabrous, with free ovate tips up to 2 mm long. *Corolline corona* absent. *Staminal corona* 3 mm high, 3 mm in diameter, basally pubescent, composed of five hyaline appendages with a truncate apex and two downcurved lobes. *Stigma* head prominent, convex, hidden by the anther appendages. *Pollinarium* erect (measuring c.)  $1000 \times 600 \mu\text{m}$  with two oblong pollinia,  $600 \times 200 \mu\text{m}$ , apex and base rounded to obtuse, retinaculum  $420 \times 120 \mu\text{m}$ , caudicles broad, laterally crested, 400  $\mu\text{m}$  long. *Ovary* bi-carpellate, bottle shaped, 1.5 mm long, each carpel c. 0.7 mm in basal diameter. Fruits and seeds not seen.

*Singapore specimens examined.* Tanglin, Nassim Road, 1901, *H.N. Ridley 14165* (SING, barcode SING0003915); Seletar, Nov? 1889, *H.N. Ridley 2730* (SING, barcode SING0003916); Kranji, 26 Feb 1889, *H.N. Ridley s.n.* (SING barcode SING0003914); Seletar, 10 Mar 1890, *J.S. Goodenough s.n.* (SING barcode SING0003919); Woodlands, Jun 1903, *H.N. Ridley s.n.* (SING barcode SING0003917); Upper Seletar track, 3 May 2011, *Rodda, Leong-Škorničková, Tran, Liew & Chew MR11-008* (SING, spirit barcode SING0126958).

ACKNOWLEDGEMENTS. We thank National Parks Board, Singapore, for funding our research, in particular the Urban Ecology RF programme, which, through the project on Enhancement of Biodiversity Research for Gingers, enabled extensive surveys across Singapore leading to this unexpected discovery. We would also like to acknowledge Art Vogel and Ed de Vogel for allowing access to the extensive living *Dischidia* collection in the Hortus Botanicus Leiden.

## References

- Blume, C. (1826) Asclepiadeae. *Bijdr. Fl. Ned. Ind.* 16: 1048–1066.
- Chong, K.Y., Tan, H.T.W. & Corlett, R.T. (2009) A Checklist of the Total Vascular Plant Flora of Singapore: Native, Naturalised and Cultivated Species. Raffles Museum of Biodiversity Research, National University of Singapore, Singapore. 273 pp. Uploaded 12 November 2009. [http://rmbn.nus.edu.sg/raffles\\_museum\\_pub/flora\\_of\\_singapore\\_tc.pdf](http://rmbn.nus.edu.sg/raffles_museum_pub/flora_of_singapore_tc.pdf).
- Decaisne, J. (1844). *Dischidia*. In: De Candolle, A. P., *Prodr.* 8: 631–633.
- Davison, G.W.H. (2008) The Red List categories. In: Davison, G.W.H., Ng, P.K.L. & Ho, H.C. (eds) *The Singapore Red Data Book: Threatened Plants and Animals of Singapore*. 2nd ed. Singapore: Nature Society (Singapore). Pp. 1–4.
- Forster, P.I., Liddle, D.J. & Nicholas, A. (1996) Asclepiadaceae. In: Robertson, R. et al. (eds) *Flora of Australia* 28. *Gentianales*: 197–283. Melbourne: CSIRO.
- Jagtap, A.P. & Singh. N.P. (1999) Asclepiadaceae. *Fascicles of Flora of India*. Fascicle 24. Calcutta: Botanical Survey of India.
- Janzen, D.H. (1974) Epiphytic myrmecophytes in Sarawak: mutualism through the feeding of plants by ants. *Biotropica* 6: 237–259.
- Li, P.T., Gilbert, M.G. & Stevens, W.D. (1995) Asclepiadaceae. In: Wu, Z. & Raven, P.H. (eds) *Flora of China* 16. *Gentianaceae through Boraginaceae*: 189–270. St. Louis: Missouri Botanic Garden.

- Livshultz, T., Tran, T.B., Bounphanmy, S & Schott, D. (2005) *Dischidia* (Apocynaceae, Asclepiadoideae) in Laos and Vietnam. *Blumea* 50: 113–134.
- Ridley, H.N. (1900) Flora of Singapore. *J. Straits Branch Roy. Asiat. Soc.* 33: 27–196.
- Ridley, H.N. (1923) *Hoya*. *Flora of the Malay Peninsula*. 2: 402–410. London: Reeve & Co.
- Rintz, R.E. (1980) The Peninsular Malayan species of *Dischidia* (Asclepiadaceae). *Blumea* 26: 81–126.
- Tan, H.T.W., Tan, K., Ali Ibrahim, Chew, P.T., Chua, K.S., Duistermaat, H., Ganesan, S.K., Goh, M.W.K., Gwee, A.T., Kiew, R., Lee, S.M.L., Leong, P., Lim, J., Lok, A.F.S.L., Loo, A.H.B., Lum, S.K.Y., Morgany, T., Saifuddin Suran, Sim, S., Samsuri Ahmad, Wee, Y.C., Yap, K.F., Yeo, C.K. & Yong, J.W.H. (2008) Checklists of Threatened Species—Seed Plants. In: Davison, G.W.H., Ng, P.K.L. & Ho H.C. (eds) *The Singapore Red Data Book*. 2nd ed. Singapore: The Nature Society (Singapore). Pp. 213–244.
- Wanntorp, L., Kocyan, A., van Donkelaar, R. & Renner, S.S. (2006a) Towards a monophyletic *Hoya* (Marsdenieae, Apocynaceae): Inferences from the chloroplast *trnL* region and the *rbcL-atpB* spacer. *Syst. Bot.* 31(3): 586–596.
- Wanntorp, L., Kocyan, A. & Renner, S.S. (2006b). Wax plants disentangled: A phylogeny of *Hoya* (Marsdenieae, Apocynaceae) inferred from nuclear and chloroplast DNA sequences. *Molec. Phylogen. Evol.* 39: 722–733.
- Wanntorp, L. & Kunze, H. (2009) Identifying synapomorphies in the flowers of *Hoya* and *Dischidia*—towards phylogenetic understanding. *Int. J. Pl. Sci.* 170(3): 331–342.
- Wanntorp, L., Gotthardt, K. & Muellner, A.N. (2011) Revisiting the Wax Plants (*Hoya*, Marsdenieae, Apocynaceae) phylogenetic tree using the chloroplast markers *matK* gene and *psbA-trnH* intergenic spacer. *Taxon* 60(1):4–14.

