



Comparison of modern classifications for filmy ferns (Hymenophyllaceae) and a new combination in *Trichomanes* L. for the filmy fern *Macroglena brassii* Croxall, from Queensland, Australia

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Introduction

The filmy ferns (Hymenophyllaceae) are a distinctive group of leptosporangiate ferns distinguished by a thin membranous lamina that is usually one cell thick (or occasionally up to four cells thick in some parts of the lamina) and marginal sori that are protected by an indusium in the form of a cup-shaped or bilabiate involucre (Ebihara *et al.* 2007). Forty nine species of this family occur in Australia, of which 15 are probably endemic (Green 1994; Bostock & Spokes 1998; Ebihara & Iwatsuki 2007). Two major lineages exist within the Hymenophyllaceae that largely correspond to the two original genera recognised within the family: *Hymenophyllum* Sm. and *Trichomanes* L. (Pryer *et al.* 2001; Hennequin *et al.* 2003; Ebihara *et al.* 2004). Numerous other classifications have been proposed that recognise several additional genera (e.g. Copeland 1938, 1947; Morton 1968; Pichi Sermolli 1977; Iwatsuki 1984) and some have been adopted in key treatments of the Australian Hymenophyllaceae. The classification used by Tindale (1963), Croxall (1975) and Andrews (1990) is most similar to the classification proposed by Copeland (1938, 1947), which recognised 16 genera in Australia. It differed from that of Copeland (1938, 1947) by some genera being recognised as subgenera of *Hymenophyllum*, while *Vandenboschia* Copel. and *Crepidopteris* Copel. were included in *Trichomanes* and *Reediella* Pichi-Sermolli respectively due to concerns that *Vandenboschia* Copel.

Abstract

Contemporary Hymenophyllaceae treatments typically follow one of two classifications that recognise monophyletic genera. One comprises nine genera, while the other recognises two genera, *Hymenophyllum* Sm. and *Trichomanes* L. Combinations exist for all Australian species that allow the former classification to be adopted in Australia. However, genera of the former classification tend to be poorly defined morphologically compared to the latter classification. All Australian species have available combinations in either *Hymenophyllum* or *Trichomanes* except for one Queensland species originally described as *Macroglena brassii* Croxall. A new combination in *Trichomanes* is made here for *M. brassii* so that the two genus classification of Hymenophyllaceae can be followed in Australia.

Keywords: *Abrodictyum*, *Trichomanes brassii*, generic limits.

and *Crepidopteris* Copel. were illegitimate, which is indeed the case for *Crepidopteris*. The Flora of Australia treatments by Du Puy & Orchard (1993), Green (1994) and Bostock & Spokes (1998) followed the classification of Iwatsuki (1984), which recognised five genera in Australia.

Genera recognised in these morphologically-based classifications have been shown to be non-monophyletic by recent phylogenetic analyses of chloroplast DNA sequence data (Hennequin *et al.* 2003, 2006, 2010; Ebihara *et al.* 2004, 2007). A more recent classification proposed by Ebihara *et al.* (2006) and followed by PPG I (2016) differed from previous classifications by including some species in *Hymenophyllum* that were once included in or previously thought to be closely related to *Trichomanes* (e.g. *Cardiomanes* C.Presl, *Microtrichomanes* (Mett.) Copel. in part and *Pleuromanis* C.Presl), and by recircumscription of some genera in the *Trichomanes* lineage. This made all Hymenophyllaceae genera monophyletic according to molecular phylogenetic analyses (Pryer *et al.* 2001; Hennequin *et al.* 2003, 2006, 2010; Ebihara *et al.* 2004). The names for all Australian Hymenophyllaceae species under this Ebihara *et al.* (2006) classification are provided by Field (2020).

While some contemporary treatments follow this classification (e.g. Smith *et al.* 2006; Jiayi *et al.* 2013), assigning some species to these genera using morphological features without an underlying knowledge of their phylogenetic placement is virtually impossible (Brownsey & Perrie 2016). This is because some of these genera lack morphological features that are shared by all species or, when they are unified by a common feature, these features are also present in species of other genera (Ebihara *et al.* 2007; Brownsey & Perrie 2016). The close morphological resemblance that can exist between some of these narrowly circumscribed genera is epitomised by *Trichomanes cupressoides* Desv. from the tropical islands of the Indian Ocean. *Trichomanes cupressoides* was shown by phylogenetic analyses of chloroplast *rbcl* to harbour two cryptic species that belonged to separate genera (*Abrodictyum* C.Presl and *Trichomanes s.s.*) under the Ebihara *et al.* (2006) classification (Bauret *et al.* 2015).

The recent practice adopted by PPG I (2016) of segregating several smaller genera from large

genera that can be both morphologically defined and monophyletic, as with *Trichomanes s.l.*, has been criticised by Christenhusz & Chase (2018). They discuss the impracticality for identification and the nomenclatural instability such splitting creates, and criticise the inconsistencies in generic concepts adopted by PPG I (2016) in retaining some large genera such as *Asplenium* L., while splitting other similarly large complex genera into several segregates. PPG I (2016) justified recognising these segregate genera because they were monophyletic and they had been previously recognised with available names. However, in the case of the Hymenophyllaceae the limits of pre-existing genera had been altered drastically to retain monophyly within the family and hardly resembled their original concepts. Consequently, Christenhusz & Chase (2018) stated that “PPG I (2016) should not be viewed automatically as the necessary and logical next step in fern classification”.

For Hymenophyllaceae, an alternative classification that also recognises monophyletic genera but avoids the issues highlighted by Christenhusz & Chase (2018) is to recognise only *Hymenophyllum* and *Trichomanes*, which are slightly altered from their traditional circumscription to correspond to the two major lineages in Hymenophyllaceae. This classification is currently used in New Zealand (Brownsey & Perrie 2016). The main limitation to this classification is that it groups together several older lineages in *Trichomanes* that have divergence times that are more typically observed in ferns between genera or even families (Schuettelpelz & Pryer 2006). However, the genera are much better defined morphologically under this classification, with *Trichomanes* having densely hairy rhizomes, compared to glabrous or sparsely hairy rhizomes in *Hymenophyllum*. Some features are also only present in many *Trichomanes* or *Hymenophyllum* that instantly allow those species to be placed into one or other genus. These include false-veins and erect rhizomes present in several *Trichomanes* species but absent in *Hymenophyllum* (with the exception of New Zealand *H. pulcherrimum* Colenso that has erect rhizomes) and toothed lamina margins in *Hymenophyllum* that are absent in *Trichomanes* (Morton 1968). The author here advocates the use of this two genus classification in Australia in preference to the classification of Ebihara *et al.* (2006) because of the ease of morphological



Figure 1. *Trichomanes brassii* plant at Herberton Range, northeast Queensland. Photo: Peter Richardson.

recognition of its genera compared to some of the genera of the latter classification.

Almost all of the Australian Hymenophyllaceae species have combinations in *Hymenophyllum* and *Trichomanes* because they were described prior to classifications that recognised several genera in addition to *Hymenophyllum* and *Trichomanes*. The one exception is the Queensland endemic *Macroglena brassii* Croxall (Figure 1). This belongs to a group of *Trichomanes* species, recognised as *Abrodictyum* C.Presl by Ebihara *et al.* (2006), that also includes the Australian species *T. caudatum* Brack. and *T. obscurum* Blume (Ebihara *et al.* 2007). Among Australian species, *M. brassii* is morphologically most similar to *T. obscurum*, which also has an erect rhizome and highly dissected fronds. *Macroglena brassii* can be distinguished from *T. obscurum* by its linear and bristle-like ultimate segments (Bostock & Spokes 1998). The ultimate segments are also narrow (only one or two rows of cells bordering the axes) and bristle-like in Malesian *T. pluma* Hook. and New Caledonian *T. laetum* Bosch. These species are more closely related to other *Trichomanes* (*Abrodictyum*) species than they are to *M. brassii* (Ebihara

et al. 2007) and can be distinguished by fronds with a 3-dimensional arrangement rather than being primarily planar. A new combination in *Trichomanes* is made here for *M. brassii* so that the two genus classification of Hymenophyllaceae can be followed in Australia.

Taxonomy

Trichomanes brassii (Croxall) D.J.Ohlsen, *comb. nov.*

Macroglena brassii Croxall, *Austral. J. Bot.* 23: 543 (1975); *Cephalomanes brassii* (Croxall) Bostock, *Fl. Australia* 48: 706 (1998); *Abrodictyum brassii* (Croxall) Ebihara & K.Iwats., *Blumea* 51(2): 243 (2006). Type: Mount Finnegan, west slopes, Qld, 6 Sept. 1948, L.J.Brass 20048; holo: BRI AQ0024748 (image!); iso: CANB 184593 (image!), K 001090238 (image!).

Acknowledgements

I would like to thank Peter Richardson for use of his photograph of *Trichomanes brassii* in Figure 1. and Patrick Brownsey, Nimal Karunajeewa, Leon Perrie and

Val Stajsic for helpful discussions on generic limits in Hymenophyllaceae.

References

- Andrews, S.B. (1990). Hymenophyllaceae, in *Ferns of Queensland, a handbook to the ferns and fern allies*, pp. 161–200. Queensland Department of Primary Industries: Brisbane.
- Bauret, L., Grall, A., Senterre, B., Rouhan, G., Hennequin, S., Ebihara, A. & Dubuisson, J.-Y. (2015). New circumscription of *Trichomanes cupressoides* Desvauz (Hymenophyllaceae), an endemic filmy fern from the Seychelles (Indian Ocean), and new insights into the genus *Abrodictyum* C.Presl in the western Indian Ocean. *Phytotaxa* **202**: 1–14.
- Bostock, P.D. & Spokes, T.M. (1998). Hymenophyllaceae, in McCarthy, P.M. (ed.), *Flora of Australia. Ferns, Gymnosperms and Allied Groups* **48**, pp. 116–148. ABRIS: Canberra/CSIRO Publishing: Collingwood.
- Brownsey, P.J. & Perrie, L.R. (2016). Hymenophyllaceae, in Breitwieser, I., Heenan, P.B. & Wilton, A.D., *Flora of New Zealand—Ferns and Lycophytes. Fascicle 15*. Manaaki Whenua Press: Lincoln.
- Christenhusz, M.J.M. & Chase, M.W. (2018). PPG recognises too many fern genera. *Taxon* **67**: 481–487.
- Copeland, E.B. (1938). Genera Hymenophyllacearum. *The Philippine Journal of Science* **67**: 1–110.
- Copeland, E.B. (1947). *Genera Filicum*. Waltham: Massachusetts.
- Croxall, J.P. (1975). The Hymenophyllaceae of Queensland. *Australian Journal of Botany* **23**: 509–547.
- Du Puy, D.J. & Orchard, A.E. (1993). Hymenophyllaceae, in George, A.S., Orchard, A.E. & Hewson, H.J. (eds), *Flora of Australia* **50**: 538–540. (Australian Government Publishing Service: Canberra).
- Ebihara, A. & Iwatsuki, K. (2007). The Hymenophyllaceae of the Pacific Area. 1. *Hymenophyllum* subgenus *Hymenophyllum*. *Bulletin of the National Museum of Nature and Science, Series B* **33**: 55–68.
- Ebihara, A., Hennequin, S., Iwatsuki, K., Bostock, P.D., Matsumoto, S., Jaman, R., Dubuisson, J.-Y. & Ito, M. (2004). Polyphyletic origin of *Microtrichomanes* (Prantl) Copel. (Hymenophyllaceae), with a revision of the species assigned to the genus. *Taxon* **53**: 935–948.
- Ebihara, A., Dubuisson, J.-Y., Iwatsuki, K., Hennequin, S. & Ito, M. (2006). A taxonomic revision of Hymenophyllaceae. *Blumea* **51**: 221–280.
- Ebihara, A., Iwatsuki, K., Ito, M., Hennequin, S. & Dubuisson, J.-Y. (2007). A global molecular phylogeny of the fern genus *Trichomanes* (Hymenophyllaceae) with special reference to stem anatomy. *Botanical Journal of the Linnean Society* **155**: 1–27.
- Field, A.R. (2020). Classification and typification of Australian lycophytes and ferns based on Pteridophyte Phylogeny Group classification PPG I. *Australian Systematic Botany* **33**: 1–102.
- Green, P.S. (1994). Hymenophyllaceae, in Wilson, A.J.G. (ed.), *Flora of Australia* **49**, pp. 557–561. Australian Government Publishing Service: Canberra.
- Hennequin, S., Ebihara, A., Ito, M., Iwatsuki, K. & Dubuisson, J.-Y. (2003). Molecular systematics of the fern genus *Hymenophyllum* s.l. (Hymenophyllaceae) based on chloroplastic coding and non-coding regions. *Molecular Phylogenetics and Evolution* **27**: 283–301.
- Hennequin, S., Ebihara, A., Ito, M., Iwatsuki, K. & Dubuisson, J.-Y. (2006). New insights into the phylogeny of the genus *Hymenophyllum* s.l. (Hymenophyllaceae): Revealing the polyphyly of *Mecodium*. *Systematic Botany* **31**: 271–284.
- Hennequin, S., Ebihara, A., Dubuisson, J.-Y. & Schneider, H. (2010). Chromosome number evolution in *Hymenophyllum* (Hymenophyllaceae), with special reference to the subgenus *Hymenophyllum*. *Molecular Phylogenetics and Evolution* **55**: 47–59.
- Iwatsuki, K. (1984). Studies in the systematics of filmy ferns VII. A scheme of classification based on the Asiatic species. *Acta Phytotaxonomica et Geobotanica* **35**: 165–179.
- Jiaxi L., Qiaoyan, Z., Ebihara, A. & Iwatsuki, K. (2013). Hymenophyllaceae, in Wu, Z.Y., Raven, P.H. & Hong, D.Y. (eds), *Flora of China*, **2–3** (Pteridophytes), pp. 93–109. Beijing Science Press: Beijing/Missouri Botanical Garden Press: St Louis.
- Morton, C.V. (1968). The genera, subgenera, and sections of the Hymenophyllaceae. *Contributions from the United States National Herbarium* **38**: 153–214.
- Pichi Sermolli, E.G. (1977). Tentamen pteridophytorum genera in taxonomicum ordinem redigendi. *Webbia* **31**: 315–512.
- PPG I (2016). A community-derived classification for extant lycophytes and ferns. *Journal of Systematics and Evolution* **54**: 563–603.
- Pryer, K.M., Smith, A.R., Hunt, J.S. & Dubuisson, J.-Y. (2001). *rbcl* data reveal two monophyletic groups of filmy ferns (Filicopsida: Hymenophyllaceae). *American Journal of Botany* **88**: 1118–1130.
- Schuettpelz, E. & Pryer, K.M. (2006). Reconciling extreme branch length differences: decoupling time and rate through the evolutionary history of filmy ferns. *Systematic Biology* **55**: 485–502.
- Smith, A.R., Pryer, K.M., Schuettpelz, E., Korall, P., Schneider, H. & Wolf, P.G. (2006). A classification for extant ferns. *Taxon* **55**: 705–731.
- Tindale, M.D. (1963). *Hymenophyllaceae, Contributions of the New South Wales National Herbarium, Flora Series* **201**: 1–49.