RACOMITRIUM

Niels Klazenga[1]

Racomitrium Brid., *Muscol. Recent.*, Suppl. 4: 78 (1819); from the Greek *rhakos* (frayed) and *mitrion* (a cap), in reference to the laciniate calyptra.

Type: *R. canescens* (Hedw.) Brid.

Dioicous, cladocarpous. Plants small to robust, growing in cushions or turfs. Stems frequently irregularly dichotomously to subpinnately branched, densely foliose; central strand lacking. Leaves appressed to falcate-secund when dry, erecto-patent and often with the tips curved outward when wet, ovate-lanceolate, often ending in a short to long hyaline point, often ±plicate; margin mostly recurved on one or both sides of the leaf; costa strong, subpercurrent to excurrent. Laminal cells thick-walled and usually nodulose.

Perichaetial leaves variously differentiated. Calyptra mitrate. Sporogones solitary. Capsules exserted, ellipsoidal to cylindrical, often slightly asymmetrical; stomata present at the base, phaneropore; annulus differentiated, revoluble. Peristome teeth narrowly triangular, asymmetrically bifid in the upper third to nearly to the base, papillose; operculum long-conical. Spores spherical, finely papillose.

Racomitrium is a genus of 60–80 species, with a bipolar to almost cosmopolitan distribution, but occurring mainly at higher latitudes or altitudes. It is characterised by elongate leaf cells with thick, strongly nodulose walls, cladocarpous perichaetial position and stems without a central strand. The genus is represented in Australia by five species that occur mainly in temperate to alpine habitats in the south-east.

Racomitrium exhibits considerable variability in a number of characters. Hastings & Ochyra (2007) divided the North American *Racomitrium sens. lat.* into four genera, all referable to Grimmiaceae subfamily Racomitrioideae Bednarek-Ochyra & Ochyra. Applying this scheme to the Australian taxa would see the retention of only *R. pruinosum* and *R. lanuginosum* in *Racomitrium sens. str.*, the remaining species being assigned to *Bucklandiella* Roivainen, which is characterised by having non-papillose laminal cells. This approach is far from universally accepted and, as there seems to be no benefit in subdividing up a small and very recognisable, it is not followed here.

References

Frisvoll, A.A. (1984), Taxonomic note on *Racomitrium crispulum* (Hook.f. et Wils.) Hook.f. et Wils., *J. Bryol.* 13: 285–290.

Frisvoll, A.A. (1986), Southern hemisphere synonyms of *Racomitrium sudeticum* (Funck) Bruch et Schimp., *J. Bryol.* 14: 339–346.

Frisvoll, A.A. (1988), A taxonomic revision of the *Racomitrium heterostichum* group (Bryophyta, Grimmiales) in N. and C. America, N. Africa, Europe and Asia, *Gunneria* 59: 1–289.

Hastings, R.I. & Ochyra, R. (2007), Grimmiaceae, *Fl. North America* 2: 204–305.

Lawton, E. (1973), *Rhacomitrium crispulum* and some related species, *Bull. Torrey Bot. Club* 4: 230–235.

Vitt, D.H. & Marsh, C. (1988), Population variation and phytogeography of *Racomitrium lanuginosum* and *R. pruinosum*, *Beih. Nova Hedwigia* 90: 235–260.

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Cite as: N.Klazenga, *Australian Mosses Online. 62. Grimmiaceae_Racomitrium.*
http://www.anbg.gov.au/abrs/Mosses_online/Grimmiaceae_Racomitrium.pdf (2012)

1 Laminal cells papillose 2
1: Laminal cells smooth 3

2: Margins of hyaline point regularly toothed, the teeth at sharp angles to the margin; stems subpinnately branched, with short (c. 5 mm long) widely spaced branches ..... **3. R. pruinosum**
2: Margins of hyaline point irregularly toothed, with blunt teeth at various angles to the margin; stems subpinnately branched, with closely spaced branches of varying length ..... **2. R. lanuginosum**

3 Leaves plicate, with 2 pleats on either side of the costa, always lacking a hyaline point ..... **4. R. ptychophyllum**
3: Leaves weakly plicate and with a single pleat on one side of the costa to ±smooth, with or without a hyaline point 4

4 Leaves 1.8-2.5 mm long, with a short hyaline point; upper margin double-layered; lamina unistratose; perichaetial leaves weakly differentiated, c. as long as to slightly longer than vegetative leaves, with a short hyaline point; capsules c. 1 mm long ..... **5. R. sudeticum**
4: Leaves 2.0–3.4 mm, with a short or long concolorous or hyaline point; upper lamina and margin usually single-layered, occasionally the lamina partly double-layered; perichaetial leaves strongly differentiated, shorter than vegetative leaves and with a blunt to broadly obtuse apex; capsules 2–3 mm long ..... **1. R. crispulum**

1. Racomitrium crispulum (Hook.f. & Wilson) Hook.f. & Wilson, *in* J.D.Hooker, *Fl. Nov.-Zel.* 2: 76 (1854)

Dryptodon crispulus Hook.f. & Wilson, *Fl. Antarct.* 124 (1844); *Grimmia crispula* (Hook.f. & Wilson) Müll.Hal., *Syn. Musc. Frond.* 2: 804 (1851), *non* Turner (1804). T: Campbell Is., New Zealand, *J.D.Hooker*; holo: BM *n.v.*

Grimmia symphyodonta Müll.Hal., *Syn. Musc. Frond.* 1: 809 (1849); *Racomitrium symphyodontum* (Müll.Hal.) A.Jaeger, *Ber. Thätigk. St. Gallischen Naturwiss. Ges.*1872–1873: 97 (1874), *symphyodon*. T: Hermite Is., Cape Horn, Chile, *J.D.Hooker*; iso: BM *n.v.*

Grimmia emersa Müll.Hal., *Bot. Zeitung (Berlin)* 9: 562 (1851); *Racomitrium emersum* (Müll.Hal.) A.Jaeger, *Ber. Thätigk. St. Gallischen Naturwiss. Ges.* 1872–73: 97 (1874). T: Mt Wellington, Tas., *S.Mossman 743*; not located.

Racomitrium heterostichum var. *tasmanicum* Hampe, *Linnaea* 25: 714 (1853); *R. crispulum* var. *tasmanicum* (Hampe) E.Lawton, *Bull. Torrey Bot. Club* 100: 233 (1973). T: "Van Diemensland" [Tas.], *C.Stuart*; holo: BM *n.v.*

Grimmia sullivanii Müll.Hal., *Hedwigia* 37: 166 (1898), as *sullivani*; *Racomitrium sullivanii* (Müll.Hal.) Broth., *in* H.G.A.Engler & K.A.E.Prantl, *Nat. Pflanzenfam.* I, 3: 455 (1902). T: Mt Cole, Vic., *D.Sullivan*; iso: MEL 1002642.

Grimmia pseudopatens Müll.Hal., *Hedwigia* 37: 167 (1898); *Racomitrium pseudopatens* (Müll.Hal.) Paris, *Index Bryol.*, Suppl. 1: 294 (1900). T: Sydney, N.S.W., *F.Kaysser*; holo: B? (destroyed).

Racomitrium chlorocarpum Mitt. ex M.Fleisch., *Musc. Buitenzorg* 1: 377 (1904). T: *n.v.*

Illustrations: G.A.M.Scott & I.G.Stone, *Mosses of Southern Australia* 107, pl. 13 (1976); J.Beever, K.W.Allison & J.Child, *Mosses of New Zealand* 33, fig. 16a–e (1992); R.D.Seppelt, *Moss Flora of Macquarie Island* 166, fig. 66 (2004).

Plants 1.5–4.0 cm tall, dark green to yellowish brown, forming loose cushions. Stems frequently dichotomously branched. Leaves erect-appressed to somewhat homomallous when dry, curved outwards when wet, ovate-lanceolate, 2.0–3.4 mm long, 0.7–1.0 mm wide, canaliculate, weakly keeled, plicate with a single pleat on one side of the costa, ending in a short concolorous to brown point or a short to long hyaline point; margin revolute in the basal two-thirds, mostly single-layered throughout, occasionally partly double-layered above, entire throughout or with some small teeth at the apex; costa subpercurrent to excurrent. Upper lamina predominantly unistratose, rarely bistratose; laminal cells oblong to elongate, 13–45 × 8–11 µm; walls nodulose, higher up shorter, isodiametric to oblong; basal cells longer, not nodulose; basal angles with thin-walled slightly inflated cells, extending a short distance along the margin in a single row.

Perichaetial leaves conspicuously shorter than vegetative leaves, with obtuse to broadly acute apices. Seta 3–5 mm long. Capsules cylindrical, 2–3 mm long, slightly asymmetrical. Peristome teeth split in the upper 50–80%, with high branched papillae. Spores 16–26 µm diam.

Known from south-western W.A., south-eastern Qld, N.S.W., Vic. and Tas., on rocks in open woodland or subalpine heath at altitudes of 250–1800 m, but usually at the higher elevations. Also in the Caribbean, Central and South America, Subantarctic islands, New Zealand, New Guinea, Japan and the Hawaiian Islands.

W.A.: Nancy's Peak, Porongorups Natl Park, *G.G.Smith 266* (MEL). Qld: South Bald Rock, near Girraween Natl Park, *I.G.Stone 13543* (MEL). N.S.W.: Rutherford Ck near Piper Lookout, c. 12 km WNW of Bemboka, *K.R.Thiele 994* (MEL). Vic.: Mt Erica, Mount Baw Baw Natl Park, *N.Klazenga 6012* (MEL); Mount Nelse Ck, Bogong Natl Park, *A.C.Beauglehole 73394* (MEL). Tas.: summit, South Sister, *D.A.Meagher 4050* (MEL).

The most common *Racomitrium* in Australia, *R. crispulum* exhibits considerable variability in the occurrence and length of the hyaline leaf tip, and in the number of cell layers in the upper leaf lamina and margin. Lawton (1973) and Frisvoll (1984) maintained that the type specimen does not belong to what is generally recognised as *R. crispulum* in Australia and New Zealand on account of having a double-layered upper lamina, the majority of the Australian and New Zealand specimens having a single-layered upper lamina and margin. Frisvoll (1984) stated the oldest available name for the majority of the Australasian material is *R. rupestre*, while Lawton (1973) recognised *R. crispulum* var. *tasmanicum* for the Australasian material, considering *R. rupestre* to be endemic to South America.

I have found the majority of Australian specimens to have uniformly unistratose leaves, as well as rare individuals with entirely bistratose upper laminae, in addition to plants with partly or entirely bistratose leaf margins, the rest of the lamina being unistratose. However, I remain unconvinced that *R. crispulum* can be subdivided using this character. While the occurrence and length of hyaline leaf points is of no diagnostic value, variability in this character could have been responsible for erroneous reports of *S. heterostichum* (Hedw.) Brid. and *S. obtusum* (Brid.) Brid. from Australia (see Excluded Names).

2. **Racomitrium lanuginosum** (Hedw.) Brid., *Muscol. Recent.*, Suppl. 4: 79 (1819)

Trichostomum lanuginosum Hedw., *Sp. Musc. Frond.* 109 (1801); *Grimmia lanuginosa* (Hedw.) Müll.Hal., *Syn. Musc. Frond.* 1: 806 (1849). T: Europe; *n.v.*

Bryum hypnoides With., *Syst. Arr. Brit. Pl.*, 4th edn, 3: 802 (1801), *nom. illeg.*; *Racomitrium hypnoides* Lindb., *Öfvers. Förh. Kongl. Svenska Vetensk.-Akad.* 23: 552 (1866), *nom. illeg.* (superfluous). T: Great Britain; *n.v.*

Racomitrium sundaicum Müll.Hal., *Verh. Zool.-Bot. Ges. Wien* 19: 224 (1869); *Grimmia sundaica* (Müll.Hal.) Mitt., *Trans. & Proc. Roy. Soc. Victoria* 19: 56 (1882). T: *n.v.*

Illustrations: D.H.Vitt & C.Marsh, *Beih. Nova Hedwigia* 90: 243, pl. 2, figs 4–9; 244, pl. 3, figs 2–6 (1988); J.Beever, K.W.Allison & J.Child, *Mosses of New Zealand* 32, fig. 15f (1992); D.Meagher & B.Fuhrer, *Field Guide to the Mosses and Allied Plants of Southern Australia* 74 (2003).

Plants to 7 cm tall, yellowish green to olive-green or brown, very hoary and whitish to greyish in appearance, forming loose turfs. Stems subpinnately branched, with closely spaced branches of variable length. Leaves falcate-secund with hyaline tips, curled and flexuose when dry, erecto-patent when wet, ovate-lanceolate, 3.3–5.2 mm long, 0.5–0.9 mm wide, canaliculate, weakly keeled, plicate with a long distinct pleat on one side and short weaker pleat on the other side of the costa; hyaline tip long, decurrent, strongly toothed, papillose; margin revolute on one side, less so on the other, entire below the hyaline part, strongly irregularly toothed with teeth in the hyaline point at sharp to broad angles with the margin; costa ending in the hyaline tip. Upper lamina unistratose; laminal cells elongate to short-linear, 40–70 × 12–15 µm, densely covered with low papillae, with nodulose walls; more distal cells gradually shorter; basal cells longer, sparingly pitted, not nodulose; basal angles with thin-walled slightly inflated cells extending a short distance along the margin in a single row. Perichaetia and sporogones not known from Australian material.

Known from two localities in Tas. where it is terrestrial in subalpine heath. Reports from the Australian mainland (Vitt & Marsh, 1988) could not be confirmed. Seppelt (2004) excluded *R. lanuginosum* from the flora of Macquarie Island.

Tas.: Outlet Ck, 0.25 m below L. Fenton, *J.H.Willis s.n.* (MEL); Mt Sprent, *J.Milne s.n.* (MEL).

This species was frequently reported from Australia until Vitt & Marsh (1988) explained the distinction between *R. pruinosum* and *R. lanuginosum* and confirmed that the majority of the Australian material belonged to the former. Thus, in *R. pruinosum* the teeth of the hyaline leaf tip are inserted at uniformly sharp angles to the margin, while in *R. lanuginosum* they are more irregular, forming sharp to broad angles. From the present study of the Australian material another difference appears to be in the branching pattern, *R. pruinosum* having short, widely spaced branches, in contrast to the tightly arranged branches of variable length in *R. lanuginosum*.

3. Racomitrium pruinosum (Wilson) Müll.Hal., *Verh. Zool.-Bot. Ges. Wien* 19: 224 (1869)

Racomitrium lanuginosum var. *pruinosum* Wilson, *in* J.D.Hooker, *Fl. Nov.-Zel.* 2: 76 (1854); *Grimmia lanuginosa* var. *pruinosa* (Wilson) Mitt., *Trans. & Proc. Roy. Soc. Victoria* 19: 56 (1882). T: North Island, New Zealand, *Colenso*; holo: BM *n.v.*

Racomitrium austrocanescens Dusén, *Ark. Bot.* 6 (10): 25 (1907). T: Rio Chico, "Patagonia australis", Chile, *J.B.Hatcher*; holo: S.

Illustrations: D.H.Vitt & C.Marsh, *Beih. Nova Hedwigia* 90: 243, pl. 2, figs 1–3; 244, pl. 3, fig. 1 (1988); J.Beever, K.W.Allison & J.Child, *Mosses of New Zealand* 32, fig.15a–e (1992); R.D.Seppelt, *Moss Flora of Macquarie Island* 167, fig. 67 (2004).

Plants to 10 cm tall, yellowish green to olive-green or brown, very hoary and whitish to greyish in appearance, forming loose turfs. Stems subpinnately branched, with short widely spaced branches to 5 mm long. Leaves falcate-secund, with the hyaline tips curled when dry, curved outwards when wet, ovate-lanceolate, 3.2–4.0 mm long, 0.5–0.8 mm wide, canaliculate, weakly keeled, plicate with a single pleat on either side of the costa, ending in a long hyaline tip that is decurrent, strongly serrate and papillose; margin partly revolute, entire below the hyaline part, serrate, with all teeth at sharp angles to the margin in the hyaline point; costa ending in the hyaline tip. Upper lamina unistratose; laminal cells short-linear to elongate, 55–80 × 9–10 µm, densely covered with low papillae, with nodulose walls, more distal cells becoming gradually shorter; basal cells longer, sparsely pitted, not nodulose; basal angles with thin-walled slightly inflated cells that extend a short distance along the margin in a single row. Perichaetia and sporogones not known from Australian material.

Occurs in the Blue Mountains and Snowy Mountains, N.S.W., also in Vic. and more widespread in Tas.; terrestrial and on rock in subalpine heath or moorland, feldspar and boulder scree or along streams at elevations of 1000–2150 m. Also in New Zealand, Auckland Is., Campbell Is., Macquarie Island, southern South America and New Guinea.

N.S.W.: Green Gully, Kanangra Boyd Natl Park, *N.H.Scarlett 130* (MEL); trail from Rawson Pass to L. Cootapatamba, Mount Kosciuszko Natl Park, *W.A.Weber & D.McVean B33329* (MEL). Vic.: Rocky Plains, SE of Mt Cobberas No. 1, *A.Thies 1496C* (MEL). Tas.: ascent to Hansons Peak, Cradle Mountain-Lake St. Clair Natl Park, *N.Klazenga 5763* (MEL); E escarpment between Naturalist Peak and Mt Field West, *J.H.Willis s.n.* (MEL).

4. Racomitrium ptychophyllum (Mitt.) Mitt., *Handb. New Zealand Fl.* 2: 426 (1867)

Grimmia ptychophylla Mitt., *Trans. Bot. Soc. Edinburgh* 8: 280 (1866). T. Otago, New Zealand, *W.L.Lindsay*; holo: NY *n.v.*

Plants to 3 cm tall, dull yellowish brown when dry, forming loose cushions. Stems frequently dichotomously branched. Leaves appressed when dry, curved outwards when wet, ovate-lanceolate, 2.8–3.7 mm long, 0.7–0.8 mm wide, canaliculate, keeled, plicate with 2 pleats on either side of the costa; apex concolorous; margin revolute in the basal 50–67%, single-layered throughout, entire; costa very short-excurrent. Upper lamina unistratose; laminal cells elongate, 25–50 × 8–10 µm, with nodulose walls; more distal cells shorter, isodiametric to oblong; basal cells longer, not nodulose; basal angles with thin-walled slightly inflated cells, extending a short distance along the margin in a single row. Perichaetia and sporogones not seen in Australian material.

Known from the Bogong High Plains in Vic.; grows on basalt at 1690–1760 m. Also in New Zealand.

Vic.: Ruined Castle, Bogong High Plains, *K.Ralston [N.Klazenga] 5166* (MEL); Basalt Hill, at head of Rocky Valley, Bogong High Plains, *J.H.Willis 58* (MEL).

Racomitrium ptychophyllum is slightly more robust than *R. crispulum*, but it is readily recognised by its doubly plicate leaves.

5. **Racomitrium sudeticum** (Funck) Bruch & Schimp., *Bryol. Europ.* 3: 141 (1845)

Trichostomum sudeticum Funck, *Deutschl. Moose* 26 (1820). T: Germany; *n.v.*

Grimmia amoena Broth., *Öfvers. Förh. Finska Vetensk.-Soc.* 42: 99 (1900); *Racomitrium amoenum* (Broth.) Paris, *Index Bryol.*, Suppl. 293 (1900). T: Mt Kosciuszko, N.S.W., *J.H.Maiden & W.Forsyth 202, 204*; H-BR.

Illustrations: A.A.Frisvoll, *J. Bryol.* 14: 341, fig. 1; 343, fig. 2 (1986); A.A.Frisvoll, *Gunneria* 59: 76, fig. 15; 81, fig. 16; 84, fig. 17 (1988).

Plants to 1.5 cm tall, yellowish brown to reddish brown, forming low cushions. Stems frequently dichotomously branched. Leaves erect to erecto-patent when dry, curved outwards when wet, ovate-lanceolate, 1.8–2.5 mm long, 0.4–0.6 mm wide, V-shaped, keeled, plicate, with a single pleat on one side of the costa, ending in a short hyaline point; margin revolute in the proximal two-thirds, double-layered in the upper half, entire throughout; costa excurrent. Upper lamina unistratose; laminal cells isodiametric to elongate, 8–28 × 8–10 µm, with nodulose walls; more distal cells shorter, isodiametric; basal cells longer, not nodulose; basal angles with thin-walled slightly inflated cells extending a short distance along the margin in a single row.

Perichaetial leaves as long as or slightly longer than vegetative leaves; apex long-acuminate, with a hyaline point. Seta 2.0–3.5 mm long. Capsules ellipsoidal, c. 1 mm long. Peristome teeth split at the apex, fenestrate below, finely papillose. Spores 13–17 µm diam.

Known from subalpine and alpine N.S.W. and Vic.; grows on rock in heathland at altitudes of 1690–1900 m. A widespread bipolar moss.

N.S.W.: Blue L., Mount Kosciuszko Natl Park, *J.H.Willis s.n.* (MEL). Vic.: at head of Rover Ck near Rover Scout Hut, Bogong High Plains, *J.H.Willis 62* (MEL); E of Pretty Valley Pondage, Bogong High Plains, *N.Klazenga 5057* (MEL).

The perichaetial leaves of *R. sudeticum* are at least as long as the stem leaves, acuminate and with hyaline points. In contrast, those of *R. crispulum* are shorter than the stem leaves, and they have a rounded to broadly acute apex without a hyaline point. When sterile, *R. sudeticum* can be recognised by its generally smaller stature, slightly more triangular leaf apices, a short hyaline point and double-layered leaf margin.

Doubtful Name

Racomitrium pycnotrichum (Müll.Hal.) Paris, *Index Bryol.*, Suppl. 294 (1900)

Grimmia pycnotricha Müll.Hal., *Hedwigia* 37: 167 (1898). T: Guy Fawkes Rivulet, Hobart, Tas., Sept. 1890, *W.A.Weymouth* (in Hb. Burchard), qui pro determinatione misit 1890; in cacumine montis Wellington leg. Weymouth Febr. 1888 formam nigritam, quam Dr. Burchard 1891 misit; eodem monte quoque Oldfield quoad Hb Brotheri".

Excluded Names

Racomitrium affine (Schleich. ex F.Weber & D.Mohr) Lindb., *Acta Soc. Sci. Fenn.* 10: 552 (1875)

Trichostomum affine Schleich. ex F.Weber & D.Mohr, *Bot. Taschenb.* 127 (1807); *Racomitrium heterostichum* subsp. *affine* (Schleich. ex F.Weber & D.Mohr) J.J.Amann, *Fl. Mouss. Suisse* 2: 143 (1918). T: *n.v.*

Racomitrium heterostichum (Hedw.) Brid., *Muscol. Recent.*, Suppl. 4: 79 (1819)

Trichostomum heterostichum Hedw., *Sp. Musc. Frond.* 109 (1801); *Grimmia heterosticha* (Hedw.) Müll.Hal., *Syn. Musc. Frond.* 1: 807 (1849). T: Germany, *n.v.*

Racomitrium heterostichum var. *alopecurum* Huebener, *Musc. Germ.* 208 (1833)

T:Germany; *n.v.*

Racomitrium obtusum (Brid.) Brid., *Muscol. Recent.*, Suppl. 4: 79 (1819)

Trichostomum obtusum Brid., *J. Bot. (Schrader)* 1800(2): 290 (1801); *Racomitrium heterostichum* var. *obtusum* (Brid.) Delogne, *Ann. Soc. Belge Microscop.* 9: 179 (1885). T: Europe; *n.v.*

Racomitrium rupestre (Hook.f. & Wilson) Hook.f. & Wilson, *in* J.D.Hooker, *Fl. Nov.-Zel.* 2: 75 (1854)

Dryptodon rupestris Hook.f. & Wilson, *London J. Bot.* 3: 544 (1844); *Racomitrium crispulum* var. *rupestre* (Hook.f. & Wilson) Dixon, *Bull. New Zealand Inst.* 3: 159 (1926). T: Hermite Is, Cape Horn, Chile, *J.D.Hooker*; holo: BM *n.v.*