

Transfer of two Asiatic taxa from *Lejeunea* to *Microlejeunea* (Lejeuneaceae, Marchantiophyta)

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Abstract – Two Asiatic *Lejeunea* species with ocelli in the leaf lobe, *Lejeunea moniliata* Mizut. and *Lejeunea wallichiana* (Lehm.) Lehm. ex Gottsche, Lindenb. et Nees, are transferred to *Microlejeunea* (Lejeuneaceae, Marchantiophyta). Two new combinations are proposed: *Microlejeunea moniliata* (Mizut.) R.L.Zhu et Y.M.Weï comb. nov. and *Microlejeunea wallichiana* (Lehm.) R.L.Zhu et Y.M.Weï comb. nov. *Microlejeunea moniliata* is only known from the type locality in northern Thailand, where it was rediscovered in 2011, and is suggested to be placed in the red list of Thai bryophytes.

Hepaticae / *Lejeunea moniliata* / *Lejeunea wallichiana* / liverworts / red list / Thailand

INTRODUCTION

The systematic position of the pantropical genus *Microlejeunea* Steph. has long been controversial. Some authors (e.g., Jovet-Ast, 1958; Bischler *et al.*, 1963; Grolle, 1995; Gradstein *et al.*, 2003; Crandall-Stotler *et al.*, 2009; Ah-Peng & Bardat, 2011; He & Zhu, 2011; Lavocat & Schäfer-Verwimp, 2011; Thouvenot *et al.*, 2011; Marline *et al.*, 2012; Thiers *et al.*, 2012) treated *Microlejeunea* as a separate genus, whereas Schuster (1955, 1963, 1980, 2001), Piippo (1990), Dey *et al.* (2008), and Katagiri & Furuki (2012) placed it in *Lejeunea* Libert. A recent molecular phylogenetic study confirmed that *Microlejeunea* is a good genus (Dong *et al.*, 2013). *Microlejeunea* is well characterized and easily separated from *Lejeunea* by the presence of ocelli in the leaf lobe, transverse section of stem consisting of seven cortical cells and three medullary cells, and keel of female bract usually winged. Our examination of Asian *Lejeunea* taxa reveals that *Lejeunea moniliata* Mizut., endemic to Thailand (Mizutani, 1979; Lai *et al.*, 2008), and *Lejeunea wallichiana* (Lehm.) Gottsche *et al.* from the Himalayas (Zhu & Long, 2003) share the above mentioned important characters of *Microlejeunea*. Moreover, our unpublished molecular data (ITS, *trnG* and *trnL-F*; Wei & Zhu, in prep.) showed that *L. moniliata*, *L. wallichiana* and other *Microlejeunea* species form a monophyletic lineage. Therefore, the following new combinations are necessary.

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TAXONOMIC TREATMENT

Microlejeunea moniliata (Mizut.) R.L.Zhu et Y.M.We, *comb. nov.*

Basionym: *Lejeunea moniliata* Mizut., *J. Hattori Bot. Lab.* 46: 357. 1979.

Type: Thailand. Payap, Mt. Chiengdao, 1900-2100 m, on tree trunk and branches, 1965, A. Touw 9313 (holotype: L!).

Representative specimens examined: Thailand. Chiang Mai, Doi Luang Chiang Dao, camping area, on evergreen shrub trunk, 19°39'314"N, 99°89'013"E, 2070 m, Dec. 2011, R.-L. Zhu 20111219-16B (HSNU); *ibid.*, on tree trunk, 19°39'247"N, 99°89'034"E, 2012 m, R.-L. Zhu 20111219-20A (HSNU); on tree branch, 19°23'620"N, 98°53'383"E, 2033 m, R.-L. Zhu 20111219-53B (HSNU).

Microlejeunea wallichiana (Lehm.) R.L.Zhu et Y.M.We, *comb. nov.*

Basionym: *Jungermannia wallichiana* Lehm., *Nov. Min. Cogn. Strip. Pupil.* 3: 5. 1831.

Type: India Orient., *Wallich s.n.* (holotype: S; isotype: G-008145!).

≡ *Lejeunea wallichiana* (Lehm.) Lehm. ex Gottsche, *Lindenb. et Nees, Syn. Hepat.:* 361, 1845.

= *Lejeunea appendiculata* Mitt., *J. Proc. Linn. Soc., Bot.* 5: 113. 1861 "1860". ≡ *Pycnolejeunea appendiculata* (Mitt.) Steph., *Sp. Hepat.* 5: 636. 1914. **Type:** India. Sikkim, Chongtam, 6000 ft, s.d., *J.D. Hooker & T. Thomson s.n.* (holotype: NY!). = *Microlejeunea longirostris* Steph., *Sp. Hepat.* 6: 422. 1923 ≡ *Lejeunea longirostris* (Steph.) H.A.Mill. et al., *Nova Hedwigia* 14: 67. 1967. "non *Lejeunea longirostris* Spruce 1884". **Type:** India. "India Himalaya". 7000 ft., s.d., *J.D. Hooker s.n.* (holotype: G-16250!).

Representative specimens examined: India. Sikkim, North District, N of Lachung, 27°43'11" N, 88°45'07" E, on trunk of *Daphniphyllum*, 3040 m, 15 July 1996, *D.G. Long* 26480 (E); Nepal. Terathum District, forested slope above Chauki, N side of Tinjure Dana, 27°12'11" N, 87°28' E, ravine in partly cleared *Rhododendron arboreum/Quercus semecarpifolia* forest, on twigs of shrub, 2690 m, 26 Oct. 1991, *D.G. Long* 21607-e (HSNU); Terathum District, Tinjure Danda ridge between Door Pani and Chauki, 27°10' N, 87°26' E, open hillside, on stem of *Elsholtzia*, 2960 m, *D. G. Long* 16480 (HSNU); Sankhuwasabha District, E side of Arun Valley, Chichila, 27°26' N, 87°12' E, mossy *Castanopsis* forest, on twigs in dense thicket, 1890 m, 20 Sept. 1991, *D.G. Long* 20248-a (E).

DISCUSSION

The clarification of the systematic relationships of *Lejeunea* and related genera has become one of the main challenges for Lejeuneaceae research (Ye *et al.*, 2013). The genus *Lejeunea* contains five unusual species with ocelli in leaf lobes, including the neotropical *L. huctumalcensis* Lindenb. et Gottsche (Reiner-Drehwald & Ilkiu-Borges, 2007), Indian *L. indica* Udar et U.S.Awasthi (Udar & Awasthi, 1981), Japanese *L. minutilobula* (Amakawa) X.L.He (Amakawa, 1960 as *Cheilolejeunea minutilobula*; He, 1999), Himalayan *L. wallichiana* (Lehm.) Lehm. ex Gottsche (Mizutani, 1964; Zhu & Long, 2003), and *L. moniliata* Mizut. endemic to Thailand (Mizutani, 1979; Lai *et al.*, 2008). Recent studies on molecular phylogeny of the complex *Harpalejeunea*, *Lejeunea*

and *Microlejeunea* (Dong *et al.*, 2013) did not contain the above-mentioned taxa. Our studies reveal that none of these species belong to *Lejeunea*. Two of them, *Lejeunea moniliata* and *L. wallichiana*, are treated here. The systematic position of the three remaining species will be published in separate papers.

Microlejeunea moniliata is very remarkable owing to its moniliate ocelli of the leaf lobe (Figs 2-3). It was originally described by Mizutani (1979), based on



Figs 1-3. **1.** The camping area of Doi Luang Chiang Dao, Chiang Mai, Thailand where *Microlejeunea moniliata* (Mizut.) R.L.Zhu *et* Y.M.Wei was found on tree trunks, shrub trunk and tree branches by R.-L. Zhu (front row right) and local bryologists (S. Chantanaorrapint, N. Printarakul, S. Kornochalert, front row, left to right) in December 2011. **2-3.** *Microlejeunea moniliata* (Mizut.) R.L.Zhu *et* Y.M.Wei. **2.** Habit. **3.** Portion of plant showing moniliate ocelli, dorsal view. All from R.-L. Zhu 20111219-20A.

a single collection made by A. Touw in northern Thailand in 1965. Recent detailed investigations have reported many new species and new records of bryophytes from northern Thailand (Akiyama & Furuki, 2011; He *et al.*, 2012; Kornochalart *et al.*, 2012; Printarakul *et al.*, 2012). *Microlejeunea moniliata*, however, remains known only from the type locality in Doi Luang Chiang Dao, northern Thailand, where it was recollected by the second author in December 2011 (Fig. 1). Therefore, we recommend that this species be protected locally and placed in the red list of Thai bryophytes. The species grows on tree trunks, tree branches and shrubs in dry evergreen forests at altitudes of 1900–2100 m. An intensive search for *M. moniliata* in Thailand and neighboring countries would be desirable to unravel further occurrences and potential habitats and to determine the actual range and conservational status of this species.

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REFERENCES

- AKIYAMA H. & FURUKI T., 2011 — Alphabetical list of bryophytes occurring in a 15 ha long-term monitoring plot at Doi Inthan, Northern Thailand. *Bryological research* 10: 153–106.
- AMAKAWA T., 1960 — Notes on Japanese Hepaticae. II. *Journal of Japanese botany* 35: 363–368.
- AH-PENG C. & BARDAT J., 2011 — *Microlejeunea strasbergii* sp. nov. (Lejeuneaceae) from Réunion Island (Mascarenes). *The bryologist* 114: 668–673.
- BISCHLER H., BONNER C.E.B. & MILLER H.A., 1963 — Studies in Lejeuneaceae VI. The genus *Microlejeunea* Steph. in Central and South America. *Nova Hedwigia* 5: 359–411.
- CRANDALL-STOTLER B., STOTLER R. & LONG D.G., 2009 — Phylogeny and classification of the Marchantiophyta. *Edinburgh journal of botany* 66: 155–198.
- DEY M., SINGH D.K. & SINGH D., 2008 — Two new species of *Lejeunea* Lib. (Hepaticae: Lejeuneaceae) from Sikkim, India. *Journal of bryology* 30: 126–132.
- DONG S.S., SCHÄFER-VERWIMP A., PÓCS T., FELDBERG K., CZUMAJ A., SCHMIDT A.R., SCHNEIDER H. & HEINRICHS J., 2013 — Size doesn't matter—recircumscription of *Microlejeunea* (Lejeuneaceae, Porellales) based on molecular and morphological evidence. *Phytotaxa* 85: 41–45.
- GRADSTEIN S.R., REINER-DREHWALD M.E. & SCHNEIDER H., 2003 — A phylogenetic analysis of the genera of Lejeuneaceae (Hepaticae). *Botanical journal of the Linnean society* 143: 391–410.
- GROLLE R., 1995 — The Hepaticae and Anthocerotae of the East African Islands: An Annotated Catalogue. *Bryophytorum bibliotheca* 48: 1–178.
- HE Q. & ZHU R.-L., 2011 — Spore output in selected species of Lejeuneaceae (Marchantiophyta) from China. *Cryptogamie, Bryologie* 32: 107–112.
- HE Q., ZHU R.-L., CHANTANAORRAPINT S., KORNOCHALERT S. & PRINTARAKUL N., 2012 — *Drepanolejeunea laciniata* (Lejeuneaceae), a new species from northern Thailand. *Cryptogamie, Bryologie* 33: 291–298.
- HE X.-L., 1999 — A taxonomic monograph of the genus *Pycnolejeunea* (Lejeuneaceae, Hepaticae). *Acta botanica Fennica* 163: 1–77.
- JOVET-AST S., 1958 — Un *Microlejeunea* nouveau de l'île de la Réunion. *Revue bryologique et lichénologique* 27: 191–194.
- KATAGIRI T. & FURUKI T., 2012 — Checklist of Japanese liverworts and hornworts, 2012. *Bryological research* 10: 193–210.
- KORNOCHALERT S., SANTANACHOTE K. & WANG J., 2012 — Lejeuneaceae subfamily Ptychanthoideae (Marchantiophyta) in Thailand. *Cryptogamie, Bryologie* 33: 39–63.

- LAI M.-J., ZHU R.-L. & CHANTANORRAPINT S., 2008 — Liverworts and Hornworts of Thailand: an updated checklist and bryofloristic accounts. *Annales botanici Fennici* 45: 331-341.
- LAVOCAT E. & SCHAFFER-VERWIMP A., 2011 — Checklist of the bryophytes of the Guadeloupe archipelago and Martinique (French West Indies). *Cryptogamie, Bryologie* 32: 232-272.
- MARLINE L., ANDRIAMIARISOA R.L., BARDAT J., CHUAH-PETIOT M., HEDDERSON T.A.J., REEB C., STRASBERG D., WILDING N. & AH-PENG C., 2012 — Checklist of the bryophytes of Madagascar. *Cryptogamie, Bryologie* 33: 199-255.
- MIZUTANI M., 1964 — Studies of little known Asiatic species of Hepaticae in the Stephani Herbarium. 1. On some little known southeast Asiatic species of the family Lejeuneaceae. *Journal of the Hattori botanical laboratory* 27: 139-148.
- MIZUTANI M., 1979 — Notes on the Lejeuneaceae. 2. Some peculiar Asiatic species in the Rijksherbarium, Leiden. *Journal of the Hattori botanical laboratory* 46: 357-372.
- PIIPPO S., 1990 — Annotated catalogue of Chinese Hepaticae and Anthocerotae. *Journal of the Hattori botanical laboratory* 68: 1-192.
- PRINTARAKUL N., TAN B.C., SANTANACHOTE K. & WONGKUNA K., 2012 — Ten new records of mosses from Doi Suthep-Pui National Park and *Fissidens flaccidus* var. *percurrans* (Fissidentaceae) var. nov. for Thailand. *Cryptogamie, Bryologie* 33: 23-31.
- REINER-DREHWALD M.E. & ILKIU-BORGES A. L., 2007 — *Lejeunea huctumalcensis*, a widely distributed Lejeuneaceae from the Neotropics, and its relation to *Ceratolejeunea*. *The bryologist* 110: 65-474.
- SCHUSTER R.M., 1955 — North American Lejeuneaceae. I. Introduction; keys to subfamilies and genera. *Journal of the Elisha Mitchell scientific society* 71: 106-126.
- SCHUSTER R.M., 1963 — An annotated synopsis of the genera and subgenera of Lejeuneaceae. I. Introduction; annotated keys to subfamilies and genera. *Nova Hedwigia Beiheft* 9: 1-203.
- SCHUSTER R.M., 1980 — *The Hepaticae and Anthocerotae of North America*. IV. New York: Columbia University Press, 133 p.
- SCHUSTER R.M., 2001 — Studies on Lejeuneaceae, IV. On the circumscription and subdivision of the subfamily Lejeuneoideae. *Journal of the Hattori botanical laboratory* 91: 137-172.
- THIERS B.M., SÖDERSTRÖM L., HAGBORG A. & VON KONRAT M., 2012 — Notes on early land plants today. 11. *Microlejeunea bischlerae* (B.M. Thiers) comb. nov. *Phytotaxa* 65: 59.
- THOUVENOT L., GRADSTEIN S.R., HAGBORG A., SÖDERSTRÖM L. & BARDAT J., 2011 — Checklist of the liverworts and hornworts of New Caledonia. *Cryptogamie, Bryologie* 32: 287-390.
- UDAR R. & AWASTHI U.S., 1981 — A new species of *Lejeunea* from India. *Cryptogamie, Bryologie Lichénologie* 2: 345-348.
- YE W., WEI Y.-M., SCHÄFER-VERWIMP A. & ZHU R.-L., 2013. — Phylogenetic position of *Oryzolejeunea* (Lejeuneaceae, Marchantiophyta): Evidence from molecular markers and morphology. *Journal of systematics and evolution*. In press.
- ZHU R.-L. & LONG D.G., 2003 — Lejeuneaceae (Hepaticae) from several recent collections from the Himalaya. *Journal of the Hattori botanical laboratory* 93: 101-115.