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Additions to and Nomenclatural Changes in the Bryaceae (Bryopsida) in Australia

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Abstract

The treatment of the family Bryaceae for Australia is updated based on recent taxonomic studies. Two species of *Ptychostomum*: *P. pallescens* (Scheicher ex Schwägr.) J.R.Spence from Tasmania and *P. bimum* (Schreb.) J.R.Spence from New South Wales, Tasmania and Western Australia are newly recorded. Reported for the first time is the tropical species *Gemmabryum erythropilum* (M.Fleisch.) J.R.Spence & H.P.Ramsay from northern Queensland. *Anomobryum* is re-instated in the Australian flora for the species *A. auratum* (Mitt.) A.Jaeger. Five Australian species of *Gemmabryum* are transferred to the newly described genus *Imbribryum* N.Pederson: *I. australe* (Hampe) J.R.Spence & H.P.Ramsay, *I. cheelii* (Broth.) J.R.Spence & H.P.Ramsay, *I. clavatum* (Schimp.) J.R.Spence & H.P.Ramsay, *I. crassum* (Hook.f. & Wilson) J.R.Spence & H.P.Ramsay, and *I. laevigatum* (Hook.f. & Wilson) J.R.Spence & H.P.Ramsay. *Bryum tuberosum* Mohamed & Damanhuri, previously placed in *Rosulabryum* by Spence and Ramsay (2006), is transferred to *Gemmabryum tuberosum* (Mohamed & Damanhuri) J.R.Spence & H.P.Ramsay. Several new nomenclatural transfers of Australian species, based on studies in North America taxa in *Plagiobryoides* (replacing *Plagiobryum cellulare)*, *Rosulabryum* and *Gemmabryum* are added to bring the Australian flora up to date.

Introduction

Since the publication of the family Bryaceae in the 'Flora of Australia' (Spence and Ramsay 2006; also see Spence and Ramsay 2012) significant new research on the family, not available at the time, has been published. This includes both morphological (Spence 2005, 2007, 2009; Spence and Ramsay 2005,) and molecular work (Pedersen and Hedenäs 2005; Pedersen et al. 2007; Holyoak and Pederson 2007). Nomenclatural transfers of several Australian species based on studies of North American taxa are presented here. Two genera new to Australasia: *Imbribryum* N.Pedersen and *Plagiobryoides* J.R.Spence, are recorded and appropriate combinations made. Other changes in taxonomic interpretations together with re-examination of the relevant herbarium specimens have added two additional *Ptychostomum* species. The first Australian report of *Gemmabryum erythropilum* (M.Fleisch.) J.R.Spence & H.P.Ramsay, a tropical Asian species, is also documented.

Species additions to *Gemmabryum* and *Ptychostomum*

Gemmabryum erythropilum (M.Fleisch.) J.R.Spence & H.P.Ramsay

Examination of some specimens from tropical Northeast Queensland has revealed the presence of *Gemmabryum erythropilum* (M.Fleisch.) J.R.Spence & H.P.Ramsay, a new record in the Bryaceae for Australia. In earlier studies *Bryum erythropilum* M. Fleisch. had been considered a synonym of *Bryum clavatum* (Schimp.) Müll. Hal. (Norris and Koponen 1984; Eddy 1996). Spence and Ramsay (2006) placed *B. clavatum* in the genus *Gemmabryum* as *G. clavatum.* In these studies the latter species has been re-interpreted as *Imbribryum clavatum* (Schimp.) J.R.Spence & H.P.Ramsay (see below).

Ochi (1985), Tan and Koponen (1989) and Tan and Iwatsuki (1991), maintained *Bryum clavatum* (here recognised as *Imbribryum clavatum*) and *B. erythropilum* (= *Gemmabryum erythropilum*) as distinct unrelated species, an interpretation we accept. Their observations together with additions from our studies separate the species as follows: the two taxa differ in sexuality – autoicous or sometimes dioicous in *G. erythropilum* (but dioicous in *I. clavatum*); in colour and length of costa – long-excurrent with strong red tints in *G. erythropilum*, (short-excurrent and lacking red tints in *I. clavatum);* in the degree of leaf border differentiation (1 or 2 rows of elongate border cells in *G. erythropilum* versus 2–5 rows of linear border cells in *I. clavatum*); and in cell size differences with relatively long distal and medial cells, > 6:1 in *G. erythropilum*, (short 3–4:1 in *I. clavatum*). Rhizoidal tubers are small, pyriform or clavate, < 60μm long in *G. erythropilum* (but large >100 μm and sphaerical in *I. clavatum*). Capsule morphology also differs - short and pyriform in *G. erythropilum* (very large and long clavate in *I. clavatum*).

Ecologically *G. erythropilum* is a species of riparian zones and running water whereas *I. clavatum* is primarily a species of calcareous seeps and springs. They also have different distributions, with *G. erythropilum* being palaeotropical and in Australia has been found so far only in far-north Queensland, whereas *I. clavatum* is largely subantarctic and southern temperate reaching only as far north as New South Wales in Australia.

Our studies have determined that *Bryum erythropilum* is related to *Gemmabryum apiculatum* (Schwägr.) J.R.Spence & H.P.Ramsay (see below) and have therefore, transferred it to the genus *Gemmabryum*.

Gemmabryum erythropilum (M.Fleisch.) J.R.Spence & H.P.Ramsay, *comb. nov.*

Basionym: *Bryum erythropilum* M.Fleisch., *Musci Flora Buitenzorg* 2: 553 fig. 102 (1904).

T: Indonesia, West Java 'bei Tjibodas auf Erde', VII 1898, *M. Fleischer s.n.* (syntype: H-BR).

Illustrations: Fleischer (1904: p. 559, fig. 102); Ochi (1964: p. 68, fig. 1; as *B. erythropilum*); Norris and Koponen (1984: p. 277, figs 4e–j; as *B. clavatum*); Ochi (1985: p. 70, figs 8A–F; as *B. erythropilum*; Eddy (1996: p. 127 fig. 414; as *B. clavatum*).

Autoicous or dioicous. Plants small, stems 1–2 cm, glossy green, usually with red tints or plants entirely red; leaves ovate-lanceolate, 1–2 mm long, acuminate, not much altered when dry, erect when wet; costa strong, red to red-purple, long excurrent in strong sometimes denticulate awn, distal and medial laminal cells very long, firm walled to distinctly incrassate, (60–) 80–100 um, 10–14 um wide, more or less elongate along costa to leaf base, alar cells abruptly short-rectangular to quadrate in corners, distal leaf margins finely serrulate, limbidium present, 1 or 2 layers wide; gemmae present as rhizoidal tubers, common, small, 40–60 μm long, red to orange, clavate to pyriform, 1 or 2 cells across, 2–5 cells along long axis. Capsule brown, 1–3 mm long, pyriform, apophysis thick, tapered, smooth, peristome well-developed. Spores not seen.

Norris and Koponen (1984) noted that a number of collections listed by Ochi (1970) under *B. clavatum* had rhizoidal gemmae. The gemmae, also present in Australian collections, are typical of *G. erythropilum* being deep red and clavate to pyriform and very similar to those of *G. apiculatum* which are pyriform to irregularly globose (Spence and Ramsay (2006).These two species can be distinguished by a variety of characters, including the strong red tints in *G. erythropilum* (green to pale pink-green in *G. apiculatum*), long excurrent awn (percurrent to short excurrent in *G. apiculatum*), the limbidium (absent in *G. apiculatum*), leaves ovate-lanceolate, acuminate (narrowly ovate and acute in *G. apiculatum*), and tubers deep red to orange (brown to red-brown in *G. apiculatum*).

The discovery of *G. erythropilum* in Queensland is not unexpected as it is a widespread paleotropical species and has a distribution similar to *G. tuberosum.* The species has been recorded previously on islands south of Japan, India, in south-east Asia, and Malesia (including New Guinea). The reference to the locality of the type collection as 'West Java bei Tjibodas auf Erde' refers to the collection being from Cibodas, dutch spelling 'Tjibodas' (West Java), now Kebun Raya Cibodas, growing on earth (hence terrestrial) (BJ Conn, pers. comm. 17 Oct 2013).

Specimens examined: Australia: Queensland: On soil on exposed granitic rocks, in rainforest below summit of Mt Lewis, *B.O. Van Zanten 681131*, 27 Jul 1968 (NSW ex GRO); Exposed on stones at edge of rainforest, Mossman River Gorge, *B.O. van Zanten 68972B*, *68979B*, *68988A*, 19 Jul 1968 (NSW ex GRO); Babinda Boulders, 60 km S of Cairns, wet soil in rainforest, *B.O.van Zanten 681034E*, 20 Jul 1968 (NSW ex GRO); On soil over granite rocks, in rainforest, 0.5 km along Mt Lewis Road, 16 33'S, 145 17' E, *P.I. Forster 5536*, 30 Jun 1989 (BRI492573).

Ptychostomum bimum (Schreib.) J.R.Spence *Phytologia* 87:20 (2005)

During recent work for the Flora of North America (Spence 2009, 2014), the status of *Ptychostomum bimum* was investigated, based on earlier work by Zolotov (2002). This species has usually been considered a synoicous form of *P. pseudotriquetrum*, but Zolotov documented several significant differences in leaf characters such as the non-decurrent or only weakly decurrent leaves, and thicker walled distal and median laminal cells. For the 'Flora of Australia' account (Ramsay and Spence 2006), the two species were treated as synonymous, but they can be separated based on these laminal characters as well as sexuality.

The following specimens, including types of *Bryum austroaffine* and *B. tasmanicum* (Ramsay & Seur (1994) correspond with *P. bimum* according to Ochi (1970). This species is likely to be much more common and widespread than these few specimens suggest.

Specimens examined: Australia: New South Wales: Yarrangobilly Caves, *Forsyth 1012*, xii.1901; *1014*, 1901 (syntypes of *Bryum austro-affine* Broth., H; isosyn:, NSW); Kiandra, *Forsyth 1010*, *1011*, xii.1901 (syntypes of *B. austroaffine* Broth. H; isosyn: MEL, NSW). **Tasmania:** *Stuart s.n.* (type of *B. tasmanicum* Hampe, holo: BM; iso: MEL). **Victoria:** Beenak, *Willis s.n.*, July 1935 (MEL1034391); Lankey Plain, Bargo High Plains, *Theis FN 1494* (MEL1050674); Glenelg River, (Williams), [*Mueller s.n.*] (as *B. tasmanicum* Hampe (BM).

Future work on the distribution and ecology of this species with the closely related species *P. pseudotriquetrum* is needed in Australia, as well as the relationships with other southern hemisphere species related to *P. pseudotriquetrum*, including *Bryum macrantherum* Müll.Hal. from southern Africa and *B. orthothecium* Card. & Broth. from South America.

Ptychostomum pallescens (Schleich. ex Schwägr.) J.R.Spence *Phytologia* 87:21 (2005)

Two collections of this species from Tasmania were inadvertently missed during herbarium work for the 'Flora of Australia' project. Both of the specimens, brought to our attention by Bill Buck (NY), were confirmed as *P. pallescens*. The species is distributed widely in the northern hemisphere (Spence 2014) and is also found in New Zealand and southern South America so its occurrence in Tasmania is not unexpected. *Ptychostomum pallescens* is related to *P. creberrimum*, differing in its autoicous sexuality, evenly foliate rather than comose stems and larger spores.

Specimens examined: Australia: Tasmania: Mt. Field National Park, alt. 3400' (1036 m), *D.A. Ratkowsky B211 & A.V. Ratkowsky*, 07 April 1973 (NY); Tim Shea, W. of Maydena, on exposed conglomerate bank, alt. 2860 ft. (872 m), *D.A. Ratkowsky B64 & A.V. Ratkowsky*, 18 Mar 1973 (NY).

Nomenclatural Corrections

Ptychostomum pseudotriquetrum (Hedw.) J.R.Spence & H.P.Ramsay ex D.T.Holyoak & N.Pedersen *Journal of Bryology* 29: 120 (2007)

While transferring *Bryum pseudotriquetrum* to *Ptychostomum*, the basionym was incorrectly cited as *Mnium pseudotriqetrum* (Hedw.) Schwägr. rather than *M. pseudotriquetrum* Hedw. This was corrected, as indicated above, by Holyoak and Pedersen (2007).

Nomenclatural Changes

The genus ***Anomobryum*** Schimper, *Synopsis Muscorum Europaeorum* cxxxviii: 382–383 (1860).

Anomobryum auratum (Mitten) A.Jaeger, *Bericht* über *die Thätigkeit der St. Gallischen Naturwissenschaftlichen Gesellschaft* 1873-74: 142 (1875).

Basionym: *Bryum auratum* Mitten, *Journal of the Proceedings of the Linnaean Society, Botany, Supplement* 1: 67 (1859).

The genera *Anomobryum* and *Bryum* were combined in Spence and Ramsay (2002) based on overall similarity in morphology. However, molecular work since then (Pedersen and Hedenäs 2005; Pedersen et al. 2007) suggests that the two genera are not related, and that their morphological similarities are due to convergence. Although subtle, a significant difference between the two genera is the presence of elongate incrassate median and distal laminal cells in *Anomobryum* which in *Bryum* tend to be relatively shorter and wider. *Bryum auratum*, with these elongate cells is thus returned to the genus *Anomobryum* as *A. auratum* (Mitt.) A.Jaeger, while *Bryum harriotii* with *Bryum*-like laminal areolation remains in *Bryum*.

The genus ***Imbribryum*** N.Pedersen *Bryologist* 108: 449 (2005).

The genus *Imbribryum* was described based on the species *Bryum alpinum* With. and its allies (Pedersen and Hedenäs 2005, Pedersen 2005). This genus consists of relatively large species with elongate evenly foliate stems and strongly imbricate leaves; median and distal laminal cells are often incrassate and large rhizoidal tubers arise from macronemata in leaf axils. They have a strong preference for wet habitats such as streams, springs and waterfalls growing on rock or soil. *Imbribryum* is related to *Gemmabryum* section *Tuberibryum* (Spence 2007) and future work may indicate that some or most of the tuber-producing species in this section may be *Imbribryum* species. The following five Australasian species match the described characteristics of the genus as currently understood and are transferred from *Gemmabryum* to *Imbribryum*.

Imbribryum australe (Hampe) J.R.Spence & H.P.Ramsay, *comb. nov*.
Basionym: *Bryum australe* Hampe, *Iconones Muscorum Novorum vel Minus Cognitorum* 26 (1844).
Lectoype (designated by Ochi 1970): Swan River, W.A., *L. Preiss s.n.* BM; isolecto: MEL.

Imbribryum cheelii (Broth.) J.R.Spence & H.P.Ramsay, *comb. nov.*
Basionym: *Bryum cheelii* Broth., *Proceeding of the Linnaean Society of New South Wales* 41: 591 (1916).
Type: Shellharbour, New South Wales, 1 Oct. 1900, *E. Cheel 407* (holo: H-BR; iso: MEL, NSW).

Imbribryum clavatum (Schimper) J.R.Spence & H.P.Ramsay, *comb. nov.*
Basionym: *Pohlia clavata* Schimper, *Annales des Sciences Naturelles; Botanique,* sér. 2, 6: 148, 11 (1836).
Type: New Zealand, *Logan H 2813* (syntype: BM).

Imbribryum crassum (Hook.f. & Wilson) J.R.Spence & H.P.Ramsay, *comb. nov*.
Basionym: *Bryum crassum* Hook.f. & Wilson, *Flora Novae-Zelandiae* 2: 86, f. 1 (‘1855’ [1854]).
Type: Manukau Bay, New Zealand, *W. Colenso 136* (iso: BM).

Imbribryum laevigatum (Hook.f. & Wilson) J.R.Spence & H.P.Ramsay, *comb. nov.*
Basionym: *Bryum laevigatum* Hook.f. & Wilson, *London Journal of Botany* 3: 546 (1844).
Type: Tasmania, *J.D. Hooker 2856* (holo: BM).

The genus ***Gemmabryum*** J.R.Spence & H.P.Ramsay *Phytologia* 87: 63 (2005).

Gemmabryum was described for small species of *Bryum* that typically produce abundant gemmae, as either rhizoidal tubers or leaf axil bulbils (Spence and Ramsay 2005), or in rare cases both, e.g. *G. indicum* (Dozy & Molk.) J.R.Spence & H.P.Ramsay. One group of species, known as the informal group ‘*Apiculata*’, includes species with small tubers and very long narrow laminal cells. Included in this latter group are *G. apiculatum* (Schwagr.) J.R. Spence & H.P. Ramsay and *G. inaequale* (Taylor) J.R.Spence & H.P.Ramsay among others.

Gemmabryum tuberosum (Mohamed & Damanhuri) J.R.Spence & H.P.Ramsay, *comb. nov*.

Basionym: *Bryum tuberosum* Mohamed & Damanhuri, *Bryologist* 93: 288 (1990).

Type: Genting Highlands, Pahang, Malaysia, *M.A. Hadji Mohamed 5397* (holo: KLU).

This species (as *Bryum tuberosum* Mohamed & Damanhuri) was placed in *Rosulabryum* by Spence and Ramsay (2006) because of its slightly obovate leaves. However, it shares a number of characters with the *Gemmabryum* ‘*Apiculata*’ group such as the very small tubers and elongate laminal cells. Overall, based on additional morphological studies, it is better placed in *Gemmabryum* and is therefore transferred to it here.

Gemmabryum caespiticium (Hedw.) J.R.Spence *Phytologia* 91: 497 (2009)

Species of *Gemmabryum* section *Caespitibryum* including the cosmopolitan *G. caespiticium* and its allies, have been examined recently using molecular data (e.g., Pedersen et al. 2007). The relationships of this taxon (as *Bryum* caespiticium) still remain ambiguous as it has been placed near both *Ptychostomum* and *Gemmabryum* in different molecular studies. The plants share several features with *Gemmabryum*, including small size, imbricate leaves with a weak limbidium or limbidium absent, elongate distal laminal cells, and short proximal laminal cells. There are also recent reports of rhizoidal tubers in the literature, although these require confirmation.

Bryum caespiticium Hedw. was recently transferred to *Gemmabryum caespiticium* (Hedw.) J.R.Spence for the Flora of North America (Spence 2009). However, if the species is finally resolved to be a member of *Ptychostomum*, then the correct name will become *P. imbricatulum* (Müll.Hal.) D.T.Holyoak & N.Pedersen instead of *P. angustifolium* (*sensu* Spence and Ramsay 2006).

Gemmabryum coronatum (Schwägr.) J.R.Spence & H.P.Ramsay, *Phytologia* 87: 66 (2005).

Spence and Ramsay (2006) treated *Bryum angustifolium* Bridel as a synonym of *Ptychostomum angustifolium* (Bridel) J.R.Spence & H.P.Ramsay. However, it has since been transferred into synonymy with *Gemmabryum coronatum* (Holyoak and Pedersen 2007).

Ochiobryum J.R.Spence & H.P.Ramsay, *Phytologia* 87: 68 (2005).

There has been some confusion about the present identity of *Bryum blandum* Hook.f. & Wilson which was transferred to the new genus *Ochiobryum* (Spence and Ramsay 2005). In the same year, it was transferred to *Imbribryum* Pederson by Pederson and Hedenas (2005). This latter genus was not typified until later that year (Pederson (2005), giving *Ochiobobryum* priority.

Ochiobryum blandum (Hook.f. & Wilson) J.R.Spence & H.P.Ramsay is related to *Imbribryum* but differs in extremely long laminal cells throughout the leaf and the complanate habit. Pederson & Hedenas (2005) moved *B. blandum* to their new genus as *I. blandum*. However, as they looked at only three of the taxa in the larger *I. alpinum* complex they were unable to determine sister relationships of the two genera. Until more work is done on the relationship between *Ochiobryum* and typical *Imbribryum*, the *I. laevigatum* group, as well as the New Guinean species, we prefer to retain *Ochiobryum* as a separate entity.

The genus ***Plagiobryoides*** J.R.Spence, *Phytologia* 87: 24 (2005).

Plagiobryoides cellularis (Hook.) J.R.Spence, *Phytologia* 91: 498 (2009).

Spence and Ramsay 2006) transferred the widespread tropical species *Bryum cellulare* Hook. to the genus *Plagiobryum* since it appeared to be morphologically closest to it and was the only Australian representative in that genus. However, the species exhibits several differences from *Plagiobryum*, including the more or less symmetrical capsule, and spores shed singly, not in tetrads as in *B. cellulare*. During work for the Flora of North America by Spence (2009) the genus *Plagiobryoides*, was described for this species and its relatives, and the required combination *Plagiobryoides cellularis* (Hook.) J.R.Spence was made. Thus the genus *Plagiobryum*, is no longer represented in the bryoflora of Australia although it does occur in New Zealand.

The genus ***Rosulabryum*** J.R.Spence, *Bryologist* 99: 222 (1996).

Rosulabryum rubens (Hedwig) J.R.Spence, *Novon* 19: 399 (2009).

Recent molecular work (Pedersen and Hedenäs 2005; Pedersen et al. 2007) shows that *Gemmabryum rubens* (Hedw.) J.R.Spence & H.P.Ramsay (Spence and Ramsay 2006), long considered a member of the small tuber-producing species in the informal '*Erythrocarpa*' group (*Gemmabryum* section *Tuberibryum* sensu J.R.Spence), is in fact very close to *Rosulabryum capillare* (Hedw.) J.R.Spence. The morphology of *G. rubens* is very different from most other species in that section of *Gemmabryum,* as it consists of plants with wide leaves, serrate distal margins, a distinct limbidium, large tubers and wide and relatively short distal and median laminal cells. Morphologically it appears to be closest to species of *Rosulabryum* section *Trichophora.* Spence (2009, 2014) transferred this species to *Rosulabryum*, as *P. rubens* (Hedwig.) J.R.Spence.

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