

SPHAGNACEAE

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Sphagnaceae Dumort., *Ann. Fam. Pl.* 68 (1829).

Type: *Sphagnum* L.

Dioicous or autoicous. Plants robust, gregarious, developing from a thallose protonema. Stems primarily erect, simple or sparingly branched, lacking a central strand, but usually with a distinct hyalodermis (outer cortex) 1–4 cells thick overlaying a scleroderm (wood cylinder) of smaller thick-walled and often coloured cells; stems bearing clusters of branches arranged in fascicles at \pm regular intervals; terminal branches crowded as a capitulum. Branches uniform or dimorphic: spreading branches at c. 90° to stem; and thinner \pm pendent branches with smaller leaves lying against the stem; branches with a single-layered hyalodermis with cortical cells uniform or dimorphic: 1–4 “retort cells”, protuberant above, with a subterminal pore, distinct from the remaining cells which are usually imperforate. Stem leaves usually differing in form from branch leaves and more remotely arranged; spiral thickenings and pores fewer than in branch leaves, sometimes absent. Branch leaves unistratose, composed of two cell types: large empty hyaline cells usually with annular or spiral strengthening fibrils and with one or more large pores; and an interposing network of narrow elongate photosynthetic cells.

Perigonia forming part of an otherwise unmodified branch; antheridia globose. Perichaetia borne on very short specialised branches at insertion of a fascicle, becoming greatly enlarged after fertilisation. Setae remaining very short. Capsules globose, raised at maturity on a stalk-like extension (pseudopodium) of the gametophyte, lacking a peristome, dehiscing by explosive discharge of the shallowly convex lid. Spores tetrahedral, 22–42 μ m diam.; distal face smooth to strongly papillose; proximal faces \pm smooth, separated by a distinct triradial ridge.

This monotypic family of c. 250 species is found in all continents except Antarctica. It occurs from near sea level to altitudes above 3000 m, mainly in wet, nutrient-poor, acidic wetland and mire habitats. Six species are known from Australia.

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SPHAGNUM

Sphagnum L., *Sp. Pl.* 2: 1106 (1753); from a Greek root referring to an unknown plant.

Lecto: *S. palustre* L.

Description as for the family.

Branch leaf outline is useful in delimiting some sections of *Sphagnum*, but it is rarely of value in identifying species. Anatomical features of branch leaves, including leucocysts (hyaline cells), chlorocysts (pigmented or chlorophyllous cells) and pores, provide most of the key characters for the recognition of species and sections. Leaves of the pendent or vestigial branches can be substantially modified, and they lack features of normal branch leaves. Stem leaf morphology is of limited taxonomic use.

Taxonomically useful characters also include the type of pore (ringed or unringed), pore distribution pattern relative to the leaf surfaces (adaxial and abaxial) and, to a lesser extent, pore diameter rather than pore frequency. However, their usefulness varies greatly between sections and, for example, considerable variation in pore number can be found in some taxa, particularly in sect. *Subsecunda*.

Anatomical details of leaves, particularly pores and the presence or absence of pseudopores in the leucocysts, are best observed when stained with an 0.5% aqueous crystal violet or Toluidine Blue solution. Leaf, stem and branch sections are also essential for accurate identification. The sectional shape, lateral ornamentation, position and exposure of the chlorophyllose cells relative to the adaxial and abaxial leaf surfaces can only be observed in thin sections of the leaves.

The number of species within the genus depends largely on interpretation of ‘species’, and many ecotypic variants have historically been described as distinct species, subspecies and varieties. Within the genus there are a number of well-defined groups which, in common with most modern treatments, are here referred to as sections.

The bryological literature includes numerous erroneous reports of *Sphagnum* spp. from Australia, as well as a large number of newly described taxa that are now regarded as

synonyms. Watts & Whitelegge (*Proc. Linn. New South Wales* 27 (Suppl.): 1–90, 1902) listed 30 species for Australia and Tasmania, while Warnstorff (1911) documented 23 species from mainland Australia and 9 from Tasmania. Watts (1912) reviewed the genus in Australia and noted 23 species for the mainland with 6 species found only in Tasmania. Andrews (1949) and Willis (1953) reduced a number of Australian taxa to synonymy, but recent studies have indicated that considerable nomenclatural confusion remains, with some of these taxa being incorrectly assigned. This is particularly true of sect. *Subsecunda*, where much Australian material has been referred incorrectly to *S. subsecundum* and *S. cymbifolioides*, and also includes the *S. molliculum*-*S. novozelandicum* complex in which there may well be additional taxa not included here.

- 1 Plants without clearly differentiated stems and branches; branches, if present, not in fascicles **5. *S. fuscovinosum***
- 1: Plants with clearly differentiated stems and branches; branches borne in fascicles on the stem2
 - 2 Cortical cells of stems and branches commonly fibrillose (sometimes almost absent in *S. perichaetiale*); branch leaves broad, cucullate, roughened at the back (abaxial side) of the broad apex and denticulate along marginal resorption furrow; hyaline cells of branch leaves with pores in 2s and 3s at adjacent cell angles, at least on adaxial surface (1:)3
 - 2: Cortical cells of stems and branches never fibrillose; branch leaves tapered to a narrow truncate apex, or less tapered and broadly truncate, usually entire, except across apex; mostly without a resorption furrow; hyaline cells of branch leaves rarely with pores in 2s or 3s at adjacent cell angles, at least on abaxial surface4
 - 3 Adaxial surface pores of branch leaf hyaline cells absent or rare; abaxial surface pores large, 2–8, ringed, often in 3s at basal angles of cells (2) **1. *S. cristatum***
 - 3: Adaxial surface pores of branch leaf hyaline cells absent or with few (1–4) simple pores scattered along commissures; abaxial surface pores in mid-leaf arranged at junction of basal and lateral angles of adjacent cells, forming pseudolacunae, with no or few additional pores **2. *S. perichaetiale***
 - 4 Stem cortical cells in 1 or 2 layers (2:)5
 - 4: Stem cortical cells in 3 (sometimes more) layers6
 - 5 Stem cortical cells predominantly in 1 layer; hyaline cells of branch leaves with numerous pores abaxially, few adaxially; chlorophyllose cells narrowly ellipsoidal or narrowly rectangular in section, exposed equally on both surfaces of leaf (4) **6. *S. novozelandicum***
 - 5: Stem cortical cells predominantly in 2 layers; hyaline cells of branch leaves with very few pores abaxially or adaxially; chlorophyllose cells triangular in section, exposed abaxially **4. *S. falcatulum***
 - 6 Hyaline cells of stem cortex fibrillose and porose (4:) **1. *S. cristatum***
 - 6: Hyaline cells of stem cortex efibrillose and porose **3. *S. australe***

Sect. 1. *Sphagnum*

Sphagnum* L. sect. *Sphagnum

Type: *S. palustre* L.

Dioicous. Stem cortical cells in 3 or 4 layers, large, thin-walled, hyaline, fibrillose, porose with 1 or more pores on outer surface. Branches stout, tumid; branch cortical cells similar to those of stem, but typically uniporose. Branch leaves imbricate, broadly ovate, deeply concave and cucullate, roughened at abaxial surface near apex by resorption of hyaline cells, narrowly bordered by partial resorption of marginal cells; adaxial surface pores of hyaline cells of branch leaves numerous, large, generally elliptic, at ends and corners and often along commissures, commonly in 3s at adjacent cell corners; abaxial surface pores fewer; chlorophyllose cells variable in shape (elliptic to equilateral-triangular or, rarely, ±trapezoidal) and exposure (from entirely immersed to exposed only on adaxial surface, or more broadly exposed on adaxial than on abaxial surface). Stem leaves small, almost flat, lingulate, finely fringed.

Two species occur in Australia.

1. *Sphagnum cristatum* Hampe, *Linnaea* 38: 661 (1874)

- T: Mt Kosciuszko, [N.S.W.], *F. Mueller*; lecto: BM-Hampe, *fide* A.J.Fife, *New Zealand J. Bot.* 34: 312 (1996).
Sphagnum subbicolor Hampe, *Flora* 63: 440 (1880). T: Mt Warning, [N.S.W.], *W. Guilfoyle s.n.*; holo: NY.
Sphagnum pachycladum Müll.Hal., *Fragm.* 11 (Suppl.): 108 (1881), *nom. nud.*
Sphagnum wilcoxii Müll.Hal., *Flora* 70: 407 (1887). T: Clarence R., N.S.W., Nov. 1875, *Wilcox*; holo: MEL.
Sphagnum leionotum Müll.Hal., *Flora* 70: 408 (1887). T: Table Mtn, South Africa, 1877, *Spielhaus*; *n.v.*
Sphagnum whiteleggei Müll.Hal., *Flora* 70: 408 (1887). T: Lawson, Blue Mountains, N.S.W., 1884, *T. Whitelegge*; holo: *n.v.*; iso: NSW?
Sphagnum australe Schimp., in *C. Warnstorf, Bot. Gaz. (Crawfordsville)* 15: 250 (1890), *nom. illeg.* (later homonym).
Sphagnum cymbophyllum F. Muell., in *C. Warnstorf, Hedwigia* 30: 36 (1891), *nom. inval.* (in synonym).
Sphagnum maximum Warnst., *Hedwigia* 30: 160 (1891). T: New Zealand, *Kirk* 8; syn: BM?; Tasmania, *Scott* 7; syn: MEL? *n.v.*
Sphagnum grandifolium Warnst., *Bot. Centralbl.* 82: 8 (1900). T: Tyagarah Rd, Byron Bay, N.S.W., *W.W. Watts* 3078, 3081, 3082, 3083; syn: H-BR.
Sphagnum decipiens Warnst., *Hedwigia* 47: 78 (1907). T: Govetts Leap, Blue Mountains, N.S.W., *W.W. Watts* 6119, 6120, 6120a, 6121, 6123, 6126a, 6128, 6130, 6132, 6133, 6135, 6137, 6138, 6142, 6142a, 6230; syn: H-BR.
Sphagnum decipiens Warnst. var. *obovatum* Warnst., *Hedwigia* 47: 79 (1907). T: not located.
Sphagnum decipiens Warnst. var. *obovatum* Warnst. f. *squarrosulum* Warnst., *Hedwigia* 47: 79 (1907). T: Blue Mountains, N.S.W., *W.W. Watts* 6119, 6129; syn: NSW.
Sphagnum decipiens Warnst. var. *obovatum* Warnst. f. *anocladum* Warnst., *Hedwigia* 47: 79 (1907). T: Blue Mountains, N.S.W., *W.W. Watts* 6120a, 6121, 6126a, 6130, 6132, 6133, 6135, 6137, 6138, 6230; syn: H-BR.?; isosyn (of 6138, 6230): NSW.
Sphagnum decipiens Warnst. var. *rotundatum* Warnst., *Hedwigia* 47: 79 (1907). T: Blue Mountains, N.S.W., *W.W. Watts* 6123, 6142, 6142a; syn: H-BR.; isosyn: NSW.
Sphagnum wardellense Warnst., *Hedwigia* 47: 81 (1907). T: Richmond River, [N.S.W.], *Wardel*, (*Watts* 5272); holo: H-BR? *n.v.*
Sphagnum maximum Warnst. var. *squarrosulum* Warnst., *Pflanzenreich* 51: 459 (1911). T: Bellinger River, [N.S.W.], *Canon* 2; holo: H-BR.
Sphagnum grandifolium Warnst. var. *brachycladum* Warnst., *Pflanzenreich* 51: 484 (1911). T: *s. loc.*, N.S.W., *W.W. Watts* 4202, 4204, 4205, 4206, 4243, 4244, 4245; syn: H-BR.; isosyn (of 4202, 4204, 4205): NSW.
Sphagnum grandifolium Warnst. var. *brachycladum* Warnst. f. *laxifolium* Warnst., *Pflanzenreich* 51: 484 (1911). T: *s. loc.*, N.S.W., *W.W. Watts* 4208; holo: H-BR? *n.v.*; iso: NSW.
Sphagnum grandifolium Warnst. var. *densum* Warnst., *Pflanzenreich* 51: 485 (1911). T: *s. loc.*, N.S.W., *W.W. Watts* 3078, 3081, 4131, 4134, 4274; syn: NSW.
Illustrations: K.W. Allison & J. Child, *Mosses of New Zealand* 30, pl. 3 (1971); R.D. Seppelt, *Hikobia* 13: 167, fig. 1 (2000).

Plants small to robust, pale green to brownish green, sometimes with a purplish brown colouration; capitulum not obscured by branches. Stem cortical cells in 3 or 4 layers surrounding a brown internal cylinder, fibrillose; outer layer with 1 or more irregularly arranged rounded to elliptic pores. Branches in fascicles of 4–5 (–6), 2 or 3 larger spreading branches and 2 or 3 pale slender pendent branches; branch cortical cells in 1 layer, ±uniform, strongly fibrillose, with or without a single pore at distal end. Branch leaves broadly ovate, concave, with cucullate and rounded apices, strongly roughened on abaxial surface near apex by cell wall resorption, serrulate above, bordered by 1 row of narrow cells; pores conspicuous under ×50 magnification; adaxial surface pores of hyaline cells absent or rare; abaxial surface pores large, 2–8, ringed, often in 3s at basal angles of cells; chlorophyllose cells narrowly elliptic in section (occasionally narrowly urceolate), narrowly exposed on both surfaces; commissural walls smooth. Stem leaves erect or pendent, lingulate; apex and margins narrowly eroded by resorption of hyaline cell walls; hyaline cells e-fibrillose to weakly fibrillose near the apex.

Mainly subalpine in N.S.W., A.C.T., Vic. and Tas.; forms turfs and mounds. Also in New Zealand.

N.S.W.: Gloucester Tops, *H.Streimann 1529* (CANB); Merritts Ck, Mt Kosciuszko, *H.Streimann 5360* (CANB). A.C.T.: Mt Gingera, *D.G.Catcheside 54.23* (AD). Vic.: L. Catani, Mt Buffalo, *D.G.Catcheside 69.238* (AD). Tas.: Mt Michael, *A.Moscal 13201* (HO).

2. *Sphagnum perichaetiale* Hampe, *Linnaea* 20: 66 (1847)

T: Brazil, *Beyrich s.n.*; holo: BM-Hampe.

Sphagnum beccarii Hampe, *Nuovo Giorn. Bot. Ital.* 4: 278 (1872). T: Sarawak, Borneo, [Malaysia], *Beccari 15*; holo: BM.

Sphagnum grandifolium Warnst., *Bot. Centralbl.* 82: 8 (1900). T: *s. loc.*, N.S.W., *W.W.Watts 3078*; holo: BM; iso: NSW.

Illustrations: A.Eddy, *Bull. Brit. Mus. (Nat. Hist.), Bot.* 5: 381, fig. 3; 382, fig. 4 (1977); R.D.Seppelt, *Hikobia* 13: 169, fig. 2 (2000).

Possibly dioicous, very rarely found fertile (not in Australia). Plants usually robust, yellowish brown to brownish green, sometimes with a dull reddish brown pigmentation, compact to lax. Stems with a well-developed cortex; cortical cells mostly 3-layered, with internal; end and external walls all with large pores; exposed outer wall of cortical cells with a single pore; without or with weakly to well-developed fibrillar thickenings. Branches in fascicles of 4 or 5 (occasionally 2 or 3), rather strongly dimorphic; spreading branches rather tumid, blunt or tapering distally; pendent branches strongly deflexed, pale, comparatively thin and attenuate; branch cortical cells uniform, of a single layer of large leucocysts, convex on outer and inner surfaces, some or all with a non-protuberant pore. Branch leaves erect-spreading, broadly ovate, concave, to 2 mm long, 1.0–1.5 mm wide; apex rounded, cucullate, scabrous abaxially due to projecting partially resorbed hyaline cells; border of 1 row of narrow cells, with a resorption furrow; leucocysts comparatively broad, 60–150 µm long, c. 25 µm wide; adaxial surface pores in mid-leaf usually lacking or with 1–4 simple pores scattered along commissures; abaxial surface pores in mid-leaf arranged at junction of basal and lateral angles of adjacent cells, forming pseudolacunae, with no or few additional pores; leucocysts, in section, plane to convex adaxially, strongly convex abaxially; chlorophyllose cells relatively narrow, urceolate to elliptic, exposed equally on both surfaces or more narrowly on abaxial surface. Stem leaves variable, erect or pendent, lingulate and almost efibrillose to strongly fibrillose and resembling branch leaves in morphology; apex typically broadly rounded, weakly bordered, variously eroded.

Occurs in N.T., Qld and N.S.W. Also in New Zealand (North Island), India, SE Asia, Malasia, Melanesia, Fiji, South America, the Caribbean, eastern U.S.A., southern Africa, Madagascar and Mauritius. Tropical to subtropical, favouring irrigated rocks and acidic, organic or inorganic substrata in open to semi-shaded, generally wetter habitats.

N.T.: Twin Falls–Jim Jim Falls area, Kakadu Natl Park, *J.Russell-Smith 1225* (MEL). Qld: Cania Gorge Natl Park, near Monto, *I.G.Stone 21072* (MEL); Cania Gorge Natl Park, *I.G.Stone 22670* (MEL). N.S.W.: L. Medlow, *E.F.Constable M 11066* (NSW).

Eddy (1977) included 52 taxa in the synonymy of *S. perichaetiale*. In the Australian material examined the fibrillar thickenings of the stem cortical cells, a characteristic of sect. *Sphagnum*, are often faint or absent; this was also reported by Eddy (1977) from other material. The species has not been found fertile in SE Asia (Eddy, 1977).

Sect. 2. *Rigida*

Sphagnum sect. **Rigida** (Lindb.) Schlieph. ex Limpr., *Rabenh. Krypt.-Fl.*, 2nd edn, 4(1): 116 (1885)

Type: *S. rigidum* (Nees & Hornsch.) Schimp.

Sphagnum vijitanum Schimp. ex Warnst., *Hedwigia* 30: 144, t. 14, fig. 8; t. 21, fig. 1 (1891). T: Viti Levu, Fiji, *Hooker 65*; holo: *n.v.*

Monoicous or dioicous. Stem cortical cells in 1–3 (–5) layers, without fibrils and pores, or cells in outer layer with 1 large pore. Branches always markedly dimorphic, with large incumbent or subsquarrose spreading branch leaves and reduced pale pendent branch leaves; pendent branches usually appressed to the stem; branch cortical cells without fibrils, uniform, the majority with a large pore near the distal end. Spreading branch leaves broad and ovate to elliptic, concave due to inrolled margins, often squarrose-truncate and dentate at the apex, rarely eroded but often somewhat cucullate, narrowly bordered, slightly denticulate by partial resorption of the marginal row of cells; adaxial surface pores usually in 3s and with pseudopores; abaxial surface pores with or without pseudopores, or absent; chlorophyllose cells narrow, almost to completely immersed on one or both leaf surfaces, with ovoid lumina. Stem leaves small and \pm vestigial.

One species is known from Australia.

3. *Sphagnum australe* Mitt., in J.D.Hooker, *Fl. Tasman.* 2: 162 (1859)

Sphagnum compactum DC. var. *ovatum* Hook.f. & Wilson, *Fl. Antarct.* 1: 122 (1844); *S. antarcticum* Mitt. var. *australe* (Mitt.) Warnst., *nom. illeg.* T: Campbell Is., 1839–43, *J.D.Hooker (Wilson 5b)*; lecto: BM-Wilson, *vide* A.J.Fife, *New Zealand J. Bot.* 34: 315 (1996).

Sphagnum confertum Mitt., in J.D.Hooker, *Fl. Tasman.* 2: 163 (1859). T: Cumming's Head, [Tas.], *W.Archer; n.v.*

Sphagnum antarcticum Mitt., *J. Proc. Linn. Soc., Bot.* 4: 100 (1860). T: Campbell Is., 1839–43, *J.D.Hooker (Wilson 5)*; lecto: BM-Wilson, *vide* A.J.Fife, *New Zealand J. Bot.* 34: 315 (1996).

Sphagnum antarcticum Mitt. var. *fluctuans* Warnst., *Hedwigia* 29: 254 (1890). T: Campbell Is.[?], in Herb. Bescherelle, *vide* C.Warnstorf, *loc. cit.*

Sphagnum macrocephalum Warnst., *Hedwigia* 32: 7, t. 2, fig. 6 (1893); *S. antarcticum* Mitt. var. *macrocephalum* (Warnst.) Warnst., *Pflanzenreich* 51: 155 (1911). T: Lake Bellinger track, Zeehan, [Tas.], 7 Feb. 1891, *W.A.Weymouth 623, 624*; syn: H-BR, NSW.

Sphagnum antarcticum Mitt. var. *ericetorum* Müll.Hal. ex Warnst. f. *densissimum* Warnst., *Pflanzenreich* 51: 157 (1911); *S. antarcticum* Mitt. var. *densissimum* (Warnst.) Rodway, *Pap. & Proc. Roy. Soc. Tasmania* 1913: 254 (1914). T: Hartz Mtns, [Tas], *Mitchell 2325*; holo: H-BR.

Sphagnum campbellianum Müll.Hal., *Pflanzenreich* 51: 153 (1911), *nom. inval.* (in synon.).

Sphagnum falcirameum Müll.Hal., *Pflanzenreich* 51: 153 (1911), *nom. inval.* (in synon.).

Sphagnum orthocladum Bryhn ex Warnst., *Pflanzenreich* 51: 153 (1911), *nom. inval.* (in synon.).

Sphagnum antarcticum Mitt. var. *subsquarrosus* Warnst. ex Rodway, *Pap. & Proc. Roy. Soc. Tasmania* 1913: 255 (1914). T: not designated.

Sphagnum weymouthii Warnst. ex Rodway, *Pap. & Proc. Roy. Soc. Tasmania* 1913: 255 (1914). T: Mt Macmichael, Blue Tier, [Tas.]; holo: *n.v.*

Illustration: R.D.Seppelt, *Hikobia* 13: 171, fig. 3 (2000).

Possibly dioicous. Plants small to robust, whitish green to pale brownish green, sometimes weakly tinged brownish purple; capitulum usually \pm obscured by upwardly directed branches. Stem cortical cells in 3–5 layers surrounding a pale brown internal cylinder; outermost layer efibrillose, most with 1 (–3) large distally placed pores. Branches in fascicles of 4 or 5, with 2 larger spreading and 2 or 3 slender pale pendent branches; branch cortical cells efibrillose, uniform in shape, in 2 or 3 layers surrounding a pale brown internal cylinder; with a single pore at the distal end. Branch leaves broadly ovate-lanceolate, acute to obtuse, concave, inrolled at margins, not roughened abaxially near apex, entire, with a few apical teeth, with a border of 2–4 rows of narrow cells and a weak intramarginal resorption furrow; adaxial surface pores fewer than on abaxial surface, often grouped in 2 or 3 in basal and adjacent lateral angles of cells; abaxial surface pores usually numerous (to 12–15), \pm irregularly distributed along lateral commissures; chlorophyllose cells ovoid-elliptic in section, narrowly exposed on both surfaces. Stem leaves usually pendent, sometimes erect, lingulate, variably eroded, bordered.

Occurs in N.S.W., A.C.T., Vic. and Tas., in lowland to subalpine, usually well-drained habitats. Also in South America, southern Africa and New Zealand.

N.S.W.: Kew, *J.B.Cleland* 21 (AD); Govetts Leap, Blackheath, *W.W.Watts* 6134 (NSW). A.C.T.: Mt Franklin, *Hj.Eichler* 13294 (AD). Vic.: Honeysuckle Ck, Victoria Ra., Grampians, *A.C.Beaglehole* 4085 (MEL). Tas.: Ballroom Forest, Cradle Mtn, *D.G.Catcheside* 86.108 (AD).

Sect. 3. Cuspidata

Sphagnum sect. **Cuspidata** (Lindb.) Schlieph. ex Schimp., *Syn. Musc. Eur.*, 2nd edn 829 (1876)

Type: *S. cuspidatum* Ehrh. ex Hoffm.

Monoicous or dioicous. Stem cortical cells in (1–) 2–3 (–4) layers, sometimes poorly differentiated from internal cylinder, without pores or fibrils. Branches uniform or dimorphic; branch cortical cells dimorphic, with distinct retort cells bearing a single \pm apical pore, not fibrillose. Branch leaves ovate to lanceolate, sometimes very long and narrow, strongly bordered and with involute margins, never with resorption furrows; apices narrowly truncate-dentate; adaxial surface pores lacking, or few near cell angles; abaxial surface pores lacking or few, small to medium-sized; chlorophyllose cells triangular to trapezoidal in section, always with wider exposure on abaxial surface and commonly immersed below adaxial surface of leaf. Stem leaves variable in size and shape.

One species occurs in Australia.

4. **Sphagnum falcatulum** Besch., *Bull. Soc. Bot. France* 32: LXVII (1885)

T: Île Hoste, Cape Horn, 1883, *Hyades*; holo: n.v.

Sphagnum serrulatum Warnst., *Hedwigia* 32: 1 (1893). T: Zeehan Railway, Zeehan, Tas., 9 Feb. 1891, *W.A.Weymouth* 622; holo: H-BR; iso: NSW.

Sphagnum lancifolium Müll.Hal. & Warnst., *Hedwigia* 36: 154 (1897). T: Sydney, [N.S.W.], Nov. 1893, *T.Whitelegge*; holo: B, presumably destroyed.

Sphagnum watsii Warnst., *Bot. Centralbl.* 76: 421 (1898). T: Richmond R., [N.S.W.], Sept. 1898, *W.W.Watts* 1113, 1024; syn: H-BR.

Sphagnum serratifolium Warnst., *Bot. Centralbl.* 82: 72 (1900). T: Tyagarah Rd, Byron Bay, N.S.W., Aug. 1899, *W.W.Watts* 3086; holo: H-BR.

Sphagnum brotherusii Warnst., *Bot. Centralbl.* 82: 74 (1900). T: Tyagarah Rd, Byron Bay, N.S.W., *W.W.Watts* 3075, 3085; syn: H-BR; E of Ballina, N.S.W., Sept. 1898, *W.W.Watts* 2273; syn: H-BR.

Sphagnum drepanocladum Warnst., *Bot. Centralbl.* 82: 75 (1900). T: Whaws Bay, Ballina, N.S.W., Apr. 1899, *W.W.Watts* 2851; holo: H-BR; iso: NSW.

Sphagnum trichophyllum Warnst., *Hedwigia* 39: 100 (1900). T: Mt Wellington [Tas.], 25 Dec. 1887, *R.A.Bastow* 2213; H-BR.

Sphagnum serratum Austin var. *serrulatum* (Schlieph.) Warnst., *Pflanzenreich* 51: 247 (1911), *nom. illeg.* (later homonym).

Sphagnum brotherusii Warnst. var. *plumosulum* Warnst., *Pflanzenreich* 51: 248 (1911). T: *s. loc.*, N.S.W., *W.W.Watts* 4265; syn?: NSW.

Sphagnum watsii Warnst. var. *leptocladum* Warnst., *Pflanzenreich* 51: 272 (1911). T: Richmond River, N.S.W., *W.W.Watts* 5606; syn?: NSW.

Sphagnum watsii Warnst. var. *macrophyllum* Warnst., *Pflanzenreich* 51: 272 (1911). T: Newcastle, N.S.W., *Murson* 4521 ex Herb. Watts; syn?: NSW.

Sphagnum rodwayi Warnst., in *L.Rodway, Pap. & Proc. Roy. Soc. Tasmania* 1913: 257 (1914). T: Strickland, Tas.; syn: HO, NSW.

Illustrations: R.D.Seppelt, *Hikobia* 13: 172, fig. 4 (2000); R.D.Seppelt, *The Moss Flora of Macquarie Island* 263, fig. 102; 271, fig. 109 (2004).

Monoicous. Plants delicate to robust, pale yellowish green to light green, finely branched; capitulum well defined. Stem cortical cells in 1 or 2 layers, sometimes indistinct, elongate, lacking pores or fibrils; internal cylinder greenish to yellowish. Branches in fascicles of 3 or 4, 1 or 2 spreading branches, 1 or 2 pendent branches \pm similar to well differentiated; branch

cortical cells in 1 layer, the retort cells clearly differentiated and with a weakly protruding distal pore, elongate. Branch leaves ovate-lanceolate; apex narrow, toothed across the apex; margin \pm undulate, inrolled towards the apex; with a border of 2 or 3 rows of narrow elongate cells; hyaline cells elongate; adaxial surface pores/pseudopores few, 1–8 or occasionally more, terminal or lateral at junction of cells; abaxial surface pores 2–8, unringed, along the lateral commissures, mostly at junctions of cells; chlorophyllose cells trapezoidal in section, exposed more widely on abaxial surface; commissural walls smooth. Stem leaves erect, spreading or pendent, broadly triangular to \pm lingulate, bordered; hyaline cells fibrillose in upper part, efibrillose in the lower half, with 4–8 adaxial pores per cell in upper fibrillose cells.

Occurs in N.S.W., Vic. and Tas.; usually in wet habitats from near sea level to subalpine, often in water where the plants can assume a particularly feathery appearance. Also in Macquarie Is., New Zealand and South America.

N.S.W.: Mt Budawang, *E.F.Constable 6967* (NSW). Vic.: Mt Clay State Forest, *A.C.Beauglehole 4471* (MEL); La Trobe R., Powelltown, Oct. 1929, *J.H.Willis* (MEL). Tas.: Blue Tier, *W.A.Weymouth 2397* (HO).

Scott & Stone (*The Mosses of Southern Australia* 60, 1976) reported this species from Queensland, but I have not seen any specimens from that State.

Rodway (1914) incorrectly attributed the name *Sphagnum cuspidatum* Ehrh. ex Hoffm., to specimens from Macquarie Harbour and Mt Wellington in Tasmania, and this misidentification has been perpetuated in the literature (Scott & Stone, 1976; Streimann & Curnow, 1989; Dalton *et al.*, 1991). Rodway's description is confused as it appears to be based on two distinct taxa, *S. falcatulum* and *S. novozelandicum*. The chlorocysts being in section "obtuse wedge shaped, the convex base free on the external surface" is characteristic of the former species while the hyalocysts having pores "small, circular, ... many along both margins" suggests the latter. Willis (1953) correctly referred *S. cuspidatum sensu* Warnstorf (1911) to *S. falcatulum*. *Sphagnum cuspidatum* is primarily a Northern Hemisphere species.

Sect. 4. Subsecunda

Sphagnum sect. **Subsecunda** (Lindb.) Schlieph. ex Schimp., *Syn. Musc. Eur.*, 2nd edn 1843 (1876)

Type: *S. subsecundum* Nees

Dioicous. Stem cortical cells usually in 1 or 2 (–4) layers, thin-walled, without fibrils, without pores or occasionally porose on the outer surface. Branches not or weakly dimorphic; branch cortical cells similar to stem cortical cells. Branch leaves proportionately broad, ovate-lanceolate to broadly ovate or elliptic, concave, narrowly truncate and dentate or eroded across apices, narrowly bordered by linear cells; hyaline cells typically long and narrow; adaxial surface pores numerous, very small, ringed, on one or both sides of the cells; abaxial surface pores absent or few to numerous; chlorophyllose cells in section normally thick-walled and barrel-shaped, ovate or urceolate with oval lumina. Stem leaves variable, sometimes greatly reduced, commonly as large as or larger than branch leaves, resembling branch leaves in cell form and structure.

Two species occur in Australia.

5. Sphagnum fuscovinosum Seppelt & H.A.Crum, *Contr. Univ. Michigan Herb.* 22: 132 (1999)

T: Tarn Shelf, Mount Field Natl Park, Tas., *P.J.Dalton 91.2*; holo: HO; iso: Herb. Dalton, CHR, MICH.

Illustration: R.D.Seppelt & H.A.Crum, *loc. cit.*, fig. 1.

Plants burgundy to deep purple-brown, branching by irregular dichotomies, lacking fascicles, to 12 cm long. Stem cortical cells in a single layer surrounding a pale yellow to brown internal cylinder, lacking fibrils, mostly without pores; retort cells not differentiated. Leaves

broadly ovate, with a truncate and irregularly 3–5-toothed apex, to 6 mm long, strongly concave, bordered by 4–6 rows of narrow elongate cells. Hyalocysts narrowly elongate, 150–200 × 15–20 µm in upper median leaf, fibrillose, becoming slightly longer below; abaxial surface pores 12–20 along margins, 4–6 µm diam., rounded to ellipsoidal; adaxial surface pores 3 or 4 per cell, similar in size and position; chlorophyllose cells in section barrel-shaped, broadly exposed on both surfaces. Reproductive structures not seen.

Endemic to Tas.; found in shallow, alpine moorland pools over basic Jurassic doleritic substrata above 1000 m.

Tas.: Mt Mawson Plateau, Mount Field Natl Park, *A.V.Ratkowsky H 447* (HO); *loc. id.*, *P.J.Dalton 82.124* (HO); Newdegate Pass, Mount Field Natl Park, *Dobson 77021* (CHR); Ben Lomond Natl Park, 13 Jan. 1979, *A.Moscal* (HO).

Considering the robustness of the plants, the stems are remarkably slender. It is likely that the species will be located in other alpine areas, at least over doleritic rather than quartzite or granitic rock, but detailed surveys have not been undertaken in many areas.

Like *S. simplex* Fife in New Zealand (Fife, 1996), collections of *S. fuscovinosum* have come from waterlogged habitats in shallow pools in subalpine to alpine locations. Plants of *S. simplex* are a pale chestnut to pale brownish green, compared to the deep purple-brown of *S. fuscovinosum*, the diameter of the branches (stem and leaves) is narrower, the leaves are smaller, and the abaxial pores of the hyalocysts are larger.

6. *Sphagnum novozelandicum* Mitt., *J. Proc. Linn. Soc., Bot.* 4: 99 (1860)

T: New Zealand, *Kerr*; lecto: NY *n.v.*, *fide* A.J.Fife, *New Zealand J. Bot.* 34: 321 (1996).

Sphagnum cymbifolioides Müll.Hal., *Bot. Zeitung (Berlin)* 9: 546 (1851), *nom. illeg.* (later homonym).

Sphagnum contortum Schultz var. *intermedium* Wilson, in J.D.Hooker, *Fl. Tasman.* 2: 162 (1859). T: *s. loc.*, [Tas.], *A.F.Oldfield 29*; holotype: BM? *n.v.*

Sphagnum contortum Schultz var. *laxum* Wilson, in J.D.Hooker, *Fl. Tasman.* 2: 162 (1859). T: Mt Wellington, [Tas.], *R.C.Gunn 41*; holotype: BM? *n.v.*

Sphagnum contortum Schultz var. *scorpioides* Wilson, in J.D.Hooker, *Fl. Tasman.* 2: 162 (1859). T: Mt Wellington, [Tas.], *R.C.Gunn 2*; holotype: BM? *n.v.*

Sphagnum molliculum Mitt., in J.D.Hooker, *Fl. Tasman.* 2: 163 (1859). T: Cheshunt, [Tas.], *W.Archer*; holotype: NY

Sphagnum subcontortum Hampe, *Linnaea* 40: 301 (1876); *S. subsecundum* Nees var. *subcontortum* (Hampe) A.Jaeger, *Ber. Tätigk. St. Gallischen Naturwiss. Ges.* 1877–78: 364 (1879) (Ad. 2: 628). T: Mt Warning, [N.S.W.], *W.Guilfoyle*; holotype: B, presumably destroyed; isotype: NSW.

Sphagnum comosum Müll.Hal., *Flora* 70: 413 (1887). T: Waterloo Marshes, Sydney, [N.S.W.], Nov. 1883, *T.Whitelegge*; syn.: NSW; Berwick, [Vic.], *G.W.Robinson*; syn.: MEL.

Sphagnum mossmannianum Müll.Hal., *Hedwigia* 29: 184 (1891), *nom. inval.* (in synonym).

Sphagnum dubiosum Warnst., *Hedwigia* 30: 20 (1891). T: “Süd-Australien”, *F.M.Campbell 5*; holotype: H-BR.

Sphagnum pseudorufescens Warnst., *Hedwigia* 32: 6 (1893). T: Mt Wellington, Tas., 15 Feb. 1888, *W.A.Weymouth 972*; syn?: BM, CHR, HO, NSW.

Sphagnum moorei Warnst., *Allgem. Bot. Zeitschr.* 1: 204 (1895). T: Kellys Basin and Macquarie Harbour [Tas.], *Moore 54*, in *Herb. W.A.Weymouth 1602*; isotype: HO.

Sphagnum submolliculum Warnst., *Hedwigia* 36: 164 (1897). T: Kellys Basin, [Tas.], *J.B.Moore*; holotype: H-BR.

Sphagnum sullivanii Müll.Hal., *Genera Musc. Frond.* 103 (1900). T: Mt William Creek, Grampians, [Vic.], Aug. 1875, *D.Sullivan 18*; holotype: B, presumably destroyed.

Sphagnum commutatum Warnst., *Magyar Bot. Lapok.* 1: 45 (1902). T: Three Mile Scrub, Byron Bay, N.S.W., 2 May 1900, *W.W.Watts 4209*; holotype: NSW.

Sphagnum laticoma Müll.Hal. ex Warnst., *Pflanzenreich* 51: 312 (1911). T: Black Spur, [Vic.], *coll. unknown*; holotype: MEL *n.v.*

Sphagnum moorei Warnst. var. *macrophyllum* Warnst., *Pflanzenreich* 51: 369 (1911). T: Port Esperance, [Tas.], *W.A.Weymouth 1693*; isotype: HO.

Sphagnum novozelandicum Mitt. var. *commutatum* Warnst., *Pflanzenreich* 51: 334 (1911). T: *s. loc.*, [N.S.W.], *W.W.Watts 3735, 3759, 3775, 4200, 4210, 4453*; syn.: H-BR; isosyn (of 3759, 3775, 4453): NSW.

Sphagnum novozelandicum Mitt. var. *laxifolium* Warnst., *Pflanzenreich* 51: 334 (1911). T: *s. loc.*, [N.S.W.], W.W.Watts 3734, 5190, 5191, 5192; syn: H-BR; isosyn (of 5191): NSW.

Sphagnum novozelandicum Mitt. var. *molle* Warnst., *Pflanzenreich* 51: 332 (1911). T: Maroubra Bay, [N.S.W.], T.Whitelegge 435; holo: H-BR; iso: NSW.

Sphagnum novozelandicum Mitt. var. *pauciporosum* Warnst., *Pflanzenreich* 51: 334 (1911). T: *s. loc.*, [N.S.W.], W.W.Watts 4272; iso: NSW.

Sphagnum novozelandicum Mitt. var. *pulvinatum* Warnst., *Pflanzenreich* 51: 334 (1911). T: Mt Wellington, [Tas.], F.L.E.Diels 6186; holo: B, presumably destroyed.

Sphagnum pseudorufescens Warnst. var. *flavescens* Warnst., *Pflanzenreich* 51: 371 (1911). T: *s. loc.*, [N.S.W.], W.W.Watts 200; iso: NSW.

Sphagnum pseudorufescens Warnst. var. *fuscorufescens* Warnst., *Pflanzenreich* 51: 371 (1911). T: *s. loc.*, [Tas.], W.A.Weymouth 972, 973, 975, 976, 977; syn: HO.

Sphagnum pseudorufescens Warnst. var. *fuscorufescens* Warnst. f. *dieladum* Warnst., *Pflanzenreich* 51: 371 (1911). T: *s. loc.*, [N.S.W.], W.W.Watts 6183; iso: NSW.

Sphagnum pseudorufescens Warnst. var. *pallens* Warnst., *Pflanzenreich* 51: 371 (1911). T: *s. loc.*, [Tas.], W.A.Weymouth 2133; iso?: HO.

Sphagnum pseudorufescens Warnst. var. *virescens* Warnst., *Pflanzenreich* 51: 371 (1911). T: *s. loc.*, [N.S.W.], W.W.Watts 6194; iso: HO.

Illustrations: R.D.Seppelt, *Hikobia* 13: 176, fig. 6; 177, fig. 7 (2000).

Dioicous. Plants very variable, small and cushion-forming to robust, yellowish brown, sometimes tinged with brownish purple; capitulum well defined with curved branches in cushion forms to ill-defined in aquatic forms. Stem cortical cells in 1 (–2) layers, surrounding a pale brownish central cylinder; outer cortical cells usually with a single distal pore, sometimes eprose. Branches in fascicles of 3–5, with 2 or 3 divergent branches and 1 or 2 more slender pendent branches; spreading branches often curved; aquatic forms with 1 or 2 branches in fascicles; branch cortical cells in a single layer, dimorphic; retort cells larger in section, with a single projecting pore at distal end. Branch leaves ovate-lanceolate, erect-spreading or appressed, strongly concave, with 3 or 4 apical teeth due to resorption; border of 1–3 rows of narrow cells; adaxial surface pores lacking or very sparse; abaxial surface pores small, ringed, numerous, 8–16 along commissures; chlorophyllose cells broadly oblong or truncated-elliptic, equally exposed on both surfaces; commissural walls smooth. Stem leaves mostly pendent, lingulate, rounded or obtuse, ±eroded near apex, bordered by 3–5 rows of narrow cells, fibrillose throughout, more weakly so in lower half of leaf; abaxial surface of hyaline cells with numerous strongly ringed pores in rows along commissures; adaxial surface with no or few pores.

Occurs in W.A., N.S.W., A.C.T., Vic. and Tas., from near sea level to subalpine; grows in moist to wet habitats in woodland, acidic shrubland or grassland and in roadside ditches. Also in New Zealand and Campbell Island.

W.A.: Weld River Bridge, SE of Manjimup, Aug. 1966, G.G.Smith (PERTH). N.S.W.: Jigamy Ck, Eden, E.F.Constable (NSW). A.C.T.: Little Ginini, Brindabella Ra., H.Streimann 4169 (CANB). Vic.: between Zumsteins and McKenzie Falls, Grampians Natl Park, A.C.Beauglehole 74107 (MEL). Tas.: Western Tiers, Dec. 1908, L.Rodway (HO).

The record from Western Australia, as *S. subsecundum*, was discussed in detail by Smith (1969).

I have included in *S. novozelandicum* Australian material misidentified as *S. molliculum*, *S. subsecundum* and *S. cymbifolioides*, as well as numerous Watts and Warnstorf names. I have taken this approach for simplicity, while at the same time acknowledging that the *Subsecunda* group is in need of further critical evaluation.

Doubtful and Excluded Names

Sphagnum centrale C.E.O.Jensen, *Bih. Kongl. Svenska Vetensk.-Akad. Handl.* 21, Afd. 3(10): 34 (1896)

This is a circumpolar, Northern Hemisphere species with continental tendencies (P.Isoviita, Studies on *Sphagnum*. I. Nomenclatural revision of the European taxa, *Ann. Bot. Fenn.* 3: 199–264, 1966). It is sometimes confused with *S. magellanicum*, but the two differ in morphology, ecology and distribution. Warnstorf (*Kryptogamenfl. Mark Brandenburg* 1: xv, 1–481, 1902–03, 1911) regarded Australasian material he had earlier determined as *S. whiteleggei* to be referable to *S. centrale*. *Sphagnum whiteleggei* was subsequently synonymised under *S. cristatum* by Willis (1953). The record of *S. centrale* for Australia is, therefore, erroneous.

Sphagnum compactum DC., *Fl. Franç.* 443 (1805)

Although listed for Australia by Streimann & Curnow (1989), Fife (1996) observed that the original record from Tasmania (J.D.Hooker, *Fl. Tasman.* 2: 162, 1859) is referable to *S. australe*. The distance along the stems between fascicles of branches is very variable, and some forms with very short internodes have the appearance of *S. compactum*. In Australia such forms, based on an examination of herbarium specimens, appear to be rare, and all the material I have examined is *S. australe*. Fife (1996) discussed the features that distinguish the two species.

Sphagnum dominii Kavina, *Sitzungsber. Königl. Bohm. Ges. Wiss. Prag. Math.-Naturwiss. Cl.* 1915(9): 2 (1916)

Listed by Streimann & Curnow (1989), but I have not been able to trace the origin of this record in the original publication, and it must remain doubtful.

Sphagnum magellanicum Brid., *Muscol. Recent.* 2(1): 24 (1798)

I have not seen any Australian material referable to this species. It was reported in an unpublished list of mosses from the A.C.T. by W.A.Weber in 1968 (*vide* Streimann & Curnow, 1989). The outer cortex of the stem either lacks or has only faintly developed fibrils. Typical plants are usually reddish pink. The plants are also rather robust, and it is likely that Australian records are misidentifications of *S. cristatum* or *S. australe*.

Sphagnum naumanii Müll.Hal., *Bot. Jahrb. Syst.* 5: 87 (1883)

Referred by Willis (1953) to probable synonymy under *S. falcatulum*. The type is from Qld and has not been located.

Sphagnum palustre L., *Sp. Pl.* 1106 (1753)

This is a Northern Hemisphere species (sect. *Sphagnum*) having similar leaf shape, stem sectional anatomy and fibrillar thickenings in the stem outer cortical cells to those of *S. cristatum*. However, in *S. palustre* the chlorocysts in sections of the branch leaves are exposed on the abaxial surface. Australian reports probably belong to *S. cristatum* Hampe, although the morphological similarities of these species merit further investigation.

Sphagnum scortechinii Müll.Hal., *Hedwigia* 36: 153 (1897)

Referred by Willis (1953) to probable synonymy under *S. falcatulum*. The type is from Qld, without locality or date, collected by Scortechini, and originally placed in B. The specimen has not been located and is likely to have been destroyed in 1943. The description in Warnstorf (1911) indicates at least a close similarity to *S. falcatulum*.

Sphagnum subsecundum Nees var. *rufescens* (Nees & Hornsch.) Huebener, *Musc. Germ.* 26 (1833)

There is one published Australian record of this variety, from N.S.W. (Crum 1984, p. 63). However, this taxon was considered by Crum (pers. comm.) not to be represented in the Australian flora.

Sphagnum vitianum Schimp. ex Warnst., *Hedwigia* 30: 144 (1891)

Reported from Australia by Kavina (Ein Beitrag zur Torfmoosflora Australiens, *Sitzungsber. Konigl. Bohm. Ges. Wiss. Prag., Math.-Naturwiss.* 1915(9): 1–9, 1916) and listed without verification by Streimann & Curnow (1989). Warnstorf (1911) recorded the species only from Fiji, while Andrews (Studies in the Warnstorf *Sphagnum* herbarium. VI. The subgenus *Inophloea* in the eastern hemisphere, *Bryologist* 54: 83–91, 1951) referred *S. vitianum* to *S. palustre* L. The report for Australia appears to be erroneous, and the specimens reported by Kavina are considered here to be most likely referable to *S. cristatum*.