



nonseptate, comb-lamellae usually absent, but sometimes weak. **Branches** short and blunt-tipped, leaves spreading. **Branch fascicles** with 2 spreading and 1 pendent branch. **Branch stems** with hyaline cells non-ornamented, no or weak funnel-like projections on the end walls of cortical cells, cortical cell walls usually with large round pores. **Branch leaves** ovate to ovate-elliptical, 1.6–2.2 × 1 mm; hyaline cells on proximal half of convex surface with round to elliptic pores along the commissures; comb-lamellae on hyaline cell wall where overlying chlorophyllous cells; chlorophyllous cells broadly triangular in transverse section and well-enclosed on convex surface, end wall not thickened. **Sexual condition** dioicous. **Capsule** unknown. **Spores** unknown.

Commonly in firm-bottomed poor to medium fen vegetation, subarctic to arctic regions; low to moderate elevations; Man., N.W.T., Nunavut, Que., Yukon; Alaska; e Asia.

Sphagnum steerei is usually easily recognized in the field by its dense growth habit and dark brown color. Its ecology is somewhat unclear due to taxonomic confusion with *S. imbricatum* in the strict sense and *S. austinii* (R. E. Andrus 1987). The latter is the only species in the *imbricatum* complex that occurs where *S. steerei* does. Contrary to the view of H. A. Crum (1997), *S. steerei* is quite distinct from *S. affine* and *S. austinii*. There is no range overlap with either of those species and the macroscopic appearance is also quite different.

1b. SPHAGNUM sect. RIGIDA (Lindberg) Limpricht in G. L. Rabenhorst et al., Krypt.-Fl. ed. 2, 4(1): 116. 1885

Sphagnum [unranked] *Rigida* Lindberg, Öfvers. Kongl. Vetensk.-Akad. Förh. 19: 135. 1862

Plants low-growing in loose mats to compact cushions, capitulum often indistinct or concealed by upwardly directed branches; pale green, straw-colored, brownish to reddish. **Stems** with superficial cortex of 1–3 layers of efibrillose, inflated, thin-walled, non-ornamented, and aporose cells. **Stem leaves** much smaller than branch leaves, triangular-lingulate, border entire and

broadened at base; hyaline cells rhomboid, e fibrillose, nonornamented, aporse, and usually nonseptate; hyaline cells not resorbed on either surface. **Branches** strongly dimorphic, spreading branches much stronger than pendent branches. **Branch fascicles** with 2–3 spreading branches and 2(–3) pendent branches. **Branch stems** green, green to brownish, surrounded by 1 layer of e fibrillose, non-ornamented, inflated, thin-walled, uniporse cells with slight protruding necks. **Branch leaves** ovate to ovate-lanceolate, apex broadly truncate, smooth and toothed; margin denticulate; hyaline cells fibrillose, smooth or papillose, convex surface with \pm 5 small to medium-sized free pores, sometimes numerous pseudopores, concave surface with large pores in cell angles; chlorophyllous cells elliptic to ovate-triangular in transverse section, completely enclosed or exposed on concave surface, end walls unthickened. **Sexual condition** monoicous or dioicous. **Capsule** 2 mm or less, with numerous pseudostomata. **Spores** mean diameter more than 30 μ m, raised Y-mark sculpture on distal surface; proximal laesura more than 0.3 spore radius.

Species 5 (2 in the flora): worldwide except Antarctica.

1. Chlorophyllous cells of branch leaves elliptic in transverse section and completely enclosed on both surfaces, adjacent hyaline cell walls smooth; stem leaves lingulate to oblong-triangular 13. *Sphagnum compactum*
1. Chlorophyllous cells of branch leaves elongate-triangular to ovate-triangular, enclosed on the adaxial surface and exposed on the convex surface, adjacent hyaline cell walls minutely papillose; stem leaves bluntly deltoid 14. *Sphagnum strictum*

13. *Sphagnum compactum* Lamarck & de Candolle, Fl. Franç. ed. 3, 2: 443. 1805



Sphagnum compactum var. *imbricatum* Warnstorf; *S. rigidum* (Nees & Hornschuch) Schimper

Plants moderate to large-sized, dense and compact, pale green, brownish white, golden brown to variegated golden brown, can be reddish in rocky seep habitats; forms small, tufted compact

cushions. **Stems** brown. **Stem leaves** small, 0.3–0.7 mm, triangular-lingulate with broad rounded apex, **Branches** short, crowded, and unranked. **Branch fascicles** 4–6 branches per fascicle, 2–3 spreading and 2–3 pendent, but plants frequently unbranched in young clones. **Branch leaves** large, 1.4–3 mm, semi-squarrose to squarrose, ovate and abruptly involute in distal portion, appearing cucullate with toothed apex, usually no more than 6 teeth; hyaline cells with 5 or more ringed, round to elliptical pores on convex surface, numerous pseudopores on concave surface with 3-ringed corner pores occurring in 3s at adjacent cell angles; chlorophyllous cells elliptic in transverse section, entirely included by hyaline cells, slightly nearer to convex surface. **Sexual condition** monoicous. **Capsule** with abundant pseudostomata. **Spores** 25–35 μ m; finely papillose on proximal surface, coarsely papillose on distal surface with raised Y-mark sculpture; proximal laesura short, 0.3–0.5 spore radius.

Capsules fairly common, mature summer. Ombrotrophic to weakly minerotrophic, commonly growing on poorly drained sand, siliceous rocks, bare peat; low to high elevations; Greenland; Alta., B.C., Man., N.B., Nfld. and Labr. (Nfld.), N.W.T., N.S., Ont., P.E.I., Que., Sask., Yukon; Alaska, Ark., Calif., Conn., Fla., Ga., Ill., Ind., Iowa, Ky., La., Maine, Md., Mass., Mich., Minn., Miss., Mo., Mont., N.H., N.J., N.Y., N.C., Ohio, Oreg., Pa., S.C., Tenn., Vt., Va., Wash., W.Va., Wis.; South America; Eurasia; Pacific Islands (New Zealand).

Sphagnum compactum is usually easily recognized by its combination of golden brown color and involute, cucullate branch leaves. *Sphagnum strictum* is paler and usually strongly squarrose.

14. *Sphagnum strictum* Sullivant, Musc. Allegh., 201. 1846



Sphagnum compactum var. *expositum* W. S. G. Maas; *S. garberi* Lesquereux & James; *S. mexicanum* Mitten

Plants moderate-sized, pale green, yellow-green to occasionally strongly reddish; growing in loose mats. **Stems** pale brown to green.

Stem leaves very small, less than 0.8 mm, triangular with blunt rounded apex. **Branches** erect in distal portion of plants. **Branch fascicles** with 2 short-spreading and 3 long-tapering pendent branches. **Branch leaves** large, 2.8 mm or longer, sub-squarrose, ovate, involute to broad, truncate apex with more than

6 teeth; hyaline cells with up to 6 non-ringed pores on convex surface with few or no pseudopores, 2–4 elliptic ringed pores on concave surface in corners or along commissures, internal commissural walls minutely papillose (best viewed in oblique sections), rarely smooth; chlorophyllous cells narrowly triangular in transverse section, more broadly exposed on convex surface, enclosed on concave surface. **Sexual condition** monoicous. **Capsule** with abundant pseudostomata on surface of capsule. **Spores** 31–43 µm; coarsely papillose on both proximal and distal surfaces, raised Y-mark sculpture on distal surface; proximal laesura moderately long, 0.4–0.7 spore radius.

Capsules common, mature early to mid summer. Pioneer species among grasses on peaty sand, pine barrens, burned-over savannas, seeps in mountainous areas inland; low to high elevations; N.B., Nfld. and Labr. (Nfld.), N.S.; Ala., Fla., Ga., La., Maine, Md., N.J., N.C., S.C., Va.; Europe.

Though they seldom if ever overlap ecologically, *Sphagnum strictum* and *S. squarrosum* both usually have squarrose branch leaves, but *S. squarrosum* has a lingulate fringed stem leaf that differs greatly from the triangular and entire-margined stem leaf of *S. strictum*.

1c. SPHAGNUM sect. INSULOSA Isoviita, Ann. Bot. Fenn. 3: 231. 1966

Sphagnum [unranked] *Truncata* Warnstorf ex Horrell, J. Bot. 38: 119. 1900, not *Sphagnum* [unranked] *Truncata* Russow 1865

Plants moderate-sized, with distinct capitulum; pale brownish yellow, yellow-green, loosely tufted. **Stems** green, superficial cortex of 3–4 layers of e fibrillose, inflated, thin-walled, non-ornamented cells, with an occasional pore in the distal end of the outer wall of the superficial cell layer. **Stem leaves** smaller than branch leaves, oblong to lingulate, moderately lacerate across broad rounded apex, border entire and broad at base; hyaline cells rhomboid, aporse, non-ornamented, usually e fibrillose, resorbed on distal portion of leaf with membrane pleats in proximal portion. **Branches** dimorphic, the spreading branches stronger than the pendent branches. **Branch fascicles** with 2–3 spreading and 2–3 pendent branches. **Branch stems** green, surrounded by 1 layer of e fibrillose, non-ornamented, inflated, thin-walled cells with inconspicuous necks. **Branch leaves** broadly ovate, very concave, apex broadly truncate, smooth, and toothed; margin entire; hyaline cells non-ornamented, fibrillose; with elliptic, ringed pores at ends and corners of cells, usually found in 3s at adjoining cell walls, pores more numerous on concave surface (5–8 per cell) than on convex surface (3–5 per cell); chlorophyllous cells in transverse section narrowly truncate-elliptic to lenticular, lacking wall sculptures, with thickened end walls equally exposed on both surfaces. **Sexual condition** dioicous. **Capsule** not seen. **Spores** not seen.

Species 1: nw North America, Eurasia.

15. *Sphagnum aongstroemii* C. Hartman, Handb. Skand. Fl. ed. 7, 399. 1858



Sphagnum cymbifolium var. *cordifolium* C. Hartman, Handb. Skand. Fl. ed. 3, 261. 1838

Stems green. **Branch leaves** very concave, truncate and toothed.

Wet rock faces and in moist depressions, usually in open among scattered shrubs and sedges in relatively minerotrophic sites;

low to moderate elevations; B.C., N.W.T., Nunavut, Yukon; Alaska; Eurasia.

Sphagnum aongstroemii can usually be easily recognized by its combination of pale green color and truncate, toothed branch leaves.

1d. SPHAGNUM sect. SQUARROSA (Russow) Schimper, Syn. Musc. Eur. ed. 2, 835. 1876

Sphagnum [unranked] *Squarrosa* Russow, Beitr. Torfm., 33. 1865

Plants moderate-sized to robust, with distinct capitulum; green, yellowish brown. Stems green to dark reddish brown, superficial cortex of 2–4 layers of e fibrillose, non-ornamented, enlarged, thin-walled, aporose, rectangular cells. Stem leaves ovate, ovate-lingulate to lingulate; with broad, fringed apex; little or no border along margins or base; hyaline cells rhomboid, e fibrillose, non-ornamented, aporose, usually nonseptate, with resorption gaps on exterior surface. Branches strongly dimorphic, pendent branches thinner but about same length as spreading branches. Branch stems green, with cortex surrounded by 1–2 layers of e fibrillose, non-ornamented, enlarged, thin-walled cells, some cells apically porose with inconspicuous necks. Branch leaves strongly squarrose or spreading, ovate, ovate-hastate or ovate-lanceolate, margins entire, apex involute and smooth; hyaline cells fibrillose; with large, round pores at cell ends and along commissures, sometimes with faint papillae on interior walls; chlorophyllous cells ovate-triangular, elliptical to ovate-elliptical in transverse section, more broadly exposed on convex surface, end walls not thickened. Sexual condition monoicous or dioicous. Capsule 2 mm or more, with scattered pseudomata. Spores less than 30 μm , both surfaces smooth to finely papillose; proximal laesura more than 0.5 spore radius.

Species 4 (4 in the flora): North America, Eurasia, Pacific Islands (New Zealand).

1. Branch leaves markedly truncate; chlorophyll cells ovate-triangular in transverse section, with the widest part at or near the convex surface 19. *Sphagnum tundrae*
1. Branch leaves not truncate; chlorophyll cells elliptical to elliptical-ovate with the broadest part typically some distance from the convex surface.
 2. Branch leaves strongly squarrose (terete in tundra forms), large (1.9–3 mm); hyaline cells of branch leaves with ringed elliptic pores on concave surface and unringed pores on convex surface; stem leaves $1/2$ – $2/3$ as long as branch leaves (1.1–1.9 mm) 17. *Sphagnum squarrosum*
 2. Branch leaves imbricate (squarrose in shade forms), moderate in size (1–1.5 mm); hyaline cells of branch leaves with unringed pores on concave and convex surfaces; stem leaves as long or longer than branch leaves (1–1.7 mm).
 3. Branch leaf hyaline cells near leaf base on convex surface mostly aporose and on concave surface with large, faint pores; 1–2 hanging branches 16. *Sphagnum mirum*
 3. Branch leaf hyaline cells near leaf base on convex surface with large, round pores and on concave surface mostly aporose; 2–3 hanging branches 18. *Sphagnum teres*

16. *Sphagnum mirum* Flatberg & Thingsgaard,
Bryologist 106: 501. 2003 [E]



Plants fairly slender to moderate-sized, green; forming low dense hummocks. Stems yellowish green; 3 layers of superficial cortical cells. Stem leaves generally longer than branch leaves, 1.1–1.7 mm, lingulate to lingulate-spathulate, hyaline cells mostly non-septate. Branches

terete. Branch fascicles of 2 spreading and 1–2 hanging branches. Branch stems with 1–2 layers of cortical cells. Branch leaves 1–1.4 mm, broadly ovate, with a narrow

involute tip; hyaline cells only slightly bulging on either surface, in proximal half of leaf aporose on convex surface and with large faint pores on concave surface; internal commissural walls distinctly papillose; chlorophyllous cells elliptical to elliptical-triangular in transverse section, enclosed on both surfaces with the widest part in the leaf middle. Sexual condition dioicous. Spores ca. 31 μm , ornamented by small somewhat amalgamated granulae.

Sporophytes abundant, capsules mature August. Ecology poorly known but probably quite minerotrophic; low elevations; Alaska.

Sphagnum mirum has only been recently discovered and so far is known only from its type locality, where it was growing in a fen mixed with *S. teres*.

17. *Sphagnum squarrosum* Crome, Samml. Deut. Laubm., 24. 1803



Sphagnum squarrosum var. *imbricatum* Schimper

Plants robust, stiff; green, pale green, yellow-green; large terminal bud; typically as loose carpets in coniferous forests. **Stem** green to red-brown; 2–3 superficial cortical layers. **Stem leaves** shorter than branch leaves, ovate-lingulate to

oblong-lingulate, 1.6–1.8 × 1–1.2 mm; hyaline cells mostly nonseptate. **Branches** long and tapering with distinct squarrose spreading leaves, often terete in tundra forms. **Branch fascicles** with 2 spreading and 2–3 pendent branches. **Branch stems** with 1–2 layers of cortical cells. **Branch leaves** larger than stem leaves, 1.9–2.8 mm, conspicuously squarrose from ovate-hastate base and abruptly narrowed $\frac{1}{2}$ – $\frac{1}{3}$ distance from apex into involute-concave acumen, often terete in tundra forms; hyaline cells convex on both surfaces, non-ringed pores at ends and corners of cells, ringed pores on concave surface (4–8/cell) and nonringed pores (2–4/cell) on convex surface, internal commissural walls smooth or indistinctly papillose, chlorophyllous cells ovate triangular with widest part at or close to the convex surface. **Sexual condition** monoicous. **Spores** 17–30 μm ; proximal surface finely papillose, distal surface smooth with raised bifurcated Y-mark sculpture; proximal laesura more than 0.5 spore radius.

Sporophytes abundant, capsules mature early to mid summer. Forming loose carpets in rich habitats such as wet coniferous forests, *Thuja* swamps, karrs, medium fens, and stream margins; low to high elevations; Greenland; Alta., B.C., Man., N.B., Nfld. and Labr. (Nfld.), N.W.T., N.S., Nunavut, Ont., P.E.I., Que., Sask., Yukon; Alaska, Ariz., Calif., Colo., Conn., Idaho, Ill., Ind., Iowa, Maine, Mass., Mich., Minn., Mont., N.H., N.J., N.Y., N.C., Oreg., Pa., S.D., Tenn., Vt., Wash., W.Va., Wis., Wyo.; Eurasia; Pacific Islands (New Zealand).

In its typical robust form with strongly squarrose branch leaves, *Sphagnum squarrosum* is unmistakable. Smaller forms such as occur in the higher mountains may be difficult to identify accurately without careful examination of microscopic details. In the tundra there sometimes occur large, terete forms of *S. squarrosum* but these are usually considerably more robust than *S. teres*. See also discussion under 14. *S. strictum*.

18. *Sphagnum teres* Ångström in C. J. Hartman, Handb. Skand Fl. ed. 8, 417. 1861



Sphagnum squarrosum var. *teres* Schimper, Vers. Entw.-Gesch.

Torfm., 64. 1858; *S. teres* var. *squarrosulum* (Schimper) Warnstorf

Plants fairly slender to moderate-sized, pale green to yellowish, or reddish brown in sun-grown forms; forms loose to dense carpets. **Stems** pale green to red-

brown; 3–4 layers of superficial cells. **Stem leaves** generally larger than branch leaves, 1.3–1.8 × 0.8–1 mm; elliptic to lingulate-spatulate, widest above middle, hyaline cells nonseptate. **Branches** long-cylindrical, branch leaves terete to sometimes distinctly squarrose in shade forms. **Branch fascicles** typically with 3 spreading (sometimes 2) and 2 pendent branches. **Branch stems** with single layer of cortical cells. **Branch leaves** 1–1.4 mm, ovate to ovate-lanceolate, gradually narrowed to an involute tip, hyaline cells somewhat bulging on concave surface and nearly plane on convex surface, with 4–8 large, elliptic, unringed pores per cell on convex surface and 1–4 irregularly rounded pores per cell on concave surface, internal commissural walls smooth to rather strongly papillose, chlorophyllous cells ovate-triangular with the widest part at or close to the convex surface. **Sexual condition** dioicous. **Spores** 21–26 μm ; proximal and distal surfaces smooth, papillae indistinct; proximal laesura 0.5–0.6 spore radius.

Sporophytes uncommon, capsules mature late spring to early summer. Strongly minerotrophic, in open to medium rich fens, less frequent in coniferous mires, characteristic species of rich, weakly acidic to slightly basic mires; low to high elevations; Greenland; Alta., B.C., Man., Nfld. and Labr. (Nfld.), N.W.T., N.S., Nunavut, Ont., Que., Sask., Yukon; Alaska, Calif., Colo., Conn., Idaho, Ill., Ind., Iowa, Maine, Mass., Mich., Minn., Mont., N.H., N.J., N.Y., N.Dak., Ohio, Oreg., Pa., Vt., Wash., Wis., Wyo.; Eurasia.

Shade forms of *Sphagnum teres* are often squarrose but these are usually considerably smaller than *S. squarrosum*. For other distinctions between these species, see discussion under the latter.