Phytotaxa 161 (4): 241–269
www.mapress.com/phytotaxa/

Article

ISSN 1179-3155 (print edition)
PHYTOTAXA
ISSN 1179-3163 (online edition)

http://dx.doi.org/10.11646/phytotaxa.161.4.1

Billolivia, a new genus of Gesneriaceae from Vietnam with five new species

DAVID J. MIDDLETON[1,3], HANNAH ATKINS[1], LUU HONG TRUONG[2], KANAE NISHII[1] & MICHAEL MÖLLER[1]

[1] *Royal Botanic Garden Edinburgh, 20A Inverleith Row, Edinburgh EH3 5LR, Scotland, UK. Email: M.Moeller@rbge.ac.uk*
[2] *Southern Institute of Ecology, Vietnam Academy of Science and Technology, 01 Mac Dinh Chi St., District 1, Ho Chi Minh City, Vietnam. Email: hongtruongluu@gmail.com*
[3] *Singapore Botanic Gardens, 1 Cluny Road, Singapore 259569. Email: david_middleton@nparks.gov.sg*

Abstract

Based on molecular and morphological data, the new genus *Billolivia* with five new species, *B. longipetiolata, B. minutiflora*, *B. poilanei*, *B. vietnamensis* and *B. violacea*, is described. IUCN conservation assessments are provided for the species.

Key words: Bayesian inference, *Cyrtandra*, ITS, maximum parsimony, molecular phylogeny, *trn*LF

Introduction

A fruiting collection of Gesneriaceae from Vietnam, *Poilane* 22604 (P), has remained unnamed, even to genus, since it was collected in 1933. In the last few years several new collections of similar plants have been made in Vietnam. These collections can be assigned to five discrete species, none of which have yet been described. They appear to be most similar to *Cyrtandra* Forster & Forster (1775: 5), particularly in the indehiscent fruit but also through similarities in inflorescence and flower morphology (e.g. two anterior stamens). The character that most clearly differentiates them from *Cyrtandra* is the alternate leaf arrangement. In *Cyrtandra* the leaves are opposite but may appear alternate by reduction of one of the leaves in each pair, sometimes to just a scale. In the five species from Vietnam there is no trace at all of a reduced leaf opposite a full-sized one, a situation that is unknown in *Cyrtandra*. In addition to this morphological difference, no species of *Cyrtandra* are known from continental Asia outside of Peninsular Malaysia and Peninsular Thailand.

Due to the morphological similarities of these plants to *Cyrtandra* molecular data have been used to analyse whether they belong to this genus or whether the alternate leaf arrangement and the allopatric distributions suggest generic distinction. We have used the largest nuclear ITS and chloroplast *trn*LF sequence matrix of Old World Gesneriaceae from Weber *et al.* (2011) for 232 samples as the basis and added sequences of four of the five species and focused particularly on their relationships to species of *Cyrtandra*.

Materials and methods

Plant materials

Leaf material of samples of four of the five Vietnamese species under investigation was taken either from herbarium specimens (*Luu Hong Truong & Pham Huu Nhan* BD624, *Ly Ngoc Sam* LY498 and *Luu Hong Truong & Nguyen Quoc Dat* BGM1601), or from a plant growing in the RBGE living collection (vouchered as *Middleton* 4210) and rapidly dried in silica gel (Table 1).

Accepted by Peter Heenan: 30 Jan. 2014; published: 3 Mar. 2014

towards mouth and a 2-lipped limb, tube and base of lobes white outside and inside, tips of lobes violet outside and inside, inside base of lower lip yellow; tube c. 22 mm long; upper lip 2-lobed, c. 11.5 mm long, sinus between lobes c. 8 mm, lobes oblong, c. 8 × 7 mm, apices rounded; lower lip 3-lobed, c. 14 mm long, lobes slightly obovate, apices rounded, lateral lobes c. 11 × 8 mm, medial lobe c. 10 × 9 mm; corolla with short colourless hairs outside on upper half of tube and base of lobes, glandular puberulent at top of tube and base of lobes inside. Stamens inserted at c. 15 mm from corolla base; filaments strongly coiled, c. 7 mm long, narrow at base, abruptly widening around middle, with sessile glands in upper half; anthers c. 1.3 × 1.3 mm, glabrous, adhering at the apices; lateral staminodes c. 3 mm long, medial staminode c. 1.5 mm long. Disc an annular ring, c. 2.2 mm high. Ovary c. 5.5 mm long, glabrous at base, glandular puberulent in upper part; style c. 12 mm long, glandular puberulent; stigma 2-lobed, lobes 1.5 mm long. Fruit ellipsoid (as reported, not seen by authors).

Etymology:—After the colour of the tips of the corolla lobes.

Distribution:—Only known from the type locality.

Ecology:—Submontane tropical evergreen closed forest at 1550 m alt.

Proposed IUCN conservation status:—Data Deficient (DD) (IUCN 2001, 2012). This species is only known from one collection from the wild and one grown on in cultivation from that collection. Its distribution, and the current state of the forest in the area, are unknown although the suitable forest habitat in the region is very likely to be much less than 5000 km^2 which could qualify it for at least an Endangered category given the deforestation in the region.

Additional specimen studied:—VIETNAM. Lam Dong**:** Duc Trong District, Nui Voi, Xa Hiep An, 1550 m alt., 17 September 2001, *Thomas, Luu & Chi 201* (E, VNM).

The type collection is a voucher taken from a plant cultivated at the Royal Botanic Garden Edinburgh which in turn was grown on from a cutting taken from the only wild collected specimen, *Thomas et al.* 201. The cultivated voucher is chosen as the type as it better shows the essential characters than the wild collected specimen.

Acknowledgements

The work of Luu Hong Truong in Bidoup-Nui Ba National Park is funded by the project TN3/T09 within the Vietnam National Key Programme KHCN-TN3/11-15 (Tay Nguyen Programme No. 3) and in Bu Gia Map National Park by the Vietnam Conservation Fund (decision No 31/QD-KL-VCF) and Binh Phuoc Provincial Department of Science and Technology (contract No 600/HD – SKHCN). He is grateful to the managers and staff of the two parks for their kind support and cooperation during the field collection. We thank Jana Leong-Škorničková and the late Mary Mendum for additional photos and Claire Banks for the illustration. We also thank Mark Hughes for the distribution map, Figure 3. The Royal Botanic Garden Edinburgh is supported by the Rural and Environment Science and Analytical Services division (RESAS) in the Scottish Government.

References

Akaike, H. (1974) A new look at the statistical model identification. *IEEE Transactions on Automatic Control* 19: 716–723. http://dx.doi.org/10.1109/tac.1974.1100705

Averyanov, L.V., Loc, P.K., Nguyen, T.H. & Harder, D.K. (2003) Phytogeographic review of Vietnam and adjacent areas of Eastern Indochina. *Komarovia* 3: 1–83.

Brown, R. (1839) *On Cyrtandreae*. A preprint from Bennett, J. J., *Plantae Javanicae Rariores*.

Burtt, B.L. (1963) Studies in the Gesneriaceae of the Old World. XXIV. Tentative keys to the tribes and genera. *Notes from the Royal Botanic Garden Edinburgh* 24: 205–220.

Burtt, B.L. (2000) *Kaisupeea*: a new genus of Gesneriaceae centred in Thailand. *Nordic Journal of Botany* 21: 115–119. http://dx.doi.org/10.1111/j.1756-1051.2001.tb01345.x

Chun, W.Y. (1946) Gesneriacearum plantae novae sinicarum. *Sunyatsenia* 6: 271–304.

Clark, J.L., Funke, M.M., Duffy, A.M. & Smith, J.F. (2012) Phylogeny of a neotropical clade in the Gesneriaceae: more tales of convergent evolution. *International Journal of Plant Sciences* 173: 894–916. http://dx.doi.org/10.1086/667229

Clarke, C.B. (1883) Cyrtandreae. *In*: de Candolle, A. & de Candolle, C. (eds) *Monographie Phanerogamarum* 5: 1–303, 32 plates.

Craib, W.G. (1920 ["1919"]) Gesneracearum novitates. *Notes from the Royal Botanic Garden Edinburgh* 11: 233–254.
Doyle, J.J. & Doyle, J.L. (1987) A rapid DNA isolation procedure for small quantities of fresh leaf tissue. *Phytochemistry Bulletin* 19: 11–15.
Doyle, J.J. & Doyle, J.L. (1990) Isolation of plant DNA from fresh tissue. *Focus* 12: 13–15.
Farris, J., Källersjö, S.M., Kluge, A.G. & Bult, C. (1995a) Constructing a significance test for incongruence. *Systematic Biology* 44: 570–572.
Farris, J., Källersjö, S.M., Kluge, A.G. & Bult, C. (1995b) Testing significance of incongruence. *Cladistics* 10: 315–319. http://dx.doi.org/10.1111/j.1096-0031.1994.tb00181.x
Forster, J.R. & Forster, G. (1775) *Characteres Generum Plantarum*. White et al., London. http://dx.doi.org/10.5962/bhl.title.4448
IUCN (2001) *IUCN Red List Categories and Criteria*, Version 3.1. Gland and Cambridge: IUCN Species Survival Commission.
IUCN (2012) *IUCN Red List Categories and Criteria*: Version 3.1. Second edition. Gland and Cambridge: IUCN Species Survival Commission.
Lamarck, J.B.P.A.D. & Poiret, J.L.M. (1783) *Encyclopédie méthodique: botanique*, v. 1. Paris and Liege. http://dx.doi.org/10.5962/bhl.title.49178
Möller, M. & Cronk, Q.C.B. (1997) Origin and relationships of *Saintpaulia* H.Wendl. (Gesneriaceae) based on ribosomal DNA internal transcribed spacer (ITS) sequences. *American Journal of Botany* 84(7): 956–965. http://dx.doi.org/10.2307/2446286
Möller, M. & Cronk, Q.C.B. (2001) Evolution of morphological novelty: a phylogenetic analysis of growth patterns in *Streptocarpus* (Gesneriaceae). *Evolution* 55: 918–929. http://dx.doi.org/10.1111/j.0014-3820.2001.tb00609.x
Möller, M., Pfosser, M., Jang, C.G., Mayer, V., Clark, A., Hollingsworth, M.L., Barfuss, M.H.J., Wang, Y.Z., Kiehn, M. & Weber, A. (2009) A preliminary phylogeny of the 'didymocarpoid Gesneriaceae' based on three molecular data sets: Incongruence with available tribal classifications. *American Journal of Botany* 96: 989–1010. http://dx.doi.org/10.3732/ajb.0800291
Möller, M., Forrest, A.L., Wei, Y.-G. & Weber, A. (2011) A molecular phylogenetic assessment of the advanced Asiatic and Malesian didymocarpoid Gesneriaceae with focus on non-monophyletic and monotypic genera. *Plant Systematics and Evolution* 292: 223–248. http://dx.doi.org/10.1007/s00606-010-0413-z
Nixon, K.C. (1999) The Parsimony Ratchet, a new method for rapid parsimony analysis. *Cladistics* 15: 407–414. http://dx.doi.org/10.1006/clad.1999.0121
Nylander, J.A.A. (2004) *MrModeltest* v2. Program distributed by the author. Evolutionary Biology Centre, Uppsala University, Sweden.
Poudel, R.C., Möller, M., Gao, L.-M., Ahrends, A., Baral, S.R., Liu, J., Thomas, P. & Li, D.Z. (2012) Using Morphological, Molecular and Climatic Data to Delimitate Yews along the Hindu Kush-Himalaya and Adjacent Regions. *PLoS ONE* 7(10): e46873. http://dx.doi.org/10.1371/journal.pone.0046873
Swofford, D.L. (2002) *PAUP*: phylogenetic analysis using parsimony (*and other methods),* version 4. Sinauer. Sunderland, Massachusetts.
Taberlet, P., Gielly, L., Pautou, G. & Bouvet, J. (1991) Universal primers for amplifi cation of three non-coding regions of chloroplast DNA. *Plant Molecular Biology* 17 : 1105–1109. http://dx.doi.org/10.1007/bf00037152
Wang, W.T. & Li, Z.Y. (1992) Genus novum Gesneriacearum e Vietnam. *Acta Phytotaxonomica Sinica* 30: 356–361.
Weber, A. (2004) Gesneriaceae. In: Kubitzki K (ed) *The families and genera of vascular plants*, vol. 7. Kadereit, J.W. (vol. ed.) Dicotyledons. Lamiales (except Acanthaceae incl. Avicenniaceae) Springer, Berlin, pp 63–158.
Weber, A., Middleton, D.J., Forrest, A.L., Kiew, R., Lim, C.L., Rafidah, A., Yao, T.L., Sontag, S., Triboun, P., Wei, Y.-G., Yao, T.-L. & Möller, M. (2011) Molecular systematics and remodelling of *Chirita* and associated genera (Gesneriaceae) *Taxon* 60(3): 767–790.