



Taxonomic changes in Marchantiaceae, Corsiniaceae and Cleveaceae (Marchantiidae, Marchantiophyta)

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Molecular phylogenetic studies of complex thalloid liverworts have resolved relationships that require taxonomic and nomenclatural changes. Since *Bucegia* and *Preissia* are deeply nested within *Marchantia*, species formerly placed in these genera are transferred to *Marchantia* as *Marchantia romanica*, *comb. nov.* and *Marchantia quadrata*, respectively, and placed in the new subgenus, *Marchantia* subg. *Preissia*, *comb. et stat. nov.* The families Exormothecaceae and Corsiniaceae are merged under the earlier name Corsiniaceae. The genus *Stephensiella* Kashyap becomes a synonym of *Exormotheca* and its sole species *S. brevipedunculata* is transferred to *Exormotheca*, with the new combination *Exormotheca brevipedunculata*. In the Cleveaceae, the recent recognition of *Clevea* as distinct from *Athalamia*, necessitates the new combination *Clevea nana* to replace the name *Clevea hyalina* on the basis of nomenclatural priority.

Key words: complex thalloid liverworts, *Athalamia*, *Bucegia*, *Clevea*, *Exormotheca*, *Marchantia*, *Preissia*, *Stephensiella*.

Introduction

In a recent phylogenetic study of the complex thalloid liverworts by Villarreal et al. (2015), considerable advances have been made over the earlier study by Forrest et al. (2006), both in terms of the extended set of genetic markers used and in the number of taxa sampled—all currently accepted genera were included in the study. The results of this study demonstrate some modifications to earlier classifications, and necessitate some taxonomic refinements. Those requiring formal changes are dealt with here.

1. Marchantiaceae (Bischler) Lindley

Until very recently the family Marchantiaceae was considered to contain five genera, *Bucegia* Radian (1903: 3), *Dumortiera* Nees in Reinwardt et al. (1824: 410), *Marchantia* Linnaeus (1753: 1137), *Neohodgsonia* Persson (1954: 40) and *Preissia* Corda (1829: 647) (see e.g., Schuster 1980, 1992; Bischler 1998), though Grolle (1983) had removed *Dumortiera* to Wiesnerellaceae along with *Wiesnerella* Schiffner (1896: 86). The recent transfer of *Dumortiera* to a new family Dumortieraceae within Order Marchantiales and the removal of *Neohodgsonia* to its own family Neohodgsoniaceae in a new order Neohodgsoniales by Long (2006) were both based on molecular data reported by Forrest et al. (2006). This change left *Bucegia* and *Preissia* along with *Marchantia* as the residual genera within Marchantiaceae. In the latter paper, the genus *Preissia* was nested within *Marchantia*. However, because only four accessions, representing four species of *Marchantia*, were included in that study, and *Bucegia* was not represented, re-alignment of the remaining three genera in the family was considered premature at that time.

In the new study (Villarreal et al. 2015) ten accessions, representing five species and all three subgenera of *Marchantia*, were included, along with two accessions of *Bucegia* and two of *Preissia*. The resulting tree supports fully the earlier exclusion of *Dumortiera* and *Neohodgsonia* from Marchantiaceae, and resolves *Bucegia* and *Preissia* in a separate clade that is nested within a well-supported monophyletic *Marchantia*. The Marchantiaceae, therefore, is herein circumscribed to include but the single genus *Marchantia*, with *Bucegia* and *Preissia* as new generic synonyms. This synonymy is supported not only by molecular data, but also by the many shared morphological characters of these taxa. The subdivision of Marchantiaceae into two subfamilies Marchantioideae and Bucegioideae Schuster (Grolle, 1983; Schuster, 1992) becomes superfluous.

Generic synonymy

Marchantia Linnaeus (1753: 1137). Lectotype: *M. polymorpha* Linnaeus (1753:1137).

= *Preissia* Corda (1829: 647), *syn. nov.* Type:—*Preissia italica* Corda (1829: 647) [= *Marchantia quadrata* Scopoli (1772: 355)].

= *Bucegia* Radian (1903: 3), *syn. nov.* Type:—*Bucegia romanica* Radian (1903: 4).

A new subgenus *Preissia* of *Marchantia*

The genus *Marchantia* has been recognised for over 300 years and is one of the most familiar of all liverworts, particularly *M. polymorpha* L. subsp. *ruderalis* Bischler-Causse & Boisselier-Dubayle (1991: 364), which grows in disturbed anthropogenic habitats throughout Europe and other continents (Bowman, 2015). Söderström et al. (2016) list 36 accepted species of *Marchantia*. The genus as recently circumscribed is subdivided into three subgenera: subg. *Marchantia*, subg. *Chlamidium* (Corda 1829: 647) Bischler (1982: 362) and subg. *Protomarchantia* Schuster (1985: 410) (see Bischler-Causse, 1989; Schuster, 1992). All three subgenera were represented in the molecular study of Villarreal et al. (2015) as follows: in *M.* subg. *Marchantia*, all three subspecies of *M. polymorpha* and a single accession of unspecified *M. polymorpha* from GenBank; in *M.* subg. *Protomarchantia*, *M. subintegra* Mitten (1860:125); and in *M.* subg. *Chlamidium*, *M. paleacea* Bertoloni (1817: 242), *M. chenopoda* Linnaeus (1753: 1137) and 2 accessions of *M. inflexa* Nees et Montagne (Montagne 1838: 43). In addition, a single accession of a new, as yet unnamed *Preissia*-like taxon that was labelled ‘*Marchantia* sp. China’ in the analysis, was also included. In the analysis, *M.* subg. *Chlamidium* is resolved as paraphyletic, but realignment of taxa in this subgenus must await more extensive taxon sampling. At the same time, however, *Bucegia* and *Preissia* are resolved as sister groups in a well defined, monophyletic lineage that is sister to but separate from the lineage that contains most, but not all of the species in *M.* subg. *Chlamidium*, in a topology that mirrors that obtained by Boisselier-Dubayle et al. (2002: fig. 2). Further, the unnamed new taxon from China, which will be described in another paper in preparation, is nested in the *Preissia* lineage. These results support the change of status for *Preissia* and its establishment as a new subgenus of *Marchantia*, as follows:

Marchantia Linnaeus (1753: 1137) subg. ***Preissia*** Corda (1829: 647) D.G.Long, Crandall-Stotler, L.L.Forrest & Villarreal, *comb. et stat. nov.*

Basionym:—*Preissia* Corda (1829: 647) in Opiz (ed.), Type:—*Marchantia quadrata* Scopoli (1772: 355).

Marchantia subg. *Preissia* differs from the other three subgenera of *Marchantia* in lacking gemma-cups and gemmae on the thalli, bearing only two rows of ventral scales, and having the antheridiophore disc unlobed, archegoniophore with shortly lobed receptacle, and archegoniophore stalk with 2 rhizoid furrows and without an assimilatory strip with air chambers.

This subgenus currently contains two species, *M. quadrata* and *M. romanica*.

Marchantia quadrata Scopoli (1772: 355) ≡ *Preissia quadrata* (Scopoli 1772:355) Nees (1838: 135)

Marchantia romanica Radian (1903: 4) D.G.Long, Crandall-Stotler, L.L.Forrest & Villarreal, *comb. nov.*

Basionym:—*Bucegia romanica* (Radian 1903: 4)

2. Corsiniaceae Engler

The molecular phylogeny published by Villarreal et al. (2015) shows that the genus *Exormotheca* Mitten (1870: 325) the type of Exormothecaceae Müll.Frib. ex Grolle (Grolle, 1972), is nested within Corsiniaceae Engler and for this reason the two families must be united under the earlier family name, Corsiniaceae. In addition to the sequence data, the merger is supported by spore ornamentation (Bischler, 1998). Furthermore, *Stephensiella brevipedunculata* (Kashyap 1914: 312) is nested within *Exormotheca* and the genus must be treated as a synonym. This necessitates the new combination *Exormotheca brevipedunculata* Kashyap (1914: 312) D.G.Long, Crandall-Stotler, L.L.Forrest & Villarreal. This transfer is also supported by spore ornamentation (Bischler, 1998).

Corsiniaceae Engler, Syllabus der Vorlesungen über specielle und medicinisch-pharmaceutische Botanik 44, 1892.

= Exormothecaceae Müll.Frib. ex Grolle, Journal of Bryology 7: 208, 1972, *syn. nov.*

Exormotheca Mitten, Natural History of the Azores, or Western Islands 325, 1870.

= *Stephensiella* Kashyap, New Phytologist 13: 312. 1914, *syn. nov.*

Exormotheca brevipedunculata (Kashyap) D.G.Long, Crandall-Stotler, L.L.Forrest & Villarreal, *comb. nov.*

Basionym:—*Stephensoniella brevipedunculata* Kashyap, *New Phytologist* 13: 312. 1914.

3. Cleveaceae Cavers

Rubasinghe et al. (2011) demonstrated that *Athalamia* Falconer (1848: 375) and *Clevea* Lindberg (1868: 289), previously treated as synonyms, should be recognized as distinct genera, raising the number of genera in the Cleveaceae to four. As a consequence, the genus *Athalamia sensu stricto* was recognized to contain a single species and the genus *Clevea*, three species, including the generitype, *C. hyalina* (Sommerfelt 1833: 234) Lindberg 1868: 291 [\equiv *Athalamia hyalina* (Sommerfelt) S.Hattori in Shimizu & S. Hattori (1954: 54)]. Unfortunately, Rubasinghe et al. (2011) overlooked the earlier name *Fimbriaria nana* Lindenberg (1829: 109), which Grolle (1981: 325), after study of the type specimen, concluded should be synonymized with *Athalamia hyalina*. *Fimbriaria nana* Lindenberg was published in 1829, four years earlier than *Marchantia hyalina* Sommerfelt (1833: 234), published in 1833. The epithet “*nana*” was blocked for use in the genus *Athalamia*, however, due to the existence of *Athalamia nana* (Shimizu & S.Hattori 1953: 34) S.Hattori in Shimizu & S. Hattori (1954: 56), but in the genus *Clevea* the epithet “*nana*” is available for use and the new combination *Clevea nana* (Lindenberg) Crandall-Stotler & D.G.Long is therefore made to replace *C. hyalina*, as mandated by Article 11.4 of the ICN (McNeill et al., 2012). Given the long history of use of the epithet “*hyalina*” for this taxon, whether in *Clevea* or *Athalamia*, a proposal to conserve *Clevea hyalina* (Sommerfelt) Lindberg over *Clevea nana* (Lindenberg) Crandall-Stotler & D.G.Long is in preparation. However, until conservation has been actually approved, the correct name for this taxon is *Clevea nana* (Lindenberg) Crandall-Stotler & D.G.Long.

Clevea nana (Lindenberg 1829: 291) Crandall-Stotler & D.G.Long, *comb. nov.*

Basionym:—*Fimbriaria nana* Lindenb., *Nov. Acta Phys.-Med. Acad. Caes. Leop.-Carol. Nat. Cur.* 14 (Suppl.), 109, 1829.

= *Marchantia hyalina* Sommerfelt, *Magazin Naturvidensk. (Christiana) II. Ser., I, fasc. 2: 234, 1833, syn.nov.*

= *Clevea hyalina* (Sommerfelt) Lindberg, *Not. Sällsk. pro Fauna et Flora Fennica* 9:291, 1868.

= *Athalamia hyalina* (Sommerfelt) S. Hattori, *J. Hattori Bot. Lab.* 12: 54, 1954.

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References

- Bertoloni, A. (1817) Fine delle osservazioni botaniche. *Opuscoli Scientifici* 1: 229–243.
- Bischler, H. (1982) *Marchantia* L.: morphologie sporale, germination et rang taxonomique des sections *Marchantia* et *Chlamidium* (Corda) Nees. *Cryptogamie Bryologie, Lichénologie* 3: 351–364.
- Bischler, H. (1998) Systematics and evolution of the genera of the Marchantiales. *Bryophytorum Bibliotheca* 51: 1–201
- Bischler-Causse, H. (1989) *Marchantia* L. The Asiatic and Oceanic taxa. *Bryophytorum Bibliotheca* 38: 1–317.
- Bischler-Causse, H. & Boisselier-Dubayle, M.C. (1991) Lectotypification of *Marchantia polymorpha* L. *Journal of Bryology* 16: 361–365.
<http://dx.doi.org/10.1179/jbr.1991.16.3.361>
- Boisselier-Dubayle, M.C., Lambourdière, J. & Bischler, H. (2002) Molecular phylogenies support multiple morphological reductions in the liverwort subclass Marchantiidae (Bryophyta). *Molecular Phylogenetics & Evolution* 24: 66–77.
[http://dx.doi.org/10.1016/S1055-7903\(02\)00201-4](http://dx.doi.org/10.1016/S1055-7903(02)00201-4)
- Bowman, J.L. (2015) A brief history of *Marchantia* from Greece to genomics. *Plant Cell Physiology* pii: pcv044.
<http://dx.doi.org/10.1093/pcp/pcv044>
- Corda, A.J.C. (1829) Genera Hepaticarum. In: Opiz, P.M. (Ed.) *Beiträge zur Naturgeschichte als Fortsetzung des Naturalientausches No. 12*. C.W. Enders, Praha, pp. 643–655.
- Falconer, H. (1848) Description of *Athalamia*, a new genus of *Marchantieae*. *Annals and Magazine of Natural History* 1: 375.
- Forrest, L.L., Davis, E.C., Long, D.G., Crandall-Stotler, B.J., Hollingsworth, M.L. & Clark, A. (2006) Unravelling the evolutionary history of the liverworts (Marchantiophyta) – multiple taxa, genomes and analyses. *Bryologist* 109: 303–334.
[http://dx.doi.org/10.1639/0007-2745\(2006\)109\[303:UTEHOT\]2.0.CO;2](http://dx.doi.org/10.1639/0007-2745(2006)109[303:UTEHOT]2.0.CO;2)
- Grolle, R. (1972) Die Namen der Familien und Unterfamilien der Lebermoose (Hepaticopsida). *Journal of Bryology* 7: 201–236.
<http://dx.doi.org/10.1179/jbr.1972.7.2.201>

- Grolle, R. (1981 '1980') Miscellanea hepaticologica 201–210. *Journal of Bryology* 11: 325–334.
<http://dx.doi.org/10.1179/jbr.1980.11.2.325>
- Grolle R. (1983) Nomina generica Hepaticarum; references, types & synonyms. *Acta Botanica Fennica* 121: 1–62.
- Kashyap, S.R. (1914) Morphological and biological notes on new and little known West Himalayan liverworts. II. *New Phytologist* 13: 308–323.
<http://dx.doi.org/10.1111/j.1469-8137.1914.tb05760.x>
- Lindberg, S.O. (1868) Musci Novi Scandinavici. *Notiser ur Sällskapet pro Fauna et Flora Fennica Förhandlingar* 9: 253–299.3.
- Lindenberg, J.B.W. (1829) *Synopsis Hepaticarum Europaeorum*. Eduard Weberum, Bonnae, pp. 1–133.
- Linnaeus, C. (1753) *Species Plantarum, ed. 1*. Laurentii Salvii, Holmiae [Stockholm], 1200 pp.
- Long, D.G. (2006) New higher taxa of complex thalloid liverworts (Marchantiophyta - Marchantiopsida). *Edinburgh Journal of Botany* 63: 57–62.
<http://dx.doi.org/10.1017/S0960428606000606>
- McNeill, J., Barrie, F.R., Buck, W.R., Demoulin, V., Greuter, W., Hawksworth, D.L., Herendeen, P.S., Knapp, S., Marhold, K., Prado, J., Pridmore, I.A., Reiche, W.F., Smith, G.F., Wiersema, J.H. & Turland, N.J. (Eds.) (2012) *International Code of Nomenclature for Algae, Fungi, and Plants (Melbourne Code)*. Adopted by the Eighteenth International Botanical Congress Melbourne, Australia, July 2011. Koeltz Scientific Books, Königstein, Germany. [Regnum Vegetabile 154]
- Mitten, W. (1860) Hepaticae Indiae Orientalis. *Journal of the Proceedings of the Linnean Society, Botany* 5: 89–128.
- Mitten, W. (1870) Hepaticae. In: Godman, F. (Ed.) *Natural history of the Azores, or Western Islands*. John Van Voorst, London, pp. 316–328.
- Montagne, J.F.C. (1838) Centurie de plantes cellulaires exotiques nouvelles (suite). *Annales des Sciences Naturelles, Botanique (sér. 2)* 9: 38–57.
- Nees, C.G. (1838) *Naturgeschichte der Europäischen Lebermoose mit besonderer Beziehung auf Schlesien und die Oertlichebkeiten des Riesengebirgs, vol. 4*. Grass, Barth & Co., Breslau, 539 pp.
- Persson, H. (1954) On *Neohodgsonia* H. Perss. the new hepatic genus from New Zealand and Tristan da Cunha. *Botaniska Notiser* 107: 39–44.
- Radian, S.S. (1903) Sur le *Bucegia* nouveau genre d'hépatiques à thalle. *Bulletin de l'Herbier de l'Institut Botanique de Bucarest* 3–4: 1–7.
- Reinwardt, C.G.C., Blume, C.L. & Nees von Esenbeck, C.G. (1824) Hepaticarum Iavanicarum, in hoc volumine a pag. 181–258 illustratarum, supplementum. *Nova Acta Physico-Medica Academiae Caesareae Leopoldino-Carolinae Naturae Curiosorum* 12: 409–417.
- Rubasinghe, S.C.K., Milne, R., Forrest, L.L. & Long, D.G. (2011) Realignment of the genera of Cleveaceae (Marchantiopsida, Marchantiidae). *Bryologist* 114: 116–127.
<http://dx.doi.org/10.1639/0007-2745-114.1.116>
- Schiffner, V. (1896) *Wiesnerella*, eine neue Gattung der Marchantiaceen. *Österreichische Botanische Zeitschrift* 46: 82–88.
<http://dx.doi.org/10.1007/BF01677836>
- Schuster, R.M. (1980) The phylogeny of the Hepaticae. In: Clarke, G.C.S. & Duckett, J.G. (Eds.) *Systematics Association Special Volume* 14: 41–82.
- Schuster, R.M. (1985) Some new taxa of Hepaticae. *Phytologia* 57: 408–414.
- Schuster, R.M. (1992) *The Hepaticae and Anthocerotae of North America* Vol. 6. Chicago: Field Museum of Natural History.
- Scopoli, J.A. (1772) *Flora carniolica. Tom. II. Editio secunda*. Joannis Pauli Krauss, Viennae, 496 pp.
- Shimizu, D. & Hattori, S. (1953) Marchantiales of Japan, I. *Journal of the Hattori Botanical Laboratory* 9: 32–44.
- Shimizu, D. & Hattori, S. (1954) Marchantiales of Japan, III. *Journal of the Hattori Botanical Laboratory* 12: 53–75.
- Söderström, L., Hagborg, A., von Konrat, M., Bartholomew-Began, S., Bell, D., Briscoe, L., Brown, E., Cargill, D.C., Costa, D.P., Crandall-Stotler, B.J., Cooper, E.D., Dauphin, G., Engel, J.J., Feldberg, K., Glenny, D., Gradstein, S.R., He, X., Ilkiu-Borges, A.L., Heinrichs, J., Hentschel, J., Katagiri, T., Konstantinova, N.A., Larrain, J., Long, D.G., Nebel, M., Pócs, T., Puche, F., Reiner-Drehwald, M.E., Renner, M.A.M., Sass-Gyarmati, A., Schäfer-Verwimp, A., Segarra Moragues, J.G., Stotler, R.E., Sukkharak, P., Thiers, B.M., Uribe, J., Váña, J., Villarreal, J.C., Wigginton, M., Zhang, L. & Zhu, R.-L. (2016) World checklist of hornworts and liverworts. *PhytoKeys* 59: 1–828.
<http://dx.doi.org/10.3897/phytokeys.59.6261>
- Sommerfelt, S.C. (1833) Bidrag til Spitzbergens og Beeren-Eilands Flora, efter Herbarier, medbragte af M. Keilhaue. *Magazin for Naturvidenskaberne* 11: 234–252.
- Villarreal, J.C., Crandall-Stotler, B.J., Hollingsworth, M.L., Long, D.G. & Forrest, L.L. (2015) Divergence times and the evolution of morphological complexity in an early land plant lineage (Marchantiopsida) with a slow molecular rate. *New Phytologist* 209 (4): 1734–1746.
<http://dx.doi.org/10.1111/nph.13716>