

# Meddelelser om Grønland

**Illustrated Moss Flora of Arctic North America  
and Greenland.**

**2. Sphagnaceae**

*Gert S. Mogensen (Ed.)*



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### *Editor – Botany*

Gert Steen Mogensen, Botanical Museum, Gothersgade 130, DK-1123 Copenhagen K. Telephone +45.1.111744.

### *Editor – Zoology*

G. Høpner Petersen, Zoological Museum, Universitetsparken 15, DK-2100 Copenhagen Ø. Telephone +45.1.354111.

*Instructions to authors.* – See page 3 of cover.

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Illustrated  
Moss Flora  
of Arctic North America  
and Greenland

Editor

Gert S. Mogensen

2. Sphagnaceae

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## Key to illustrations

Each moss illustrated is shown at life size in the upper left-hand corner.

bl ..... branch leaf  
 rc..... retort cell  
 scc..... stem cortex cells  
 sl..... stem leaf  
 x cross-section; xb of branch, xbl of branch leaf; xs  
 of stem.

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## Sphagnaceae

by Howard A. Crum

The Herbarium, University of Michigan, Ann Arbor, Michigan 48109, U. S. A.

Illustrations by Victoria G. Friis and Gert S. Mogensen<sup>1</sup>

Branches usually of two types, spreading and pendent, in fascicles that are spirally disposed around the stem and crowded at the stem tip in a capitulum, stem and branch leaves normally differentiated, branch leaves consisting of a network of narrow, green cells enclosing large, empty, hyaline cells that are nearly always porose on the surface and reinforced inwardly by annular fibrils; antheridia globose, paraphyses lacking; sporophyte without a seta, elevated at maturity on a pseudopodium, capsules globose, dehiscent by a lid, with a solid wall provided with an abundance of pseudostomata, the sporogenous tissue derived from the amphithecium except where overarched by the domelike columella; protonema normally thallose, producing 1, rarely 2, gametophores.

### 1. *Sphagnum*

*Sphagnum* L., Sp. Plant. 1106, 1753. – Type: *S. palustre* L.

Plants of wet habitats, growing in carpets, cushions, or hummocks, sometimes submerged. Stems erect (or in aquatic species weak and horizontal), sparsely forked, consisting of a core of thin-walled parenchyma surrounded by a pigmented wood cylinder which is generally enveloped in a cortex of 1 or more layers of large, empty, hyaline, thin-walled cells. Branches grouped in fascicles which are spirally disposed around the stem and crowded at the stem tip in a head-like capitulum, normally some branches spreading to ascending and others, more slender in construction, pendent and  $\pm$  appressed to the stem. Branch cortex usually in 1 layer, consisting of large, empty, hyaline cells which may be uniformly porose or some non-porose and others enlarged as retort cells which are porose at the end of a somewhat protruding neck. Branch leaves spirally arranged in a 2/5 phyllotaxy, sometimes distinctly seriate, consisting of a network of linear green cells enclosing large, empty, rhomboidal hyaline cells reinforced on the inner surface by annular fibrils and perforated on 1 or both surfaces by rounded to elliptic pores, bordered by 2–3(5) rows of linear cells or sometimes by a marginal resorption furrow consisting of a single row of elongate cells digested away at the outer margin and appearing as a narrow, denticulate border. Stem leaves less crowded, usually distinctly differentiated in size and shape, with hyaline cells sometimes subdivided, generally with a lesser development of pores and fibrils and often extensively resorbed on 1 or both surfaces resulting in membrane pleats or gaps. Dioicous or monoicous; antheridial branches catkin-like, with leaves not much differentiated but more crowded and sometimes highly colored, single or in fascicles of 2–3, the antheridia globose, long-stalked, borne singly at the side of each leaf of the catkin; perichaetial branches short, single or in fascicles of 2 or more, bearing 1–5 flask-shaped archegonia at the apex, the perichaetial leaves much enlarged and otherwise differentiated, enclosing the sporophyte until maturity.

Sporophyte consisting of a capsule and a massive foot embedded in the tip of the perichaetial branch axis which elongates as a seta-like pseudopodium to elevate the mature capsule beyond the perichaetium. Capsules globose, becoming cylindrical or urceolate when dry and empty, dark red-brown to black, operculate; capsule wall of several layers of cells and no intercellular spaces, nearly always in the lower half of the capsule (or more) with many pseudostomata consisting of paired guard cells but no pore; columella massive, overarched by the spore sac. Spores large (ca. 17–42  $\mu\text{m}$ ), tetrahedral, with a conspicuous triradiate ridge, nearly smooth to finely papillose, explosively discharged as the capsule shrinks on drying. Calyptra a delicate membrane investing the capsule until maturity, rupturing irregularly.

*Sphagnum* has less than 200 species, of which about 30 occur in the Arctic.

The microscopic features of diagnostic value are best observed on staining. Crystal violet in a saturated aqueous solution gives good contrast.

<sup>1</sup>Botanical Museum, University of Copenhagen, Gothersgade 130, DK-1123 Copenhagen K, Denmark.

Financial support is acknowledged from the Carlsbergfondet and the Danish Natural Science Research Council (both to Gert S. Mogensen) and from the National Science Foundation (to the New York Botanical Garden: William C. Steere). Robert R. Ireland and Barbara Murray provided much help in species mapping.

Key to the Sections of *Sphagnum*

1. Cortical cells of stems and branches reinforced by delicate spiral fibrils; branch leaves broad, broadly pointed, and cucullate-concave, rough at back of the apex, denticulate along a marginal resorption furrow ..... p. 4 Sect. *Sphagnum*
1. Cortical cells not reinforced by spiral fibrils; branch leaves generally narrower and usually tapered to a slender, truncate apex, involute-concave, not cucullate or rough at the apex, only rarely denticulate at the margins or with marginal resorption, mostly bordered by linear cells.
  2. Cortical cells of branches uniform, each with a single pore at the upper end; stem leaves very small; branch leaves broadly truncate, denticulate at the margins and bordered by a resorption furrow. .... p. 10 Sect. *Rigida*
  2. Cortical cells of 2 kinds, some without pores, others enlarged, apically porose, and retort-shaped; stem leaves generally not particularly small; branch leaves usually tapered to narrow, truncate apex, nearly always entire except across the narrow apex, bordered by linear cells.
    3. Stems unbranched or with 1–3 branches per fascicle; hyaline cells of both stem and branch leaves with thick annular fibrils nearly dividing the cell into squarish segments, without pores on the outer surface or with 1–4 rounded membrane gaps, with short membrane pleats variously oriented in each segment. .... p. 37 Sect. *Hemitheca*
    3. Stems branched, with 3 or more branches per fascicle; hyaline cells with thinner fibrils, porose on 1 or both surfaces, without membrane pleats (or rarely with long membrane pleats oriented lengthwise).
      4. Branches crowded in fascicles of 6 or more; capitulum large, globose, dense; stem leaves very small, branch leaves widely recurved when dry. .... p. 44 Sect. *Polyclada*
      4. Branches in fascicles of 5 or less; capitulum usually not conspicuously large and dense; stem leaves usually not notably small; branch leaves not widely recurved when dry though sometimes  $\pm$  spreading at the tips when dry or squarrose from an erect base wet or dry.
        5. Plants often tinged with orange-yellow; branches of the capitulum usually curved; branch leaves usually  $\pm$ secund; hyaline cells of branch leaves usually numerous and crowded in bead-like commissural rows on 1 or both surfaces. .... p. 38 Sect. *Subsecunda*
        5. Plants green, yellowish to brown, or reddish; branches not or rarely curved; branch leaves erect to spreading, rarely subsecund; hyaline cells with pores not particularly numerous, not crowded in commissural rows.
          6. Plants red or red-tinged (or rarely green, brown, or yellow-brown); green cells of branch leaves triangular to trapezoidal in section, exposed exclusively or more broadly on the inner surface ..... p. 46 Sect. *Acutifolia*
          6. Plants not reddish; green cells of branch leaves exposed equally on both surfaces or more broadly on the outer.
            7. Branch leaves broadly ovate and broadly truncate; hyaline cells of branch leaves with pores on the outer surface grouped in 3's at adjacent angles; green cells truncate-elliptic in section, equally exposed. .... p. 13 Sect. *Insulosa*
            7. Branch leaves more elongate and more tapered; hyaline cells of branch leaves with pores not conspicuously in 3's; green cells triangular to trapezoidal in section, exposed exclusively or more broadly on the outer surface.
              8. Stem leaves extensively resorbed on the inner surface of hyaline cells, rarely on both surfaces across the apex and/or down the middle, resulting in laceration; branch leaves often undulate at the margins when dry; hyaline cells smooth. .... p. 18 Sect. *Cuspidata*
              8. Stem leaves mostly resorbed on the outer surface except at the apex where both surfaces are resorbed, resulting in perforation and slight fringing; branch leaves not undulate when dry.  $\pm$ spreading at the tips, especially when dry, or conspicuously squarrose above an erect base wet or dry; hyaline cells of branch leaves commonly very finely papillose on walls lying adjacent to the green cells. .... p. 16 Sect. *Squarrosa*

Sect. *Sphagnum*

Cortical cells of stems and branches uniformly porose and delicately spiral-fibrillose. Stem leaves nearly flat, linguulate, rounded at the apex, finely fringed all around. Branches stout and tumid. Branch leaves broadly ovate, deeply concave, cucullate, roughened at back of the apex because of extensive resorption of hyaline cells and narrowly denticulate-bordered because of partial resorption of marginal cells (resulting in a resorption furrow); hya-

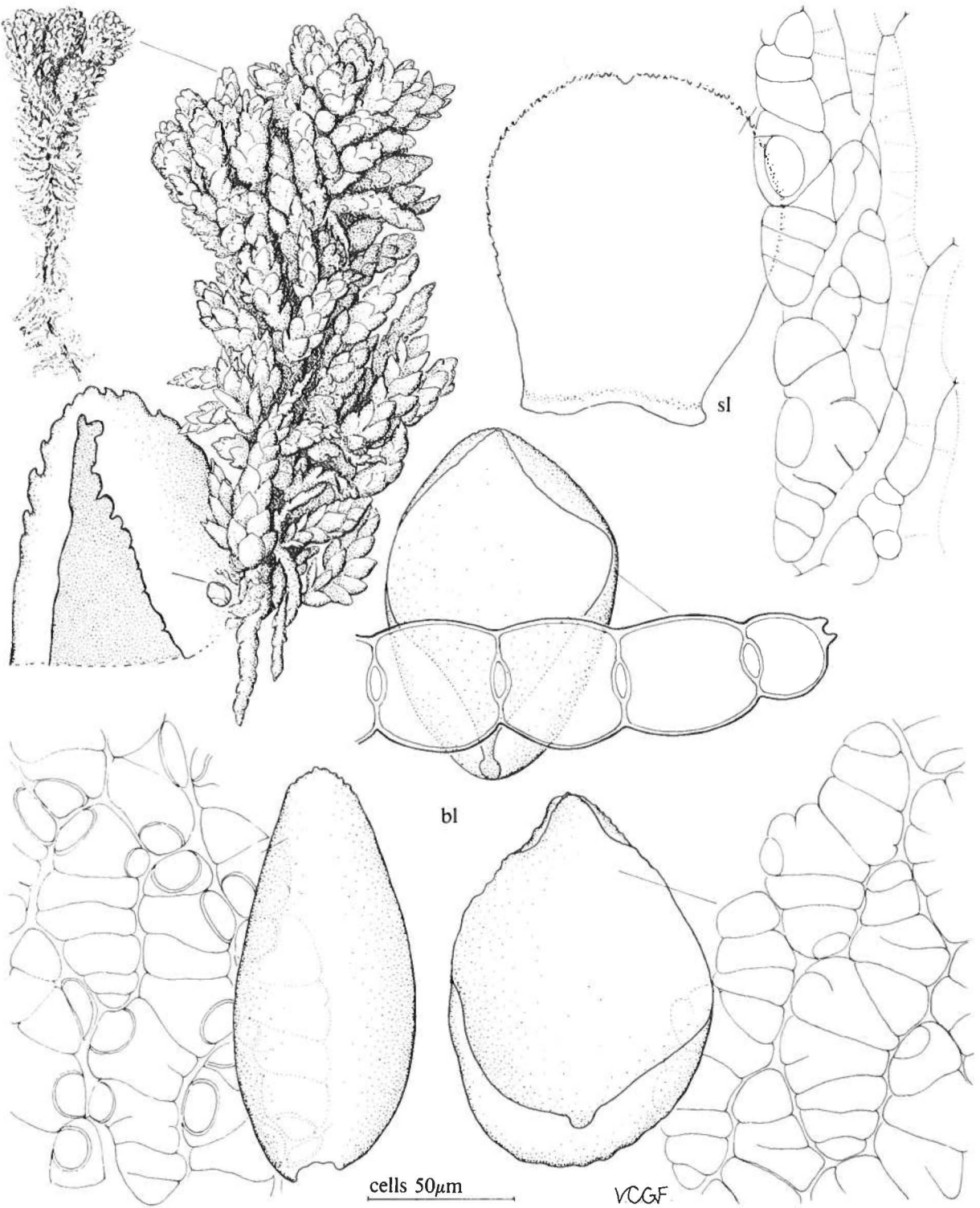


Fig. 1. *Sphagnum magellanicum*, Summit Lake, Yukon Territory, Canada; leg. 1972 Scotter 17814, (C).

line cells of branch leaves on the outer surface with large, elliptic, ringed pores grouped in 3's at adjacent angles, the apical cells largely resorbed on the outer surface. Dioicous.

Essential features include stout, tumid branches; branch leaves broadly ovate, cucullate-concave, denticulate-bordered by a resorption furrow, and roughened at the back of the apex; hyaline cells of branch leaves on the outer surface with ringed, elliptic pores conspicuously grouped at adjacent corners; cortical cells of stems and branches spirally fibrillose and porose; and stem leaves oblong-lingulate, rounded at the apex, and finely fringed all around.

1. Plants reddish; hyaline cells of branch leaves plane or nearly so; green cells in section elliptic, central, entirely included. . . . . 1. *S. magellanicum*
1. Plants green, yellowish, or brownish; hyaline cells convex or bulging-convex on the outer surface; green cells in section lenticular, triangular, or triangular-trapezoidal, exposed on 1 or both surfaces.
  2. Hyaline cells of branch leaves bulging-convex on the outer surface, with ridge-like comb fibrils on the inner side walls; green cells in section equilateral-triangular. . . . . 4. *S. imbricatum*
  2. Hyaline cells convex but scarcely bulging on the outer surface, smooth or papillose on the inner side walls; green cells lenticular with thickened end walls or triangular-trapezoidal.
    3. Green cells in section lenticular, narrowly exposed on both surfaces owing to thickened end walls; hyaline cells smooth on the inner side walls; hyaline cells of stem leaves undivided. . . . . 2. *S. centrale*
    3. Green cells in section triangular-trapezoidal; hyaline cells densely papillose on the inner side walls (or sometimes smooth or nearly so); hyaline cells of stem leaves frequently 1-divided. . . . . 3. *S. papillosum*

**1. *Sphagnum magellanicum* Brid.**

Fig. 1. Map 1.

Musc. Recent. 2(1): 24. 1798.

Plants stout, green or, more commonly, pinkish to purplish-red, in compact cushions or hummocks. Wood cylinder red; cortex of 3-4 layers of cells, those at the surface with 1(-4) large, rounded to elliptic pores. Stem leaves with hyaline cells not divided, without fibrils or sometimes fibrillose near the apex, resorbed on the outer surface or sometimes on both surfaces. Branches in fascicles of 4-5, with 2-3 spreading; cortical cells uniporose. Branch leaves normally imbricate; hyaline cells plane or nearly so; green cells in section elliptic, central entirely included.

Spores 22-27 µm.

Common and widespread in wet, open and exposed, relatively acid habitats.

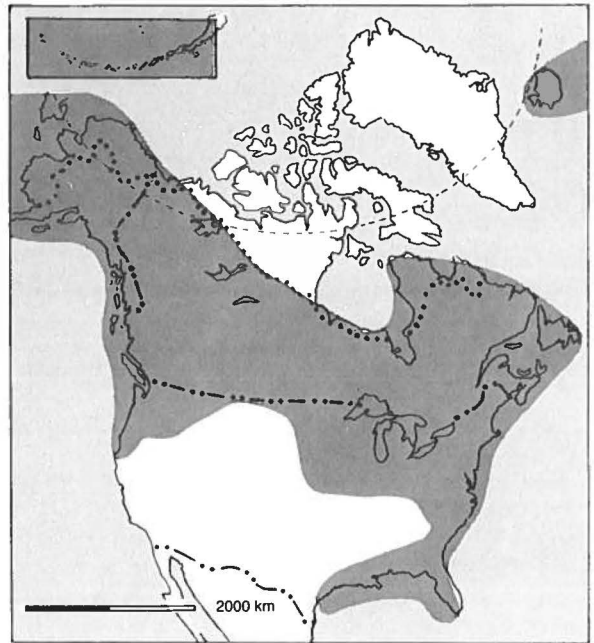
Newfoundland, across the continent to arctic Alaska, south to Washington, Montana, Iowa, Indiana, and the Atlantic Coast southward along the coast and in the uplands to Alabama and Florida; Bermuda, West Indies; Mexico and Central America; South America throughout the Andean Chain; Falkland Islands; New Zealand (South Island); Azores; northern and central Europe; Taiwan; reported from Japan and the Soviet Far East, probably common across northern Siberia.

Selected specimens seen (MICH):

Canada. Quebec, Lac Payne, 59°17'N, 73°25'W; 1965 Hermann 8123.

Alaska. Fairbanks Quad, Farmers Loop, 64°52'N, 147°47'W; 1974 Calmes 4 - Bettles Quad, 66°19'N, 150°24'W 1982 Lewinsky 2585. - McGrath and vicinity, Kuskokwim River, 62°57'N, 155°35'W; 1949 Steere 14618. - Six miles west of Nome, 64°34'N, 165°23'W; 1972 Pegau Sept. 18th.

*Sphagnum magellanicum* is easily recognized by its stout, tumid branches and reddish color. The green cells of branch leaves are unique in sectional view, being central and entirely included. *Sphagnum centrale* is a woodland species differing from *S. magellanicum* in its pale-green color, hyaline cells of branch leaves convex on



Map 1. *Sphagnum magellanicum*.

both surfaces, and green cells central but elongate and narrowly exposed on both surfaces owing to thickened end walls.

**2. *Sphagnum centrale* C. Jens. ex Arn. & C. Jens.**

Fig. 2. Map 2.

Bih. K. Sv. Vet.-Akad. Handl. 21, 3(10): 34. 1896.

Plants stout, in shiny, pale-green, compact mats. Wood cylinder of stem green or brownish; cortical cells with 1-4(10) rounded pores. Stem leaves with hyaline cells un-

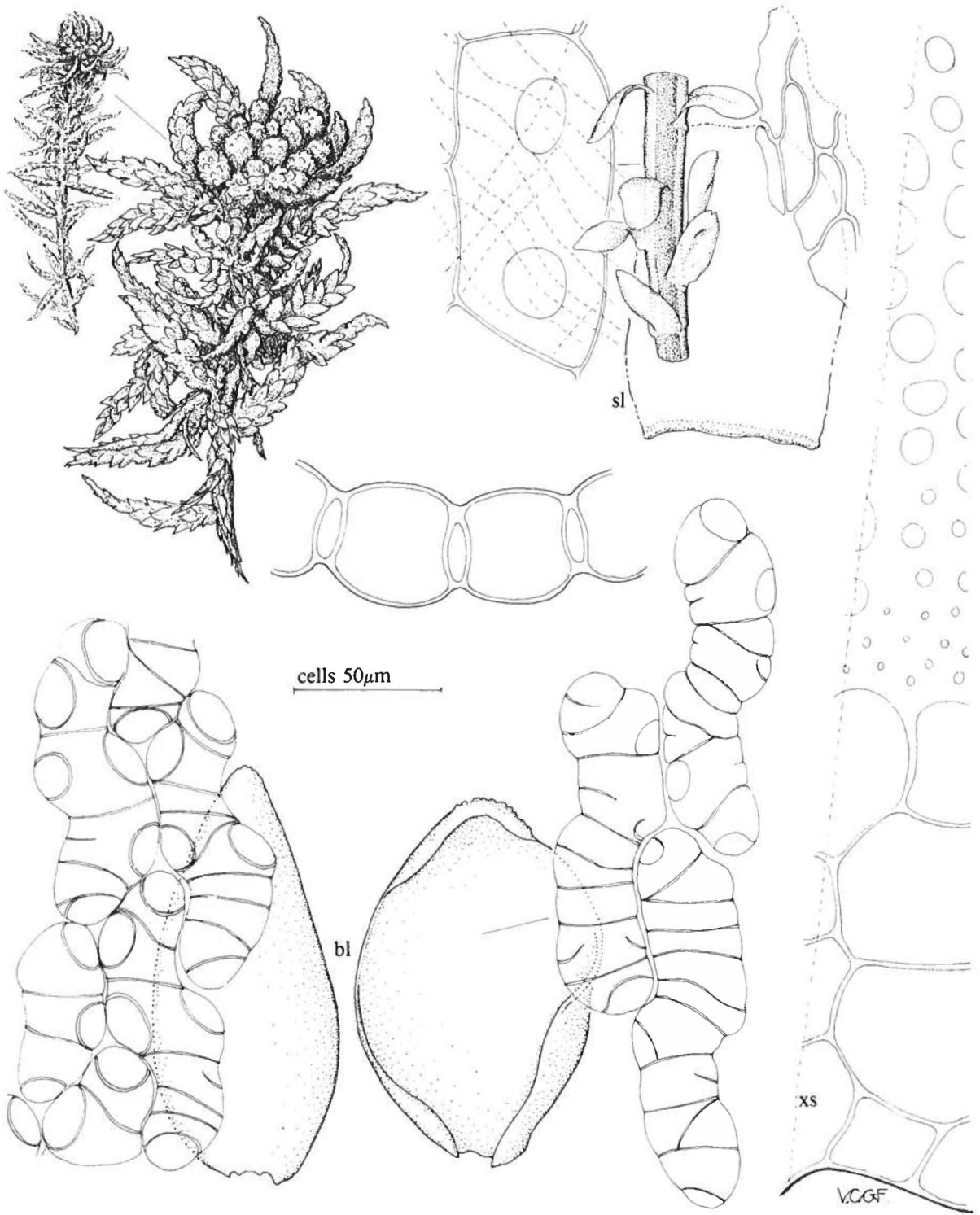


Fig. 2. *Sphagnum centrale*, head of Amitsuarsuk, S Greenland; leg. 1974 Holmen 74-590, (C).





Map 2. *Sphagnum centrale*.

divided, without fibrils, mostly resorbed on both surfaces. Branches in fascicles of 4–5, with 2 spreading; cortical cells usually uniporose. Branch leaves imbricate; hyaline cells moderately convex on the outer surface, plane or slightly convex on the inner; green cells in section narrowly elliptic to lenticular, central but narrowly exposed on both surfaces because of thickened cell ends.

Spores 23–31  $\mu\text{m}$ .

The whitish-green plants grow in shade, in compact mats, in depressions in mineral-rich, often calcareous swamps or in *Larix* stands in fens or among shrubs in more northern peatland.

Southernmost Greenland; Newfoundland, across southern Canada to southeastern Alaska, southward to New Jersey, West Virginia, Indiana, Illinois, and Iowa, Montana and Washington; northern and central Europe; reported from northern Asia.

The green cells of branch leaves appear in section to be central and included, yet they are thickened at either end and thus give narrow exposure on both surfaces.

### 3. *Sphagnum papillosum* Lindb.

Acta Soc. Sci. Fenn. 10: 280. 1872.

Plants robust,  $\pm$  dull yellow-brown, in dense carpets. Wood cylinder of stem brown or blackish; cortical cells with 1–3(5) rather small pores. Stem leaves with hyaline cells frequently 1-divided, non-fibrillose, largely resorbed on both surfaces. Branches in fascicles of 4–5,

with 2 spreading; cortical cells often with a single pore at the upper end. Branch leaves imbricate or slightly spreading; hyaline cells convex on the outer surface, only slightly so on the inner; green cells in section narrowly triangular–trapezoidal, the inner walls lying next to the green cells densely and finely papillose (or sometimes smooth).

Spores 29–31  $\mu\text{m}$ .

In low cushions or, more commonly, extensive mats, typically in the open, in coastal regions usually in oligotrophic habitats, toward the north in hollows of raised bogs, for example, inland in relatively mineral-rich parts of poor fens or growing as a pioneer mat-former at the edge of more acid lakes.

Reported from southern Greenland; Labrador and Newfoundland to New Jersey and coastal regions of the Carolinas, inland through the Hudson Bay lowlands and the Great Lakes area as far west and south as Minnesota, Wisconsin, Illinois, Indiana, Ohio, and New York; southeastern Alaska and the Aleutians to California; Iceland; northern, central, and western Europe; Japan; reported from northern Asia.

Selected specimens seen (MICH):

Alaska. Aleutian Is, Adak I., 51°45'N, 176°45'W; 1975 Smith 4105. – Attu I., 52°55'N, 172°55'W; 1949 Jordal & Miller 3002.

*Sphagnum papillosum* can often be recognized by its growth in extensive brown, compact carpets. The green cells of the branch leaves are, in section, triangular–trapezoidal, and the hyaline cells are densely and often conspicuously papillose where they adjoin the green cells. However, in the var. *sublaeve* Warnst. ex Röll and the var. *laeve* Warnst. (neither worthy of recognition), the papillae are faint or even lacking.



Map 3. *Sphagnum papillosum*.

Fig. 3. Map 3.



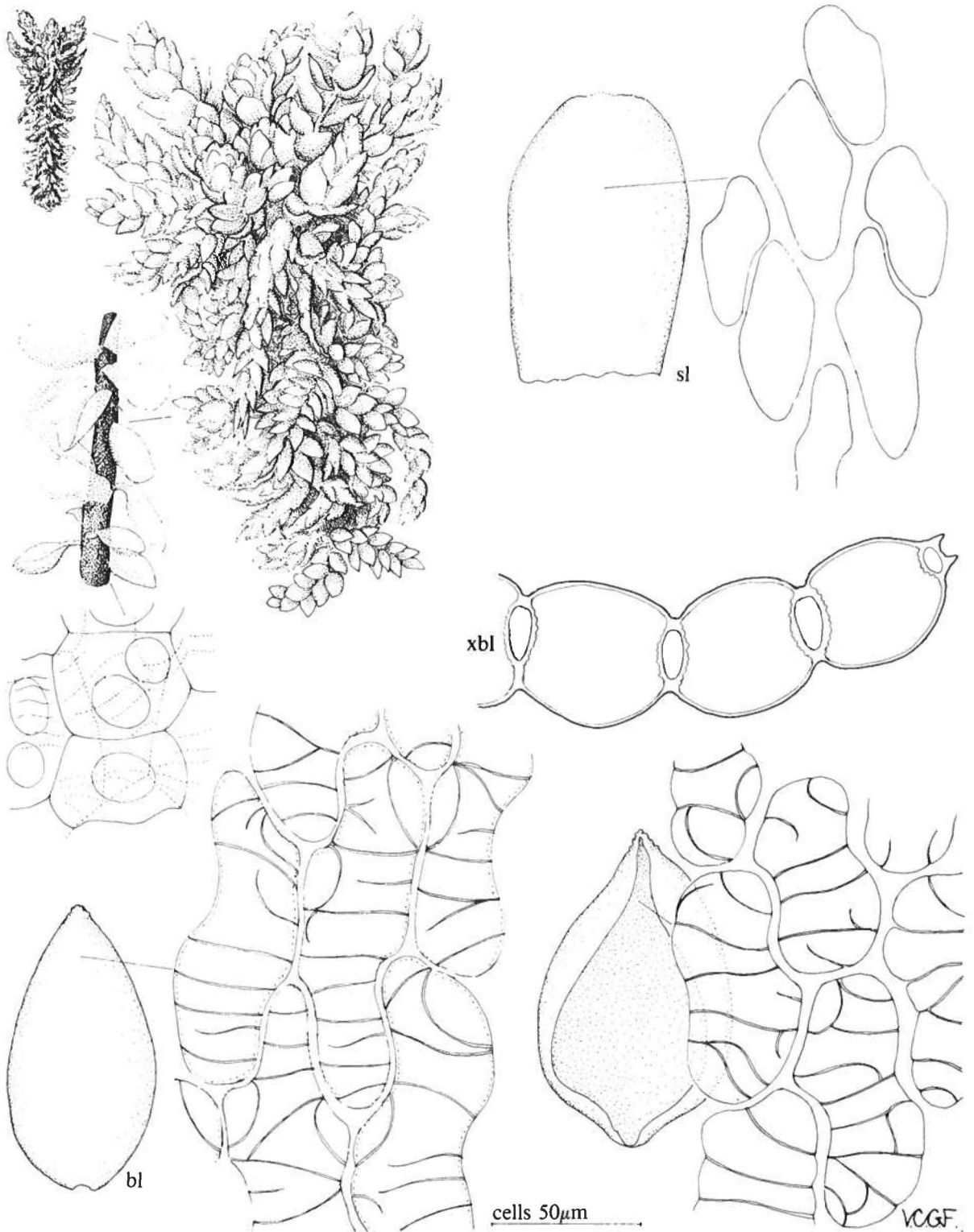


Fig. 3. *Sphagnum papillosum*. SE of Akugdleq, SW Greenland; leg. 1968 Øllgaard 68-178, (C).

**4. *Sphagnum imbricatum* Hornsch. ex Russ.**

Fig. 4. Map 4.

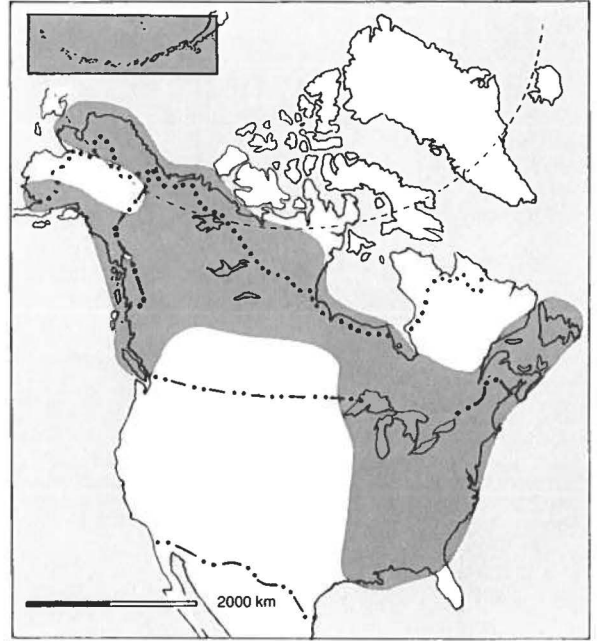
Arch. Naturk. Livl. Ehst. Kurl. 2, 7: 99. 1865.

Plants pale-green or, more often, yellowish to light- or dark-brown, in dense carpets or hummocks. Wood cylinder brown; cortical cells of stems with (1)4–8(10) irregularly rounded pores, the inner walls of the innermost layer of cells finely and densely transverse-striate. Stem leaves with hyaline cells sometimes divided, without fibrils or pores, almost entirely resorbed on the outer surface. Branches in fascicles of 5, with 2 spreading; cortical cells uniporose. Branch leaves imbricate or spreading at the tips; hyaline cells bulging–convex on the outer surface, the inner side walls usually conspicuously beset with comb-fibrils (which may be poorly developed, sometimes lacking or visible only at the leaf base); green cells in section equilateral–triangular, broadly exposed on the inner surface.

Spores 26–27  $\mu\text{m}$ .

Forming extensive carpets or large, often deep hummocks in open tundra among *Eriophorum* and other sedgy plants, farther south in wet, oligotrophic and somewhat minerotrophic habitats, in ombrotrophic peatlands in oceanic areas, elsewhere in sedge meadows or alder thickets near lakes or ponds.

Newfoundland and the Canadian Maritimes south along the coast to Florida and Texas, also scattered inland in the mountains and other uplands as far west as Illinois and Missouri; arctic and southeastern Alaska and Aleutian Islands, coastal British Columbia and a few localities in arctic and subarctic Canada (Thelon Game Sanctuary and Beverly Lake in the Mackenzie District and Churchill, Manitoba); northern, western, and central Europe; eastern Siberia; reported from Japan.



Map 4. *Sphagnum imbricatum*.

Even when the comb fibrils are lacking, the equilateral–triangular green cells broadly exposed on the inner surface of branch leaves are unmistakable.

**Sect. *Rigida* (Lindb.) Schlieph. ex Limpr.**

Cortical cells of stems and branches without fibrils, those of the stems in 1–3 layers, without pores, those of the branches uniformly porose at the upper ends. Stem leaves very small, lingulate to deltoid, slightly concave, somewhat bordered at base; hyaline cells not divided, without pores or fibrils. Branch leaves often wide-spreading at the tips, broadly ovate to elliptic, concave because of inrolled margins but broadly truncate at the apex and not cucullate though sometimes concave-pointed, not roughened at back of the apex, narrowly denticulate-bordered because of partial resorption of a marginal row of cells resulting in a resorption furrow; pores on the inner surface of the branch leaves grouped in 3's at adjacent angles.

Decisive features of the section include the small stem leaves, uniformly porose branch cortical cells, branch leaves bordered by a resorption furrow (but not roughened at back of the apex), and hyaline cells of branch leaves with pores grouped in 3's at adjoining angles on the inner surface (rather than the outer as in the sect. *Sphagnum*).

**5. *Sphagnum compactum* DC. ex Lam. & DC.**

Fig. 5. Map 5.

Flore Franç. 2: 443. 1805.

Plants compactly tufted in low cushions, whitish–green to yellowish, brown, or red-brown, rarely pinkish. Wood cylinder of stems brown. Stem leaves 0.4–0.7(1.0) mm long; hyaline cells with longitudinal membrane pleats on the outer surface and an apical membrane gap on the inner. Branches in fascicles of 4–6,

with 2–3 spreading. Branch leaves imbricate to squarrose or rarely subsecund; hyaline cells on the outer surface with 4–8  $\pm$  ringed, round pores and few to numerous pseudopores along the commissures (especially noticeable toward the leaf tip); green cells in section elliptic, central, included. Monoicous.

Spores 25–33  $\mu\text{m}$ .

In small cushions on slopes wet by late snow melt and also in wet tundra among tussocks of *Eriophorum*.

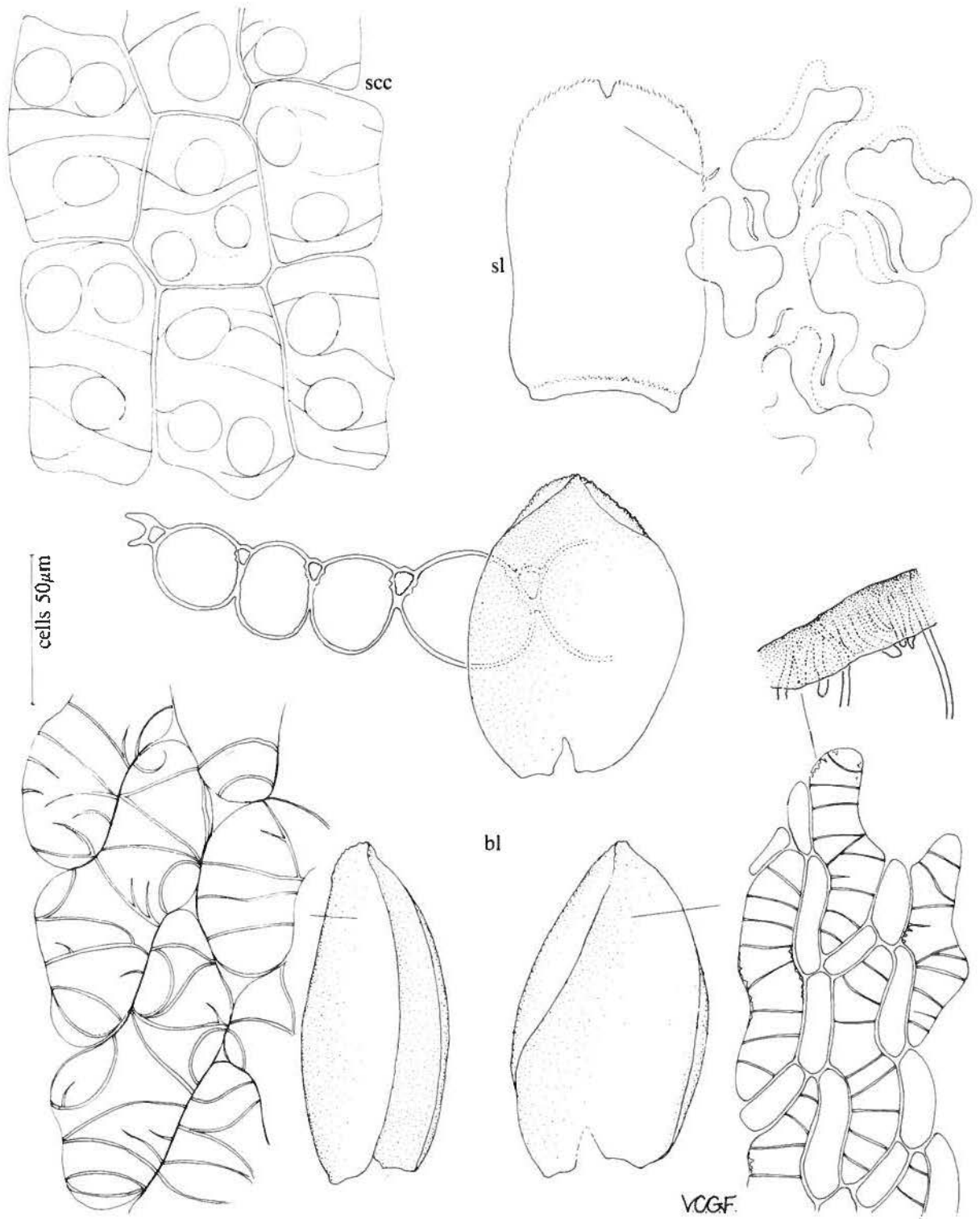


Fig. 4. *Sphagnum imbricatum*, Atkasuk, Meade River, Alaska; leg. Holmen and Mårtensson 61-072, (C).

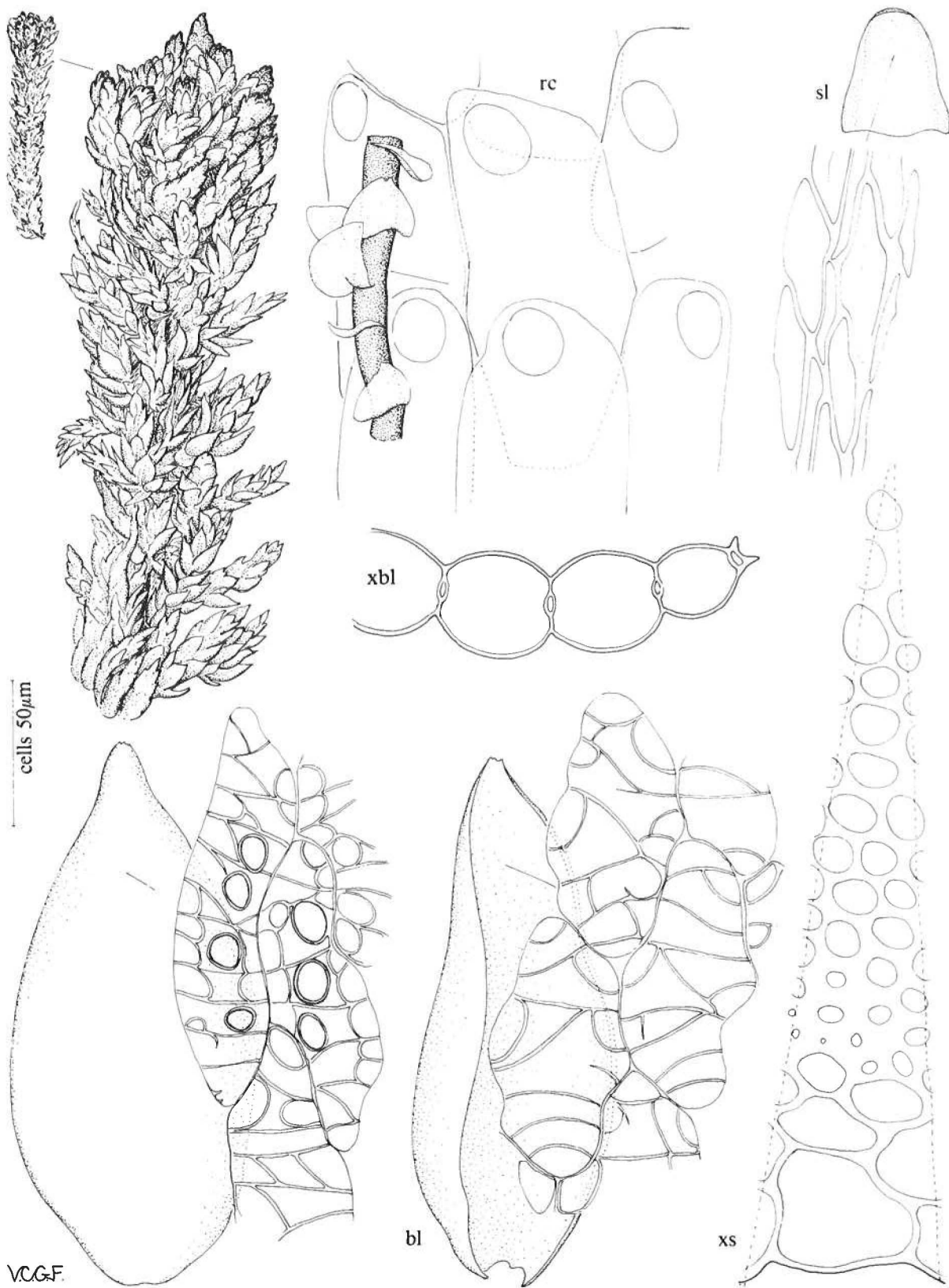


Fig. 5. *Sphagnum compactum*. Perserajórssuaq, SW Greenland; leg. Damsholt 71-893, (C).



Map 5. *Sphagnum compactum*.

Iceland and southern half of Greenland; arctic Alaska southward to the Aleutian Islands and California and scattered

across Canada from the Yukon to Baffin Island and from British Columbia across northern parts of Saskatchewan, Manitoba, and Quebec to Labrador and Newfoundland, also scattered over a broad range in eastern temperate North America from the Canadian Maritimes southward along the coast to Georgia and inland to Wisconsin, Iowa, and Louisiana; Colombia; Hawaii (Maui); northern, western, and central Europe; Asia Minor (Turkey); reported from Siberia, the Caucasus, eastern Asia, and Macaronesia.

Selected specimens seen (MICH):

Canada, Quebec, Ungava, 56°31'–32'N, 64°40'–45'W; 1975 Weber 1236. – Wolstenholme, 62°N, 77°W; 1936 *s. coll.* 24 August. – Northwest Territories, Keewatin, Lake Garry, 66°00'N, 100°20'W; 1948 Oldenburg 48-400.

Alaska. Bettles Quad, 66°19'N, 150°24'W; 1982 Lewinsky 2584. – McGrath, Kuskokwim River, 62°57'N, 155°35'W; 1949 Steere 14600. – Nome and vicinity, Seward Penins., 64°30'N, 165°25'W; 1949 Steere 13086. – Umiat, Colville River 69°22'N, 152°08'W; 1960 Steere, Holmen and Mårtenson (Bryoph. Arc. Exc. 3).

In northern and alpine habitats the cushions may be golden-yellow, brown, or pinkish- to reddish-brown, and the leaves may be markedly secund. The leaves are broadly truncate or rounded at the apex though sometimes concave-pointed. The central, included green cells of the branch leaves, as well as the marked development of pseudopores, give ample separation from *S. strictum* Sull. (which occurs in Newfoundland and Nova Scotia and southward in a very extensive range).

### Sect. *Insulosa* Isov.

Cortical cells of stems without fibrils, some of them apically porose. Stem leaves lingulate, rounded and somewhat fringed at the apex, with a border of long, narrow cells abruptly broadened at the base; hyaline cells mostly undivided and generally without fibrils, largely resorbed on the outer surface. Branch cortex of 2 types of cells, some without pores, others larger, retort-shaped, and apically porose. Branch leaves erect, very concave, broadly ovate, broadly truncate and toothed at the apex, bordered by linear cells; hyaline cells on the outer surface with ringed, elliptic pores at the ends and corners, conspicuously grouped in 3's at the adjacent corners; green cells in section narrowly truncate-elliptic, equally exposed on both surfaces because of thickened ends.

This section, consisting of a single species, *S. aongstroemii* C. Hartm., has a unique combination of characters, including broadly ovate and broadly truncate branch leaves bordered by linear cells and having green cells equally exposed and hyaline cells with pores grouped in 3's at adjacent corners (on the outer surface). The sizable stem leaves are lingulate, rounded and somewhat fringed at the apex and wide-bordered at the base.

### 6. *Sphagnum aongstroemii* C. Hartm.

*Figs 6 and 7. Map 6.*

Handb. Skand. Fl. (ed. 7). 399. 1858.

Plants of moderate size, pale, yellow-green or brownish-yellow, loosely tufted. Wood cylinder of stem yellow-green; cortical cells in 3–4 layers. Stem leaves 1–1.2 mm long, with hyaline cells on the outer surface almost entirely resorbed above, with membrane pleats below, on the inner surface resorbed in 2 or 3 rows of cells at the apex (resulting in a degree of laceration),

with small membrane gaps as well as pleats below that region. Branches in fascicles of 5, with 2 or 3 spreading. Branch leaves 1.7–2 mm long; hyaline cells on the outer surface with 3–6 ringed, elliptic pores at ends and corners, on the inner surface with a few medium-sized pores in the angles and near the commissures (fairly numerous at the leaf apex and near the sides). Dioicous.

Spores ca. 25 µm.

In moist depressions somewhat above the water level, often in places where snow accumulates in winter, sometimes in

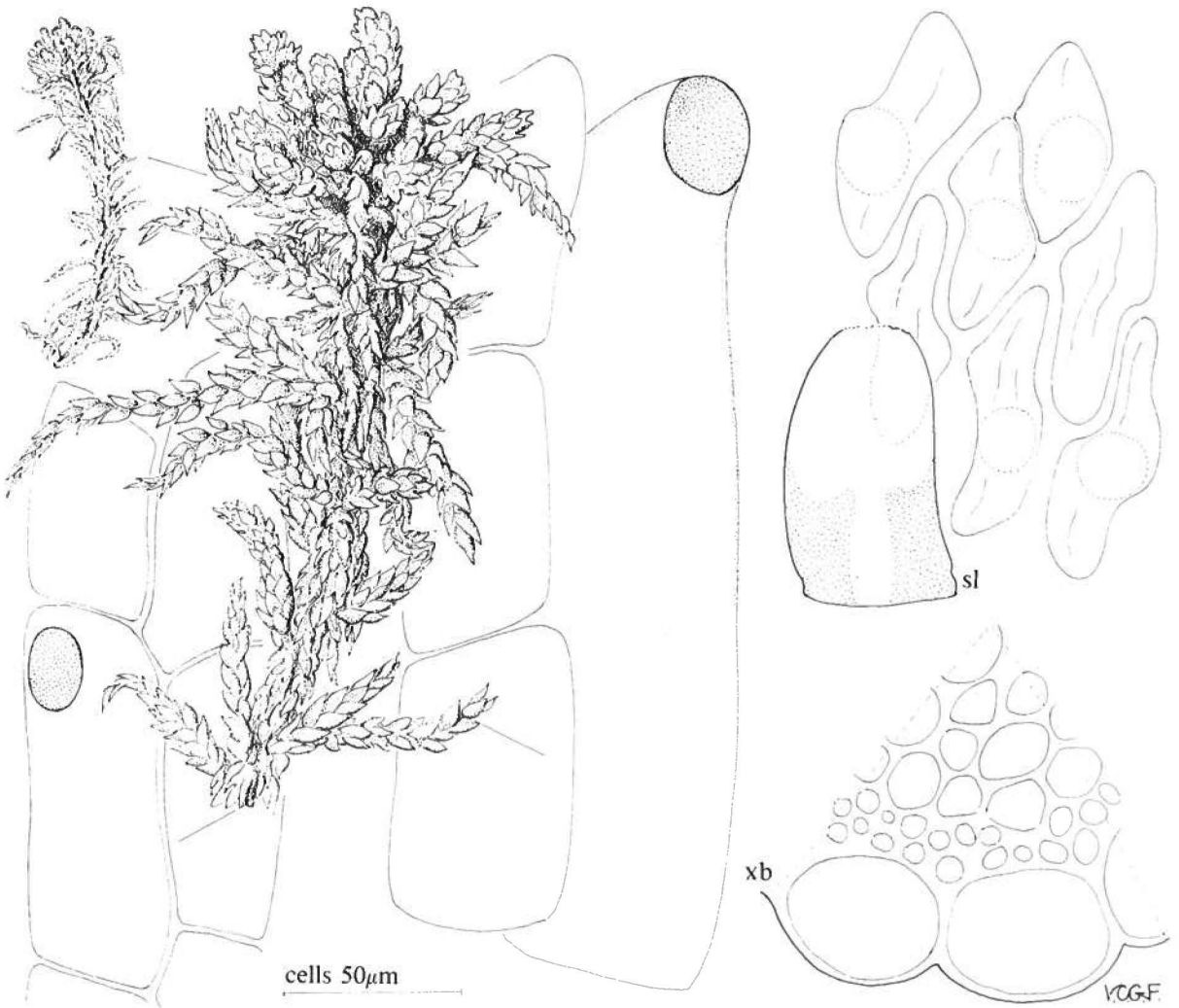


Fig. 6. *Sphagnum aongstroemii*, Cape Sabine, Pitmegea River, Alaska; leg. 1960 Steere, Holmen and Mårtensson 60-225. (C).



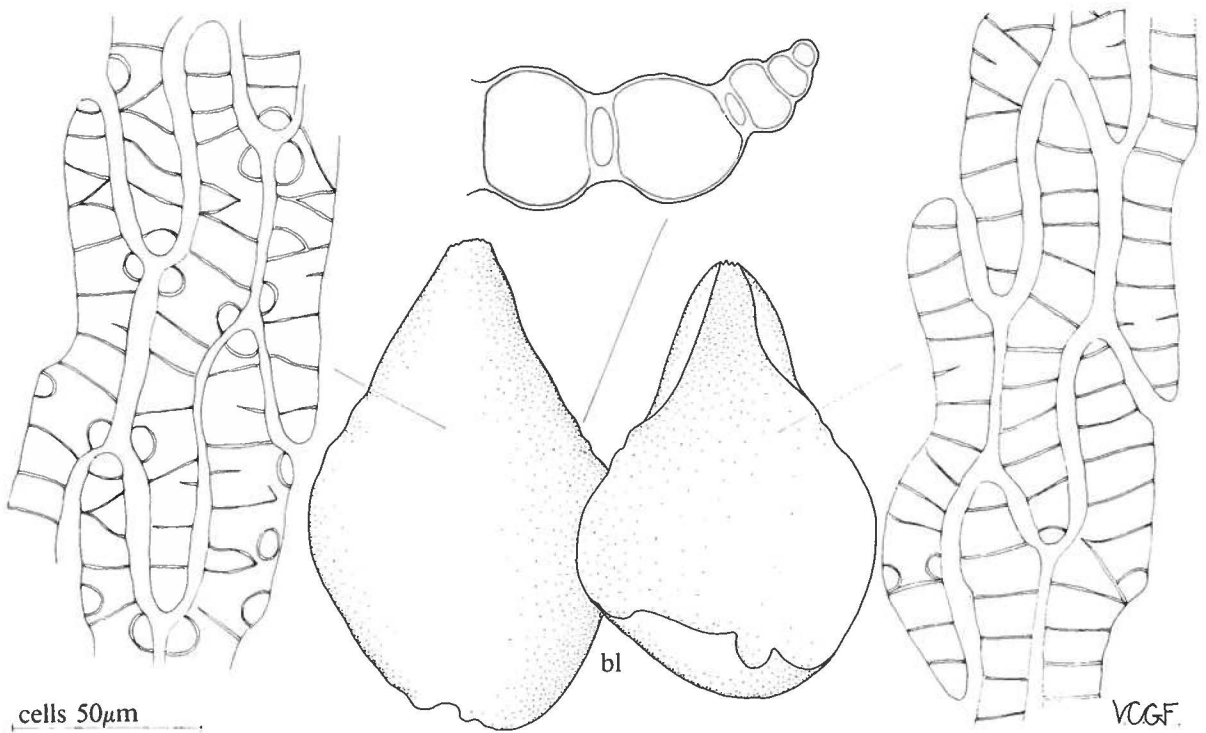


Fig. 7. *Sphagnum aongstroemii*; from same specimen as Fig. 6.



Map 6. *Sphagnum aongstroemii*.

wooded, boggy areas but more commonly in the open, among scattered dwarfed shrubs or in willow thickets at the margins of brooks and ponds, often among *Carex* or *Eriophorum* in wet tussock tundra, in such mineral-rich places growing with or slightly above *Sphagnum lindbergii*.

Arctic, central, southeastern, and western Alaska and the Canadian Northwest, in the Yukon, northern British Columbia, and the Mackenzie and Keewatin Districts, also on Baffin Island; northern Europe; Siberia (Yenisei); reported from Korea and Japan.

**Selected specimens seen (MICH):**

Canada. Keewatin, NW extremity of Nueltin Lake, mouth of Windy River, 60°20'N, 99°30'W; 1975 Harper 2404.

Alaska, Livengood Quad, Mi 11 Elliott Highway, 65°05'N, 147°42'W; 1974 Calmes 766. – Colville River, Umiat, 69°22'N, 152°08'W; 1946 Lepage 22587. – Pitmegea River, Cape Sabine, 68°54'N, 164°37'W; 1960 Steere, Holmen and Mårtensson (Bryoph. Arc. Exs. 18). – Colville River, Umiat, 69°22'N, 152°08'W; 1960 Steere, Holmen and Mårtensson (Bryoph. Arc. Exs. 73). – Kuskokwim River, McGrath and vicinity, 62°57'N, 155°35'W; 1949 Steere 14603. – Seward Penins., between Snake and Stewart rivers, north of Nome, 64° 40'N, 165°30'W; 1949 Steere 13224.

Though smaller and daintier, the plants have the tumid appearance of the sect. *Sphagnum*. The insipid yellow-green or yellow-brown shades are distinctive.

Sect. *Squarrosa* (Russ.) Schimp.

Terminal buds large. Cortical cells of the stems in 2–4 layers, without fibrils, sometimes with a single pore or rounded thin spot at the upper end. Stem leaves ± flat, elliptic, broadly rounded at the apex, perforated and slightly fringed at the apex, not or indistinctly bordered; hyaline cells undivided, without fibrils, on the outer surface mostly resorbed, on the inner surface resorbed only in the upper portion of the leaf, with membrane pleats below. Branches in fascicles of 5, with 2–3 spreading; cortical cells without fibrils, of 2 kinds, some without pores, the others enlarged, retort-like, and apically porose. Branch leaves with tips generally spreading to squarrose at least when dry, ovate–lanceolate or ovate–hastate, involute–concave, narrowly truncate, bordered by linear cells; hyaline cells plane or nearly so on the outer surface, somewhat convex on the inner, with pores (or gaps) on the outer surface large, round to round–elliptic, and thin-margined, those on the inner surface elliptic, with distinct or even ringed margins; green cells triangular to trapezoidal, exposed exclusively or more broadly on the outer surface, the adjacent walls of hyaline cells usually very finely papillose.

The section is characterized by a large terminal bud; stem leaves perforate and often somewhat fringed at a broad, rounded apex; branch leaves generally spreading or squarrose at the tips, at least when dry; hyaline cells with pores on the inner surface of branch leaves having distinct or ringed margins and green cells exclusively or more broadly exposed on the outer surface, the adjoining walls of hyaline cells commonly very finely papillose.

1. Branch leaves abruptly narrowed to a squarrose acumen from a broadly oblong, erect base; hyaline cells on the inner surface with ringed, elliptic pores, on the outer surface with similar, though thin-margined pores. . . . . 7. *S. squarrosom*
1. Branch leaves gradually tapered, erect or ±spreading at the tips when dry; hyaline cells on the inner surface with distinct, though unringed, elliptic pores, on the outer surface with large, irregularly rounded, thin-margined pores or gaps (often nearly as wide as the cells). . . . . 8. *S. teres*

7. *Sphagnum squarrosom* Crome

Fig. 8. Map 7.

Samml. Deutschl. Laubm. 24. 1803; also in Hoppe. Bot. Zeit. (Regensb.) 2: 324. 1803.

Plants tall, relatively robust, in loose, pale-green or yellowish carpets. Wood cylinder green to red-brown. Branch leaves 2–2.5 mm long, conspicuously squarrose from an erect base, abruptly narrowed to the acumen; hyaline cells on the outer surface near the apex with 1–3 rounded–elliptic, thin-margined pores at ends and corners, more numerous below. Monoicous.

Spores 17–27 μm.

In open tundra in wet, grassy heaths or among scrub willows, farther to the south commonly in depressions in coniferous swamps, in minerotrophic habitats.

In Greenland north to app. 78°, across to Alaska and the Aleutian Islands, south to the mountains of North Carolina and westward to Ohio, Michigan, Iowa, Colorado, northern Mexico (Chihuahua), and California; widespread in Europe from Scandinavia to Switzerland and the Armenian SSR; Azores; Siberia; China and Japan; reported from Korea, India, and New Zealand.

Selected specimens seen (MICH):

Greenland. S 1. Nunarssuaq, 60°02'N, 45°16'W; 1890 Lundholm (May–June). – W 3. "Muslingebugten", 65°50'N, 53°02'W; 1958 Christensen. – W 5. Disko, Kangerdluarssuk, 69°30'N, 53°53'W; 1898 Porsild 1769.

Canada. Northwest Territories, Keewatin, Chesterfield Inlet, 63°25'N, 90°40'W; 1936 Dutilly 591. – Labrador, head of Kangalaksiorvik Fiord, 59°24'N, 63°50'W; 1975 Weber 1552.

– Baffin I., Arctic Bay, 73°02'N, 85°10'W; 1936 Polunin 2562-4.  
Alaska. Barrow Village, 71°17'N, 156°47'W; 1960 Steere, Holmen and Mårtensson (Bryoph. Arc. Exs. 35). – Fairbanks



Map 7. *Sphagnum squarrosom*.



Fig. 8. *Sphagnum squarrosum*, Kangerdluatsiaq, Arveprinsen Ejland, W Greenland; leg. 1971 Holmen and Mogensen 71-1286, (C).

Quad, 64°52'N, 147°51'W; 1974 Calmes 721. – North shore of St. Lawrence I., Bering Sea, 63°30'N, 170°00'W; 1949 Steere 13905. – Seward Penins., Imuruk Lake area, 65°36'N, 163°13'W; 1948 Sigafos 1443.

In its large size and bright-green color, as well as its conspicuously squarrose leaf tips, *S. squarrosus* is normally unmistakable. However, reduced arctic material may be difficult to separate from *S. teres*. In *S. squarrosus* the branch leaves are about 2–2.5 mm long and abruptly narrowed near the middle to the squarrose-spreading limb; the pores on the outer surface of branch leaf hyaline cells are regularly elliptic. In *S. teres*, by contrast, the branch leaves are only 1–1.3 mm long and uniformly tapered from the base and erect or spreading at the tips when dry; the pores on the outer surface of the branch leaf hyaline cells are larger and irregularly rounded, more like membrane gaps than pores.

### 8. *Sphagnum teres* (Schimp.) Ångstr. ex C. Hartm.

Fig. 9. Map 8.

Handb. Skand. Fl. (ed.8) 417. 1861. *S. squarrosus* var. *γ. teres* Schimp., Vers. Entw.-geschichte Torfm. 64. 1858.

Plants relatively slender, in rather dense cushions or loose carpets, yellowish or brownish. Wood cylinder pale, green or yellow to brown; cortical cells sometimes with a single round membrane thinning or actual pore. Branch leaves imbricate when moist but usually squarrose at the tips when dry, 1–1.3 mm long, ovate-lanceolate, gradually narrowed to the apex; hyaline cells on the outer surface toward the leaf apex with 1–3 large, irregularly rounded pores or gaps, often as wide as the cell (the upper one especially large). Dioicous.

Spores about 22 μm.

A calciphile of pioneering habitats, among sedges at the margins of sluggish streams or near water in rich fens.

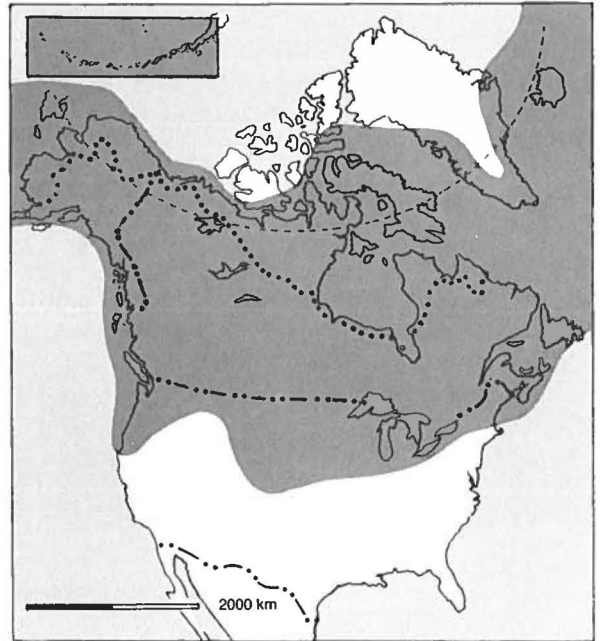
In Greenland north to app. 72°, across to Alaska and the Aleutians, south to California, Colorado, Illinois, Pennsylvania and New England; northern and central Europe; Caucasus; reported from central Asia and Japan.

Selected specimens seen (MICH):

Greenland. S 1: Narssarsuaq, 61°11'N, 45°23'W; 1962 Steere 62-712. – W 3: Ameragdla, 64°15'N, 50°12'W; 1973 Lewinsky 73-267. – E 3: Angmagssalik, 65°59'N, 37°26'W; 1970 Lewinsky 70-1098.

### Sect. *Cuspidata* (Lindb.) Schlieph. ex Schimp.

Plants of wetter habitat niches, in wet hollows or submerged, green or yellow to brown. Cortical cells of stems in 1–4 layers though sometimes poorly differentiated, without pores or fibrils. Stem leaves extensively resorbed on the inner surface, rarely on both surfaces across the apex and in a V-shaped area extending well toward the base, resulting in perforation and laceration. Cortical cells of branches of 2 kinds, some lacking pores, others larger, apically porose, and retort-shaped. Branch leaves involute-concave but sometimes ± flattened out and wavy-margined when dry, ovate to long-lanceolate, gradually tapered to a narrowly truncate apex, bordered by linear cells; hyaline cells variously porose; green cells triangular to trapezoidal, with exclusive or greater exposure on the outer surface.



Map 8. *Sphagnum teres*.

Canada. Baffin I., Cumberland Sound, 65°20'N, 65°70'W; 1924 Soper 00854. – Northwest Territories, Melville Penins., Ross Bay, 66°50'N, 85°00'W; 1948 Cody 1493. – Quebec, Port Harrison, 58°27'N, 78°09'W; 1936 Dutilly 1569a-25. Alaska. Circle Quad., vicinity of Eagle Summit, 65°29'N, 145°25'W; 1972 Steere 72-815. – Meade River Post Office, 70°28'N, 157°25'W; 1973 Inoue and Iwatsuki 73-327. – Brooks Range, Schrader Lake, 69°22'N, 145°W; 1960 Steere, Holmen and Mårtensson, (Bryoph. Arc. Exs. 5).

The plants are small, relative to *S. squarrosus*, yellow-brown, and restricted to wet, base-rich habitats. The terminal bud is large, and the branch leaves generally spread at the tips when dry. The branch leaves are gradually tapered from near the base, and the hyaline cells have large, irregularly rounded pores or gaps on the outer surface, often as broad as the cells near the leaf tip.

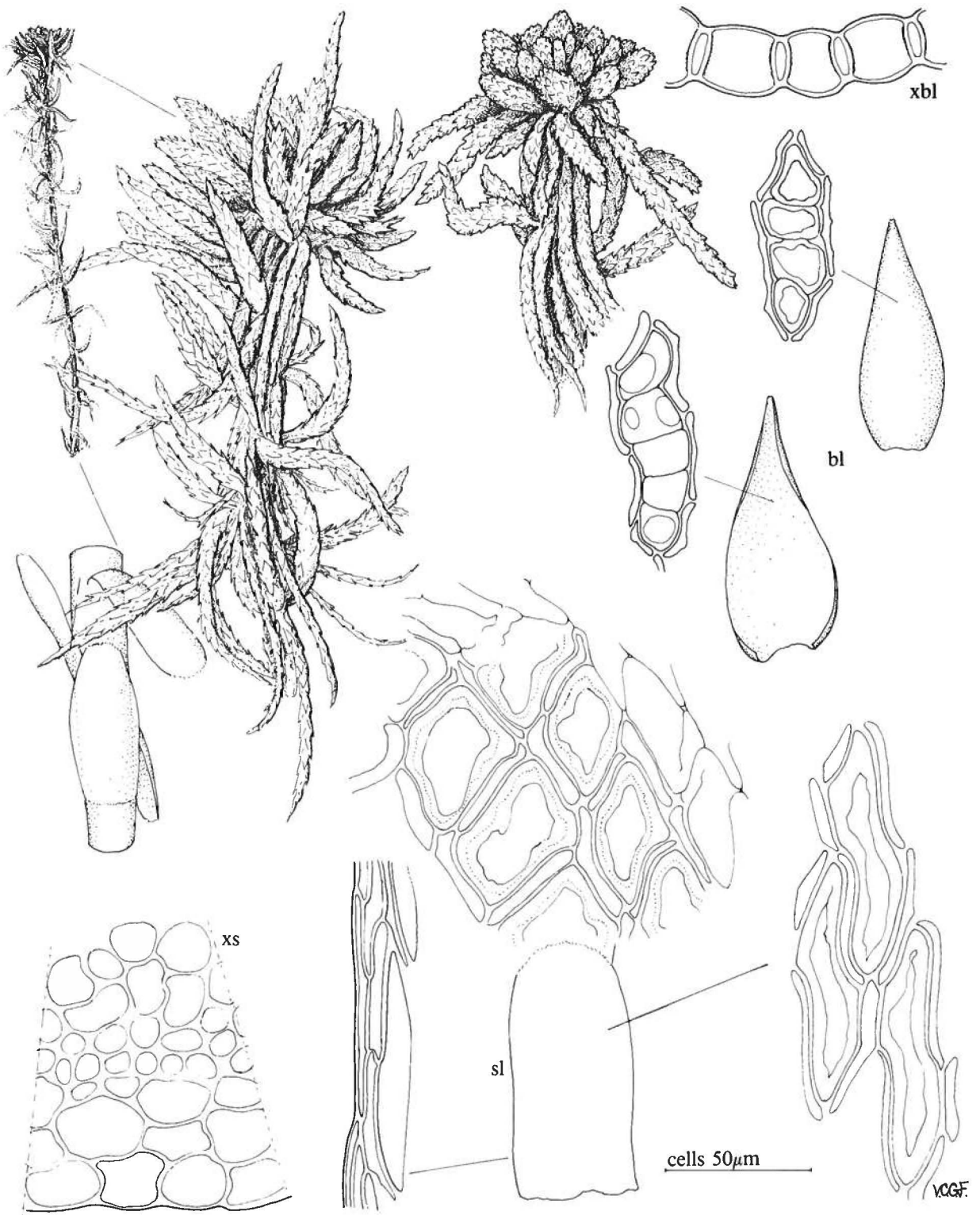


Fig. 9. *Sphagnum teres*, Qeqertarsuaq (Godhavn), Disko, W Greenland; leg. 1971 Holmen and Mogensen 71-872, (C).

The section is too large and heterogeneous to allow easy characterization. However, growth in especially wet habitats, yellow or brown pigmentation, relatively poor differentiation of the stem cortex, extensive resorption on the inner surface of the stem leaves, and broad exposure of green cells on the outer surface of branch leaves have significance.

- 1. Stem leaves conspicuously resorbed at a broad apex and in a triangular, sieve-like area extending to the middle or below.
  - 2. Stem leaves lacerate-fringed across a broad apex, the sieve-like area occupying most of the leaf. . . . . 17. *S. lindbergii*
  - 2. Stem leaves less conspicuously lacerate or fringed at the apex, the sieve-like area much less extensive.
    - 3. Plants green or yellow-green; terminal bud very large; stem leaves commonly torn down the middle . . . . . 15. *S. riparium*
    - 3. Plants orange-brown or copper-colored; terminal bud not much differentiated; stem leaves fringed at the apex (and sometimes torn down the middle). . . . . 16. *S. lenense*
- 1. Stem leaves not or somewhat fringed at the apex, not extensively resorbed in a sieve-like area below the apex.
  - 4. Stem and branch leaves not much differentiated in size, shape, and structure, broadly oblong or elliptic; retort cells remarkably long-necked. . . . . 11. *S. tenellum*
  - 4. Stem and branch leaves distinctly differentiated; branch leaves oblong-ovate to lanceolate; retort cells with less conspicuously differentiated retort cells.

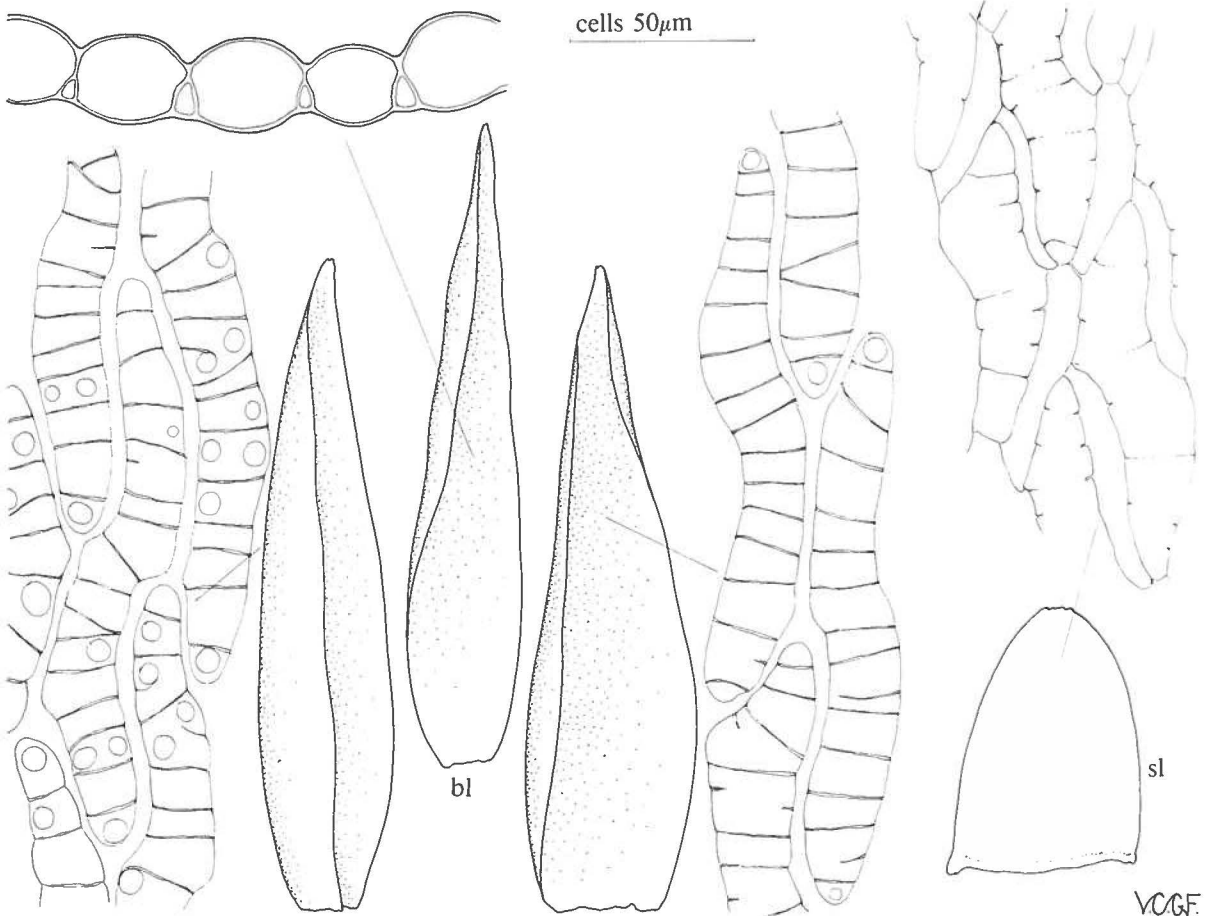


Fig. 10. *Sphagnum majus*, Noel Lake, Northwest Territories, Canada; leg. 1966 Scotter 9180, (C).



- 5. Plants submerged (but sometimes stranded late in the season).
  - 6. Hyaline cells of branch leaves with numerous, relatively large pores in 1–2 rows on the outer surface, few or none on the inner. . . . . 9. *S. majus*
  - 6. Hyaline cells with an abundance of small pores on both surfaces. . . . . 10. *S. jensenii*
- 5. Plants not normally submerged.
  - 7. Young pendent branches as seen between the rays of the capitulum not noticeably paired; hyaline cells of stem leaves fibrillose on the outer surface, also with stumps of fibrils surrounding a large membrane gap on the inner surface. . . . . 12. *S. balticum*
  - 7. Young pendent branches as seen between the rays of the capitulum appearing to be paired; hyaline cells of stem leaves normally without fibrils.
    - 8. Hyaline cells of branch leaves on the outer surface toward the apex with few pores but some connecting fibrils, on both surfaces toward the base with tiny membrane thinnings (visible on strong staining). . . . . 14. *S. obtusum*
    - 8. Hyaline cells of branch leaves without pseudopores or membrane thinnings, on the outer surface with conspicuous window-like pores at the upper ends.
      - 9. Stem leaves broad, lingulate to somewhat oblong-triangular, ±erose-fringed across a broadly rounded to truncate apex. . . . . 13. *S. recurvum* var. *recurvum*
      - 9. Stem leaves narrow, ±triangular, not or only slightly erose at the apex.
        - 10. Plants with rather large, 5-radiate capitula; stem leaves 0.7–1.1 mm long, acute to concave-apiculate, not erose at the apex; branch leaves undulate at the margins and with spreading tips when dry. . . . . 13. *S. recurvum* var. *brevifolium*
        - 10. Plants with small capitula; stem leaves 0.5–0.8 mm long, slightly erose at a blunt or rounded apex; branch leaves crowded and imbricate with spreading tips but not or only slightly undulate at the margins when dry. . . . . 13. *S. recurvum* var. *tenue*

**9. *Sphagnum majus* (Russ.) C. Jens.**

*Fig. 10. Map. 9*

Festskr. Bot. Foren. Kjøbenhavn. 106. 1890. – *S. cuspidatum* δ. *majus* Russ., Arch. Naturk. Livl. Ehistl. Kurl. 2, 7: 136. 1865.  
*S. dusenii* C. Jens. ex Russ. & Warnst., Sitz.-ber. Naturf.-Ges. Univ. Dorpat 9: 99. 1891 (also pre-printed 1889), *nom. inval.*

Plants rather robust but usually not very elongate, brown or brownish-green (sometimes only in the capitulum). Terminal bud fairly prominent; young pendent branches (as seen between rays of the capitulum not paired). Wood cylinder of stem yellow-green; cortical cells in 1–3 layers, somewhat enlarged. Stem leaves 1–1.8 mm long, oblong to oblong-triangular, rounded-obtuse but appearing narrower because of apical concavity), abruptly broad-bordered at base; hyaline cells not divided, without pores, usually fibrillose in the upper half or less. Branches in fascicles of 4–5, 1 distinctly pendent, the others variously spreading, somewhat curved. Branch leaves often subsecund, ± undulate-margined when dry, 1.5–2.5 mm long, ovate-lanceolate; hyaline cells with many large, rounded, unringed pores in 1 or 2 irregular rows over the outer surface (about 5–10 above, 10–20 below), on the inner surface with pores none or sometimes 1–4, small, rounded or ± elliptic, in corners; green cells isosceles-triangular to trapezoidal. Dioicous.

Spores 31–36 μm.

Growing in water and submerged to emergent in drainage tracks or other depressions in open, boggy habitats.

Newfoundland and Labrador to New England and New York and inland through the Great Lakes region, also scattered westward, in Wyoming, Saskatchewan, Alberta, and British Columbia; reported from the Mackenzie District of the Canadian Northwest and southern Alaska; northern and central Europe; reported across northern Asia to Japan.



Map 9. *Sphagnum majus*.

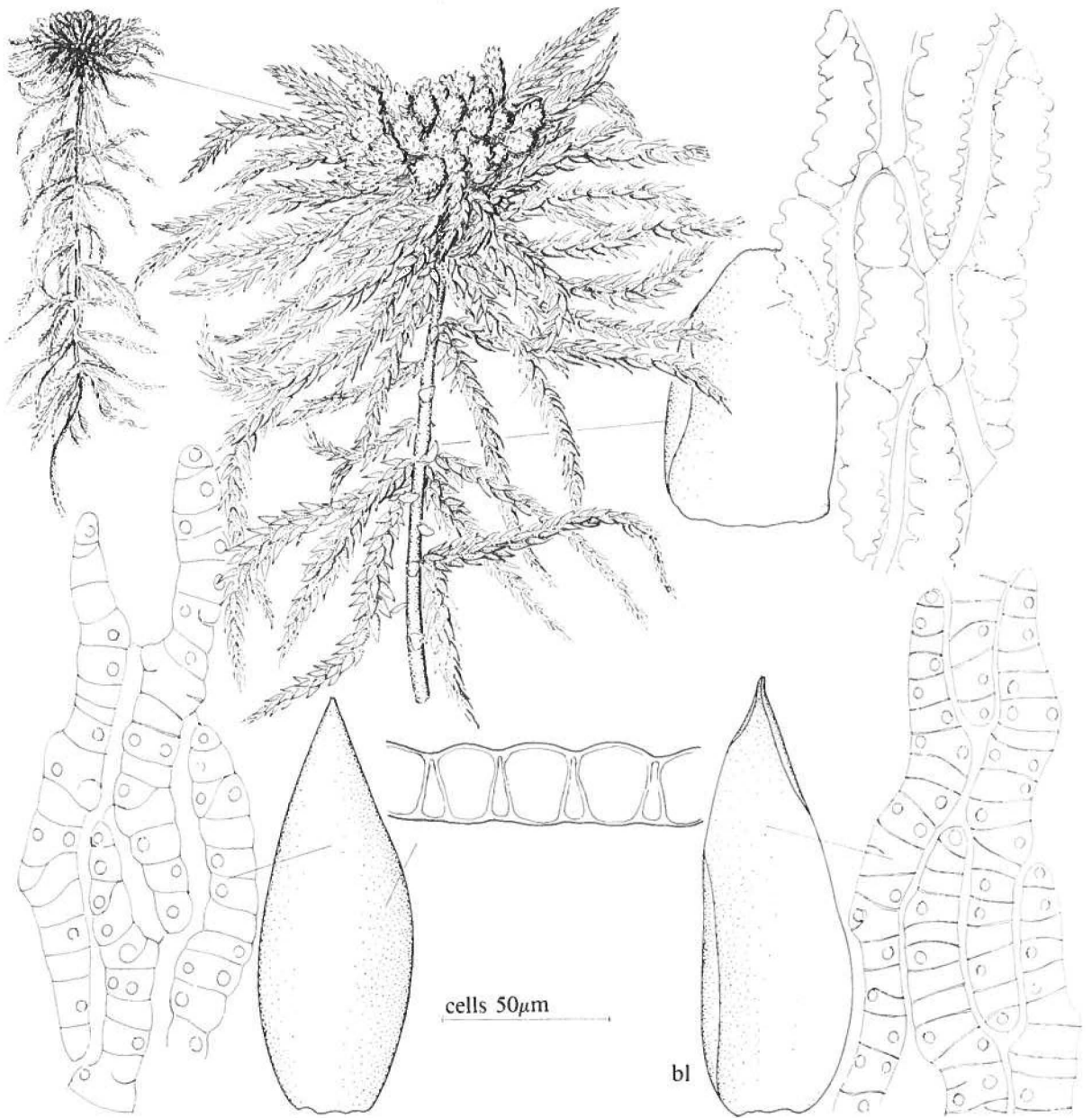


Fig. 11. *Sphagnum jensenii*, valley of Kuskokwim River, Alaska; leg. 1948 Layden Aug. 5th., (C).

The aquatic habitat and brownish color, together with numerous large, round pores in one or two rows over the outer surface of branch leaf hyaline cells but few or none on the inner surface, make identification easy. *Sphagnum jensenii* has smaller pores, and they are abundant on both surfaces.

### 10. *Sphagnum jensenii* H. Lindb.

Fig. 11. Map 10.

Acta Soc. Fauna Fl. Fenn 18(3): 13. 1899.

*S. annulatum* var. *porosum* (Schlieph. & Warnst. ex Warnst.) Maass & Isov. ex Maass, Nova Hedwigia 14: 189. 1967. – *S. recurvum* var. *porosum* Schlieph. & Warnst., Flora 67: 482. 1884.

Plants relatively robust but not particularly elongate, usually brownish. Terminal bud moderately large. Wood cylinder of stem yellowish; cortical cells poorly differentiated in 1–2 layers. Stem leaves 1–1.5 mm long, ± concave, oblong-triangular, obtuse to ± rounded at the apex, strongly bordered but the border gradually merging with other cells at the leaf base; hyaline cells not divided, on the outer surface with no pores but a few pseudopores at the corners, fibrillose in the upper half. Branches in fascicles of 4, with 2 spreading. Branch leaves ± undulate-margined when dry, 1.8–2.6 mm long, ovate-lanceolate; hyaline cells on the outer surface with 7–15(25) small, round, ringed and unringed pores in 2 irregular rows over the surface (or occasionally of moderate size and uniseriate), on the inner sur-

face with 4–18 medium-sized, round, mostly unringed pores near the commissures or, more often, in 2 rows over the surface; green cells isosceles-triangular, the apex not always reaching the inner surface. Dioicous.

Spores not seen.

Submerged or emergent, in hollows that are usually flooded, in flarks of string bogs, among sedges in swales, or in drainage tracks in open boggy habitats.

Scattered in boreal regions from Labrador, Quebec, and New York to British Columbia and southern Alaska; reported from the Mackenzie District of the Canadian Northwest; northern Europe; Japan.

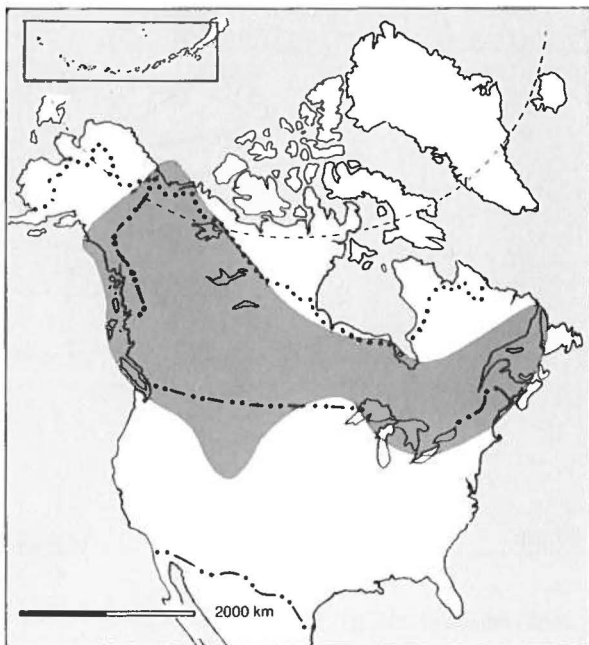
The brownish color and aquatic habitat, as well as the abundance of pores on both surfaces of the branch leaf hyalocysts, distinguish this species from *S. majus*. *Sphagnum jensenii* H. Lindb., very rare but widely scattered in the Northern Hemisphere, including Labrador and northern Quebec, Ontario, and Alberta, has few to numerous, rather large pores in addition to pseudopores on the outer surface of branch leaf hyaline cells but few or none on the inner.

### 11. *Sphagnum tenellum* Ehrh. ex Hoffm.

Fig. 12. Map 11.

Deutschl. Fl. 2: 22. 1796.

Plants small and delicate, in loose, soft, pale, yellow-green to brownish carpets. Terminal bud not noticeably differentiated; branches of the capitulum ± curved-ascending, the young pendent branches not paired. Stem brown; wood cylinder yellow-green; cortical cells mod-



Map 10. *Sphagnum jensenii*.



Map 11. *Sphagnum tenellum*.

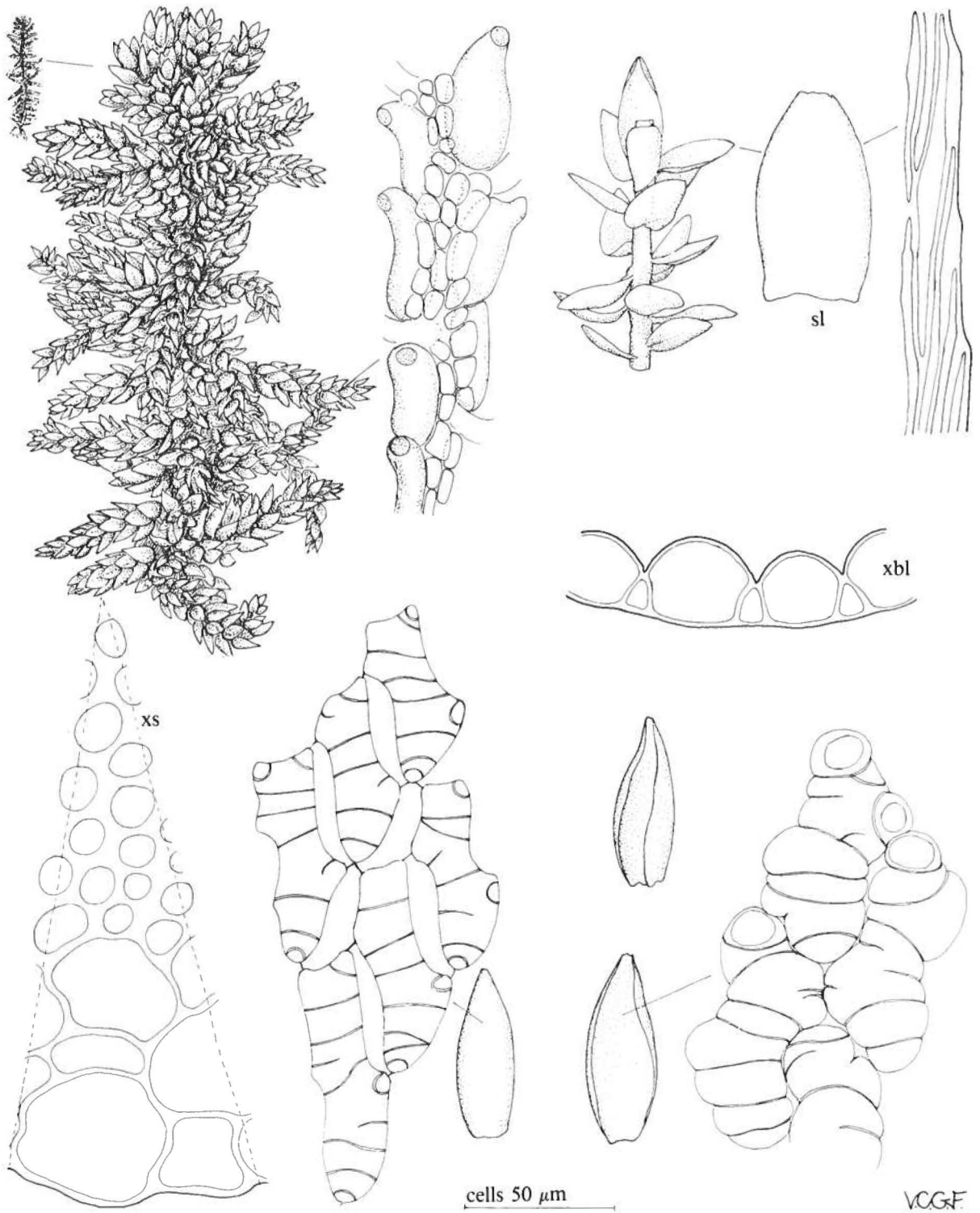


Fig. 12. *Sphagnum tenellum*, Igdlukasik island, W Greenland; leg. 1962 Holmen 62-205, (C).

erately differentiated in 2–3 layers. Stem leaves much like branch leaves, 1.3–1.4 mm long, oblong or elliptic, concave and appearing to be broadly acute because of incurved margins, the border not or slightly broadened at base; hyaline cells not or occasionally 1-divided, fibrillose in the upper half or nearly throughout, on the outer surface with 1–4 small corner pores, on the inner surface with 1–2 large, non-ringed pores at the corners or with a few  $\pm$  large membrane gaps (especially in the upper side regions). Branches in fascicles of 3–5, with 1–3 variously spreading; retort cells conspicuously long-necked. Branch leaves not crowded, loosely spreading or incurved to subsecund, about 1.3 mm long, concave, oblong-ovate to elliptic, broadly acute when dry but somewhat involute-concave at a short, narrow tip when moist; hyaline cells bulging-convex on the inner surface, on the outer surface with 2–4 small, round, ringed corner pores, on the inner surface with 2–3 large, round, non-ringed pores; cells broadly triangular (or occasionally trapezoidal). Dioicous.

Spores 27–31  $\mu$ m.

In loose carpets in seepage around late snow-patches or other wet, oligotrophic habitats.

In coastal habitats in southwestern Greenland, Newfoundland, and Miquelon south to Long Island, New York, and the New Jersey pine barrens, also inland in Labrador, northern and central Quebec, northern Ontario, and the mountains of New York and North Carolina; southeastern Alaska and British Columbia; eastern Mexico; reported from Ecuador and Brazil; northern, western, and central Europe; Japan.

The plants are easily recognized. They are small, delicate, and loosely aggregated in carpets. They appear especially soft when dry. The well-spaced, broad leaves are more or less flattened but not wavy-margined when dry. The stem and branch leaves are similar in shape and structure. The retort cells are remarkably long-necked.

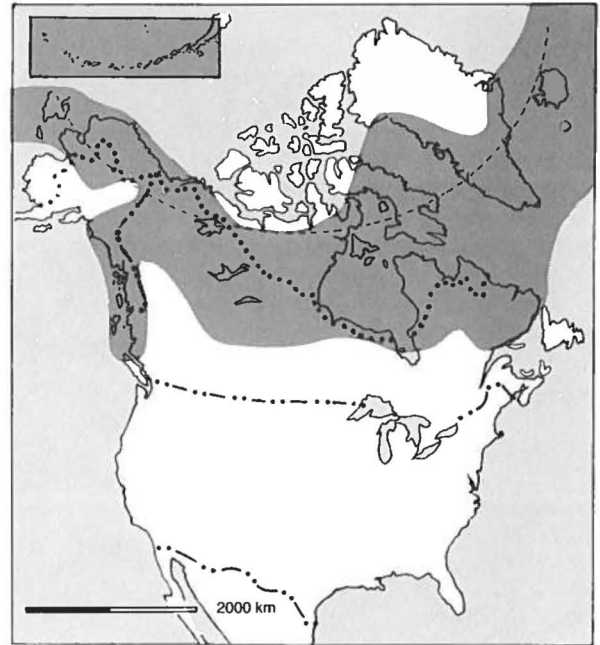
## 12. *Sphagnum balticum* (Russ.) C. Jens.

Fig. 13. Map 12.

Festskr. Bot. Foren. Kjøbenh. 100, 116. 1890.

*S. cuspidatum*  $\eta$ . *mollissimum* Russ., Arch. Naturk. Livl. Ehstl. Kurl. 2, 7: 139. 1865.

Plants small and delicate, in soft, yellowish- or whitish-brown carpets. Terminal bud not much differentiated; young pendent branches (as seen between the rays of the capitulum) not appearing paired. Wood cylinder of stems yellow-green; cortical cells moderately differentiated in 2–3 layers. Stem leaves spreading, about 1 mm long, somewhat longer than broad, oblong-elliptic or oblong-triangular, rounded-obtuse but usually acute because of concavity, the border merging with longer cells below and thus not well differentiated at base; hyaline cells not divided, on the outer surface fibrillose in the upper half or less, with small, round pores at the corners and sometimes at the commissures, the apical pores larger and window-like, on the inner surface lar-



Map 12. *Sphagnum balticum*.

gely resorbed but with vestiges of fibrils around the membrane gaps in the upper part of the leaf. Branches in fascicles of 3–4, with 2 spreading. Branch leaves when dry nearly flat, not or slightly undulate, and often subsecund, 1.3–2 mm long, ovate or ovate-lanceolate; hyaline cells on the outer surface with few to numerous (2–8, rarely 12) pores, those in the corners small,  $\pm$  round, ringed and unringed, those along the commissures elliptic and ringed, the apical pores larger and window-like, increasing in size toward the leaf base, on the inner surface with pores 3–5(9), large, round, and unringed, in ends and corners; green cells in section triangular, rarely reaching the inner surface. Dioicous.

Spores ca. 26  $\mu$ m.

Growing in wet tundra habitats with *Carex* and *Eriophorum*, often associated with *Sphagnum lindbergii*, in black-spruce muskeg occurring at sedge margins of ponds.

In Greenland north to app. 78° on the west coast, to app. 71° on the east coast; Labrador shore and northern Quebec; Churchill, Manitoba, and Southampton Island, westward from Hudson Bay in the Keewatin District, northern Saskatchewan, Alberta, and British Columbia, apparently more common northward, in the Mackenzie River region and the Yukon; arctic Alaska as well as oceanic areas in southeastern Alaska and the Aleutians; northern Europe; England; eastern Siberia.

Selected specimens seen (MICH):

Canada. Manitoba, along shore between Churchill and Fort Churchill, 58°46'N, 94°10'W; 1956 Schofield 6951. – Northwest Territories, Keewatin District, Lake Garry, 66°00'N, 100°20'W; 1948 Oldenburg 48-394. – Keewatin District, Southampton I., 64°08'N, 83°17'W, 1948 Cody 1363.

Alaska. Colville River, Umiat, 69°22'N, 152°08'W; 1948 Lepage 22601. – Brooks Range, eastward from Wiseman, 67°25'N, 150°06'W; 1949 Jordal 1960. – Toolik Lake, North Slope, 68°38'N, 149°35'W, 1977 Spatt 336.



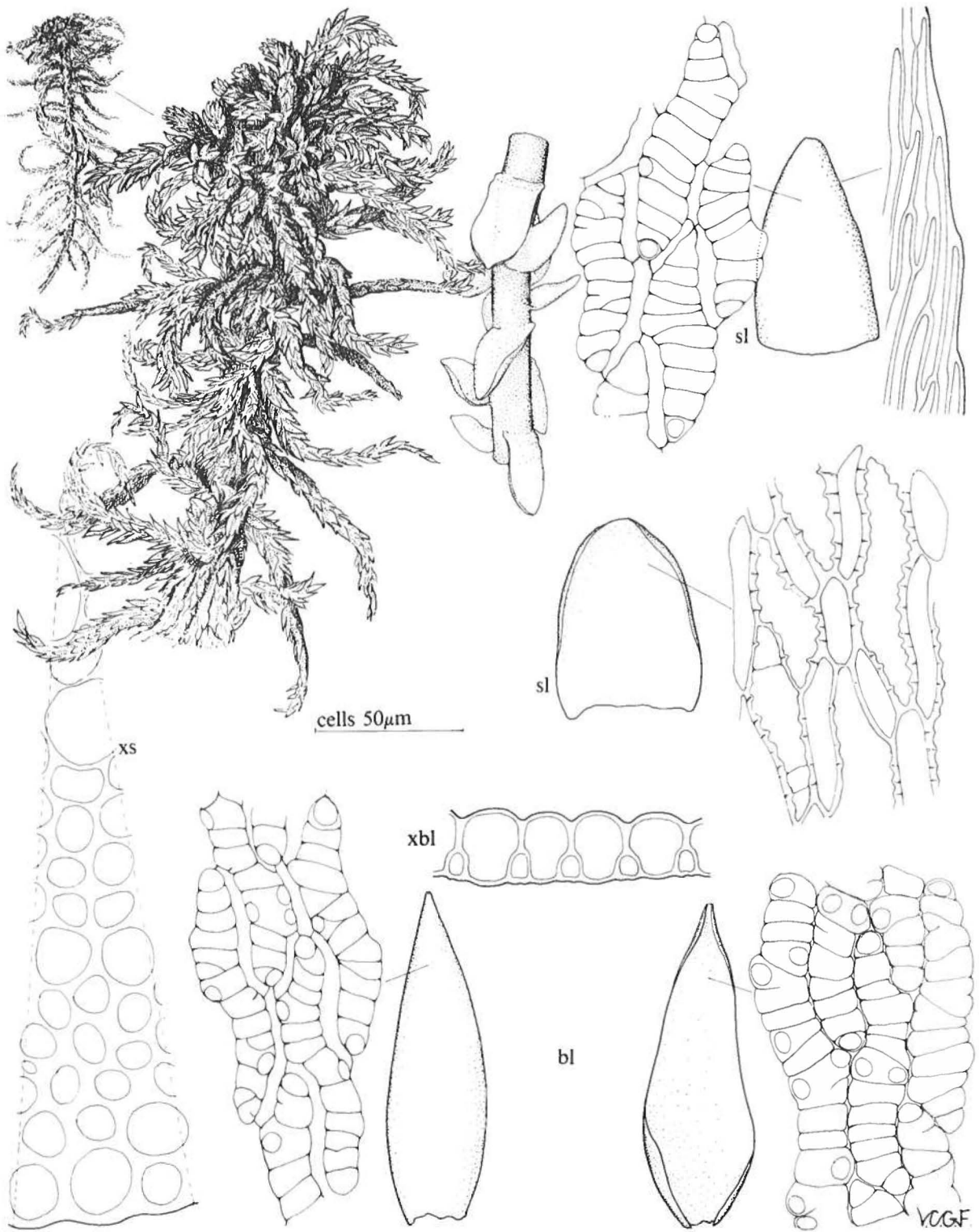


Fig. 13. *Sphagnum balticum*, "Dyrnæs", Ilimaussaq, S Greenland; leg. 1962 Holmen 62-683. (C).



Normally recognized by a subtle shade of whitish-brown, the plants are soft and delicate. The leaves are usually flattened out on drying but scarcely undulate, although they may also be less crowded and wavy. The relatively numerous commissural pores on the outer surface of branch leaves give some distinction from *S. recurvum*, as does the distribution of fibrils in the upper portion of stem leaves. The hyaline cells are fibrillose on the outer surface but largely resorbed on the inner, but toward the leaf tips stumps of fibrils surround the large membrane gaps.

### 13. *Sphagnum recurvum* P.-Beauv.

Prodr. Aethéog. 88. 1805.

#### Var. *recurvum*

*S. flexuosum* Dozy & Molk., Prodr. Fl. Batav. 2(1): 76. 1851.  
*S. recurvum* ssp. *amblyphyllum* Russ., Sitz.-ber. Naturw.-Ges. Dorpat 9: 99. 1889.

Plants in loose, bright- to yellow-green or yellow-brown carpets. Tips of stems and bases of branches often red-flushed; terminal bud not noticeably enlarged; young pendent branches (as seen between the rays of the capitulum) appearing to be paired; leaves of young spreading branches in the capitulum spiral-ranked when moist. Cortical cells of stems rather poorly differentiated in 1 layer; wood cylinder yellow-green. Stem leaves 0.7–1.3 mm long, flat, usually somewhat longer than broad, ± lingulate or less commonly, broadly triangular, ± erose across a broadly round or truncate apex, the border broader at base but not abruptly widened or sharply differentiated; hyaline cells not divided, on the outer surface normally without pores or fibrils, mostly resorbed on the inner surface toward the apex. Branches in fascicles of 4–5 or 6, with 2–3 spreading and 2, rarely 3 pendent. Branch leaves when dry flattened, with wavy margins and recurved tips, 1.3–1.4 mm long; hyaline cells on the outer surface with a rather large window-pore at the upper end and near the leaf tip with few (2–6) small, ringed pores at the corners and along the commissures, on the inner surface with 3–7 rather large, unringed, round pores at corners and along the commissures; green cells in section isosceles-triangular with the apex usually reaching the inner surface. Dioicous.

Spores 22–27 μm.

In low, relatively wet and ± mineral-rich habitats, in hollows in open mires and at shrubby pond margins.

Widespread in eastern North America from Nova Scotia to Wisconsin and south to Florida and Arkansas; central Alaska and western Canada to California; Cuba, Mexico, and northern South America; widespread in Europe; reported from Japan and probably ranging across northern Asia.

The plants are bright-green in shaded habitats but take on yellowish to yellow-brown tinges in exposed sites. The young pendent branches, as viewed between rays of the capitulum, appear to be paired, and the young spreading branches have leaves in noticeable spirals

Map 13.



Map 13. *Sphagnum recurvum*.

when moist. The bases of branches and the upper portion of stems often show pink flushes. The stem leaves are relatively large, flat, and usually lingulate, with a broad, more or less erose apex. The branch leaves are flattened out with wavy margins and recurved tips when dry. The window pores at the upper ends of hyaline cells are fairly conspicuous, and the green cells in section are isosceles-triangular and usually extend to the inner surface of the leaf. The stem leaves give the most reliable characters for sorting out most examples, but the biological significance of the varieties given below need to be evaluated.

#### Var. *brevifolium* (Lindb. ex Braithw.) Warnst.

Flora 67: 608. 1884.

*S. cuspidatum* δ. *fallax* Klinggr., Schr. Phys.-Ök. Ges. Königsb. 13: 7. 1872. – *S. fallax* (Klinggr.) Klinggr., Topogr. Fl. Westpr. 128. 1880. – *S. recurvum* var. *fallax* (Klinggr.) Paul in Koppe, Abh. Landesm. Westfal. 10(2): 12. 1939, non Warnst. 1884.

*S. cuspidatum* var. *brevifolium* Lindb. ex Braithw., Sphagn. Eur. & N. Amer. 84. 1878.

Stem leaves 0.6–1.1 mm long, broadly acute or sub-obtuse but nearly always ± concave-tipped, ovate-triangular to dentate, not erose (or rarely slightly so at the middle of the apex). Branch leaves undulate at the margins and spreading or recurved at the tips when dry.

In loose carpets in open or shaded habitats, in hollows in relatively mineral-rich habitats.

Newfoundland to central Alaska, widespread in eastern North America, ranging southward to Georgia and Missouri, across southern Canada and in the West southward at least to Ore-

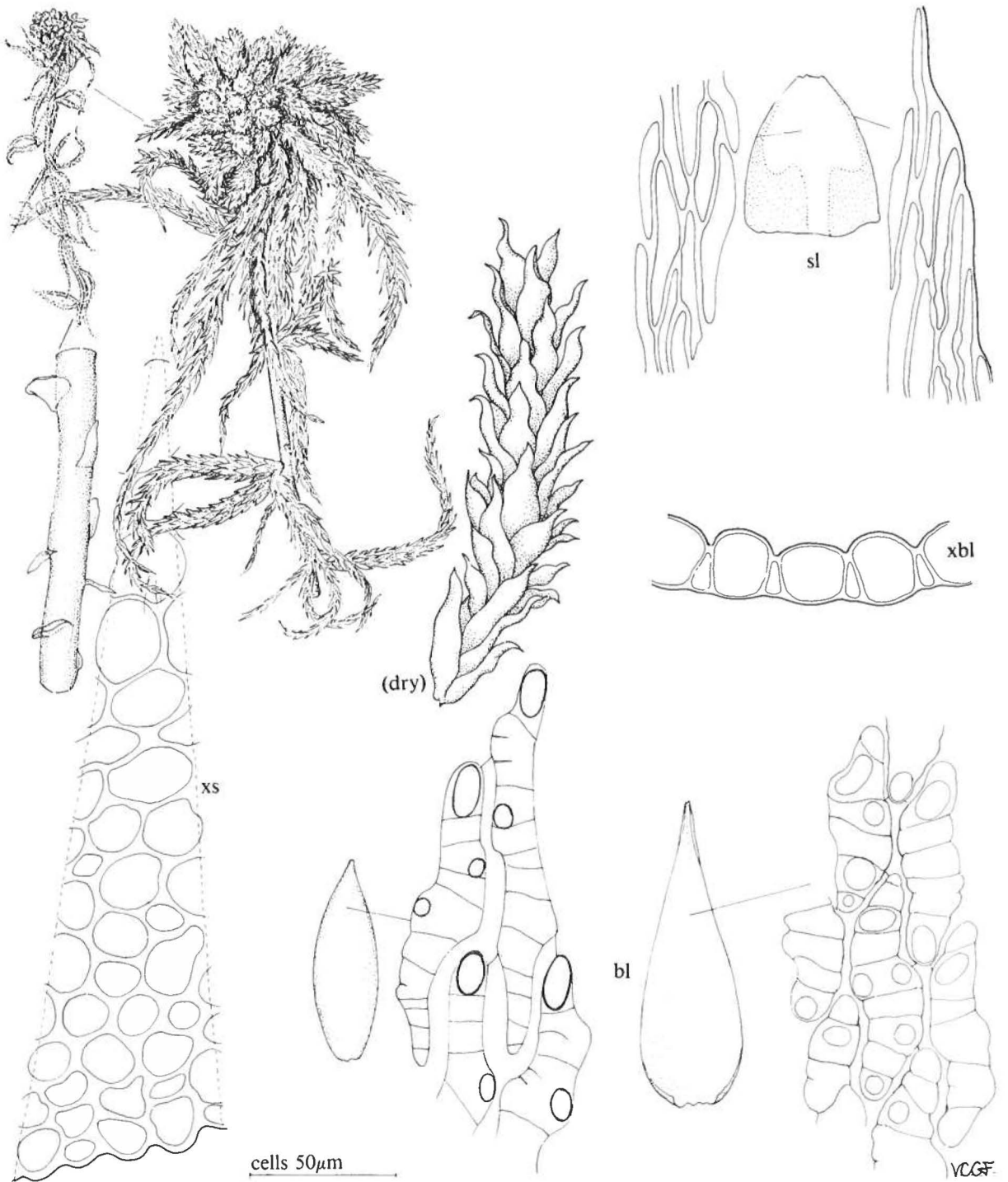


Fig. 14. *Sphagnum recurvum* var. *tenue*, Niaqornârssuk, Núp kangerdlua, S Greenland; leg. 1966 Gravesen and Hansen 66-277. (C).

gon; widespread in Europe; Japan and eastern Asia, probably also across northern Asia.

The concave-apiculate stem leaves are usually helpful in the mechanical sorting of specimens, but intergrades with var. *recurvum* (having large, flat, broadly pointed and  $\pm$  erose stem leaves) and also var. *tenue* (having small, flat-tipped, and slightly erose stem leaves) are troublesome.

#### Var. *tenue* Klinggr.

Fig. 14.

Schr. Phys.-Ök. Ges. Königsb. 13: 5. 1872.

*S. recurvum* ssp. *angustifolium* C. Jens. ex Russ., Sitz.-ber. Naturw.-Ges. Dorpat 9: 112. 1889. *S. angustifolium* (C. Jens. ex Russ.) C. Jens., Bih. Sv. Vet.-Akad. Handl. 3, 16: 48. 1891.

Stem leaves 0.5–0.8 (rarely 1) mm long, nearly as broad as long, typically flat, deltoid to oblong-triangular, usually slightly erose at a rounded or broadly pointed apex. Branch leaves when dry crowded–imbricate with tips spreading but margins not or only slightly undulate.

In open peat lands, often in hummocks well above the water level.

In Greenland north to 67°; across northern Canada and Alaska, south to Oregon, Colorado, the Great Lakes region, and West Virginia; northern Europe and presumably across northern Asia (reported from Japan, Korea, and the Soviet Far East).

The capitulum is small, with rays usually not conspicuously radiate. The crowded branch leaves, spreading at the tip but not wavy when dry, can be distinctive but, like the characters of the stem leaves, cannot be entirely depended on.

#### 14. *Sphagnum obtusum* Warnst.

Fig. 15. Map 14.

Bot. Zeit. 35: 478. 1877.

Plants in loose, pale, greenish to yellowish-brown carpets. Terminal bud moderately enlarged but  $\pm$  hidden among young branches of the capitulum; young pendent branches (as seen between rays of the capitulum) appearing to be in pairs. Wood cylinder of the stems yellow–green; cortical cells only slightly enlarged in 1–3 layers. Stem leaves 1–1.3 mm long, not or slightly concave, broadly oblong–triangular, rounded and  $\pm$  erose at the apex, indistinctly bordered; hyaline cells normally without fibrils, not divided (or occasionally with some division below midleaf), resorbed on both surfaces near the apex. Branches in fascicles of 4, with 2 spreading. Branch leaves 2 mm long, rather broad and flat with undulate margins and spreading tips when dry; hyaline cells on the outer surface near the leaf apex with few end and corner pores as well as some membrane thinnings and few to numerous pseudopores or connecting

fibrils, toward the base with numerous very small, round membrane thinnings in 1–2 irregular rows, on the inner surface near the apex with end pores and toward the base with numerous very small membrane thinnings; green cells isosceles–triangular, usually reaching the inner surface. Dioicous.

Spores 23–26  $\mu$ m.

In low, relatively wet and rather minerotrophic sites in sedge habitats, such as *Carex-Eriophorum* associations, often at margins of ponds, sometimes in alder-dwarf birch associations.

Central West Greenland; scattered in northern Canada, in the Yukon and the Mackenzie and Keewatin Districts of the Northwest Territories, also in arctic and central Alaska, northern Alberta and Manitoba, western Ontario; reported from northern Ontario and Quebec, southern Manitoba, and Minnesota; northern and central Europe; Japan; reported from northern Asia and Iceland.

Selected specimens seen (MICH):

Greenland. W 5: Jakobshavn, 69°13'N, 51°06'W; 1956 Holmen (Bryoph. Arc. Exs. 94).

Canada. Kenora District, Patricia section, 55°48'N, 87°31'W; 1978 Riley 9045.

Alaska. Fairbanks Quad., Fairbanks, 64°52'N, 147°45'W; 1977 Vitt 18559. – Pitmegea River, Cape Sabine, 68°54'N, 164°37'W; 1960 Steere, Holmen and Mårtensson (Bryoph. Arc. Exs. 21).

The species resembles *S. recurvum* and has no doubt been overlooked in collecting because of that resemblance. The outstanding characters for identification are the numerous minute, round membrane thinnings on both surfaces of the hyaline cells of branch leaves, especially toward the base. On the outer surface near the apex are some few pores and pseudopores and often a fair number of connecting fibrils as well.



Map 14. *Sphagnum obtusum*.

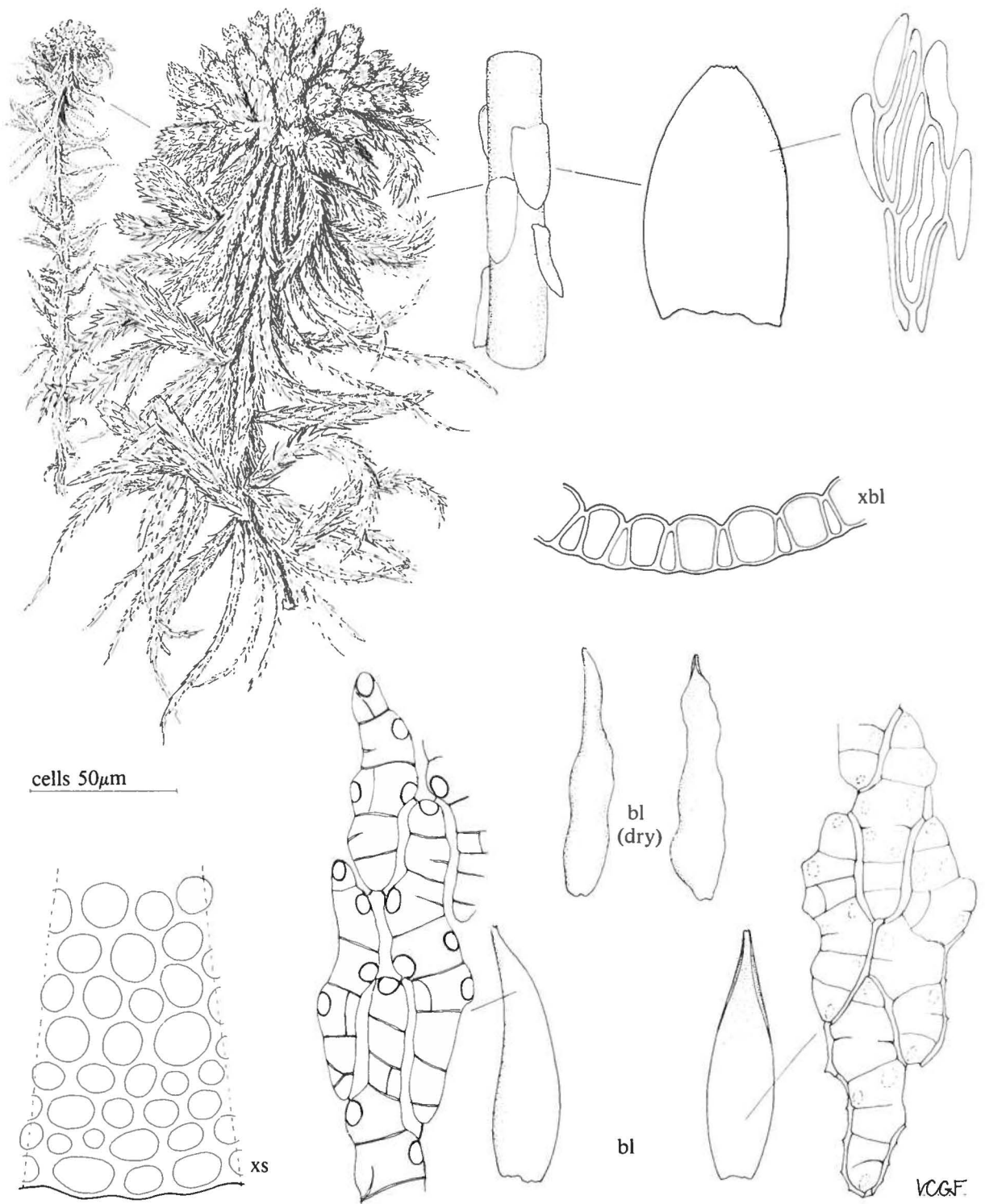


Fig. 15. *Sphagnum obtusum*, Kangerdluatsiaq, Arveprinsen Ejland, W Greenland; leg. 1971 Holmen and Mogensen 71-1271, (C).

15. *Sphagnum riparium* Ångstr.

Figs 16 and 17. Map 15.

Öfv. K. Sv. Vet.-Akad. Förh. 21: 198. 1864

Plants relatively tall and stout, in loose, light- or dark-green to yellowish carpets. Terminal bud very large and sharply conic; young pendent branches (as seen between rays of the capitulum) not or sometimes appearing to be paired. Wood cylinder of stems green; cortical cells  $\pm$  enlarged in 3–4 layers. Stem leaves rather large, oblong-ovate, rounded to broadly acute at the apex,

with a large triangular area of resorption and often deeply torn down the middle, the border not much broadened at base; hyaline cells commonly 1–2-divided, without pores or fibrils, on the outer surface with membrane pleats below. Branches in fascicles of 4–5, with 2 spreading. Branch leaves loosely imbricate and not ranked when moist, flattened out and  $\pm$  undulate-margined with spreading to recurved tips when dry, ovate-lanceolate, bordered by 2–5 rows of linear cells; hyaline cells on the outer surface with 2–3 small,  $\pm$  ringed pores at ends and corners toward the apex, with larger,

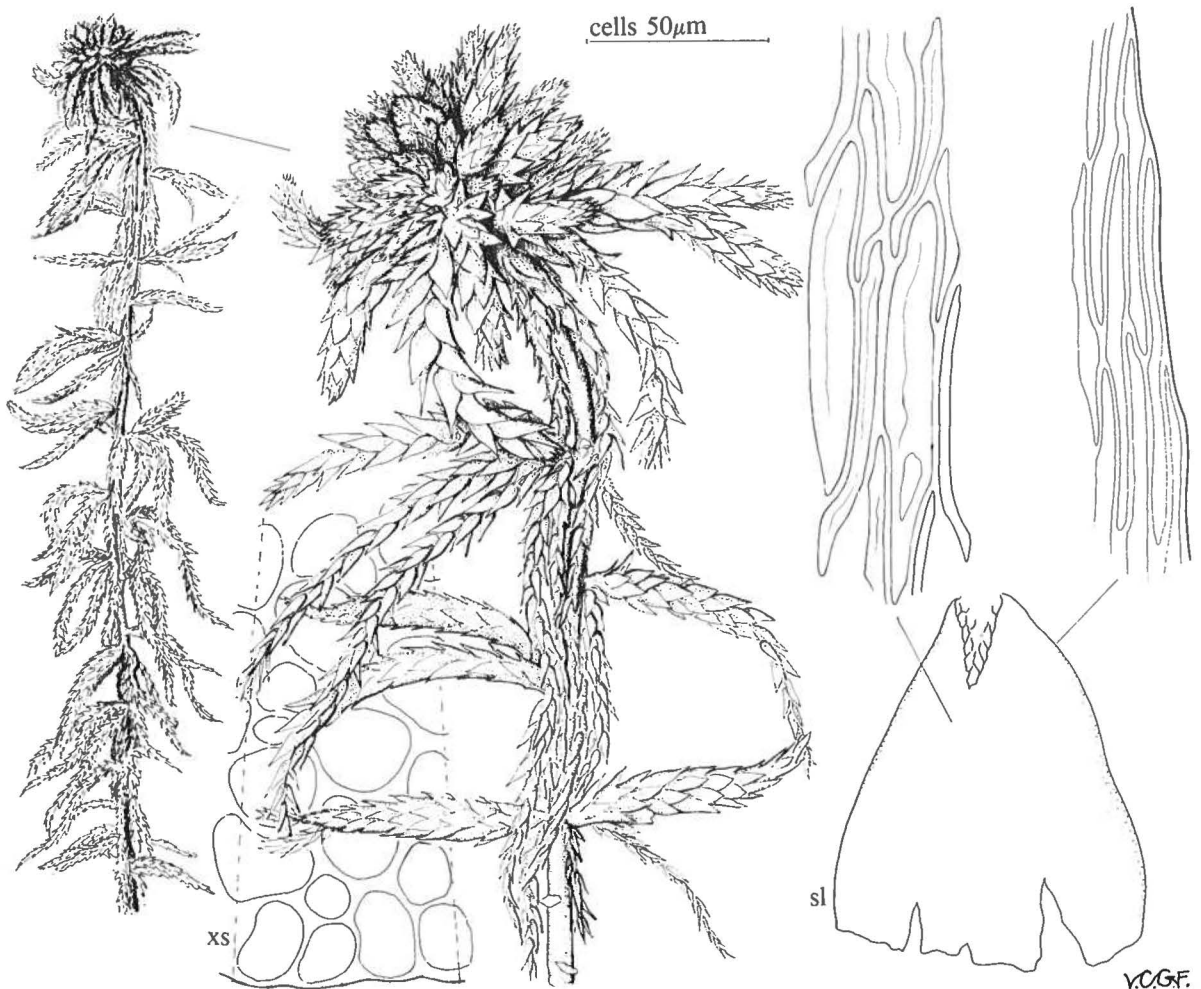


Fig. 16. *Sphagnum riparium*, Igdlukasik island, W Greenland; leg. 1962 Holmen 62-212, (C).

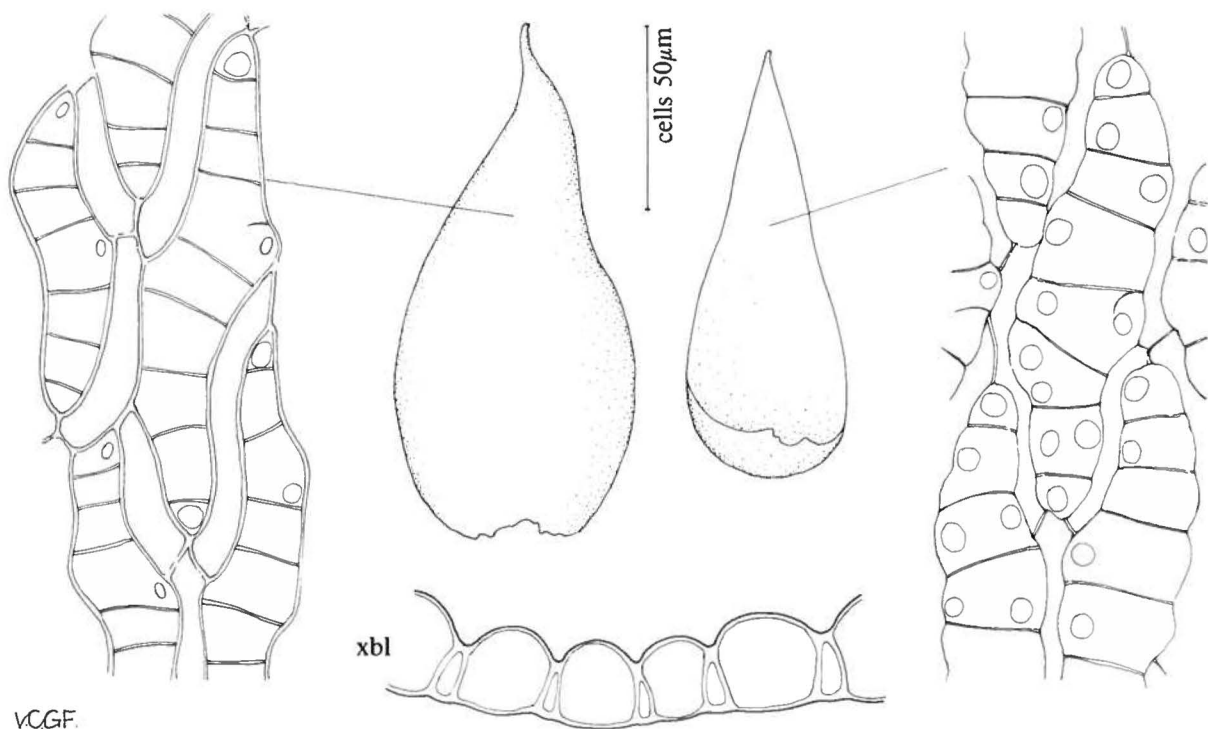


Fig. 17. *Sphagnum riparium*, from same specimen as Fig. 16.

window-like pores at the upper ends in the lower 2/3 of the leaf, on the inner surface with 1–4 round, thin-margined pores at ends and corners (but nearly as wide as the cell), on both surfaces often with interconnecting fibrils forming pseudopores; green cells in section broadly triangular to trapezoidal. Dioicous.

Spores 24–27µm.

In loose, often extensive carpets in depressions, rarely submerged, generally in somewhat minerotrophic sites in open bogs, often near water, sometimes in willow or alder thickets.

Scattered in Greenland north to app. 72°; Newfoundland and Labrador and westward in northern Quebec, Manitoba, Alberta, the Mackenzie District, and the Yukon to arctic, central, and southern Alaska; St. Paul Island (Bering Straits), southward to Connecticut, New York, Michigan, and Wisconsin; reported from Minnesota; northern and central Europe; reported from Japan.

Features of distinction are provided by stout, tumid branches, a huge, sharply conic terminal bud, and large stem leaves with a sieve-like triangular area of resorption at the apex, sometimes deeply torn down the middle. The branch leaf tips are noticeably hard and green owing to uniformly green cells rather than the usual network of dimorphous cells. The very large window-pores in the lower two-thirds of the branch leaves are striking.



Map 15. *Sphagnum riparium*.



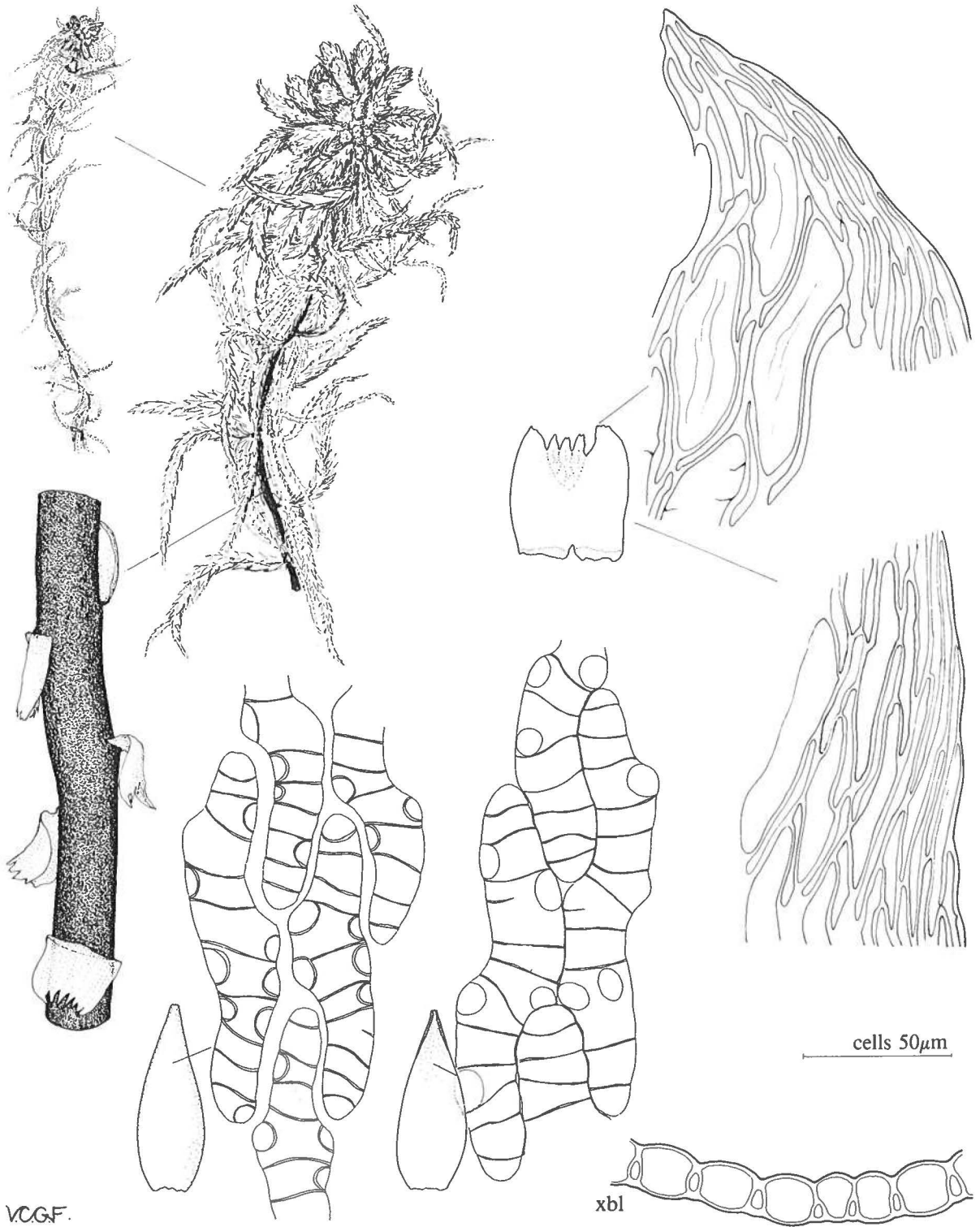


Fig. 18. *Sphagnum lenense*, Pákitsoq, Berggren Havn, W Greenland; leg. 1971 Holmen and Mogensen 71-2055, (C).

**16. *Sphagnum lenense* H. Lindb. ex Pohle**

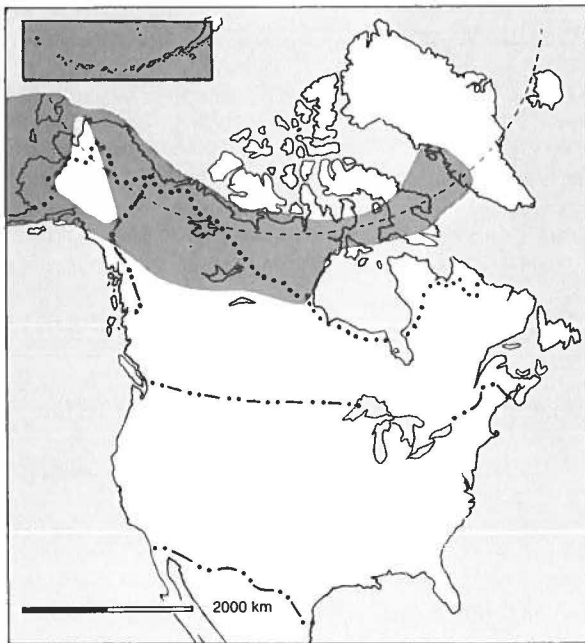
Fig. 18. Map 16.

Acta Horti Petrop. 33: 14. 1915.

Plants rather small, in low, compact cushions or mounds, bright orange-brown to copper-colored when moist, shiny red-brown when dry. Spreading branches short and equal giving the plants a compactly columnar appearance; terminal bud moderately large; young pendent branches appearing to be paired. Stem dark-brown; wood cylinder brown; cells of cortex rather large, in 3–4 layers. Stem leaves about 0.7 mm long, broadly oblong–lingulate, lacerate at the broad apex, sieve-like in a large, triangular area and sometimes deeply torn down the middle, the border not much differentiated; hyaline cells not divided, with fibrils and pores none (or occasional cells with remnants of fibrils). Branches in fascicles of 4–5, with 2 spreading; cortical cells in 1–2 layers. Branch leaves usually  $\pm$  appressed, spirally arranged wet or dry, not undulate, about 0.8–0.9 mm long; hyaline cells on the outer surface with rather large, round window-pores at 1 or both ends and a number of smaller, elliptic pores or pseudopores along the commissures, on the inner surface with a few round pores at ends and along the commissures.

In open sedge habitats or in the sparse cover of shrubby willows, birches, and alders, also in better drained tundra sites, on high-center polygons and in lichen heaths on sloping terrain.

Northern Europe (Kola Peninsula in the Russian Arctic); eastern Siberia; Bering Sea area and arctic Alaska south to the Aleutian Islands; Yukon Territory; Mackenzie River delta south to Great Slave Lake and eastward in a few localities west of Hudson bay, Baffin Island, and central western Greenland.



Map 16. *Sphagnum lenense*.

Selected specimens seen (MICH):

Greenland. W 5: Christianshåb, 68°49'N, 51°12'W; 1956 Holmen (Bryoph Arc. Exs. 63).

Canada. Baffin I., Frobisher Bay, along bank of Sylvia Grinnell River, 63°45'N, 68°32'W; 1948 Calder 2151. – Northwest Territories, Mackenzie Delta, Inuvik, 68°35'N, 133°00'W; 1969 Dickson M 458. – Quebec, Ungava, head of Kangelaksiorvek Fiord, 59°21'N, 64°00-05'W; 1975 Weber 1553.

Alaska. Meade River Post Office, 70°28'N, 157°25'W; 1973 Steere, Inoue and Iwatsuki 73-334. – Toolik River watershed, 68°41'N; 149°11'W; 1977 Spatt 335. – Baird Inlet Quad, Vicinity of Kasigluk, 60°52'N, 162°32'W; 1970 Charles 10.

Very distinctive, occupying relatively dry sites for one of the sect. *Cuspidata*, the plants are small, columnar, and compactly tufted in cushions that are shiny and red-brown when dry but almost copper-colored when moist. Differences from *S. lindbergii* include growth in compact cushions, terminal bud only moderately differentiated, young pendent branches seeming to be in pairs, branch leaves  $\pm$  imbricate, scarcely undulate when dry, and spirally ranked, and stem leaves small, with extensive resorption in a large median area and often torn down the middle.

**17. *Sphagnum lindbergii* Schimp. ex Lindb.**

Fig. 19 and 20. Map 17.

Öfv. K. Sv. Vet.-Akad. Förh. 14: 126. 1857.

*S. lindbergii* var. *microphyllum* Warnst., Hedwigia 32: 11. 1893.

Plants tall and robust, growing in dark, red-brown carpets. Terminal bud very large, conic; young pendent branches not paired. Stem dark-brown; wood cylinder brown; cortical cells somewhat enlarged, in 3–4 layers. Stem leaves 1–2 mm long, broadly fan-shaped, conspicuously lacerate across a broad, truncate apex and broad-meshed in a large, triangular area of resorption extending downward to the middle of the leaf base, the border of narrow cells broader toward the base; hyaline cells resorbed on both surfaces, sometimes 1–2-divided (especially in the side regions). Branches in fascicles of 4–5, with 2–3 spreading. Branch cortex in 1 layer. Branch leaves  $\pm$  spiral-ranked when moist but when dry not distinctly ranked, usually  $\pm$  spreading and  $\pm$  complanate, sometimes loosely secund, and flattened out with undulate margins, 1.5–2.5 mm long, oblong–lancoleate; hyaline cells on the outer surface with few small,  $\pm$  ringed pores at ends and corners and elsewhere along the leaf margins, on the inner surface with few small, round, unringed pores at end and corners, on both surfaces near the leaf apex with occasional interconnecting fibrils forming pseudopores; green cells in section isosceles–triangular to narrowly trapezoidal. Monoicous.

Spores 23–31  $\mu$ m.

In extensive carpets in wet, open, base-poor habitats, in hollows and at pond margins in oceanic areas, elsewhere in poor fens, commonly in association with *Carex* and *Eriophorum*.



Fig. 19. *Sphagnum lindbergii*, Kangilinâq, between Nísat and Angíssat, W Greenland; leg. 1974 Mogensen Aug. 11, (C).

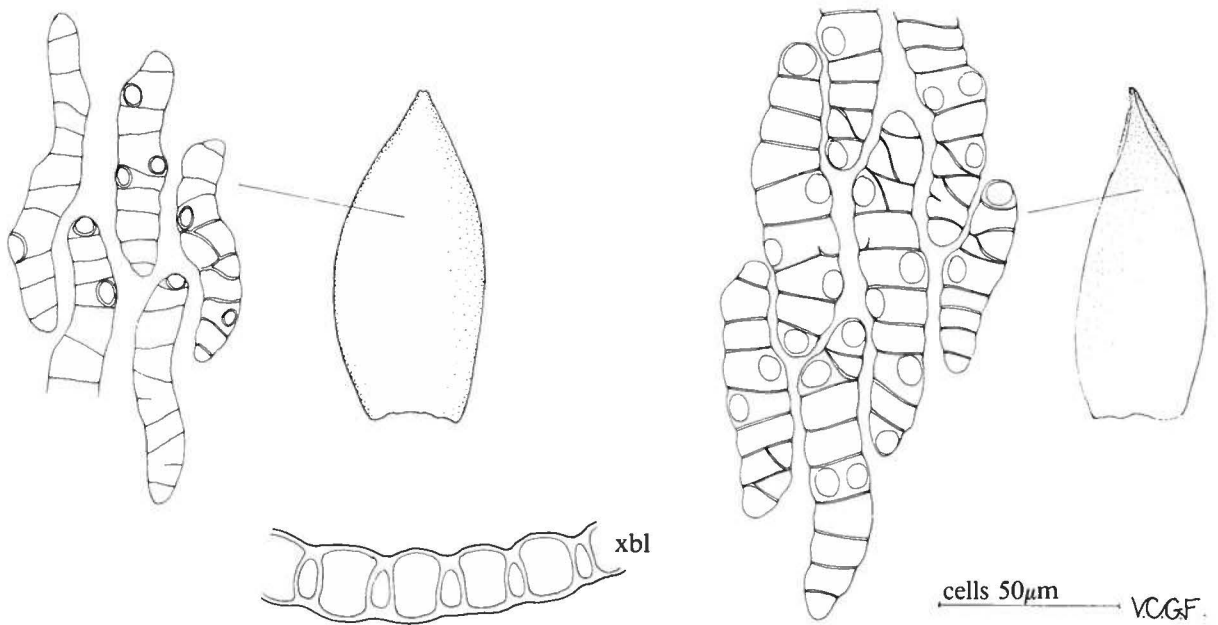


Fig. 20. *Sphagnum lindbergii*, from same specimen as Fig. 19.

ern Asia to Japan; north to app. 74° in Greenland; Baffin Island; Newfoundland and Miquelon, westward across Labrador and northern parts of Quebec, Manitoba, Saskatchewan, Alberta, and British Columbia, a few localities in the Mackenzie and Keewatin Districts of the Canadian Northwest and the Yukon; arctic Alaska south to the Aleutians, coastal British Columbia and the Olympic Peninsula of Washington; in eastern North America in the Canadian Maritimes and a few montane sites, in the Gaspé (Mt. Albert), New Hampshire (Mt. Monroe), and New York (Mt. Haystack and Whiteface Mountain).

Selected specimens seen (MICH):

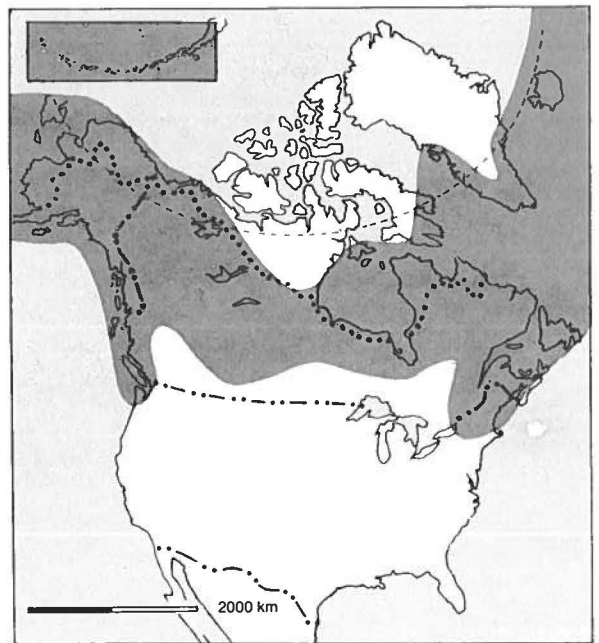
Greenland. W 4: Christianshåb, 68°49'N, 51°10'W; 1956 Holmen 12048.

Canada. Baffin I., Cumberland Sound, Kinguait Fiord, 1924 Soper 838. – Perry Bay, Meta Incognita Penins., 61°58'N, 66°30'W; 1975 Fife 1216.

Alaska. Fairbanks, North Star, College Avenue Peat Bog; 1982 Luken (Mosses of North America 928). – Colville River, Umiat, 69°22'N, 152°08'W; 1960 Steere, Holmen & Mårtensson (Bryoph. Arc. Exs. 17.) – McGrath and vicinity, Kuskokwim River, 62°57'N, 155°35'W; 1949 Steere 14607.

This very distinctive species is recognized by its considerable size, dark, rich-brown color, and habit of growth in wide lawns. The terminal bud is very large, and the branches are somewhat flattened. The branch leaves tend to be somewhat spiral-ranked when moist, but on drying they become unranked and wavy margined. The stem leaves are large and fan-shaped, with considerable laceration across a broad apex owing to extensive resorption in a large triangular area. The young pendent branches, as seen between the rays of the capitulum, are not paired, as they are in *S. lenense*. Small expressions common in the arctic and referable to the var.

*microphyllum* Warnst. have a columnar form and short leaves not or only slightly wavy when dry. Such plants resemble *S. lenense*, which has a small terminal bud, branch leaves seriate wet or dry, and stem leaves smaller and much less resorbed in the apical regions.



Map 17. *Sphagnum lindbergii*.

Sect. *Hemitheca* Lindb. ex Braithw.

Plants relatively short, compactly tufted, nearly always dark, orange-yellow to maroon, purple, brown, or black. Stems nearly simple or with 1–3 branches per fascicle. Cortical cells small but well differentiated in 1–2 layers, without fibrils or pores. Branch cortex with retort cells only slightly differentiated. Stem and branch leaves similar, those of the stem larger, strongly concave, rounded–ovate, rounded at the apex, narrowly and indistinctly bordered, the margins sometimes hyaline because of resorption of the inner surface of marginal cells; hyaline cells  $\pm$  plane on both surfaces, with very strong fibrils almost dividing the cells into separate segments, on the outer surface without pores (or rarely with 1–5 large, irregularly rounded membrane gaps in a single row), with short, irregularly oriented membrane pleats, especially toward the margins and base of the leaf, on the inner surface with small pores at the ends and sometimes also at the side corners; green cells in section broadly rectangular to somewhat trapezoidal with slightly broader exposure on the inner surface, with thick walls, the lumen small and rounded–ovate (broader toward the inner surface). Perichaetial leaves similar to stem leaves but somewhat larger. Pseudopodium short. Capsules immersed or slightly emergent, shallowly hemispheric when deoperculate, without pseudostomata.

This section consists of a single species.

The section has many distinguishing features: small, immersed, hemispheric capsules lacking pseudostomata; scarcely differentiated perichaetial bracts; poorly bordered and scarcely differentiated stem and branch leaves with very thick fibrils and few or no pores but numerous short membrane pleats oriented in various directions. Subsimplex forms occur in montane habitats in wet crevices of cliffs or in seepage around vegetation mats. Freely branched forms grow submerged.

18. *Sphagnum pylaesii* Brid.

Bryol. Univ. 1: 749. 1827.

Fig. 21. Map 18.

Plants short, compactly tufted, simple or sparsely branched to more elongate and loosely branched. Terminal bud large. Wood cylinder of stem yellowish to brownish; cortical cells small but well differentiated in 1–2 layers. Branches none, single, or in fascicles of 2–3. Branch leaves erect–imbricate and sometimes slightly secund, crowded and appressed at ends of branches, much smaller than stem leaves, strongly concave, often as broad as long or even broader; hyaline cells plane or nearly so on both surfaces. Dioicous.

Spores 30–40  $\mu$ m.

In acid habitats, submerged in the shallow water of heath pools and often near sea level in the North, farther south in montane habitats on ledges or depressions of granitic rock, wet by seepage but not usually submerged.

Southernmost Greenland; Newfoundland, St. Pierre, Miquelon, Labrador, and Nova Scotia; near the coast in Maine (Mt. Desert Island), Connecticut, and New Jersey; mountains of New Hampshire, New York, North and South Carolina, and Tennessee; reported from eastern Quebec and Massachusetts; Colombia and Peru; northwestern France and northwestern Spain.

The simple and branched forms, though strikingly different, are responses to habitat conditions and are scarcely worth taxonomic notice. In wet depressions and shallow pools in bog mats is a freely branched and maroon to blackish expression which has been called the var. *ramosum* Aust. (with black examples referred to the fo. *nigrescens* Warnst.). The correct name for the branched expression is, however, var. *austinii* (Husn.) Warnst. In montane habitats, on seepy ledges, is found a stout, yellow–orange, essentially unbranched form, variously designated as var. *prostratum* (Brid.) Card.,

var. *sedoides* (Brid.) Lindb. ex Warnst., and var. *camusii* (Husn.) Warnst. Of these names, the var. *prostratum* is nomenclaturally most acceptable. In this form the outer surfaces of hyaline cells may have large, round pores or gaps, generally in a single row the length of each cell. The submerged, “pinnate” form usually lacks perforations, although a few pores can occasionally be found near the leaf tips. Both forms take on a hard, shiny appearance on drying.



Map 18. *Sphagnum pylaesii*.



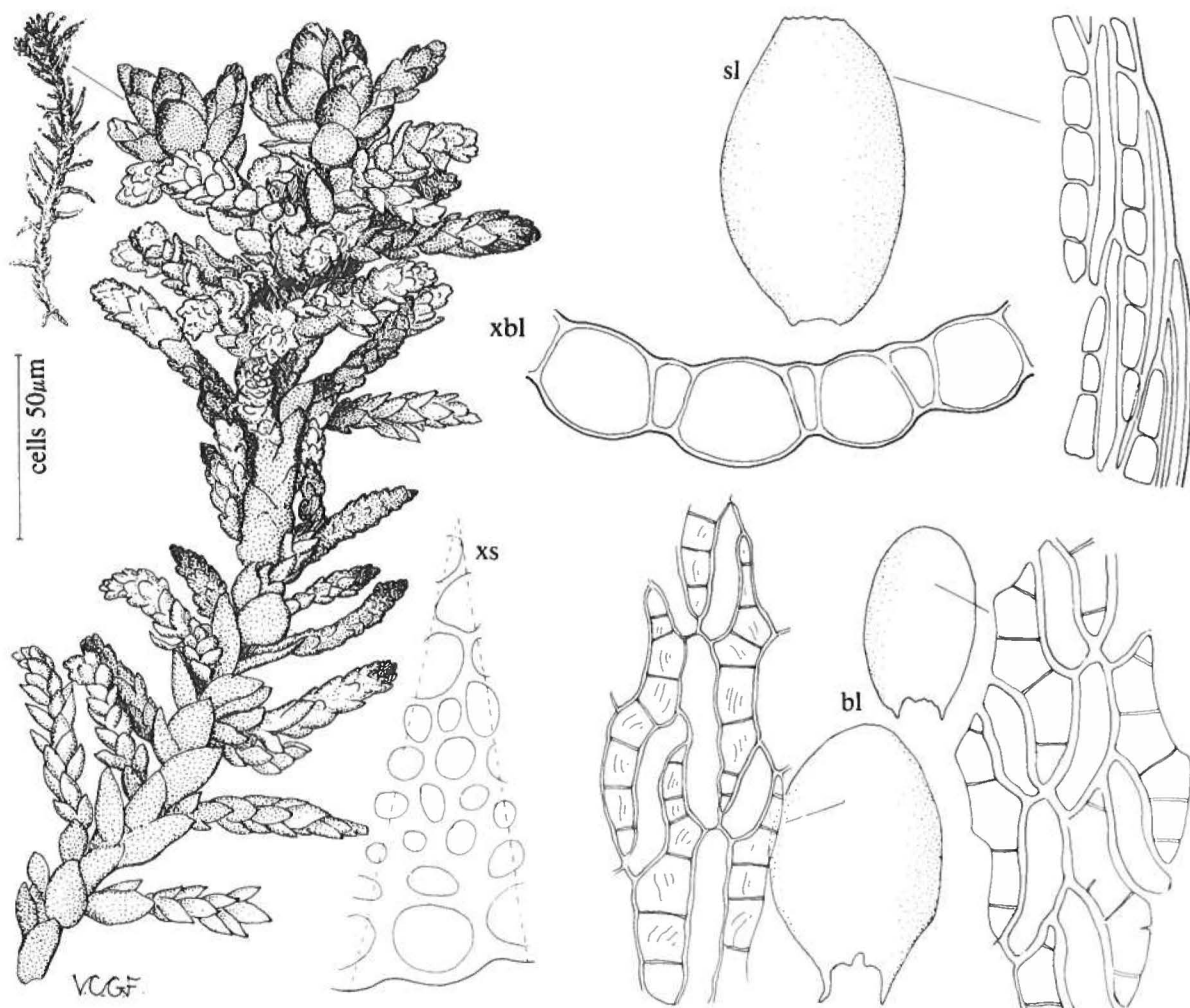


Fig. 21. *Sphagnum pylaesii*, Anordliuitsoq, Pamiagdhluk, S Greenland; leg. 1970 Jacobsen 8005, (C).

Sect. **Subsecunda** (Lindb.) Schlieph. ex Schimp.

Plants in small tufts or cushions in wet depressions, often tinged with orange-yellow or red-brown, often shiny when dry. Cortical cells of the stems in 1–4 layers, not fibrillose, sometimes porose or with a pore-like thin spot at the upper end. Stem leaves varying considerably in size, shape, and structure, sometimes much resembling branch leaves, the border not much widened at base; hyaline cells sometimes divided, usually fibrillose and porose at least near the apex, with numerous pores along the commissures on 1 or both surfaces. Branch cortex with retort cells with inconspicuous necks. Branch leaves often  $\pm$  secund, concave wet or dry, ovate–lanceolate to broadly ovate or elliptic, narrowly truncate and toothed across the tip, narrowly bordered by linear cells; hyaline cells  $\pm$  convex on both surfaces, on the outer surface generally with many ringed, elliptic pores crowded along the commissures (and rarely scattered elsewhere on the cell surface as well), on the inner surface with pores none, few, or fairly numerous, also along the commissures; green cells in section truncately elliptic to rectangular or  $\pm$  trapezoidal, with exposure equal or somewhat more on 1 surface or the other.

The plants grow in low tufts or cushions in wet, relatively mineral-rich habitats and commonly develop yellow or orange shades. The branch leaves are often secund, and the pores on branch leaves, sometimes also on stem leaves, tend to be conspicuously arranged in commissural rows. The green cells are exposed equally or somewhat more broadly on the outer surface, less commonly on the inner.



1. Hyaline cells of branch leaves with pores on the outer surface in rows along the commissures and also (on some leaves and in some cells) scattered in 1–3 irregular rows over the cell surface. . . . . 20. *S. orientale*
1. Hyaline cells of branch leaves with pores on the outer surface only along the commissures, usually in conspicuously bead-like rows.
  2. Stem cortex in 1 layer.
    3. Stem leaves much smaller than branch leaves, oblong-deltoid, fibrillose and porose on the outer surface only near the apex. . . . . 19. *S. subsecundum* var. *subsecundum*
    3. Stem leaves about the same length as the branch leaves, oblong-lingulate, with fibrils none or reduced to mere stumps and pores on the outer surface none or very few near the apex. . . . . 19. *S. subsecundum* var. *junsaiense*
  2. Stem cortex in 2–3 layers (best determined in unstained sections).
    4. Terminal bud scarcely noticeable, pendent branches concealing the stem; stem leaves smaller than the branch leaves,  $\pm$ deltoid; hyaline cells of stem leaves secund. . . . . 19. *S. subsecundum* var. *contortum*
    4. Terminal bud large; branches not clearly differentiated into spreading and pendent types, not concealing the stem; stem leaves large, often as long as the branch leaves, sometimes longer, broadly elliptic; hyaline cells of stem leaves fibrillose and porose nearly to the base; branches in fascicles of 1–3(4); branch leaves imbricate, not secund. . . . . 19. *S. subsecundum* var. *platyphyllum*

**19. *Sphagnum subsecundum* Nees ex Sturm**

Deutschl. Fl. 2(17): sp. 3. 1819.

**Var. *subsecundum***

*Fig. 22. Map 19.*

Plants of medium size, often yellow-green or orange, in soft, loose cushions. Terminal bud small. Stems brown; wood cylinder light- to dark-brown; cortical cells in 1 layer, without pores or with cracks, less commonly thin spots or actual pores at the upper ends. Stem leaves shorter than branch leaves, 0.6–1, rarely 1.3 mm long, oblong to broadly oblong-triangular, rounded-obtuse and cucullate-concave, the border narrow, poorly differentiated at base; hyaline cells not divided or occasionally 1–(3)-divided, usually  $\pm$  fibrillose close to the leaf apex, on the outer surface with pores none or few at the extreme apex, on the inner surface with numerous commissural pores close to the apex. Branches in fascicles of 4–6, with 2–3 spreading, curved, especially in the capitulum. Branch leaves 1–2 mm long, curved-secund, ovate or ovate-lanceolate; hyaline cells on the outer surface with numerous elliptic pores in commissural rows, on the inner surface with few (0–5) small pores at ends and corners; green cells exposed equally or somewhat more broadly on the outer surface. Dioicous.

Spores 22–26  $\mu$ m.

In small cushions or loose mats in low, wet, mineral-rich habitats, often among sedges, often in meadows and swales, especially along streams and near ponds, less commonly in alder thickets, sometimes at the pioneering edge of floating mats or in the relatively minerotrophic *Larix* zone in temperate latitudes of North America.

Southernmost and northeastern Greenland to arctic Alaska and southward to the Gulf of Mexico and in the West to Wyoming, Idaho, California, and the Aleutians; northern and central Europe; probably across northern Asia; reported from Korea, India (Khasia), Thailand, Bali, and New Guinea.

**Selected specimens seen:**

Canada. Northwest Territories, Queen Elizabeth Is, Devon I., 75°45'N, 84°03'W; 1972 Vitt (*Sphagn. Bor.-Amer.* 62).  
 Alaska. Fairbanks Quad, 64°53'N, 147°18'W; 1974 Calmes 2004.

The plants have a yellow-green, yellow-brown, or orange cast and a hard, shiny appearance when dry. The leaves are very concave and noticeably curved-secund, especially on the short, curved branches of the capitulum. The hyaline cells of the branch leaves show on their outer surface a beaded arrangement of commis-



Map 19. *Sphagnum subsecundum* var. *subsecundum*.

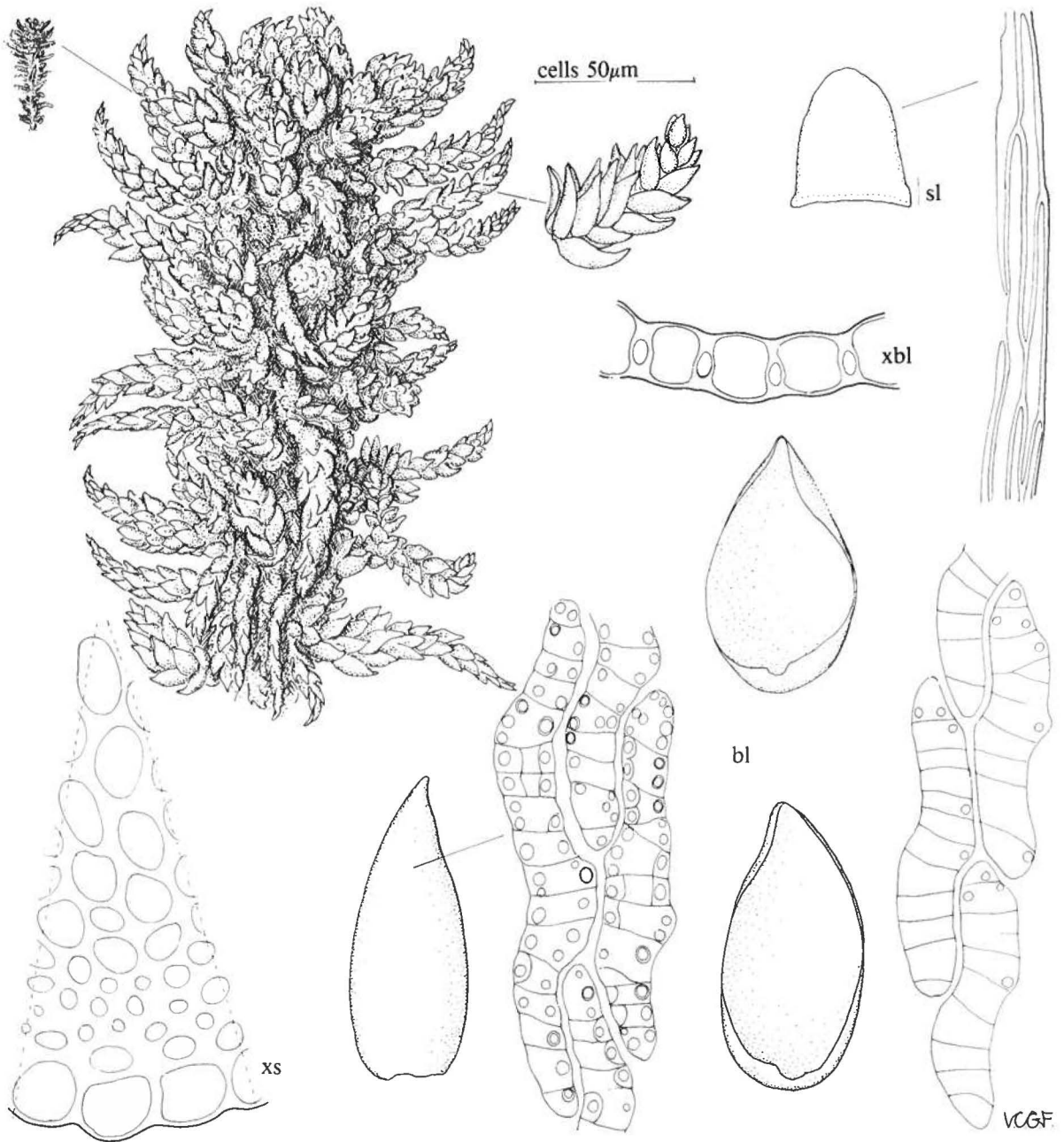


Fig. 22. *Sphagnum subsecundum* var. *subsecundum*, Geographical Society Ø, NE Greenland; leg. 1958 Holmen 18096, (C).

sural pores. The cortical cells of the stem are one-layered. The stem leaves are considerably shorter than the branch leaves. They are blunt and cucullate with pores and fibrils only near the apex, with pores normally only on the inner surface but sometimes with a few pores on the outer surface of a few apical cells as well.

**Var. *junsaiense* (Warnst.) Crum**

No. Amer. Fl., Series II (11): 61. 1984. – *S. microporum* var. *junsaiense* Warnst., Sphagn. Univ. 314. 1911.

*S. subobesum* Warnst., Hedwigia 39: 104. 1900.

*S. uzenense* Warnst., Sphag. Univ. 394. 1911.

Plants medium-sized, in loose, light orange-yellow to dark- or red-brown tufts. Terminal bud small. Cortical

cells of stem in 1 layer, often porose at the upper ends; wood cylinder dark-brown. Stem leaves ca. 1.3 mm long, oblong-lingulate, rounded-truncate at a concave apex; hyaline cells rarely divided, with fibrils none or reduced to mere stubs, on the outer surface with pores none or with a few minute commissural pores at the leaf apex, on the inner surface with numerous scattered, unringed commissural pores in the upper part of the leaf, somewhat larger at the cell corners. Branched in fascicles of 3-4 (with 2-3 spreading), curved (especially in the capitulum). Branch leaves secund, ca 1.2 mm long, oblong-ovate; hyaline cells on the outer surface with numerous small, ringed pores at angles and along commissures, on the inner surface with pores usually lacking.

Spores 36-39  $\mu\text{m}$ , minutely granulose.

On moist slopes or in crevices of cliffs, from sea level to about 450 ft. alt.

Alaska. Aleutian Is. (Adak), Mt. McKinley National Park, Bering Straits District, and British Columbia (Pitt I. and also Moresby and West Moresby Is. in the Queen Charlotte Islands); Japan.

The stem leaves are lingulate and about the same length as the branch leaves. Their hyaline cells are undivided and have pores few or none on the outer surface and fibrils none or reduced to mere stumps. The branch leaves have an abundance of commissural pores on the outer surface.

#### Var. *contortum* (Schultz) Hüb.

Musc. Germ. 27. 1833. - *S. contortum* Schultz, Prodr. Starg. Suppl. 1: 64. 1819

Plants of medium size, yellow-brown to brownish-green. Terminal bud small. Branches of the capitulum curved. Stem pale; wood cylinder green or brown; cortical cells in 2-3 layers. Stem leaves shorter than branch leaves, 0.7-1.3 mm long, oblong-deltoid, rounded-obtuse, concave at the tip; hyaline cells not divided, fibrillose in the upper 0.2-0.4 or nearly throughout, on the outer surface with pores 0-6 near the apex, on the inner surface with pores few to numerous (usually more numerous than on the outer surface). Branches in fascicles of 4-6. Branch leaves 1.2-2 mm long,  $\pm$  curved-secund, oblong-ovate; hyaline cells on the outer surface either numerous in commissural rows and usually small and not contiguous or few and scattered along the commissures, on the inner surface few or none.

In wet, sedgy habitats in rich fens, often near water, usually in the open.

Nova Scotia to Ontario and Michigan, south to New England, New York, Ohio, Illinois, and Missouri; central and southern Alaska; British Columbia; reported from Alberta and Washington; northern, central, and western Europe; reported also from the Caucasus and across northern Asia to Japan.

Diagnostic are the pale stems with a multistratose cortex, stem leaves shorter than branch leaves, and hyaline cells with small pores often in more or less interrupted rows.

#### Var. *platyphyllum* (Lindb. ex Braithw.) Card.

Fig. 23.

Bull. Soc. Roy. Bot. Belg. 25: 73. 1886. - *S. laricinum* var.  $\gamma$ . *platyphyllum* Lindb., Not. Sällsk. Fauna Flora Fenn. Förh. 13: 403. 1874, *nom. inval.*; Lindb. ex Braithw., Trans. Roy. Microsc. Soc. 13: 230. 1875. - *S. platyphyllum* (Lindb. ex Braithw.) Sull. ex Warnst., Sphagn. Eur. no. 187. 1884.

Plants stout, sometimes elongate, tumid when wet, in loose, limp, green or yellowish patches. Capitulum not much differentiated; terminal bud large (especially conspicuous when wet). Cortical cells of stems in 2-3 layers, mostly porose at the upper ends; wood cylinder dark-brown. Stem leaves 1.5-2, rarely 3 mm long, similar to branch leaves and sometimes as long or longer, nearly flat, broadly elliptic; hyaline cells fibrillose throughout the leaf, not or rarely divided, on the outer surface with membrane pleats and few to many small, ringed, elliptic pores or pseudopores at ends and corners and along the commissures, sometimes in interrupted rows, on the inner surface with 2-5 small, rounded-elliptic, ringed pores, especially at ends and corners in the median region, more numerous toward the margins. Branches straight, 1-3 per fascicle, not differentiated into spreading and pendent types, not concealing the stem, stout and tumid. Branch leaves erect-imbricate, 1.6-2.5 mm long, very broadly oblong-ovate or elliptic; hyaline cells on the outer surface with 4-5 small, elliptic, ringed pores scattered along the commissures or as many as 10, 15, or even 40 arranged in bead-like rows, on the inner surface with pores very few or none, unringed.

Barely submerged or emergent at the margins of ponds and lakes, in sedge meadows or other eutrophic habitats dominated by *Carex*, *Juncus*, or *Typha*.

In Greenland only on the west coast, north to app. 69°; Newfoundland and Labrador, scattered westward and southward to Ontario, Michigan, Wisconsin and Missouri; arctic, central, and southeastern Alaska, Alberta, Saskatchewan, Wyoming, and Arizona; northern Europe; reported from northern Asia and Japan, also from Montana and the Yukon.

Selected specimens seen (MICH):

Greenland. W 3: Qasigiánguit, 64°05'N, 51°02'W; 1973 Lewinsky 73-629.

Canada. Labrador, head of Kangalaksiorvik Fiord, 59°21-23'N, 64°00-05'W; 1975 Weber 1571.

Distinctive features include the large terminal bud, tumid branches scarcely differentiated into spreading and pendent types and not concealing the stems, and large stem leaves much resembling branch leaves in size, shape, and cellular detail.

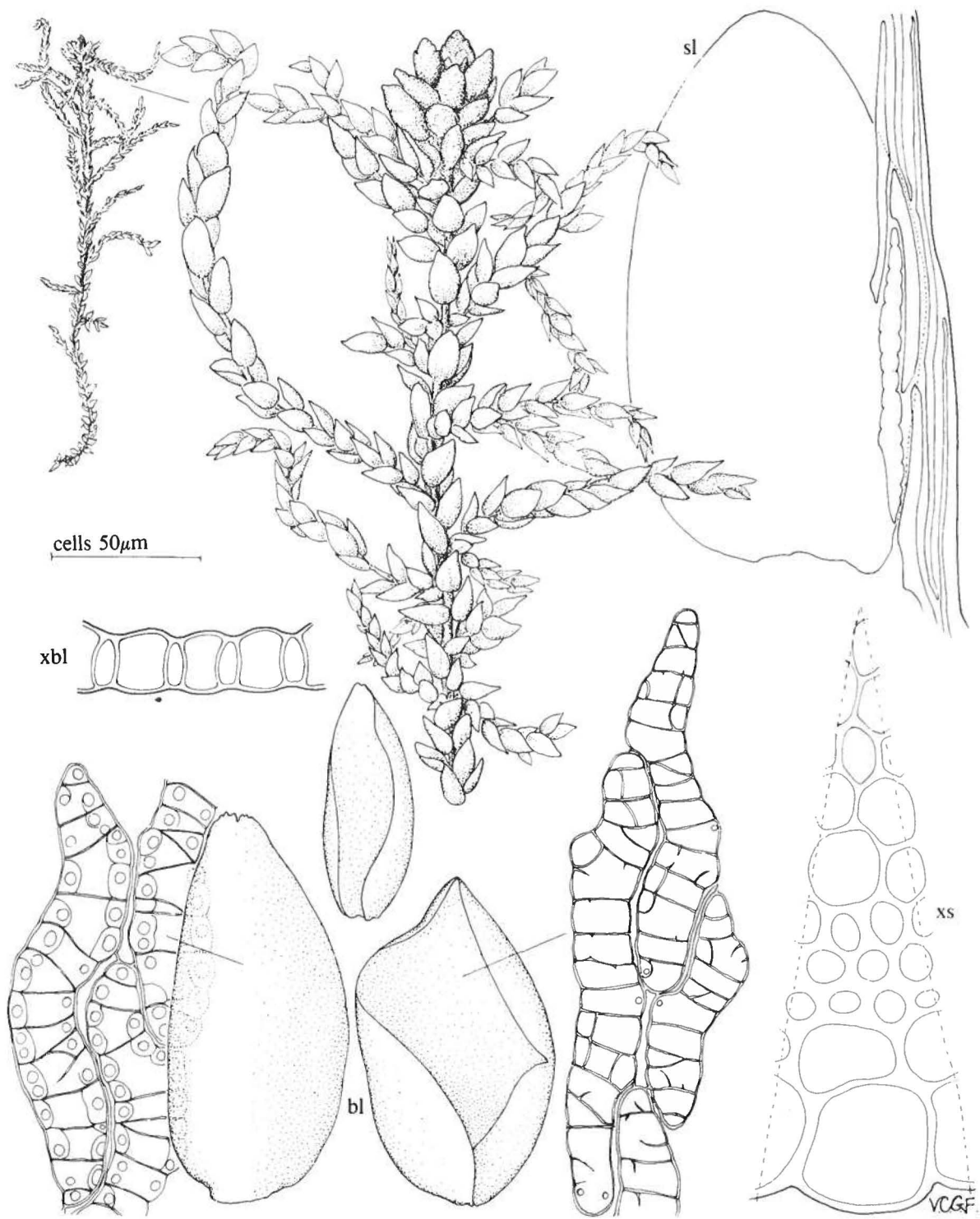


Fig. 23. *Sphagnum subsecundum* var. *platyphyllum*, Majoraríssap ilua, SW Greenland; leg. 1971 Damsholt 71-814, (C).

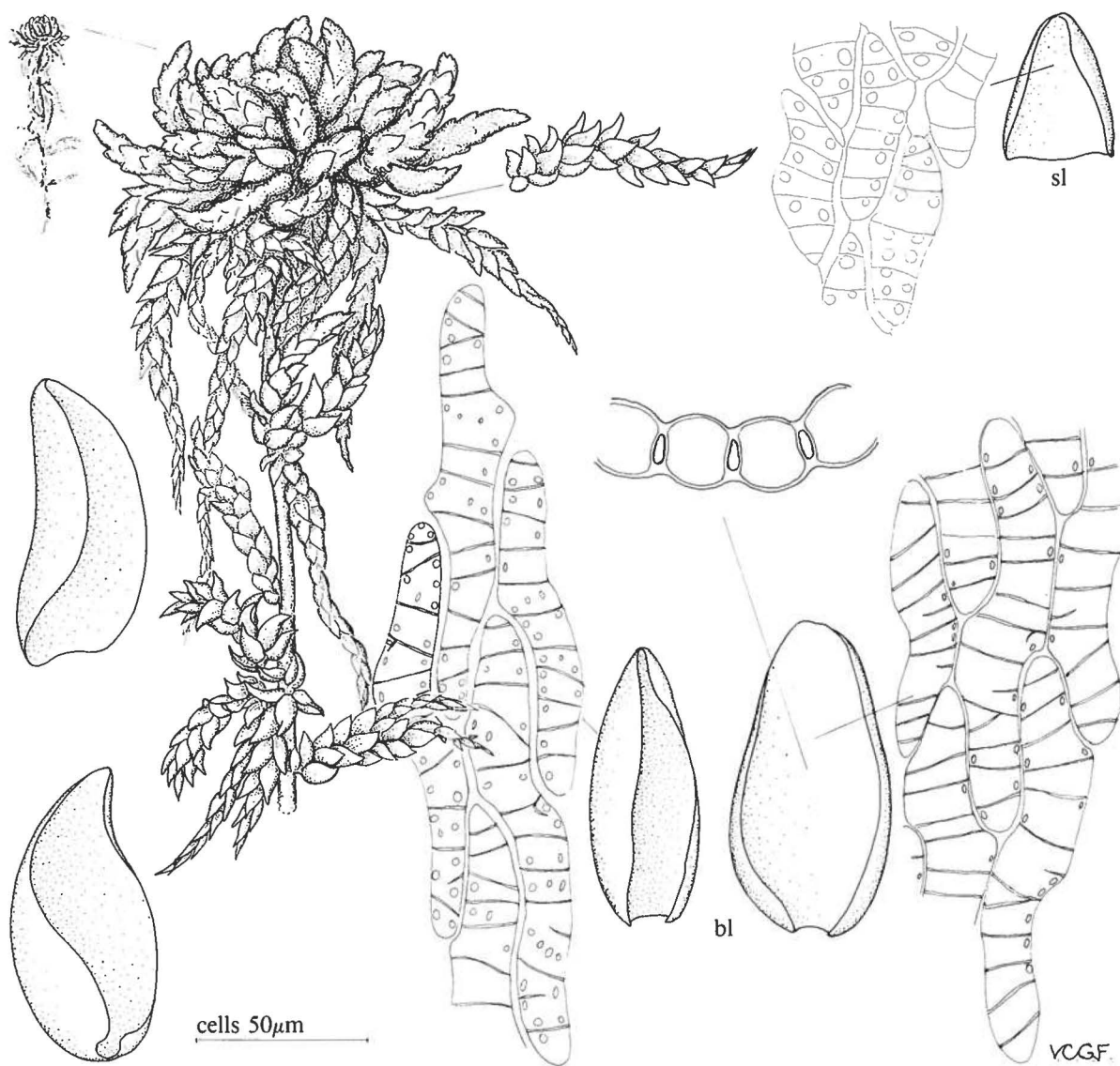


Fig. 24. *Sphagnum orientale*, Sparbo-Hardy Lowland, Devon I., Northwest Territories, Canada; leg. 1972 Vitt July 28th, (Andrus and Vitt: *Sphagnotheca Boreali-Americana* No. 62), (C).

## 20. *Sphagnum orientale* Sav.-Lub.

Fig. 24. Map 20.

Not. Syst. Bot. Sect. Crypt. Inst. Bot. Komar. Acad. Sci. USSR 7: 206. 1951.

*S. perfoliatum* Sav.-Lub., Not. Syst. Bot. Sect. Crypt. Inst. Bot. Komar. Acad. Sci. USSR 7: 208. 1951.

Small plants in compact, dark yellow-brown, often blackish-tinged tufts, shiny when dry. Terminal bud small. Stems brown; wood cylinder brown; cortical cells in 2 irregular layers. Stem leaves 0.9–1.1 mm long, somewhat concave, oblong, rounded-obtuse, slightly erose at the apex, scarcely bordered; hyaline cells not divided, usually fibrillose in the upper half, on the outer

surface with numerous small, round pores along the commissures, sometimes with some scattered over the surface as well, on the inner surface with numerous small, round commissural pores. Branches in fascicles of 4, with 2 spreading, curved. Branch leaves distinctly curved-secund, deeply concave, 1.3–1.5 mm long, oblong-ovate, bluntly pointed, bordered by 2–3 rows of linear cells; hyaline cells slightly convex on both surfaces, on the outer surface with tiny round pores, both ringed and unringed, along the commissures and, in some cells, also in 1–2(3) irregular rows over the surface, on the inner surface with numerous, rather small, elliptic,  $\pm$  unringed commissural pores (and sometimes



with few to  $\pm$  numerous pores scattered over the surface); green cells elliptic in section, exposed by thickened walls on both surfaces, sometimes more broadly on the outer surface.

At boggy margins of tundra pools, associated with *Carex* and *Eriophorum*, sometimes growing with *S. aongstroemii*, *S. obtusum*, *S. girgensohnii*, *Polytrichum commune* var. *diminutum*, and *Cinclidium subrotundum*.

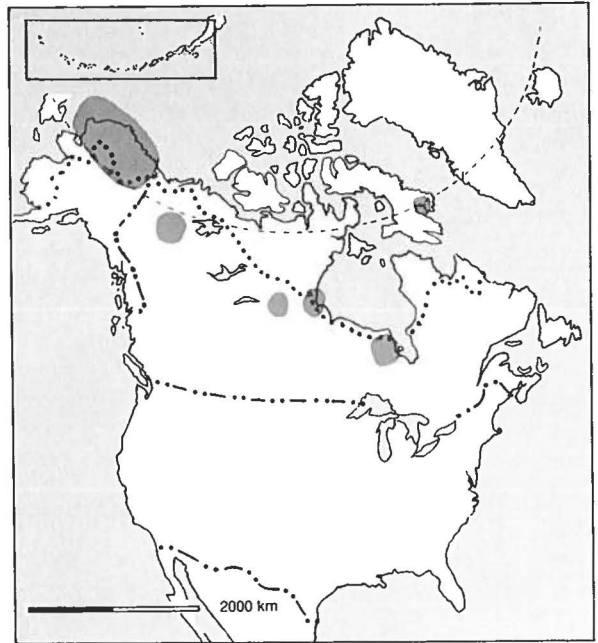
Rare and scattered in the arctic and subarctic of North America. Arctic and central Alaska; Northwest territories, at Beverly Lake, and Pangnirtung, Baffin J.; northern Manitoba, near Churchill; Yukon (according to Maass, in lit.); reported from Western Siberia, at Omsk, and the Yamal and Anadir Peninsulas of arctic Siberia (type from "Siberia boreali-occidentalis", without locality).

Selected specimens seen:

Canada. Northwest Territories, Keewatin District, Snow Bunting Lake, north of Baker Lake; 1966 Larsen August 3rd. – Baffin J., Pangnirtung; 1980 Belland et al. 14552.

Alaska. Pitmegea River, Cape Sabine, 68°54'N, 164°37'W, 1960 Steere, Holmen, and Mårtensson (Bryoph. Arc. Exs. 39).

The plants resemble *S. subsecundum* var. *subsecundum* in appearance. They tend to be brownish, with a varnished gloss on drying. The hyaline cells of the branch leaves, and sometimes also the stem leaves, are perforated by scattered tiny pores over the surface in addition to those in commissural rows. Sometimes the scattered pores are found only in some leaves and some few cells. The pores are mostly unringed, although some of those



Map 20. *Sphagnum orientale*.

at the commissures are ringed, and sometimes, as in other members of the sect. *Subsecunda*, two or three may be enclosed in a common ring.

#### Sect. *Polyclada* (C. Jens.) Warnst.

Rather robust, loosely tufted, brownish-green plants with large, dense, globose capitula. Stems dark, stiff and wiry when moist, brittle when dry. Cortical cells of stems rather small but distinctly differentiated, without pores or fibrils; wood cylinder red-brown. Stem leaves very small, slightly concave, oblong-triangular, bluntly pointed, indistinctly bordered, sometimes slightly fringed at the apex; hyaline cells in part 1(2)-divided, without fibrils, on both surfaces with membrane gaps in the upper part of the leaf and membrane pleats in the lower. Branches crowded, in fascicles of 6–12. Branch cortex with some cells enlarged and retort-like. Branch leaves widely recurved when dry, involute-concave, ovate-lanceolate, narrowly bordered by 2–3 rows of linear cells, toothed across a narrow, truncate tip; hyaline cells convex on both surfaces, on the outer surface with 4–8 small, strongly ringed, elliptic pores at corners and along the commissures, on the inner surface with 2–3 round, unringed pores at the corners; green cells in section narrow, truncately elliptic, narrowly exposed on both surfaces, sometimes more broadly so on the outer, the inner side walls adjacent to the green cells often faintly papillose. Dioicous or monoicous.

Spores 18–24  $\mu$ m.

This section consists of a single species characterized by the numerous branches crowded in the fascicles and a large, dense capitulum, as well as the small stem leaves and neatly recurved branch leaves having strongly ringed pores on the outer surface of hyaline cells and green cells narrowly exposed on both surfaces.



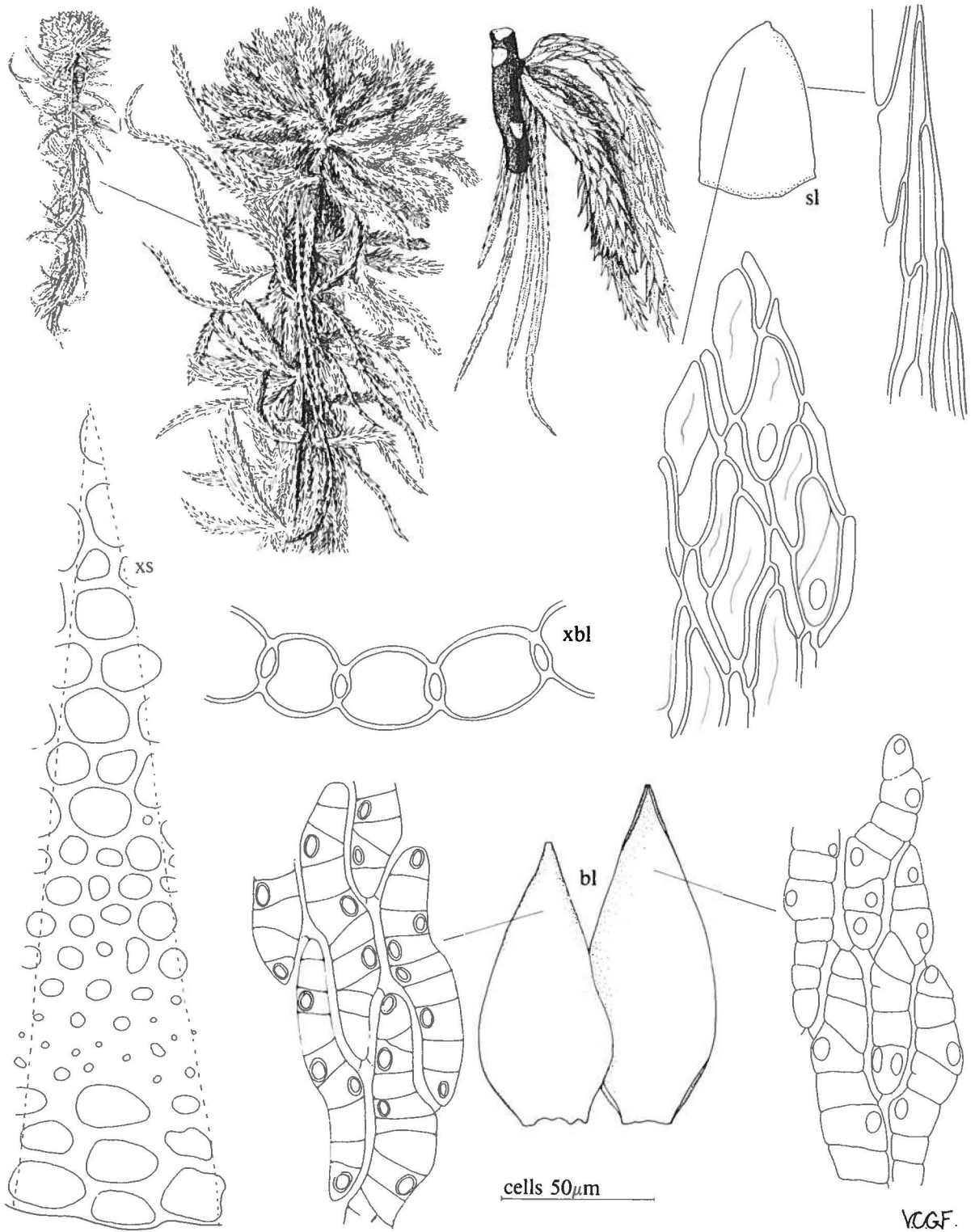


Fig. 25. *Sphagnum wulfianum*, Lyngmarksbugten, Qeqertarsuaq (Godhavn), Disko, W Greenland; leg. 1967 Lange 430, (C).

**21. *Sphagnum wulfianum* Girg.**

Fig. 25. Map 21.

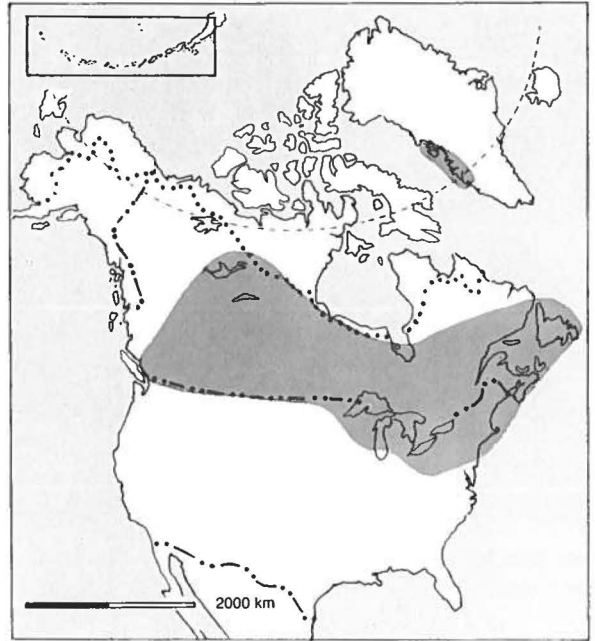
Arch. Naturk. Livl. Ehst. Kurl. 2: 173. 1860.

Occupying the driest, most acid habitats available in wet, mineral-rich, coniferous woodlands in the Great Lakes–St. Lawrence region (characteristic of *Thuja* swamps and growing in loose mounds or long ridges representing stumps or logs in an advanced state of decay, rarely also in open boggy habitats among *Chamaedaphne* or alder thickets marginal to bog mats), in the boreal forest of Canada in black spruce muskeg, especially in richer sites occupied by *Larix*. The species occurs in forested zones in Europe, as in North America. In western Greenland it is found in a treeless moss bog habitat with *Betula nana* and *Ledum decumbens* and along a brook with *Alnus crispa*.

Central western Greenland; Nova Scotia, New Brunswick, and Quebec, westward through Manitoba and northern Saskatchewan to Alberta (and reported from Vancouver Island, British Columbia) and arctic Alaska, south to Pennsylvania, Ohio, Michigan, Wisconsin, and Minnesota; northern and central Europe.

Selected specimens seen (MICH):  
Greenland. W 5: Disko, Godhavn, 69°15'N, 53°33'W, 1956  
Holmen, (Bryoph. Arc. Exs. 26).

Small northern forms (as exemplified by Steere & Holmen's Bryophyta Arctica Exs. 26, 1975) may bear some resemblance to *S. warnstorffii*.



Map 21. *Sphagnum wulfianum*.

**Sect. *Acutifolia* Wils.**

Plants generally slender, often reddish, growing in cushions or hummocks. Cortical cells of stems in 2–4 layers, without fibrils, sometimes uniporose at or near the upper ends. Stem leaves about as long as branch leaves, nearly flat to ± concave, oblong–lingulate to ovate, broadly rounded to concave–pointed, sometimes fringed or lacerate at the apex, rarely also down the sides, bordered by linear cells, the border commonly abruptly widened below, hyaline cells short and undivided or longer and often divided 1–several times, without fibrils and pores (and with membrane pleats on the outer surface) or fibrillose with pores or gaps on the outer surface, generally largely resorbed on the inner surface. Branch cortex without fibrils, with some cells retort-like. Branch leaves involute–concave, ovate–lanceolate, toothed across a narrow, truncate tip, bordered by 1–3 rows of linear cells (or very rarely with some degree of marginal resorption); hyaline cells strongly convex on the outer surface, somewhat convex on the inner, on the outer surface with ringed, elliptic (or rarely round) pores at corners and along the commissures, on the inner surface with more rounded, thin-walled pores; green cells triangular to trapezoidal with exclusive or broader exposure on the inner surface.

The *Acutifolia* have branch leaves with green cells exposed exclusively or more broadly on the inner surface and hyaline cells bulging on the outer. The hyaline cells of branch leaves generally have ringed, elliptic pores along the commissures. The hyaline cells of stem leaves are largely resorbed on the inner surface. The border at the margins of stem leaves is commonly abruptly expanded at base. A tendency toward isophylly is especially marked in this group, and the species are not always as distinct as one might wish. In general, however, the shape and structure of the stem leaves provide reliable diagnostic characters.

A number of the species develop a red color when exposed to the sun. Shade forms of the red species show some tinges of red in the stem, wood cylinder, stem leaves, or antheridial branches.

- 1. Plants not reddish; terminal bud large; stem leaves distinctly fringed, with a conspicuous triangular sieve-like area of resorption at the middle of the base.
- 2. Stem leaves fan-shaped, lacerate-fringed nearly all around. . . . . 29. *S. fimbriatum*
- 2. Stem leaves not fan-shaped, erose-fringed only across the broad apex. . . . . 28. *S. girgensohnii*
- 1. Plants mostly reddish; terminal bud not or somewhat enlarged; stem leaves not fringed but sometimes ±toothed or slightly erose at the middle of the apex, without a conspicuous mid-basal area of resorption.

- 3. Stem leaves  $\pm$ flat, oblong-lingulate, broadly rounded at the apex, broadly bordered at the base.
  - 4. Hyaline cells in the upper part of the branch leaves with minute, round or rounded-elliptic, strongly ringed pores (often contiguous with the commissures)..... 24. *S. warnstorffii*
  - 4. Hyaline cells with large, elliptic, moderately ringed pores along the commissures.
    - 5. Cells of the stem cortex commonly porose; stem leaves  $\pm$ erose at the middle of the apex; hyaline cells near the apex of stem leaves short,  $\pm$ rhombic, undivided..... 27. *S. russowii*
    - 5. Cells of the stem cortex not or rarely porose; stem leaves not erose at the apex; hyaline cells of stem leaves elongate, rhomboidal, commonly divided at the leaf apex and elsewhere.
      - 6. Plants brown; branches of the capitulum straight, with leaves crowded, erect, strongly concave and thus appearing narrow; stem leaves oblong-lingulate, longer than broad..... 25. *S. fuscum*
      - 6. Plants reddish; branches of the capitulum typically upcurved, with leaves usually not particularly crowded, subsecund, broadly concave and thus appearing broad; stem leaves broadly lingulate, not much elongate..... 26. *S. capillifolium* var. *tenellum*
- 3. Stem leaves generally  $\pm$ concave, especially at the tips, oblong to oblong-triangular, broadly acute to concave-pointed in most cases not conspicuously broad-bordered at base.
  - 7. Plants reddish (or in shade green but with red tinges in the stem, wood cylinder, stem leaves, or antheridial catkins), not shiny; hyaline cells of stem leaves fibrillose, usually some few of them with membrane gaps of moderate size on the outer surface..... 26. *S. capillifolium* var. *capillifolium*
  - 7. Plants pale brown or yellow-brown and sometimes tinged with flecks of pink or purple-brown, shiny when dry; hyaline cells of stem leaves not or imperfectly fibrillose, without membrane gaps on the outer surface.
    - 8. Plants yellow-brown, tinged with pinkish- to purplish-brown; wood cylinder of stems red-brown; stem leaves 1.3–1.7 mm long, oblong-triangular, broadly acute and abruptly concave-apiculate, with the border only slightly broadened at base; branch leaves somewhat recurved when dry, lanceolate, with relatively long, narrow tips..... 23. *S. subnitens*
    - 8. Plants uniformly pale-brown; wood cylinder dark-brown; stem leaves 0.8–1.6 mm long, oblong-lingulate, rather broadly pointed, with the border moderately broadened at base; branch leaves appressed when dry, ovate-lanceolate, short-pointed..... 22. *S. subfulvum*

**22. *Sphagnum subfulvum* Sjörs**

Fig. 26. Map 22.

Sv. Bot. Tidskr. 38: 404. 1944.

Plants of medium size, soft, uniformly pale- or whitish-brown (or pale-green in the shade), never tinged with red, shiny when dry. Wood cylinder brownish; cortical cells without pores. Stem leaves about 1–1.5 mm long, oblong, broadly acute, relatively flat-tipped, the border only moderately broadened at the base; hyaline cells mostly 1–2-divided, without fibrils or occasionally fibrillose toward the leaf tip or with vestiges of fibrils here and there, often with membrane pleats on the outer surface. Branches in fascicles of 3, with 2 spreading. Branch leaves loosely imbricate and not seriate when moist, ca. 1.2–1.7 mm long, ovate, rather broad and short-pointed; hyaline cells with numerous large, elliptic commissural pores on the outer surface. Monoicous.

Spores 23–31  $\mu$ m.

In moderately wet depressions in minerotrophic rich fen habitats, in open flat bogs and especially in sedge mats; scattered and uncommon.

Northern Michigan, New York, Maine, Ontario, northern Quebec, and Newfoundland; in Greenland north to app. 78°, Baker Lake and the Keewatin District of the Northwest Terri-



Map 22. *Sphagnum subfulvum*.

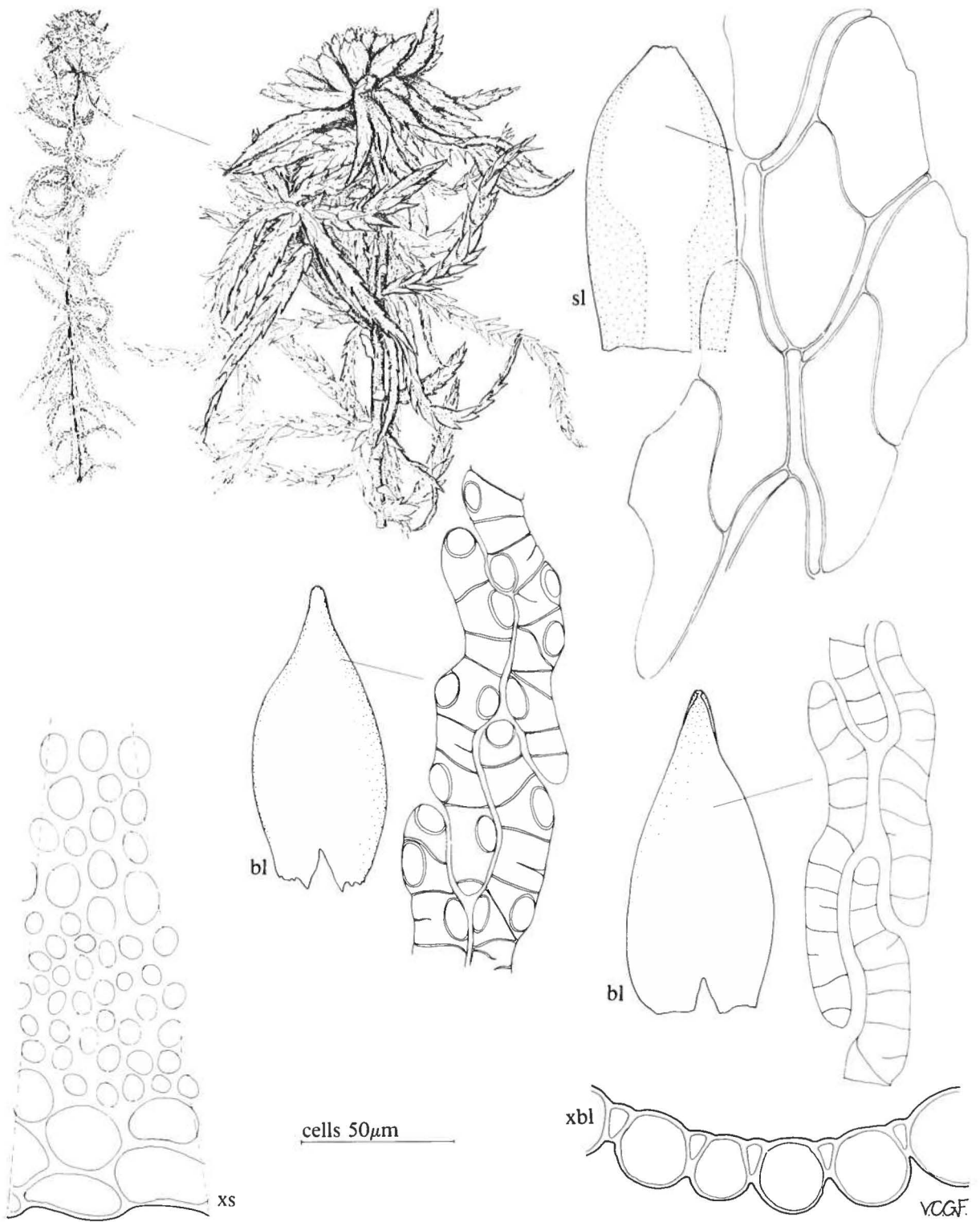


Fig. 26. *Sphagnum subfulvum*, Pákitsoq, Berggren Havn, W Greenland; leg. 1971 Holmen and Mogensen 71-2051. (C).

ories, and arctic and southern Alaska; reported from the Yukon and Baffin Island; northern Europe (and reported from Switzerland and Wales).

Selected specimens seen:

Canada. Northwest Territories, Baker Lake, 64°N, 95°W; 1936 Dutilly 478. – Quebec, south shore of Hudson Strait, Wakeham (Stupart's) Bay, 61°37'N, 72°00'W; 1936 Polunin 1476a-7.

Alaska. Colville River, Umiat, 69°22'N, 152°08'W; 1960 Steere, Holmen and Mårtensson (Bryoph. Arc. Exs. 30). – Alaska Penins., Naknek, 58°44'N, 157°01'W; 1948 Lepage 22663.

*Sphagnum subfulvum* is a soft, light-brown moss, shiny when dry. Its stem leaves are broadly oblong and narrowed toward the tip to a relatively flat, right-angled apex. The border is moderately broadened at the base, and the hyaline cells, normally with no indication of fibrils, are mostly 1–2-divided. In contrast with *S. subnitens*, *S. subfulvum* has no tinges of red; shorter, broader branch leaves; and stem leaves broadly pointed and not abruptly concave-apiculate.

### 23. *Sphagnum subnitens* Russ. & Warnst. ex Warnst.

Fig. 23. Map 23.

Vehr. Bot. Ver. Prov. Brandenb. 30: 115. 1888.

*S. plumulosum* Röhl, Flora 69: 89. 1886, *nom. inval.*

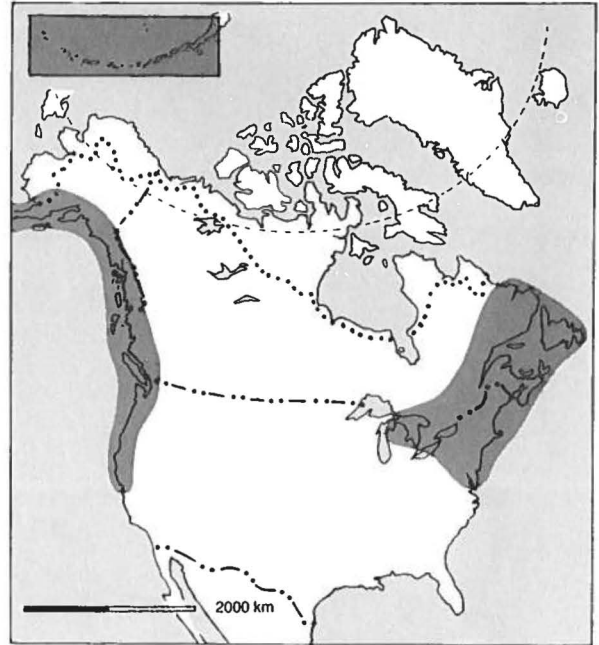
Plants of medium size, soft, pale, whitish- to yellow-green or yellow-brown, variegated with tinges of bluish-, pinkish-, or purplish-brown, shiny when dry. Wood cylinder of stems greenish, brown, or red-brown; cortical cells without pores. Stem leaves up to about 1.6 mm long, oblong to oblong-triangular, broadly acute and abruptly narrowed to a short, concave-apiculate point (or rarely merely pinched at the apex), the border not much broadened at base; hyaline cells mostly 1–2-divided (or sometimes more), with fibrils none or rarely with traces of fibrils here and there, often with membrane pleats on the outer surface. Branches in fascicles of 3–4, with 2 spreading. Branch leaves erect when moist, ± recurved at the tips when dry, about 1.5–2 mm long, lanceolate, long involute-pointed; hyaline cells with 2–5 large, elliptic, ringed commissural pores on the outer surface. Monoicous.

Spores 22–30 µm.

In oceanic areas in depressions of ombrotrophic bogs, rare and scattered inland in moderately minerotrophic habitats.

Reported from Greenland; Newfoundland and Labrador; Maine, New York, New Jersey, northern Michigan; reported from Wisconsin; Aleutian Islands and British Columbia to California. Records from arctic, central, and southern Alaska, the Azores, Siberia, Japan, New Zealand, and South America need verification.

The plants are soft and yellowish to brownish, with pink or bluish-red variegation, and have a blue-gray sheen when dry. The differences between *S. subnitens* and *S. subfulvum* are troublesome, but the blue-red tinges, narrower branch leaves, and pinched-apiculate stem leaves of *S. subnitens* have diagnostic significance. Both



Map 23. *Sphagnum subnitens*.

species are shiny when dry and have hyaline cells of stem leaves generally divided once, twice, or more.

*Sphagnum subnitens* and *S. subfulvum* are, at best, difficult to define and justify. A final evaluation should include the variability of *S. flavicomans* (Card.) Warnst. and *S. angermanicum* Melin as well as some information on range and habitat not yet available. I have been reasonably satisfied in sorting out the species on the basis of a complex of variables, giving emphasis to color, sheen, and size and shape of leaves (and especially the stem leaf apex). I have not taken into account any difference in pores of branch leaves. Flatberg (Lindbergia 11(1): 41, 1985), on the other hand, has defined *S. subnitens* as having small, short, distinctly margined pores on the outer surface of branch leaves in contrast to the larger, elliptic, indistinctly margined ones of *S. subfulvum*. By choosing that character as diagnostic, he demonstrated an even greater variability and lesser importance of all other characters of customary use. Especially because of finding color variants in some few mixed collections, he recognized two new subspecies as genetically significant entities. One of these (with small pores but violet-pink variegation) Flatberg referred to *S. subnitens*, and the other (with large pores but violet-pink variegation), he referred to *S. subfulvum*. I am not prepared to do so, but one could use his careful and detailed analyses as evidence that neither of the species or their subspecies are very distinct or meaningful. I do not know how much the pore character should be weighted, but I do feel reluctant to define the species in terms of a single character and, for the sake of argument at least, in terms of that particular character.



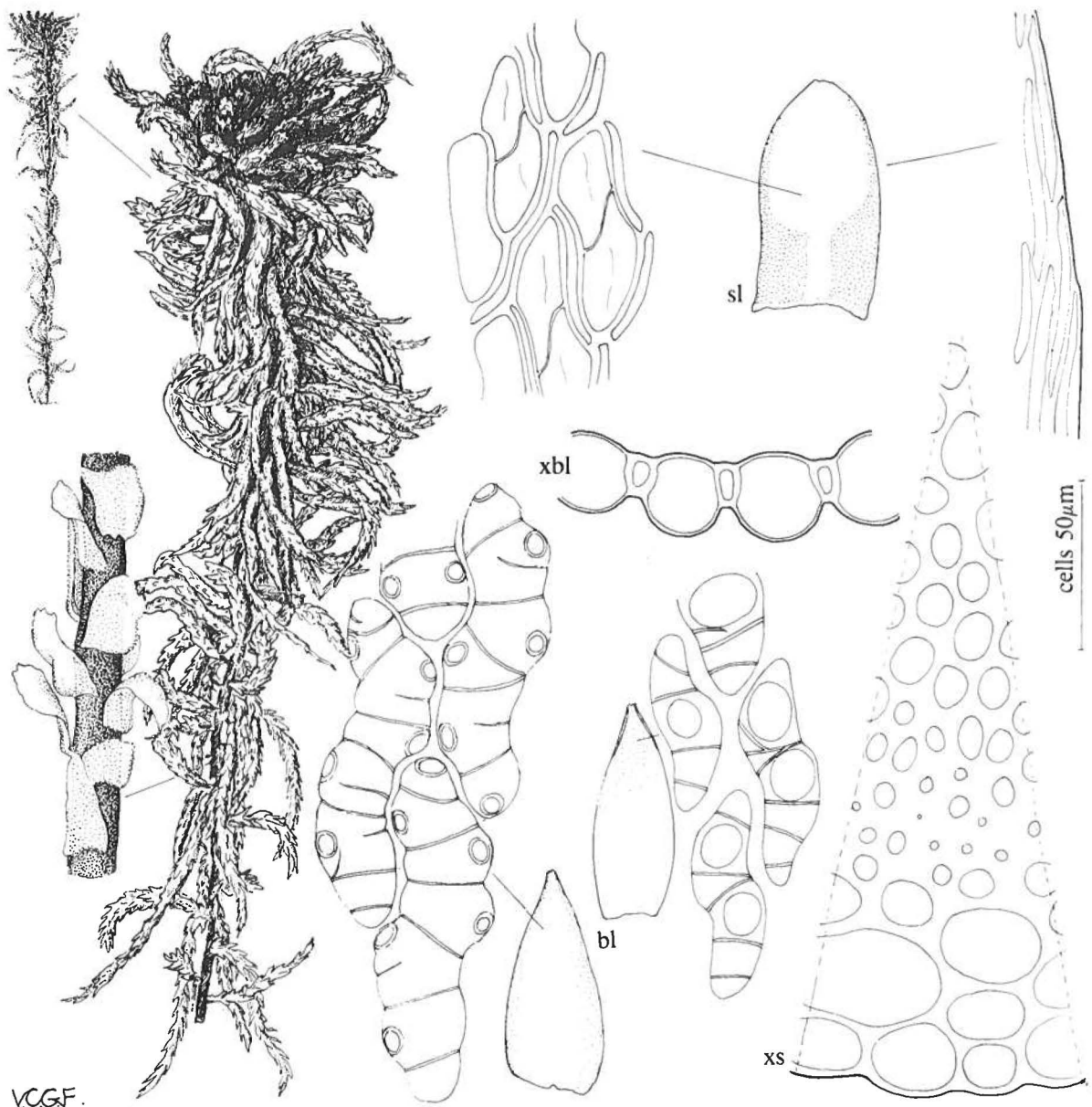


Fig. 27. *Sphagnum warnstorffii*, Nordre Laksebugt, Disko, W Greenland; leg. 1971 Mogensen 71-2364, (C).

The point may be illustrated outside the relationship under consideration in *S. warnstorffii*, for example. No one would question its worth as a species, ecologically and morphologically. Its very small, heavily ringed, rounded pores are most characteristic, yet they are sometimes difficult to demonstrate. They show some variation in size, shape, and ringing in different populations or on branches of different age and in portions of the same leaf. The pores are indeed important in defining *S. warnstorffii*, but I would not wish to depend solely on them.

If one uses pores to define *S. subnitens*, its other characters become less usable. If one uses instead color, sheen, and leaf shapes and sizes, the pores become variable. How does one decide which character is *the* character?

The specimens on which I have based my opinions are not now available for re-examination. For a similar reason, I am unable to comment on another species of some superficial similarity to *S. subfulvum*, namely *S. arcticum* Flatb. & Frisv. (Bryologist 87: 143-148, 1984). It seems close to *S. russowii* Warnst. in many ways. In



the Arctic, *S. fimbriatum* Wils. and *S. girgensohnii* Russ. take on a strangely stunted appearance and a brownish color. Is it possible that the related *S. russowii* might also exist in some brownish form owing to the peculiarities of habitat?

#### 24. *Sphagnum warnstorffii* Russ.

Fig. 27. Map 24.

Sitz.-ber. Naturw.-Ges. Dorpat 8: 315. 1888, *non* Röhl 1886, *nom. inval.*

*S. warnstorffianum* Du Rietz in Sjörs, Sv. Bot. Tidskr. 38: 405. 1944, *nom. superfl.*

Plants slender, in loose carpets or low tufts, dark-green in the shade, reddish to dark-purple in the sun. Wood cylinder of stems reddish; cortical cells without pores. Stem leaves somewhat concave, broadly oblong-lingulate, obtuse or broadly acute, the border moderately to considerably broadened at base; hyaline cells mostly 1(2)-divided, with fibrils usually none but sometimes few to numerous cells having vestiges of fibrils, on the outer surface with membrane pleats. Branches in fascicles of 3–4, with 2 spreading. Branch leaves 5-ranked and recurved at the tips when dry, lanceolate, narrowly pointed; hyaline cells on the outer surface in the upper half or less with 3–7 minute, round or shortly elliptic, strongly ringed pores close to or contiguous with the commissures, those below larger, more elliptic, and less strongly ringed. Dioicous.

Spores 17–22  $\mu$ m.

A pronounced calciphile of rich fens and *Thuja* swamps in the Great Lakes–St. Lawrence area, also in rich fens and wet tundra northward.

In Greenland north to app. 78°, to Alaska, south to New York, Ohio, Michigan, Iowa, Colorado, Utah, and Washington; northern and central Europe; Japan; reported from the Caucasus and Siberia.

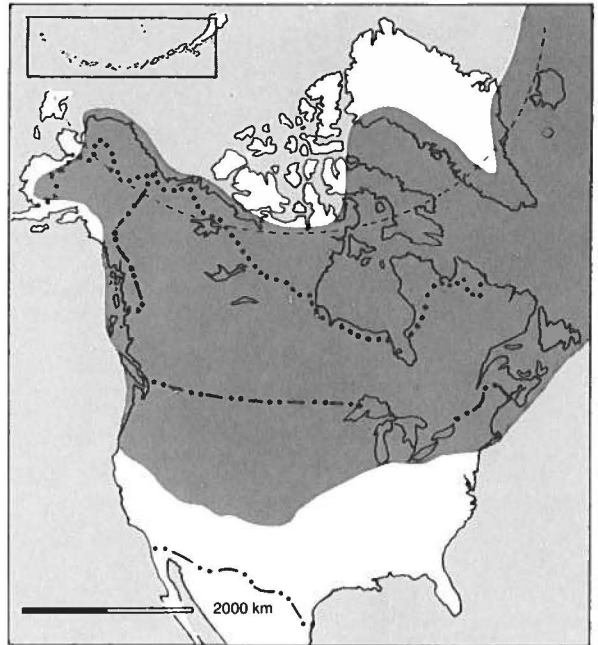
Selected specimens seen (MICH):

Greenland. W 5: Godhavn, 69°15'N, 53°33'W; 1928 Erlanson 3099. – E 2: Dronning Marie Dal, 63°28'N, 41°55'W; 1970 Lewinsky 70-254. – E 5: Gurreholm, 71°14'N, 24°30'W, 1958 Holmen (Bryoph. Arc. Exs. 74).

Canada. Manitoba, Fort Churchill, 58°46'N, 94°10'W; 1956 Crum & Schofield 6772. – Quebec, Fort Chimo Area, 58°07'N, 68°23'W; 1948 Senn 3457.

Alaska. Franklin Bluffs on the Sagavanirktok River, 69°50'N, 148°40'W; 1958 Shushan sb-175. – Colville River, Umiat, 69°22'N, 152°08'W; 1928 Lepage 22545. – Circle Quad., vicinity of Egel Summit, 65°29'N, 145°25'W, 1972 Steere 72-831.

The plants are made somewhat recognizable in the field by a highly minerotrophic habitat coupled with slender stature and loose tufting. They are green if growing in shade but deep red, dark bluish-pink, or purple in the sun. When dry, the branch leaves are 5-ranked with out-turned tips. The minute, strongly ringed, and generally round pores on the outer surface of the upper hyaline cells of branch leaves are unique. Visible only as mere



Map 24. *Sphagnum warnstorffii*.

dots under low power of the microscope, the pores are arranged very close to or contiguous with the commissures. The hyaline cells of the stem leaves are nearly all divided into two, three, or four compartments, and fibrils are essentially lacking.

#### 25. *Sphagnum fuscum* (Schimp.) Klinggr.

Fig. 28. Map 25.

Schr. Phys.-ök. Ges. Königsb. 13: 4. 1872.

*S. acutifolium* var. *e. fuscum* Schimp., Mém. Hist. Nat. Sphaignes 64. 1857.

Plants slender, in compact, brown or brownish-green tufts, generally at the top of hummocks. Wood cylinder of stems brown; cortical cells without pores. Stem leaves only slightly concave, longer than broad, lingulate, broadly rounded at the apex, the border much broadened at base; hyaline cells mostly 1(2)-divided, usually without fibrils, with membrane pleats on the outer surface. Branches in fascicles of 3–4, with 2 spreading. Branch leaves imbricate or somewhat spreading, lanceolate, involute-pointed; hyaline cells on the outer surface with 3–8 good-sized, elliptic,  $\pm$  ringed pores near the commissures. Dioicous.

Spores 20–24  $\mu$ m.

In compact hummocks, usually topping old, dry hummocks in open bogs or black spruce muskegs, in the southern part of the range also in hollows of mineral-rich fens.

In Greenland north to app. 71°, to Alaska and southward to West Virginia, Ohio, Michigan, Wisconsin, Colorado, and California; northern and central Europe; apparently also across northern Asia.

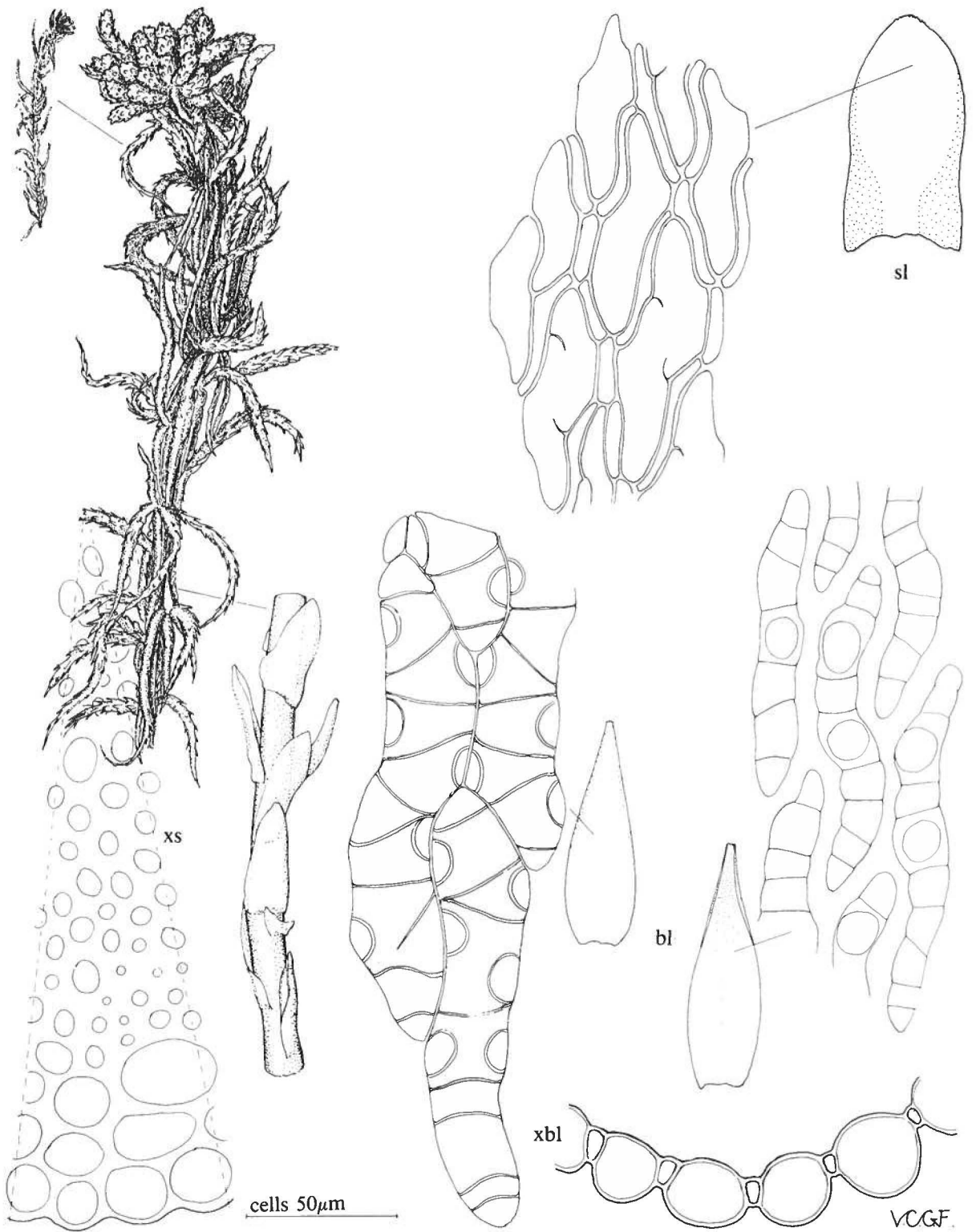
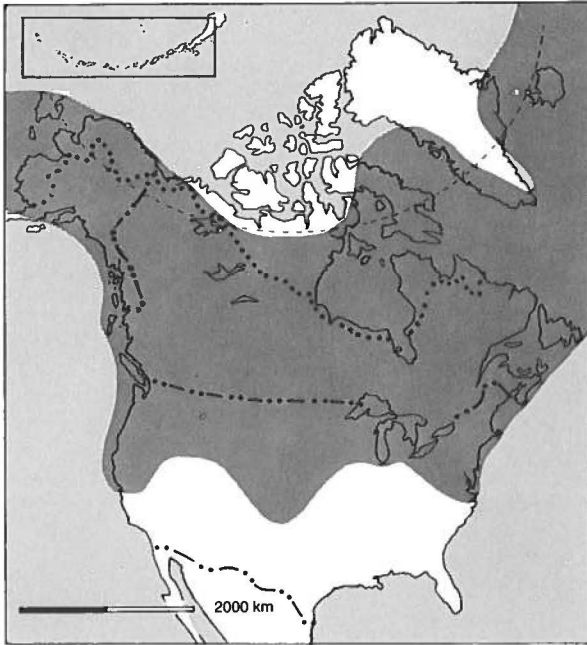
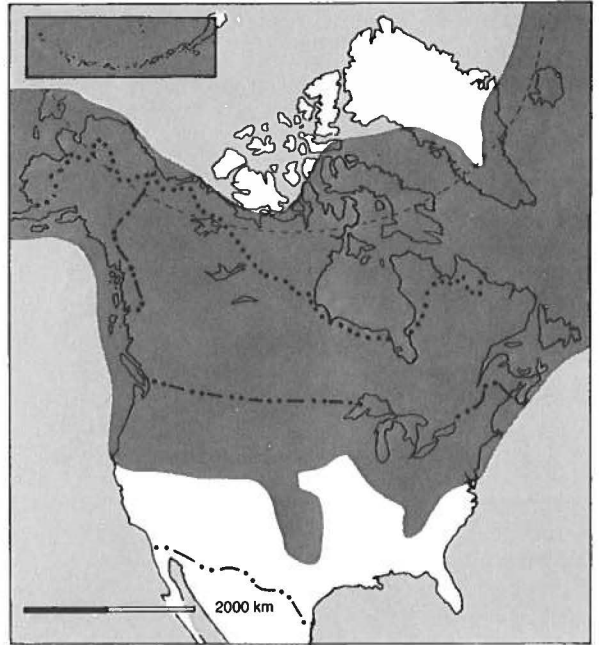


Fig. 28. *Sphagnum fuscum*, Qingua, Tunugdliarfik, S Greenland; leg. 1974 Holmen 74-860, (C).



Map 25. *Sphagnum fuscum*.



Map 26. *Sphagnum capillifolium*.

Selected specimens seen (MICH):

Canada. Manitoba, Elma, 49°53'N, 95°57'W; 1969 Reader Aug. 5th. – Northwest Territories, District of Keewatin, Chesterfield Inlet, Igluliguar I.; 1937 Dutilly 4216. – Quebec, Ungava, east of George River 56°50'–52'N, 64°55'–57'W; 1975 Weber 1217.

Alaska. Livengood Quad, Washington Creek Fire Ecology Research Area, 65°10'N, 147°52'W; 1975 Viereck 10146. – Nome, Beltz study plot, 64°35'N, 165°26'W; 1970 Pegau M-13-70.

Easily recognized in the field by a brown color and compact growth and also by a characteristic occurrence at the top of old, dry hummocks. The slender spreading branches interwoven inside the hummocky growth impart a distinctive thready look, but the chief characters are provided by the pigmentation and the nearly flat, lingulate stem leaves, rounded at the apex, with the border strongly differentiated at base and the hyaline cells eifibrillose and 1–2 septate.

## 26. *Sphagnum capillifolium* (Ehrh.) Hedw.

Map 26.

Fund. Hist. Nat. Musc. Frond. 2: 86. 1782. – *S. palustre capillifolium* Ehrh., Hannover Mag. 15. 235. 1780. – (*S. palustre* ... *capillaceis* Dill., Hist. Musc. 243. 1741.) – *S. palustre* β. Linn., Sp. Plant. 1106. 1753.

*S. palustre capillaceum* Weiss, Plant. Crypt. Gött. 265. 1770. – *S. capillaceum* (Weiss) Schrank, Baier. Fl. 2: 435. 1789.

*S. acutifolium* Ehrh. ex Schrad., Spic. Fl. Germ. 38. 1794. ?*S. nemoreum* Scop., Fl. Carn. (ed.2). 305. 1772.

var. **capillifolium**

Fig. 29.

Plants slender and compact, often with rounded, convex capitula, green and ± red-tinged to pinkish or distinctly red. Wood cylinder of stems reddish; cortical cells without pores. Stem leaves oblong–ovate, ± concave-pointed, the border moderately differentiated at base; hyaline cells fibrillose above or throughout, mostly 1(2)-divided (especially below the leaf middle), generally some cells on the outer surface with 1–2, rarely 3 irregularly rounded or oblong membrane gaps, sometimes with membrane pleats. Branches in fascicles of 3–4, with 2 spreading. Branch leaves imbricate or slightly spreading, not ranked, lanceolate, involute-pointed; hyaline cells on the outer surface with 5–12 large, ringed, elliptic commissural pores. Dioicous or monoicous.

Spores 22–29 μm.

Very common, growing in compact cushions, most characteristically on tops or sides of hummocks in open bogs but also initiating hummocks in younger, more minerotrophic portions of bog mats, common also in more shaded boggy situations, in black spruce muskeg, for example, also in the mountains on or among wet rocks.

In Greenland north to app. 71°; from Newfoundland to Alaska, south to California, Utah, Kansas, Arkansas, and Georgia; reported from Colorado; northern and central Europe; Japan; reported from Korea and the Soviet Far East. South American records can be referred, at least in part, to *S. sparsum* Hampe.

Selected specimens studied (MICH):

Greenland. W 2: Ivigtut, 61°12'N, 48°14'W; 1941 Dutilly 974. –



Fig. 29. *Sphagnum capillifolium* var. *capillifolium*. Nūa, Törnárssuk, S Greenland; leg. 1967 Hansen, Kliim-Nielsen and Øllgaard 67-125. (C).

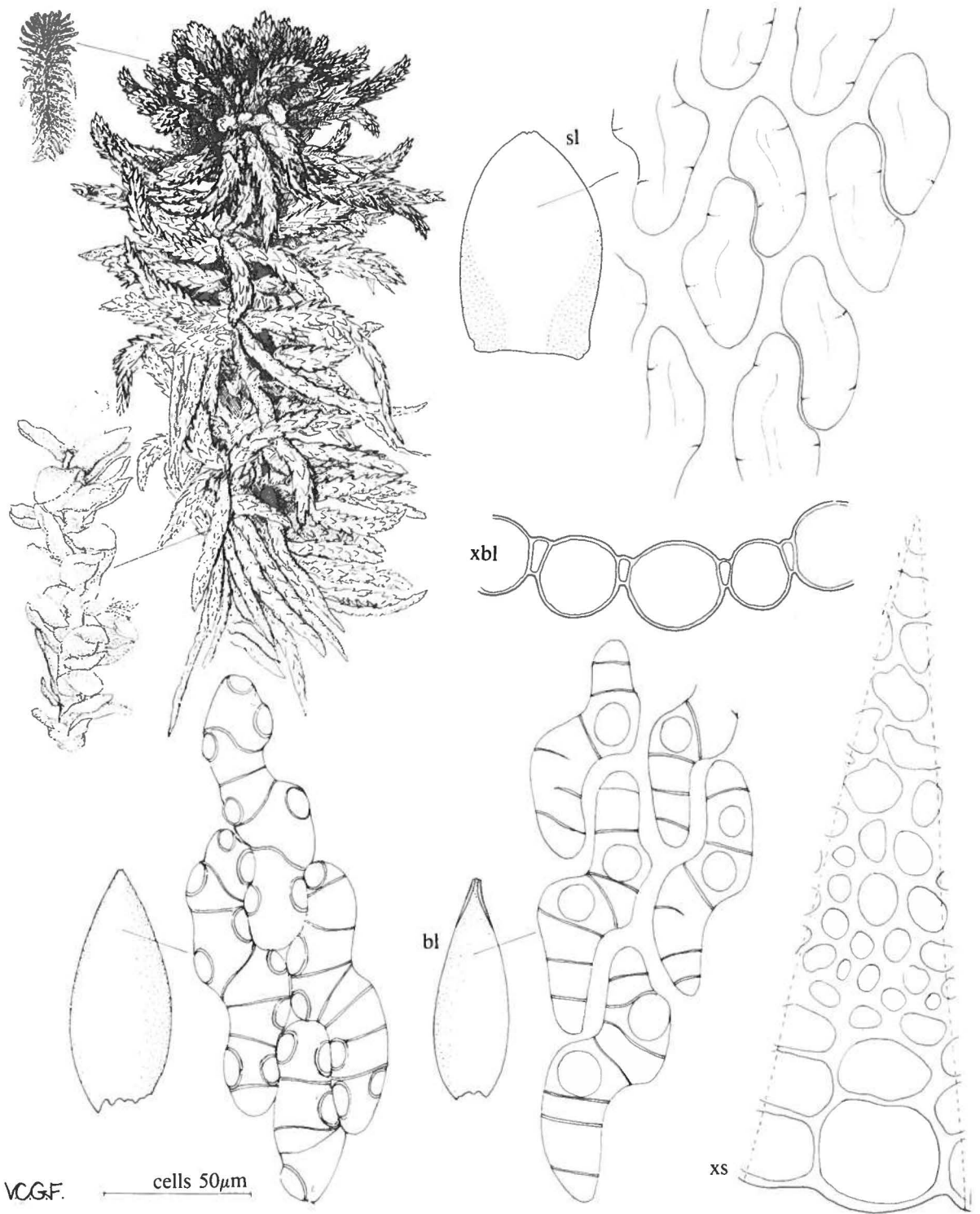


Fig. 30. *Sphagnum capillifolium* var. *tenellum*, Torssukátak, S Greenland; leg. 1962 Milan Petersen 202, (C).



W 5: Godhavn, 69°15'N, 53°33'W; 1928 Erlandson 2849. – W 7: Upernavik, 72°47'N, 56°09'W; 1976 Sünksen 8. Canada. Northwest Territories, SW Keewatin, extremity of Nueltin Lake, mouth of Windy River, 60°20'N, 99°30'W; 1947 Harper 2513. – Quebec, Scoter Lake, 58°30'N, 76°44'W; 1944 Taylor 98. – W.-side of Mollie T. Lake, 55°02'N, 67°09'W; 1953 Harper 3844. Alaska. Northeast of Barometer Mountain, near Red Devil Mine, on the middle Kuskokwim River, 61°46'N, 157°19'W; 1958 Shacklette 5232. – Livengood Quad., Wickersham Dome Fire Research Area, 65°10'N, 147°53'W; 1971 Vier-eck 9610. – Point Barrow and vicinity, 71°20'N, 156°39'W; 1951 Steere 15305.

The capitula are characteristically crowded, rounded, and convex. (The var. *tenellum* has a different aspect owing especially to its flat-topped capitula with curved and upturned branches). The oblong–triangular, concave-pointed leaves are only moderately bordered at base; the hyaline cells are fibrillose, and normally some of them have on the outer surface irregularly rounded or oblong gaps of moderate size.

var. **tenellum** (Schimp.) Crum Fig. 30.

Contr. Univ. Mich. Herb. 11(2): 90. 1975. – *S. acutifolium* var. *tenellum* Schimp., Mém. Hist. Nat. Sphaignes 63. 1857. – *S. tenellum* (Schimp.) Klinggr., Schrift. Phys. Oek. Ges. Königsb. 13: 4. 1872, non Ehrh. ex Hoffm. 1796, nec Pers. ex Nees, Hornsch. & Sturm 1823. – *S. capillaceum* var. *tenellum* (Schimp.) Andr., No. Amer. Fl. 15(1): 28. 1913. *S. rubellum* Wils., Bryol. Brit. 19. 1855.

Capitula commonly flat, with young branches somewhat upcurved. Stem leaves ± flat, broadly oblong or oblong–lingulate (the sides parallel), broadly rounded at the apex, the border abruptly and conspicuously broadened at base; hyaline cells mostly 1–2(3)-divided, without fibrils or sometimes with fibrils ± developed, with membrane pleats on the outer surface. Branches in fascicles of 3–5, with 2 spreading. Branch leaves spreading and often subsecund, usually broadly concave and thus appearing to be broad and broadly pointed. Dioicous or monoicous. Spores 23–30 µm.

On hummocks, often at or near the top, particularly characteristic of ombrotrophic bogs in oceanic regions but also scattered widely inland in more minerotrophic peatlands.

Baffin Island, Labrador, and Newfoundland to arctic Alaska and south to Idaho, Colorado, the Great Lakes region, and the mountains of the Southeast; northern and central Europe; Siberia; reported from Japan. Records from Greenland and Washington were not confirmed.

Selected specimens seen (MICH):  
 Greenland. S 1: Tigssaluk, 60°42'N, 45°38'W; 1940 Porsild 8118.  
 Canada. Northwest Territories, Baffin I., Perry Bay, 61°58'N, 66°30'W; 1975 Fife 1162. – South shore of Hudson Strait, Wakeham Bay, 61°37'N, 72°00'W; 1936 Polunin 1476a-10. – Quebec, Sugluk Bay, 62°15'N, 75°28'W; 1938 Dutilly 6983.  
 Alaska. Meade River Post Office, 70°28'N, 157°25'W; 1973 Steere, Inoue, and Iwatsuki 73-370. – Circle Quad., White Mts, 65°29'N, 145°25'W; 1971 Gravesen PG A1 24. – Colville River, Umiat, 69°22'N, 152°08'W; 1946 Jachowski 7.

In its best expression the variety is made distinctive by a flat-topped capitulum with curved “bull’s horn” branches and broadly pointed branch leaves that are not much crowded, usually spreading, and often subsecund. The diagnostic features are otherwise found in the stem leaves: flat, broadly oblong–lingulate with a broadly rounded apex and a border conspicuously broadened at base; the hyaline cells are mostly divided and commonly lack fibrils.

**27. Sphagnum russowii** Warnst. Fig. 31. Map 27.

Hedwigia 25: 225. 1886.  
*S. acutifolium* α. *robustum* Russ., Beitr. Torfm. 39. 1865, non Bland. ex Nees, Hornsch. & Sturm 1823. – *S. acutiforme* var. *robustum* Warnst., Flora 67: 501. 1884. – *S. robustum* (Warnst.) Röhl, Flora 69: 109. 1886, nom. inval.

Plants of medium size, green but usually tinged with red and often speckled with red because of conspicuously colored antheridial catkins. Terminal bud somewhat enlarged; branches of capitulum relatively coarse and somewhat clavate. Wood cylinder of the stems green or red-tinged; cortical cells, at least in part, with a single, large, round pore at the upper end. Stem leaves relatively flat, generally reddish, broadly oblong–lingulate, with a broadly pointed to rounded–obtuse apex which is ± erose at the middle, the border usually conspicuously broadened at base, the cells at mid-base somewhat enlarged but not forming a conspicuous meshwork; hyaline cells short and generally undivided toward the leaf apex, sometimes 1(2)-divided in the lower two-thirds,



Map 27. *Sphagnum russowii*.



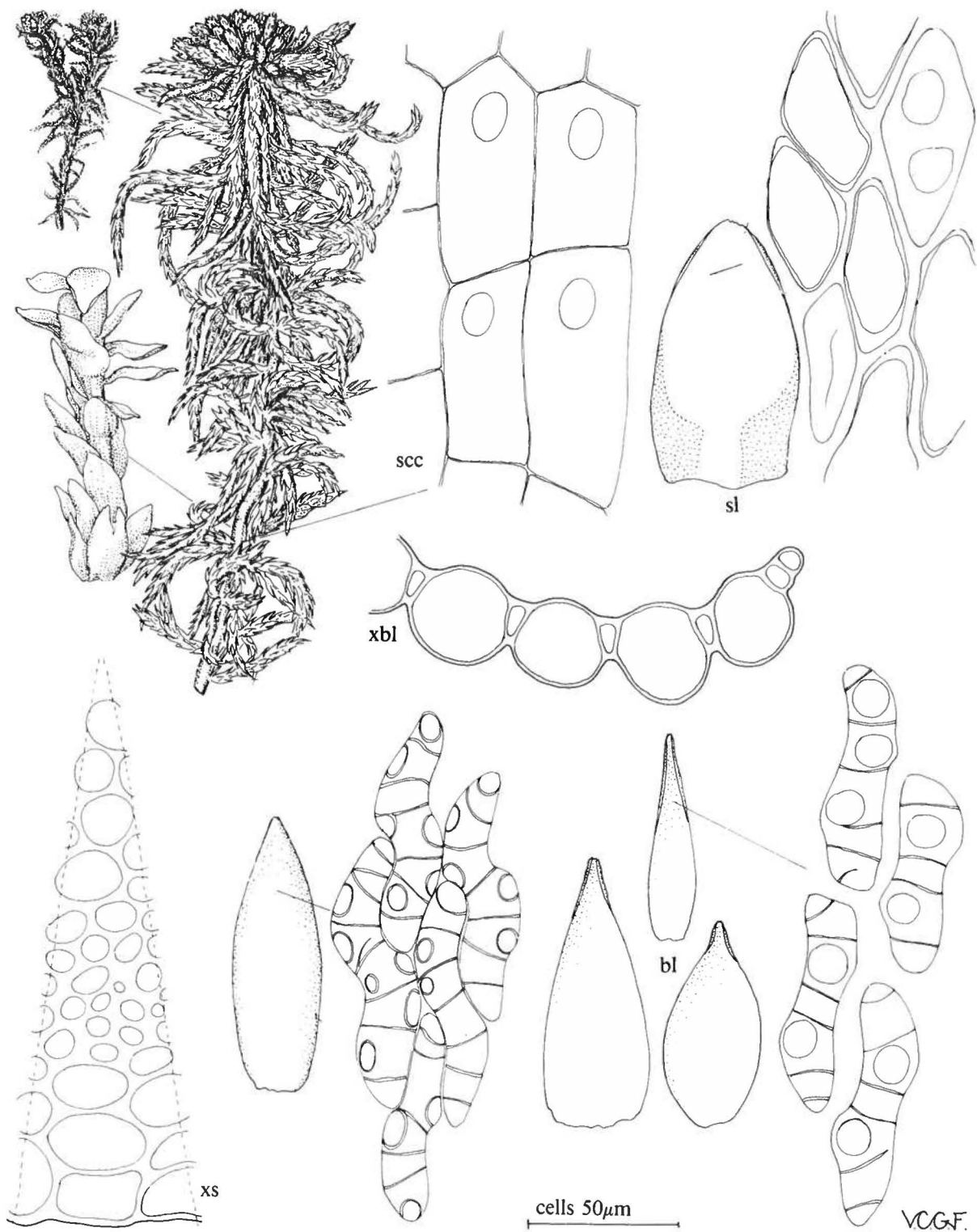


Fig. 31. *Sphagnum russowii*, Qeqertarsuaq (Godhavn), Disko, W Greenland; leg. 1981 Mogensen 81-636, (C).

with fibrils none, vestigial, or sometimes rather well developed, on the outer surface with membrane pleats. Branches in fascicles of 3–4, with 2 spreading. Branch leaves imbricate, lanceolate, involute-acuminate; hyaline cells on the outer surface with numerous large, elliptic, ringed commissural pores. Dioicous or monoicous.

Spores 18–26  $\mu$ .

In dense cushions, often on top of hummocks in older portions of bog mats or in black spruce muskeg, also in seepage on rock or moist soil slopes in montane habitats.

Greenland north to app. 71°; Newfoundland to central and southern central Alaska, south to Washington, Colorado, and Iowa eastward to New York; northern and central Europe; reported from the Soviet Far East, Korea, and Japan.

Selected specimens seen (MICH):

Greenland. W 3: Sukkertoppen, 65°22'N, 52°50'W; 1956 Holmen 17082. – W 7: Upernavik, 72°47'N, 56°09'W; 1976 Sünksen 62. – E 3: Angmagssalik, 65°45'N, 37°13'W; 1970 Lewinsky 70-1127.

Canada. Yukon Territory, First River Basin, 68°40'N, 141°W; 1958 Shanks 1 Aug. – Quebec, Ungava, 56°31-32'N, 64°40-45'W; 1975 Weber 1242. – Manitoba, Fort Churchill, 57°45'N, 94°05'W; 1948 Gillett 2199.

Alaska. Livengood Quad., Wickersham Fire Research Area, 65°10'N, 147°53'W; 1976 Vierek 10182. – McGrath and vicinity, Kuskokwim River, 62°57'N, 155°35'W; 1949 Steere 14616.

The plants are not easily recognized in the field. The short, stout,  $\pm$  club-shaped young branches of the capitulum are rather coarse as compared with those of *S. capillifolium*. The capitulum is relatively flat, and the terminal bud is somewhat enlarged. The red antheridial catkins, if present, impart a mottled appearance. The porose stem cortex and the broad, strongly bordered stem leaves, somewhat erose at the middle of the broad apex, provide diagnostic features. The hyaline cells on the outer surface and toward the apex are short and normally undivided; they generally lack fibrils and have membrane pleats. (The lower cells are longer and sometimes divided.)

## 28. *Sphagnum girgensohnii* Russ.

Fig. 32. Map 28.

Beitr. Torfm. 46. 1865; also Arch. Naturk. Livl. Ehst. Kurl. 2, 7: 124. 1865.

Plants relatively robust, in loose green carpets or extensive mounds, in arctic habitats in low, compact, brownish cushions. Terminal bud moderately enlarged; branches of the capitulum (in well-developed material) in 5 distinctly radiating rows and the lower spreading branches long and decurved. Stems wiry; wood cylinder green or brown; cortical cells subquadrate to short-rectangular, with a single, large, round pore at the middle or above. Stem leaves broadly lingulate, shortly erose-fringed across a broadly truncate apex, strongly bordered at the sides, the border abruptly broadened at base and extending to a conspicuous triangular, mid-



Map 28. *Sphagnum girgensohnii*.

basal sieve-like area of resorption; hyaline cells greatly resorbed on both surfaces, not divided or few to numerous cells 1–2-divided. Branches in fascicles of 3–5, with 2–3 spreading. Branch leaves imbricate, narrowly ovate, involute-pointed; hyaline cells on the outer surface with 4–12 large, elliptic, ringed commissural pores. Monoicous or sometimes dioicous.

Spores 18–22  $\mu$ .

In the Great Lakes–St. Lawrence River area typically in depressions in *Thuja* swamps (which are mineral-rich and periodically wet), in montane regions in more acid situations, on rocks in seepage and on humic soil of slopes, more or less restricted to coniferous forest zones but in arctic and alpine areas in open tundra.

In Greenland north to app. 77; Newfoundland to arctic Alaska and south to Washington, Idaho, Iowa, the Great Lakes region, and the mountains of the Southeast; Iceland, widespread in Europe; across northern and central Asia; Japan.

Selected specimens seen (MICH):

Greenland. E 2: Dronning Marie Dal, 63°28'N, 41°55'W; 1970 Lewinsky 70-59. – E 3: Angmagssalik, 65°57'N, 36°40'W; 1971 Lewinsky 71-935. – E 6: Röhss Fjord, 72°45'N, 27°05'W; 1932 Sørensen 007.

Canada. Labrador, Ungava, head of Kangalaksiorvik Fiord, 69°21-23'N, 64°00-05'W; 1975 Weber 1572. – Northwest Territories, 68°155'N, 135°54'W, 1966 Krajina 6508091. – Quebec, Lac Payne, 59°17'N, 73°25'W; 1965 Legault, Brissen 8173.

Alaska. Bering Strait, Little Diomed I., 65°46'N, 168°55'W; 1926 A. E. & R. T. Porsild Aug. 14–20th. – Old Rampart, 67°15'N, 141°40'W; 1957 Buckley 157. – Livengood Quad., Wickersham Dome Fire Research, 65°10'N, 147°54'W; 1971 Vierek 9623.

In north-temperate woodlands the plants grow loosely in deep-green mounds or carpets. The capitula are flat

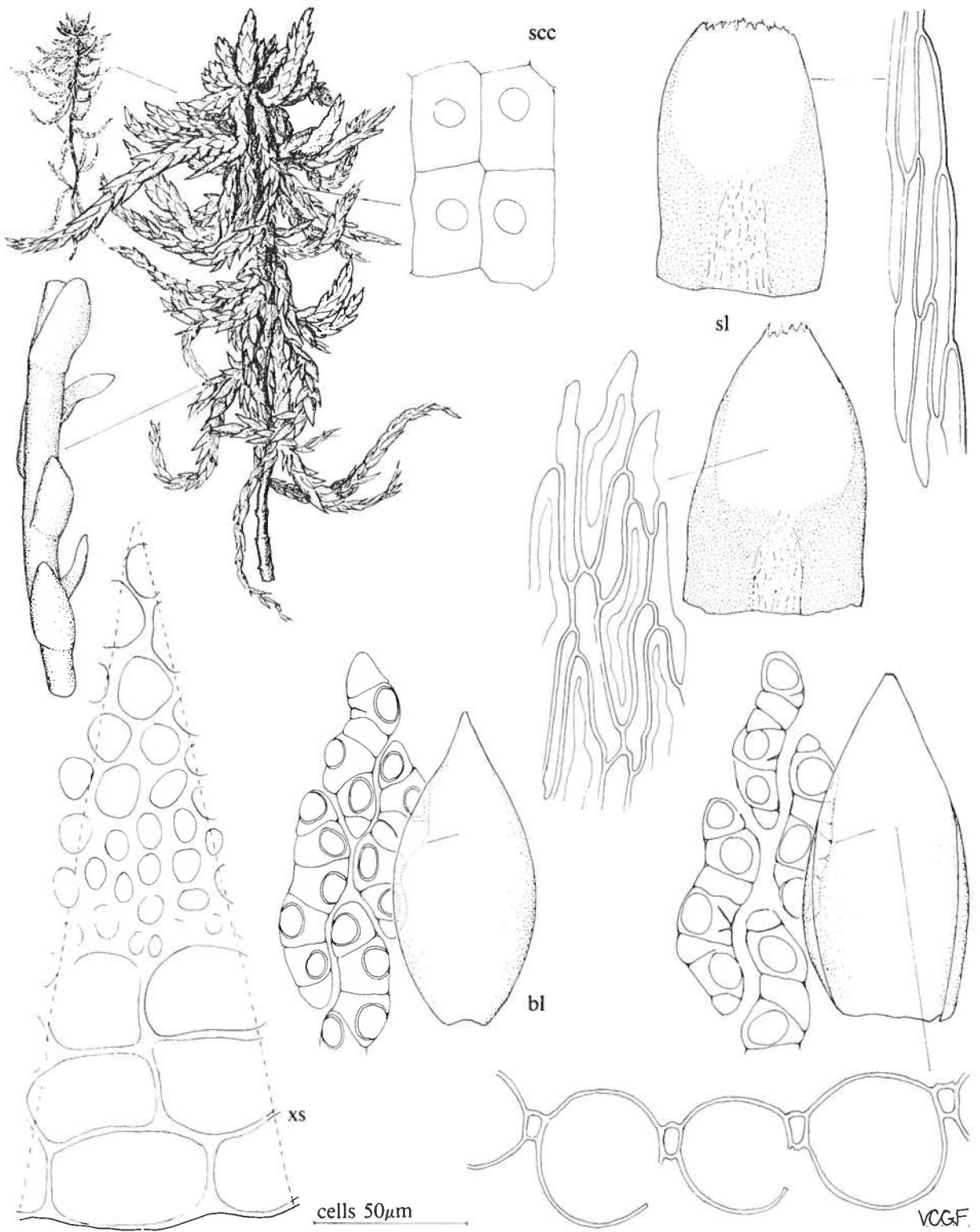
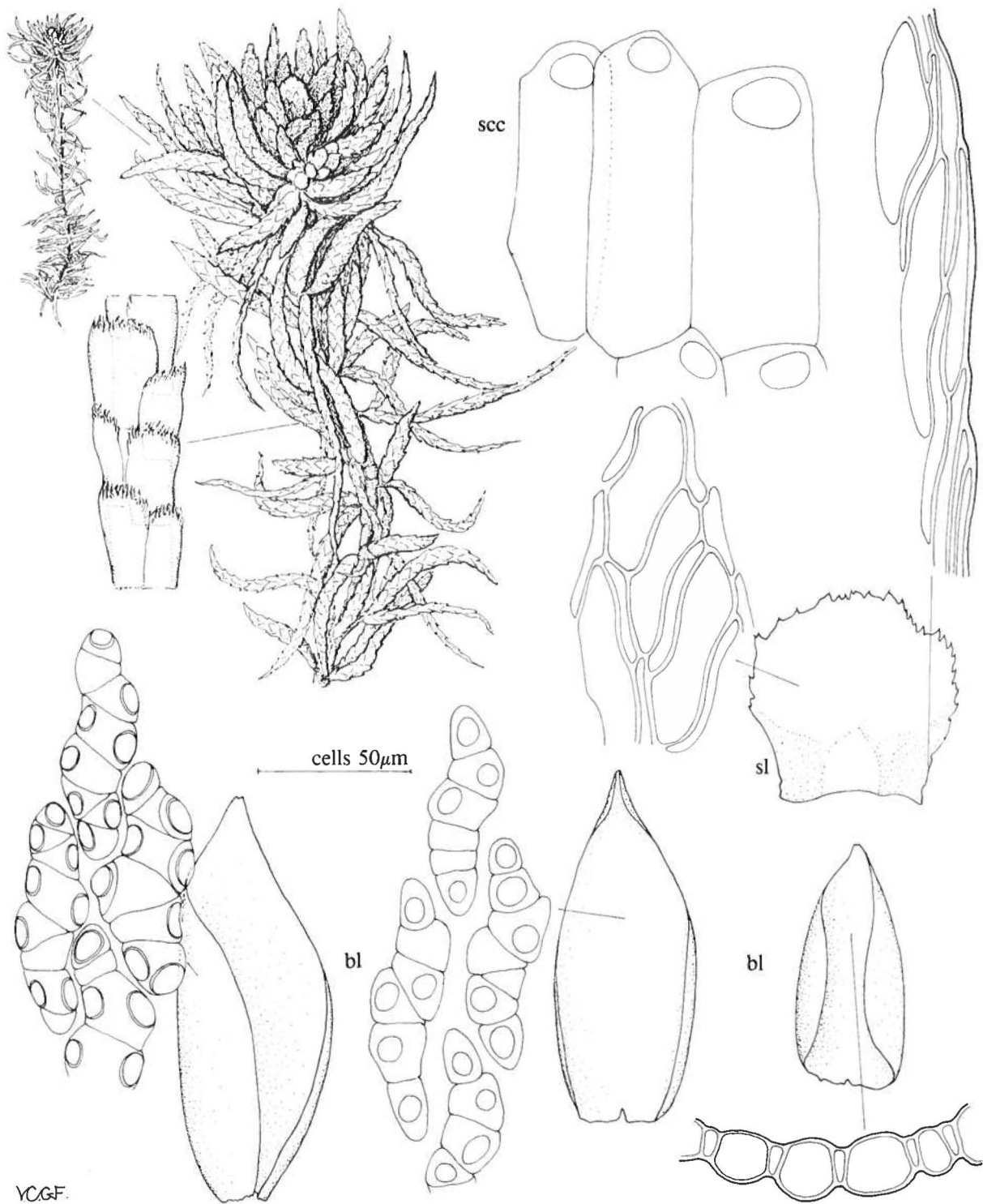


Fig. 32. *Sphagnum girgensohnii*, Ivnaq, Arveprinsen Ejland, W Greenland; leg. 1971 Holmen and Mogensen 71-1052, (C).



YCGF.

Fig. 33. *Sphagnum fimbriatum*, Kangilinâq between Nisat and Angissat, W Greenland; leg. 1974 Mogensen Aug. 11th, (C).

and star-like, and the lower branches are long and decurved. In tundra the plants are smaller and columnar, in brownish, compact cushions (much resembling expressions of *S. fimbriatum* developed under similar sub-optimal conditions).

The terminal bud is rather large. The cells of the stem cortex are normally squarish, with a large median pore. The stem leaves, shortly erose-fringed across a broad apex, have a border of narrow cells extending well up the sides, and at the base it is abruptly broadened on either side of a triangular area of extensive resorption.

**29. *Sphagnum fimbriatum* Wils. ex Wils. & J.D. Hook. in J.D. Hook.**

Fig. 33. Map 29.

Bot. Antarctic Voy. Erebus & Terror 1: 398. 1847.

*S. teres* var. *concinnum* Berggr., K. Sv. Vet.-Akad. Handl. 13(7): 94. 1875. – *S. fimbriatum* var. *concinnum* (Berggr.) Warnst., Flora 66: 377. 1883.

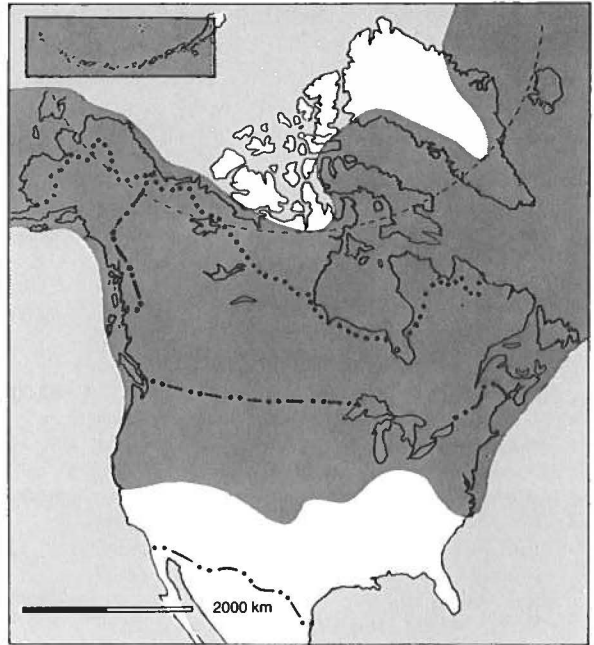
*S. fimbriatum* var. *arcticum* C. Jens., Cat. Pl. Soc. Bot. Copenhagen. Adnot. 23. 1883.

Slender plants in loose, pale- or grayish-green or yellowish hummocks or, in arctic regions, short, compact, and pale- to dark-brown. Terminal bud large, conic, whitish-gray. Wood cylinder of stem green; cortical cells short-rectangular, thin-walled, each with a single large, round pore at the upper end. Stem leaves clasping the stem, broadly fan-shaped (often broader than long), lacerate-fringed around the broad, rounded apex and down the sides, broadly bordered at base on either side of a triangular, sieve-like area of resorption; hyaline cells almost completely resorbed on both surfaces, mostly 1–2(3)-divided. Branches slender and flexuose, usually in fascicles of 5, with 2 or 3 spreading. Branch leaves imbricate, narrowly ovate, involute-pointed; hyaline cells on the outer surface with 4–12 large, elliptic commissural pores (strongly ringed above, larger, round and thin-margined below). Monoicous.

Spores 20–26 µm.

In older, drier parts of bogs, especially in the bushy transition from open mat to bog forest, in loose, broad hummocks, often supported by the lower branches of shrubs such as *Chamaedaphne*, also in small cushions in hardwood and tamarack swamps and in wet arctic tundra.

In Greenland north to app. 77° to arctic Alaska and south to California, Colorado, Missouri, West Virginia, and Maryland; northern and central Europe; Armenian SSR; Siberia; Japan; southern South America (Chile and Patagonia); Falkland Islands; reported from Tierra del Fuego, New Zealand, and



Map 29. *Sphagnum fimbriatum*.

South Africa (the original collections cited as “Hermit Island, Cape Horn, and the Falkland Islands”).

Selected specimens seen (MICH):

Greenland. W 4: Grønne Ejland, 68°50'N, 51°50'W; 1928 Erlanson 3527. – W 5: Godhavn, 69°15'N, 53°33'W; 1928 Erlanson 2843. – Atanikerdluk, 70°02'N, 52°18'W; 1928 Erlanson 3200.

Canada. Northwest Territories, Keewatin District, Chesterfield Inlet, 63°25'N, 90°40'W; 1936 Dutilly 660. – Baffin I., Clyde River, 70°26'N, 68°50'W; 1941 Dutilly 9374. – Ungava Bay, small island, 59°08-09'N, 65°45-46'W; 1975 Weber 1409.

Alaska. Barrow, 73°17'N, 156°47'W; 1973 Skorepa 7153. – Bering Sea, St. George Island, 56°35'N, 169°35'W; 1893 Townsend (Sphag. Bor-Amer. Exs. 16). – Nome and vicinity, 64°30'N, 165°25'W; 1949 Steere 12779. – Meade River Post Office, 70°28'N, 157°25'W; 1973 Steere, Inoue, and Iwatsuki 73-328.

The conspicuously enlarged and cobwebby, gray terminal bud and the fan-shaped stem leaves, deeply lacerate at the sides and apex, aid in separation of *S. fimbriatum*. The conspicuous triangular area of resorption at the middle of the base of stem leaves is an interesting feature of this species and *S. girgensohnii*. In the arctic, both *S. fimbriatum* and *S. girgensohnii* occur in small, compact, brownish forms that are troublesome to distinguish except on the basis of stem leaf characters.

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# Biology of the squid *Gonatus fabricii* (Lichtenstein, 1818) from West Greenland waters

THOMAS K. KRISTENSEN

Kristensen, Thomas K. 1984. Biology of the squid *Gonatus fabricii* (Lichtenstein, 1818) from West Greenland waters. – Meddr Grønland, Biosci. 13, 17 pp. Copenhagen 1984-05-30.

Three hundred adult and subadult *Gonatus fabricii* and about 7000 juveniles from West Greenland waters were examined. In spring and early summer large numbers of juvenile *G. fabricii* hatch in Davis Strait. Their abundance fluctuates from year to year. In Disko Bugt the juveniles hatch in autumn and early winter. Juvenile *G. fabricii* hatch over a large area in Davis Strait at depths exceeding 200 m. At night juveniles south of the polar circle perform vertical upward migrations. Likewise it seems that shoals of juveniles disperse at the same time. The number of juvenile *G. fabricii* is found to be about the same as the number of larvae of the Greenland halibut, *Rheinhardtius hippoglossoides*, a common commercial fish. The growth of *G. fabricii* was found to be 8–9 mm per month. The development of the gonads in relation to pen length is describable by the allometric equation. The testis begins to develop at a pen length of about 8–10 cm, the penis at a pen length of 3–5 cm. The largest mature male measured 29.3 cm pen length. The ovary begins to develop at a pen length of 6–8 cm. No mature females were found. In Greenland waters males probably mature at about 20 cm pen length, females between 25 and 30 cm pen length.

51% of specimens had empty stomachs, 27% were half full and 22% full. Crustaceans, fish and cephalopods were found in the stomachs and crustaceans were the most important. The protein percent was found to be 12.5 and in the liver the lipid percent was 63.

Spawning and predators of *G. fabricii* are also discussed.

Thomas K. Kristensen, Danish Bilharziasis Laboratory, Jægersborg Allé 1 D, DK-2920 Charlottenlund, Denmark.

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# Biology of the peregrine and gyrfalcon in Greenland

William A. Burnham and William G. Mattox

Burnham, William A. and Mattox, William G. 1984. Biology of the peregrine and gyrfalcon in Greenland. – Meddr Grønland, Biosci. 14, 25 pp. Copenhagen 1984-05-30.

A ten year study began in 1972 in West Greenland to investigate the breeding biology of the peregrine falcon. Data on nesting gyrfalcons were also collected. Thirty-four peregrine nesting sites were examined in the 6050 km<sup>2</sup> inland study area near Sønder Strømfjord. Limited research also centered in Disko Bugt and Frederikshåb. Peregrines were found nesting predominantly on high, south-facing cliffs which overlooked large areas. The mean minimum distance between peregrine eyries was 7.7 km for the inland area (1972 and 1973) and 55 km for the coast (1974). Approximately 60 percent of the inland nesting sites were occupied each year. A ten-year average production of 1.90 young per occupied site and 2.78 young per successful site was determined. Lapland longspurs, snow buntings, wheatears, and redpolls comprised 90 percent of the peregrine's diet. Raven nests and prey availability may affect gyrfalcon nesting. Gyrfalcons and peregrines did not breed successfully on the same cliffs as they do in Alaska where prey species number and density is greater. Competition for nest sites probably occurs, but prey availability may be the most significant factor affecting falcon density. Added peregrine eggs, eggshell fragments, and peregrine prey species were collected. Whole eggs averaged 14.3 ppm wet weight (305 ppm lipid weight) DDE, while eggshell measurements showed a 16 percent thinning compared with pre-1940 eggs from Greenland. Prey species carried low levels of DDE. The peregrine population appears to be at a near critical contamination level, and a small increase in DDE level could contribute to a population decline. No indication of a decline has been observed during the study, and the population appears stable. The project banded 185 peregrines, from which 8 recoveries occurred. The recoveries suggest peregrines migrate south to winter in South America.

William A. Burnham, Cornell University, The Peregrine Fund, 1424 N. E. Frontage Road, Fort Collins, Colorado 80524, U.S.A.

William G. Mattox, Ohio Department of Natural Resources, Fountain Square, Columbus, Ohio 43224, U.S.A.

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# A phytogeographical study of South Greenland. Vascular plants

JON FEILBERG

Feilberg, J. 1984. A phytogeographical study of South Greenland. Vascular plants. – Meddr Grønland, Biosci. 15, 70 pp. Copenhagen 1984-11-22

South Greenland, extending from 59° 45' to 62° 20' N., is considered a botanical province ranking with those of West, North and East Greenland. The province is divided into six vegetational zones, based on the distribution of selected taxa.

A phytogeographical analysis grouped the 346 taxa into eleven distribution types, each with two to seven subtypes. Each taxon is characterized further by a map of its distribution in South Greenland, by its holarctic distribution type (HDT) and climatic distribution type (CDT), and by a chorological index value (CI).

The flora of South Greenland is compared with that of adjacent areas in Greenland, and its affinities to the floras of Europe and North America shows a slight predominance of the American elements.

The following new combinations are proposed: *Elymus violaceus* (Hornem.) J. Feilberg, *Lychnis alpina* L. ssp. *americana* (Fern.) J. Feilberg and *Vaccinium oxycoccos* L. ssp. *microphyllum* (Lange) J. Feilberg.

Bioscience 15 · 1984

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Jon Feilberg, Botanical Museum, Gothersgade 130, DK-1123 Copenhagen K, Denmark.

# Populations and breeding schedules of waders, Charadrii, in high arctic Greenland

HANS MELTOFTE

Meltofte, H. 1985. Populations and breeding schedules of waders, Charadrii, in high arctic Greenland. – Meddr Grønland, Biosci. 16, 43 pp. Copenhagen 1985-10-31.

Waders are the dominant birds of the high arctic tundra of Greenland, both in terms of population densities and number of species. Of 11 species of waders breeding regularly in Greenland, nine have their main distribution within the high arctic part. *Charadrius hiaticula*, *Arenaria interpres*, *Calidris canutus*, *Calidris alpina*, *Calidris alba* and *Phalaropus fulicarius* are the most abundant. Living conditions in high arctic Greenland are characterized by extremely low and often sparse vegetation, moderate snow-cover and short cool summers. Large regional, local and annual differences occur, however, and the breeding phenology and population densities of waders are described and analysed in relation to these differences. The annual schedules of the wader populations are reviewed, and the governing factors discussed for each stage, as well as the factors involved in controlling population densities, sizes and changes, and distribution on a larger scale.

A very strong negative correlation was found between start of laying and snow-cover in early June, while breeding densities were best correlated with snow-free vegetation cover at this time. The most important ultimate factors involved are probably feeding conditions early in the season and, in snow-rich areas, also increasing predation risk with increasing snow-cover. Compared to other arctic areas, the waders in high arctic Greenland show moderate or low population densities, but they breed earlier than most other arctic populations. Low productivity, as compared to the extremely productive low arctic tundras of North America and Siberia, is responsible for the lower densities, while the limited spring snow-cover makes it possible for the waders to breed earlier in high arctic Greenland.

Finally an attempt is made to estimate the total population sizes of the waders breeding in high arctic Greenland, using both breeding density estimates and estimates of the same populations during winter in the Old World.

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Hans Meltofte, Zoological Museum, sect. 4, Universitetsparken 15, DK-2100 København Ø, Denmark.

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