

SPHAGNUM MOSSES OF ONTARIO:
IDENTIFICATION BY
MACROSCOPIC FEATURES

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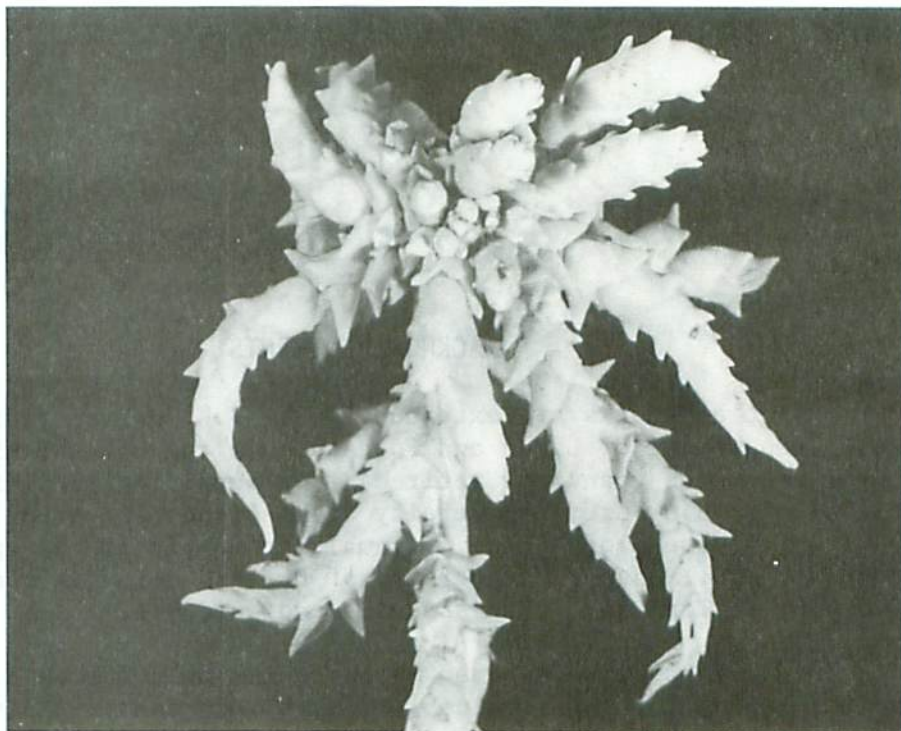
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Frontispiece. Top: *Sphagnum magellanicum* showing cucullate branch leaves.
Bottom: *Sphagnum girgensohnii* showing "stellate head"
and lanceolate branch leaves.

ABSTRACT

The taxonomy of 23 species and one variety of *Sphagnum* mosses that occur in Ontario wetlands was studied. A key for the separation of the species, using features that are readily visible on dry herbarium specimens, is presented. Illustrations and brief summaries of macrofeatures are included for each species studied.

RÉSUMÉ

Étude taxonomique de 23 espèces et d'une variété de *Sphaigne* qu'on trouve dans les terrains humides de l'Ontario. Présentation d'une clé pour la distinction des espèces, utilisant les traits les plus évidents sur les herbiers, avec illustrations et sommaires des traits macroscopiques pour chaque espèce étudiée.

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Cover photo: *Sphagnum wulfianum*

INTRODUCTION

Many keys and lists of descriptive features have been published to aid in differentiating among the various species of *Sphagnum*. Certain species are very difficult to separate, however. Consequently, researchers have attempted to isolate features that can be distinguished only after specific procedures have been followed, including the use of microscopes at a magnification of 25 x or greater. One of the most complete and up-to-date works using microscopic features is that published by Nyholm (1969). Tuomikoski (1946), on the other hand, using only macroscopic features and relying heavily on habitat and plant color, prepared a key and descriptions for the *Sphagna* of Finland. Until now, no key using only macroscopic features for the identification of North American *Sphagna* has been available.

Some 300 species and countless varieties of *Sphagnum* are known around the world. The 23 species and one variety described in this paper are the only ones that have been collected in Ontario and include specimens deposited in the Herbarium of the National Museum of Canada in Ottawa up to 1965. The nomenclature used herein conforms with that of Nyholm (1969).

The key is based on features visible on dry herbarium specimens, but comparable specimens can be produced in the field within a few hours. Most characteristic features are visible under field conditions as well as in the dried specimens, but dried specimens are needed for the evaluation of waviness in branch leaves.

METHOD OF STUDY

Herbarium specimens and samples were briefly soaked in warm water to make the plants more pliable. Readily visible features, e.g., color, compactness, size, robustness, and the number of branches most commonly occurring per fascicle were recorded. The relative positions of branch and stem leaves were observed, and macroscopic features (characteristics readily visible at a magnification of 10 x or less) were confirmed under 25 x magnification. The color of the stem and stem sclerodermis were noted. The attitude of the divergent branches was recorded, and the disposition of the pendent branches was examined to see whether they covered the stem completely or only partially.

TERMINOLOGY

Botanical usage restricts the terms "leaf" and "stem" to higher plants with well-developed xylem and phloem. Since the leafy stems of *Sphagnum* mosses lack xylem and phloem elements, but bear sex organs and the gametes (Hill et al. 1950), they have been called "gametophores". Two kinds of appendages (branches) occur on these gametophores: short, erect ones clustered around the top (head), and long, pendent and/or divergent ones comprising the lateral fascicles (groups of branches

originating at a common point). The leaflike expansions arranged imbricately (overlapped like shingles) along the branch axes and sporadically along the gametophore are unlike true leaves because they are structurally only one cell in thickness and lack the characteristic midrib and associated vascular system. I have accepted the morphological nomenclature of bryologists and have equated "gametophore" with "stem", "gametophore appendages" with "(lateral) branches", and "leaflike expansions" with "branch leaves" or "stem leaves", depending on their location.

The principal morphologic structures of *Sphagna* are illustrated in Figure 1. Other descriptive terms used in this paper are explained below.

The most common terms used to designate the variety in leaf shapes are defined as follows:

- Hastate - arrowhead-shaped (stem leaf [sl] Fig. 6).
- Lanceolate - narrowly tapering, lancelike (branch leaf [bl] Fig. 9).
- Lingulate - tongue-shaped (sl Fig. 8).
- Ovate - egg-shaped, narrow part distal (bl Fig. 7).
- Spatulate - gradually narrowed from a rounded apex (sl Fig. 10).

Leaf tips are described as follows:

- Cucullate - hooded, hood-shaped (bl Fig. 15).
- Cuspidate - terminating in a point (sl Fig. 16).
- Denticulate - minutely toothed (sl Fig. 3).
- Dentate - toothed (sl Fig. 19).
- Fimbriate - fringed (sl Fig. 15).
- Involute - rolled inward (bl Fig. 12).
- Lacerate - irregularly slit, as if torn (sl Fig. 18).
- Lacinate - fringed but cut into deep, irregular lobes (sl Fig. 9).
- Mucronate - terminating in a sharp attenuate point (sl Fig. 6).
- Truncate - square-ended, as if cut (sl Fig. 8).

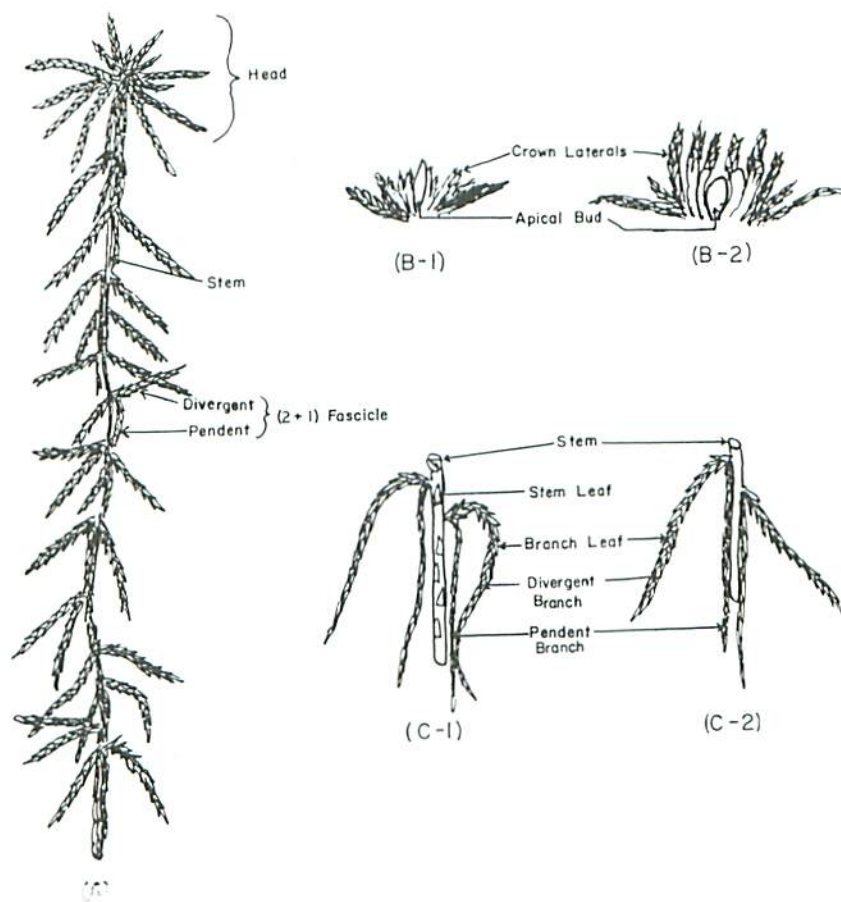


Figure 1. (A) Schematic *Sphagnum* stem showing the head (the top of which is the crown), the stem, and a typical fascicle with two divergent branches and one pendent branch (2+1 arrangement).

(B) Schematic longitudinal sections through the crowns of two *Sphagnum* species. (B-1) Apical bud clearly visible, protruding above the surrounding crown laterals (e.g., *S. squarrosum*). (B-2) Apical bud deeply buried within the crown (e.g., *S. compactum*).

(C) Pendent branch attitudes. (C-1) Pendent branches not tightly appressed to the stem (e.g., *S. girgensohnii*). (C-2) Pendent branches tightly appressed to the stem. If fascicles are not too distant, the stem may be completely hidden (e.g., *S. teres*).

Branch leaves are described as:

- Recurved - leaf apices bent backward (bl Fig. 6).
- Secund - leaves bent laterally (bl Fig. 18).
- Squarrose - leaves bent backward (up to 90°) from midway up the leaf (bl Fig. 20).
- Wavy - leaves undulate or flexuous when dried (bl Fig. 16).

Branches may be:

- Attenuate - slenderly tapering, cordlike (branches Fig. 7).
- Decurved, deflexed - curved or bent downward (branches Fig. 12).

The stem is covered by a mantle of hyalin cells (hyalodermis) which in some species (e.g., *S. centrale*) is easily removed. The height of a *Sphagnum* plant is measured by the length of the green portion, which is living, and usually upright. Plants are considered short when this portion is less than 10 cm long.

KEY TO THE MACROSCOPIC IDENTIFICATION OF SPHAGNA

The following key is based on the more prominent macroscopic features of peat mosses found in Ontario. The species considered herein divide into six groups. Those in the first group are recognized by their cucullate branch leaves. *Sphagnum wulfianum*, representing the second group, is readily distinguished as the only species having more than six branches per fascicle. The third group has an apical bud which protrudes above its surrounding crown laterals. The fourth group has branch leaves that become wavy when the specimens are dried. The characteristic of the fifth group is the "five-ranked" leaf arrangement along the divergent branches. The sixth is a mixed group composed largely of species of the Acutifolia subsection.

Even though it should be relatively easy to allocate a species to its group, some difficulty may arise in differentiating between species within a group, especially in the sixth group. Because of the great variation in colors, this feature was avoided as much as possible unless the difference was obvious.

- 1a. Branch leaves quite wide (length:width is 2-3:1), strongly concave (boat-shaped), usually with a cucullate tip; stem leaves large (> 1.0 mm except in *S. compactum* and *S. subsecundum*)
- 2a. Branch leaves cucullate; stem leaves large
- 3a. Leaves red (can be green in shade) *S. magellanicum* (Fig. 10)
- 3b. Leaves green, yellowish, or brown
- 4a. Plants yellow-brown (dirty-brown) to almost black
 *S. papillosum* (Fig. 15)
- 4b. Plants pale green to greyish white (sometimes slightly purplish)
- 5a. Stem sclerodermis dark red-brown; lateral branches long (> 1 cm); fascicles usually 2 + 3
 *S. centrale* (Fig. 2)
- 5b. Stem sclerodermis yellow-brown; lateral branches short (< 1 cm); fascicles usually 2 + 2
 *S. palustre* (Fig. 14)
- 2b. Branch leaves not cucullate; stem leaves small
- 6a. Branch leaves coarse, appressed to strongly spreading, large (2.0-3.0 mm), ovate-hastate; plant robust, usually greenish (brownish on exposed sites), pendent branches longer than divergent branches and very dissimilar in appearance *S. compactum* (Fig. 3)
- 6b. Branch leaves fine, appressed, small (< 1.0 mm), ovate-lanceolate; plants frail, carrotty or brownish, pendent and divergent branches about the same length (more or less similar in appearance)
 *S. subsecundum* (Fig. 21)
- 1b. Branch leaves narrow (length:width is 3:1 or >), not strongly concave, apices not cucullate; stem leaves often small (< 1 mm)
- 7a. More than six branches per fascicle
 *S. wulfianum* (Fig. 25)
- 7b. Fewer than six branches per fascicle

8a. Apical bud visible

- 9a. Branch leaves squarrose, not tightly appressed; stem leaves large (up to 2.4 mm), oblong-lingulate to spatulate, with a fringed apex; fascicles usually 2 + 2 or 3 + 2
- 10a. Branch leaves always squarrose; fascicles usually 3 + 2, plants usually large, robust, blue-green to yellow
 *S. squarrosus* (Fig. 20)
- 10b. Branch leaves usually squarrose, with tips, at least, protruding; fascicles usually 2 + 2; plants medium-sized, somewhat frail, yellow-brown *S. teres* (Fig. 23)
- 9b. Branch leaves usually appressed for most of their length; stem leaves small (< 1.0 mm), short-lingulate with fimbriate-lacerate apex; fascicles usually 2 + 1
- 11a. Plants small and frail, pale grey-green; branch leaves sometimes very large (up to 2.0 mm), ovate-lanceolate to ovate; stem leaves lacerate across top and down sides; apical bud clearly visible *S. fimbriatum* (Fig. 7)
- 11b. Plants large and robust, blue-green to dark green; branch leaves up to 1.4 mm, lanceolate to ovate; stem leaves lacerate only across top; apical bud barely visible *S. girgensohnii* (Fig. 9)

8b. Apical bud not visible

- 12a. Plants with branch leaves that become wavy upon drying
- 13a. Branch leaves large (1.5-3.0 mm), narrowly ovate-lanceolate to lanceolate, tightly appressed and tips not recurved
- 14a. Stem sclerodermis green, yellow-brown or brown; plant light green, yellow-green to yellow-brown, large but delicate
 *S. cuspidatum* (Fig. 4)
- 14b. Stem sclerodermis yellow-green; plant green to dark yellow-brown to dirty dark brown, large and robust

- 15a. Fascicles usually 2 + 1; branch leaves somewhat secund, crescentic, never five-ranked *S. majus* (Fig. 11)
- 15b. Fascicles usually 2 + 3; branch leaves sometimes slightly recurved, sometimes five-ranked
- 16a. Branch leaves < 1.6 mm, very concave, lacquered appearance, definitely five-ranked, sometimes wavy when dry
. *S. pulchrum* (Fig. 16)
- 16b. Branch leaves > 1.6 mm (to 3.0 mm), broadly ovate, dull appearance, slightly five-ranked, usually wavy when dry
. *S. obtusum* (Fig. 13)
- 13b. Branch leaves small (1.0 - 1.2 mm), lanceolate-ovate, not tightly appressed and tips recurved when dry
- 17a. Branch leaves wavy when dry, tips strongly recurved; all branches very thin and up to 1.5 cm long
. *S. fallax* (Fig. 5)
- 17b. Branch leaves slightly wavy when dry, tips only slightly recurved; only pendent branches thin and up to 1.0 cm long *S. fallax* var. *S. angustifolium* (Fig. 6)
- 12b. Plants with branch leaves not becoming wavy when dry
- 18a. Plants with branch leaves sometimes five-ranked
- 19a. Stem sclerodermis pale, greenish, yellowish, to brown
- 20a. Branch leaves 1.6 - 3 mm long, usually wavy when dry; stem completely hidden by tightly appressed pendent branches
. *S. obtusum* (Fig. 13)
- 20b. Branch leaves < 1.6 mm, never wavy when dry; stem not completely hidden by pendent branches
- 21a. Fascicles 3 + 2 (2 + 3); branch leaves dull in appearance when dry; plants never brown tinged
. *S. quinquefarium* (Fig. 17)
- 21b. Fascicles usually 2 + 2; branch leaves have lacquered appearance when dry; plants always brown tinged
. *S. pulchrum* (Fig. 16)

- 19b. Stem sclerodermis red
- 22a. Branches of the head more or less straight; tips of branch leaves straight when dry; plants usually robust, greenish or yellowish
 *S. russowii* (Fig. 19)
- 22b. Branches of the head \pm curved; tips of branch leaves recurved when dry; plants usually delicate, usually reddish
 *S. warnstorfi* (Fig. 24)
- 18b. Plants with branch leaves never five-ranked
- 23a. Branch leaves < 1.0 mm
- 24a. Stem sclerodermis red, red-brown to brown; fascicles 2 + 1 (2 + 2); pendent branches long (1.0 - 2.0 cm)
- 25a. Plants rusty brown to dark brown, fine textured and wiry looking; stem leaves broader than long
 *S. fuscum* (Fig. 8)
- 25b. Plants reddish, red-violet, usually quite robust; stem leaves longer than they are wide
- 26a. Branches of the head more or less straight; branch leaves not recurved when dry
 *S. russowii* (Fig. 19)
- 26b. Branches of the head curved; branch leaves with slightly recurved tips when dry
 *S. warnstorfi* (Fig. 24)
- 24b. Stem sclerodermis yellow; fascicles 2 + 2 (2 + 3); pendent branches short (up to 0.8 cm)
 *S. fallax* var. *S. angustifolium* (Fig. 6)
- 23b. Branch leaves > 1.0 mm
- 27a. Stem leaves short (< 1.2 mm), broad concave
- 28a. Stem leaves minute (much less than 1.0 mm); triangulate; branch leaves very concave

- 29a. Plants delicate and loose, red-brown (carrotty), green, yellow-green; branch leaves 1.0-1.5 mm long, ovate-lanceolate, slightly secund; pendent branches about the same length as divergent branches and similar in appearance *S. subsecundum* (Fig. 21)
- 29b. Plants robust and compact, grey-green, yellowish, dirty-white; branch leaves 2.0-3.0 mm long, ovate-hastate, straight; pendent branches longer than divergent branches and very dissimilar in appearance *S. compactum* (Fig. 3)
- 28b. Stem leaves about 1.0 mm long, lingulate; branch leaves not very concave
- 30a. Stem leaves coarsely laciniate-fimbriate across broad apex; stem sclerodermis white or greyish *S. girgensohni* (Fig. 9)
- 30b. Stem leaves toothed or slightly fringed only in middle part of broadly rounded apex; stem sclerodermis usually reddish *S. russowii* (Fig. 19)
- 27b. Stem leaves > 1.2 mm long, narrow, not very concave
- 31a. Plants robust, yellowish with pink tinges *S. tenerum* (Fig. 22)
- 31b. Plants delicate, red, or green with red
- 32a. Plants brilliant green with reddish tinges; stem sclerodermis pale or reddish; branch leaves straight, not tightly appressed to stem *S. nemoreum* (Fig. 12)
- 32b. Plants red; stem sclerodermis red-brown; branch leaves slightly secund, tightly appressed to stem *S. rubellum* (Fig. 18)

COMMENTS ON THE FIGURES AND DESCRIPTIONS

Considerable intraspecific variation in size, color, and external characteristics was found in the limited sample available. These morphological variations may be attributed to differences in site conditions, growth habits, genetic factors, etc. Although most species of *Sphagnum* are site specific, some may be found both on exposed sites and under varying degrees of shade, the latter definitely affecting the external appearance of the peat mosses. Specimens growing in shade are usually paler and exhibit a more delicate growth habit than those growing under exposed conditions. Differences also occur in external appearance within those species growing in very wet (almost submerged) locations as well as relatively dry locations. The morphological variations due to differences in environmental conditions may often result in the superficial resemblance of species.

The illustrations show the range occurring in the shapes and sizes of branch and stem leaves. The schematic representations of the fascicles illustrate the most frequently occurring number of branches per fascicle, the relative sizes of the divergent and the pendent branches, and the approximate arrangement of the branch leaves on them. The arrangement of the branches, as shown, is not necessarily characteristic since it was usually necessary to isolate individual branches in order to draw them. An attempt was made, however, to show the relationship between the pendent branches and the stem.

The descriptions attempt to characterize each species for identification purposes. The salient features of the plant's habit are given along with the most commonly occurring colors. Where it is considered important, descriptions of the stem and sclerodermis are given. The most common fascicular arrangement is shown and specific features of the divergent and pendent branches are given. Detailed characterization of the branch and stem leaves is provided. The italicized notations are those considered most useful for macroscopic identification of the *Sphagnum* species.

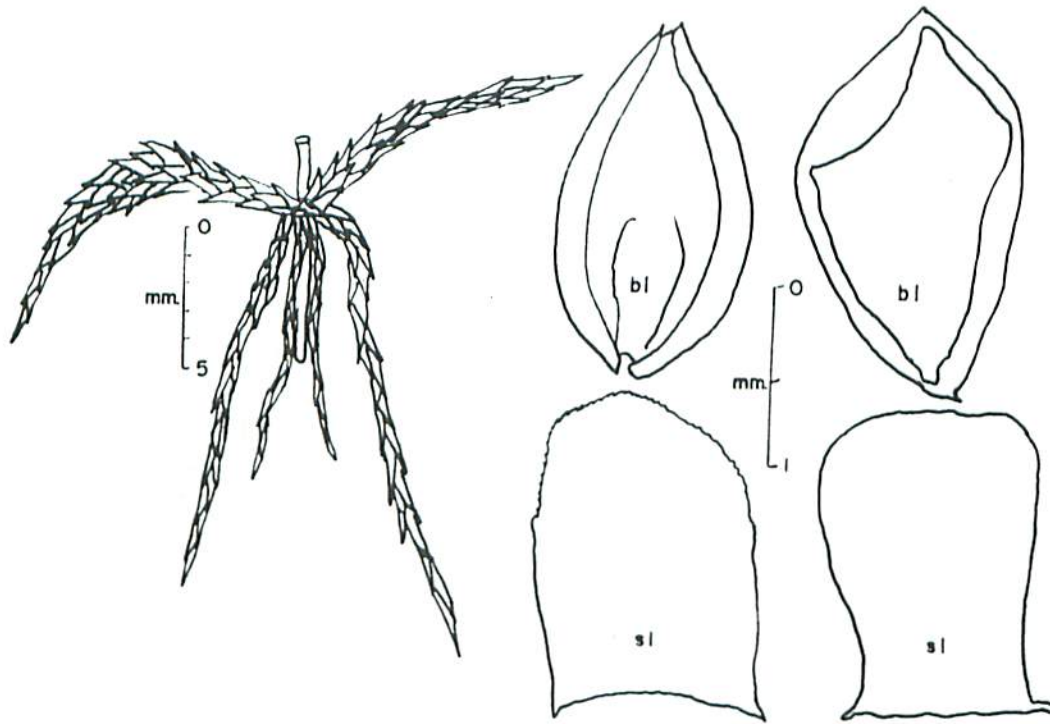


Figure 2. *Sphagnum centrale* C. Jens. 1896.

Plant large, robust, long branches, very soft looking, usually pale green, yellowish, brownish, light reddish, even purple-tinged; stem sclerodermis orange or dark red-brown and covered by a white hyalodermis, easily removed; fascicles usually 2 + 3 (2 + 4 shown); divergent branches long, robust and reflexed; pendent branches long but weaker, more or less hiding the stem; *branch leaves very large* (1.5-2.5 mm), oblong-ovate, usually *cucullate-tipped and very concave*; *stem leaves large* (1.2-2.2 mm long x 0.8-1.0 mm wide), broadly lingulate-spatulate with, at the most, a fine fringe across the top and partly down the sides (denticulate).

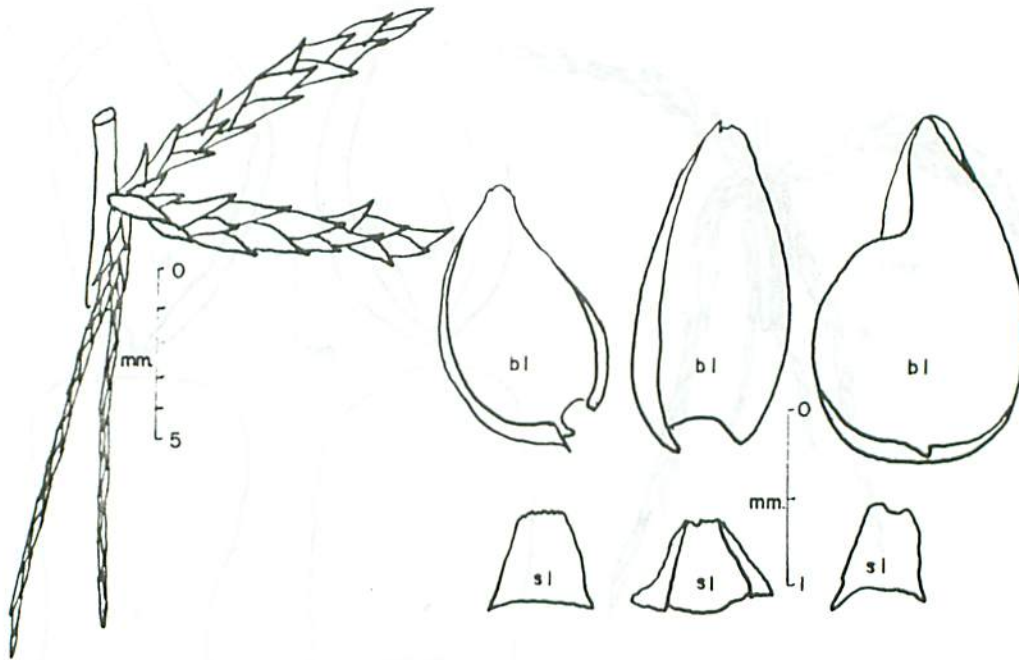


Figure 3. *Sphagnum compactum* D.C. 1805.

Plant short (4-8 cm), rigid, robust, and compact (forming dense pillows), grey-green, glaucous-green, yellowish, dirty white when dry, but mostly a mottled dirty brown and sometimes even grey-brown or yellow-brown; stem usually brown, sometimes yellowish in the upper parts; fascicles close together, 2 + 2 (2 + 3); divergent branches robust, horizontal or ascending, short (up to 1 cm); pendent branches tightly appressed to the stem, narrowly tapered; branch leaves large (2.0-3.0 mm), very concave, coarse, imbricate to rigidly squarrose, ovate-hastate with involute margins, toothed and truncate apex; stem leaves minute (0.3-0.7 mm long x 0.5-0.6 mm wide), concave, short-lingulate to triangular-lingulate with rounded, eroded, or lacerate broad and square tip.

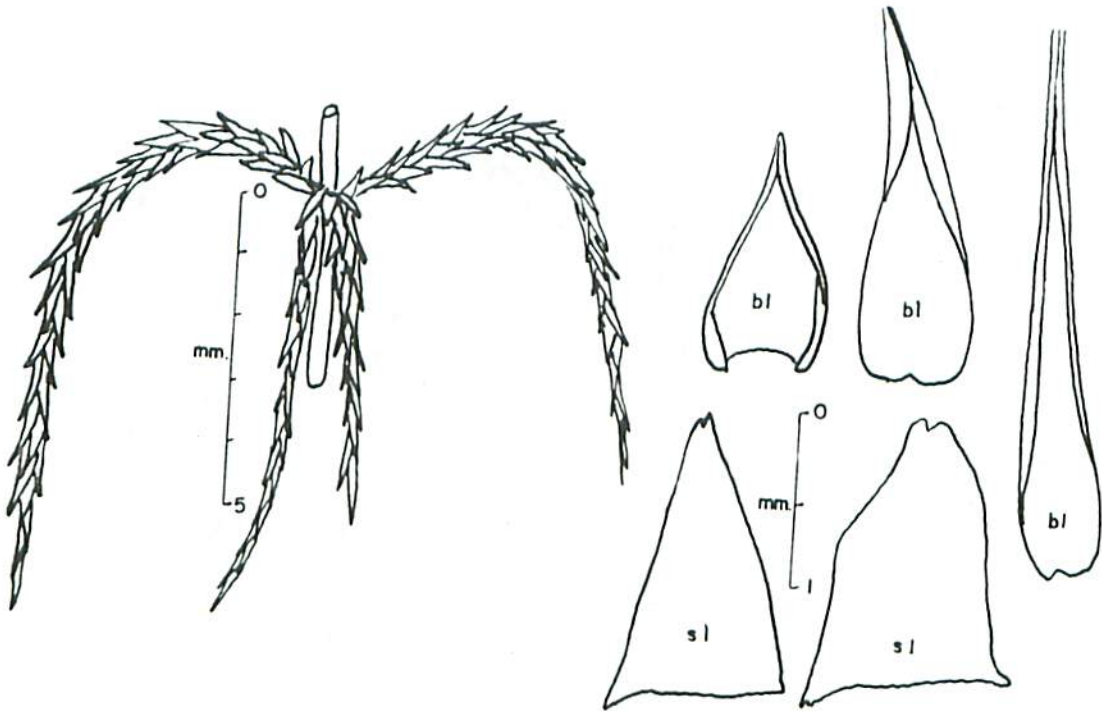


Figure 4. *Sphagnum cuspidatum* Hoffm. 1795.

Plants large (12-40 cm), slender, delicate or robust with a wet, feathery appearance, usually greenish, may be bright green, yellow, yellow-brown or brown, never red; somewhat glossy; branches of head quite pointed and head stellate when plant growing at or below water surface; stem sclerodermis green or brown; 3-5 branches per fascicle, long and limp, all divergent or 1-2 poorly developed pendent ones which do not conceal the stem; *branch leaves* varying in size, *usually very long* (up to 3.0 mm long x < 1.0 mm wide), lanceolate-acuminate to linear, deeply concave, loose, erect and spreading, *markedly wavy when dry*, little or no metallic luster, may be slightly curved or secund; stem leaves smaller, concave, broadly (sometimes narrowly) triangular, longer than broad, toothed at the tip.

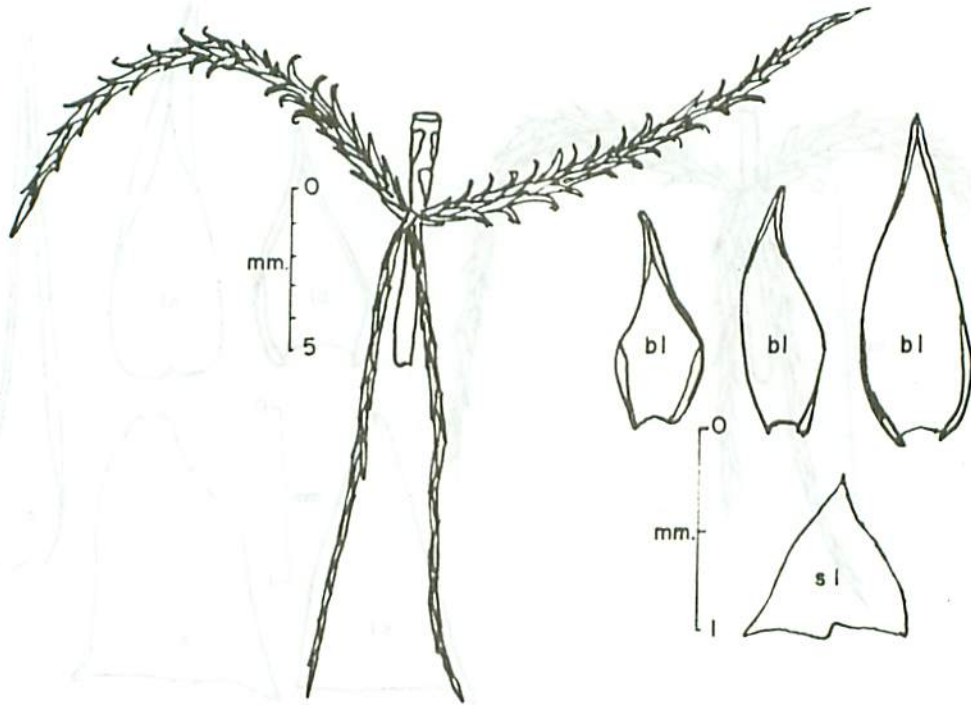


Figure 5. *Sphagnum fallax* (Klinggr.) Klinggr. 1880.

Plants usually robust, tall (up to 30 cm) with very dense heads, usually green, green-yellow, sulphur-yellow, white-yellow, brown-tinged, glossy; stem sclerodermis nearly white to yellow-green; fascicles 2 + 2 (2 + 3); branches long (up to 1.5 cm) but very thin; pendent branches tightly appressed, but more or less covering the stem if fascicles not too distant; branch leaves quite large (1.0-2.0 mm long), narrowly lanceolate to lanceolate-ovate, involute tips, imbricate and somewhat wavy with recurved tips when dry; stem leaves small (0.5-0.8 mm long), short-triangular, hastate, triangular-lingulate (broader than long), with mucronate, rounded or truncate tips which may be slightly eroded.

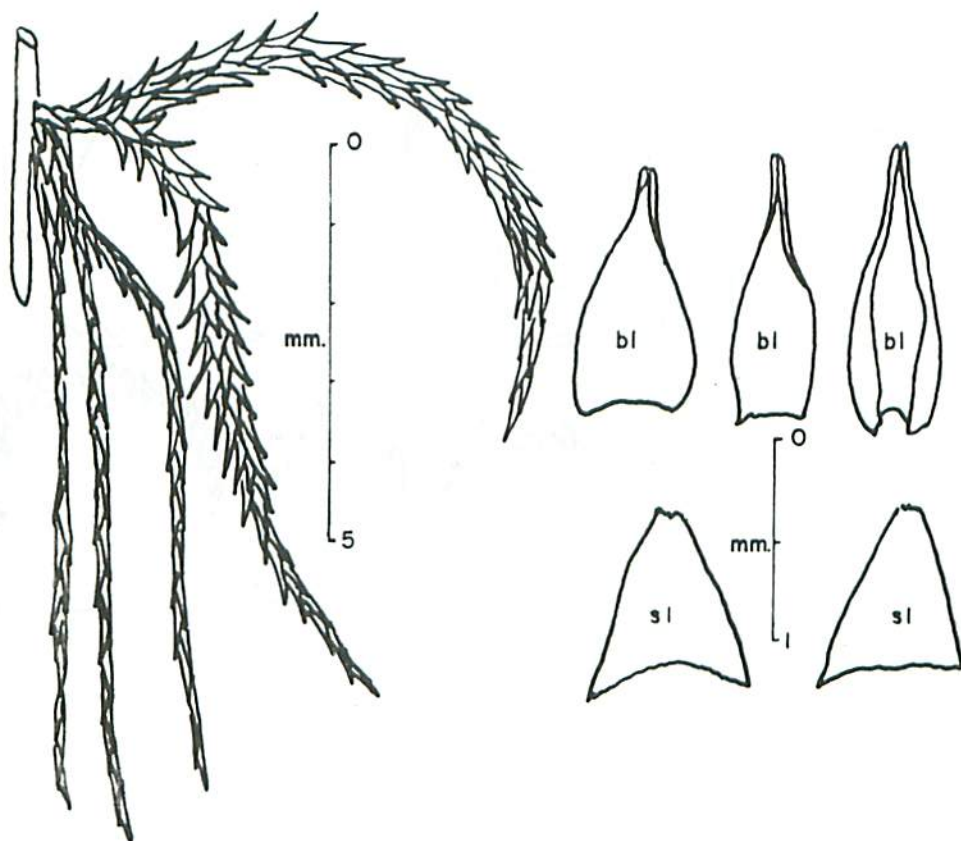


Figure 6. *Sphagnum fallax* var. *angustifolium* (C. Jens) 1891.

Plants robust, of medium height (10-12 cm), green, pale yellow-green, yellowish; very dense heads; stem sclerodermis yellow; fascicles 2 + 2 (2 + 3); divergent branches short (0.8 cm); pendent branches thin, up to 1.0 cm long; branch leaves loosely imbricate, about 1.0 mm long, lanceolate, concave, somewhat wavy and tips slightly recurved when dry; stem leaves rather small (1.0 mm), equilateral-triangular or triangular-lingulate, with dentate tips.

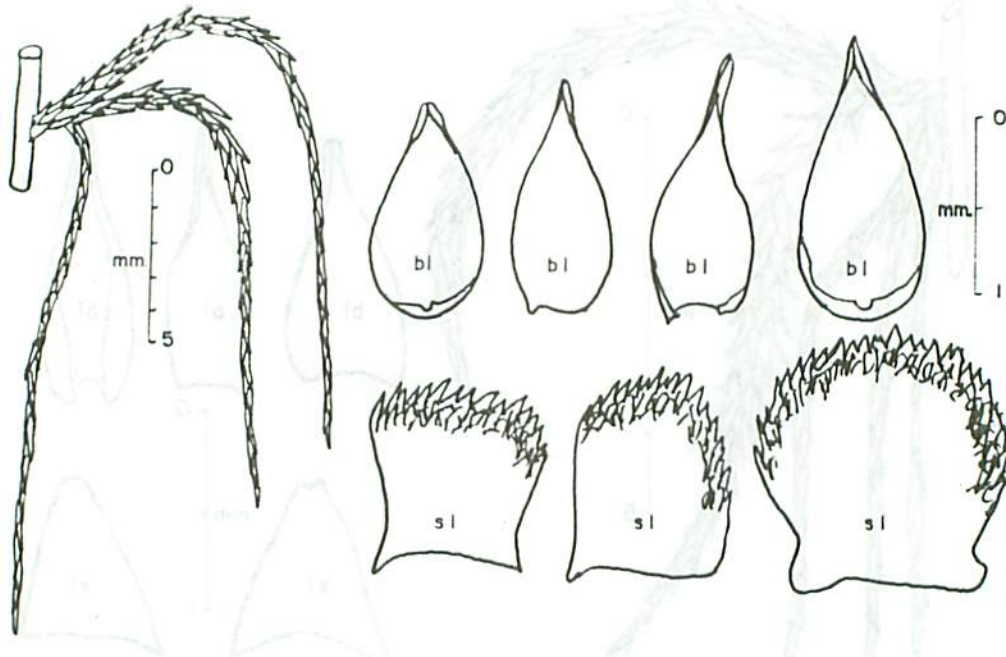


Figure 7. *Sphagnum fimbriatum* Wils. 1846.

Plants small (4-5 cm high), slender, very delicate (occur in loose tufts), pale or grey-green near the top, remainder green, yellowish, or brown, lusterless; *apical bud protrudes much above the surrounding crown laterals*; stem thin and well proportioned; stem sclerodermis pale greenish or yellowish; fascicles 2 + 1 or 2 + 2; branches rather thin, very long and almost cordlike (filiform); pendent branches up to 2.5 cm long, not tightly appressed to stem; divergent branches arcuate and decurved; branch leaves small to medium-sized (0.55-2.0 mm long), ovate to ovate-lanceolate, strongly concave, imbricate, strongly involute near the narrow truncate (or sometimes dentate) apex; *stem leaves broadly obovate-spatulate to short-spatulate (0.7-0.8 mm long), often wider than long, spoon-shaped (concave), clasping the stem, coarsely fimbriate-lacerate across the top and partially down the sides.*

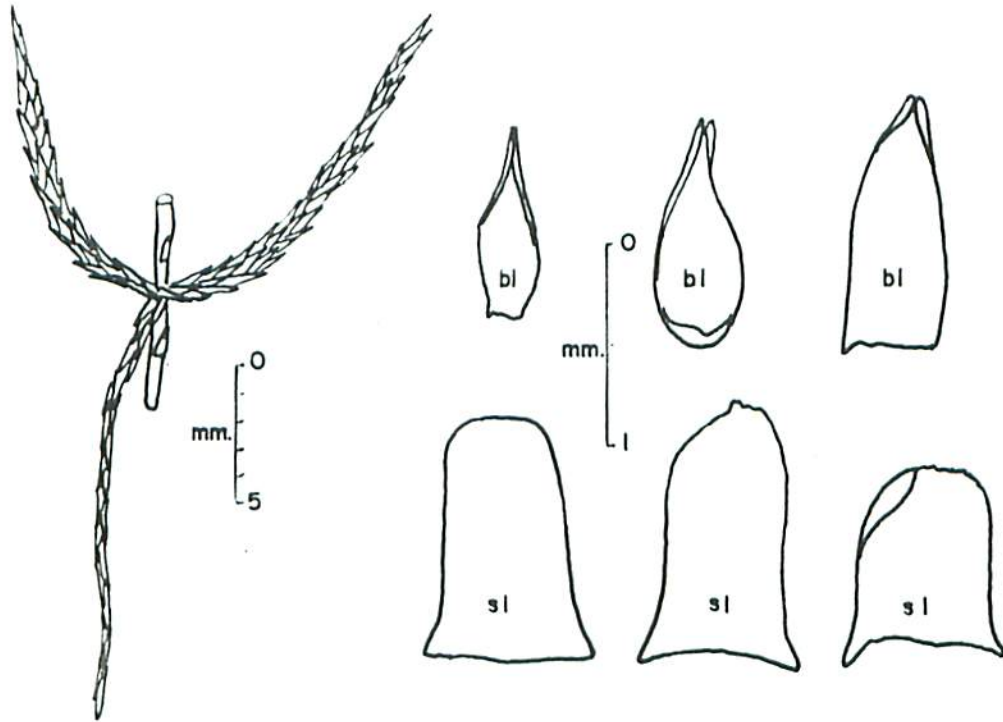


Figure 8. *Sphagnum fuscum* (Schimp.) Klinggr. 1872.

Plant delicate (seldom robust), small, compact and dense, (wiry appearance), usually rust-brown to dark-brown, rarely greenish except at the top; stem sclerodermis dark brown to red-brown, sometimes yellow; fascicles 2 + 1; divergent branches short (up to 1 cm long); pendent branches up to 2 cm long; branch leaves rather small (1.0-1.3 mm long), appressed, fine, ovate-lanceolate, involute to finely toothed apex; stem leaves medium-sized (0.8-1.2 mm long x 0.5-0.8 mm wide), broadly lingulate, slightly fringed at the center of the widely rounded tip or ending in a short, truncate, toothed tip.

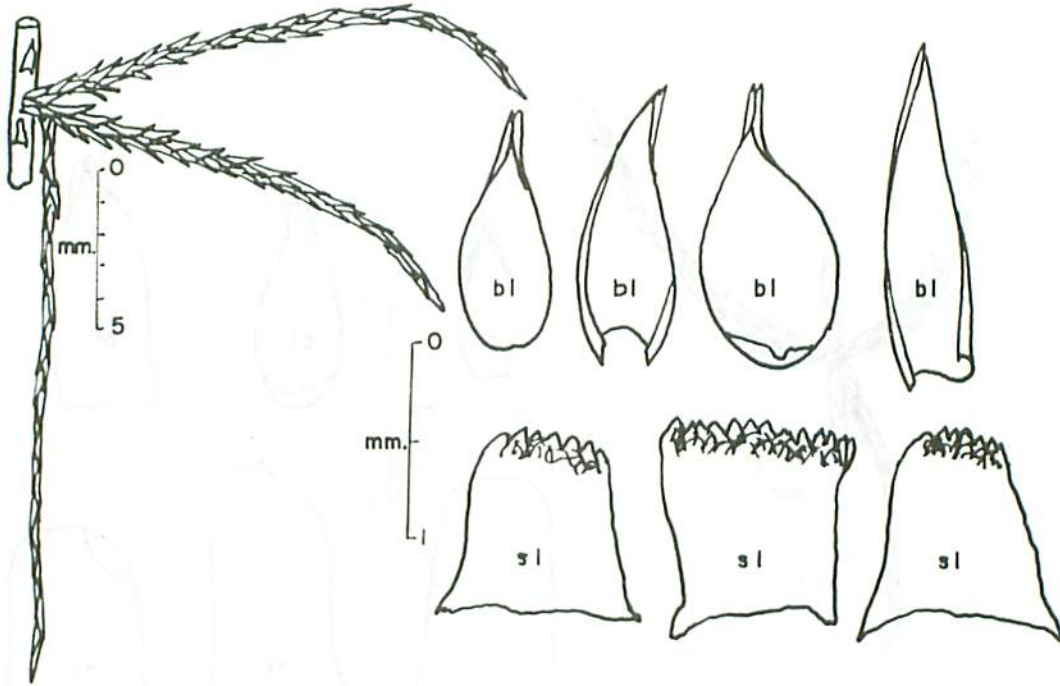


Figure 9. *Sphagnum girgensohnii* Russow 1865.

Plants fairly robust, rigid, often very tall (10-15 cm) and loose, but can be dense and low, usually green, yellowish or brownish, may be pale green-yellow, grey-green, dark green or dark blue-green, dull in appearance; *apical bud protrudes above the crown laterals* or may be just even with them; stem sclerodermis nearly white, green, yellowish, brownish; stem generally quite robust; fascicles usually 2 + 1 (2 + 2); branches long (1.5-2.5 cm), curved and deflexed; pendent branches not tightly appressed to the stem; branch leaves rather small (1.0-1.4 mm long), lanceolate, lanceolate-ovate or ovate, involute to involute-tubular at a toothed apex, very imbricate to somewhat squarrosely spreading; *stem leaves* medium-sized (1.0-1.2 mm long x 0.7-0.9 mm wide at the base), as broad as long or longer, lingulate, slightly concave with broad apex that is coarsely lacinate-fimbriate.

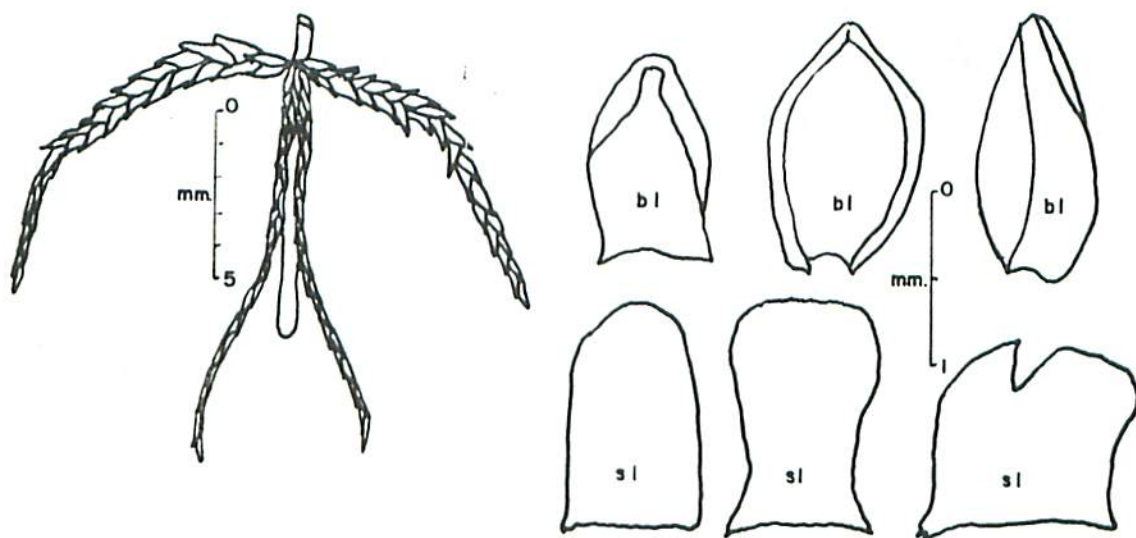


Figure 10. *Sphagnum magellanicum* Brid. 1798.

Plants compact, robust, coarse, medium-sized to large (8-20 cm); bright green, grey-green to blue-green, *always tinged with pink, red, or purple*; stem sclerodermis and axes of branches red, red-brown or purple-red; stem covered by white, easily removed hyalodermis; fascicles 2 + 2 (2 + 3); branches short (up to 1 cm long, but occasionally 1.5 cm); pendent branches appressed; *branch leaves* appressed to spreading, *large* (1.5-2.0 mm long), broadly ovate, *very concave*; *tips cucullate*, rounded, may have slightly denticulate margins; *stem leaves large* (1.0-2.0 mm long), long-lingulate, broadly lingulate or spatulate, upper margins and broadly rounded apices fringed.

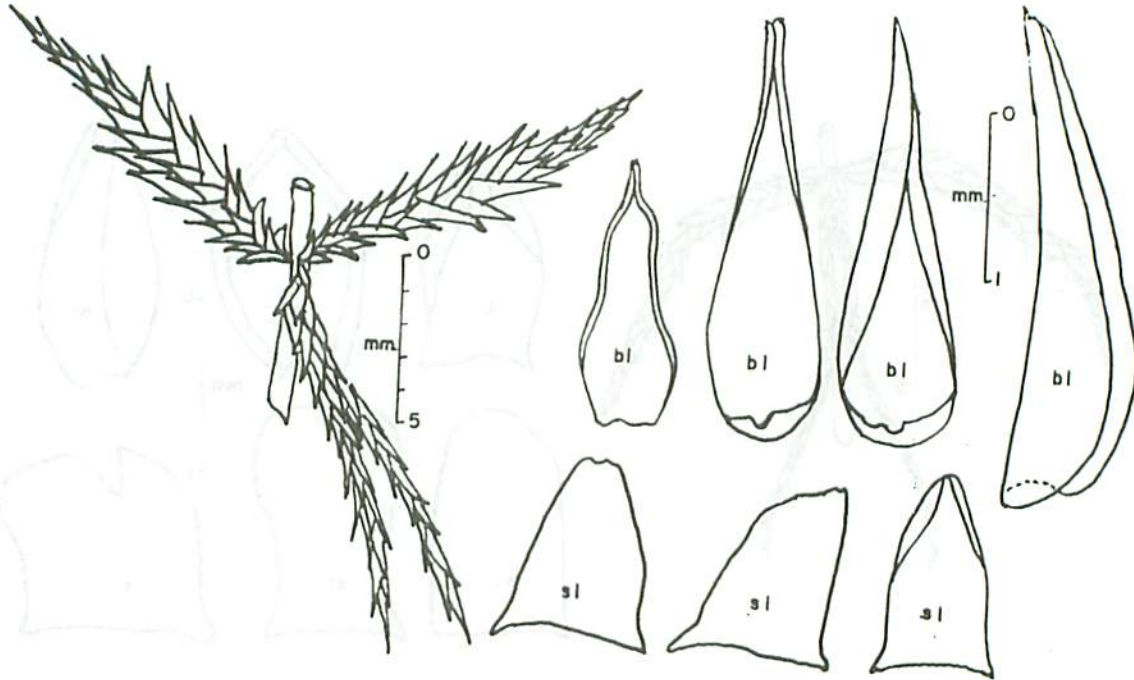


Figure 11. *Sphagnum majus* (Russow) C. Jens. 1890.

Plant usually large, robust, but may be delicate (forms loose, soft mat); green, brownish, yellow-green, dark dirty green (less frequently a light grassy green), glossy; slight purple tinges often noticeable in crown; branches of the head blunter than lower branches; stem sclerodermis pale to yellow-green; fascicles 2 + 2; divergent branches long; pendent branches only somewhat shorter; *branch leaves large* (up to 2.3 mm long x > 1.0 mm wide); ovate-lanceolate, occasionally more or less secund and crescentic, crowded or loosely imbricate, *often wavy, when dry*, strongly involute; stem leaves readily visible, medium-sized (0.8-1.3 mm long x 0.7-0.9 mm wide), triangular-lingulate to lingulate, may be concave and have light fringe on rounded tip which is involute to blunt. This species may easily be mistaken for *S. cuspidatum* but usually is more brown and has broader leaves.

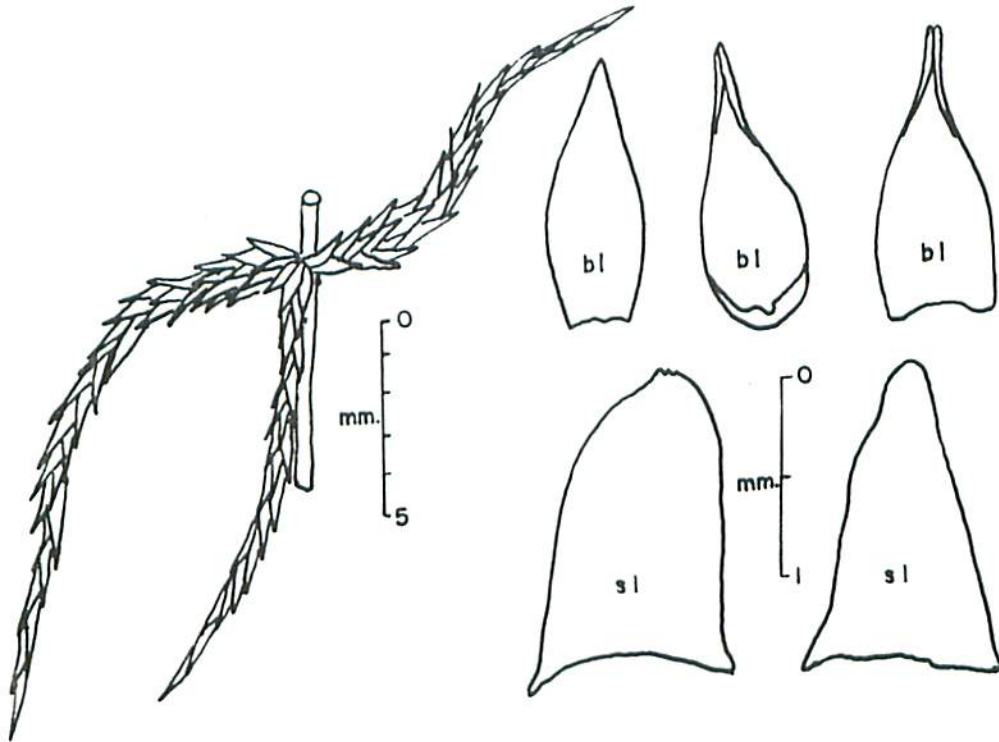


Figure 12. *Sphagnum nemoreum* Scop. 1772.

Plants usually short (5-8 cm), compact, stiff, sometimes forked, usually pale green with red tinges; stem sclerodermis light-colored or reddish, rarely yellowish or green; stem not completely hidden by the appressed pendent branches; fascicles 2 + 1 or 2 + 2; divergent branches usually recurved, fairly long (up to 1.5 cm), lower ones flagelliform; branch leaves appressed to slightly spreading, long (1.0-2.0 mm), ovate-lanceolate to lanceolate, slightly involute above to a somewhat toothed or truncate apex, lusterless when dry; stem leaves large (1.0-2.0 mm long x 0.4-0.8 mm wide), lingulate, triangular-lingulate to isosceles-triangulate, very concave, terminating in an involute, truncate, often five-toothed apex.

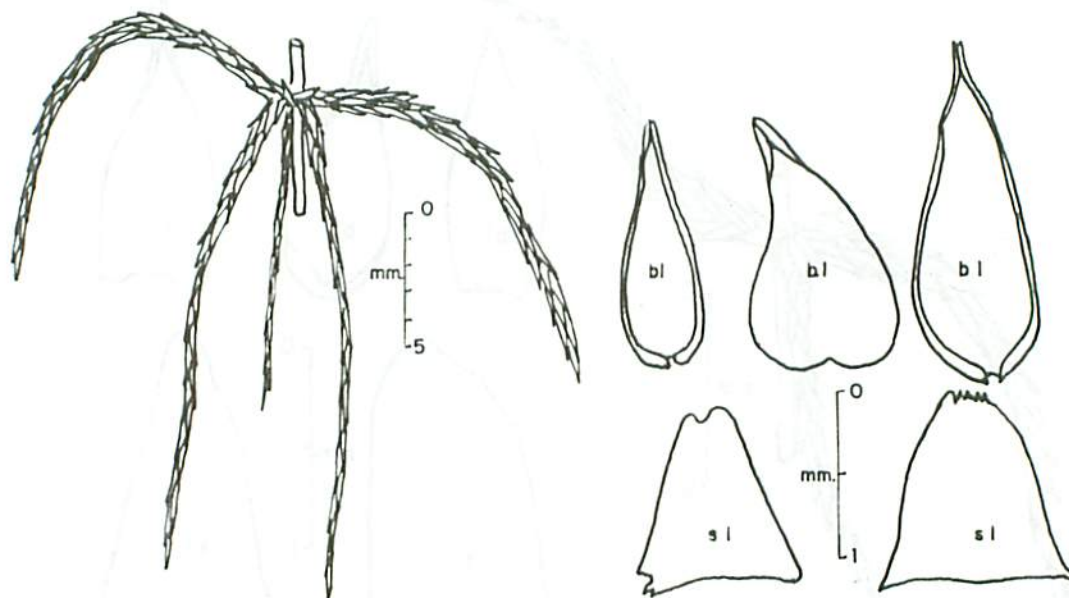


Figure 13. *Sphagnum obtusum* Warnst. 1877.

Plants large, robust, pale yellow and greenish to almost black, may have brownish variations, glossy; head very dense; *stem stiff* with a light-colored or yellowish sclerodermis; branches long and thick; *pendent branches completely hide the stem*; fascicles usually 2 + 3; *branch leaves large* (2.0-3.0 mm long), broadly ovate-lanceolate, becoming longer toward branch tip, *wavy when dry*, may have slightly recurved apices, *occasionally somewhat five-ranked*; stem leaves medium-sized (0.8-1.3 mm long x 0.8-1.2 mm wide), triangular-lingulate to lingulate, blunt rounded tips may be somewhat fringed.



Figure 14. *Sphagnum palustre* L. 1753.

Plants robust (8-10 cm high, can be up to 30 cm), green, blue-green, yellow-green, green-white (grey-white when dry), at times tinged with brown, seldom yellow-brown; stem yellow-brown or red-brown covered by white, easily removed hyalodermis; *fascicles* 2 + 2 (2 + 3); *branches short* (1-1.5 cm), blunt-tipped and swollen due to the crowded concave branch leaves; pendent branches tightly appressed; *branch leaves large* (up to 3.0 mm long), broadly ovate, imbricate (with some spreading), *very concave*, involute-margined and with a *cucullate* tip; *stem leaves large* (up to 3.0 mm long x 1.25 mm wide), long-lingulate, spatulate to spatulate-lingulate, apices broadly rounded and slightly erose-fimbriate.

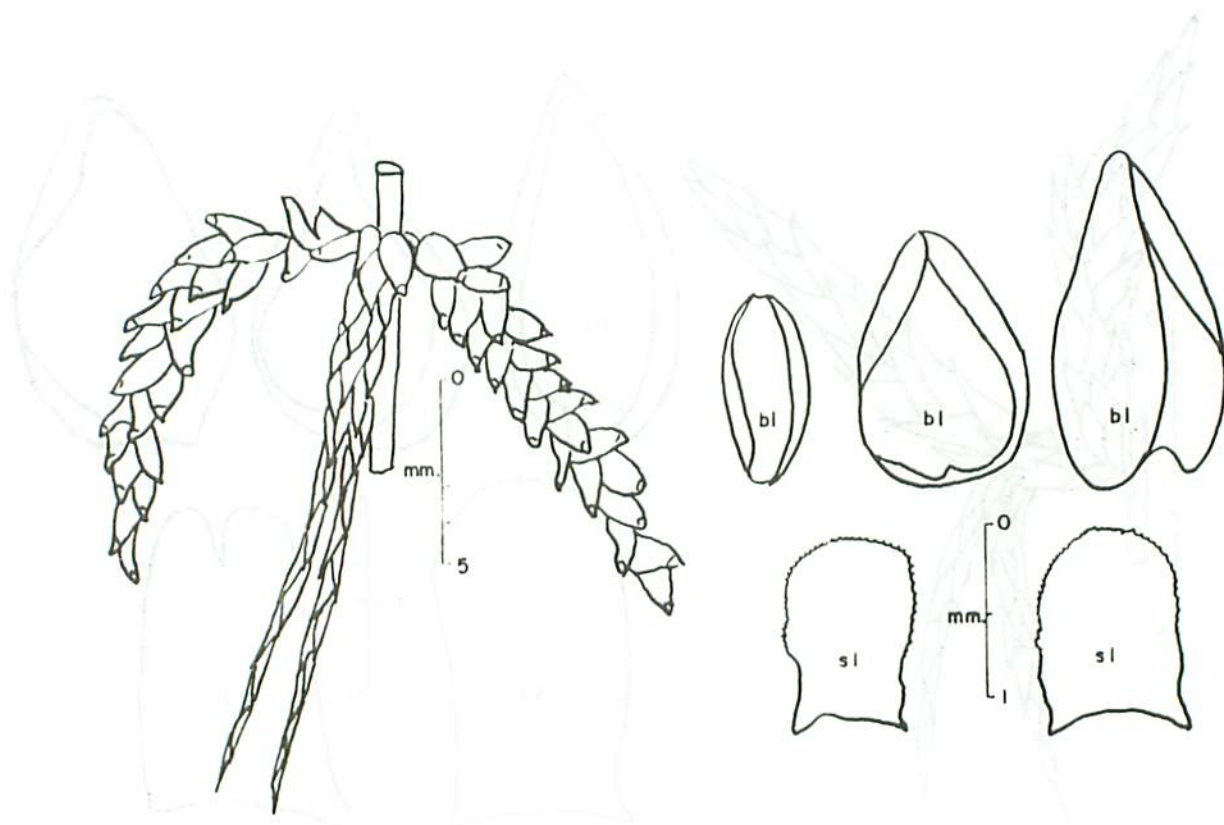


Figure 15. *Sphagnum papillosum* Lindb. 1872.

Plants variable in size, *strongly tinged with yellow; yellow-brown or dirty brown, often dark coffee-brown to nearly black*, can also be light green to almost orange, never red; fascicles 2 + 2 arrangement; branches blunt and swollen; pendent branches almost cover stem; stem sclerodermis dark mahogany brown to black-brown, covered by white, easily removed mantle; *branch leaves* loosely imbricate, large (up to 2.0 mm long), ovate to broadly ovate, *very concave, with cucullate tip*; *stem leaves* large (1.1-1.6 mm long x 0.7-0.8 mm wide), lingulate-spatulate, tip and upper sides finely fringed. Habit is usually more compact than in *S. palustre*, of which it may be suggestive.

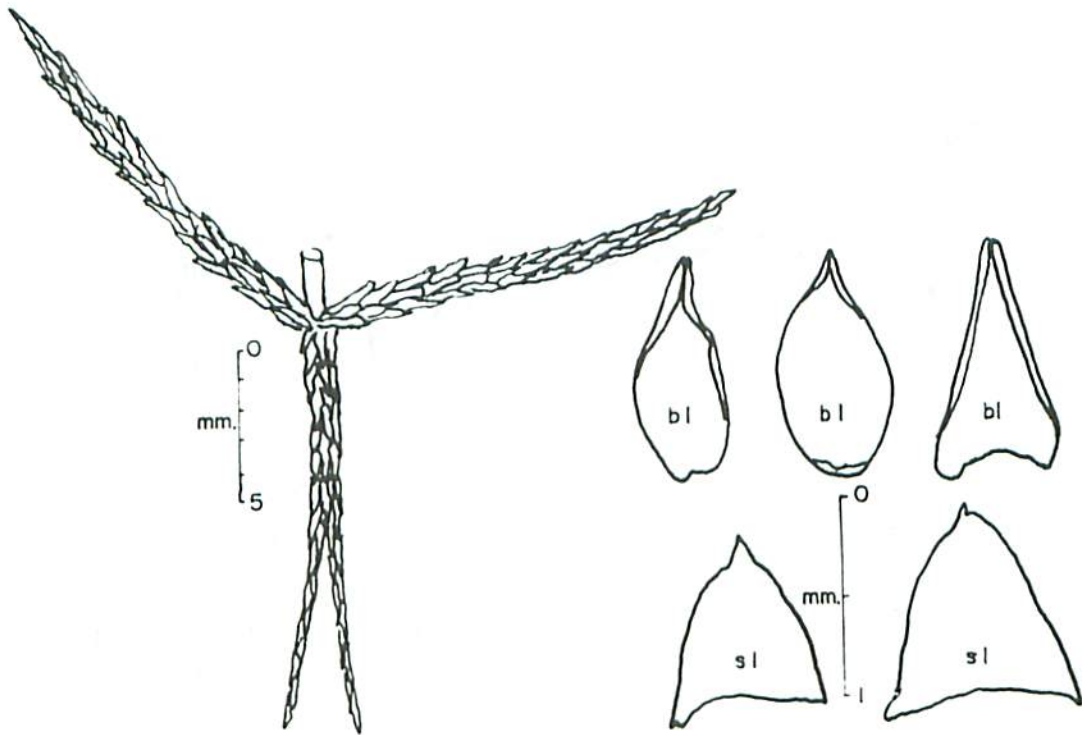


Figure 16. *Sphagnum pulchrum* (Braithw.) Warnst. 1900.

Plant coarse, robust, may be stiffly tall or short, usually brown at the top with remainder yellow to dirty green-brown with violet tinges, often with lacquered appearance; head very dense; fascicles 2 + 2; branches quite thick; stem not hidden by the pendent branches; stem sclerodermis usually brown (white-brown or yellow-brown); *branch leaves* long (1.6 mm) and very wide, widely ovate-lanceolate, *very concave*, more or less secund, involute near the apex, slightly recurved and *somewhat wavy when dry, definitely five-ranked* (leaves on pendent branches not tightly imbricate, whereas those on divergent branches are); *stem leaves very numerous*, small (0.9-1.1 mm long x 0.7-0.8 mm wide), equilateral-triangular, hastate, short isosceles-triangular, sharply cuspidate, quite concave and involute at the apex.

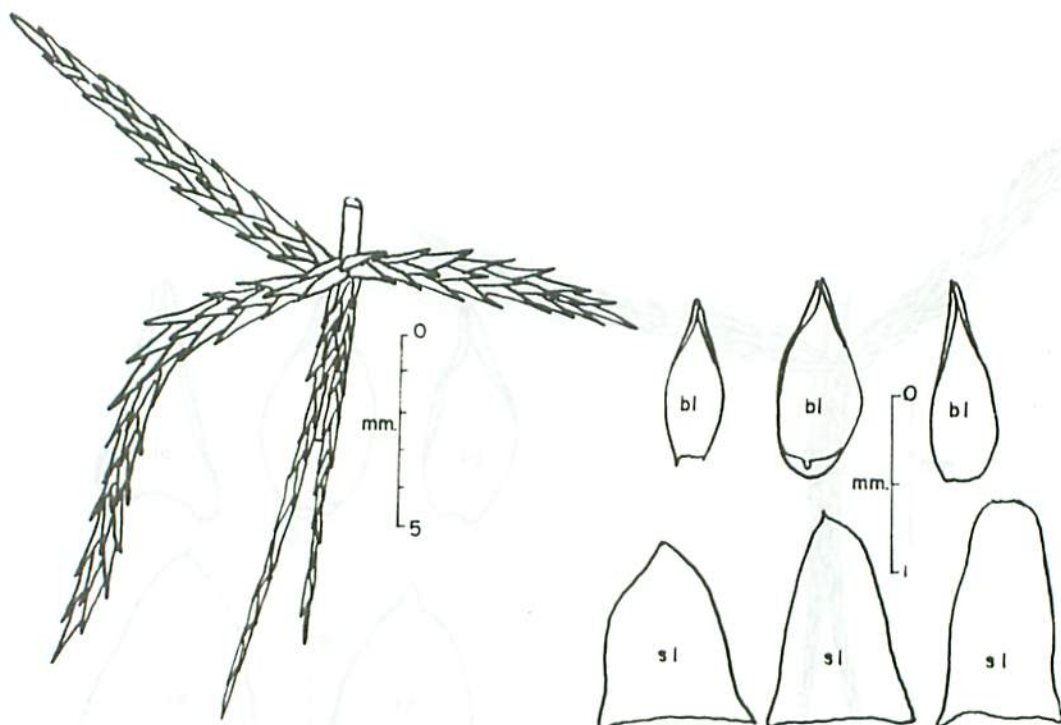


Figure 17. *Sphagnum quinquefarium* (Braithw.) Warnst. 1886.

Plant very densely branched with a very dense head, loose, tall, pale grey to grass-green, reddish to violet-red, straw-colored or any combination of these, *never brown*; stem slender, graceful, more or less hidden by the pendent branches; stem sclerodermis almost white, green or yellowish; fascicles 3 + 2 (2 + 3); *branch leaves* medium-sized (1.0-1.3 mm long), lanceolate or lingulate-lanceolate, not secund, *dull or lusterless when dry, definitely five-ranked*; stem leaves more or less same size (1.0-1.3 mm long x 0.7-0.9 mm wide), equilateral- or isosceles-triangular, with a slight broadening of the base, tip narrower, truncate and toothed.

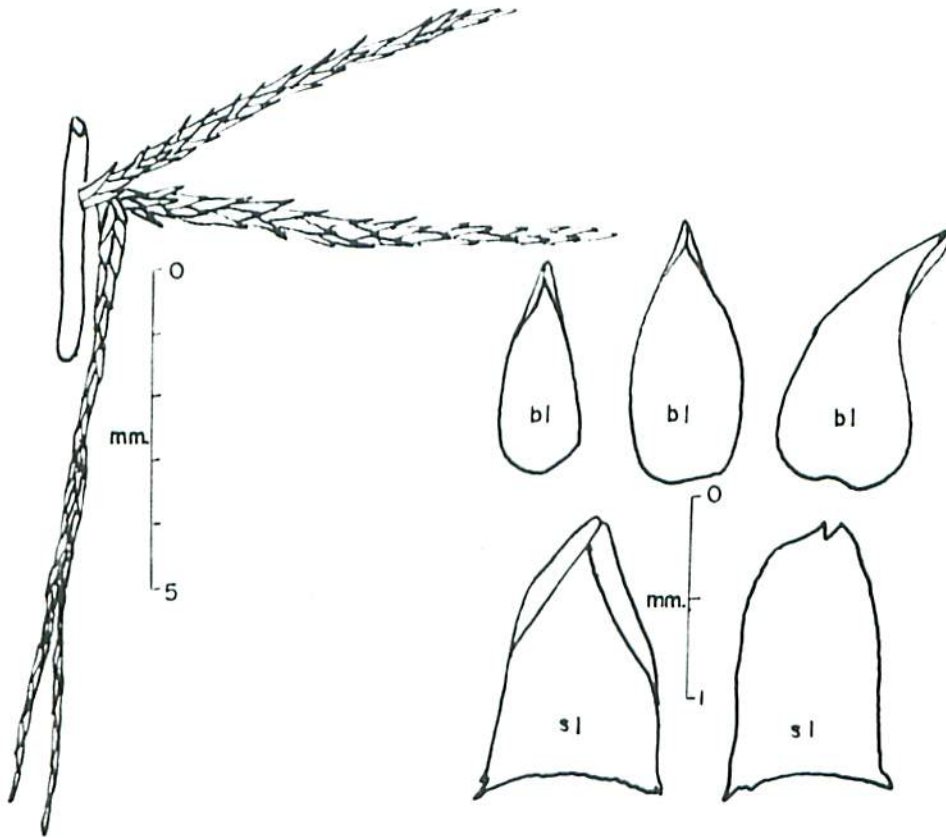


Figure 18. *Sphagnum rubellum* Wils. 1855.

Plants delicate, (in dense tufts), red, sometimes with green; stem sclerodermis red-brown; fascicles generally 2 + 2 (2 + 1); pendent branches nearly hide the stem; branch leaves medium-sized (1.0-1.5 mm long), ovate to ovate-lanceolate, secund and slightly involute at tip; stem leaves relatively large (about 1.5 mm long), lingulate with a slightly lacerate tip or with a single short rent.

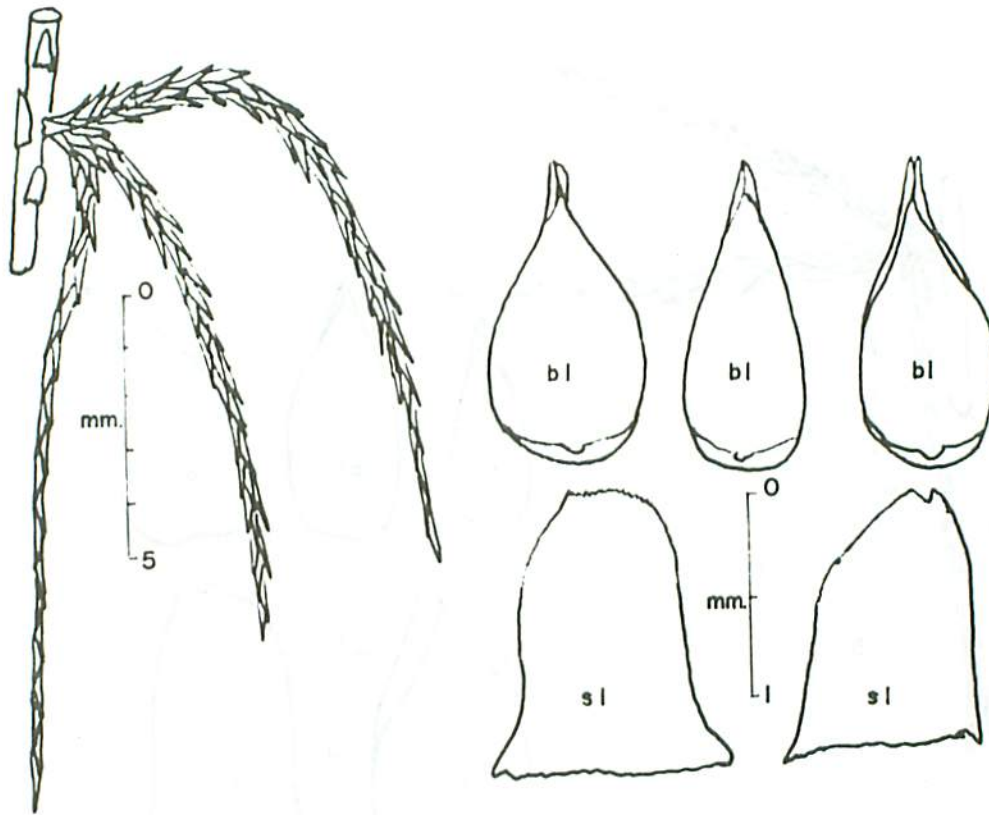


Figure 19. *Sphagnum russowii* (Warst.) 1886.

Plant usually tall, loose, quite robust, less frequently low and dense, often multicolored with the top tinged with red or red-violet, (rarely green, pale yellowish, or brown throughout); stem slender with the *sclerodermis* reddish, less frequently yellowish or light-colored; sclerodermis of the branch axes colorless; branches of the head more or less straight; fascicles 2 + 1; branches usually > 1 cm long (male branches clavate with even the immature ones always violet or purple-red); pendent branches and the cordlike tips of the drooping divergent branches colorless; branch leaves imbricate, medium-sized (0.8-1.3 mm long), involute to a narrow and toothed tip, occasionally very distinctly five-ranked; stem leaves medium-sized (0.8-1.3 mm long x 0.6-0.9 mm wide), lingulate to lingulate-ovate, toothed or slightly fringed only in the middle part of the broadly rounded tip.

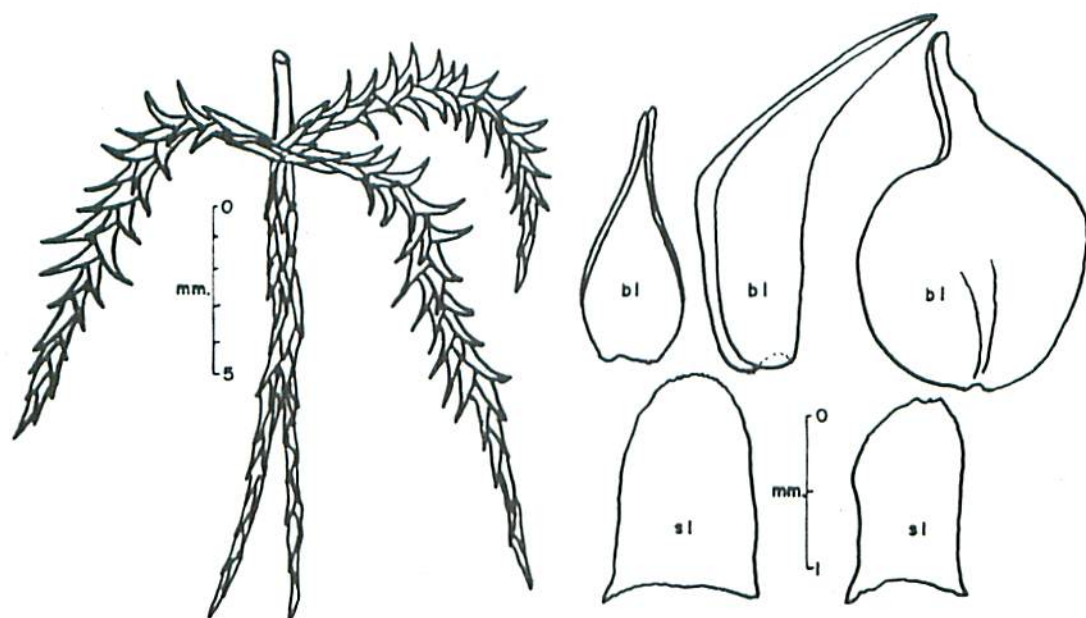


Figure 20. *Sphagnum squarrosum* Crome 1803.

Plant fairly robust with branches attenuated tipward, varies from light to dark green, white-green or yellowish, dark blue, yellow-green to brown (occasionally some red coloration); *readily visible, sharp, globular, apical bud*; stem sclerodermis varies from pale green to red-brown; fascicles 2 + 2 (3 + 2); pendent branches appressed to stem; *branch leaves* large (0.9-2.8 mm long), tapering about halfway up from a widely ovate (hastate) base to a short or long tip, *usually squarrose*, rarely imbricate; stem leaves coarse, large (1.6-2.4 mm long x 1.0-1.2 mm wide), lingulate to spatulate with a long fringe at the top.

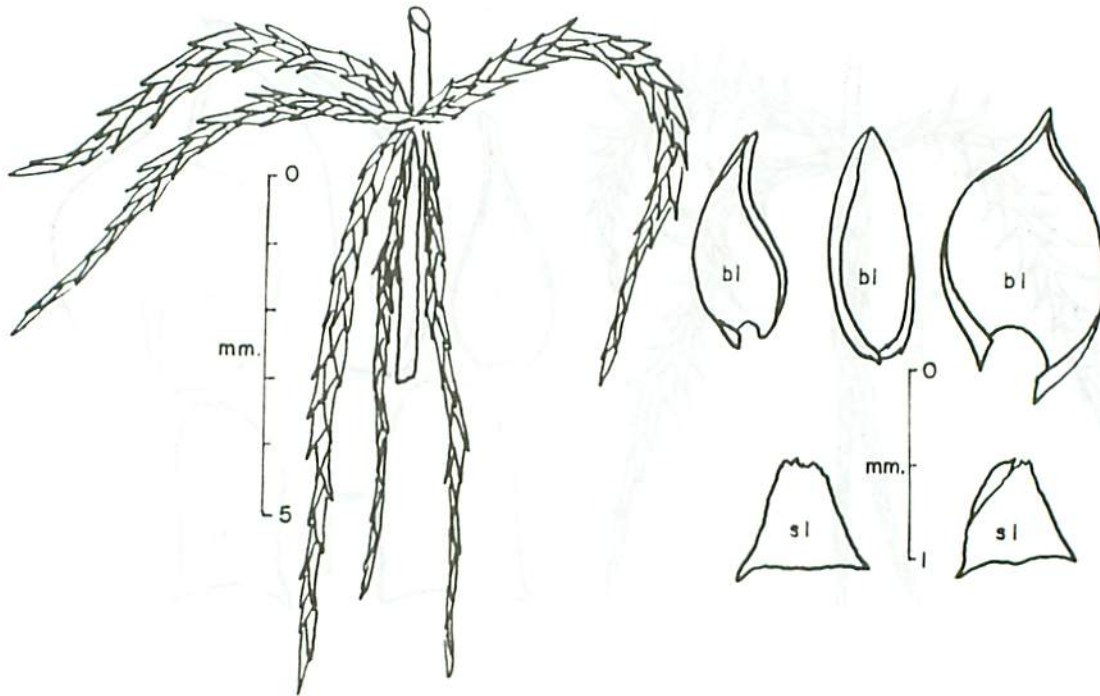


Figure 21. *Sphagnum subsecundum* Nees 1819.

Plant usually small (5 cm high but may grow up to 20 cm), delicate to robust, (known to be exceedingly variable in all characteristics), usually green or yellow-green, *carrotty-brown (orangish)* to black-brown, purple-brown, never a rose-red; head narrow, with the crown branches quite curly; fascicles 2 + 3, 2 + 4, or 3 + 3; *divergent and pendent branches similar in appearance and length*, usually short (0.6-0.8 cm); stem sclerodermis yellow, yellow-green, purple-brown to dark brown, covered for the most part by the pendent branches, (axes of the lateral branches dark brown); *branch leaves up to 1.2 mm long, boat-shaped (very concave)*, narrow and deeply involute, curved and slightly secund, short-elliptic or broadly ovate, tightly imbricate when dry; *stem leaves small* (0.6-0.8 mm long) and almost as broad, triangular-lingulate, lingulate to ovate, concave, apices broadly rounded (blunt).

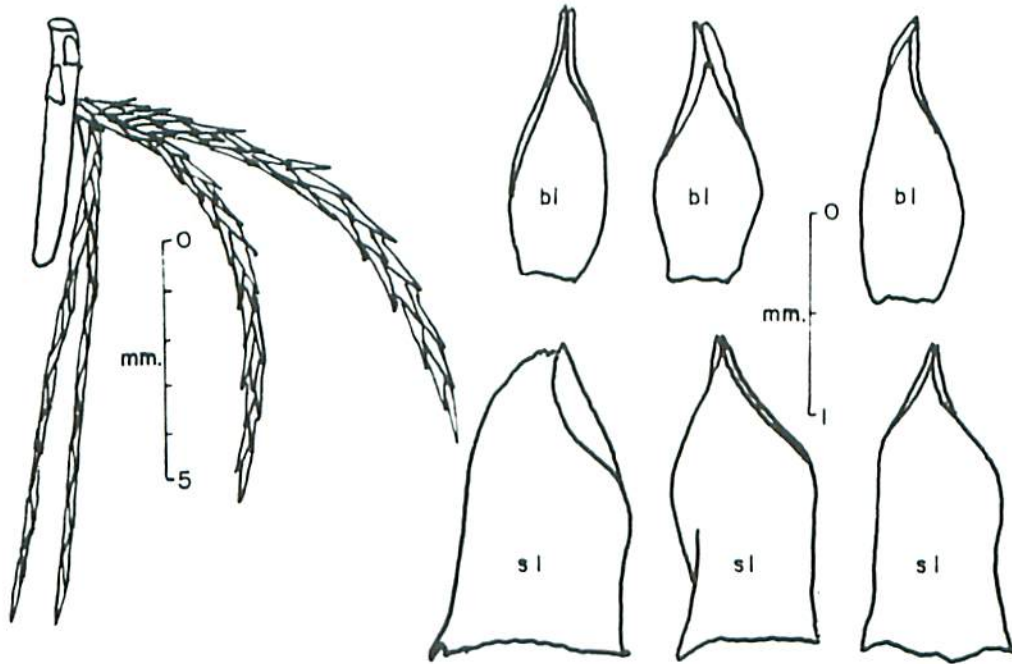


Figure 22. *Sphagnum tenerum* Sull. & Lesq. 1856.

Plant robust and compact, usually yellowish or pink-tinged; stem sclerodermis red with evidence of this even in the branch axes; fascicles 2 + 2 (2 + 1); *stem leaves usually larger than branch leaves*; branch leaves fairly large (about 1.4 mm long), ovate-lanceolate, with an involute and toothed, obtuse apex, usually very regularly imbricate; stem leaves medium-sized to large (1.3-1.6 mm long), triangular, isosceles-triangular, ovate, slightly concave, involute at narrow lacerate apex.

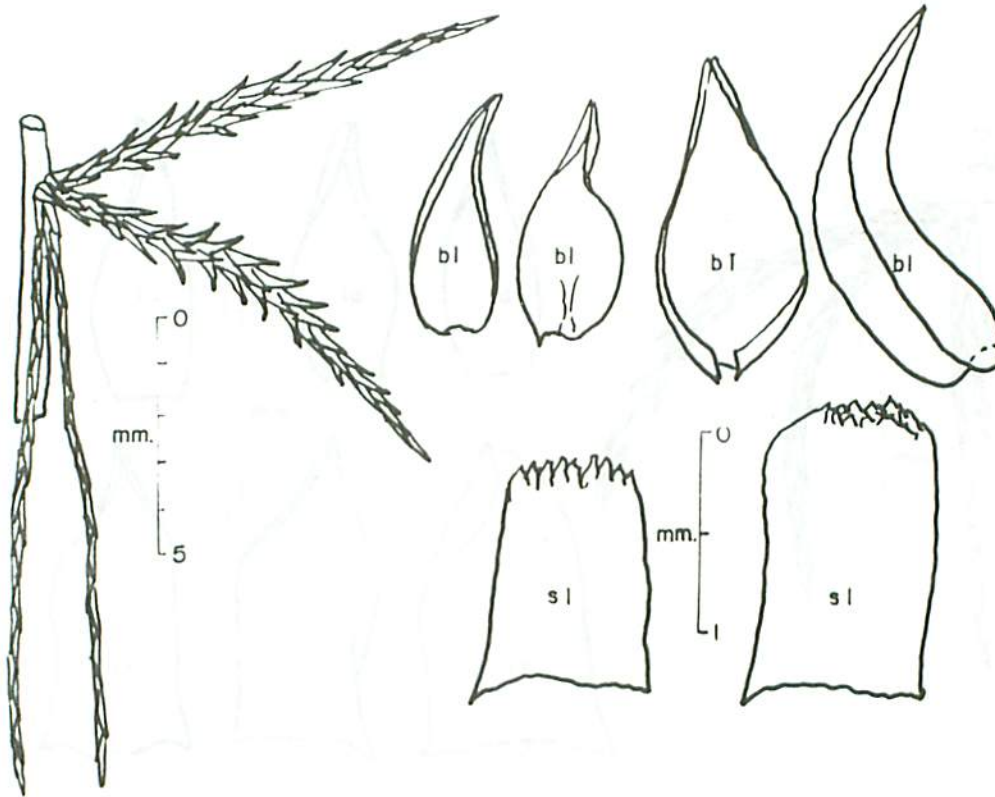


Figure 23. *Sphagnum teres* (Schimp.) Ångstr. 1861.

Plants medium-sized, yellow, reddish or brown, less frequently a flat green; head quite definitely stellate with the branches of the head straight; *apical bud visible* above the surrounding crown laterals; stem sclerodermis green to red-brown; fascicles 2 + 2 (2 + 3); divergent branches usually fairly short, rigidly cylindrical, tend to diverge strongly; pendent branches usually tightly appressed to stem; *branch leaves* vary from completely imbricate to very squarrose (*the squarroseness usually much less than 90°*), ovate or lingulate-lanceolate, may have spreading tips abruptly changing to a narrow apex, tips may be slightly recurved at the obscurely dentate apex; stem leaves (as in *S. squarrosum*) very large (1.3-2.4 mm long x 1 mm wide), oblong-lingulate or spatulate, slightly concave, slightly widened above, with a long fringe across the top.

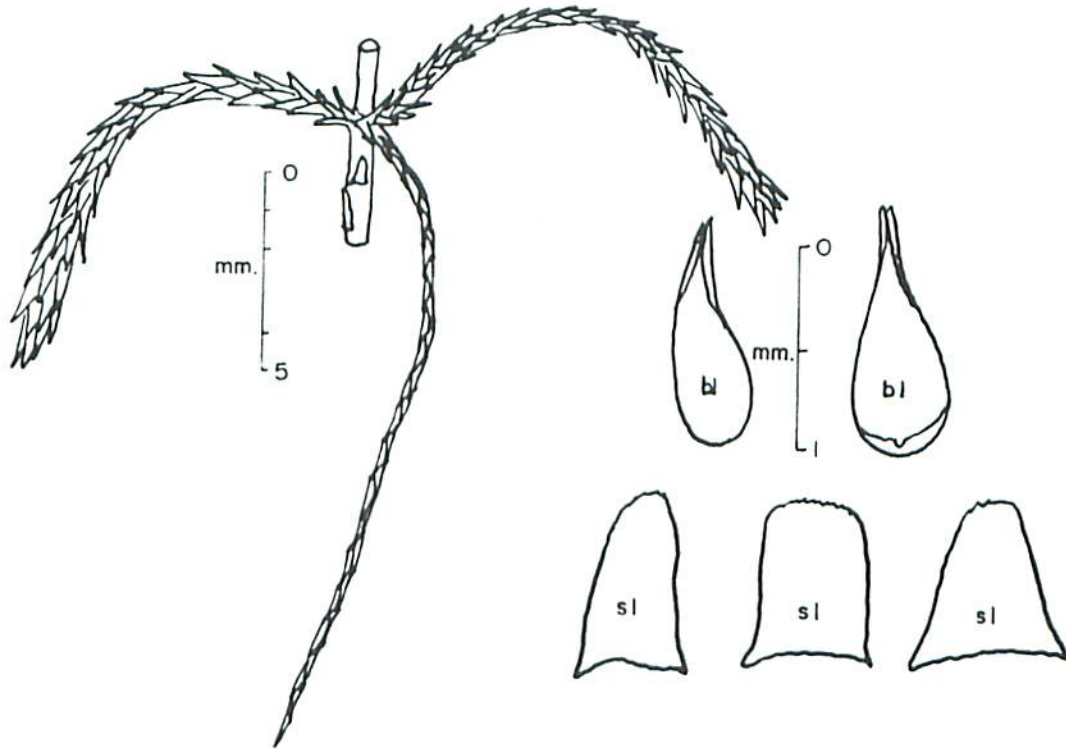


Figure 24. *Sphagnum warnstorffii* (Russow) 1887.

Plant more or less soft, loose and low growing, may be multicolored, purple-red, carmine-red, or violet-tinged in the crown (less frequently greenish); stem weak and slender, with a red sclerodermis (rarely light-colored or greenish); branches of head more or less curved; fascicles 2 + 1 or 2 + 2; pendent branches often reddish, more than 1 cm long and not tightly appressed to the stem; divergent branches generally broader toward the tip; branch leaves medium-sized (0.9-1.5 mm long), narrowly ovate or ovate-lanceolate, definitely five-ranked, tips somewhat recurved when dry; stem leaves medium-sized (0.8-1.2 mm long x 0.5-0.6 mm wide), lingulate to lingulate-ovate, slightly concave, with narrow or broad apices which are entire or toothed at the middle of the rounded extremity.

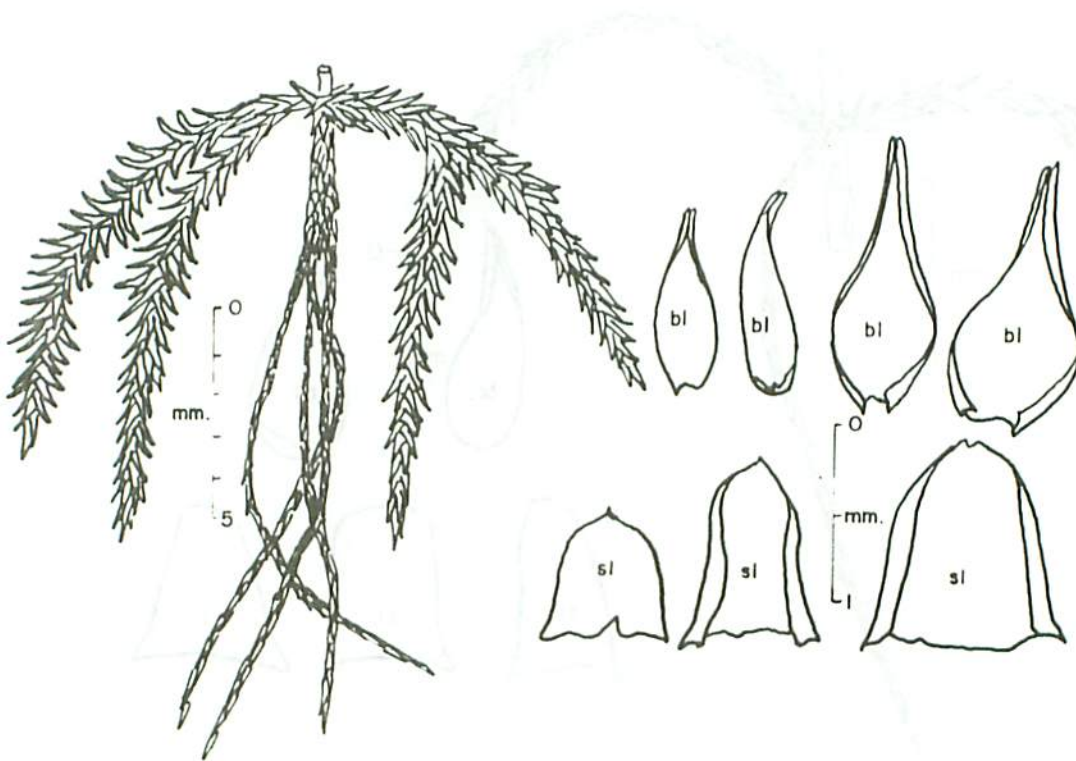


Figure 25. *Sphagnum wulfianum* Girg. 1860.

Plants robust, stiff-stemmed, often in firm, pillowlike mats, rose-red or dull green, often mottled with brown; branches of the head short, straight, blunt and crowded into a compact, globular head; stem sclerodermis red-brown to black-brown; stem seemingly more than 0.5 cm thick because of dense covering by the numerous pendent branches; *fascicles have many branches* (6-12), with 3-6 strongly divergent; branch leaves long, involute to narrowly ovate-lanceolate, 1.0-1.2 mm long, may be bowed or arched outward with straight ends which are small and narrowly truncate when dry, may have slightly reflexed tips; stem leaves usually small (0.8 mm long), triangular-lingulate, more or less concave.

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