THE GENUS SPHAGNUM IN ILLINOIS

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ABSTRACT. — Fourteen species and two varieties of the peat moss, *Sphagnum*, occur in Illinois. Keys, descriptions, distribution and habitat data are given for each taxon.

Various species of the genus *Sphagnum* (peat or bog moss) have been reported from Illinois in a number of bryological and ecological papers (Calkins 1910; Taylor, 1920; Waterman, 1921, 1923, 1926; Kurz, 1928; Hague, 1934; Richards, 1940; Vaughan, 1941; Arzeni, 1941; Hatcher, 1952; Reichle and Doyle, 1965; Skorepa and Snider, 1967); however, no systematic account of the genus in the state has ever been published. This paper will summarize the species of *Sphagnum* known from Illinois, present keys and descriptions, and provide distributional and habitat data.

Andrews has done much to alleviate the problem posed by intraspecific variation by making a thorough study of both North American and European specimens and reducing a large number of species and varieties to synonomy. In presenting his concepts and theories, Andrews (1911-61) discussed a natural classification of the peat mosses in a series of "Notes on North American *Sphagnum*".

Most of the characters used to separate the species need not be a great problem if care is used in preparing the specimens for examination. For a discussion of methods helpful in the study of *Sphagnum*, reference should be made to Blomquist (1938).

The key and descriptions are based on Illinois material and cover the important features of the species discussed. The taxonomic arrangement and species concepts are based on Andrews (1913). For illustrations to a number of the species, reference can be made to Blomquist (1938) and Welch (1957). Collections used in this study were obtained from the herbaria of the Illinois Natural History Survey (ILLS), University of Illinois (ILL), Field Museum of Natural History (F), Southern Illinois University (SIU), and Duke University (DUKE).

MORPHOLOGY

The genus is composed of plants ranging in size and habit from short mats or tufts of just a few centimeters in height, to large, erect specimens many centimeters in height. Gametophyte development is apical, and rhizoids are absent in the mature plant. The stem is comprised of three regions. The central, or innermost, region consists of thin-walled, hyaline, parenchymatous cells. Surrounding the central region is usually a region of colored, thick-walled, prosenchymatous cells, and the outermost region, the cortex, consists of hyaline cells which vary from one to five cells in thickness, are often porose, and may or may not

contain spiral thickenings. Branches are of two forms, spreading and drooping, each containing a single, cortical layer of cells. The branches are normally intermixed in fascicles arranged spirally around the stem. Near the apex of the stem the branches are crowded, forming a tuft or capitulum. Branch and stem leaves are spirally arranged and are composed of a single layer of two types of cells; narrow chlorophyll-bearing cells surrounding larger, hyaline cells which are porose and usually contain spiral fibril-bands. Larger, irregular openings, or resorbed areas, in the hyaline cell walls of the leaves may or may not be present. In some cases leaf margins may be composed of few to numerous rows of narrow, elongated cells. In others the margin may be composed of a row of chlorophyllose cells bearing a resorption furrow composed of a strip of incompletely developed hyaline cells along the outer edge. Plants may be monoicous or dioicous with archegonial and antheridial branches distinct. Perichaetial leaves are larger and much differentiated from branch leaves and enclose the capsule until it reaches maturity. The capsule is globose, ranging from brown to black at maturity. An annulus and peristome are lacking. After dehiscence the capsule is urn-shaped to cylindrical. Spores are tetrahedral and yellowish to brown.

Key and Descriptions to the Illinois Taxa of Sphagnum

1. Cortical cells of stem and branches reinforced with fibril-bands .....2.
   2. Chlorophyllose cells of branch leaves elliptical in cross-section, appearing centrally positioned, entirely included between both surfaces of adjacent hyaline cells .....*S. magellanicum* (1)
   2. Chlorophyllose cells of branch leaves triangular in cross-section, base of triangle exposed on inner surface of leaf .....3.
      3. Chlorophyllose cells of branch leaves isosceles-triangular in cross-section, walls of hyaline cells adjacent to chlorophyllose cells smooth ....*s. palustre* (2)
      3. Chlorophyllose cells of branch leaves equilateral-triangular in cross-section, walls of hyaline cells adjacent to chlorophyllose cells with fringe-like fibrils .....*S. imbricatum* (3)
1. Cortical cells of stem and branches lacking fibril-bands .....4.
   4. Cortical cells of branches uniform, each with a pore at the upper end; chlorophyllose cells of branch leaves elliptical in cross-section, closer to the outer surface, entirely included between surfaces of adjacent hyaline cells .....*S. compactum* (4)
   4. Cortical cells of branches of two kinds, the large retort-cells with pores and smaller cells lacking pores, or, if uniform, cortical cells without pores; chlorophyllose cells of branch leaves other than elliptical in cross-sections exposed on one or both surfaces of adjacent hyaline cells ..5.
      5. Chlorophyllose cells of branch leaves triangular to trapezoidal or rounded-rectanguar in cross-section, more broadly exposed on the outer surface to equally exposed on both surfaces .....6.
         6. Apex of stem leaves broad, fimbriate-lacerate; branch leaves squarrose when dry..7.
            7. Plants robust, branch leaves squarrose wet or dry, ovate-hastate ....*S. squarrosum* (5)
            7. Plants slender, branch leaves imbricate when moist, ovate-lanceolate.. .....*S. teres* (6)
         6. Apex of stem leaves rounded to acuminate, not fimbriate-lacerate; branch leaves imbricate to spreading when dry .....8.
            8. Cortical cells of stem small, scarcely differentiated from inner cells; branch leaves, when dry, usually twisted at tips .....9.

9. Branch leaves undulate when dry, with spreading, twisted, recurved tips.. .....*S. recurvum* (7)

9. Branch leaves not undulate when dry due to the smaller size of the leaf.. ..S. *recurvum* var. *tenue* (7a)

8. Cortical cells of stem large, thin-walled, in 1-3 layers; branch leaves, when dry, not twisted at tips .....10.

10. Outer surface of branch leaves with few, small, ringed pores in ends and corners of hyaline cells, 2-5 per cell ....*S. cuspidatum* (8)

10. Outer surface of branch leaves with numerous, small, ringed pores in a row along sides of hyaline cells, 10-20 per cell ....*S. subsecundum* (9)

5. Chlorophyllose cells of branch leaves triangular to trapezoidal in cross-section, more broadly exposed on the inner surface ..11.

11. Stem leaves lacerate across the broad, truncate apex ....*S. girgensohnii* (10)

11. Stem leaves not lacerate across apex .....12.

12. Pigment brown, branch leaves spreading .....*S. fuscum* (11)

12. Pigment red, branch leaves imbricate .....13.

13. Outer surface of branch leaves with very small, round, strongly ringed pores (easily observed when stained) in apical portion; branch leaves arranged in five rows ..*S. warnstorfii* (12)

13. Outer surface of branch leaves with large, unringed pores; branch leaves not arranged in five rows .....14.

14. Stem leaves with fibrils faint to lacking, pores few; free convexity of hyaline cells of branch leaves in cross-section less than half their diameter .....15.

15. Stem leaves narrowly lingulate to triangular-ovate, fibrils faint, hyaline cells of stem leaves mostly not divided .*S. capillaceum* (13)

15. Stem leaves broadly lingulate, fibrils lacking, hyaline cells of stem leaves above basal region all divided ..... *S. capillaceum* var. *tenellum* (13a)

14. Stem leaves strongly fibrillose and porose, free convexity of hyaline cells of branch leaves in cross-section more than half their diameter ....*S. tenerum* (14)

1. *Sphagnum magellanicum* Brid.

Plants compact to robust, green to brown, usually tinged pink to red; cortical cells of stem and branches with fibril-bands; outer cells of stem containing 1-2 large, round to elongate pores; cortical cells of branches porose; stem leaves long-lingulate to lingulate-spatulate, hyaline cells non-fibrillose to fibrillose in apex, porose on outer surface, apex broad, rounded; branch leaves imbricate to spreading, ovate, border denticulate near the cucullate apex, hyaline cells fibrillose, porose; chlorophyllose cells elliptic in cross-section, central, entirely enclosed by hyaline cells, walls of hyaline cells adjacent to chlorophyllose cells smooth.

S. magellanicum is one of four species with a reddish color occurring in Illinois. In the field it may be separated from the other three species by its larger, hood-shaped, cucullate branch leaves. Microscopically, it differs in having fibril-bands present in the cortical cells of stem and branches.

Habitat—Thus far found only in boggy situations, commonly forming

hummocks around the bases of higher plants.

Distribution—Lake Co.: Tamarack Swamp, *Hill 255* (F). McHenry Co.: Ringwood, *Vasey s. n.* (F).

2. *Sphagnum palustre* L. *(S. cymbifolium* Ehrh.)

Plants compact to robust, green to tinged with brown; cortical cells of stem and branches with fibril-bands; outer cells of stem cortex containing 1-4 irregularly rounded pores; cortical cells of branches with a single pore; stem leaves spatulate to elongate-lingulate, hyaline cells porose and fibrillose in apical region, apex rounded; branch leaves imbricate to squarrose, ovate, margins involute to the cucullate apex, hyaline cells fibrillose and porose; chlorophyllose cells narrowly isoceles-triangular in cross-section, exposed on the inner leaf surface; walls of adjacent hyaline cells smooth.

S. palustre is one of three species in the state which has cortical cells containing fibril-bands and with large, cucullate branch leaves. It can be separated from *S. magellanicum* by the latter's reddish color, and from *S. imbricatum,* microscopically, by its fringe-like fibrils along the walls of the hyaline cells of the branch leaves.

Habitat—Found in bogs and swampy areas, wet woodlands, and along moist sandstone stream banks.

Distribution—Kendall Co.: Millington Fen, *Mohlenbrock s. n.* (SIU). Lake Co.: Starved Rock State Park, *Umbach s. n.* (F). Clark Co.: Rocky Branch, *Arzeni s.n.* (Duke)

3. *Sphagnum imbricatum* Hornsch. *ex* Russ.

Plants usually robust, green to tinged with brown; cortical cells of stem and branches with fibril-bands, containing on their inner surface a corrugation consisting of ridges and grooves lying in the same direction as the fibril-bands, but more numerous than the bands; cortical cells of stem with 4-10 irregularly rounded pores; cortical cells of branches with 1-2 pores; stem leaves lingulate to slightly spatulate, hyaline cells without pores and fibrils; branch leaves imbricate to squarrose-spreading, ovate, margins denticulate, apex cucullate, hyaline cells fibrillose, porose; chlorophyllose cells equilateral-triangular in cross-section, exposed on inner surface; inner walls of hyaline cells adjacent to chlorophyllose cells with fringe-like fibrils on the wall opposite the chlorophyllose cells.

This species is characterized by the fringe-like fibrils on the walls opposite the chlorophyllose cells.

Habitat—Moist wooded areas and swamps.

Distribution — Fulton Co.: Canton, *Wolf s. n.* (F). Massac Co.: Long Springs, *Schwegman s. n.* (SIU). Pope Co.: Sphagnum Springs, *Schwegman 7* (SIU)

4. *Sphagnum compactum* Lam. & DC.

Plants short, compact, dirty white to green, sometimes with a brownish tinge; cortical cells of stem and branches lacking fibril-bands; outer cells of stem lacking pores; cortical cells of branches with a pore at the upper end; stem leaves concave, short-lingulate to triangular-lingulate, apex slightly lacerate, hyaline cells lacking pores and fibrils; branch leaves usually large, squarrose, ovate-hastate, leaf margin denticulate, involute, toothed at apex, hyaline cells

fibrillose, porose; chlorophyllose cells elliptic in cross-section, not exposed on either surface, but usually nearer the outer surface.

S. compactum is our most common species. In aspect it resembles the above three species, but the leaves are channeled and truncate (but not cucullate) at the apex. The cortical cells of the stem and branches also are not fibrillose. The compact manner of growth, with branches erect and leaves relatively large and fleshy in appearance, as well as a washed-out dirty green color, distinguish this species.

Habitat — Wet meadows, moist woodlands, wet sandstone bluffs and roadside ditches.

Distribution—Cook Co.: *Thieret 975* (F). Jackson Co.: Little Grand Canyon, *Hatcher 947* (SIU). Pope Co.: Lusk Creek Canyon, *Bailey & Swayne 2353* (SIU). Randolph Co.: Rock Castle Creek, *Snider 185* (SIU). Will Co.: Custer Park, *Franzen s.n.* (F). Grundy Co.: Goose Lake Prairie, *Zales 964* (SIU).

5. *Sphagnum squarrosum* Sw. *ex* Crome

Plants normally tall and robust, bright green to yellowish; cortical cells of stem and branches lacking fibril-bands; cortical cells of stem in 2-3 layers, thin-walled, lacking pores; cortical cells of branches composed of smaller, non-porose cells and larger, porose, retort cells with inconspicuous necks; stem leaves long, ovate-lingulate, concave, border of narrower cells extending to base, apex broad, fimbriate-lacerate, hyaline cells lacking fibrils and pores; branch leaves strongly squarrose, spreading or imbricate, ovate-hastate, contracting to an acute, involute, toothed apex, hyaline cells fibrillose, porose; chlorophyllose cells triangular to trapezoidal in cross-section, base exposed on the outer surface, narrow to no exposure on inner surface.

This woodland species is easily recognized by its large size and widely spreading branch leaf tips. It also has a prominent terminal bud similar to *S. teres,* to which it is closely related.

Habitat—Bogs, moist woods, and along sandstone creek banks.

Distribution—Clark Co.: Rocky Branch, *Arzeni s.n.* (Duke). Lake Co.: reported by Reichle & Doyle (1965) in Volo Bog, specimen not examined. Kankakee Co.: Farris Wood, *De Selm 630* (F).

6. *Sphagnum teres* (Schimp.) Angstr. *ex* C. Hartm.

Plants usually slender, green to tinged with brown; cortical cells of stem in 3-4 layers, thin-walled, fibril-bands and pores lacking; cortical cells of branches lacking fibril-bands, composed of smaller, non-porose cells and larger, porose, retort cells with inconspicuous necks; stem leaves long-lingulate, concave, hyaline cells lacking fibrils and pores, broadly fimbriate-lacerate at apex; branch leaves imbricate to slightly squarrose, ovate-lanceolate, apex involute, toothed, hyaline cells fibrillose and porose; chlorophyllose cells triangular to trapezoidal in cross-section, exposed more on outer leaf surface.

S. teres is a species of wet habitats. It is characterized by its weak habit and large terminal bud. The branches are relatively stiff and slender with leaves appressed when moist but spreading to squarrose when dry.

Occasional robust forms may be separated from *S. squarrosum* which it resembles most by the latter's ovate-hastate rather than ovate-lanceolate branch leaves.

Habitat—Has been found only in Volo Bog adjacent to the floating mat stage.

Distribution — Lake Co.: Volo Bog, *Richards & Fuller 986* (F).

7. *Sphagnum recurvum* P. Beauv.

Plants normally robust, green to yellowish to brownish; cortical cells of the stem scarcely differentiated, lacking fibril-bands and pores; cortical cells of branches lacking fibril-bands, composed of smaller, non-porose cells and larger, porose, retort cells with inconspicuous necks; stem leaves loosely triangular, hyaline cells normally lacking fibrils and pores, apex mucronate, rounded or truncate and slightly eroded; branch leaves narrowly lanceolate, when dry undulate with spreading, recurved tips, apex involute, slightly toothed, hyaline cells fibrillose, porose; chlorophyllose cells triangular in cross-section, base exposed on outer surface, reaching inner leaf surface.

S. recurvum can be recognized in the field, in dry condition, by the usually undulate, twisted, recurved tips of the branch leaves. When moist, the young pendent branches are in pairs between the rays of the capitulum. Aquatic forms may be confused with *S. cuspidatum,* but the key characters pertaining to the cortical cells will separate the two species.

Habitat — This species may be found as floating mats in bogs, in seepage areas, on moist sandstone bluffs and along creek banks.

Distribution—Cook Co.: Argonne Forest Preserve, *Steyermark 65856* (F). Johnson Co.: Cedar Falls, *Mohlenbrock & Hopkins s.n.* (SIU). Lake Co.: Tamarack Swamp, *Hill 218* (F). McHenry Co.: Ringwood, *Vasey s.n.* (F).

7a. var. *tenue* Klinggr. — Plant smaller, shorter than the species, dry branch leaves scarcely undulate due to its smaller size.

Habitat—Same as for the species.

Distribution—Lake Co.: Wauconda Bog, *Hill 261* (F).

8. *Sphagnum cuspidatum* Ehrh. *ex* Hoffm.

Plants delicate to somewhat robust, green to yellowish; cortical cells of stem thin-walled, in 1-3 layers, fibril-bands and pores lacking; cortical cells of branches lacking fibril-bands, composed of smaller, non-porose cells and larger, porose, retort cells with inconspicuous necks; stem leaves triangular-ovate, deeply concave, hyaline cells with or without fibrils in apical portion, apex toothed; branch leaves long-lanceolate, involute, apex toothed, hyaline cells fibrillose, porose; chlorophyllose cells trapezoidal in cross-section with broader exposure on the outer leaf surface.

A plant of very wet habitats, *S. cuspidatum* is often submerged and appears weak and limp. The branch leaves are relatively long and narrow and stick together like the point of an artist's brush when drawn from the water.

Habitat—wet woods and marshes.

Distribution—Cook Co.; Argonne Forest Preserve, *Steyermark 65856* (F). Lake Co.: Cranberry Marsh, *Hill 243* (F). Williamson Co.: Carterville, *Snider 461* (SIU).

9. *Sphagnum subsecundum* Nees *ex* Sturm

Plants small and delicate to robust, highly variable, green to brown to purplish-brown; cortical cells of stem thin-walled, in 1-3 layers, lacking fibril-bands, rarely with pores; cortical cells of branches lacking fibril-bands, composed of smaller, non-porose cells and larger, porose, retort cells with inconspicuous necks; stem leaves triangular-lingulate to ovate, slightly auriculate, concave, hyaline cells rarely containing fibrils and pores, apex broad, rounded; branch leaves subsecund to imbricate, concave, ovate, acuminate, involute, toothed at apex, hyaline cells fibrillose, on the inner surface of the leaf with a few small, round pores in cell angles, the outer surface with numerous small, ringed, round to elliptic bead-like pores along the sides of the cells; chlorophyllose cells in cross-section truncately elliptic, barrel-shaped, large, exposed on both the inner and outer leaf surface.

S. subsecundum is a highly complex species consisting of numerous segregates. Its outstanding character is the arrangement of pores like a string of beads along the margins of the hyaline cells of the branch leaves. All Illinois specimens examined were very similar in character, thus no segregates are recognized.

Habitat—Sandstone creek banks, wet meadows, bogs, and wet woods.

Distribution—Clark Co.: Rocky Branch, *Pepoon s.n.* (ILLS). Cook Co.: Zander's Woods, *Mohlenbrock s.n.* (SIU). Johnson Co.: Benson's Bluff, *Snider 463* (SIU). Lake Co.: Barrington, *Steyermark 80321* (F). McHenry Co.: Ringwood, *Vasey s.n.* (F).

10. *Sphagnum girgensohnii* Russ.

Plants usually tall and robust, green to yellow or brownish; cortical cells of stem in 2-4 layers, large, thin-walled, varying in size and shape, each cell with a single, large, rounded pore in the upper end, fibril-bands lacking; cortical cells of branches lacking fibril-bands, composed of smaller, non-porose cells and larger, porose, retort cells with conspicuous necks; stem leaves short-lingulate, concave, lanceolate at the broad apex, hyaline cells normally not fibrillose or porose; branch leaves normally imbricate, small, ovate, involute to the toothed apex, hyaline cells fibrillose, porose; chlorophyllose cells trapezoidal to triangular in cross-section, more broadly exposed on the inner leaf surface.

The conspicuously star-shaped capitulum and the spreading branches which are long and drooping in five rows aid in field recognition of this attractive species.

Habitat—Wet sandstone bluffs.

Distribution—LaSalle Co.: Tonti Canyon, Starved Rock State Park, *Voth & Richards s.n.* (DUKE).

11. *Sphagnum fuscum* (Schimp.) Klinggr.

Plants slender and delicate, forming large, compact hummocks, normally brown or with a brownish tinge; cortical cells of stem in 2-4 layers, large, thin-walled, lacking fibril-bands and pores; cortical cells of branches lacking fibril-bands, composed of smaller, non-porose cells and larger, porose, retort cells with conspicuous necks; stem leaves lingulate, concave, hyaline cells non-porose, usually non-fibrillose; branch leaves usually spreading, narrowly lanceolate, involute towards the toothed apex, hyaline cells fibrillose,

porose; chlorophyllose cells triangular to trapezoidal in cross-section, broadly exposed on the inner leaf surface.

This hummock-forming species can be recognized in the field by its brown pigmentation, brown stem, and spreading branch leaves, although red-brown forms of *S. capillaceum* and its var. *tenellum* can be confused with it.

Habitat—Known only from Tamarack Swamp where it forms scattered hummocks around the bases of *Larix*.

Distribution—Lake Co.: Tamarack Swamp, *Hill 269* (F).

12. *Sphagnum warnstorfii* Russ.

Plants slender, delicate, green to tinged with pink to red; cortical cells of stem in 2-4 layers, large, thin-walled, lacking fibril-bands and pores; cortical cells of branches lacking fibril-bands, composed of smaller, non-porose cells and larger, porose, retort cells with conspicuous necks; stem leaves lingulate to lingulate-ovate, concave, hyaline cells non-fibrillose and non-porose; branch leaves often five-ranked, spreading, lanceolate, involute to the toothed apex, hyaline cells fibrillose, on outer surface with numerous small, strongly ringed pores in upper area, pores below are larger and less strongly ringed; chlorophyllose cells triangular to trapezoidal in cross-section, broader exposure on the inner leaf surface.

This species is one of four with a reddish color. When green shoot forms are found the red branch axis can be seen through the leaves. In the field it can be recognized by the arrangement of the branch leaves in five distinct rows and curved outward when dry.

Habitat—Known only from Wauconda Bog.

Distribution—Lake Co.: Wauconda Bog, *Hill 257* (F).

13. *Sphagnum capillaceum* (Weiss) Schrank (*S. acutifolium* Ehrh.; *S. acutifolium Schimperi* Warnst.)

Plants short, compact, green generally tinged with red; cortical cells of stem in 2-4 layers, thin-walled, lacking fibril-bands and pores; cortical cells of branches lacking fibril-bands, composed of smaller, non-porose cells and larger, porose, retort cells with conspicuous necks; stem leaves at least twice as long as wide, lingulate to triangular ovate, deeply concave, apex normally involute, toothed, hyaline cells with fibrils faint to lacking, pores few to absent; branch leaves imbricate to slightly spreading, normally lanceolate, involute above to the toothed apex, hyaline cells fibrillose, porose; chlorophyllose cells triangular to trapezoidal in cross-section, broader exposure on the inner leaf surface, hyaline cells slightly convex on the inner surface, strongly so on the outer.

This species and *S. tenerum* intergrade to such a high degree that at times one cannot distinguish between them. Much work is needed to clarify the differences between these two species, if, indeed, any exist. Illinois plants can nearly always be separated by the degree of fibrillosity and porosity of the hyaline cells of the stem leaves, *S. capillaceum* being faintly fibrillose and with a few pores present to entirely lacking, whereas in *S. tenerum* the hyaline cells of the stem leaves are heavily

fibrillose with numerous pores dispersed theroughout. It is when one examines specimens throughout a wide area of their range that the problem is recognized.

Habitat—Found in bogs, meadows, wet woods, swamps, and along moist sandstone bluffs.

Distribution—Clark Co.: Rocky Branch, *Vaughan 6* (F). Cook Co.: Huckleberry Bog, *Calkins 320* (F). Lake Co.: Tamarack Swamp, *Hill 256* (F). Pope Co.: Hayes Creek Canyon, *Schwegman s.n.* (SIU). Will Co.: New Lennox, *Hill s.n.* (ILL).

13a. var. *tenellum* (Schimp.) Andr.—Stem leaves more lingulate with most hyaline cells divided; branch leaves shorter, somewhat secund. Habitat same as for species.

Distribution—Lake Co.: Tamarack Swamp, *Hill 270* (F).

14. *Sphagnum tenerum* Sull. & Lesq.

Plants compact to robust, yellowish to whitish, usually tinged with pink to deep scarlet above; cortical cells of stem in 2-3 layers, large, thin-walled, lacking fibril-bands and pores; cortical cells of branches lacking fibril-bands, composed of smaller, non-porose cells and larger, porose, retort cells with conspicuous necks; stem leaves lingulate-acuminate, involute towards apex, hyaline cells fibrillose throughout or nearly so, inner surface with many large, rounded pores; branch leaves imbricate, lanceolate to ovate, somewhat involute near toothed apex; hyaline cells fibrillose, porose; chlorophyllose cells small, triangular in cross-section, exposed on the inner leaf surface; hyaline cells convex on inner surface, extremely convex on outer surface, usually one half the diameter of the cell, or more.

S. tenerum is noted for its red to scarlet color, which, however, is not always evident. See comments under *S. capillaceum*.

Habitat—Moist creek banks and sandstone bluffs.

Distribution — Pope Co.: Lusk Creek Canyon, *Bailey & Swayne 2468* (SIU). Clark Co.: *Arensi s.n.* (Duke). Randolph Co.: Piney Creek, *Skorepa s.n.* (SIU).

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