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New combinations in the fern genus *Leptochilus* (Polypodiaceae)

LIANG ZHANG[1, 2], LEI GUO[1, 3] & LI-BING ZHANG[4, *]
[1]*CAS Key Laboratory for Plant Diversity and Biogeography of East Asia, Kunming Institute of Botany, Chinese Academy of Sciences, Kunming, Yunnan 650201, China.*
[2]*Southeast Asia Biodiversity Research Institute, Chinese Academy of Sciences, Yezin, Nay Pyi Taw 05282, Myanmar.*
[3]*University of Chinese Academy of Sciences, Beijing 100049, China*
[4]*Missouri Botanical Garden, 4344 Shaw Blvd., St. Louis, Missouri 63110, U.S.A.; Chengdu Institute of Biology, Chinese Academy of Sciences, Chengdu, Sichuan, Chian.*
** Author for correspondence*: *Libing.Zhang@mobot.org*

Abstract

Following the results of a molecular phylogeny we made nine new combinations in *Leptochilus* based on morphological, ecological, and distributional evidence. The new combinations include: *Leptochilus chilangensis*, *L. chingii*, *L. dissimilialatus*, *L. evrardii*, *L. flexilobus*, *L. fluviatilis*, *L. pentaphyllus*, *L. poilanei*, and *L. saxicola*.

Keywords: *Colysis*, *Microsorum*, *Paraleptochilus*, Vietnam

Introduction

As the earliest published genus in microsoroid ferns, *Leptochilus* Kaulfuss (1824: 147) had been a monospecific genus containing only *L. axillaris* (Cavanilles 1799: 101) Kaulfus (1824: 147). The genus was then characterized by having epiphytic habit, simple sterile leaves, and much contracted fertile leaves fully covered with sori (acrostichoid sori). Further morphological studies on the genus and related genera of microsoroids indicated close relationships with *Colysis* C. Presl (1849: 146), *Microsorum* Link (1833: 110), and *Paraleptochilus* Copeland (1947: 198), which resulted in the inclusion of *Paraleptochilus* and some species of *Colysis* or *Microsorum* within *Leptochilus* (Bosman 1991, Nooteboom 1997, Fraser-Jenkins 2008). Most recently, *Leptochilus* has been estimated to contain 20–30 species (Zhang & Nooteboom 2013). Molecular phylogenetic studies indicated that most genera of microsoroids are paraphyletic, while the broadly defined monophyletic *Leptochilus* including *Colysis*, *Kontumia* S.K. Wu & K.L. Phan (2005: 245), and *Paraleptochilus* could be recognized (Dong *et al.* 2008, Kreier *et al.* 2008, Kim *et al.* 2012). Our most recent study on the molecular phylogeny of *Leptochilus* found highly divergent lineages within the genus (Zhang *et al.*, 2018). Together with morphological, ecological, and distribution information, we conclude that the species number of the genus is likely to double the most recent estimate. To translate our reconstructed phylogeny of *Leptochilus* into taxonomy, some overlooked species or mistreated synonyms or ranks in previous studies (Nooteboom 1997, Zhang & Nooteboom 2013) must be recognized as species.

Taxonomic treatment

Leptochilus chilangensis (V.N. Tu) Liang Zhang & Li Bing Zhang, *comb. nov.*
Basionym: *Colysis chilangensis* V.N. Tu (1980: 582).
Type:—VIETNAM. Lang Son Province: Chi Lang district, 14 September 1964, *Quy 72* (HN).

Notes:—This species is similar to *Leptochilus dissimilialatus* (Bonaparte 1923: 155) Liang Zhang & Li Bing Zhang in having pinnatifid fertile leaves, but differs from the latter in having smaller habit and simple sterile leaves with entire margins. This fern is endemic to karst regions of northern Vietnam.

The species was not sampled in our molecular phylogeny of *Leptochilus* (Zhang *et al.*, 2018) and it is recognized

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here based on the morphology. The elliptic and deeply pinnatifid fertile leaves support it as a member of the *L. ellipticus* clade.

Leptochilus chingii Liang Zhang & Li Bing Zhang, *nom. nov.*

≡*Colysis bonii* Ching (1933: 322), *Polypodium bonii* (Ching) Christ (1934: 145).

Type:—VIETNAM. Province unknown: "Tonkin," 9 January 1884, *Bon 2395* (holotype P-0626870!, isotypes BM-001054009; P-0626869!).

Notes:—When this species is transferred to *Leptochilus*, a new combination based on *Colysis bonii* Ching is blocked by *Leptochilus bonii* (Christ 1904: 610) C. Christensen (1906: 384). The new epithet is in honor of the late professor Ren-Chang Ching, one of the best renowned pteridologists, who carried out some carefully morphological studies on *Colysis*. This fern is most close to *Leptochilus pedunculatus* (Hooker & Greville 1827: TAB IV) Fraser-Jenkins (2008: 62), but differs from the latter in having leaves narrowly lanceolate, base shortly attenuate (Ching 1933), petioles shorter than or as long as laminae.

This species was resolved in the *Leptochilus ellipticus* clade as sister to a clade containing four samples similar to *L. pedunculatus* (Zhang *et al.*, 2018).

Leptochilus dissimilialatus (Bonap.) Liang Zhang & Li Bing Zhang, *comb. nov.*

Basionym: *Polypodium dissimilialatum* Bonaparte (1923: 155).

≡*Colysis dissimilialata* (Bonap.) Ching (1933: 330).

Type:—VIETNAM. Lào Cai Province: September 1919, *Eberhardt 5097* (lectotype P-00709503!, isolectotype BM-001038414!; **here designated**!).

Notes:—When *Polypodium dissimilialatum* was published, both *Eberhardt 5097* and *Eberhardt 5115* were cited without designating type specimen. This species is similar to *Leptochilus ellipticus* (Thunberg ex Murray 1784: 935) Nooteboom (1997: 283), but differs from the latter in having leaves distinct dimorphic, fertile leaves with lobes of more than 10 pairs, lobes narrow and long with large space each other. *Colysis morsei* (Ching 1931: 17) Ching (1933: 330) is endemic to southern Guangxi, China, which may be conspecific with *L. dissimilialatum*. This rare fern occurs in limestone mountains in northern Vietnam.

Our reconstructed phylogeny resolved three samples of *Leptochilus dissimilialatus* as sister to a clade formed by four samples of *L. flexilobus,* but weakly supported. Given the morphological difference between *L. dissimilialatum* and *L. flexilobus* mentioned above, we recognize both of the species.

Leptochilus evrardii **(**Tardieu**)** Liang Zhang & Li Bing Zhang, *comb. nov.*

Basionym: *Colysis evrardii* Tardieu (1940: 372).

Type:—VIETNAM. Lam Dong Province: Dalat, 17 December 1924, *Evrard 2250* (lectotype P-00709509!; **here designated**).

Notes:—When *Colysis evrardii* was published, both *Evrard 2250* and *Evrard 1921* were cited without designating its type. This fern is similar to *Leptochilus decurrens* Blume (1828: 206), but differs from the latter in having narrower sterile leaves and wider fertile leaves. It is also similar to *Colysis diversifolia* W.M. Zhu (1979: 93) and *Leptochilus ×beddomei* (Manickam & Irudayaraj 1997: 267) X.C. Zhang & Nooteboom (2013: 834) in having narrowly lanceolate fertile leaves with interrupted sori. However, the large leaves of *L. evrardii* are sterile, while the large leaves of *Colysis diversifolia* and *Leptochilus ×beddomei* often have irregularly scattered sori.

The species was resolved as a member of the *Colysis* clade (Zhang *et al.* 2018), and is most closely related to *L. decurrens*.

Leptochilus fluviatilis (Lauterb.) Liang Zhang & Li Bing Zhang, *comb. nov.*

Basionym: *Polypodium fluviatile* Lauterbach (1910: 507).

≡*Colysis fluviatilis* (Lauterb.) Ching (1933: 319), *Leptochilus macrophyllus* var. *fluviatilis* (Lauterb.) Nooteboom (1997: 289), *Pleopeltis fluviatilis* (Lauterb.) Alderwerelt (1917: 403).

Type:—MALAYSIA. Sarawak: 'Borneo. Zwischen Batu Babi und Lumowia', 10 July 1908, *Winkler 2830* (holotype B-200087499!; isotype L-0051793!).

Notes:—The species was treated as a variety of *Leptochilus macrophyllus* (1997: 286), or a synonym of *L. pedunculatus*

(Zhang & Nooteboom 2013). However, it differs from the latter two in having leaves strong dimorphic, fertile leaves 2–3 times longer than sterile leaves, petioles the same length as or much longer than laminae, laminae thin-herbaceous.

Our recent molecular study of *Leptochilus* did not sample this species. Based on the distinctly dimorphic leaves and the distribution of the species, we assume that it is a member of the *L. macrophyllus* clade.

Leptochilus flexilobus (Christ) Liang Zhang & Li Bing Zhang, *comb. nov.*

Basionym: *Polypodium flexilobum* Christ (1904: 107).

≡*Colysis elliptica* var. *flexiloba* (Christ) L. Shi & X.C. Zhang (1999: 74), *C. flexiloba* (Christ) Ching (1933: 330), *Leptochilus ellipticus* var. *flexilobus* (Christ) X. C. Zhang (2012: 652).

Type:—CHINA. Yunnan Province: Mengzhi County, *Henry 10769A* (holotype K-000959637!).

Notes:—This species was often treated as a synonym or a variety of *Leptochilus ellipticus* (e.g., Nooteboom 1997, Cheng *et al.* 2005, Zhang & Nooteboom 2013). However, our reconstructed phylogeny indicated that this species is more closely related to *L. dissimilialatum* and *L. digitatus* (1997: 282) than to *L. ellipticus* (Zhang *et al.*, 2018). *Leptochilus flexilobus* is distinguished in the genus by having rachis broadly winged and margins of pinnae often undulate-repand. It might occur in southern China and northern Vietnam only.

The species is apparently a member of the *L. ellipticus* clade (Zhang *et al.* 2018). In addition to *L. dissimilialatus*, the species is also similar to some species with entire to irregularly lobed leaves, e.g., *L. hemitomus*, *L. wrightii.*

Leptochilus pentaphyllus (Baker) Liang Zhang & Li Bing Zhang, *comb. nov.*

Basionym: *Gymnogramma pentaphylla* Baker (1898: 233).

≡*Colysis pentaphylla* (Baker) Ching (1933: 332), *Leptochilus ellipticus* var. *pentaphyllus* (Baker) X.C. Zhang & Nooteboom (2013: 837), *Polypodium ellipticum* var. *pentaphyllum* (Baker) C. Christensen (1906: 524), *Selliguea pentaphylla* (Baker) Christ (1906: 248).

Type:—CHINA. Yunnan Province: Mengzhi County, elev. 6000 feet, *Henry 9033* (holotype K-000959642!; isotypes E-00417694!, US-00345214!).

Notes:—This species is endemic to southern Yunnan, and was often treated as a synonym or a variety of *Leptochilus ellipticus* (e.g., Nooteboom, 1997; Zhang & Nooteboom, 2013), which is not supported by our phylogenetic analyses (Zhang *et al.*, 2018). This fern is most similar to *L. pothifolius* (Buchanan-Hamilton ex D. Don 1825: 13) Fraser-Jenkins (2008: 181) by having 1–3(4) pairs of large lobes, lobes up to 4 cm wide, but differs from the latter in having narrowly winged rachis.

The species was resolved as an isolated clade in *Leptochilus*. Its sister relationship with the *Colysis* clade was poorly supported (Zhang *et al.* 2018).

Leptochilus poilanei (C..Chr. & Tardieu) Liang Zhang & Li Bing Zhang, *comb. nov.*

Basionym: *Colysis poilanei* C. Christensen & Tardieu (1939: 201).

Type:—VIETNAM. Phu Hu Province: de Nhatrang, 19 January 1923, *Poilane 5373* (lectotype BM000036782!; **here designated!**).

Notes:—This fern is similar to *Leptochilus evrardii* and *L. decurrens* in having strongly dimorphic leaves, but differs from them in having both sterile and fertile leaves irregularly lobed.

The species was not included in our molecular phylogeny of *Leptochilus* but should be a member of the *Colysis* clade based on its strongly dimorphic leaves.

Leptochilus saxicola **(**H.G. Zhou & H. Li) Liang Zhang & Li Bing Zhang, *comb. nov.*

Basionym: *Colysis saxicola* H.G. Zhou & H. Li (1993: 253).

Type:—CHINA. Guangxi: Napo County, Nonghua, elev. 1100 m, *Hougao Zhou 2605* (holotype in GXAC; isotypes in PYU).

Notes:—The species was treated as a synonym of *Leptochilus pedunculatus* (Zhang & Nooteboom 2013), but differs later in having monomorphic leaves, lamina base slightly lobed. The species is most similar to *L.* × *hemitomus* (Hance 1883: 269) Nooteboom (1997: 293), differs later in having lamina base cordate, lower lamina margins slightly lobed or entire, and laminae chartaceous. This rare fern occurs in limestone mountains in Guangxi Province of southern China and Bac Kan Province of northern Vietnam.

The species was resolved much more closely related to *Leptochilus dissimilialatus* and *L. flexilobus* than to *L. hemitomus.*

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