Rapport botanisk serie 2002-1

Norges teknisk-
naturvitenskapelige universitet
Vitenskapsmuseet

# The Norwegian Sphagna: a field colour guide

Kjell I. Flatberg

Trondheim

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**Eksempler:**

**Tidsskrift/serie**

Flatberg, K.I. 1993. *Sphagnum rubiginosum* (Sect. Acutifolia), sp. nov. - Lindbergia 18: 59-70.

Moen, A. & Selnes, M. 1979. Botaniske undersøkelser på Nord-Fosen, med vegetasjonskart. - K. norske Vidensk. Selsk. Mus. Rapp. bot. Ser. 1979-4: 1-96.

**Kapittel**

Gjærevoll, O. 1980. Fjellplantene. - s. 316-347 i Voksø, P. (red.) Norges fjellverden. Forlaget Det Beste, Oslo.

Høeg, H.I. 1994. En pollenanalytisk undersøkelse av Tverrlisætri i Grimsdalen, Dovre kommune, Oppdal. - s. 193-200 i Mikkelsen, E. (red.) Fangstprodukter i vikingtidens og middelalderens økonomi. Universitetets Oldsakssamling Skr. Ny Rekke 18.

**Monografi/bok**

Bretten, S. 1973. Slekta *Draba* i Knutshø-Finshøområdet på Dovre. Sider ved dens systematikk og autøkologi. - Hovedfagsoppg. Univ. Trondheim. 113 s. Upubl.

Rønning, O.I. 1972. Vegetasjonslære. - Universitetsforlaget, Oslo. 101 s.

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**Forsidebilder**

Hybrid mellom rikmyrorkidéene engmarihånd *Dactylorhiza incarnata* ssp. *incarnata* og brudespore *Gymnadenia conopsea*. Fra Sølendet naturreservat, Røros, Sør-Trøndelag. Foto Asbjørn Moen.

Skjøtsel av kulturlandskap: Slått av rikmyr i Tågdalen naturreservat, Surnadal, Møre og Romsdal. Foto Asbjørn Moen.

Kalktelg *Gymnocarpium robertianum*, en østlig art som kartlegges av Det norske floraatlaset. Foto Eli Fremstad.

Skjøtsel av kulturlandskap: Brenning av kystlynghei på Tarva, Bjugn, Sør-Trøndelag. Foto Liv S. Nilsen.

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Kjell I. Flatberg

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## Summary

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Colour plates illustrate fifty-four *Sphagnum* taxa, 50 species and 4 subspecies. This constitues all the known peat mosses from Norway including arctic Svalbard. Macroscopic keys to sections and species and subspecies within the different sections are presented. These keys used in combination with the colour plates and a hand lens should in most cases enable the correct determination of the Norwegian peat mosses in the field.

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## Preface

This colour guide of Norwegian peat mosses is the result of many years of field and laboratory work on this fascinating group of plants. Norway, with its great variation in climate and topography and large areas of undisturbed mires and other wetlands, is a unique country for field studies of Sphagna.

It has been a tradition for a long time among Fennoscandian mire ecologists and phytosociologists to be able to recognize and identify Sphagna in the field. Outstanding field sphagnologists such as R. Tuomikkoski from Finland and E.G. Du Rietz and H. Sjörs from Sweden can be mentioned.

But the person who has had the greatest influence for my own *Sphagnum* studies, is the Finnish sphagnologist, Pekka Isoviita. His encouragement and support have been of great importance for my studies.

The guide has been prepared in connection with the 6th field symposium of the International Mire Conservation Group being held in Norway in July 1994. It was not possible to include descriptions of the Norwegian peat mosses. I plan to publish a revised and more complete version of the guide, including descriptions of the characteristics of the taxa, aspects relating to their differentiation and variation, and notes on distributional patterns and habitat preferences.

I am grateful to my son Truls, who has done most of the work during the final preparation of this guide, and Richard Binns for checking the language.

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It is eight years since this peat moss flora first appeared, and it has been out of print for most of these years. A revised and extended flora including descriptions and comments on the various species and taxa is under preparation, but it will still take some time until it is published. The demand for the flora has been extensive. The excursion included in the arrangement "The Third International Symposium on the Biology of *Sphagnum*, Uppsala- Trondheim, 13 – 23 August 2002", has further stressed the access to this flora. Therefore, I have decided to reprint the flora mainly in accordance with the first edition, but including some alterations and corrections. However, new information on peat mosses, which has appeared in more recent taxonomic/phylogenetic papers, is for practical reasons not considered. For example, the new sectional division of the genus *Sphagnum* recently proposed by A. Jonathan Shaw is not included.

Kjell I. Flatberg, August 2002.

# 1 Introduction

The *Sphagnum* flora of Norway is the most diverse in Europe and all the known European species are found except for *S. lenense* H. Lindb., *S. pylaesii* Brid. and *S. skyense* Flatb. *Sphagnum subtile* (Russ.) Warnst. is not included in the present list of Norwegian peat mosses, either, because I feel uncertain about its taxonomy.

Altogether, 50 Norwegian species and 4 subspecies of peat mosses are distinguished, including some occurring only in the arctic archipelago of Svalbard. Thirteen species have been recorded from this arctic outpost of Norway and three of these have not been reported from mainland Norway, viz. *S. arcticum* Flatb. & Frisv., *S. olafii* Flatb. and *S. tundrae* Flatb., nor is *S. fimbriatum* ssp. *concinnum* found in mainland Norway.

All the mainland Norwegian peat mosses occur in the Trøndelag region of central Norway, which is therefore one of the most diverse peat moss provinces in the northern hemisphere and perhaps in the world. This high diversity is due to the meeting here of floristic elements of southern, western, eastern, alpine and northern geographical affinities and the still great variation of undisturbed wetland vegetation types.

My taxonomic revision of northwestern European peat mosses during the last decades has resulted in the description of seven new species and four subspecies based on Norwegian material, Svalbard included. Daniels & Eddy (1990), in their "Handbook of European Sphagna", recognize 40 European species, 10 less than in my list of Norwegian species. This difference is partly due to contrasting taxonomic views, partly to description of new species after their flora appeared. For example, Daniels & Eddy (1990) distinguish three species in the *S. recurvum* complex, while I distinguish five.

The purpose of this field colour guide is to enable correct determination of Norwegian sphagna in the field using a hand lens or in the laboratory with a dissecting microscope. The colour plates are therefore particularly important.

There are many handbooks and papers that are also relevant for Norwegian peat mosses and can be consulted to obtain more information, e.g. Nyholm (1969), Lange (1982), Crum (1984), Daniels & Eddy (1990), McQueen (1990), Hill (1992) and Johansson (1993).

# 2 Taxonomy and nomenclature

The grouping of species into sections and the order of the sections follow Daniels & Eddy (1990). This includes nine Norwegian sections, and I also follow those authors by separating *S. tenellum* in a section of its own, i.e. Section Mollusca. In most previous taxonomic treatments of the genus this species has been grouped under Sect. Cuspidata.

There is no general agreement among sphagnologists as to what constitutes a species, subspecies or variety. I use a different taxonomic evaluation of some taxa and groups of species than Daniels & Eddy (1990), mostly based on my own taxonomic studies and revisions of northwestern European sphagna during the last decade (Flatberg 1984, 1985, 1986, 1987, 1988a,b,c, 1992, 1993a,b,c, 1994, Flatberg & Frisvoll 1984).

Some taxa need comments:

***Sphagnum affine - S. austinii***
In my taxonomic treatment of the *Sphagnum imbricatum* complex (1984, 1986), I distinguished two European taxa, viz. ssp. *affine* (Ren. & Card.) Flatb. and ssp. *austinii* (Sull.) Flatb. These were shown to differ in both morphology, habitat preference and distribution. Subspecies *imbricatum*, which is confined to eastern Asia, was shown to combine morphological characteristics of the two European taxa.

After reconsideration, I now find that separating these taxa at the species level reflects better their interrelationship, i.e. *S. affine* (Plate 5) with main distribution in mesotrophic fen lawns and high carpets, and *S. austinii* (Plate 6) mainly confined to elevated cushions in ombrotrophic mires.

***Sphagnum centrale - S. palustre***
*Sphagnum centrale* and *S. palustre* differ in morphology, habitat preference and distribution in Scandinavia, and I have not found intermediate plants that connect the two morphologically. They are therefore treated as different species.

***Sphagnum capillifolium - S. rubellum***
*Sphagnum capillifolium* and *S. rubellum* behave as distinct species in Norway with different morphology, habitat preference and distribution. When they meet in the field, they are common in mixed stands, and plants of the two species can in most cases easily be separated from each other (see Plate 15).

***Sphagnum subfulvum - S. subnitens***
That there are two distinct species is unquestionable. But, as shown by Flatberg (1985) both show intraspecific, genetically based variations. *Sphagnum subfulvum* occurs with a distinct red morph (ssp. *purpureum* Flatb.) which can be confused with *S. subnitens* (s. str.). The distribution of this taxon is uncertain, but it seems to express an eastern tendency in its Fennoscandian distribution. *Sphagnum subnitens* on the other hand occurs with a brown morph (ssp. *ferrugineum* Flatb.). This taxon has a westerly distribution in Europe and is recorded from many localities along the western coast of Norway and from Ireland. This taxon probably deserves recognition at the species level.

***Sphagnum inundatum***
I have treated *Sphagnum inundatum* as a separate species. I agree with Daniels & Eddy (1990) that it stands closer to *S. subsecundum* than to *S. auriculatum*. However, it differs from *S. subsecundum* in essential morphological characteristics (see e.g. different capitulum structure, Plates 31 & 32), has a somewhat different habitat preference and shows a different distribution in Fennoscandia.

***Sphagnum cuspidatum - S. viride***
*Sphagnum cuspidatum* and *S. viride* (Plates 35 & 36) undoubtedly are closely related (Flatberg 1988c), but when I prefer to distinguish them at the species level it is due to different preference for habitats and distributions. In Norway, *S. viride* is almost exclusively found in minerotrophic mire sites, while *S. cuspidatum* has its main occurrences in ombrotrophic sites (although it is also found in poor fen sites).

*Sphagnum viride* has a more southerly and coastal distribution in Norway than *S. cuspidatum*.

***Sphagnum majus***
*Sphagnum majus* was separated into two subspecies, viz. ssp. *majus* and ssp. *norvegicum* (Flatberg 1987). Further experience with the two taxa is necessary for elucidating their systematic relationships.

***Sphagnum annulatum - S. jensenii***
As shown by Flatberg (1988b), *Sphagnum annulatum* and *S. jensenii* constitute distinct species separated by many morphological characters. Their real taxonomic status has for a long time been misinterpreted, and *S. annulatum* in the sense of for example Crum (1984) and Daniels & Eddy (1990) refers to aberrant "crispate" plants, which in my opinion do not deserve taxonomic recognition.

***The Sphagnum recurvum complex***
I recognize five European species in the *Sphagnum recurvum* complex, viz. *S. angustifolium, S. brevifolium, S. fallax, S. flexuosum and S. isoviitae* (Flatberg 1992, 1993a). *Sphagnum angustifolium* and *S. flexuosum* were also recognized by Daniels & Eddy (1990), whereas *S. brevifolium, S. fallax* and *S. isoviitae* would be included in their concept of *S. recurvum* var. *mucronatum. Sphagnum recurvum* (s. str.) is not found in Europe.

The nomenclature of *Sphagnum* species follows Isoviitae (1966), but *S. capillifolium* is used instead of *S. nemoreum* (see Flatberg 1983). Additions are the species *S. arcticum* (Flatberg & Frisvoll 1984), *S. rubiginosum* (Flatberg 1993c), *S. olafii* (Flatberg 1993b), *S. tundrae* (Flatberg 1994), *S. viride* (Flatberg 1988c), *S .troendelagicum* (Flatberg 1988a), *S. brevifolium* (see Flatberg 1992, 1993a), *S. isoviitae* (Flatberg 1992). The nomenclature of *Sphagnum annulatum* and *S. jensenii* follows Flatberg (1988b), and of *S. affine* and *S. austinii* follows Flatberg (1984).

The nomenclature of the "brown" mosses shown on the colour plates, follows Hedenäs (1993).

## 3 The keys
With experience, it is possible to identify all the Norwegian sphagna in their typical field habitats with a high degree of certainty by combining the colour, size and structural characteristics of the capitula when viewed from above. These capitulum characteristics are not always easy to describe exactly in keys, but I hope the colour illustrations will help the user to understand the morphological terminology I have used to describe the various species. I have, in addition, mainly used the following macroscopic characters:
- stem colour
- number, orientation, relative length and shape of divergent and pendent branches
- shape and arrangement of the branch leaves
- orientation, shape and relative size of the stem leaves

Microscopic characters are not mentioned.

The characteristics are described on the basis of moist capitula and plants. Characteristics based on dry plants are only occasionally mentioned.

Some branch fascicles below the capitulum must be removed to examine the stem leaf characteristics. The shape of the stem leaves can then be examined with a hand lens by holding the stem towards the light. The stem colour is also best seen by removing the branch fascicles from a plant.

When the stem leaf orientation is being evaluated, the uppermost leaves just beneath the capitulum should be avoided as these are spreading in most species.

The following main keys are included:
- key to sections and selected species
- key to species and subspecies within the sections

Both types of keys try to cover the morphological behaviour of the various species as they are found in their most common habitats, but do not aim to cover the morphological response to the total habitat variation. The differences particularly concern plants from unusually wet habitats, like floating mats.

Capitula of female and male plants of dioicous species often look different during late summer and autumn, and if one is not aware of this phenomenon of sexual dimorphism, female and male plants of the same species can be mistaken for separate species in the field (see Plates 30 & 44). During late summer and autumn, the male plants can easily be recognized by the antheridial branches which constitute the outer branches of the capitulum and often, in addition, the spreading branches just below the capitulum. The antheridial branches differ from the ordinary branches by having swollen, club-shaped ends, which are distinctly darker than the rest of the branch (see e.g. Plates 10 & 44).

I have only in one case included a separate key for the male plants (see the key to Section Cuspidata p. 28).

Characteristics concerning the terminal bud of the capitulum have generally been used in the keys (e.g. invisible, visible, distinct). It should be kept in mind that this is a character, which varies through the growing season. In late autumn, the terminal bud is more distinct than in the summer and may be visible even in species that normally have an invisible terminal bud (see e.g. Plate 44, *S. fallax* upper right-hand picture). The terminal bud may also be more visible than normal in spring and early summer when the growth starts after the winter. Moreover, the terminal bud of a particular species is more visible in a wet than a dry habitat.

## 4 The colour plates

There is one main colour plate for each of the 54 *Sphagnum* taxa considered, which are all the Norwegian and Fennoscandian taxa that I currently recognize at the species and subspecies levels. Many of the taxa can also be seen on other plates (see index of taxa p.42). Thus, in practice, various capitulum morphs of each species occurring in different habitats are included.

On most of the plates, whenever suitable colour slides have been available, I have tried to include both typical plants of the taxon concerned, variation aspects and mixtures of related taxa. Some other mosses are also seen on the pictures, but these are not always named.

The colour plates are paper positive reproductions of colour slides made with Kodachrome 21, Kodachrome 64 and, in recent years, Fujichrome Velvia films. All the pictures were taken by the author in the field, mostly using a 105 mm lens with extension tubes, a tripod and natural light. The scales are not given, and vary, which should be remembered when capitulum sizes are being compared.

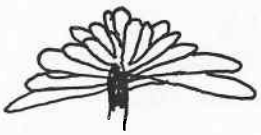
A letter in the lower left-hand corner indicates that only the relevant *Sphagnum* taxon can be seen on the plate. Otherwise, the lettering indicates where capitula of the relevant taxon can be found, often further indicated by arrows. This taxon is also often present at other places on a particular plate without being explicitly marked.

# 7 Morphological terminology

## Capitulum

The capitulum (head) constitutes the uppermost part of the shoot, and usually is the only visible part of the peat moss plant when viewed from above in the field without picking up the shoots.

### Shape of capitulum

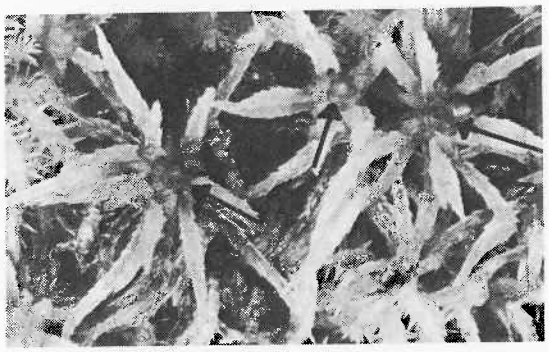


**Convex capitulum**
Distinctly convex capitulum as viewed from the sides, e.g.
- *S. wulfianum*, Plate 29
- *S. angustifolium*, Plate 47
- *S. capillifolium*, Plate 15

**Flat capitulum**
Nearly flat or only somewhat convex capitulum as viewed from the sides, e.g.
- *S. lindbergii*, Plate 51
- *S. warnstorfii*, Plate 17

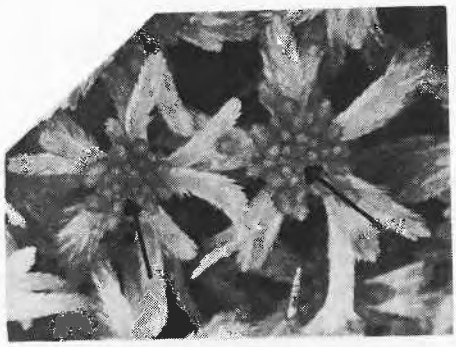
### Terminal bud of capitulum

This constitutes the apical "growing point" of the shoot and can in many cases be seen in the centre of the capitulum as a small or larger conical bud. It is visible or hidden by the inner branches of the capitulum.



**Conspicuous terminal bud**
Terminal bud fairly large and conical and seen also without a hand lens; often exceeding the inner branches in length when the capitulum is viewed from the sides, e.g.
- *S. teres,* Plate 26
- *S. riparium,* Plate 50
- *S. angermanicum,* Plate 20

**Distinct terminal bud**
Terminal bud fairly large and easily seen with a hand lens, but often shorter than the innermost branches when the capitulum is viewed from the sides, e.g.
- *S. girgensohnii,* Plate 10
- *S. jensenii,* Plate 40



**Visible but inconspicuous terminal bud**
The terminal bud is small, but can be seen with a hand lens, e.g.
• *S. isoviitae,* Plate 46

**Invisible terminal bud**
The terminal bud is small and mostly hidden by the innermost branches, e.g.
• *S. angustifolium,* Plate 47
• *S. wulfianum,* Plate 29

**Capitulum branches**

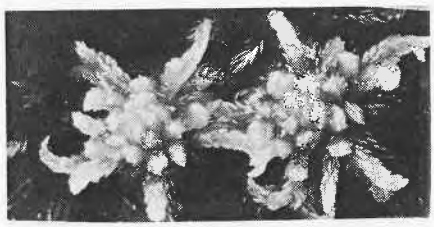
**Differentiation of capitulum branches**

**Inner branches**
The short and often erect branches in the centre of the capitulum

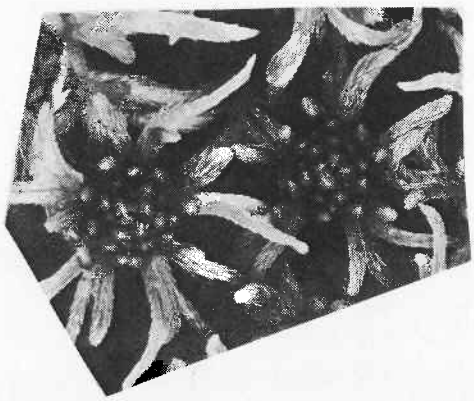
**Medium-long branches**
The branches outside the innermost branches and inside the longest ones

**Outer branches**
The outermost and longest branches of the capitulum

**Orientation of capitulum branches**



**Incurved inner branches**
The innermost branches are curved towards the centre of the capitulum as viewed from the sides, e.g.
• *S. subsecundum,* Plate 30



**Concentrically arranged inner branches**
The inner branches of the capitulum are arranged in concentric rings as viewed from above, e.g.
• *S. flexuosum,* Plate 48

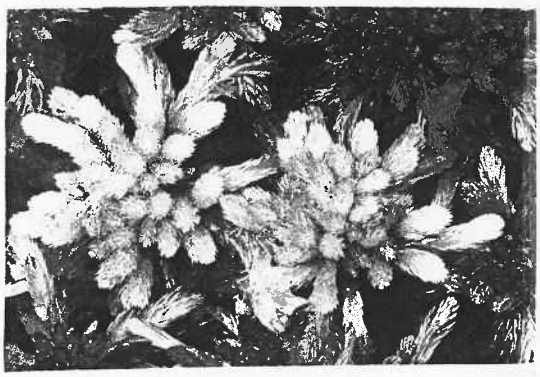
**Laterally curved branches**
Many to most of the capitulum branches are more or less laterally curved as viewed from above, e.g.
• *S. majus,* Plate 38
• *S. fallax,* Plate 44

**Straight capitulum branches**
Many to most of the capitulum branches are fairly straight as viewed from above, e.g.
• *S. lindbergii,* Plate 51
• *S. girgensohnii,* Plate 10
• *S. inundatum,* Plate 31

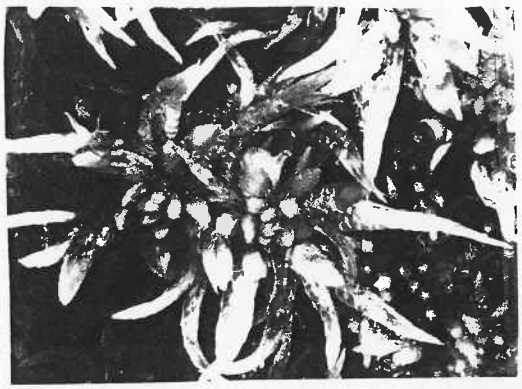
**Stellate capitulum**
The outer and also often the medium-long branches of the capitulum form a 5-star as viewed from above, e.g.
• *S. girgensohnii,* Plate 10
• *S. flexuosum,* Plate 48

## Distal end shapes of branches

**Obtuse branches**
Refer mostly to the distal end shape of medium-long branches of the capitulum; distal ends have an angle of more than 90°, e.g.
- *S. fallax,* Plate 44
- *S. obtusum,* Plate 49



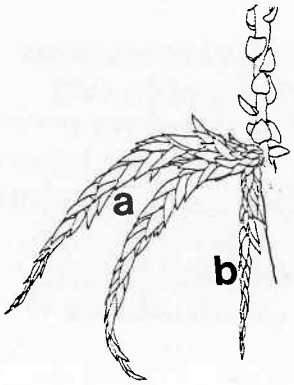
**Acute-obtuse branches**
The distal ends of the branches terminate with an angle of aprroximately 90°
- many species



**Acute branches**
Refer to branches with an angle of the distal ends less than 90°, e.g.
- *S. angermanicum,* Plate 20

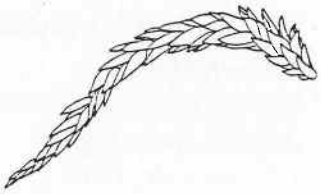
## Branch fascicles

Each branch fascicle normally consists of both divergent (spreading) and pendent (hanging) branches.

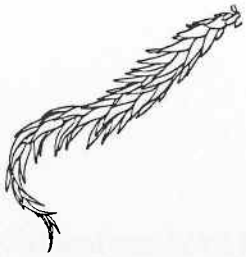



**Divergent branches**
Usually 2(-3) in number (a)

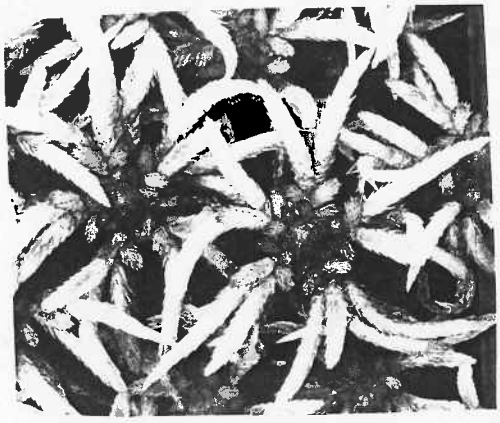
**Pendent branches**
Usually 1-3, rarely lacking (b)



**Decurved divergent branches**
The divergent branches are curved downwards in their distal half.



**Sigmoid-curved divergent branches**
The distal end of the branch is S-like curved, e.g.
- *S. cuspidatum,* Plate 35



**Terete divergent branches**
Refer to smooth and cylindrical branches, e.g.
- *S. riparium,* Plate 50
- *S. austinii,* Plate 6

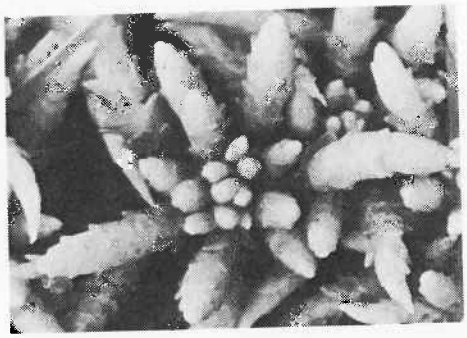
## Divergent branch leaves

Refer to leaves of the divergent branches.

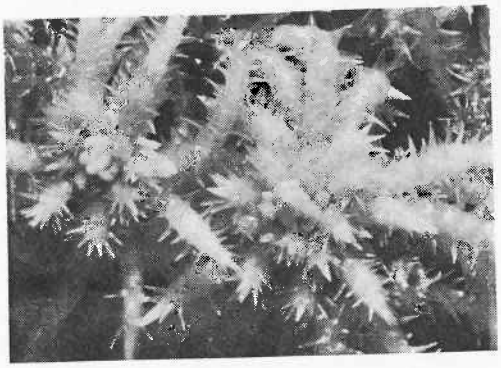
### Arrangement of divergent branch leaves

**5-ranked branch leaves**
The leaves of the outer capitulum branches and the divergent branches below the capitulum are arranged in five rows, e.g.
- *S. lindbergii*, Plate 51
- *S. warnstorfii*, Plate 17

**Non-ranked (unranked) branch leaves**
The leaves are not arranged in distinct rows, e.g.
- *S. centrale*, Plate 3
- *S. jensenii*, Plate 40

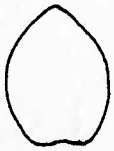


**Imbricate branch leaves**
The leaves are tightly arranged and overlapping on the branch, e.g.
- *S. austinii*, Plate 6
- *S. riparium*, Plate 50

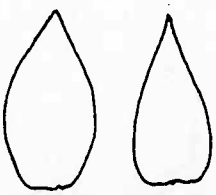


**Squarrose branch leaves**
The branch leaves are curved back at their distal end, e.g.
- *S. squarrosum*, Plate 25
- *S. strictum*, Plate 54

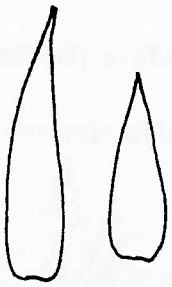
**Shape of divergent branch leaves**



Ovate

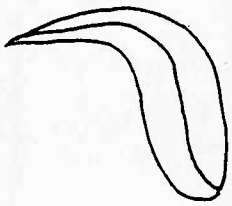


Ovate-lanceolate



Lanceolate

Subsecund



Squarrose

**Apex of divergent branch leaves**

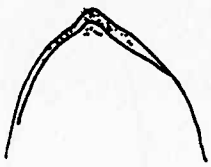
Narrowly involute
e.g. *S. cuspidatum*

Broadly involute

Narrowly cut

Truncate (broadly cut)
e.g. *S. aongstroemii*

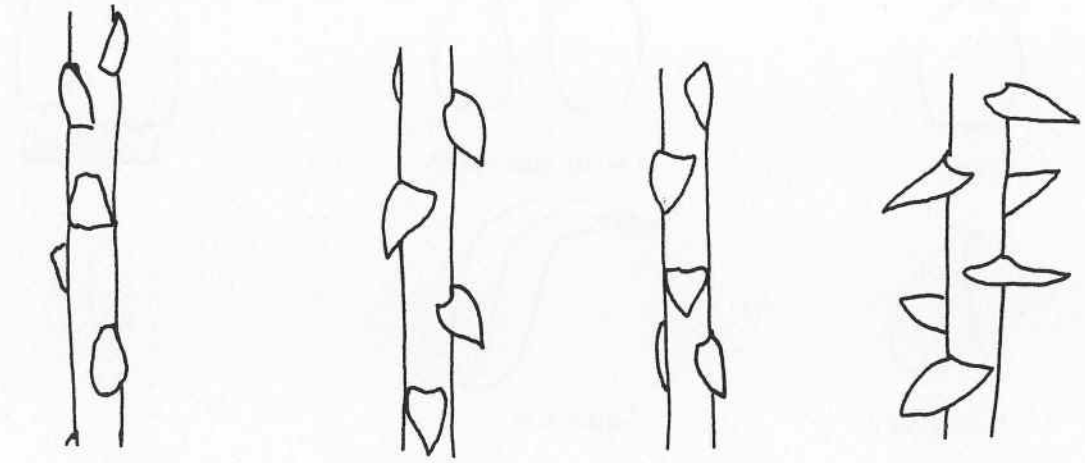
Dentate
e.g. *S. angermanicum*



Cucullate (hooded)
Sect. *Sphagnum*

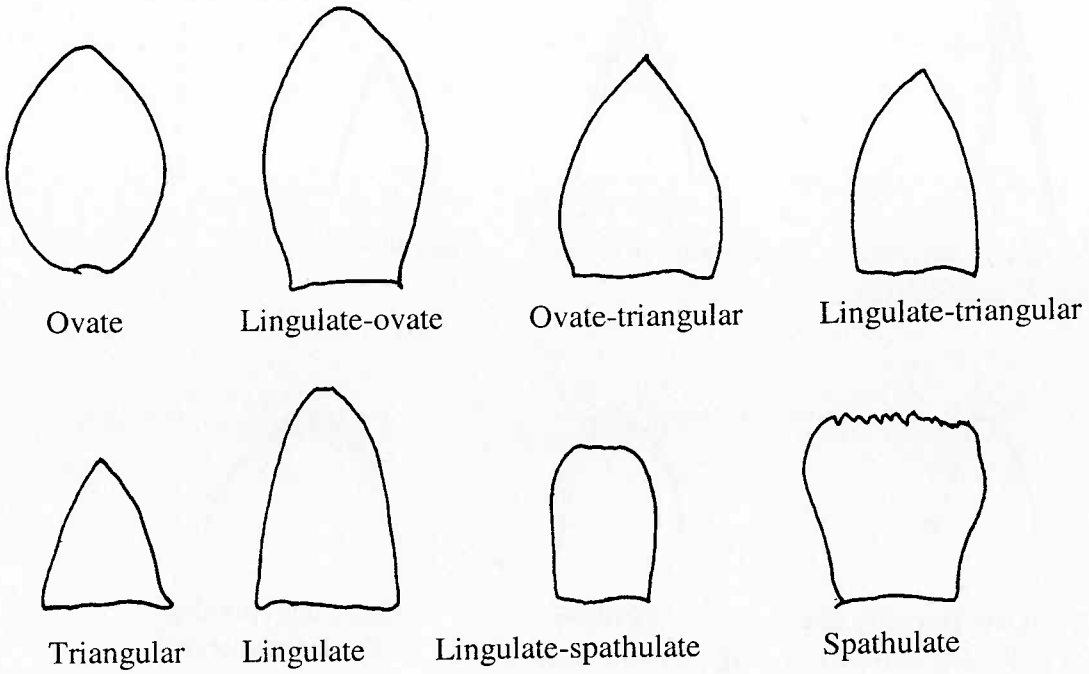
## Stem leaves

### Orientation of stem leaves



Erect-appressed | Spreading-pendent (divergent-pendent) | Pendent-appressed | ± spreading (± divergent)

### Shape of stem leaves



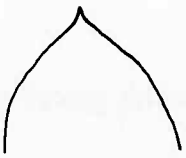
Ovate | Lingulate-ovate | Ovate-triangular | Lingulate-triangular

Triangular | Lingulate | Lingulate-spathulate | Spathulate

**Apex of stem leaves**

Acuminate
e.g. *S. cuspidatum*

Acute
e.g. *S. subfulvum*



Apiculate
e.g. *S. isoviitae*

Obtuse
e.g. *S. balticum*

Obtuse-rounded
e.g. *S. fuscum*

Narrowly fimbriate
e.g. *S. girgensohnii*

Broadly fimbriate
e.g. *S. fimbriatum*

Notched
e.g. *S. riparium*

## 6 Key to sections and selected species

1. Capitulum more or less brown .....**2**

1. Capitulum more or less red .....**9**

1. Capitulum greenish to yellowish-green; without brown or red .....**10**

**********

**Capitulum more or less brown (in *S. cuspidatum* Sect. Cuspidata the brown colour is confined to the proximal parts of capitulum branches; see Plate 35)**

2. Stem entirely pale, or pale with pale-red flecks .....**Sect. Cuspidata**
.....**Sect. Mollusca (S. tenellum, Plate 52)**

2. Stem dark, or pale with brownish flecks .....**3**

3. Divergent branch leaves distinctly 5-ranked; stem leaves spathulate with widely fringed apices .....**Sect. Cuspidata (S. lindbergii, Plate 51)**

3. Divergent branch leaves non-ranked .....**4**

4. Capitula hemispherical; fascicles with 6-8(12) branches .....
.....**Sect. Polyclada (S. wulfianum, Plate 29)**

4. Capitula flat to somewhat convex, but never hemispherical; fascicles with 6 or fewer branches .....**5**

5. Capitulum leaves with straight and cut apices; small to large plants.....**6**

**5.** Capitulum leaves with cucullate (hooded) apices; moderately large to large plants.....**7**

**6.** Stem leaves upwards directed on the stem ..... **Sect. Acutifolia**

*** S. fimbriatum ssp. fimbriatum, Plate 8**
*** S. arcticum, Plate 9**
*** S. olafii, Plate 13**
*** S. fuscum, Plate 22**
*** S. subfulvum ssp. subfulvum, Plate 23**
*** S. subnitens ssp. ferrugineum, Plate 19**
*** S. rubellum, brown morph, Plate 16**
*** S. girgensohnii, brown morph, Plate 10**

6. Stem leaves varyingly spreading, spreading-pendent to pendent-appressed .....**6a**

6a. Branch leaves rather wide above ..... **Sect. Subsecunda** (Plates **30-34)**

6a. Branch leaves rather narrow above ..... **Sect. Squarrosa**

*** S. teres, Plate 26**
*** S. squarrosum, arctic morph, Plate 25**

7. Branch leaf ends (apices) with small teeth (scabrid) on the convex surface (hand lens!); stem leaves spathulate with widely obtuse and fringed apices .....**Sect. Sphagnum (Plates 1-6)**

7. Branch leaf ends (apices) without teeth; stem leaves lingulate to lingulate-triangular with narrowly rounded and somewhat eroded apices .....**8**

8. Outer capitulum branches smooth with imbricate leaves and narrowly tapering ends; divergent branches just below the capitulum decurved; stem leaves large and spreading to spreading-pendent from stem .....**Sect. Subsecunda (S. auriculatum in wet habitats)**

8. Outer capitulum branches abruptly ending and with spreading leaves; divergent branches just below the capitulum upward directed; stem leaves minute and pendent-appressed to stem .....**Sect. Rigida (S. compactum, Plate 53)**

**Capitulum more or less red**

9. Plants small; divergent branch leaves ovate-lanceolate and with narrowly involute and cut apices .....**Sect. Acutifolia (e.g. Plate 17)**

9. Plants large; divergent branch leaves ovate, strongly concave and with wide and cucullate (hooded) apices .....**Sect. Sphagnum**

*** S. magellanicum, Plate 1**
*** S. palustre, Plate 2**

9. See also: S. **compactum** in **Sect. Rigida (Plate 53) S. wulfianum in Sect. Polyclada** (sometimes with a tinge of red in the capitula)

**Capitulum greenish to yellowish-green without brown or red**

10. Stem pale throughout .....**11**

10. Stem pale with red or violet-pink flecks ..... **15**

10. Stem dark black-brown or pale with yellow-brown or brownish flecks .....**17**

11. Capitula and divergent branches with squarrose leaves.....Sect. **Rigida (S. strictum, Plate 54)**

11. Capitula and divergent branches with non-squarrose leaves .....**14**

12. Stem leaves spreading, spreading-pendent to pendent-appressed to stem .....**14**

12. Stem leaves predominantly erect to erect-appressed to stem .....**Sect. Acutifolia**

*** S. angermanicum, Plate** 20
*** S. molle, Plate 21**

*** S. fimbriatum, Plate 7**
*** S. girgensohnii, Plate 10**
*** S. rubiginosum, Plate 11**

13. Capitulum leaves and divergent branch leaves with wide, distinctly truncate-dentate apices .....**Sect. Insulosa (S. aongstroemii, Plate 28)**

13. Capitulum leaves and divergent branch leaves narrowly involute above or wide but not distinctly truncate-dentate .....**14**

14. Divergent branch leaves broadly ovate; stem leaves spreading and approaching the branch leaves in shape and size .....**Sect. Mollusca (S. tenellum, Plate 52)**

14. Divergent branch leaves lanceolate to lanceolate-ovate; stem leaves spreading to more commonly spreading-pendent to pendent-appressed to stem; stem leaves dissimilar in shape from branch leaves .....**Sect. Cuspidata**

15. Stem leaves erect to erect-appressed to stem .....**Sect. Acutifolia**
*** plants in shaded habitats which have more or less red capitula under more exposed conditions**
*** occasional morphs of S. rubellum (Plate 16), S. fuscum, S. subnitens, S. warnstorfii (also in exposed habitats)**

15. Stem leaves spreading to spreading-pendent .....**16**

16. Plants medium-sized, many capitulum branches laterally curved when viewed from above; divergent branch leaves lanceolate to ovate-lanceolate.....**Sect. Cuspidata**
*** S. viride, Plate 36**

16. Plants small; capitulum branches straight or nearly so when viewed from above; divergent branch leaves broadly ovate, stem leaves ovate-lingulate .....**Sect. Mollusca (S. tenellum, Plate 52)**

17. Capitula distintly hemispherical; fascicles with 6-8(12) branches; stem dark .....**Sect. Polyclada (S. wulfianum, Plate 29)**

17. Capitula nearly flat to moderately convex; fascicles with less than 6 branches stem pale brownish or pale with brownish to yellow-brown flecks.....**18**

18. Capitulum leaves and divergent branch leaves more or less squarrose .....**19**

18. Capitulum leaves and divergent branch leaves non-squarrose .....**20**

19. Outer capitulum branches narrowly tapering; stem leaves large, lingulate with wide, rounded and fringed apices .....**Sect. Squarrosa**
*** S. squarrosum, Plate** 25
*** S. teres (sometimes in shaded habitats)**

19. Outer capitulum branches obtusely tapering; stem leaves minute, pendent to pendent-appressed to stem, triangular with narrowly rounded apices .....**Sect. Rigida**

*** S. compactum (rare plants in deep shade)**

20. Outer capitulum branches and divergent branches with 5-ranked leaves .....**Sect. Cuspidata**

*** S. pulchrum, Plate 43A (green morph)**

20. Branch leaves non-ranked.....**21**

21. Divergent branch leaves with truncate-dentate apices .....**Sect. Squarrosa**

***S. tundrae, Plate 27**

21. Divergent branch leaves with narrow non-truncate apices, sometimes looking circulate .....**Sect. Subsecunda**

**(plants from low carpets and floating mats, and plants in shaded habitats)**

***********

## 7 Keys to species and subspecies within the sections

### Sect. Sphagnum

1. Capitulum with at least some red or pink **2**

1. Capitulum variously green, yellow-green, yellow-brown or brown **3**

2. Capitulum wine-red to deep wine-red throughout (exposed habitats) or predominantly greenish, but with some red (in shade); stem with branches removed and held up to the light, deep wine-red or purple or with at least flecks of such colour; central part of capitulum not particularly arched above the outer parts; branches in outer part of capitulum and just below rather blunt and not elongate and narrowly tapering .....**S. magellanicum (Plate 1)**

2. Capitulum red-brown or pinkish at least in parts, but never wine-red; stem with branches removed and held up to the light, brownish or with at least flecks of brown; central part of capitulum often distinctly arched above the outer parts; branches in the outer part of the capitulum and just below coarse, elongate and narrowly tapering .....**S. palustre (Plate 2)**

3. Capitulum chestnut-brown and sometimes with a tinge of dark purple-brown; outer capitulum branches and divergent branches narrowly tapering and densely covered by imbricate leaves; fascicles with one pendent branch; plants closely packed with branches in dense, compact cushions .....**S. austinii (Plate 6)**

3. Capitulum varyingly green, yellow-green, yellow-brown to sometimes brown, but never dark brown; outer branches of capitulum and divergent branches with at least somewhat spreading leaves with visible apices when branches are viewed from the

sides towards the light; fascicles with predominantly 2-3 pendent branches; plants in mats or loose to sometimes fairly compact cushions .....**4**

4. Capitulum green; stem with branches removed and held up towards the light, with at least flecks of deep wine-red or purple .....**S. magellanicum (Plate 1)**
**(plants in shade in swampy conifer forests)**

4. Stem with branches removed and held up towards the light, brownish or at least with flecks of brown .....**5**

5. Outer branches of capitulum and divergent branches below blunt not narrowly tapering; divergent branch leaves often distinctly spreading with many leaves with an angle to the branch between 45°-90° ..... **S. papillosum (Plate 4)**

5. Outer branches of capitulum and divergent branches below narrowly tapering; divergent branch leaves not distinctly spreading with the leaves usually with an angle to the branch of less than 45° .....**6**

6. Capitulum indistinctly stellate when viewed from above, usually green or yellow-green, never uniformly brown; central part of capitulum distinctly arching above the outer parts .....**S. palustre (Plate 2)**

6. Capitulum somewhat stellate when viewed from above, green, yellow-green, yellow-brown to pale brown; central part of capitulum not distinctly arching above the outer parts .....**7**

7. Plant coarse; main habitat swampy forests, and meso- and eutrophic mire margins of shrub-mires, in the north also on open rich fen hummocks (and then often with brown capitula) .....**S. centrale (Plate 3)**

7. Plant slender; main habitat mesotrophic fen lawns and high carpets, more rarely low hummocks, rarely in swampy forests .....**S. affine (Plate 5)**

## Sect. Acutifolia

1. Capitulum brownish or with at least some brown, without red .....2

1. Capitulum reddish or red-brown or with at least some reddish or red-brown .....8

1. Capitulum greenish without brown or red ..... 20

** ** * * *

**Capitulum brownish or with at least some brown, without red**

2. Stem leaf apex obtuse-rounded to broadly truncate, at least partly fringed and often widely so .....3

2. Stem leaf apex acute, acute-obtuse to rounded, not or indistinctly fringed .....5

3. Stem leaves widest in their apical part; stem leaf apex and apical part of lateral leaf margins fringed all over .....**S. fimbriatum ssp. concinnum (Plate 8) (Svalbard)**

3. Stem leaves with parallel lateral margins, evenly wide in most of leaf length; stem leaf apex partly to wholly fringed but lateral leaf margins mostly unfringed .....4

4. Stem leaves large and distinctly longer than wide .....**S. arcticum (Plate 9) (Svalbard)**

4. Stem leaves small and not distinctly longer than wide .....**S. girgensohnii (Svalbard plants, and boreal plants in habitats exposed to sun, e.g. after clear-felling of spruce forests)**

5. Stem reddish; capitulum pale yellow-brown; bog and poor fen hummocks and lawns .....**S. rubellum (Plate 16) (brown morph not uncommon among ordinary red S. rubellum on mires in central Norway)**

5. Stem brownish; capitulum yellow-brown, pale brown to dark brown .....6

6. Divergent branches terminating into whitish tips; stem leaves lingulate to lingulate-spathulate with obtuse-rounded apices; semi-dry plants without metallic lustre; capitula brown to dark brown .....**S. fuscum (Plate 22)**

6. Divergent branches not terminating into whitish tips; stem leaves triangular-lingulate with acute to acute-obtuse apices; semi-dry plants with metallic lustre (squeeze out water from the plants!); capitula yellow-brown to pale brown .....7

7. Stem leaf apices acute and often distinctly and abruptly involute; divergent branch leaves narrowly ovate-lanceolate; inner capitulum branches with markedly recurved leaf apices when examined dry .....**S. subnitens ssp. ferrugineum (Plate 19)**

7. Stem leaf apices acute to acute-obtuse and not markedly involute; divergent branch leaves broadly ovate-lanceolate; inner capitulum branches with nearly straight leaf apices when examined dry .....**S. subfulvum ssp. subfulvum (Plate 23)**

*******

**Capitulum reddish or red-brown or with at least some reddish or red-brown**

8. Fascicles with predominantly three divergent branches.....**9**

8. Fascicles with predominantly two divergent branches .....**10**

9. Capitulum distinctly convex when viewed from the sides; divergent branch leaves often in distinct rows particularly on upper branches; stem leaves triangular with fairly acute apices .....**S. quinquefarium (Plate 14)**

9. Capitulum fairly flat when viewed from the sides; divergent branch leaves not in distinct rows; stem leaves lingulate-spathulate with obtuse-truncate and fringed apices .....**S. rubiginosum (Plate 11)**

10. Terminal bud conspicuous and surrounded by flattened inner branches (hand lens); branch leaf apices broad, not innrolled, and distinctly dentate; stem leaves lax, large, broadly ovate to ovate-lingulate, markedly widest at about mid-leaf; plant with a glass-like appearance .....**S. angermanicum (Plate 20)**
**(particularly male plants in autumn have reddish capitula)**

10. Terminal bud invisible or inconspicuous, or when visible not surrounded by distinctly flattened inner branches; branch leaf apices narrow and indistinctly dentate due to innrolled margins; stem leaves widest in their lower part or parallel-sided and evenly wide most of the leaf-length (except **S. molle**; widest at mid-leaf); plant without glass-like appearance .....**11**

11. Capitulum rather flat when viewed from the sides, distinctly stellate when viewed from above; terminal bud visible and sometimes distinct; stem leaves lingulate and mostly parallel-sided, apex rounded and varyingly fringed at the middle .....**S. russowii (Plate 12)**

11. Capitulum nearly flat to markedly convex hemispherical when viewed from the sides; capitulum indistinctly stellate when viewed from above; terminal bud invisible or inconspicuous, stem leaves lingulate to lingulate-triangular and widest in their lower part (except **S. molle**; widest at mid-leaf) .....**12**

12. Capitulum brown with a tinge of red in outer branches .....**S. olafii (Plate 13)**
**(Svalbard)**

12. Capitulum with distinct red, violet-red or pink, without brown .....**13**

13. Forming tight and velvety soft mats and low cushions with an even capitulum structure where the individual capitula are hardly discernible from each other; stem leaves widest at about mid-leaf; divergent branches often somewhat upwards directed; stem pale or pale with flecks of pink .....**S. molle (Plate 21)**
**(usually pale green without red, but sometimes in exposed habitats with at least some violet-red in the outer part of the capitula)**

13. Forming mats and cushions with the individual capitula easily discerned from each other when viewed from above; stem leaves widest in their lower part; divergent branches at least downwards directed in their distal half; stem reddish (at least in flecks) to dark brown red.....**14**

14. Divergent branch leaves distinctly 5-ranked .....**15**

14. Divergent branch leaves non-ranked .....**16**

15. Divergent branches just below the capitulum fairly straight; divergent branch leaves straight and with markedly recurved tips when examined dry; plants often greyish black-violet in their lower parts; growing in intermediate and rich fens .....**S. warnstorfii (Plate 17)**
**(plants in lawns and low hummocks)**

15. Divergent branches just below the capitulum usually curved and often irregularly so; divergent branch leaves often somewhat curved (secund) to one side and not with distinctly recurved tips when dry; plants not greyish black-violet in their lower parts; growing in bogs and poor fens .....**S. rubellum (Plate 16)**
**(plants in high carpets and lawns)**

16. Plants in tight cushions; capitula often hemispherical convex in shape when viewed from the sides and often arranged in a faceted pattern when viewed from above; divergent branches often long, hanging and tapering into distinct whitish tips; divergent branch leaves tightly covering the branch and hide the branch itself; lower parts of plant often coloured like a blood orange; stem leaves narrowly lingulate to lingulate-triangular with acute-obtuse apices .....**S. capillifolium (Plate 15)**

16. Plants in mats or more or less tight cushions; capitula fairly flat to moderately convex, not distinctly arranged in a faceted pattern when viewed from above; divergent branches not particularly long and hanging nor tapering into distinct whitish tips; divergent branch itself visible or not; plant without blood orang colour.....**17**

17. Plants (particularly some distance below the capitulum) with a metallic luster when semi-dry (squeeze out excess water from the plants!); capitulum pink and reddish purple and often with some red-brown, with a greasy appearance when moist; divergent branch leaves tightly arranged and hiding the branch itself; stem leaves mostly lingulate-triangular with acute-rounded, acute to acuminate apex due to innrolled margins.....**18**

17. Plants without metallic lustre when semi-dry; capitulum red to deep red but not reddish purple and without brown-red; divergent branch leaves loosely arranged and often distinctly spreading from branch, the branch itself visible; stem leaves mostly lingulate with acute-obtuse to rounded apex.....**19**

18. Leaves of inner capitulum branches with distinctly recurved tips when examined dry; stem leaf apices often appear narrow due to innrolled margins .....**S. subnitens ssp. subnitens (Plate 18)**

18. Leaves of inner capitulum branches with nearly straight tips when examined dry; stem leaf apices less innrolled above ....**S. subfulvum ssp. purpureum (Plate 24)**

19. Divergent branch leaves straight, not curved to one side, with distinctly recurved tips when examined dry .....**S. warnstorfii (Plate 17)**
**(the Svalbard plant generally and plants in high hummocks in the boreal zone without distinctly 5-ranked leaves)**

19. Some to many divergent branch leaves curved to one side, without distinctly recurved tips when examined dry .....**S. rubellum (Plate 16)**
**(plants in lawns and hummocks)**

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**Capitulum greenish without brown or red**

20. Stem pale without red .....**21**

20. Stem pale with flecks of red .....**25**

21. Stem leaf spathulate and widest in upper portion; stem leaf apex broadly rounded-truncate and fringed throughout; terminal bud conspicuous .....**S. fimbriatum ssp. fimbriatum (Plate 7)**

21. Stem leaf spathulate, lingulate-spathulate or ovate-lingulate; terminal bud invisible, visible to conspicuous .....**22**

22. Apices of divergent branch leaves broad and distinctly dentate; terminal bud conspicuous and surrounded by flattened inner branches; stem leaves widest at or just above mid-leaf .....**S. angermanicum (Plate 20)**

22. Apices of divergent branch leaves narrow and indistinctly dentate; terminal bud visible, but not surrounded by distinctly flattened inner branches; stem leaves widest at mid-leaf or with parallel lateral sides and evenly wide throughout most of the leaf .....**23**

23. Plants in soft, compact mats and low cushions with the individual capitula little discernable from each other; capitula not stellate when viewed from above; stem leaf ovate-lingulate, widest at mid-leaf; stem leaf apex rounded-truncate but not distintly fringed .....**S. molle (Plate 21)**

23. Plants in loose mats with individual capitula easily discernible from each other; capitula distinctly steallate when viewed from above; stem leaf spathulate to lingulate-spathulate; stem leaf apex narrowly to broadly truncate and fringed .....**24**

24. Capitula dull green; many to most or all fascicles with 3 divergent branches; divergent branch leaves lanceolate; monoicous and commonly with abundant sporophytes .....**S. rubiginosum (Plate 11)**

24. Capitula bright green; most or all fascicles with two divergent branches; divergent branch leaves ovate-lanceolate; dioicous and less common with sporophytes .....**S. girgensohnii (Plate 10)**

25. Many to most fascicles with three divergent branches; stem leaves triangular to triangular-lingulate, apex acute; at least the upper divergent branches with 5-ranked leaves .....**S. quinquefarium (Plate 14)**

25.Many to most fascicles with two divergent branches, stem leaves triangular-lingulate to lingulate, apex acute-obtuse to rounded; divergent branch leaves 5-ranked or not .....**26**

26. Divergent branch leaves 5-ranked, but sometimes indistinctly so; fascicles distantly arranged making the stem visible .....**S. warnstorfii (slender plants occurring occasionally in shaded swampy eutrophic forests and forested eutrophic mire margins, and occasionally morphs in exposed habitats)**

26. Divergent branch leaves non-ranked; fascicles tightly arranged and totally covering the stem.....**27**

27. Capitula pale green and plants tightly arranged in soft mats and cushions; divergent branches irregularly curved and not particularly long, branch leaves often curved to one side (secund) .....**S. rubellum (green morph occasionally found among normal red S. rubellum in exposed mire expanse habitats)**

27. Capitula dull green and plants arranged in loose mats and cushions; divergent branches often elongately decurved, branch leaves straight .....**S. capillifolium (in shaded forest habitats)**

27. Occasional green morphs of **S. fuscum** and **S. subnitens ssp. subnitens,** often found growing among normally coloured plants

## Sect. Squarrosa

1. Outer capitulum branches and divergent branches with squarrose leaves .....**2**

1. Outer capitulum branches and divergent branches with imbricate, non-squarrose leaves .....**3**

2. Capitula green; plant slender to moderately robust; terminal bud conspicuous; divergent branch leaves moderately squarrose .....**S. teres (rare plants in shaded mire margins and eutrophic swampy forests)**

2. Capitula green or in exposed habitats and sometimes in Svalbard, yellow-brown; plant robust; terminal bud visible, but not conspicuous; divergent branch leaves distinctly squarrose .....**S. squarrosum (Plate 25)**

3. Leaves in capitula and on divergent branches truncate (square-cut) at their apices (capitula or branches viewed towards the light with a hand lens); capitula green, yellow-green or pale yellow-brown .....**S. tundrae (Plate 27) (Svalbard)**

3. Leaves in capitula and on divergent branches narrowly tapering above and non-truncate and seemingly non-dentate at their apices; capitula green (rarely; see above), yellow-green, or most commonly yellow-brown or brown .....**S. teres (Plate 26)**

## Sect. Subsecunda

1. Outer capitulum branches smooth with tightly imbricate leaves, straight to more or less curved like horns; medium-sized to large plants .....2

1. Outer capitulum branches less smooth with more or less spreading leaves, not particularly horn-like; small to medium-sized plants .....3

2. Plant medium-sized; capitulum dull green, yellow-green, green-brown, yellow-brown or brown; terminal bud conspicuous and surrounded by distinctly flattened inner branches; stem leaves large and concave approaching the branch leaves in both size and shape; fascicles with one pendent branch or pendent branches lacking; stem pale to light brown, never blackish brown .....**S. platyphyllum (Plate 33)**

2. Plant medium-sized to large; capitulum dull green (in low carpets and floating mats), green-yellow, green-brown, or often golden yellow-brown, and sometimes in spring fen habitats and along lake shores, brown-red, and in pools sometimes with a blackish red tinge; terminal bud often visible but usually not conspicuous except in very wet habitats; stem leaves fairly large but shorter and much less concave than the branch leaves; fascicles with usually two pendent branches; stem blackish brown, but robust plants in wet carpets have paler stem ...**S. auriculatum (Plate 32)**

3. Many to most medium-long and outer capitulum branches laterally curved when viewed from above; many to most leaves of divergent branches curved to one side (secund) .....4

3. Medium-long and outer capitulum branches straight or only slightly laterally curved when viewed from above; leaves of divergent branches often straight or curved only in the proximal part of the branch.....5

4. Capitulum golden yellow-orange-brown; stem dark brown except for the upper part just below the capitulum; divergent branch leaves ovate and with only somewhat innrolled margins above .....**S. subsecundum (Plate 30)**

4. Capitulum yellow-green, green-brown or yellow-brown, but lacks distinct orange; stem pale in upper part, pale grey-brown or yellow-brown in lower parts; divergent branch leaves ovate-lanceolate and often narrow above due to innrolled margins .....**S. contortum (Plate 34)**

5. Leaves at the proximal (lower) end of the divergent branches somewhat secund; capitulum dull green or varyingly green-yellow-brown, but not golden yellow-brown; stem leaves look small compared with the branch leaves .....**S. inundatum (Plate 31)**

5. Leaves of divergent branches straight or indistinctly curved (including the leaves near the proximal end of the branches); capitulum often golden yellow-brown and sometimes have a dark reddish strain; stem leaves look fairly large compared with the branch leaves .....**S. auriculatum (Plate 32)**
**(small plants along spring edges and streams in snow-bed depressions in the mountains, and in wet soaks on shallow peat and on rocks in coastal heath)**

## Sect. Cuspidata

*Sphagnum tenellum* (Sect. Mollusca) is also included in this key.

**A. Main key** ..... **p. 28**

**B. Key to species which always or not uncommonly occur with green capitula in the field** ..... **p. 33**

**C. Key to male plants of species in the S. recurvum complex (angustifolium, brevifolium, fallax, flexuosum, isoviitae) including S. balticum and S. pulchrum** ..... **p.34**

## A. Main key

1. Stem dark brown, to pale brown/reddish; divergent branch leaves 5-ranked; terminal bud of capitulum distinct ..... **2**

1. Stem pale, pale with a reddish tinge in portions to pale red-brown/brown in the greater part; divergent branch leaves non-ranked or 5-ranked; terminal bud invisible to conspicuous ..... **3**

2. Stem leaves spathulate with broadly obtuse and fringed apex; capitulum and stem usually dark brown ..... **S. lindbergii (Plate 51)**

2. Stem leaves ovate-triangular to triangular with acute to apiculate apex; capitulum brown, yellowish green-brown to sometimes green; stem pale brown/reddish ..... **S. pulchrum (Plate 43)**

3. Stem leaves deeply notched or torn at the middle of the apex; capitulum green; terminal bud conspicuous; divergent branch leaves non-ranked; coarse green plant. ..... **S. riparium (Plate 50)**

3. Stem leaves acute to obtuse at apex and not notched or torn; capitulum green, yellowish green, yellowish brown to ± brown; divergent branch leaves non-ranked to 5-ranked; terminal bud invisible to distinct ..... **4**

4. Plant small and delicate; no clear distinction between pendent and divergent branches; stem leaves ovate-lingulate and approaching the branch leaves in both size and shape; divergent branch leaves ovate and arranged on the branch like a row of pearls ..... **S. tenellum (Plate 52)**

4. Plant small (but then with clear differentiation between pendent and divergent branches), medium-sized to large; stem leaves ovate-triangular, lingulate-triangular to triangular, divergent branch leaves ovate-lanceolate to lanceolate ..... **5**

5. Pendent branches not tightly covering the stem, but somewhat to distinctly spreading ..... **6**

5. Pendent branches tightly covering the stem (two alternatives, A and B) .....**16**

6. Capitulum distinctly convex (as viewed from the sides), and often indistinctly 5-radiate when viewed from above; divergent branches often terminating into a sigmoidally-curved point; at least some leaves in distal half of divergent branches markedly subsecund .....**7**

6. Capitulum fairly flat to somewhat convex, and often distinctly 5-radiate when viewed from above; divergent branches ± decurved but not terminating into a sigmoidally-curved point; leaves in distal half of divergent branches straight to indistinctly subsecund .....**11**

7. Capitulum branches predominantly greenish .....**8**

7. Capitulum branches predominantly brownish .....**10**

8. Capitulum branches dirty yellowish grey-green (often with a weak brownish tinge) throughout; divergent branches themselves red-brown in their proximal part; stem leaf apex acute, acute-obtuse to obtuse .....**S. majus (Plates 37 & 38)**

8. Capitulum branches dull green in their outer part and red-brown in inner part; divergent branches themselves distinctly red-brown in their proximal half; stem leaf apex acute to acuminate .....**S. cuspidatum (Plate 35)**

8. Capitulum branches bright green to yellowish green throughout; divergent branches themselves without red or occasionally weakly red at proximal end; stem leaf apex acute to acuminate .....**S. viride (Plate 36)**

10. At least some of the outer branches of the capitulum obtuse and swollen and darker at their distal end than elsewhere .....**male plants of S. cuspidatum, S. viride and S. majus during autumn (Plates 35 & 36)**

10. Outer branches of the capitulum narrowly tapering and not markedly darker at their distal end than elsewhere .....**S. majus (Plates 37 & 38)**

11. Divergent branch leaves distinctly 5-ranked .....**12**

11. Divergent branch leaves non-ranked .....**13**

12. Terminal bud of capitulum distinct to conspicuous; fascicles with two pendent branches, divergent branches stout and often abruptly tapering .....**S. pulchrum (Plate 43)**

12. Terminal bud of capitulum invisible to visible but inconspicuous; fascicles often with one pendent branch; divergent branches slender and narrowly tapering .....**S. balticum (Plate 41)**

13. Plants soft and often with a metallic lustre when semi-dry; some of the outer branches of capitulum and divergent branches below capitulum with distal ends thin, whitish/silvery and with marked distantly arranged leaves .....**S. troendelagicum (Plate 42)**

13. Plants not particular soft nor with a metallic lustre when semi-dry; outer branches of capitulum and divergent branches below capitulum not particularly thin or pale at their distal ends, branch leaves are rather tightly arranged.....**14**

14. Capitulum small, rarely exceeding 10(-15) mm in diameter; many to most of the medium-long and outer branches of capitulum rather abruptly and obtusely ending.....**S. balticum (Plate 41)**

14. Capitulum medium-sized to sometimes very large, usually exceeding 15 mm in diameter; most of the medium-long and outer branches of the capitulum gradually and narrowly tapering.....**15**

15. Capitulum glossy; terminal bud of capitulum always visible and usually conspicuous; outer branches of the capitulum markedly arcuato-decurved in their distal part; leaves of divergent branches distinctly concave and distinctly smalle and more ovate near the proximal end than in the middle part of the branch .....**S. annulatum (Plate 39)**

15. Capitulum dull and not particular glossy; terminal bud of capitulum usually visible but inconspicuous and sometimes hidden by incurved inner branches; outer branches of capitulum fairly straight to only somewhat decurved in their distal part; leaves of divergent branches not markedly concave and not distinctly ovate nor distinctly shorter near the proximal end than in the middle part of the branch .....**S. jensenii (Plate 39)**

*******

**Pendent branches tightly covering the stem. Alternative a.**

16. Pendent branches distinctly longer than divergent ones; capitulum distinctly convex when viewed from the sides; capitulum branches straight to (only the inner ones) slight laterally curved; stem leaves small (ca. 0.8 mm) and pendent-appressed to stem .....**S. angustifolium (Plate 47)**

16. Pendent branches about equally long as or somewhat shorter than divergent ones; capitulum convex to rather flat when viewed from the sides; capitulum branches ± curved; stem leaves longer (usually> 0.9 mm) and predominantly spreading-pendent to spreading from stem .....**17**

17. Terminal bud of capitulum distinct to conspicuous; divergent branches stout; divergent branch leaves 5-ranked .....**S. pulchrum (Plate 43)**

17. Terminal bud of capitulum invisible to visible but not conspicuous; divergent branches rather slender; divergent branch leaves non-ranked to 5-ranked .....**18**

18. Many to most of capitulum branches laterally curved when viewed from above .....**19**

18. At least some of medium-long and outer branches rather straight when viewed from above .....**21**

19. Capitulum with obtusely tapering medium-long branches .....**20**

19.Capitulum with fairly acute tapering branches including the medium-long branches.....**S. brevifolium (Plate 45)**

20.Capitulum branches coarse and distinctly laterally curved when viewed from above; stem leaves mostly pendent-spreading; stem leaf apex obtuse-truncate and ± fringed .....**S. obtusum (Plate 49)**

20.Capitulum branches not particular coarse and only somewhat laterally curved when viewed from above; stem leaves mostly pendent-appressed; stem leaf apex fairly acute and non-fringed .....**S. fallax (Plate 44)**

21.Capitulum distinctly brownish; terminal bud visible; divergent branch leaves more or less 5-ranked; divergent branches themselves distinctly reddish in their proximal half .....**22**

21.Capitulum green to greyish green-brown; terminal bud mostly invisible; divergent branch leaves non-ranked; divergent branches themselves pale throughout or weakly reddish close to their proximal end .....**S. flexuosum (Plate 48)**

22.Divergent branch leaves usually indistinctly 5-ranked; stem leaves stiffly spreading from stem, markedly concve; stem leaf apex obtuse-rounded (but sometimes look acutish due to innrolled margins); fascicles often with only one pendent branch
.....**S. balticum (Plate 41)**

22.Divergent branch leaves distinctly 5-ranked; stem leaves spreading-pendent to pendent-appressed, not markedly concave; stem leaf apex acute and often apiculate; fascicles with two pendent branches .....**S. isoviitae (Plate 46)**

*******

**Pendent branches tightly covering the stem. Alternative b.**

16. Capitulum green .....**17**

16. Capitulum more or less brownish.....**20**

17.Terminal bud distinct to conspicuous and often surrounded by inner branches, which are paler than outer ones; divergent branch leaves 5-ranked
.....**S. pulchrum (Plate 43)**

17.Terminal bud visible but not conspicuous and inner branches surrounding the capitulum not particularly paler than the outer ones; branch leaves non-ranked to only indistinctly 5-ranked .....**18**

18. Plant coarse; most of the capitulum branches marked laterally curved when viewed from above; stem leaves mostly spreading-pendent from stem .....**S. obtusum (Plate 49)**

18. Plant rather slender; capitulum branches more or less laterally curved when viewed from above; stem leaves mostly pendent-appressed .....**19**

19. Capitulum rather clearly differentiated in inner (often 'yarn-like') part of small and tightly arranged (often in a concentric pattern) branches and an outer part of long, thin and pale-whitish branches forming a rather distinct stellate shape when viewed from above; stem leaf apex obtuse-rounded and somewhat fringed .....**S. flexuosum (Plate 48)**

19. Capitulum not clearly differentiated in an inner and outer part when viewed from above; outer branches not particular long, thin and pale, forming a less distinct stellate shape when viewed from above; stem leaf apex acutish and not fringed .....**S. fallax (Plate 44)**
**(see also S. angustifolium, Plate 47)**

20. Divergent branches themselves pale throughout or slightly reddish just near their proximal end; stem leaf apex obtuse-rounded and slightly to somewhat fringed .....**21**

20. Divergent branches themselves reddish to brownish in at least their proximal half; stem leaf apex acute-obtuse, acute or apiculate .....**23**

21. Plants slender; capitulum clearly differentiated in an inner and outer part when viewed from above, with the outer branches long, thin and pale and forming a distinct stellate shape when viewed from above, inner part with tightly often concentrically arranged short branches; stem leaf apex obtuse-rounded and somewhat fringed .....**S. flexuosum (Plate 48)**

21. Plants slender to coarse; capitulum not clearly differentiated in an inner and outer part when viewed from above, and without a stellate shape of long, thin and pale outer branches; stem leaf apex obtuse-truncate, obtuse-rounded or fairly acute.....**22**

22. Plant coarse; most capitulum branches marked laterally curved when viewed from above; stem leaves mostly divergent-spreading; stem leaf apex obtuse-truncate to obtuse-rounded and somewhat fringed .....**S. obtusum (Plate 49)**

22. Plant fairly slender; at least some capitulum branches somewhat laterally curved when viewed from above; stem leaves mostly pendent-appressed; stem leaf apex fairly acute and non-fringed .....**S. fallax (Plate 44)**

23. Capitulum markedly convex when viewed from the sides; terminal bud invisible; pendent branches longer than divergent ones; most capitulum branches rather straight when viewed from above; stem leaves short (ca. 0.8 mm) and pendent -appressed to stem .....**S. angustifolium (Plate 47)**

23. Capitulum almost flat to only moderately convex when viewed from the sides; terminal bud visible to distinct; pendent branches about equally long as or somewhat shorter than divergent ones; many capitulum branches somewhat laterally curved when viewed from above; stem leaves longer (usually 0.9-1.1 mm), mostly spreading to pendent-spreading from stem..... .....**24**

24. Terminal bud distinct to sometimes conspicuous; divergent branches stout, fairly straight to only somewhat decurved in their distal half and often terminating rather abruptly; stem often pale reddish/brownish .....**S. pulchrum (Plate 43)**

24. Terminal bud usually visible but not conspicuous; divergent branches slender, markedly decurved in their distal half and terminating gradually and narrowly; stem usually pale or pale with reddish portions, more rarely pale brownish more or less throughout .....**25**

25. Stem leaves markedly concave and stiffly spreading from stem; fascicles often with only one pendent branch .....**S. balticum (Plate 41)**

25. Stem leaves not markedly concave and mostly pendent-spreading from stem; fascicles with two pendent branches .....**26**

26. Most capitulum branches - also often the outer ones - more or less laterally curved when viewed from above and acutish tapering; stem leaves rather densely arranged .....**S. brevifolium (Plate 45)**

26. Many to most of the inner and medium-long capitulum branches somewhat laterally curved, but outer ones often rather straight; medium-long branches acute-obtusely tapering; medium-long and outer capitulum branches often distinctly browner at their distal end than otherwise; stem leaves more distantly arranged .....**S. isoviitae (Plate 46)**

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**B. Key to species which always or not uncommonly occur with green capitula**

1. Plant small and delicate; no clear distinction between pendent and divergent branches; stem leaves ovate-lingulate and approaching the branch leaves in both size and shape; divergent branch leaves ovate and loosely arranged on the branch like a row of pearls .....**S. tenellum (Plate 52)**

1. Plant medium-sized to large; stem leaves ovate-triangular, lingulate-triangular to triangular; divergent branch leaves ovate-lanceolate to lanceolate .....**2**

2. Capitulum with distinct to conspicuous terminal bud .....**3**

2. Capitulum with invisible to inconspicuous terminal bud .....**4**

3. Divergent branches terete and smooth with imbricate and non-ranked leaves; stem leaves with notched and torn apex .....**S. riparium (Plate 50)**

3. Divergent branches with loosely arranged, non-imbricate and usually 5-ranked leaves; stem leaf apex fairly acute and not notched .....**S. pulchrum (Plate 43)**

4. Pendent branches somewhat to distinctly spreading from stem; divergent branches commonly sigmoidally-curved at their distal ends; leaves in distal part of divergent branches distinctly subsecund
.....**5**

4. Pendent branches covering the stem; divergent branches decurved in their distal part, but without sigmoidally-curved ends; leaves in distal part of divergent branches rather straight to only somewhat subsecund .....**6**

5. Capitulum branches dull green except for red-brown basal parts
.....**S. cuspidatum (Plate 35)**

5. Capitulum branches dirty yellowish grey-green throughout
.....**S. majus ssp. norvegicum (Plate 38)**

5. Capitulum branches bright green to yellowish green throughout
.....**S. viride (Plate 36)**

6. Pendent branches longer than divergent ones; capitulum branches mostly straight when viewed from above .....**S. angustifolium (Plate 47)**

6. Pendent branches about equally long as or somewhat shorter than divergent ones; some to many capitulum branches laterally curved when viewed from above .....**7**

7. Capitulum rather clearly differentiated in an inner (often yarn-like) convex part with short and often concentrically arranged acute-obtuse inner branches, and an outer part of long, thin and pale branches forming a stellate shape when viewed from above; stem leaf apex obtuse-rounded and somewhat fringed
.....**S. flexuosum (Plate 48)**

7. Capitulum not clearly differentiated into an inner and outer part when viewed from above, but with more gradual transitions from the short inner branches to the long outer ones; stem leaf apex obtuse-truncate or fairly acute .....**8**

8. Capitulum branches coarse and many to most of them marked laterally curved when viewed from above; stem leaves mostly divergent-pendent; stem leaf apex obtuse-truncate and somewhat fringed .....**S. obtusum (Plate 49)**

8. Capitulum branches not particularly coarse and only somewhat laterally curved; stem leaves mostly pendent-appressed; stem leaf apex fairly acute
.....**S. fallax (Plate 44)**

**C. Key to male plants of species in the S. recurvum complex (S. angustifolium, S. brevifolium, S. fallax, S. flexuosum, S. isoviitae) including S. balticum and S. pulchrum**

This key considers male plants during autumn when antheridial branches are formed in the capitula. The antheridial branches are recognized by their swollen distal ends, which are darker brown than the remainder of the branch. The swollen ends consist of tightly imbricate perigonial leaves which are more ovate in shape than the ordinary leaves on the branch. One ± sphaerical to ovoid translucent antheridium is present in the axil on the inside of each perigonial leaf. The antheridia can be seen even in the field with a good hand lens, and are easily seen under the dissection microscope in the laboratory.

The key includes all species in the section which have pendent branches covering the stem, except for *S. obtusum* and *S. riparium.*

1. Capitulum rather flat to only somewhat convex when viewed from the sides .....**2**

1. Capitulum distictly convex when viewed from the sides (at least the inner part) ....**3**

2. Stem leaves distinctly concave and stiffly spreading from the stem; fascicles often with only one pendent branch .....**S. balticum**

2. Stem leaves not distinctly concave; most stem leaves pendent -spreading to pendent -appressed to stem; fascicles with two pendent branches .....**S. isoviitae (Plate 44 & 46)**

3. Antheridial branches laterally curved when viewed from above .....**S. brevifolium**

3. Antheridial branches straight .....**4**

4. Pendent branches longer than divergent ones .....**S. angustifolium**

4. Pendent branches equally long as or somewhat shorter than divergent ones .....**5**

5. Stem leaf apex obtuse and somewhat fringed; divergent branch leaves non-ranked .....**S. flexuosum**

5. Stem leaf apex fairly acute and non-fringed; divergent branch leaves more or less 5-ranked .....**6**

6. Divergent branches stout; most stem leaves divergent to divergent -pendent from stem; stem often pale red-brown .....**S. pulchrum**

6. Divergent branches rather slender; most stem leaves divergent-pendent to pendent-appressed to stem; stem pale or rarely with pale reddish flecks .....**S. fallax (Plate 44 & 46)**

## Sect Rigida

1. Capitulum green, yellow-green or occasionally in very exposed habitats, pale yellow-brown; leaves in the capitulum and on divergent branches, squarrose and with truncate, dentate apices (easily seen when the capitulum is held up towards the light and examined with a hand lense); stem pale or sometimes in exposed habitats with pale yellow-brown flecks .....**S. strictum (Plate 54)**

1. Capitulum occasionally (in shade) greenish, usually variegated green and yellow-brown, orange-brown or brown, sometimes purple-brown; leaves in the capitulum with hooded apices but which are not roughened with small teeth (scabrid) on the convex surface (as species in Sect. Sphagnum); divergent branch leaves usually non-squarrose, but sometimes in shade with sub-squarrose leaves; stem dark brown to black, but paler in shaded habitats .....**S. compactum (Plate 53)**

## 8 Survey of colour plates: taxonomic arrangement of taxa

**Sect. Sphagnum**

| | |
|---|---|
| *Sphagnum magellanicum* Brid. | Plate 1 |
| *Sphagnum palustre* L. | Plate 2 |
| *Sphagnum centrale* C. Jens. | Plate 3 |
| *Sphagnum papillosum* H. Lindb. | Plate 4 |
| *Sphagnum affine* Ren. & Card. | Plate 5 |
| *Sphagnum austinii* Sull. | Plate 6 |

**Sect. Acutifolia**

| | |
|---|---|
| *Sphagnum fimbriatum* Wils. ssp. *fimbriatum* | Plate 7 |
| *Sphagnum fimbriatum* Wils. ssp. *concinnum* (Berggr.)Flatb. & Frisv. | Plate 8 |
| *Sphagnum arcticum* Flatb. & Frisv. | Plate 9 |
| *Sphagnum girgensohnii* Russ. | Plate 10 |
| *Sphagnum rubiginosum* Flatb. | Plate 11 |
| *Sphagnum russowii* Warnst. | Plate 12 |
| *Sphagnum olafii* Flatb. | Plate 13 |
| *Sphagnum quinquefarium* (Braithw.)Warnst. | Plate 14 |
| *Sphagnum capillifolium* (Ehrh.)Hedw. | Plate 15 |
| *Sphagnum rubellum* Wils. | Plate 16 |
| *Sphagnum warnstorfii* Russ. | Plate 17 |
| *Sphagnum subnitens* Russ. & Warnst. ssp. *subnitens* | Plate 18 |
| *Sphagnum subnitens* Russ. & Warnst. ssp. *ferrugineum* Flatb. | Plate 19 |
| *Sphagnum angermanicum* Melin | Plate 20 |
| *Sphagnum molle* Sull. | Plate 21 |
| *Sphagnum fuscum* (Schimp.)Klinggr. | Plate 22 |
| *Sphagnum subfulvum* Sjörs ssp. *subfulvum* | Plate 23 |
| *Sphagnum subfulvum* Sjörs ssp. *purpureum* Flatb. | Plate 24 |

**Sect. Squarrosa**

| | |
|---|---|
| *Sphagnum squarrosum* Crome | Plate 25 |
| *Sphagnum teres* (Schimp.)Ångstr. | Plate 26 |
| *Sphagnum tundrae* Flatb. | Plate 27 |

**Sect. Insulosa**

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|---|---|
| *Sphagnum aongstroemii* C. Hartm. | Plate 28 |

**Sect. Polyclada**

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|---|---|
| *Sphagnum wulfianum* Girg. | Plate 29 |

**Sect. Subsecunda**

| | |
|---|---|
| *Sphagnum subsecundum* Nees | Plate 30 |
| *Sphagnum inundatum* Russ. | Plate 31 |
| *Sphagnum auriculatum* Schimp. | Plate 32 |
| *Sphagnum platyphyllum* (Braithw.)Warnst. | Plate 33 |
| *Sphagnum contortum* Schultz | Plate 34 |

**Sect. Cuspidata**

| | |
|---|---|
| *Sphagnum cuspidatum* Ehrh. ex Hoffm. | Plate 35 |
| *Sphagnum viride* Flatb. | Plate 36 |
| *Sphagnum majus* (Russ.)C. Jens. ssp. *majus* | Plate 37 |
| *Sphagnum majus* (Russ.)C. Jens. ssp. *norvegicum* Flatb. | Plate 38 |
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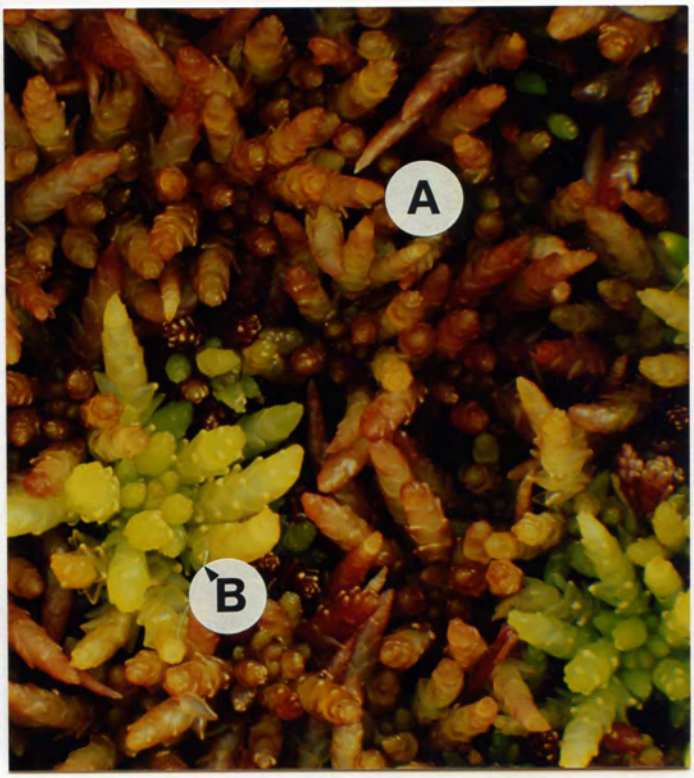
| | 2 | Bretten, S. & A. Krovoll (red.). Fagmøte i vegetasjonsøkologi på Kongsvold 1990 og 1991. 168 s. | kr 100 |
| 1992 | 1 | Bretten, S. & A. Krovoll (red.). Fagmøte i vegetasjonsøkologi på Kongsvold 1992. 100 s. | kr 100 |
| 1993 | 1 | Arnesen, T., A. Moen & D.-I. Øien. Sølendet naturreservat. Oversyn over aktiviteteten i 1992 og sammendrag for DN-prosjektet "Sølendet". 62 s. | kr 100 |
| | 2 | Krovoll, A. & A. Moen (red.). Fagmøte i vegetasjonsøkologi på Kongsvoll 1993. 76 s. | kr 100 |
| 1994 | 1 | Moen, A. & R. Binns (eds.). Regional variation and conservation of mire ecosystems. Summary of papers. 61 s. | kr 100 |
| | 2 | Moen, A. & S. Singsaas. Excursion guide for the 6th IMCG field symposium in Norway 1994. 159 s. | kr 100 |
| | 3 | Flatberg, K. I. Norwegian Sphagna. A field colour guide. 42 s. 54 pl. | utgått |
| | 4 | Aune, E. I. & A. Moen. (red.). Fagmøte i vegetasjonsøkologi på Kongsvoll 1994. 50 s. | kr 50 |
| | 5 | Arnesen, T. Vegetasjonsendringer i tilknytning til tråkk og tilrettelegging av natursti i Sølendet naturreservat. 49 s. | kr 50 |
| 1995 | 1 | Singsaas, S. Botaniske undersøkelser for konsesjonssøknad i forbindelse med planer om overføring av Nesåa, Nord-Trøndelag. 56 s. | kr 100 |
| | 2 | Holien, H. & T. Prestø. Kartlegging av nøkkelbiotoper for trua og sårbare lav og moser i kystgranskog langs Arnevik-vassdraget, Åfjord kommune, Sør-Trøndelag. 32 s. | kr 50 |
| | 3 | Aune, E. I. & A. Krovoll (red.). Fagmøte i vegetasjonsøkologi på Kongsvoll 1995. 81 s. | kr 100 |
| | 4 | Singsaas, S. Botaniske undersøkelser med skisse til skjøtselsplan for Garbergmyra naturreservat, Meldal, Sør-Trøndelag. 31 s. | kr 50 |
| | 5 | Prestø, T. & H. Holien. Floraundersøkelser i Øggdalen, Holtålen kommune, Sør-Trøndelag - grenser for framtidig landskapsvernområde og konsekvenser for skogsdrift. 24 s. | kr 50 |
| | 6 | Mathiassen, G. & A. Granmo. The11th Nordic mycological Congress in Skibotn, North Norway 1992. 77 s. | kr 100 |
| | 7 | Holien, H. & T. Prestø. Inventering av lav- og mosefloraen ved Henfallet, Tydal kommune, Sør-Trøndelag. 26 s. | kr 50 |
| | 8 | Holien, H. & S. Sivertsen. Botaniske registreringer i Storbekken, Lierne kommune, Nord-Trøndelag. 24 s. | utgått |
| 1996 | 1 | Sagmo Solli, I.M., Flatberg, K.I., Söderström, L., Bakken, S. & Pedersen, B. Blanksigd og luftforurensninger - fertilitetsstudier. 14 s. | kr 50 |
| | 2 | Prestø, T. & Holien, H. Botaniske undersøkelser i Lybekkdalen, Røyrvik kommune, Nord-Trøndelag. 44 s. | kr 50 |
| | 3 | Elven, R., Fremstad, E., Hegre, H., Nilsen, L. & Solstad, H. Botaniske verdier i Dovrefjell-området. 151 s. | kr 100 |
| | 4 | Söderström, L. & Prestø, T. State of Nordic bryology today and tomorrow. Abstracts and shorter communications from a meeting in Trondheim December 1995. 51 s. | kr 100 |
| 1997 | 1 | Fremstad, E. (red.). Fagmøte i vegetasjonsøkologi på Kongsvoll 1996. 175 s. | kr 100 |
| | 2 | Øien, D-I, Nilsen. L.S., & Moen, A. Skisse til skjøtselsplan for deler av Øvre Forra natur-reservat i Nord-Trøndelag. 26 s. | kr 50 |
| | 3 | Nilsen, L.S., Moen, A. & Solberg, B. Botaniske undersøkelser av slåttemyrer i den foreslåtte nasjonalparken i Snåsa og Verdal. 38 s. | kr 50 |
| 1998 | 1 | Smelror, M. (red.). Abstracts from the Sixth International Conference on Modern and Fossil Dinoflagellates Dino 6, Trondheim, June 1998. 154 s. | kr 100 |
| | 2 | Sarjeant, W.A.S. From excystment to bloom? Personal recollections of thirty-five years of dinoflagellate and acritarch meetings. 21 s., 14 pl. | utgått |
| | 3 | Fremstad, E. Nasjonalt rødlistede karplanter i Nord-Trøndelag. 37 s. | kr 50 |
| | 4 | Fremstad, E. (red.). Fagmøte i vegetasjonsøkologi på Kongsvoll 1998. 73 s. | kr 100 |
| | 5 | Nilsen, L.S. Skisse til skjøtselsplan for Kjeksvika-området i Nærøy, Nord-Trøndelag. 22 s. | kr 50 |
| 1999 | 1 | Prestø, T. Botanisk mangfold i Rotldalen, Selbu, Sør-Trøndelag. 65 s. | kr 100 |

| | | | |
|---|---|---|---|
| 1999 | 2 | Tretvik, A.M. & Krogstad. K. Historisk studie av utmarkas betydning økonomisk og sosialt innen Tågdalen naturreservat for Dalsegg-grenda i Øvre Surnadal. 38 s. | kr 100 |
| 2000 | 1 | Nilsen, L.S. & Fremstad, E. Skjøtselsplan for Skeisnesset, Leka, Nord-Trøndelag. 31 s. | kr 100 |
| | 2 | Nilsen, L.S. & Moen, A. Botanisk kartlegging og plan for skjøtsel av Oppgården med utmark i Lierne. 44 s. | kr 100 |
| | 3 | Fremstad, E. Botanisk mangfold i Verdal, dokumentert hovedsakelig med litteratur og herbariemateriale. 81 s. | kr 100 |
| | 4 | Holien, H., Prestø, T. & Sivertsen, S. Lav, moser og sopp i barskogreservatene Hilmo og Råndalen, Tydal og Selbu, Sør-Trøndelag. 32 s. | kr 50 |
| | 5 | Fremstad, E. & Nilsen, L.S. Botaniske undersøkelser og forslag til skjøtsel av kulturmark på Nærøya. 34 s. | kr 100 |
| | 6 | Fremstad, E. Skjøtselsplan for innmarka til Kongsvold Fjeldstue. 34 s. | kr 100 |
| | 7 | Moen, A. Botanisk kartlegging og plan for skjøtsel av Tågdalen naturreservat i Surnadal. 45 s. | kr 100 |
| | 8 | Prestø, T. Sammenhenger mellom forstlige variabler og botanisk diversitet i Trondheim bymark. 56 s. | kr 100 |
| | 9 | Nilsen, L.S. Botanisk kartlegging og plan for skjøtsel av sørvestlige deler Aspøya i Flatanger, Nord-Trøndelag. 26 s. | kr 100 |
| | 10 | Fremstad, E. & Nilsen, L.S. Tarva: verdifull kulturmark i utmark. 29 s. | kr 100 |
| 2001 | 1 | Arnesen, T. Botaniske undersøkelser og forslag til skjøtsel av Brakstadøyene (Måsøya og Nordøya) i Fosnes. 29 s. | kr 100 |
| | 2 | Arnesen, T. Knollmjødurt *(Filipendula vulgaris)* på Skånes, Levanger. 16 s. | kr 50 |
| | 3 | Arnesen, T. & Øien, D.-I. Myrområdet ved Tvinna, Stryn. 16 s. | kr 50 |
| | 4 | Fremstad, E. & Moen, A. (red.) Truete vegetasjonstyper i Norge. 231 s. | kr 100 |
| | 5 | Prestø, T. & Holien, H. Forvaltning av lav og moser i boreal regnskog. 77 s. | kr 100 |
| 2002 | 1 | Flatberg, K.I. The Norwegian Sphagna: a field colour guide. 44 s. + 54 Plates. | kr 300 |

# Sphagnum magellanicum Brid.

Plate 1

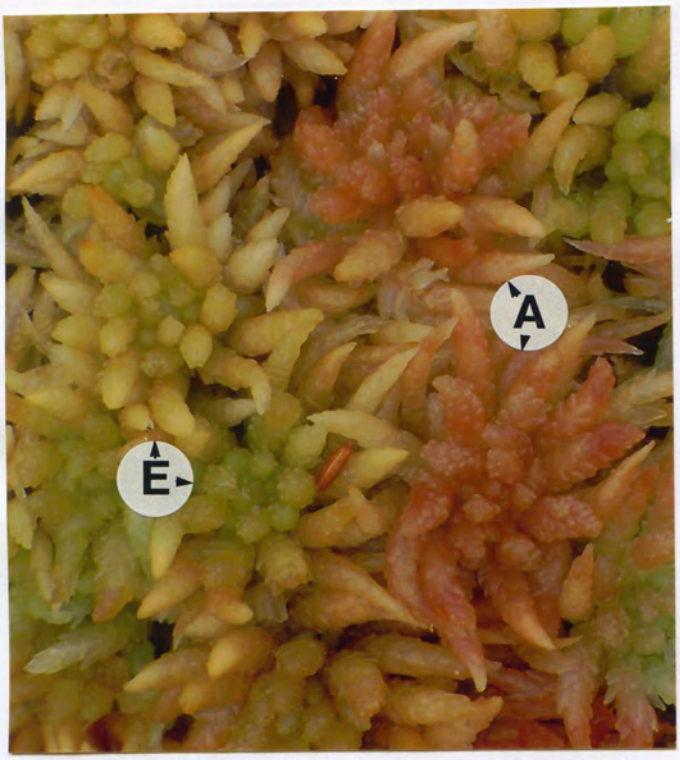


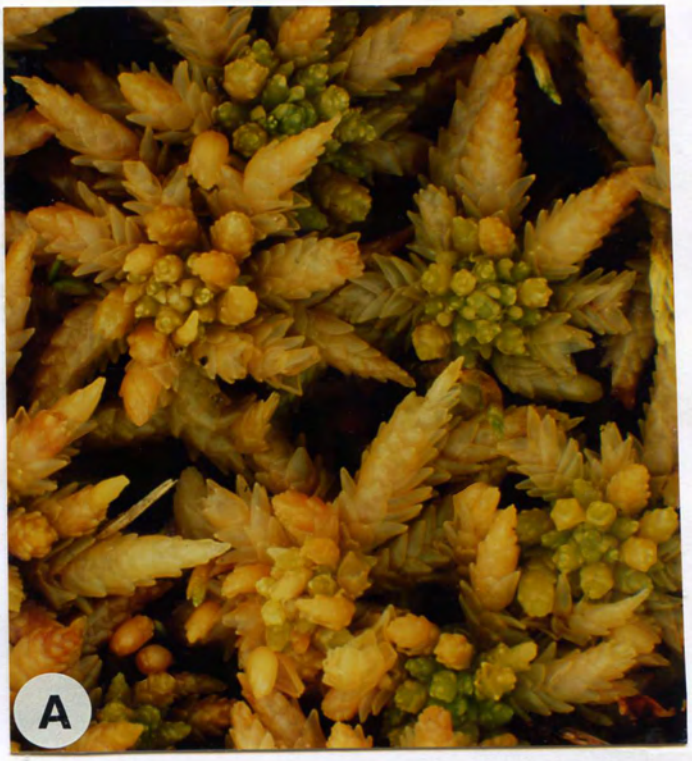
A: magellanicum
B: papillosum

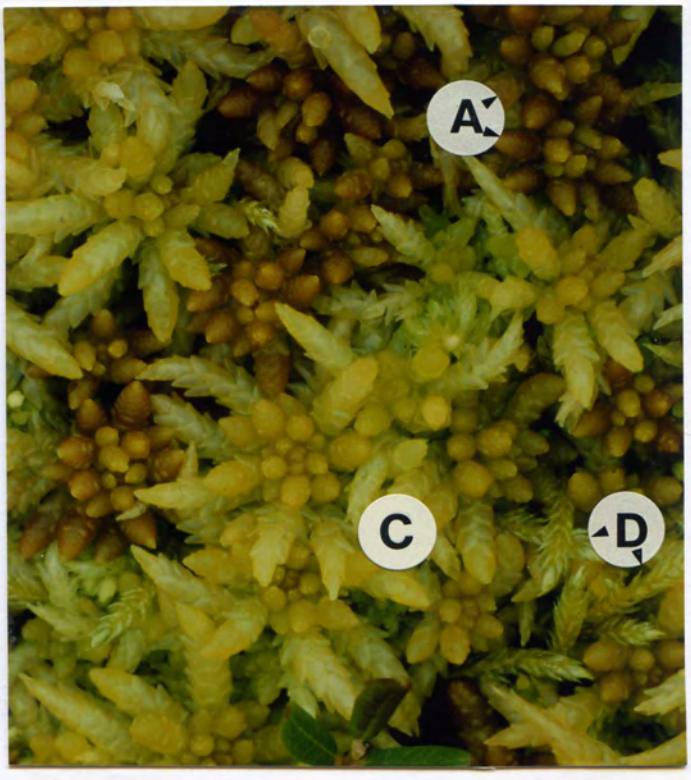
C: angustifolium, male

# Sphagnum palustre L.





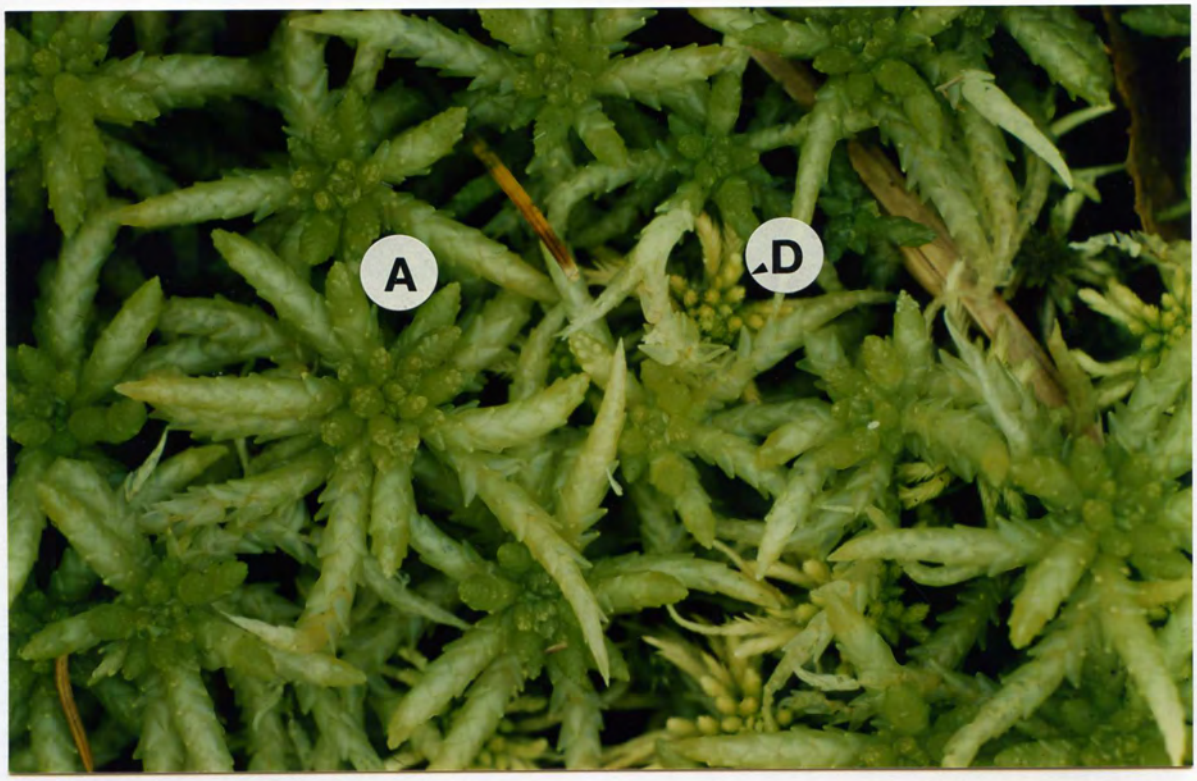






A: palustre, female
B: palustre, male
C: papillosum
D: Straminergon stramineum
E: centrale

# Sphagnum centrale C. Jens.



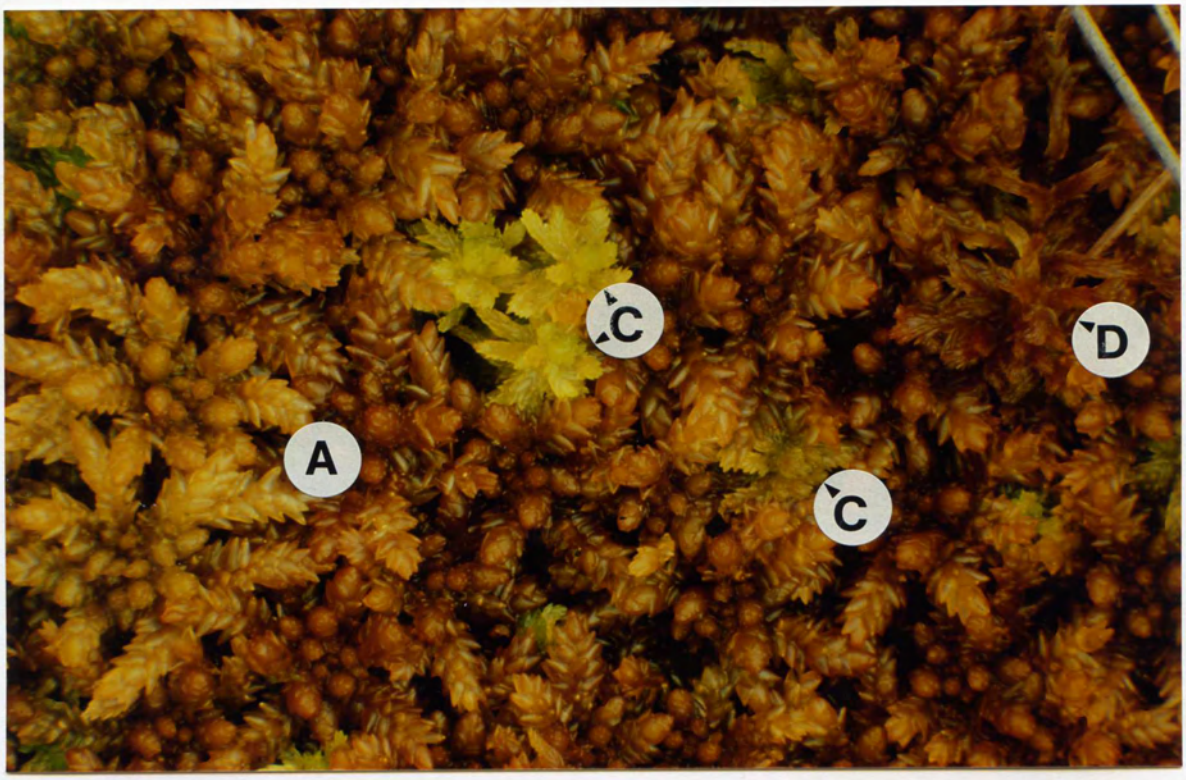


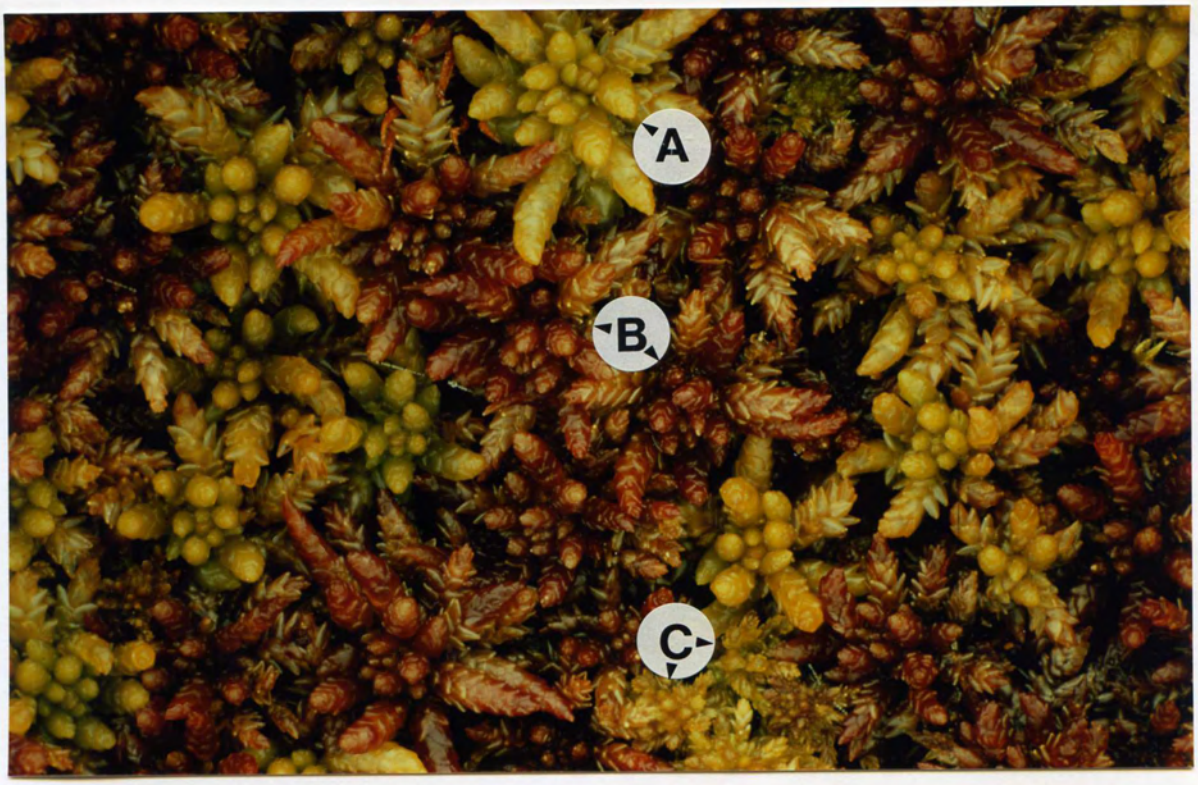
A: centrale
B: papillosum
C: contortum

D: girgensohnii
E: Straminergon stramineum

# Sphagnum papillosum H. Lindb.



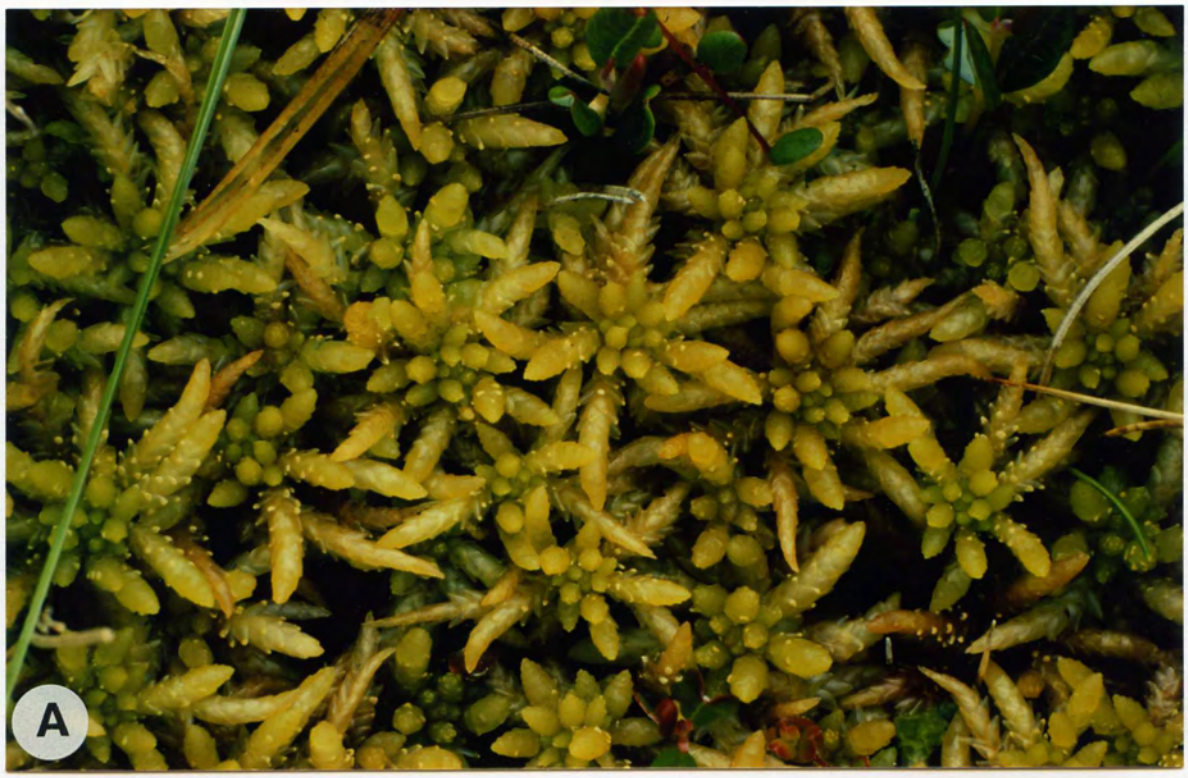


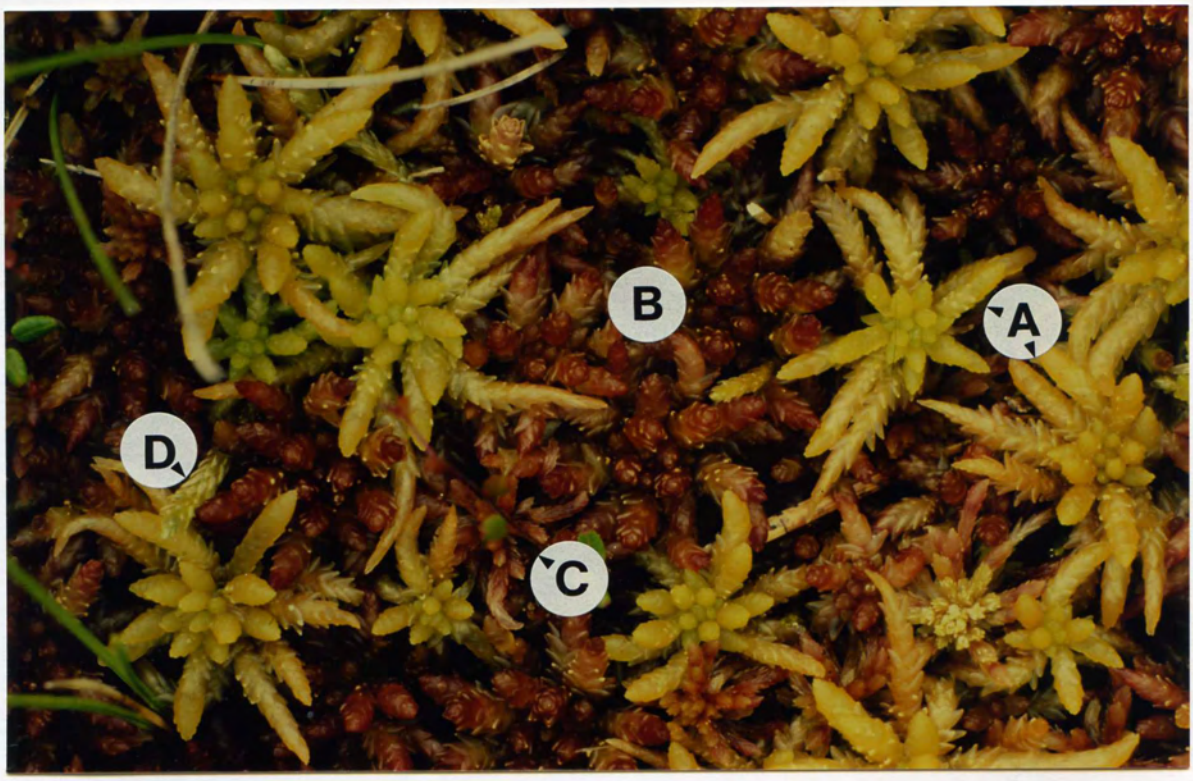




A: papillosum
B: magellanicum
C: tenellum
D: balticum

# Sphagnum affine Ren. & Card.

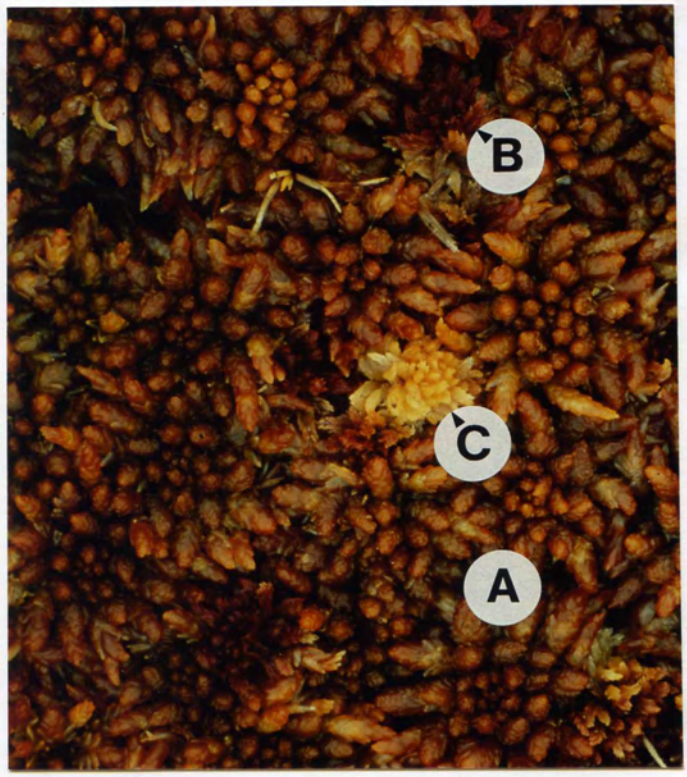


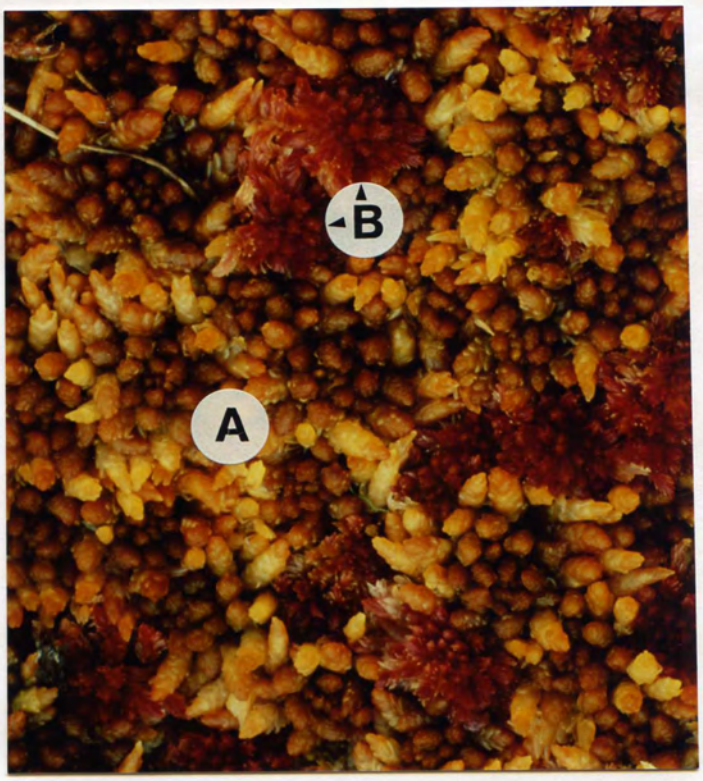



**A: affine**
**B: magellanicum**
**C: rubellum**
**D: Straminergon stramineum**

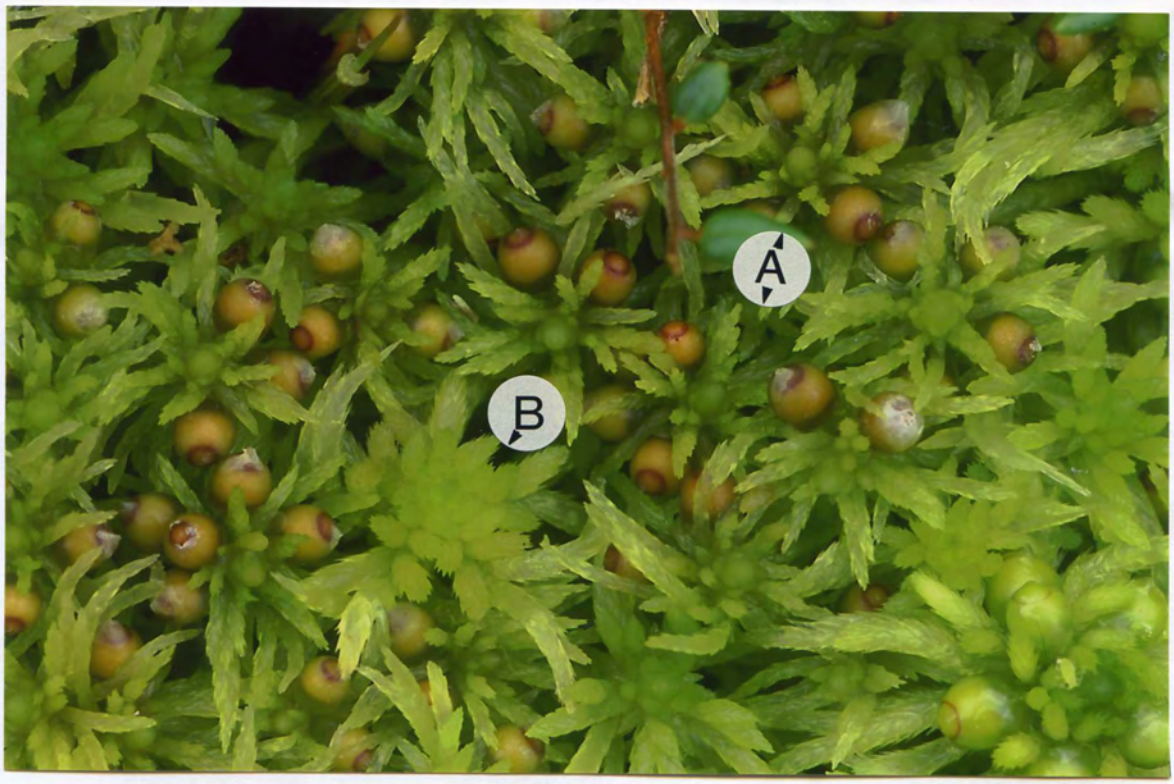
# Sphagnum austinii Sull.




**A: austinii**
**B: rubellum, red morph**
**C: rubellum, pale brown morph**

# Sphagnum fimbriatum Wils. ssp. fimbriatum

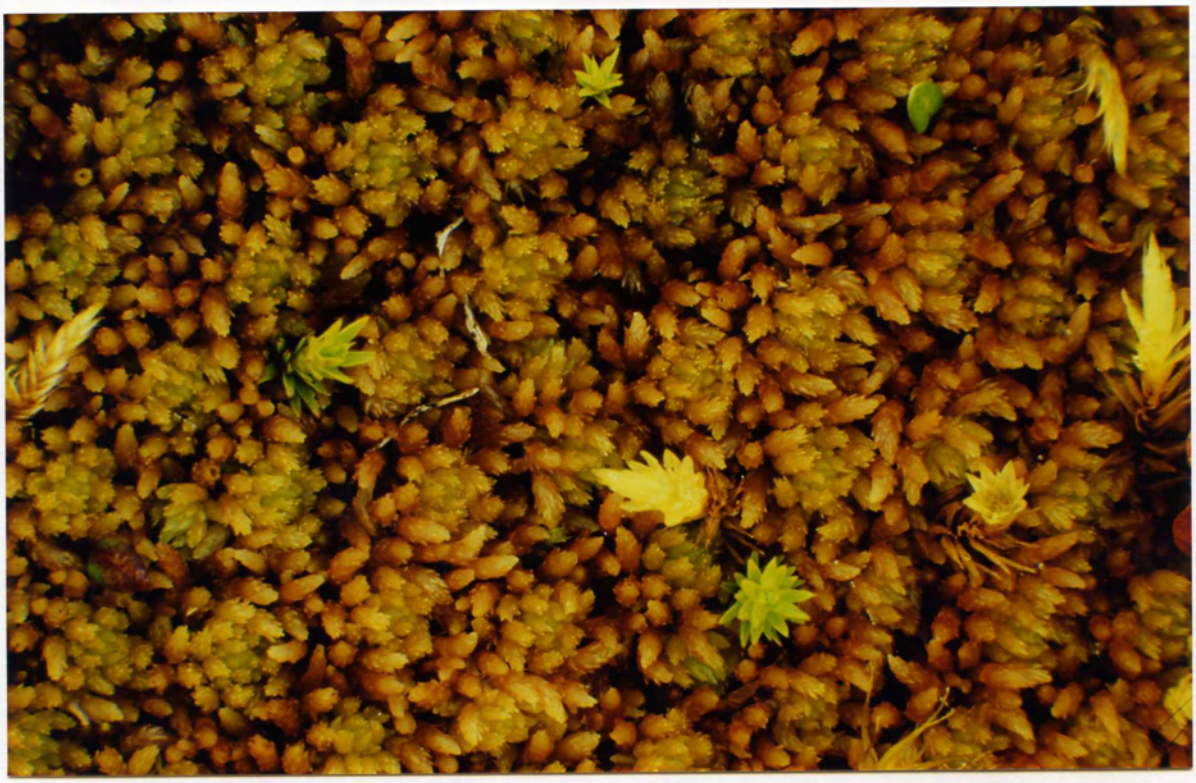



**A: fimbriatum ssp. fimbriatum** **B: riparium**

# Sphagnum fimbriatum Wils.
## ssp. concinnum (Berggr.) Flatb. & Frisv.

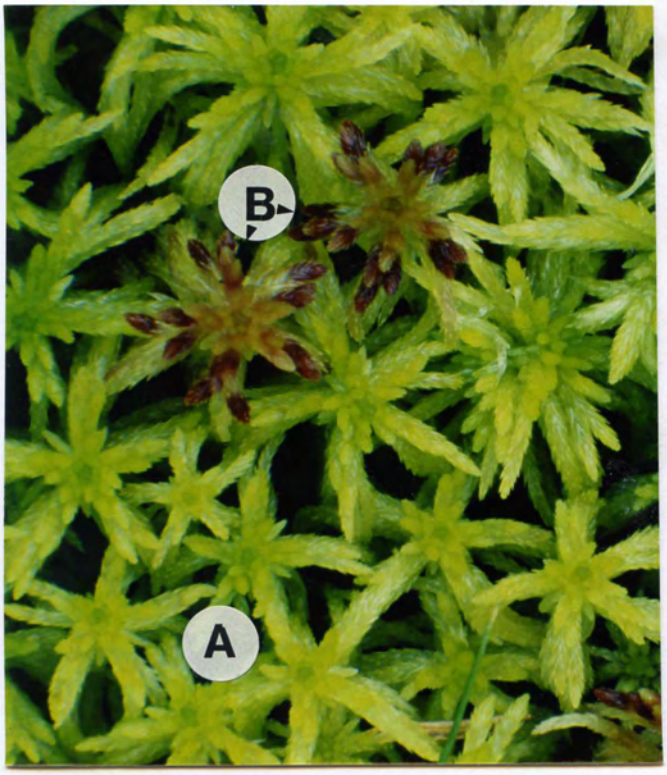
# **Sphagnum arcticum** Flatb. & Frisv.

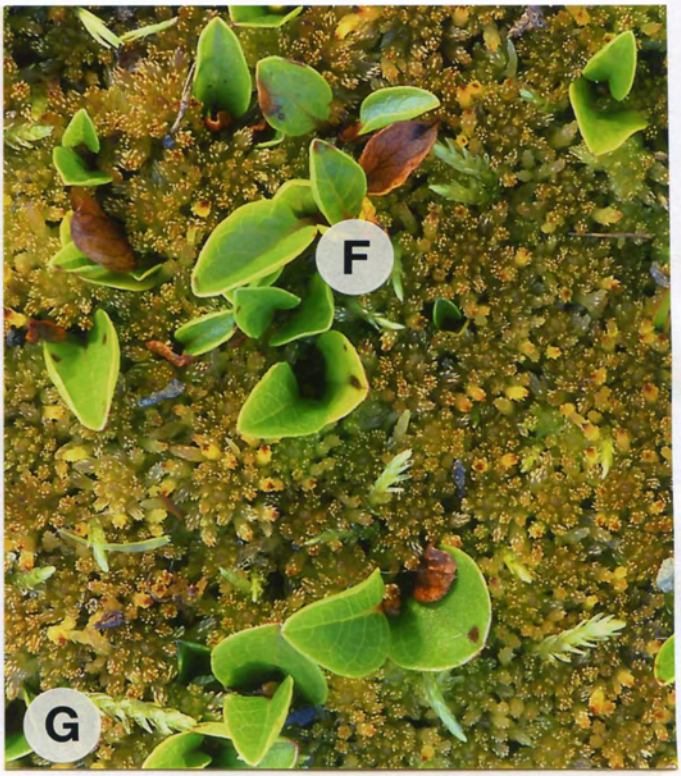
Plate 9

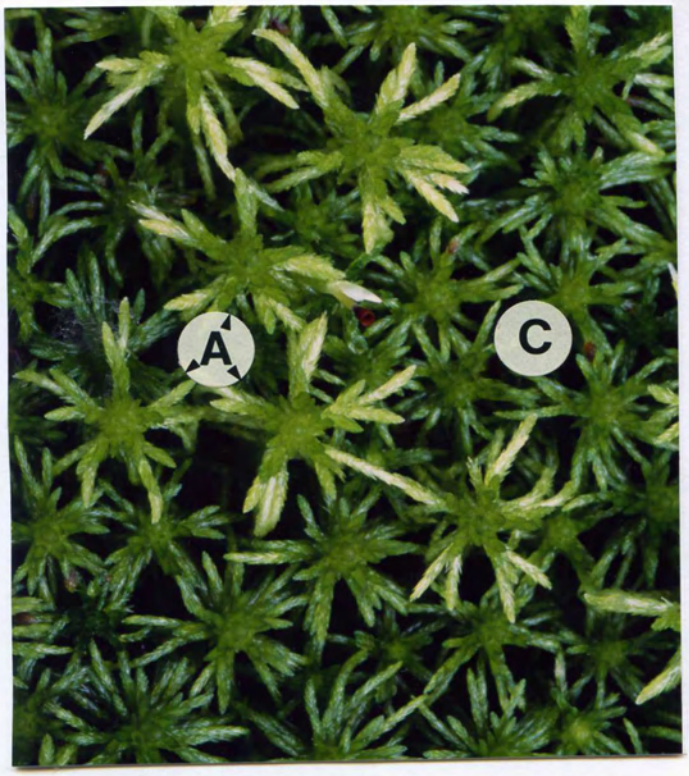


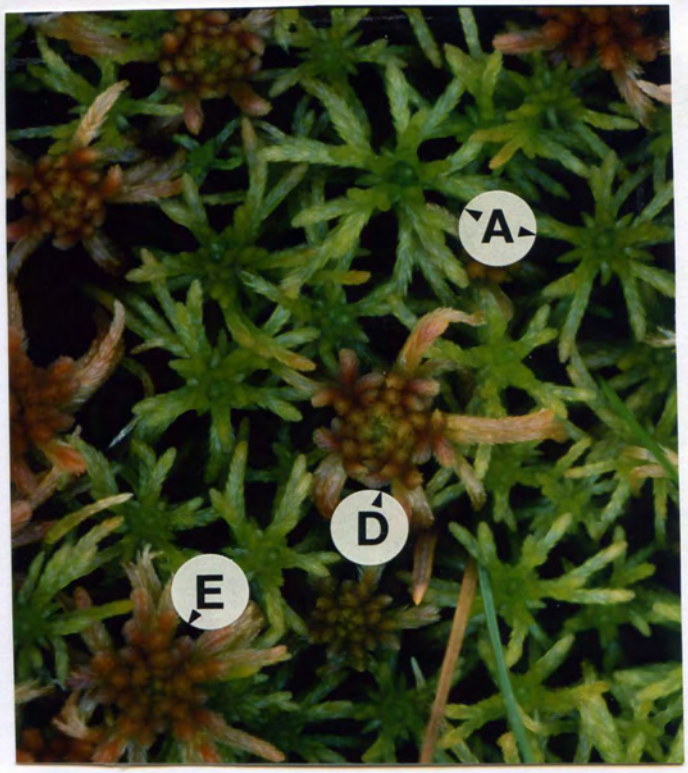
# Sphagnum girgensohnii Russ.





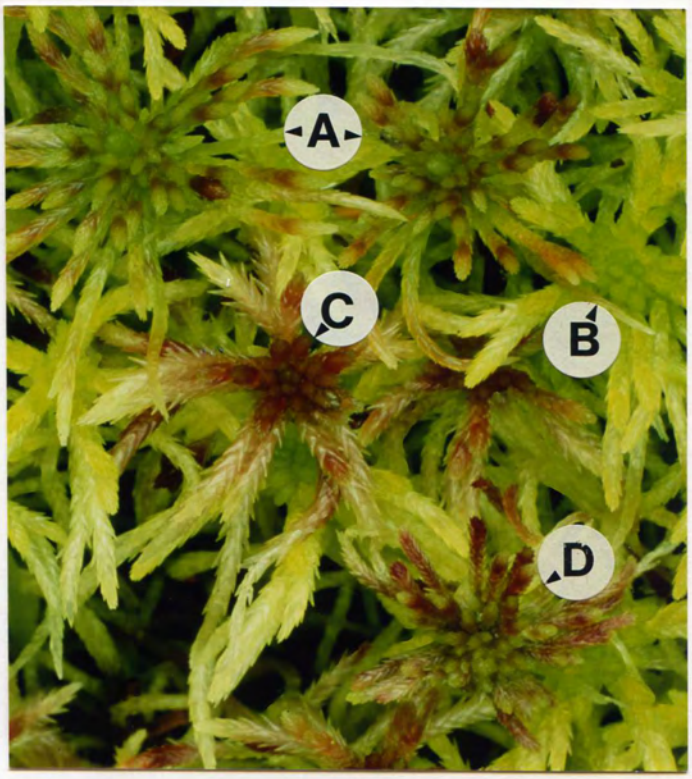




A: girgensohnii, boreal plant
B: russowii, male
C: rubiginosum
D: flexuosum
E: angustifolium
F: Salix polaris
G: girgensohnii, arctic plant

# Sphagnum rubiginosum Flatb.

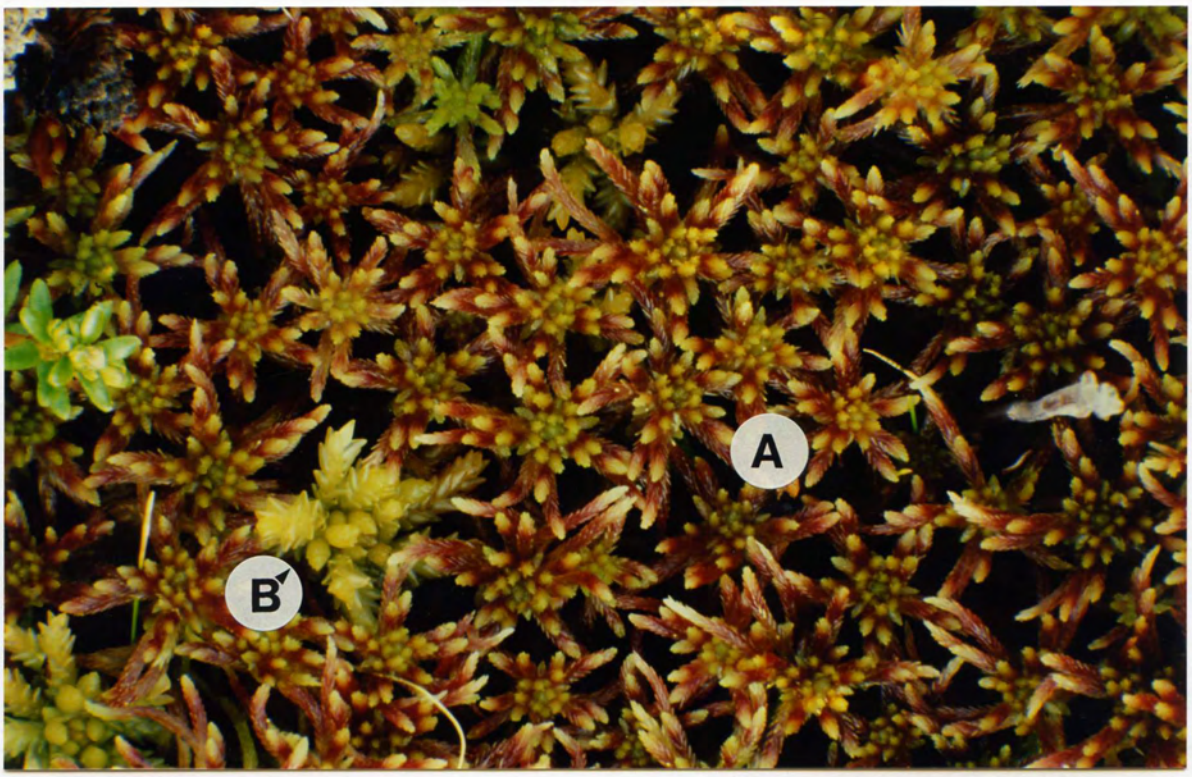


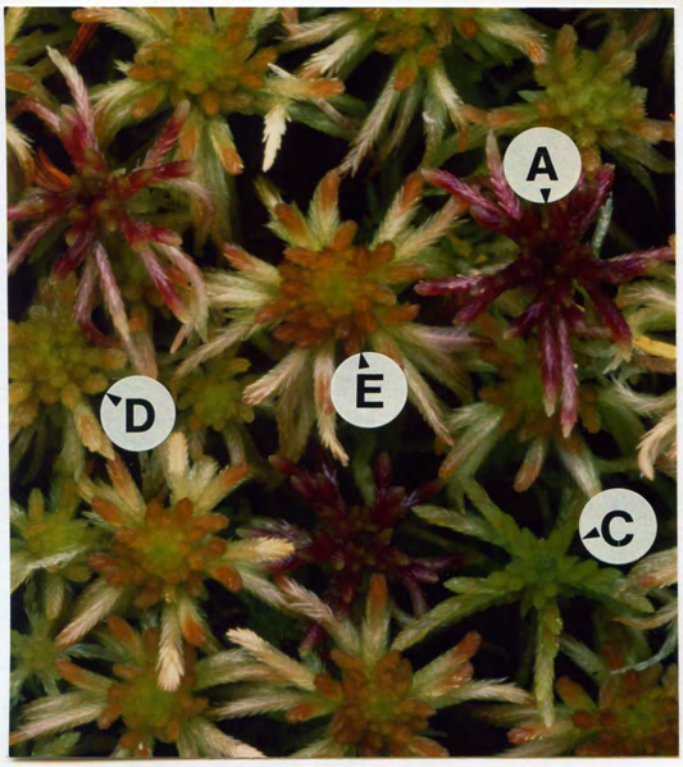

A: rubiginosum
B: girgensohnii

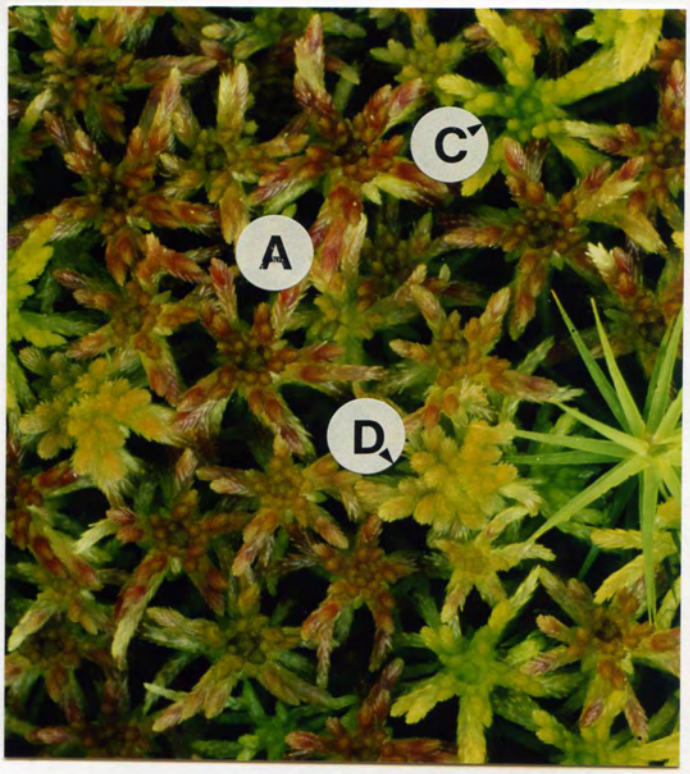
C: russowii
D: quinquefarium

# Sphagnum russowii Warnst.






A: russowii
B: papillosum
C: girgensohnii

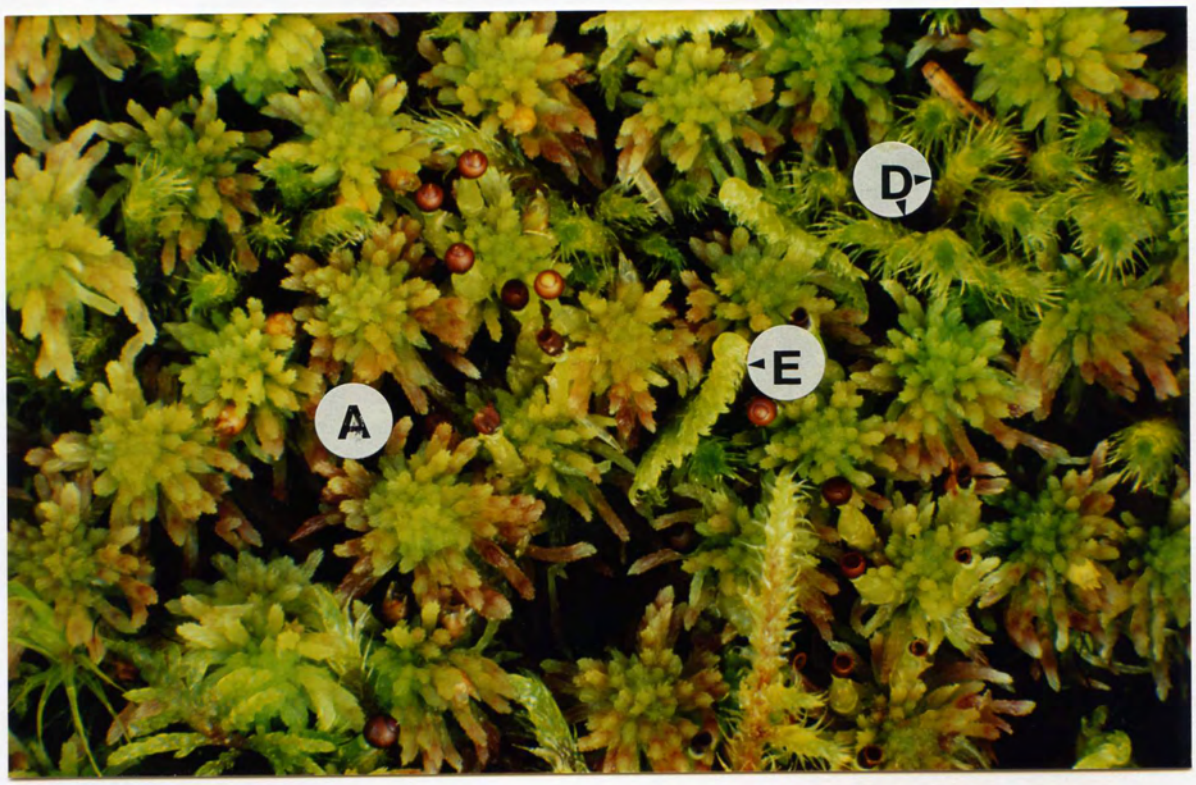
D: angustifolium
E: fallax

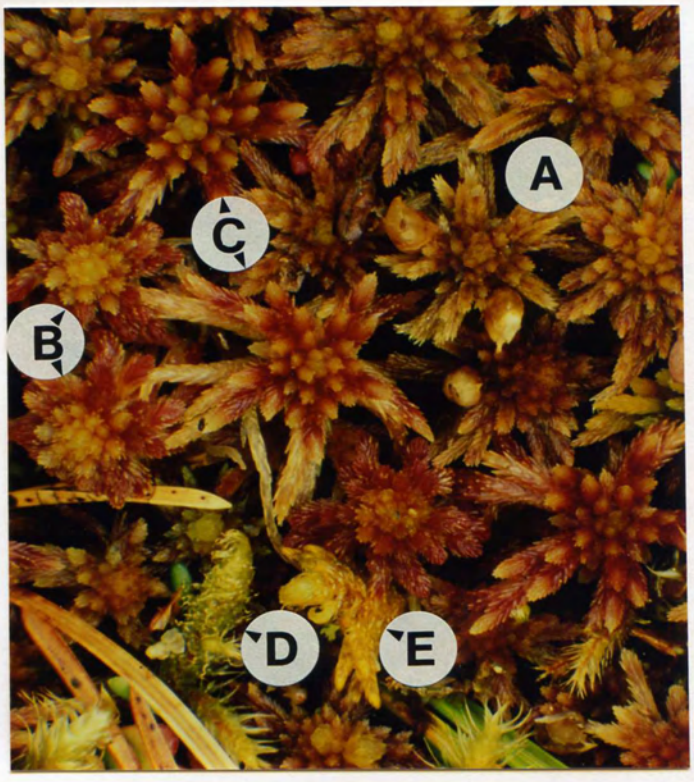
# **Sphagnum olafii** Flatb.

**Plate 13**

# Sphagnum quinquefarium (Braith.) Warnst.





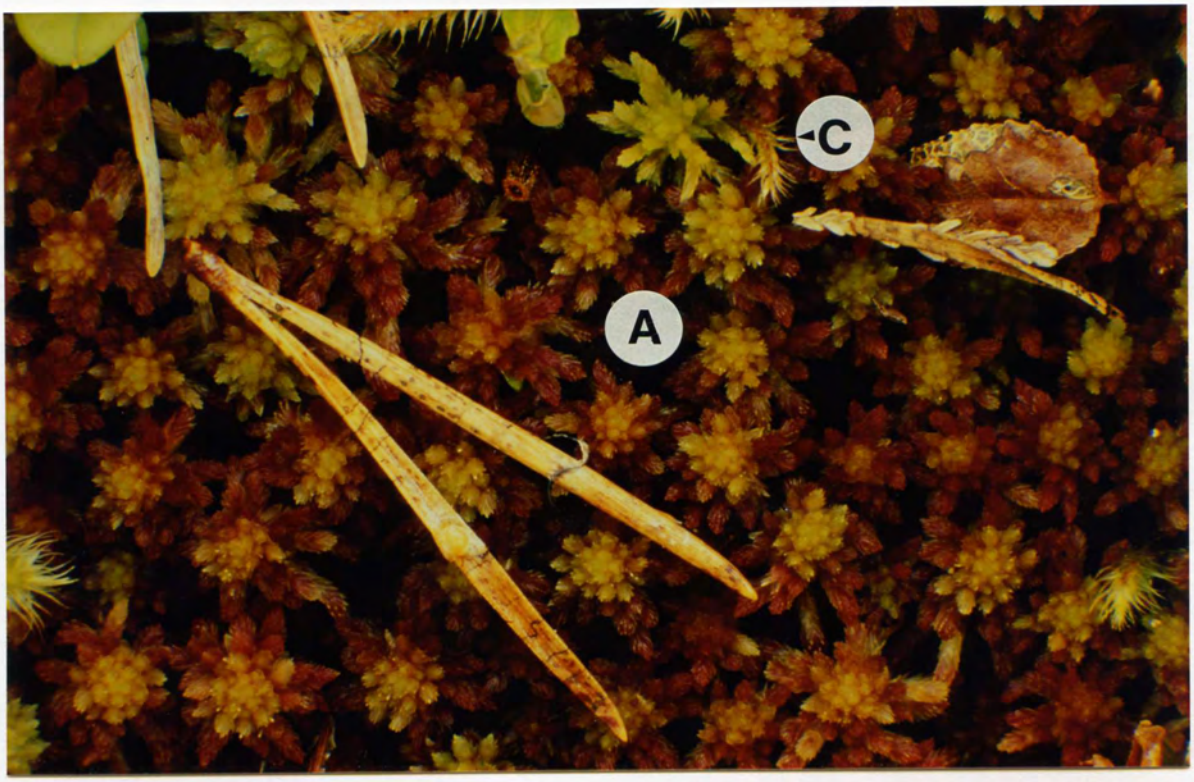


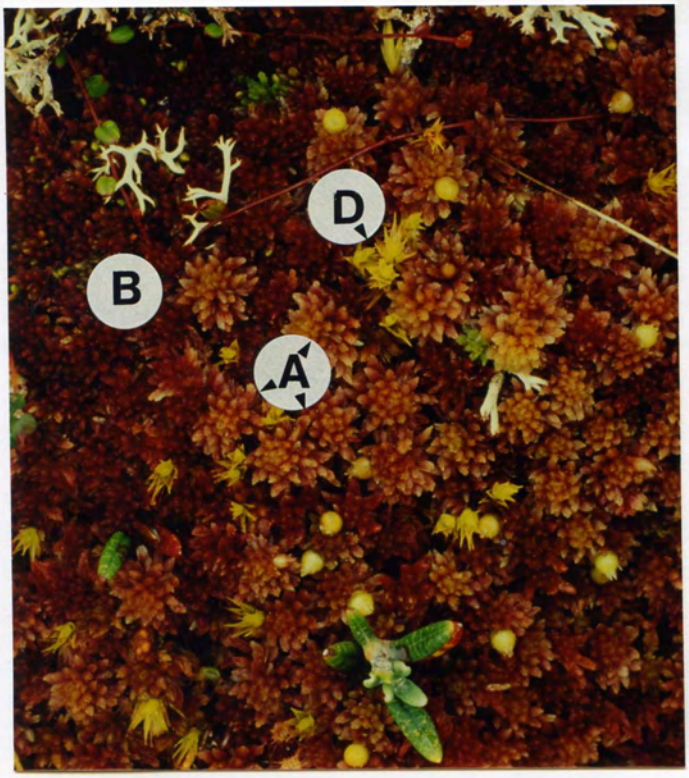

A: quinquefarium
B: capillifolium
C: russowii

D: Rhytidiadelphus loreus
E: Ptilium crista-castrensis

# Sphagnum capillifolium (Ehrh.) Hedw.





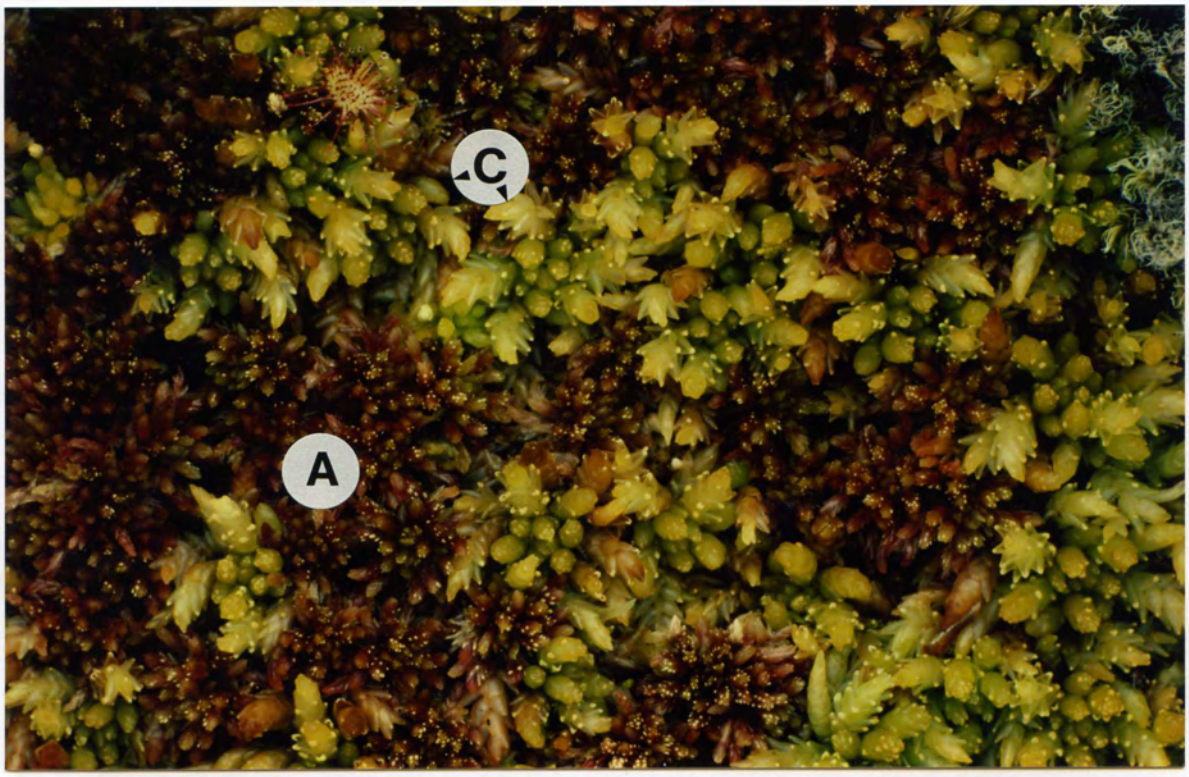



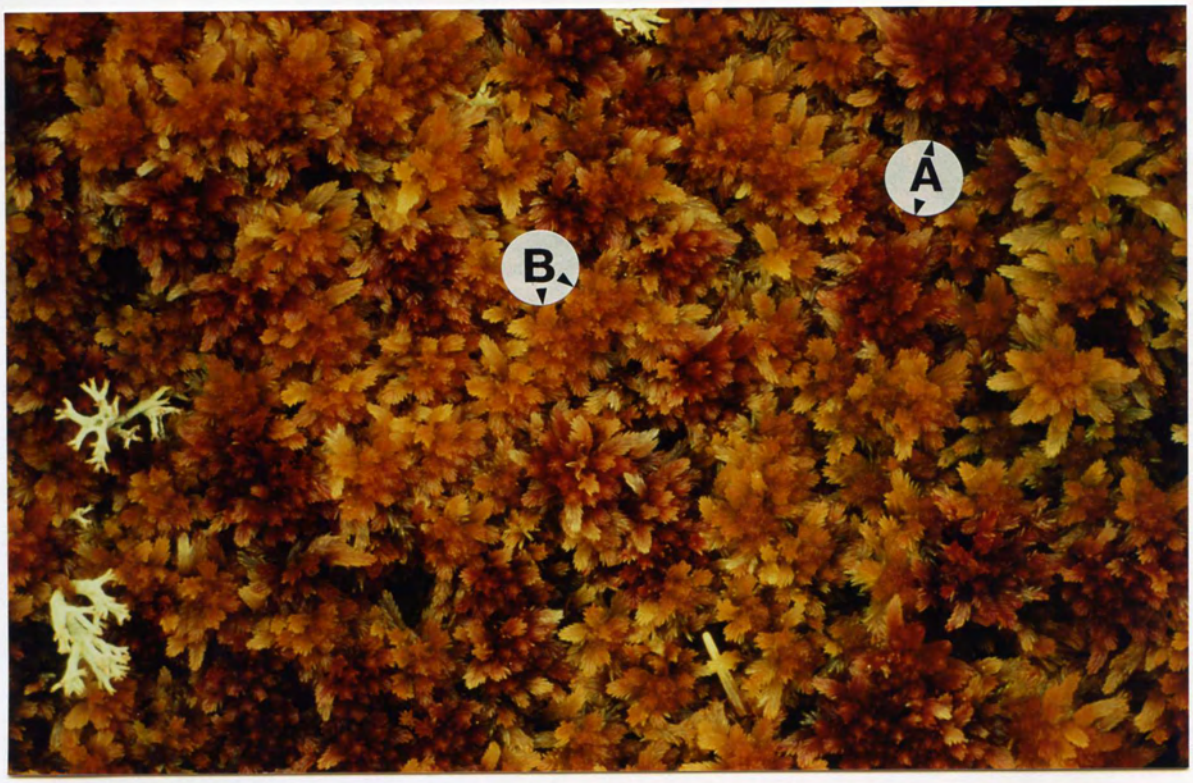
A: capillifolium
B: rubellum

C: Rhytidiadelphus loreus
D: Dicranum leioneuron
E: Straminergon stramineum

# Sphagnum rubellum Wils.

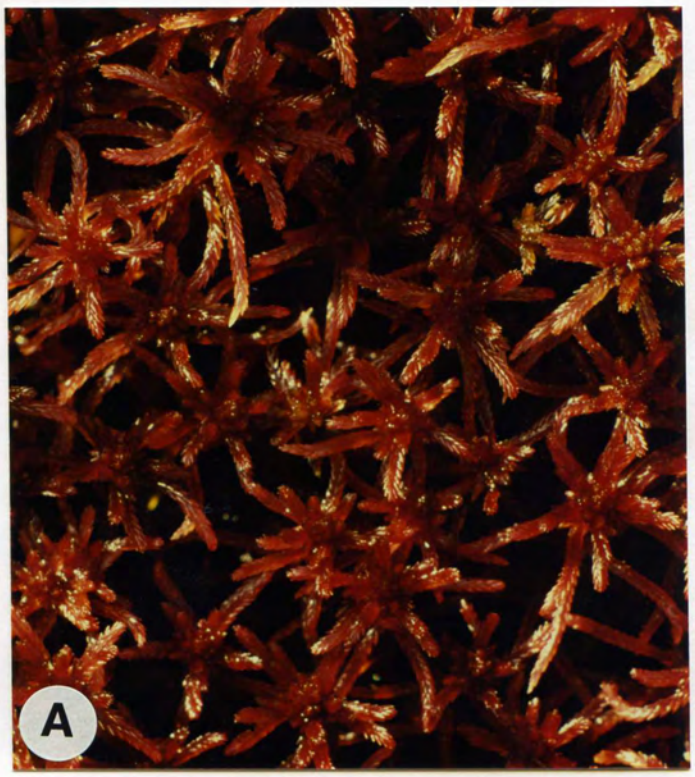


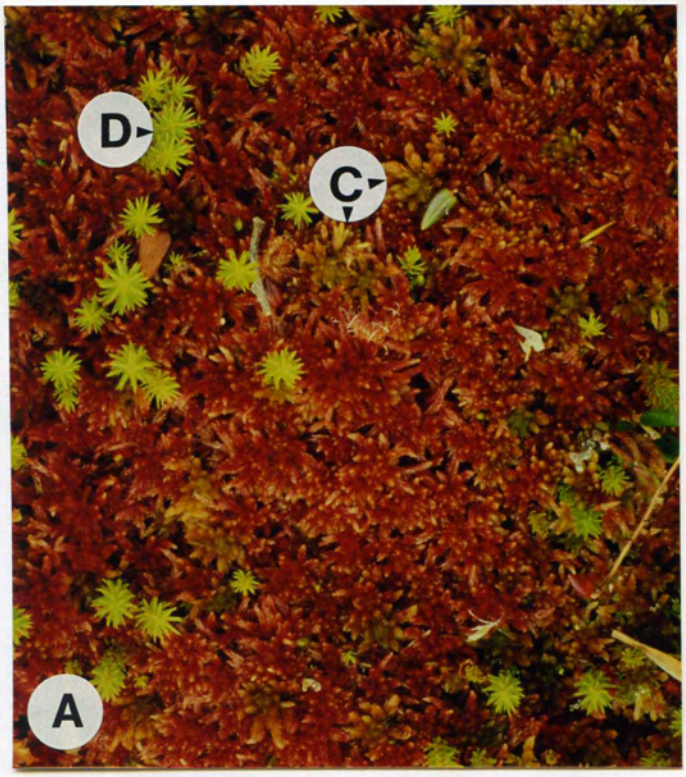



**A: rubellum, red morph**
**B: rubellum, pale brown morph**
**C: papillosum**

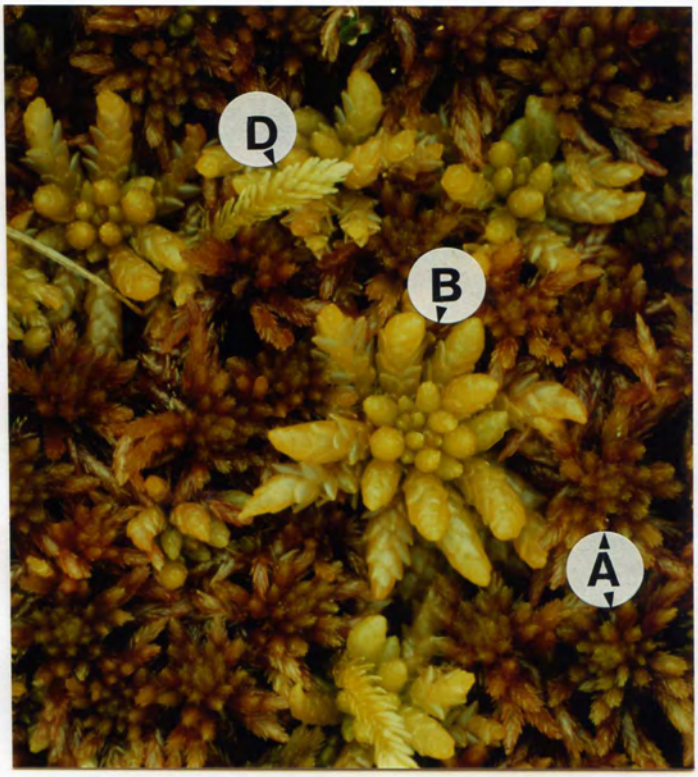
# Sphagnum warnstorfii Russ.

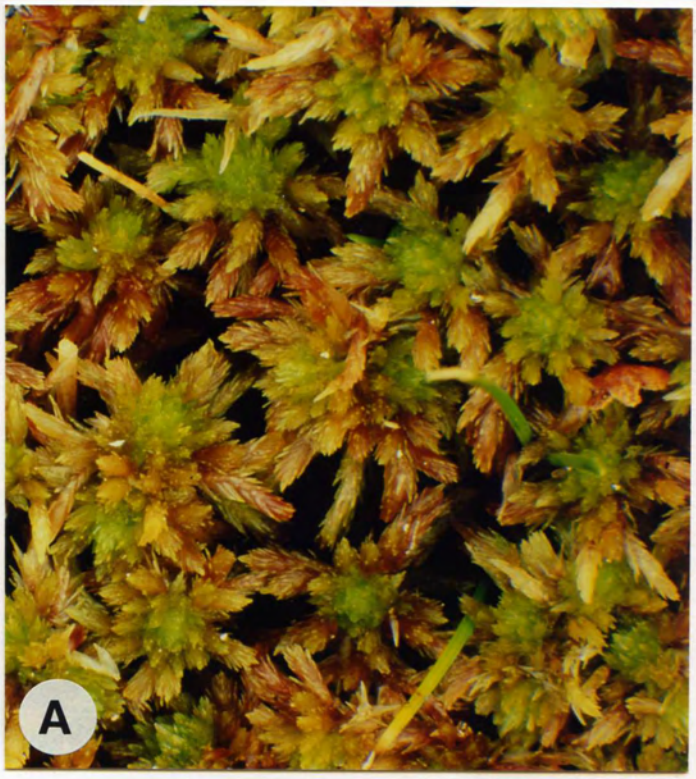


**A: warnstorfii, boreal plant**
**B: warnstorfii, arctic plant**
**C: subfulvum ssp. subfulvum**
**D: Polytrichum strictum**

# Sphagnum subnitens Russ. & Warnst. ssp. subnitens





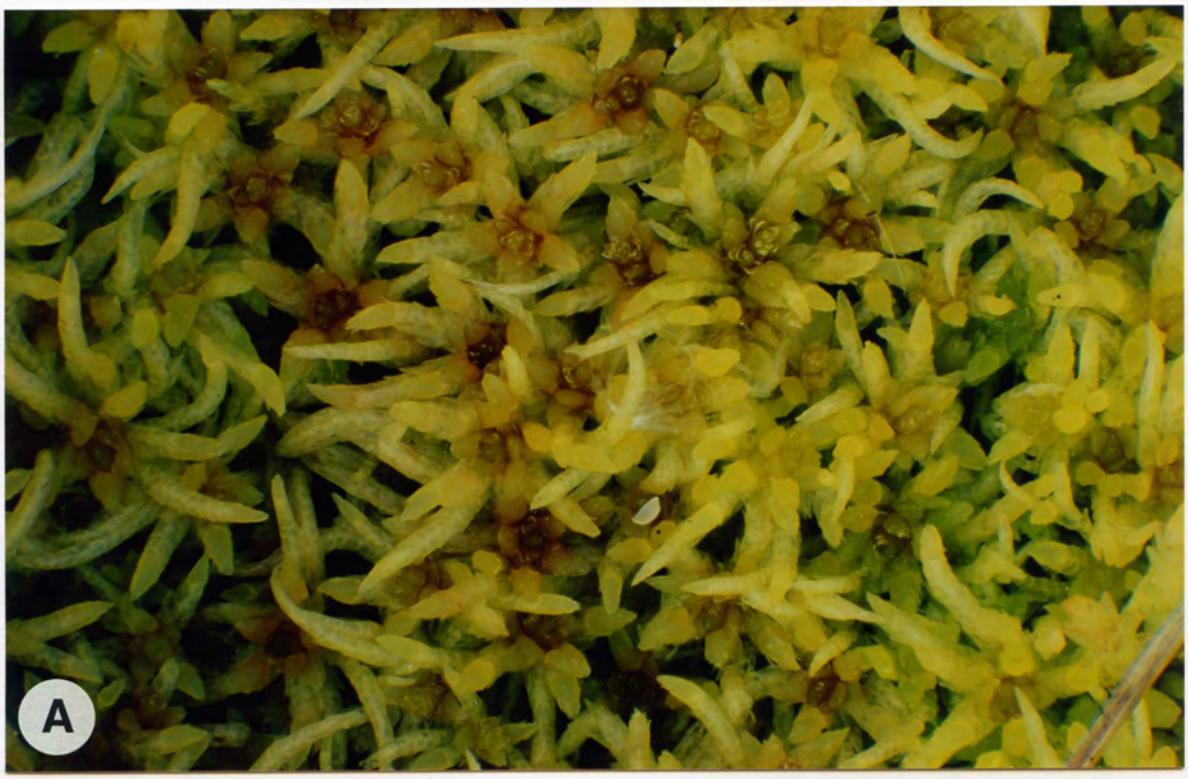

A: subnitens ssp. subnitens
B: papillosum
C: teres
D: Straminergon stramineum

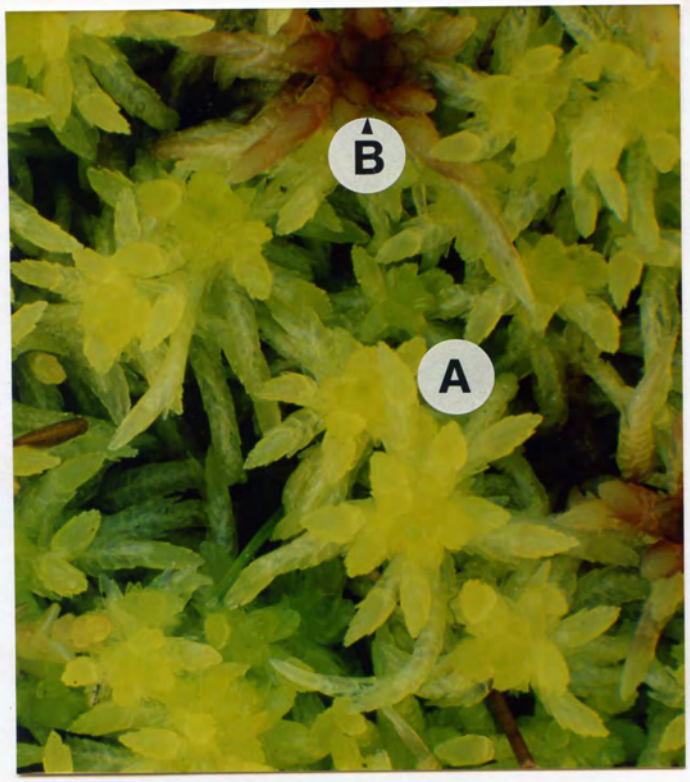
# Sphagnum subnitens Russ. & Warnst. ssp. ferrgugineum Flatb.

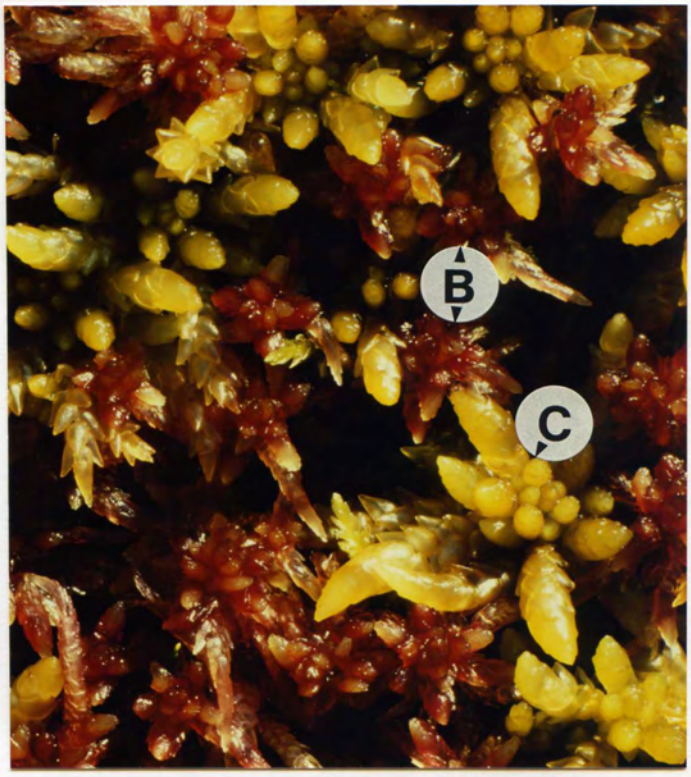
A: subnitens ssp. ferrugineum
B: subnitens ssp. subnitens
C: angermanicum
D: papillosum
E: magellanicum
F: tenellum

# Sphagnum angermanicum Melin





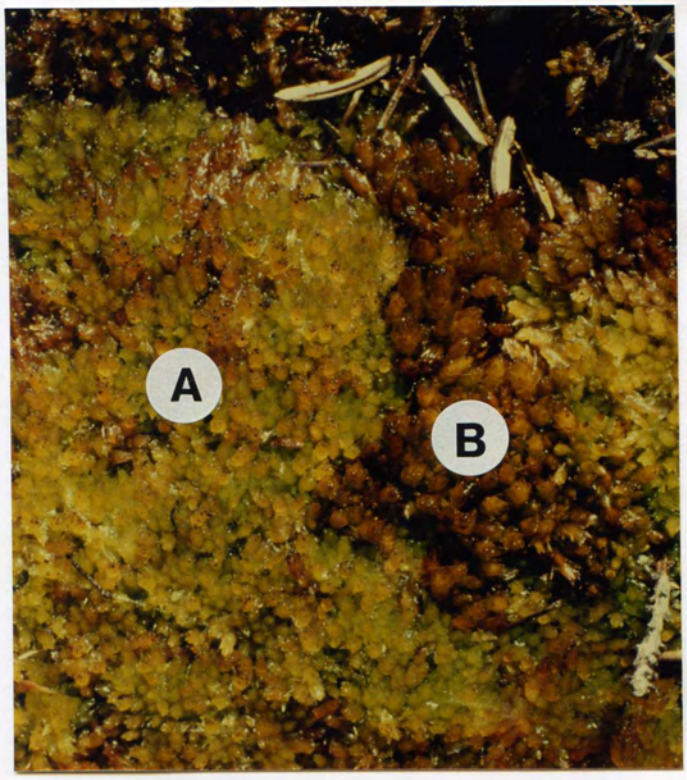



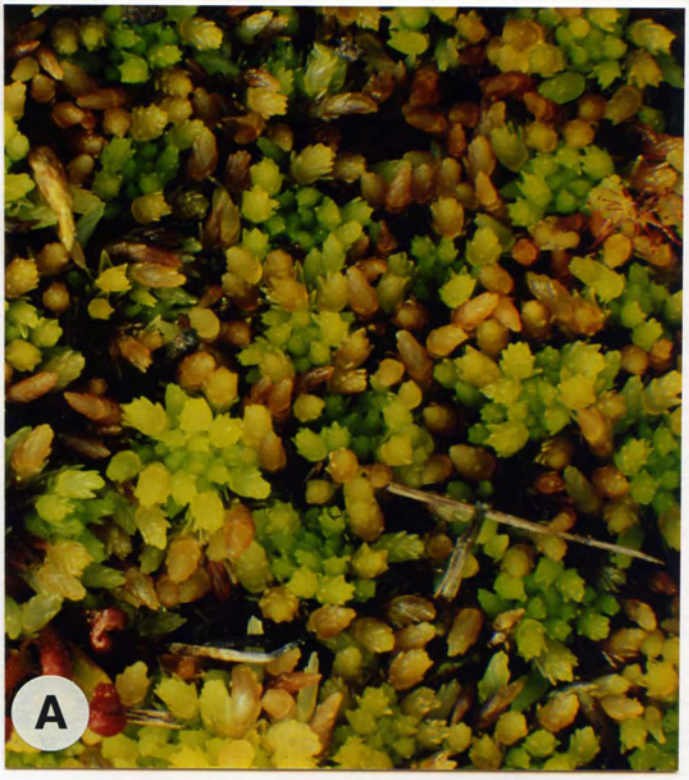

**A: angermanicum, female**
**B: angermanicum, male**

**C: papillosum**

# Sphagnum molle Sull.



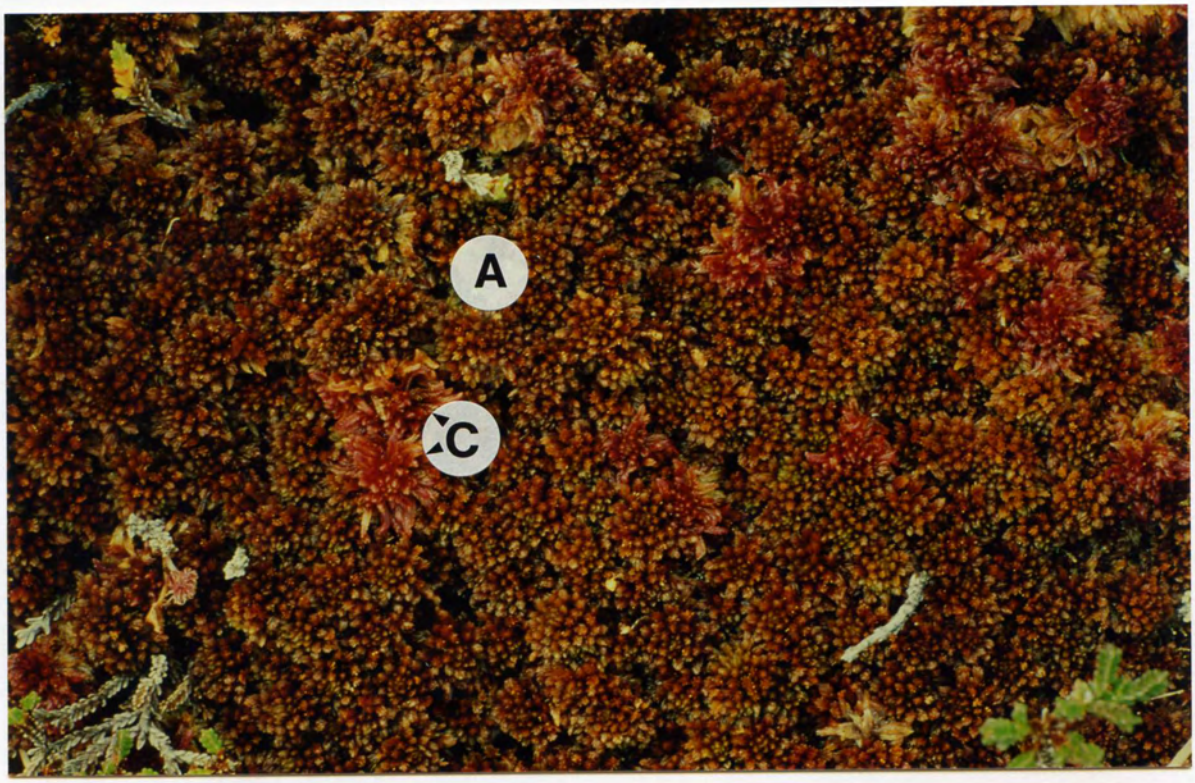

A: molle

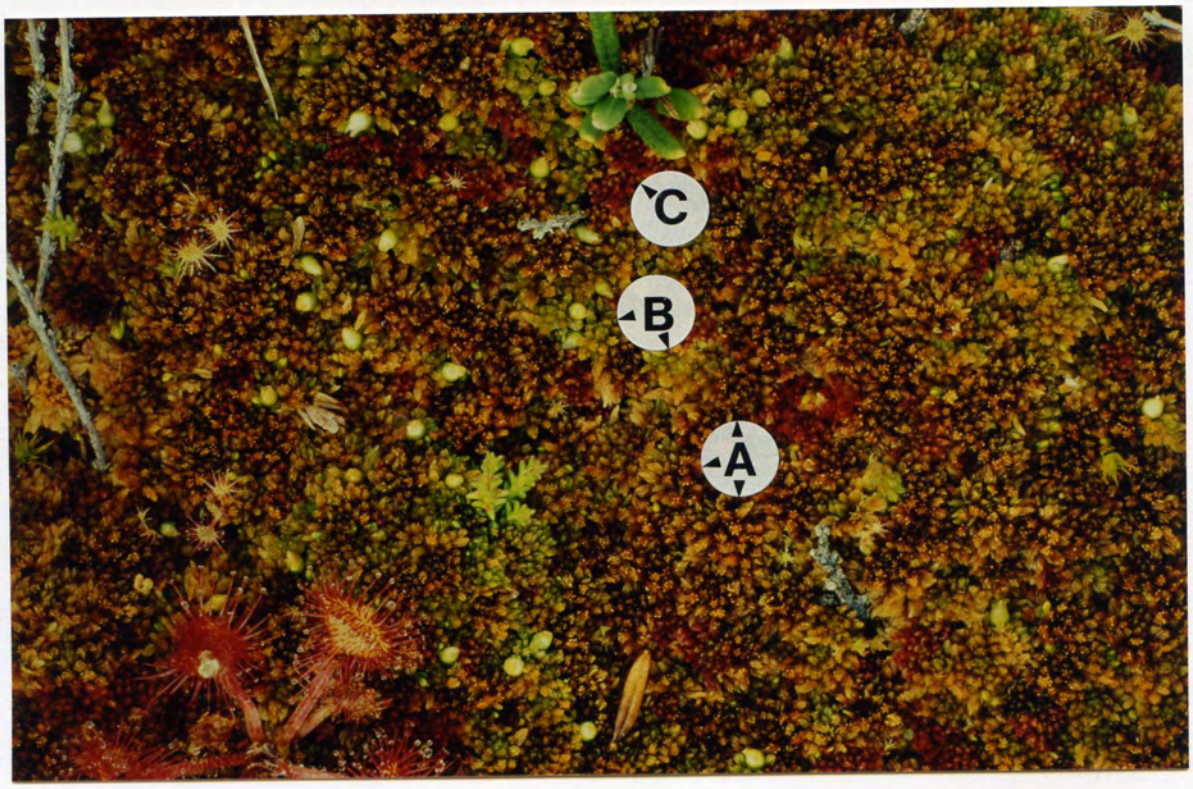



B: compactum

# Sphagnum fuscum (Schimp.) Klinggr.





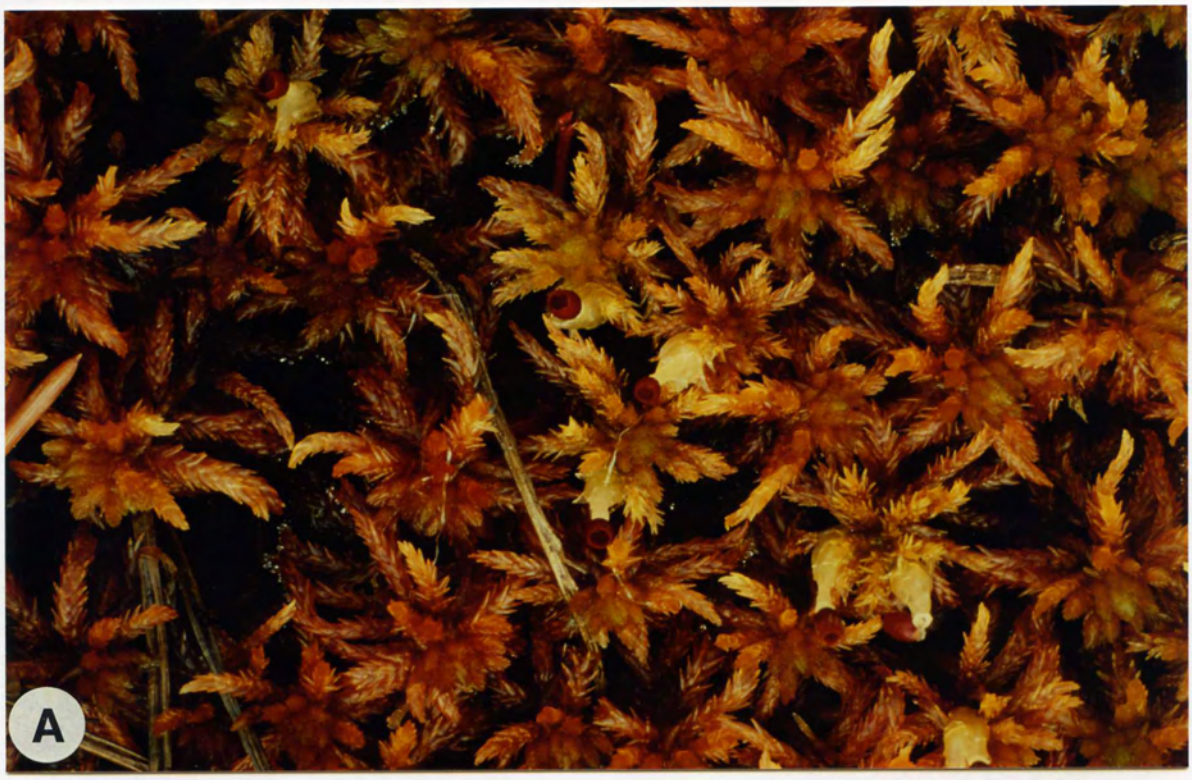

**A: fuscum, dark brown morph**
**B: fuscum, pale brown morph**
**C: rubellum**

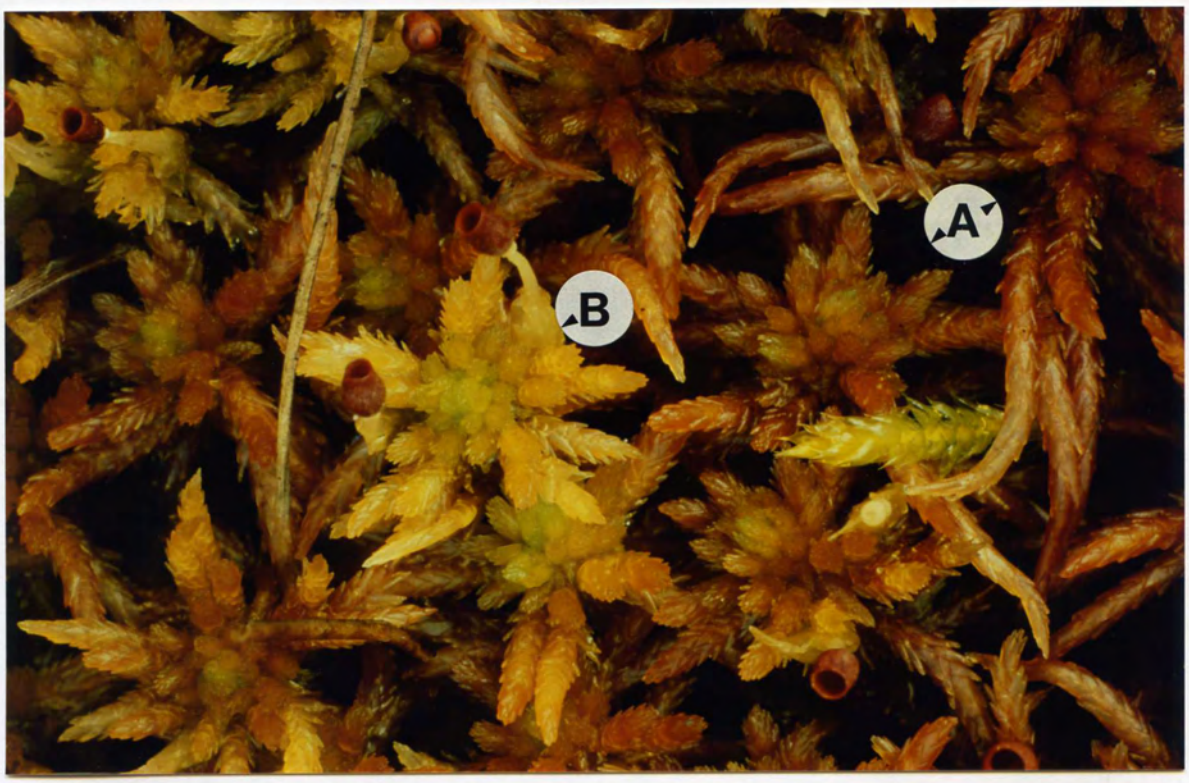
# Sphagnum subfulvum Sjörs ssp. subfulvum

A: subfulvum ssp. subfulvum
B: subnitens ssp. subnitens
C: warnstorfii
D: Loeskypnum badium

# Sphagnum subfulvum Sjörs ssp. purpureum Flatb.

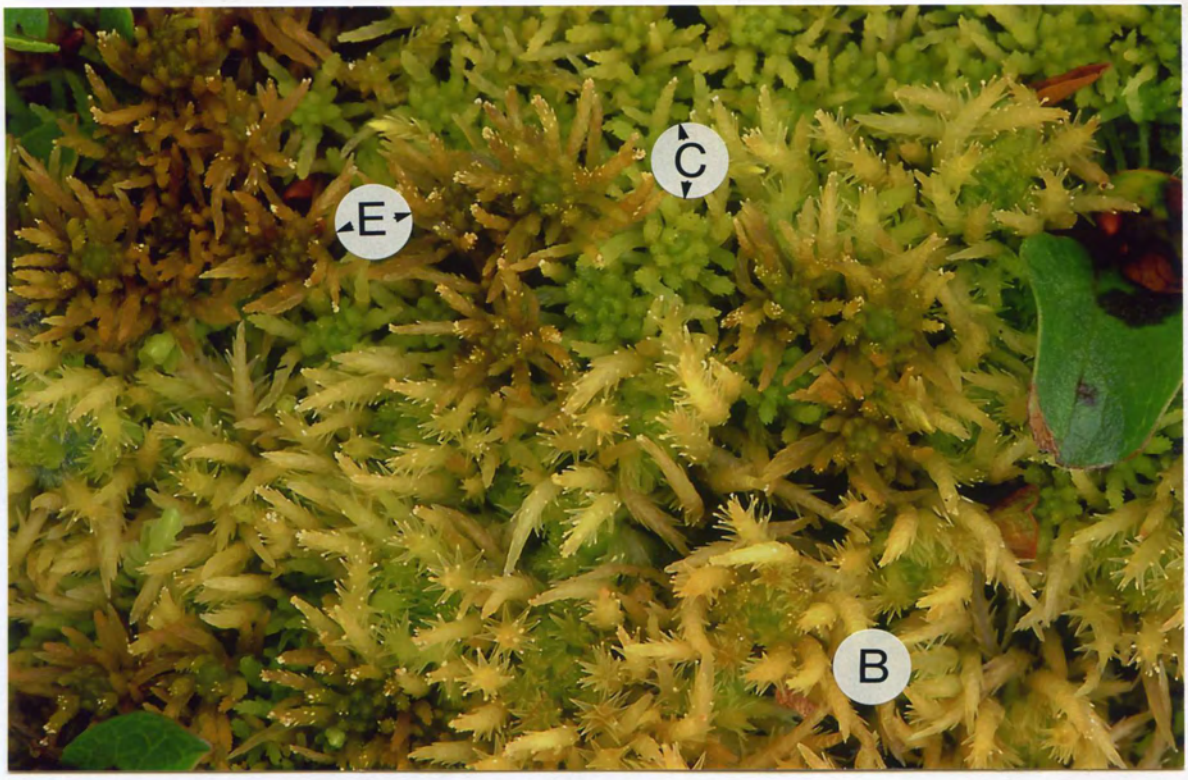





**A: subfulvum ssp. purpureum** **B: subfulvum ssp. subfulvum**

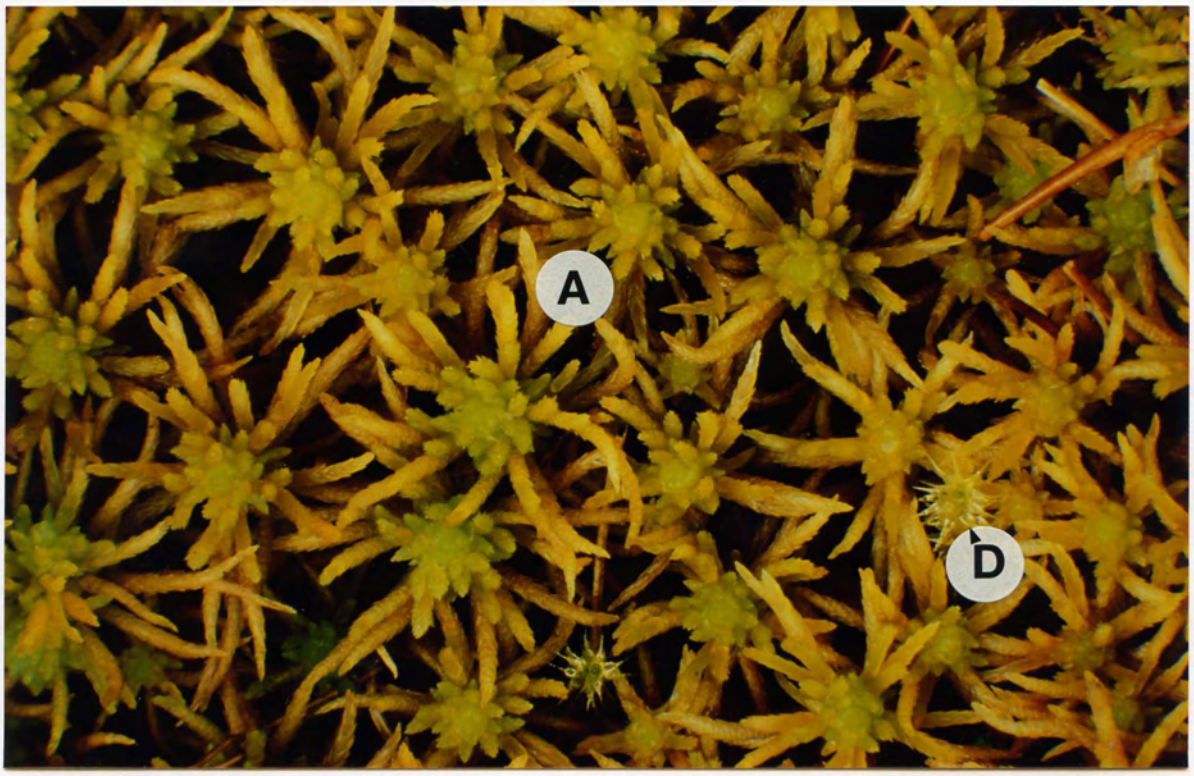
# Sphagnum squarrosum Crome

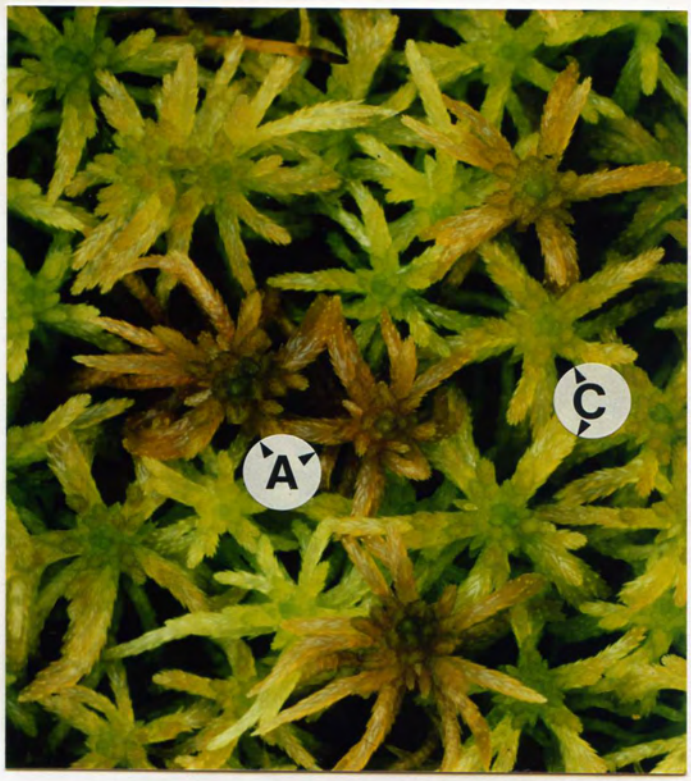



**A: squarrosum, boreal plant**
**B: squarrosum, arctic plant**
**C: tundrae**
**D: girgensohnii**
**E: teres**

# Sphagnum teres (Schimp.) Ångstr.



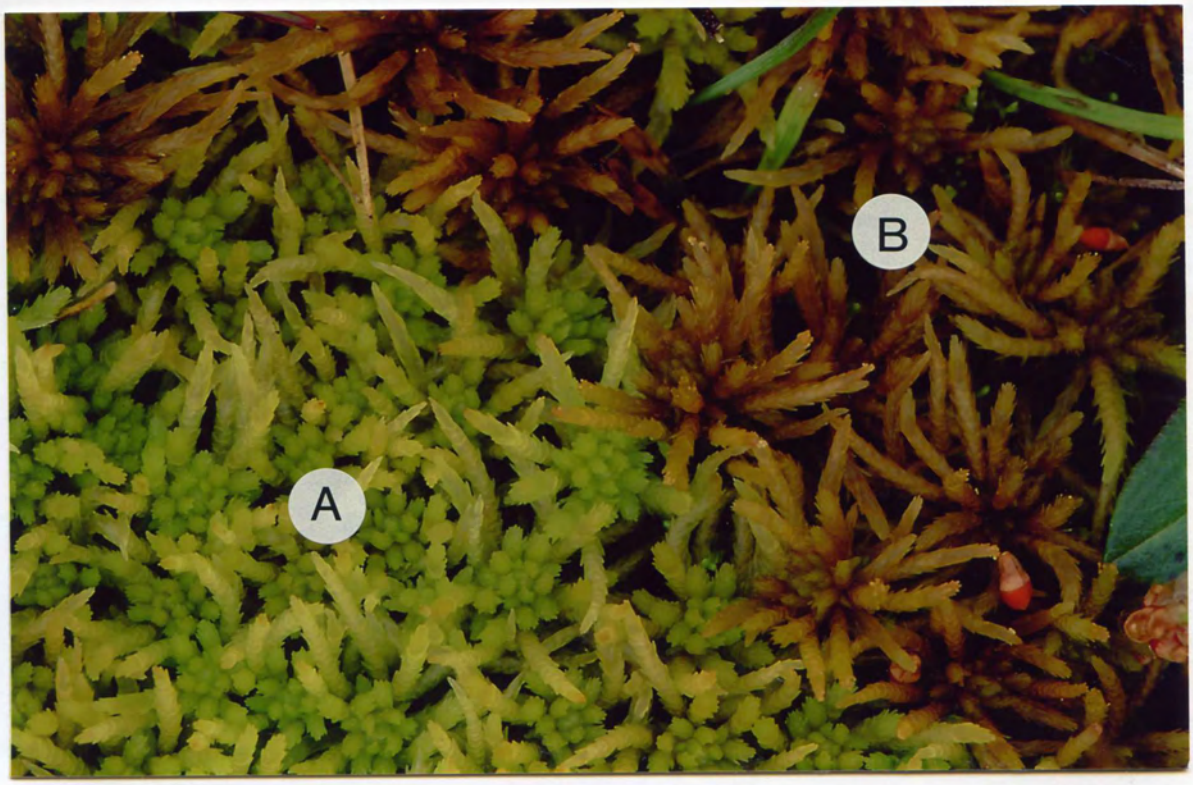





**A: teres**
**B: squarrosum**

**C: girgensohnii**
**D: Campylium stellatum**

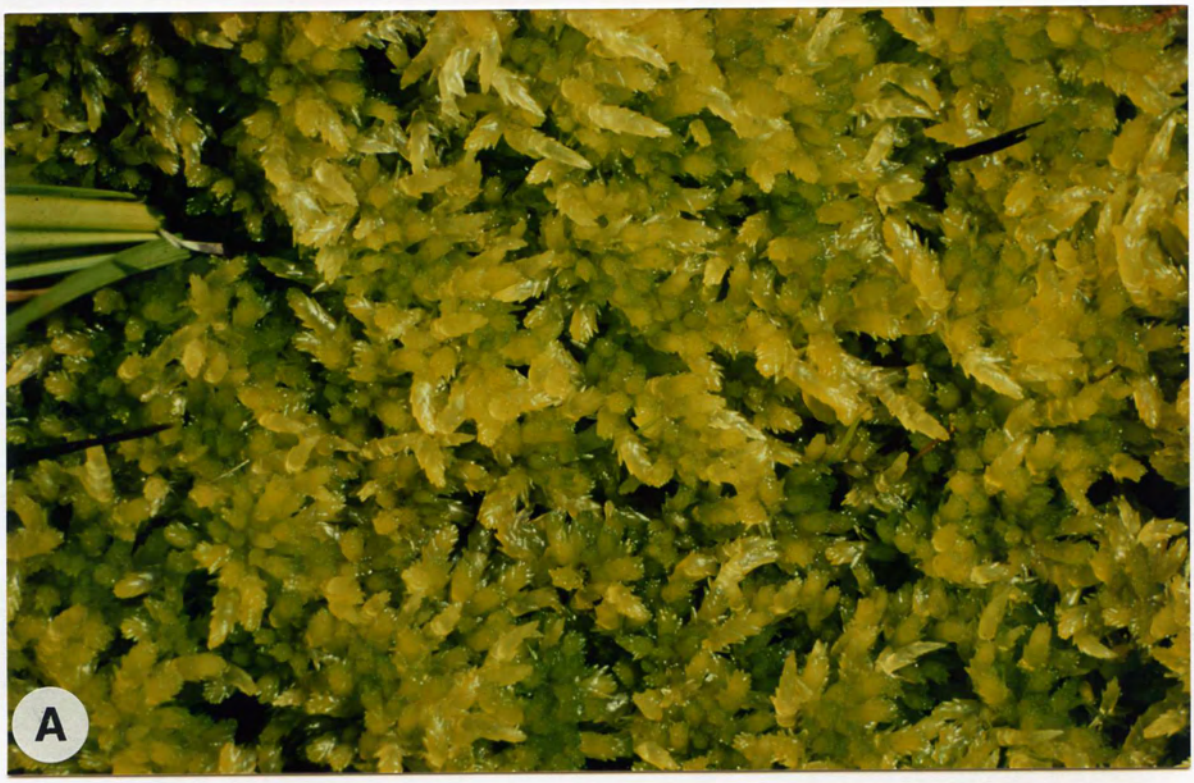
# Sphagnum tundrae Flatb.




**A: tundrae** **B: teres**

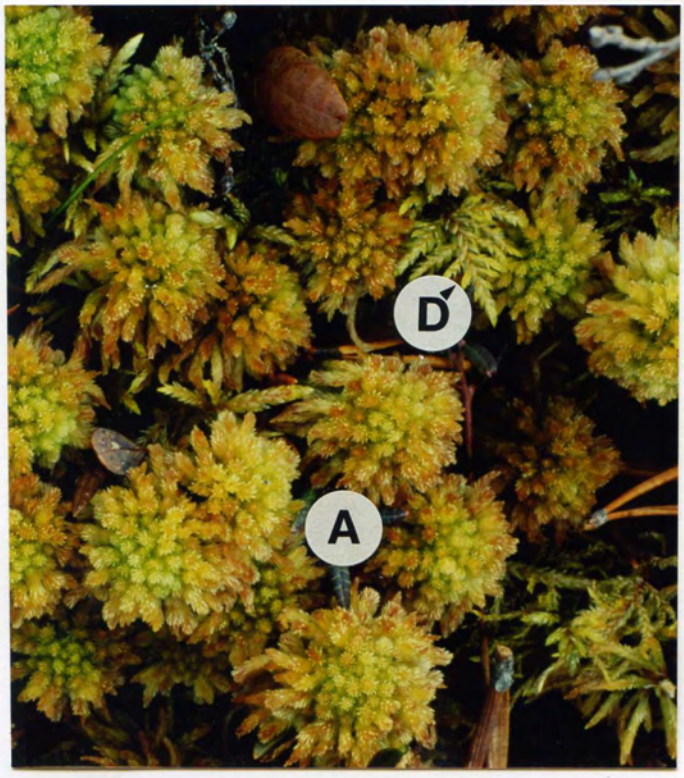
# Sphagnum aongstroemii C. Hartm.





A: aongstroemii, boreal plant
B: aongstroemii, arctic plant
C: Straminergon stramineum

# Sphagnum wulfianum Girg.

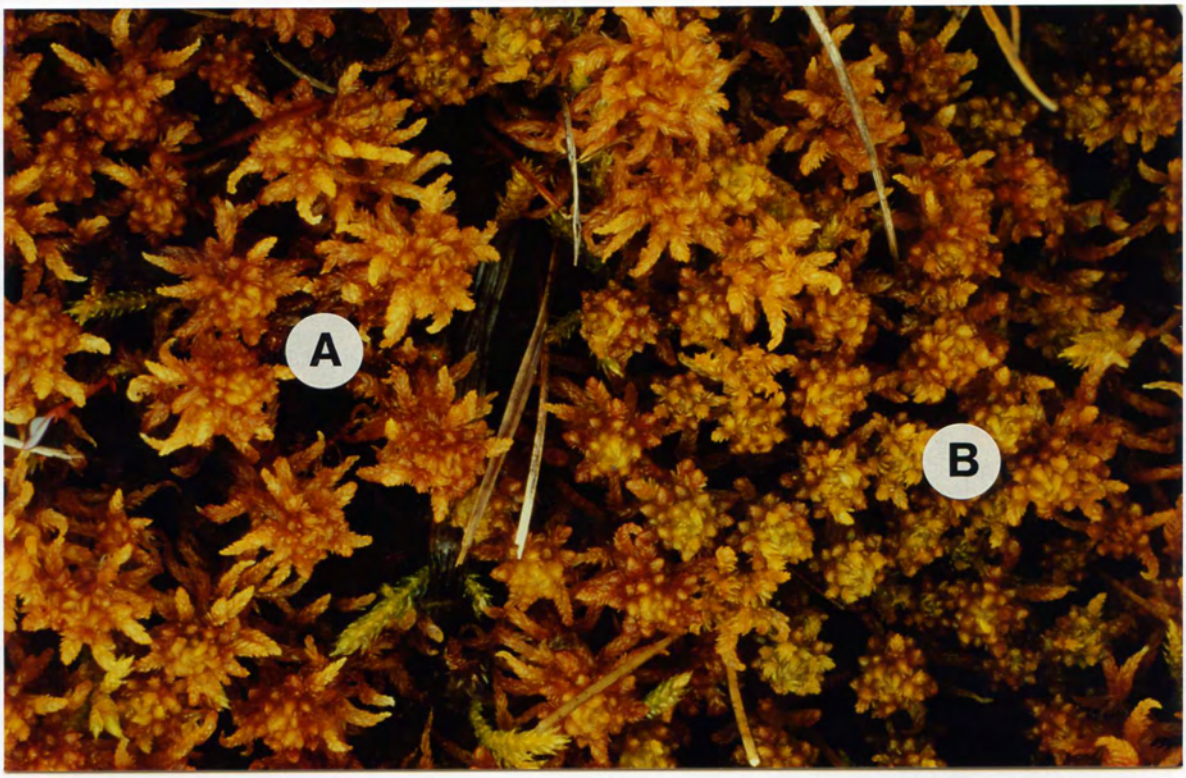


**A: wulfianum**
**B: teres**

**C: warnstorfii**
**D: Hylocomium splendens**

# Sphagnum subsecundum Nees

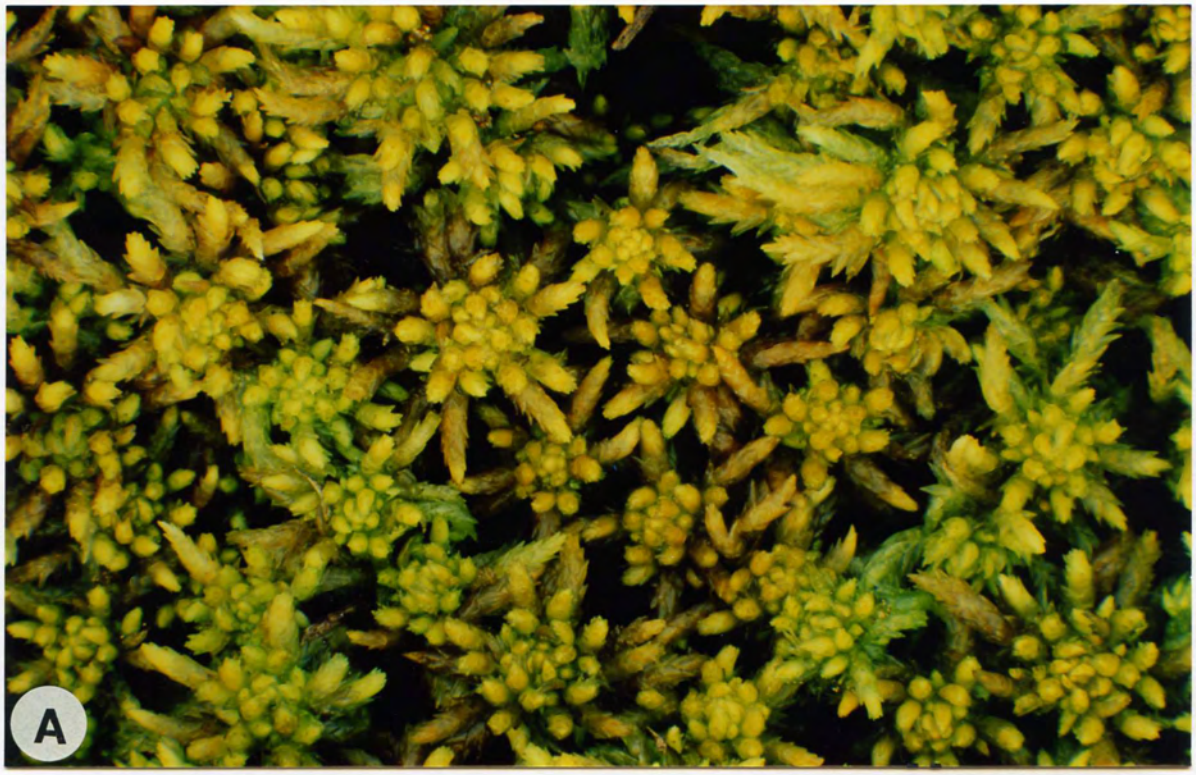


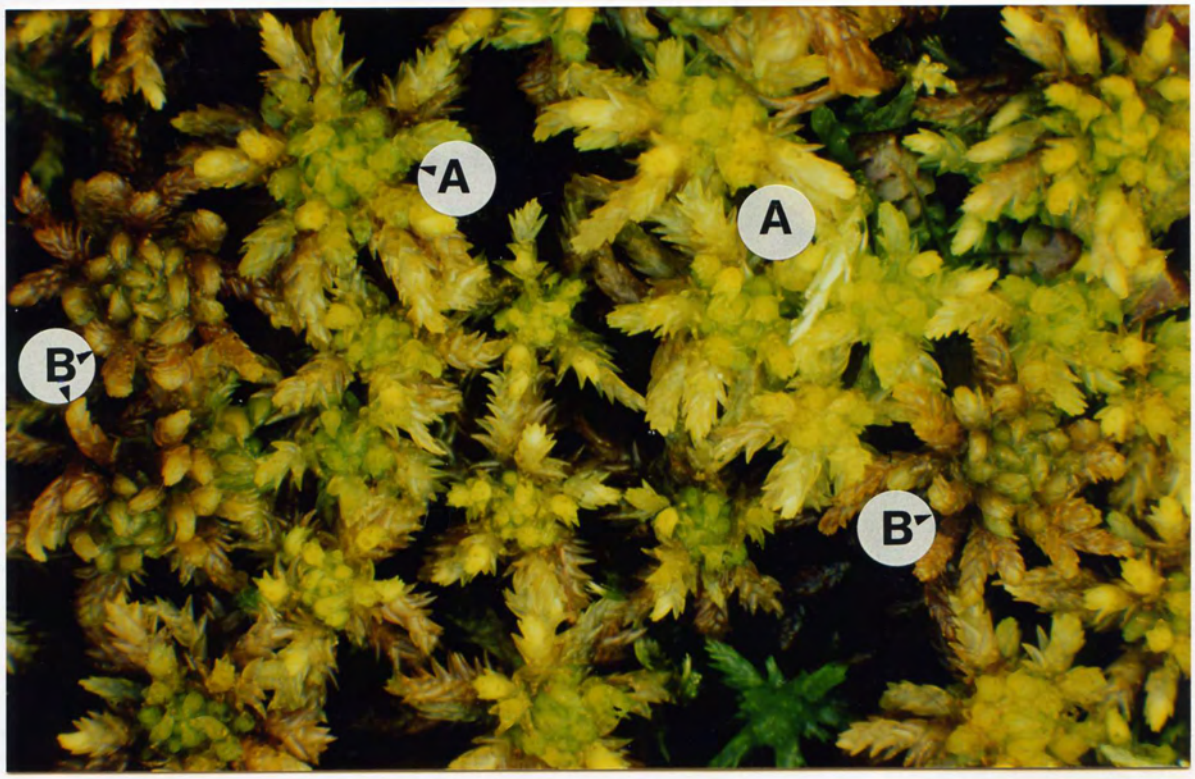


**A: subsecundum, female**
**B: subsecundum, male**
**C: auriculatum**
**D: lindbergii**
**E: majus ssp. majus**

# Sphagnum inundatum Russ.



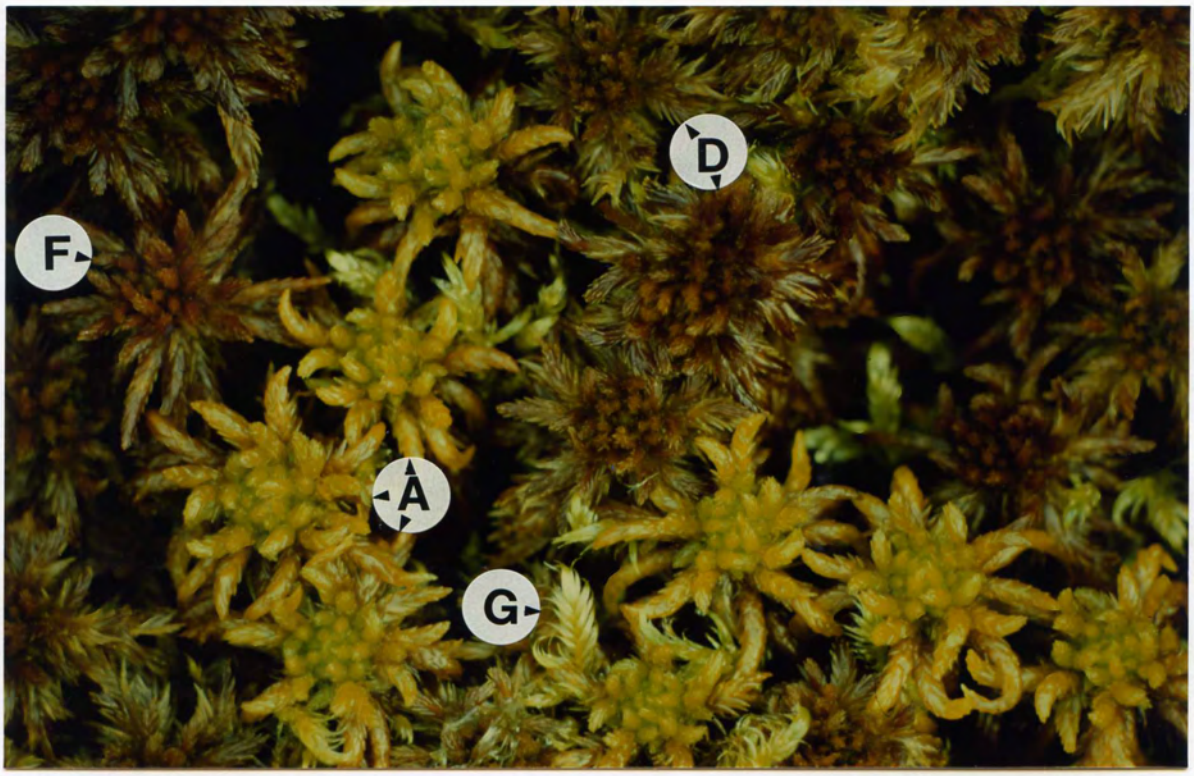


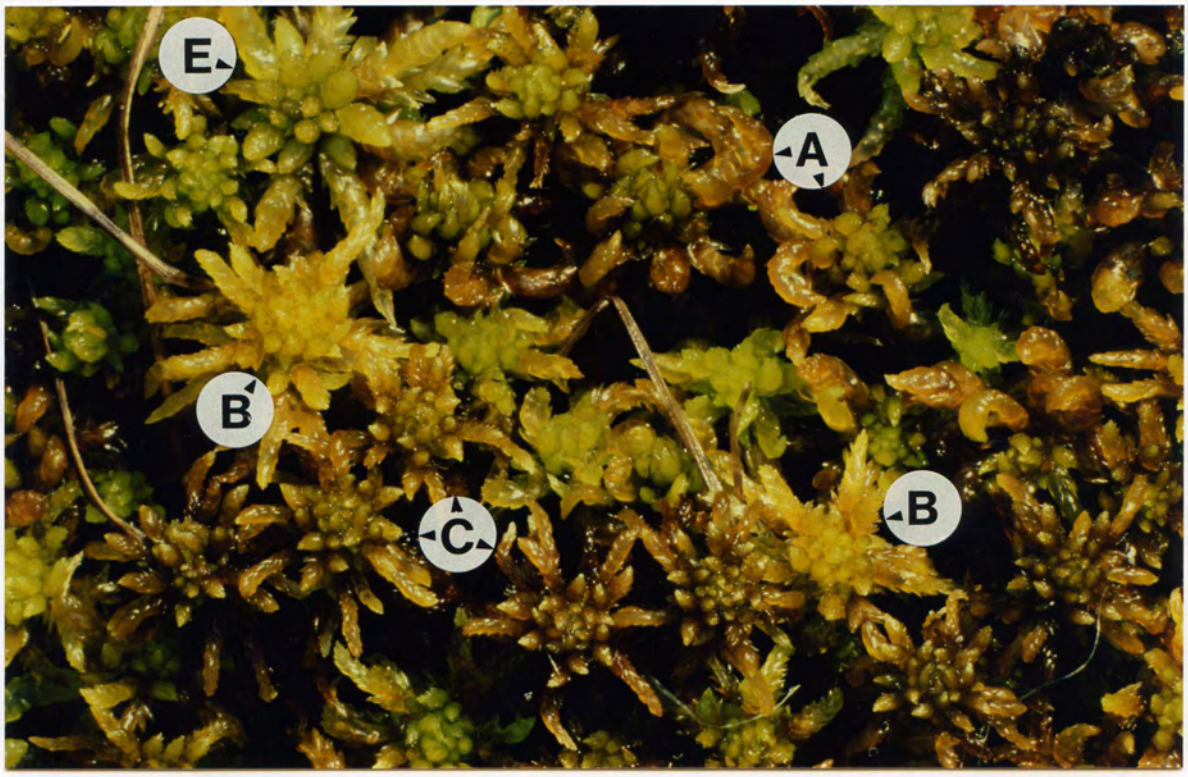




**A: inundatum** **B: subsecundum**

# Sphagnum auriculatum Schimp.



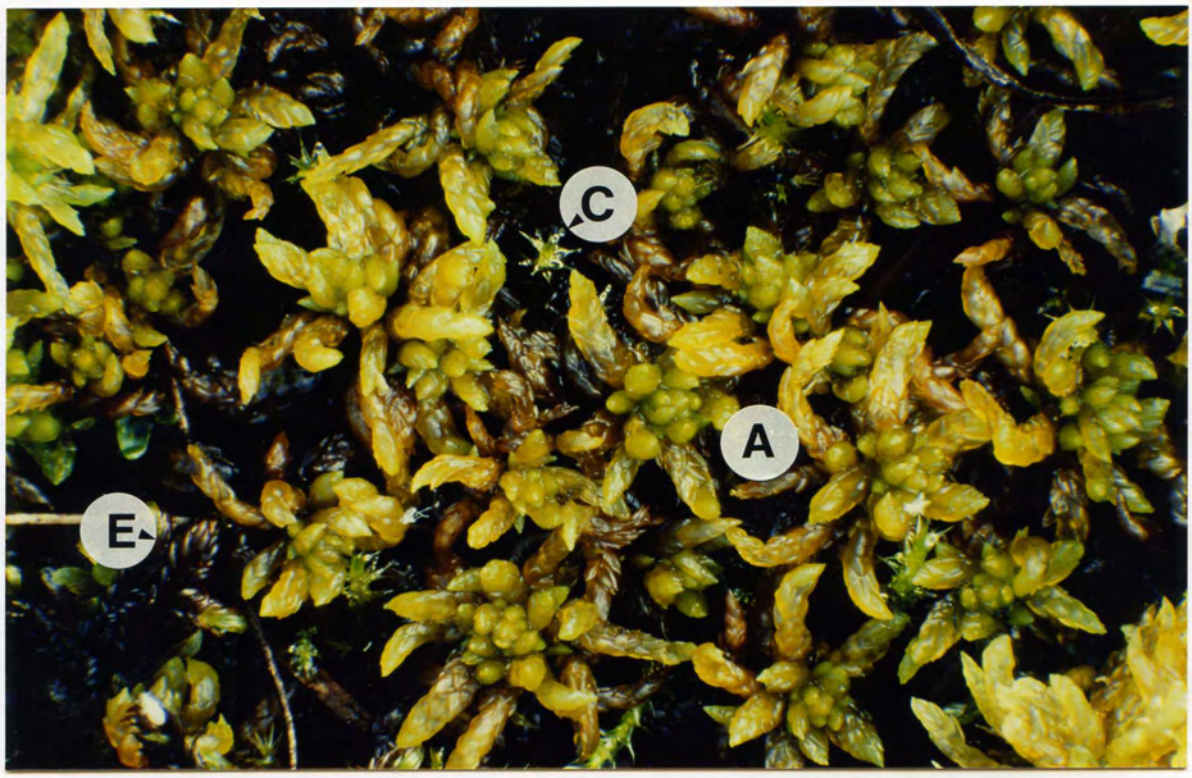


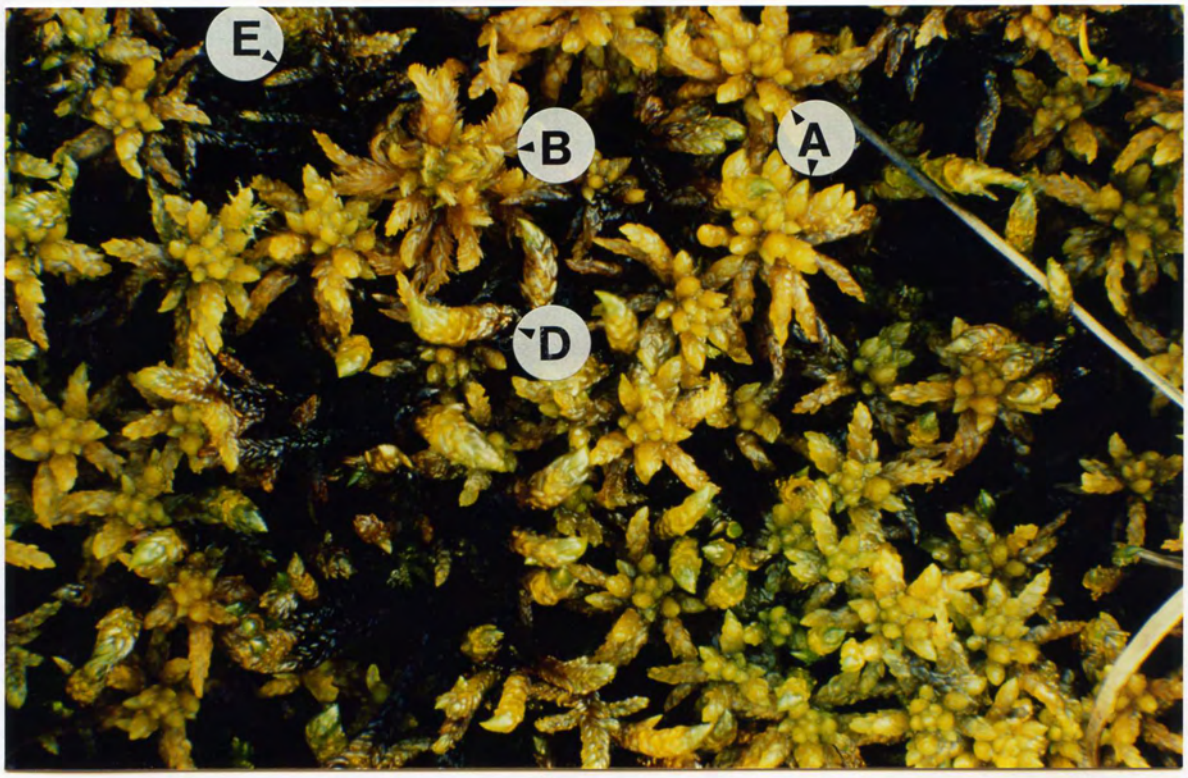




**A: auriculatum**
**B: inundatum**
**C: subsecundum**
**D: majus ssp. majus**
**E: papillosum**
**F: annulatum**
**G: Warnstorfia exannulata**

# Sphagnum platyphyllum (Braithw.) Warnst.



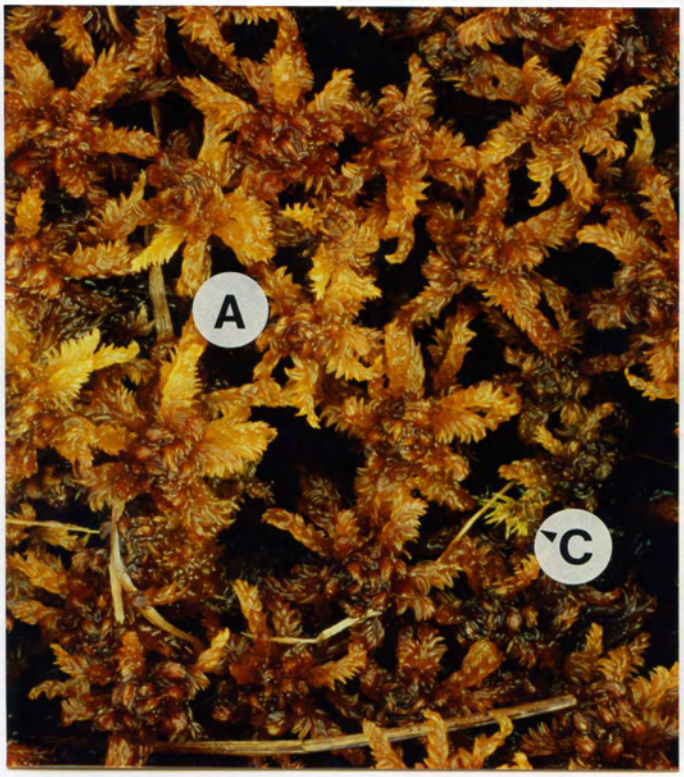


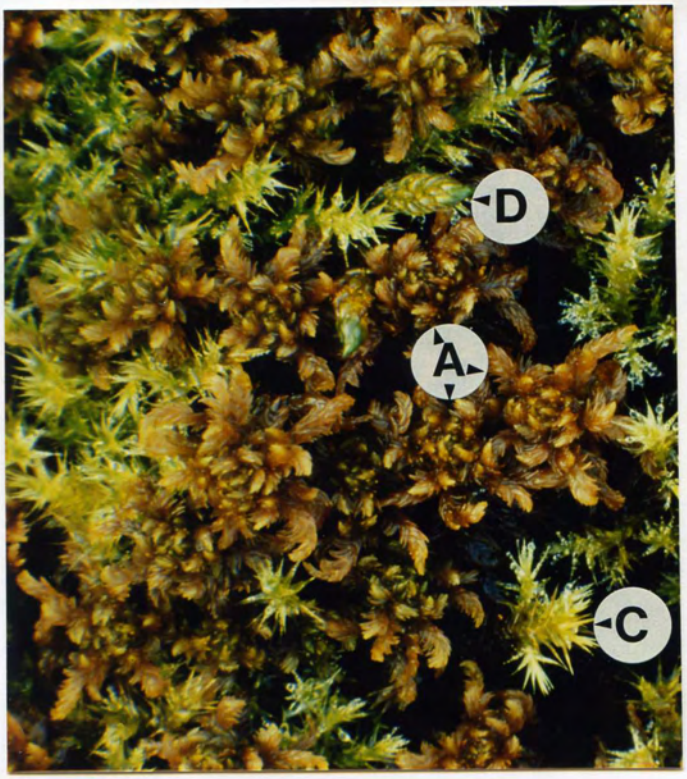



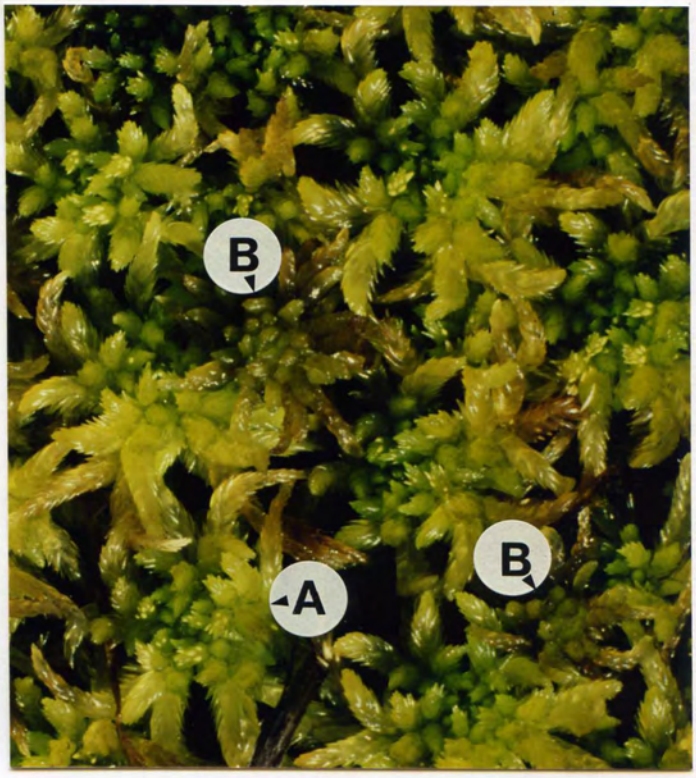

**A: platyphyllum**
**B: contortum**
**C: Campylium stellatum**
**D: Scorpidium scorpioides**
**E: Scorpidium cossoni**

# Sphagnum contortum Schultz





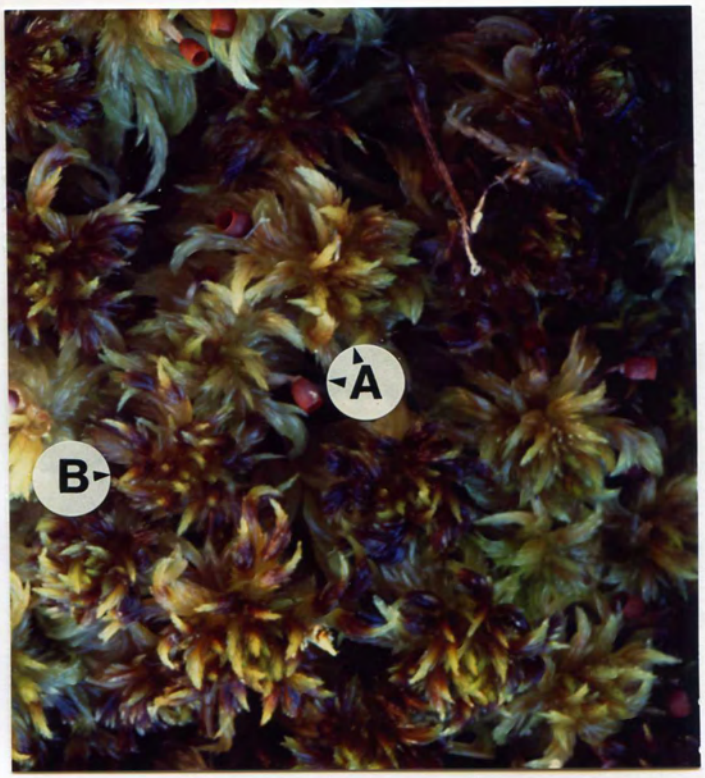


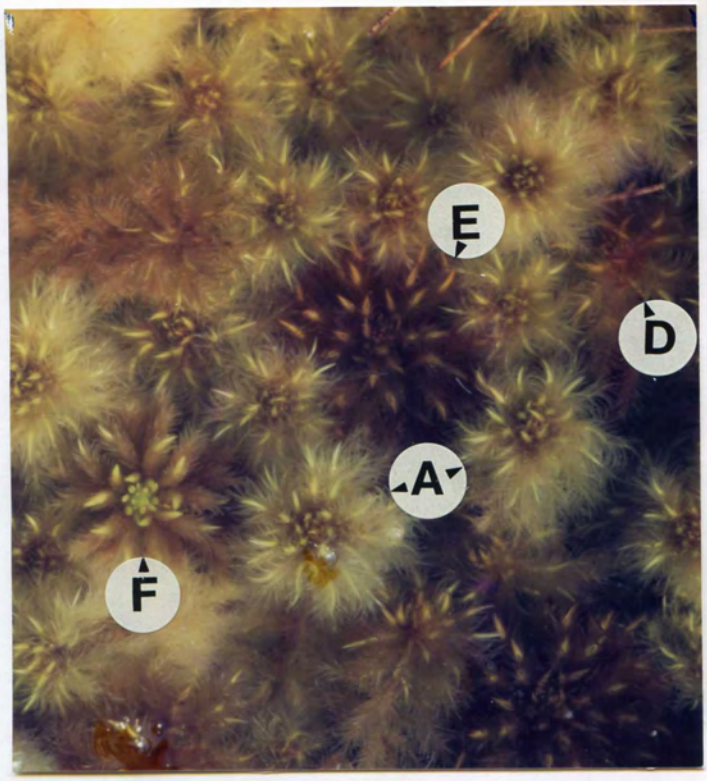



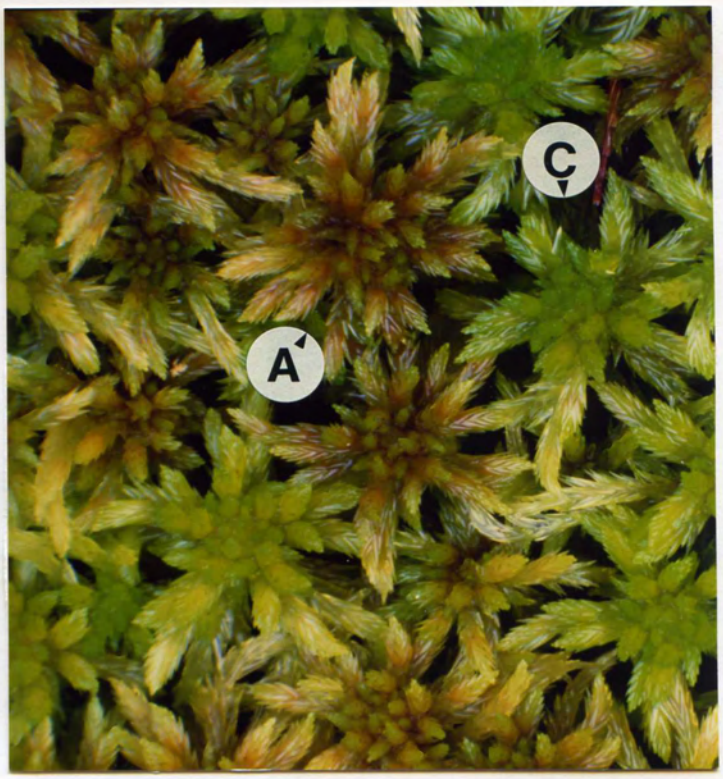

A: contortum
B: subsecundum

C: Campylium stellatum
D: Scorpidium scorpioides

# Sphagnum cuspidatum Ehrh. ex Hoffm.



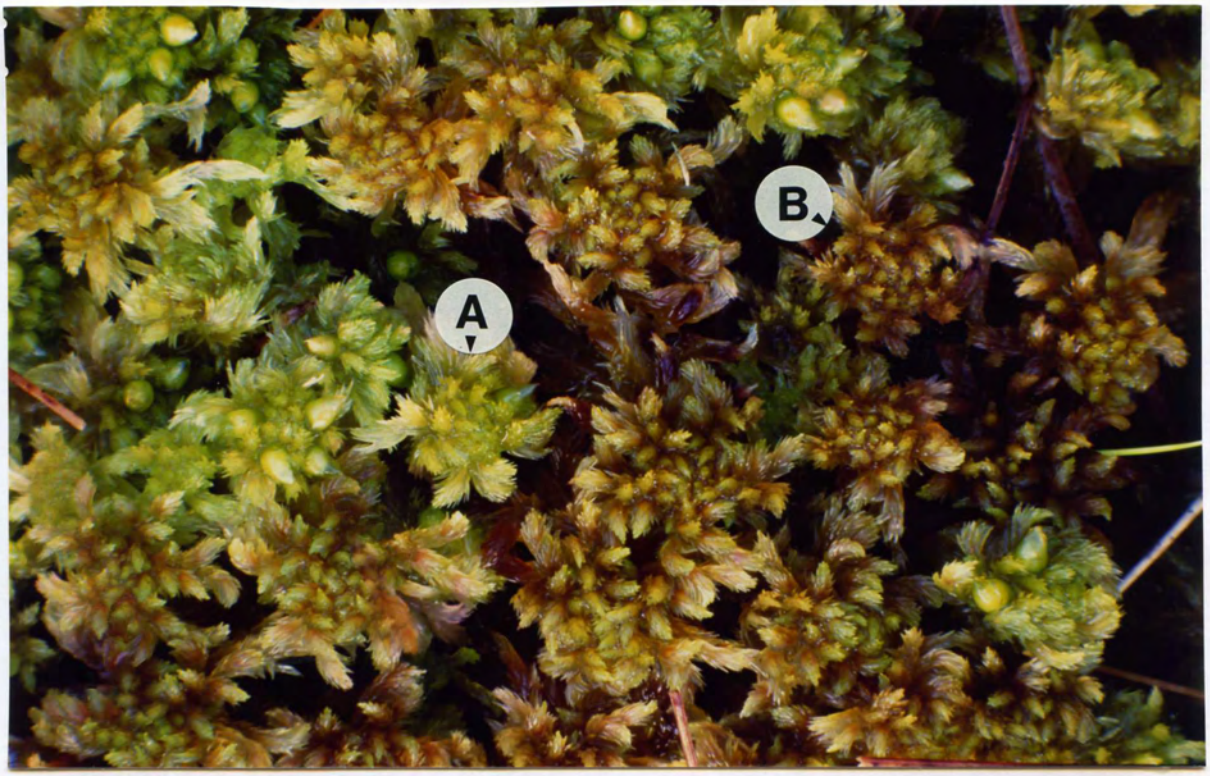



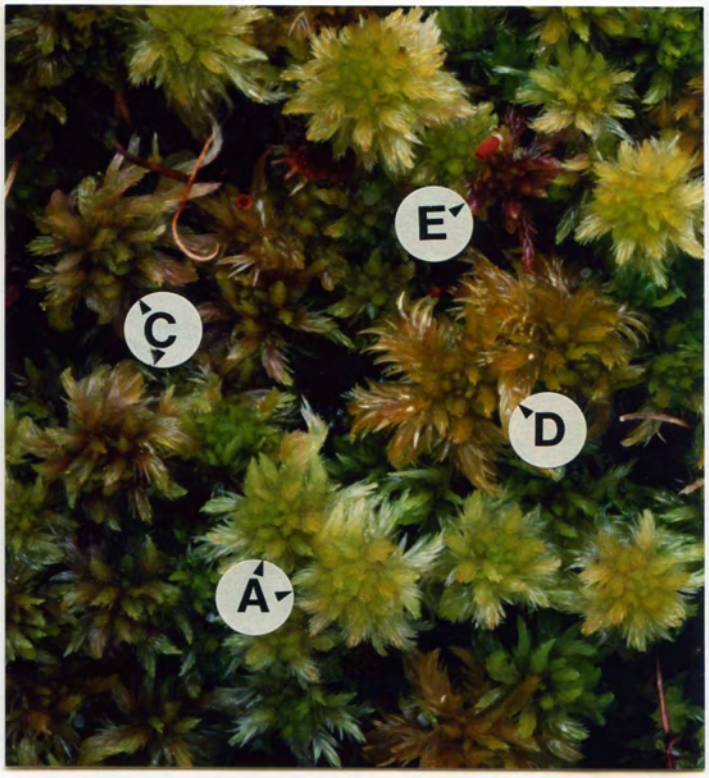

A: cuspidatum, female
B: cuspidatum, male
C: viride

D: balticum
E: lindbergii
F: pulchrum

# Sphagnum viride Flatb.





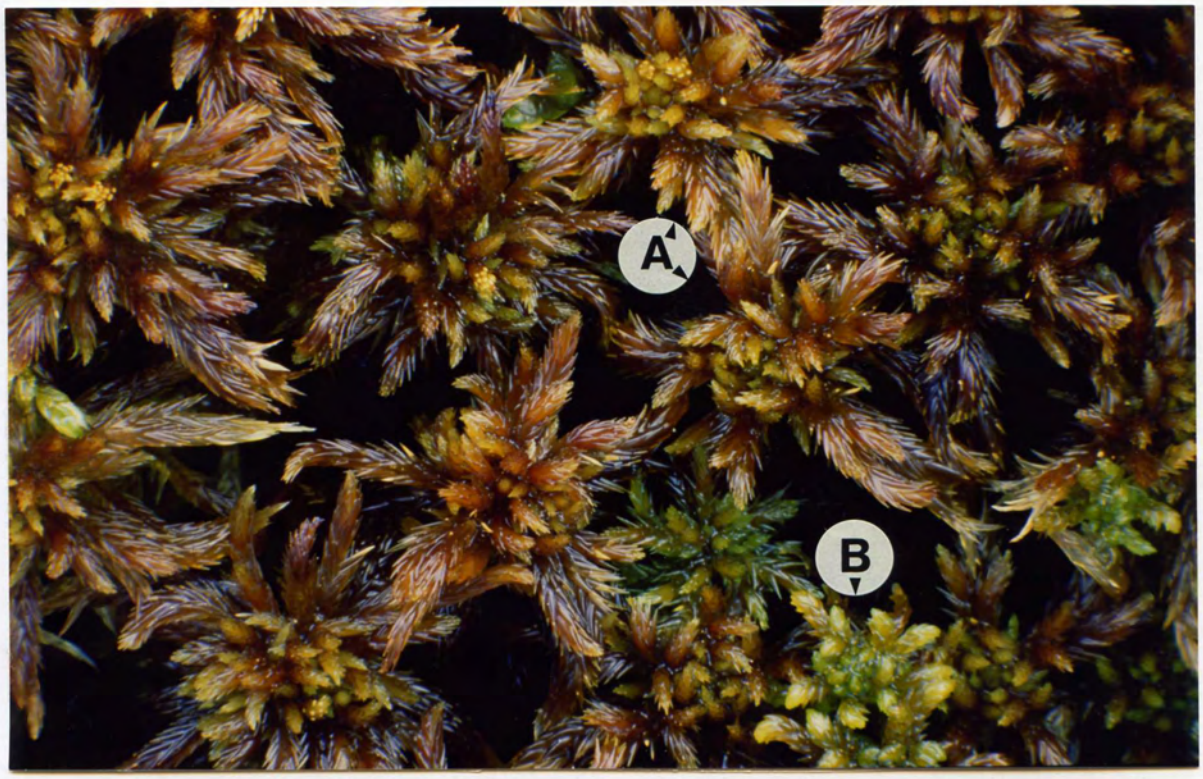


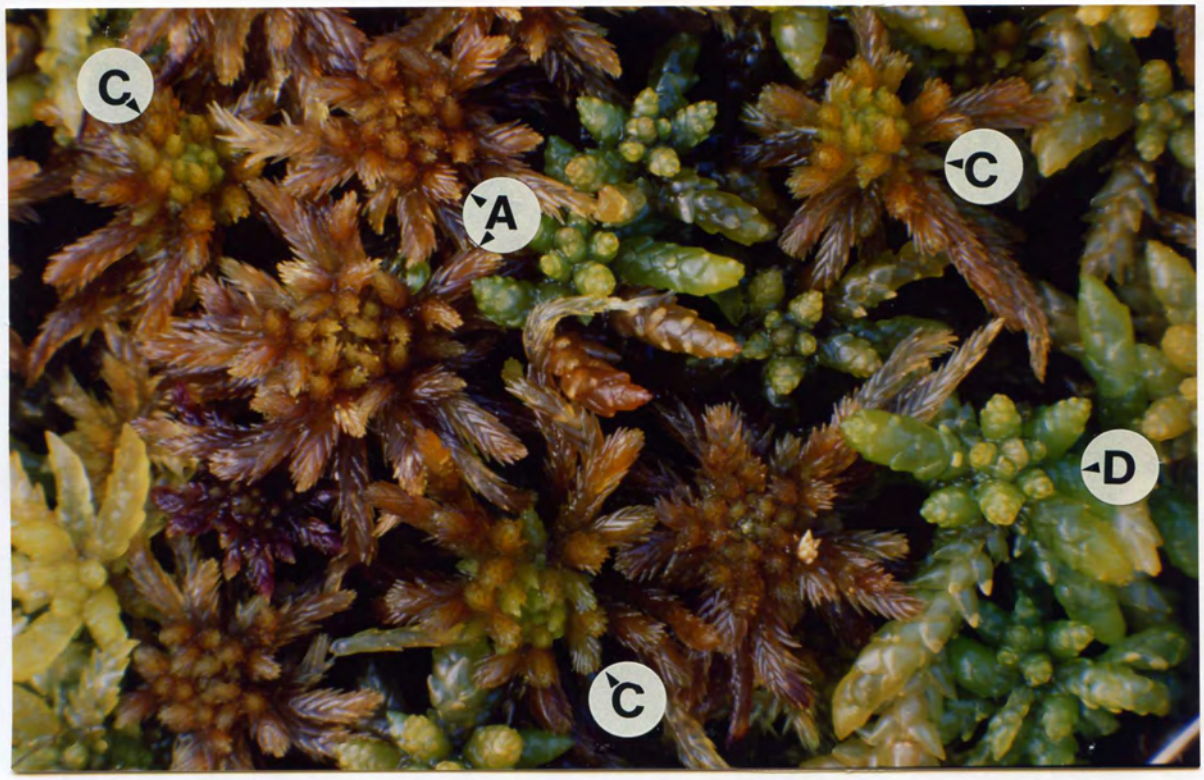

A: viride, female
B: viride, male
C: cuspidatum, female

D: majus ssp. majus
E: rubellum

# Sphagnum majus (Russ.) C. Jens. ssp. majus

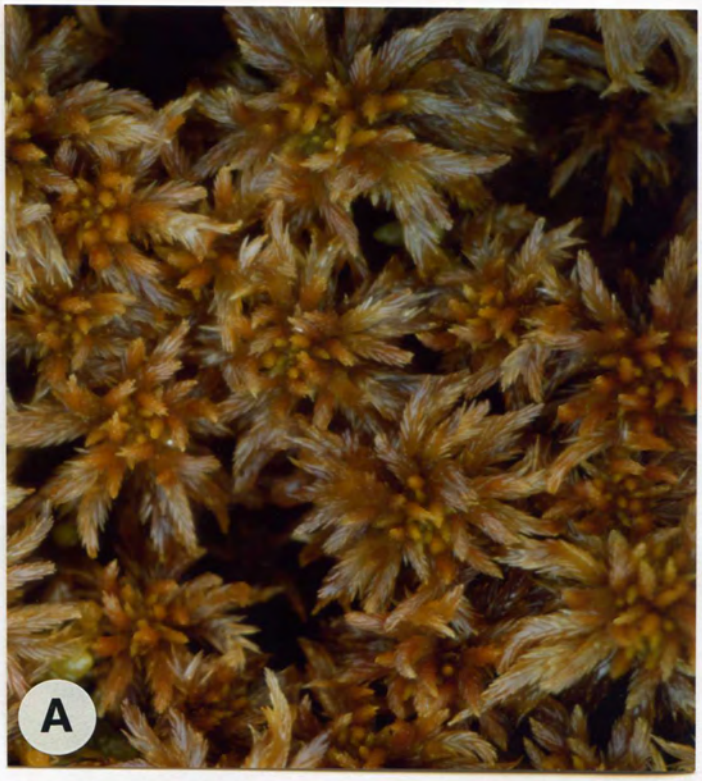


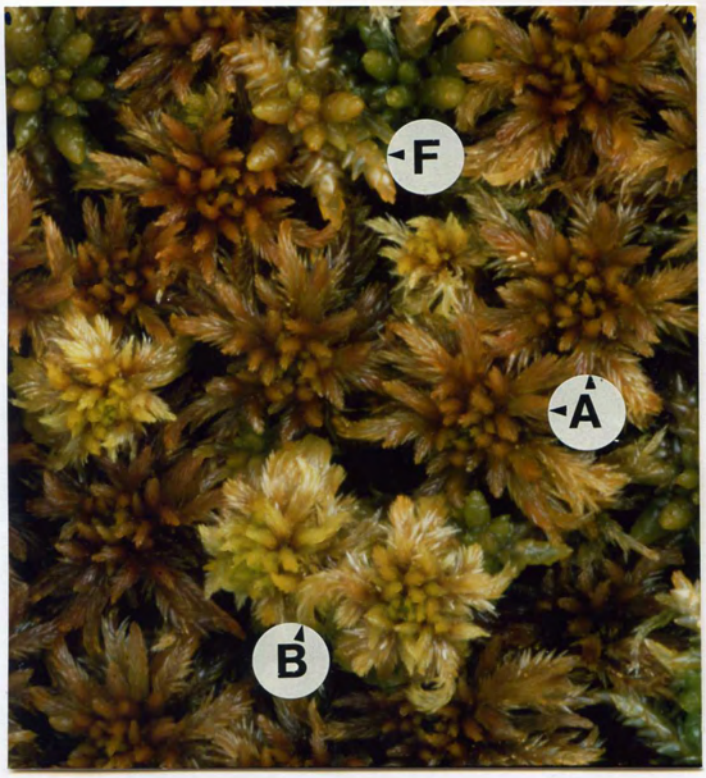


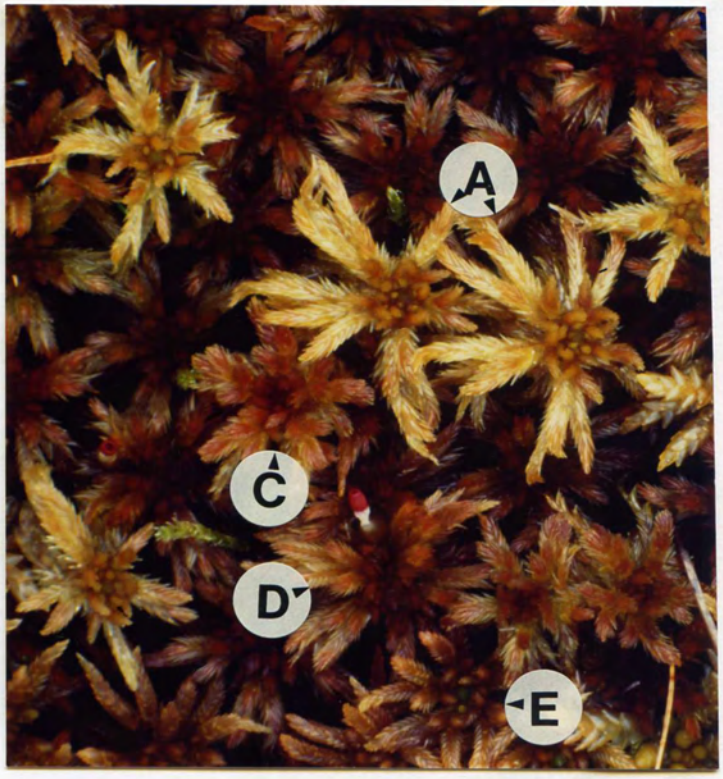




A: majus ssp. majus
B: subsecundum
C: balticum
D: papillosum

# Sphagnum majus (Russ.) C. Jens. ssp. norvegicum Flatb.

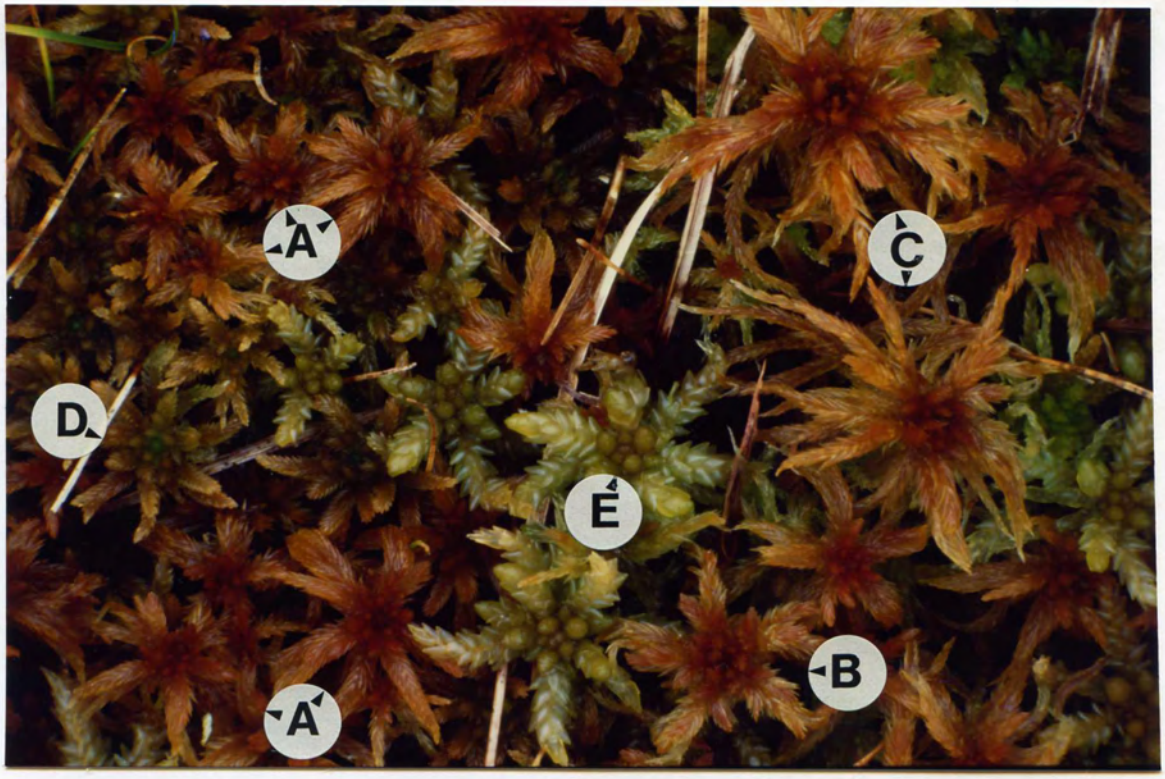



A: majus ssp. norvegicum
B: cuspidatum
C: majus ssp. majus, male
D: lindbergii
E: pulchrum
F: papillosum

# Sphagnum annulatum Warnst.



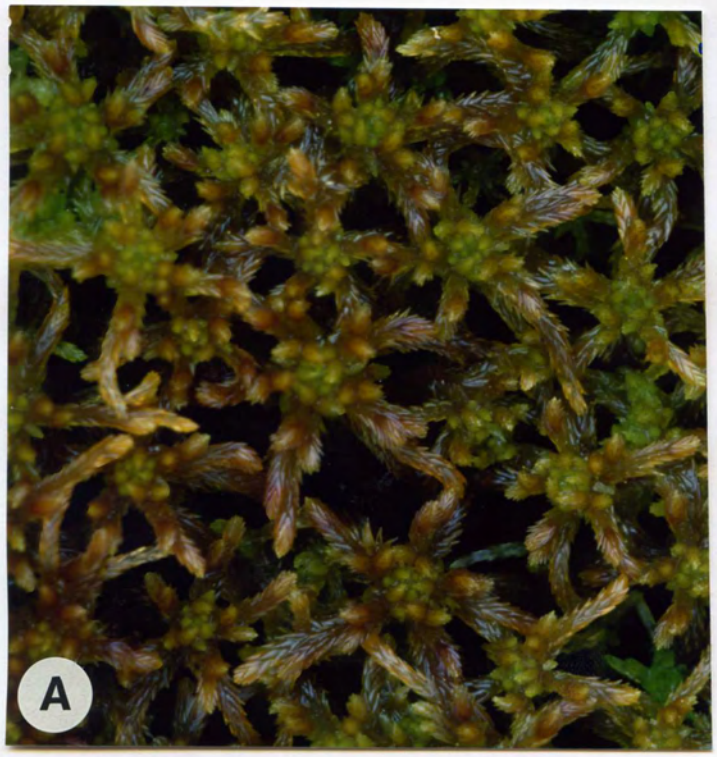

A: annulatum
B: majus ssp. majus
C: jensenii
D: pulchrum
E: papillosum

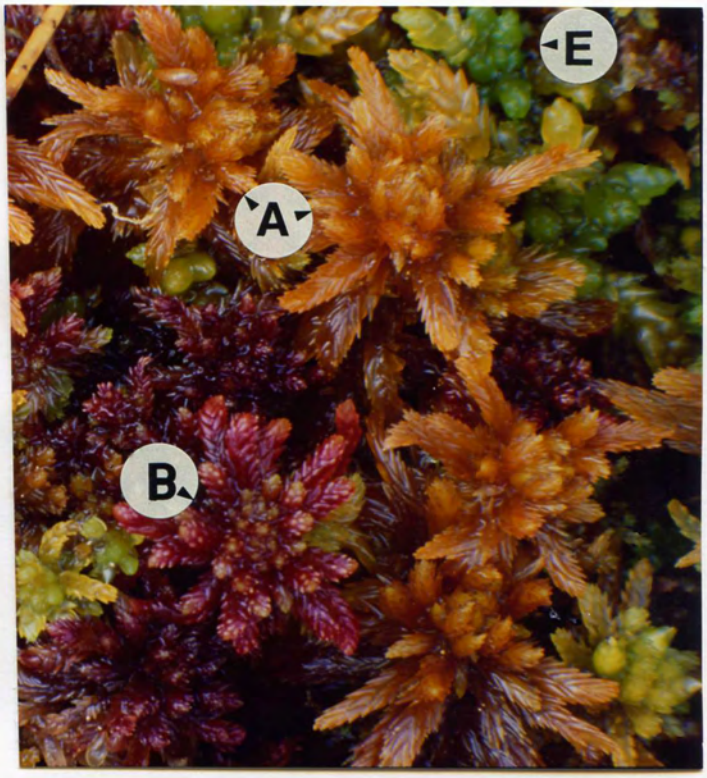
# Sphagnum jensenii H. Lindb.

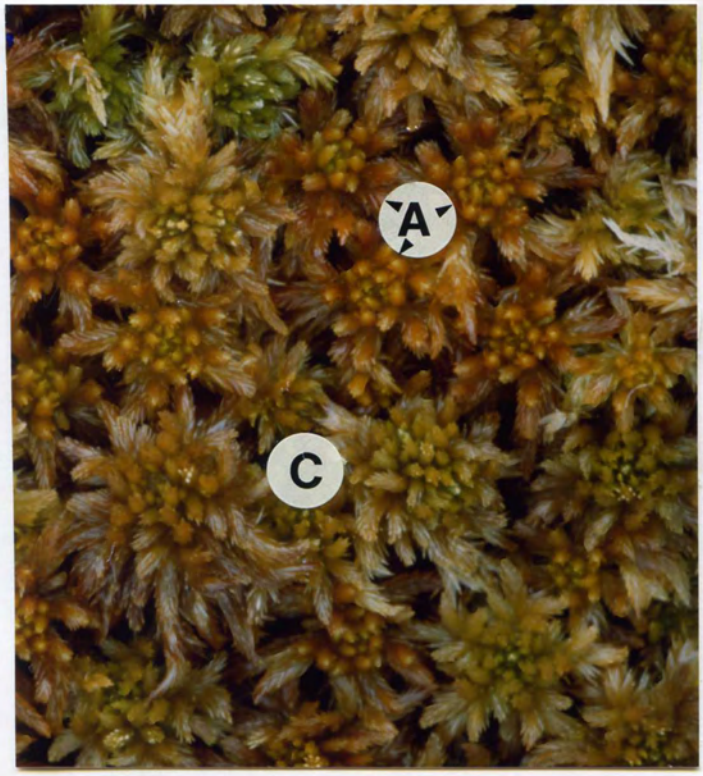
**A: jensenii**
**B: majus ssp. majus, male**
**C: majus ssp. norvegicum**
**D: pulchrum**

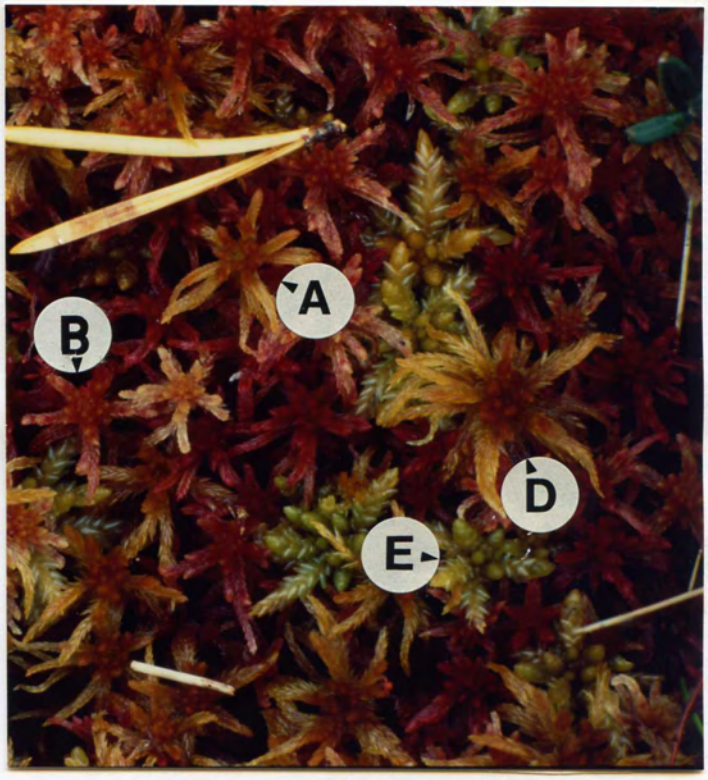
# Sphagnum balticum (Russ.) C. Jens.





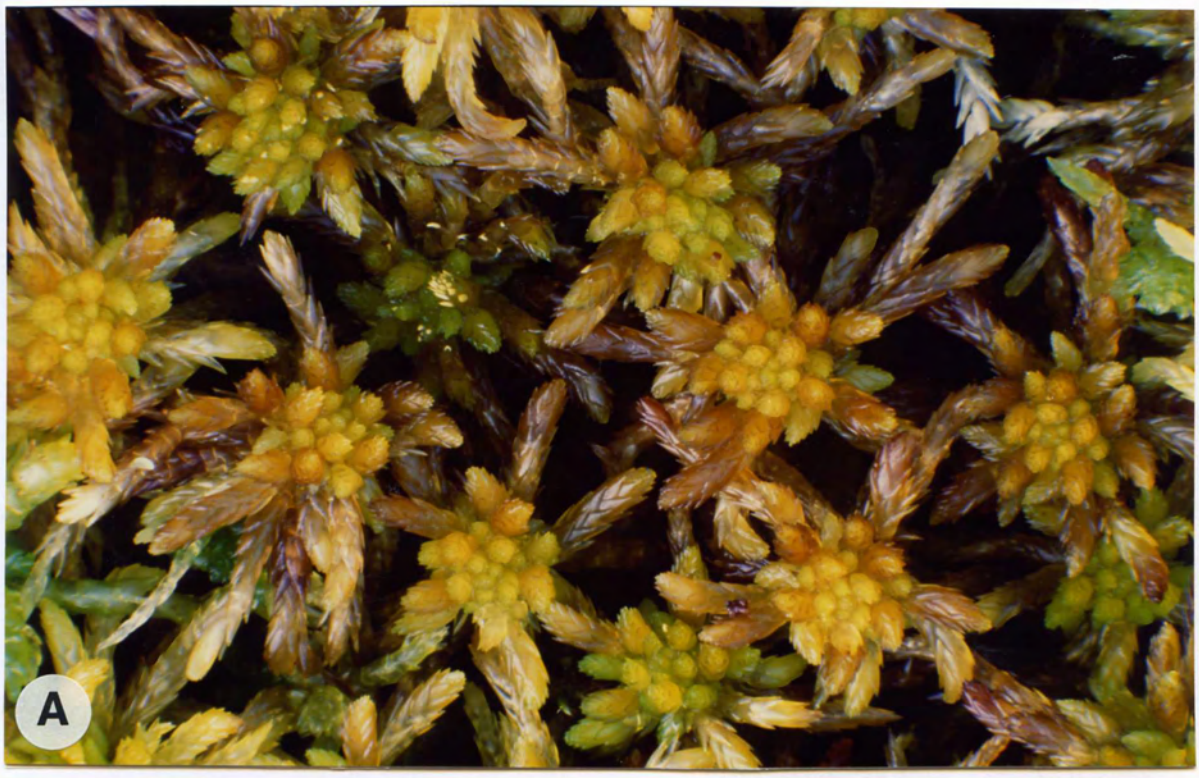



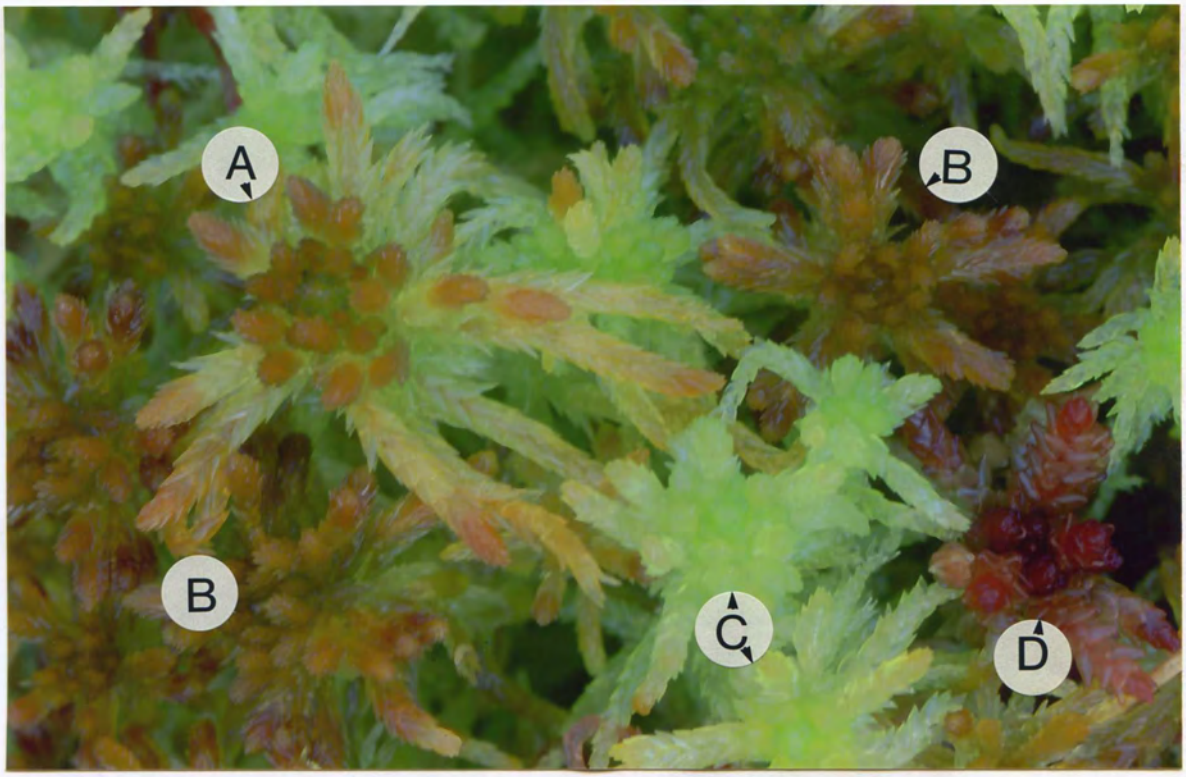




A: balticum
B: rubellum
C: majus ssp. norvegicum
D: jensenii
E: papillosum

# Sphagnum troendelagicum Flatb.



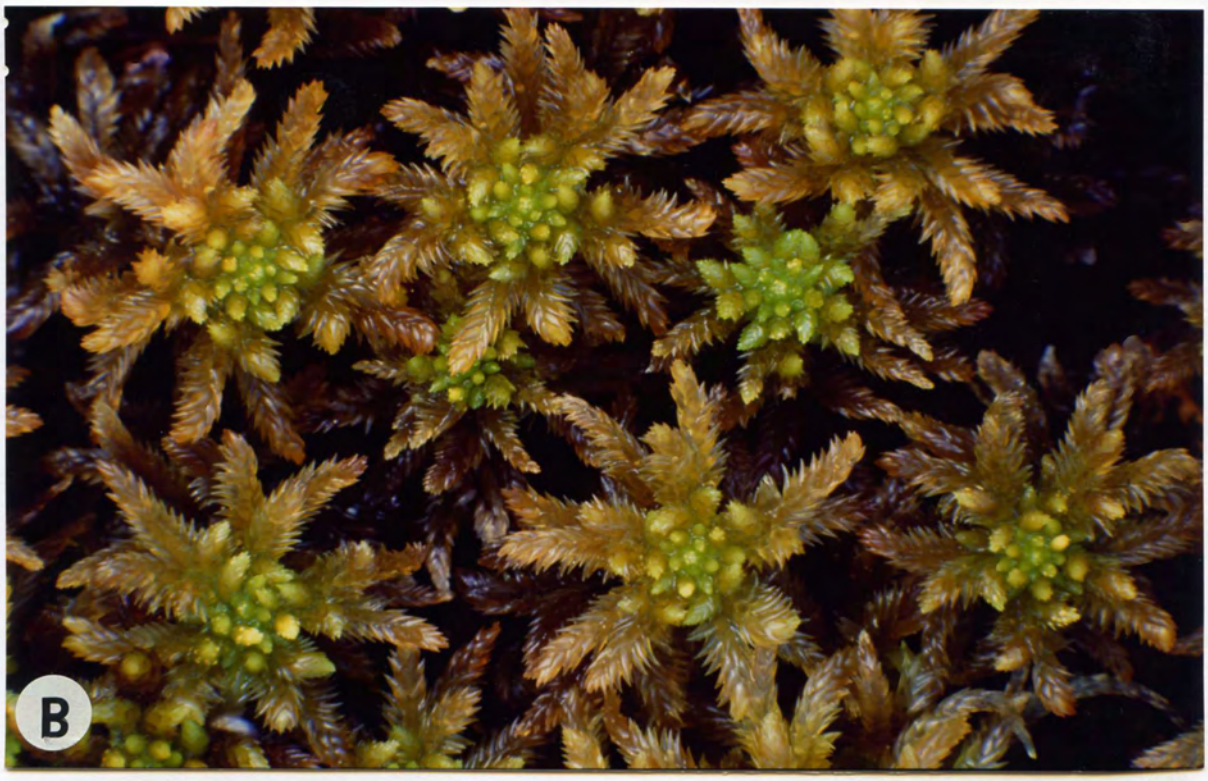


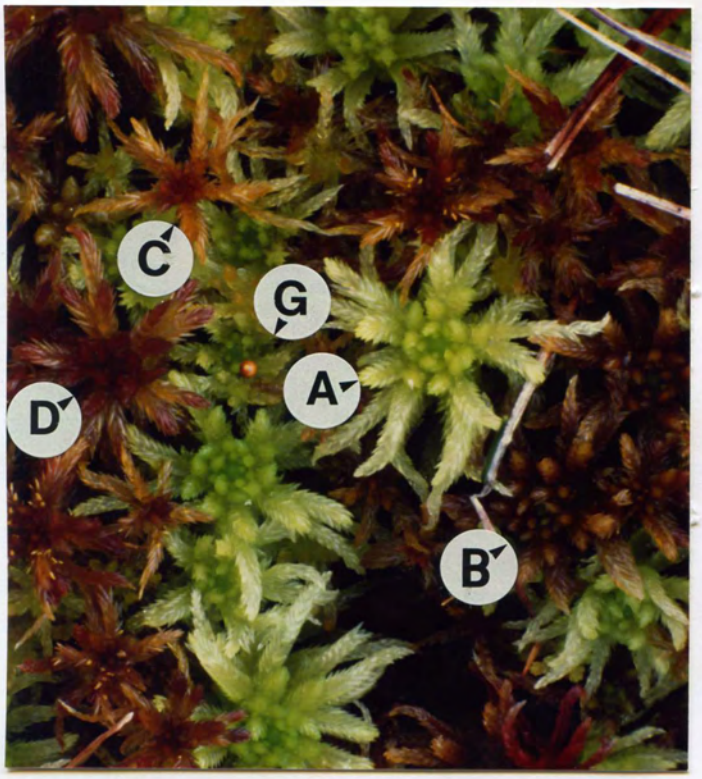



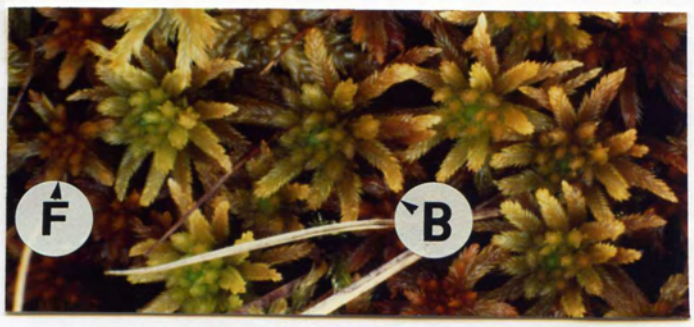

A: troendelagicum
B: balticum
C: tenellum
D: magellanicum

# Sphagnum pulchrum (Braithw.) Warnst.





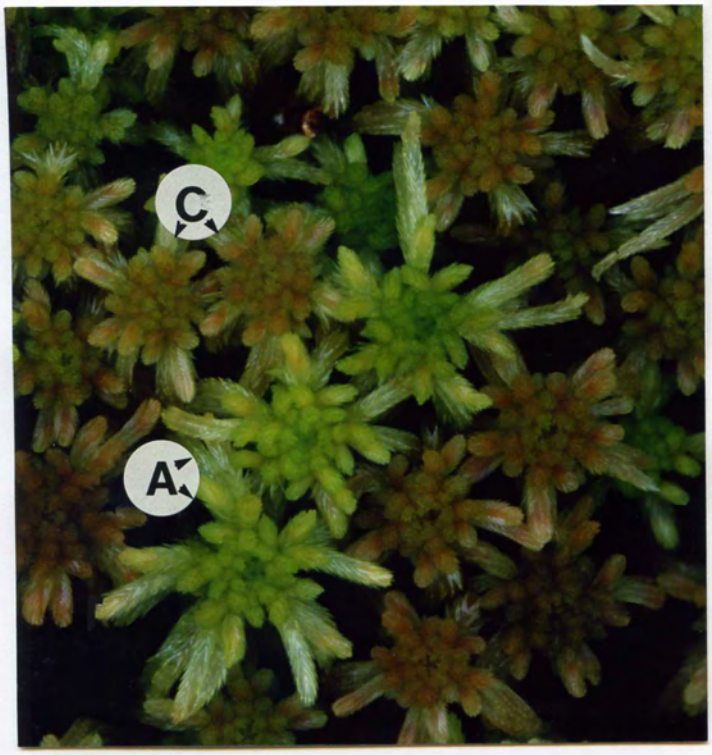



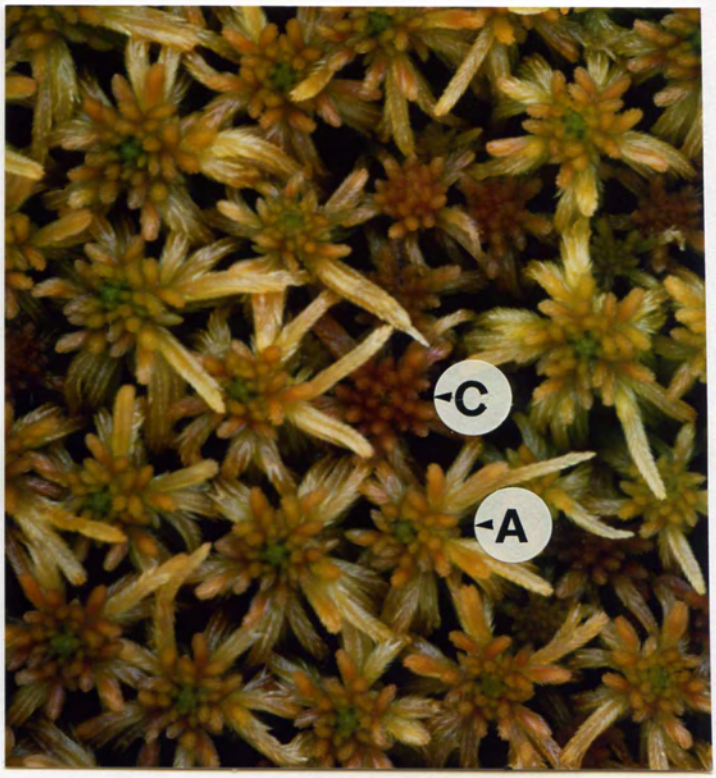


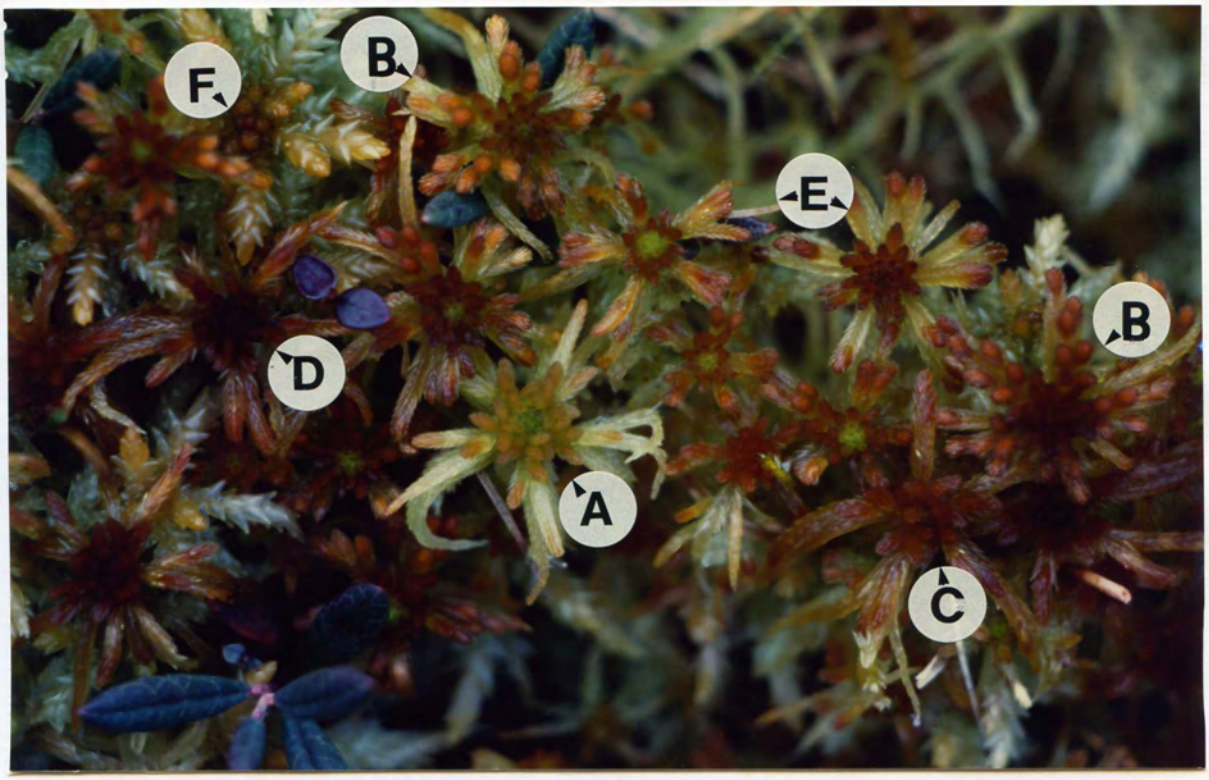

A: pulchrum, green morph
B: pulchrum, brown morph
C: annulatum
D: jensenii
E: lindbergii
F: balticum
G: tenellum

# Sphagnum fallax (Klinggr.) Klinggr.





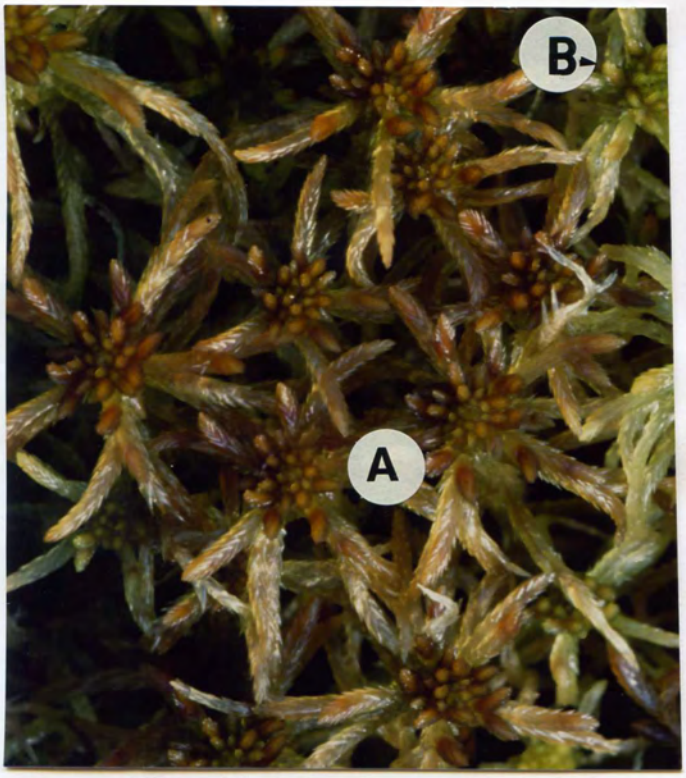



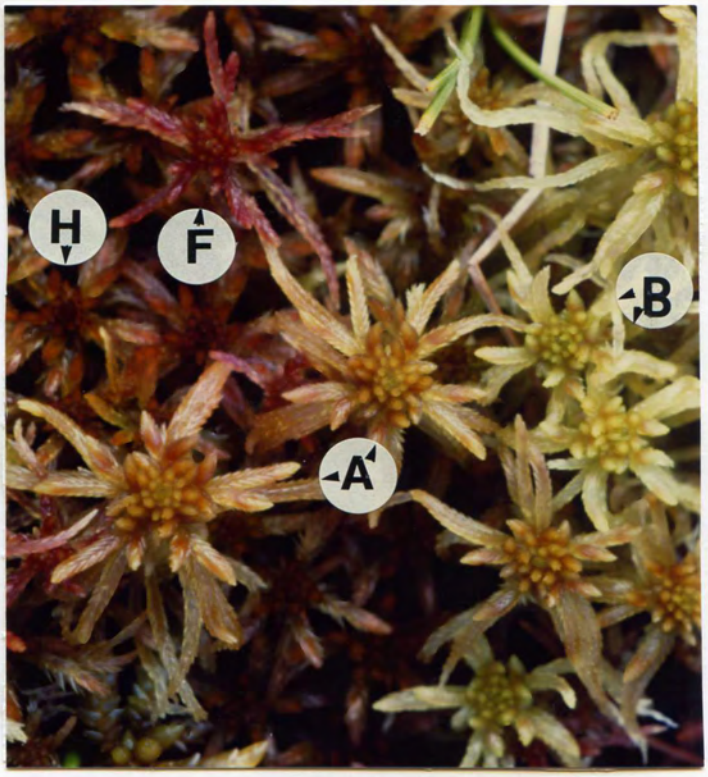



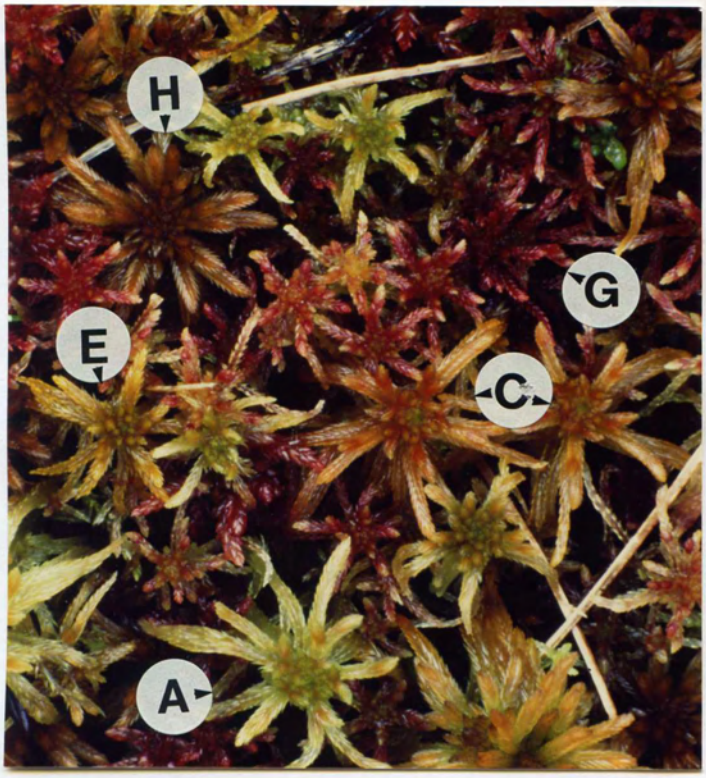

A: fallax, female
B: fallax, male
C: angustifolium, female
D: isoviitae, female
E: isoviitae, male
F: papillosum

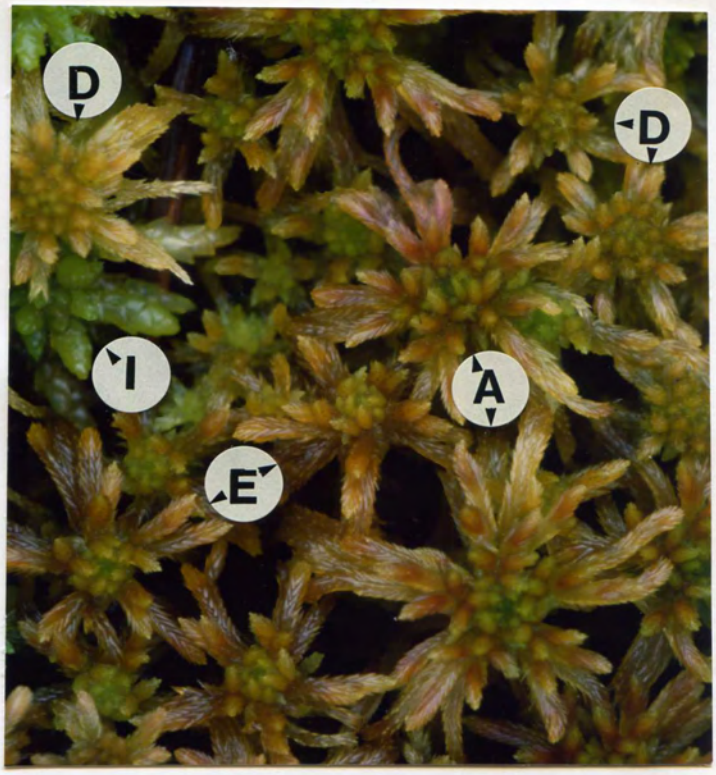
# Sphagnum brevifolium (Braithw.) Roell





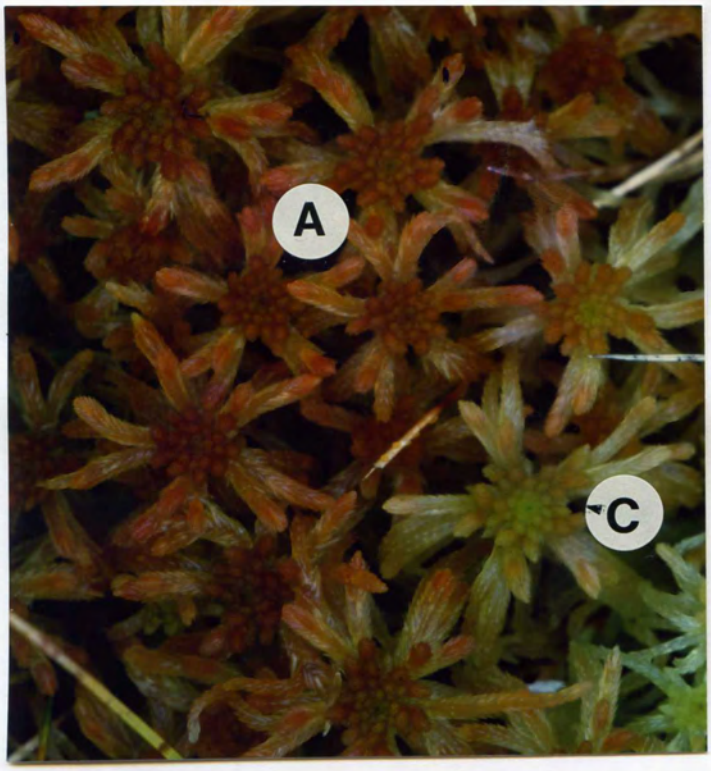



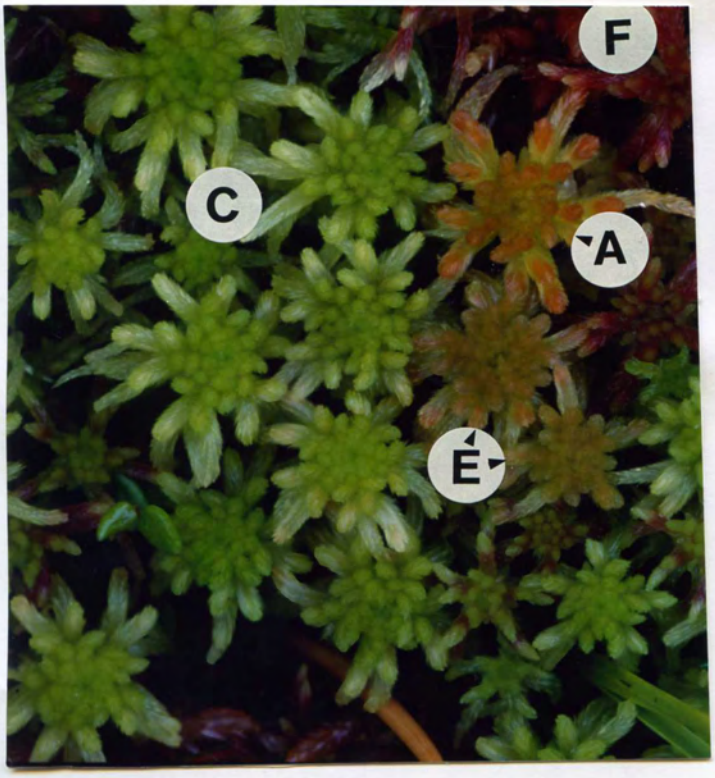

A: brevifolium
B: flexuosum
C: isoviitae
D: angustifolium
E: balticum

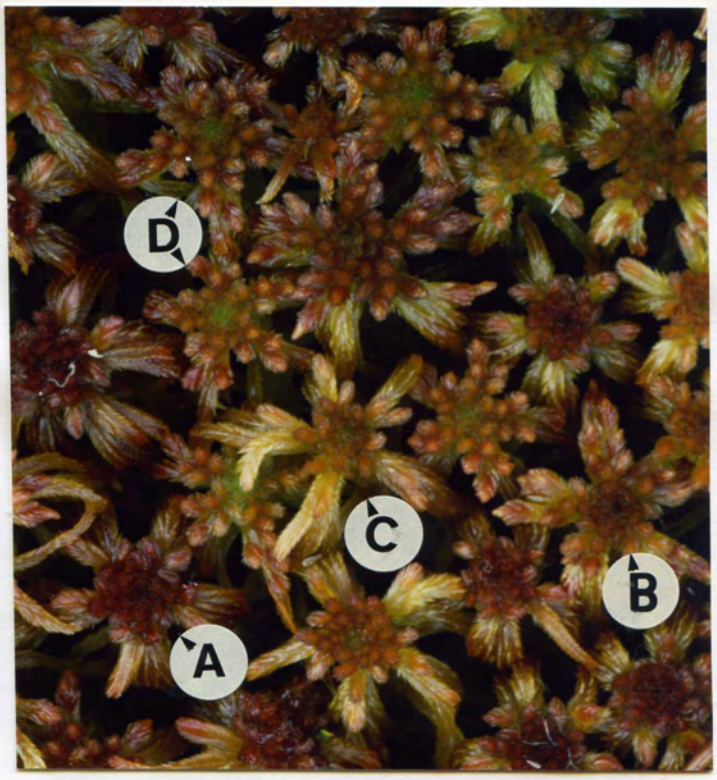
F: russowii
G: rubellum
H: lindbergii
I: papillosum

# Sphagnum isoviitae Flatb.







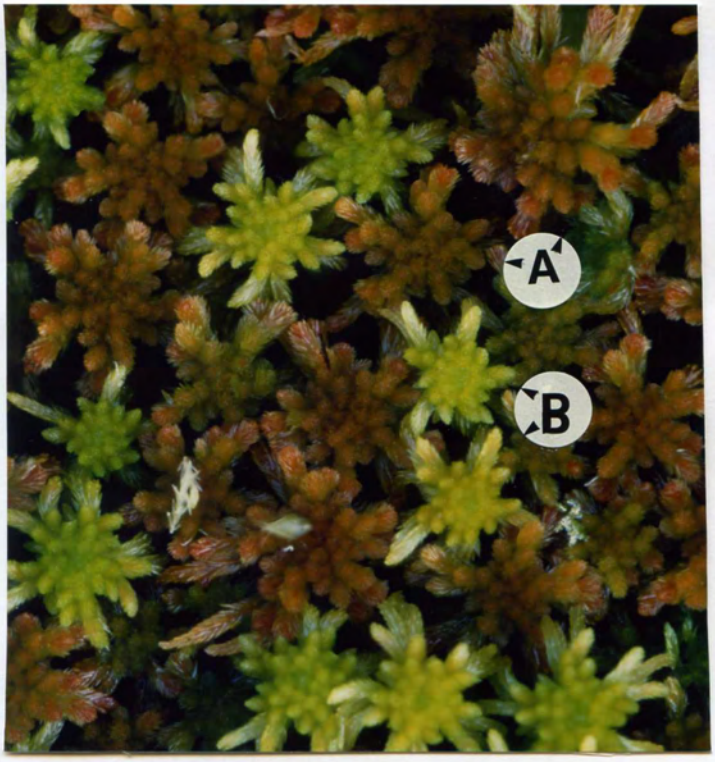



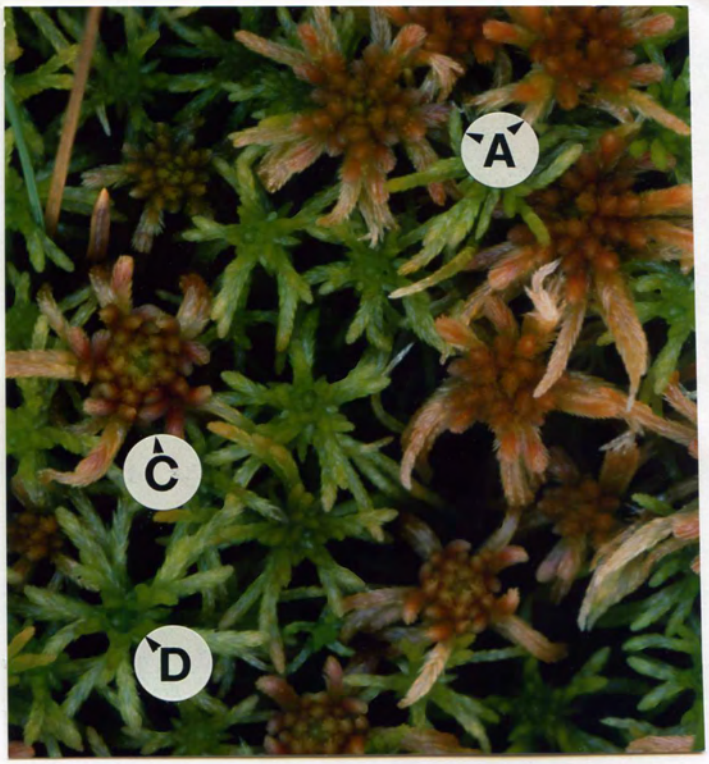

A: isoviitae, female
B: isoviitae, male
C: fallax, female

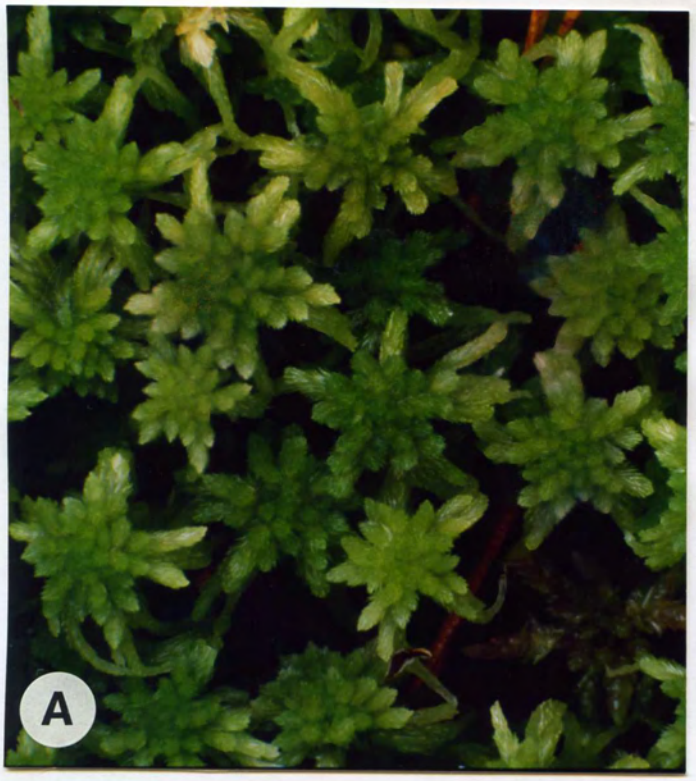
D: fallax, male
E: angustifolium
F: russowii

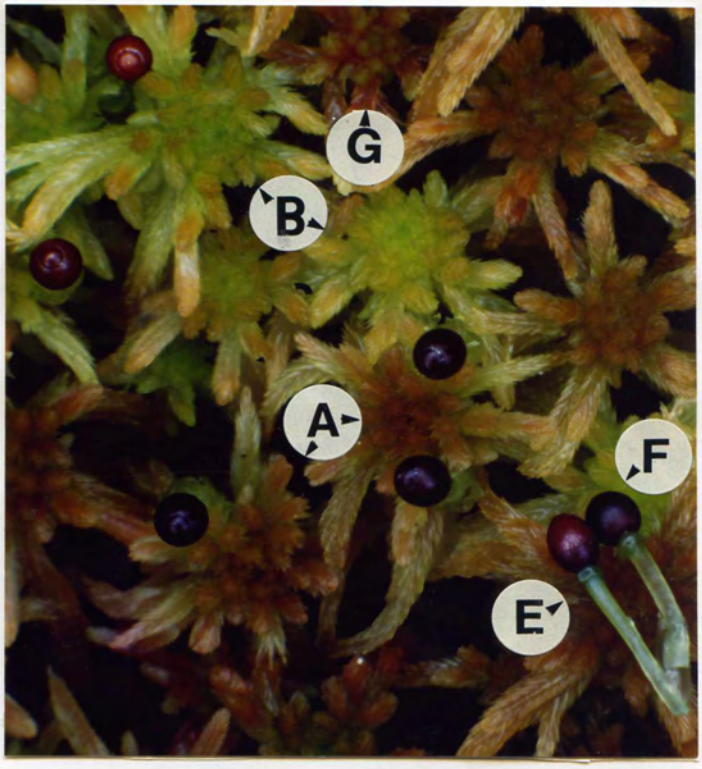
# Sphagnum angustifolium (Russ.) C. Jens.





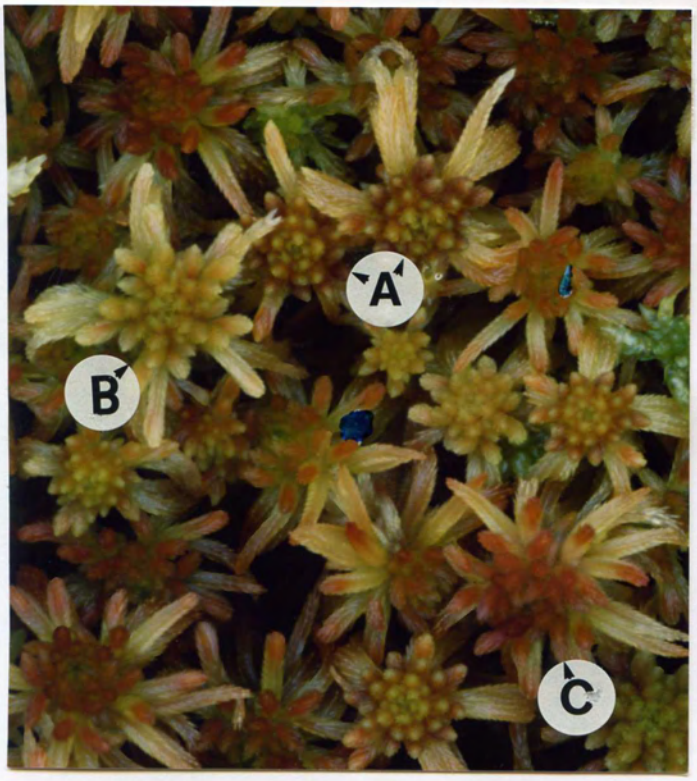



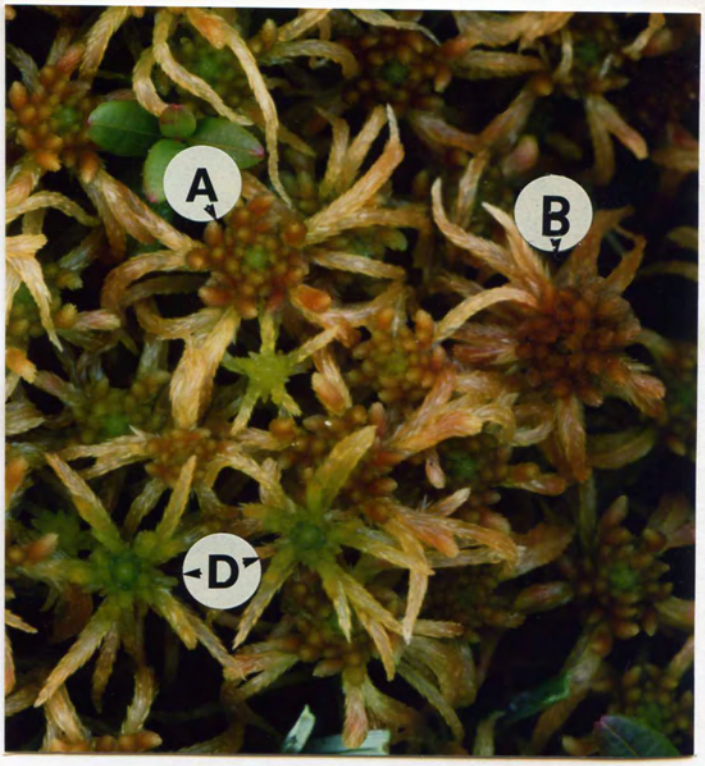




A: angustifolium
B: fallax
C: flexuosum
D: girgensohnii

E: sporophyte fallax
F: sporophyte angustifolium
G: russowii

# Sphagnum flexuosum Dozy & Molk.



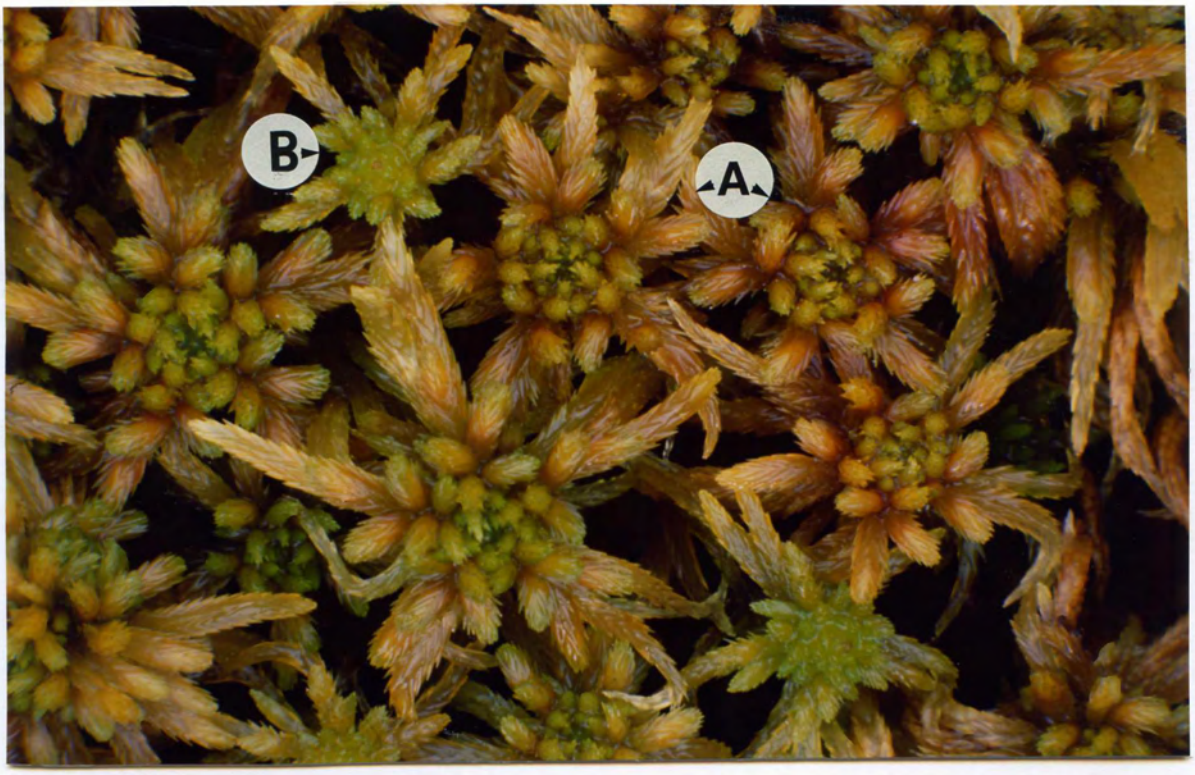



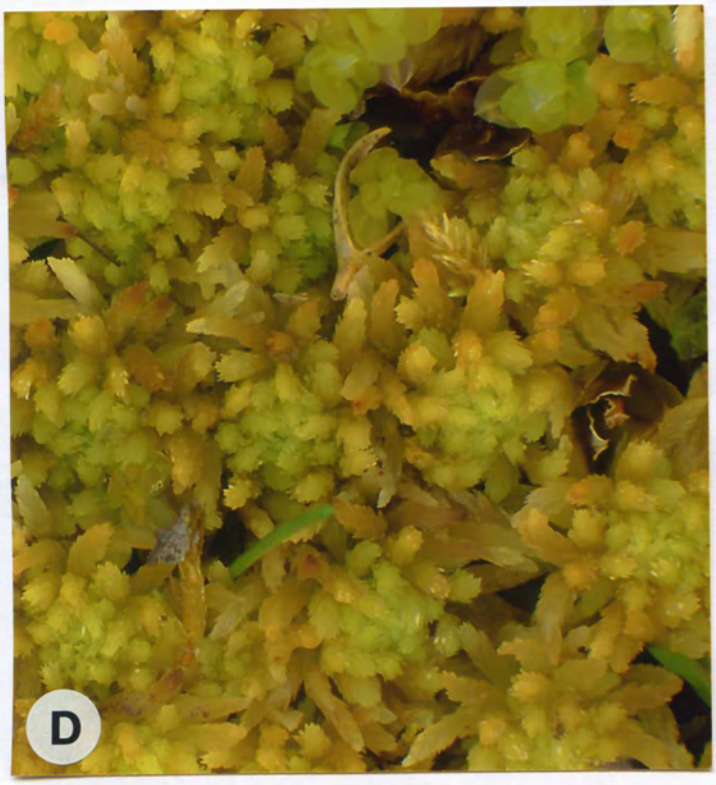

A: flexuosum
B: angustifolium

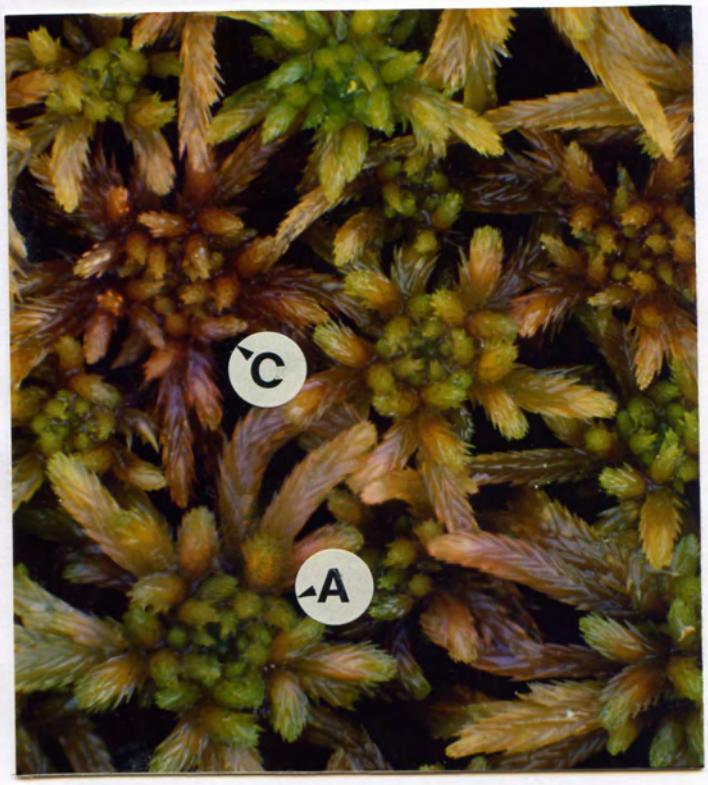
C: fallax
D: girgensohnii

# Sphagnum obtusum Warnst.





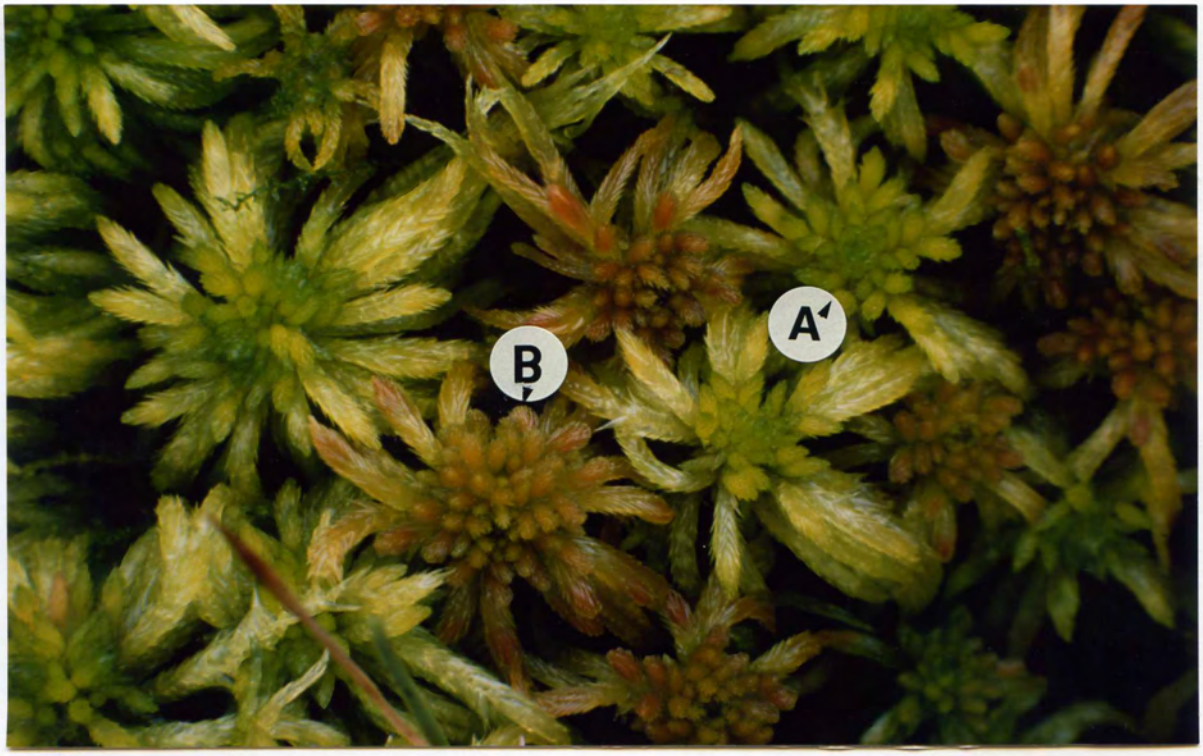



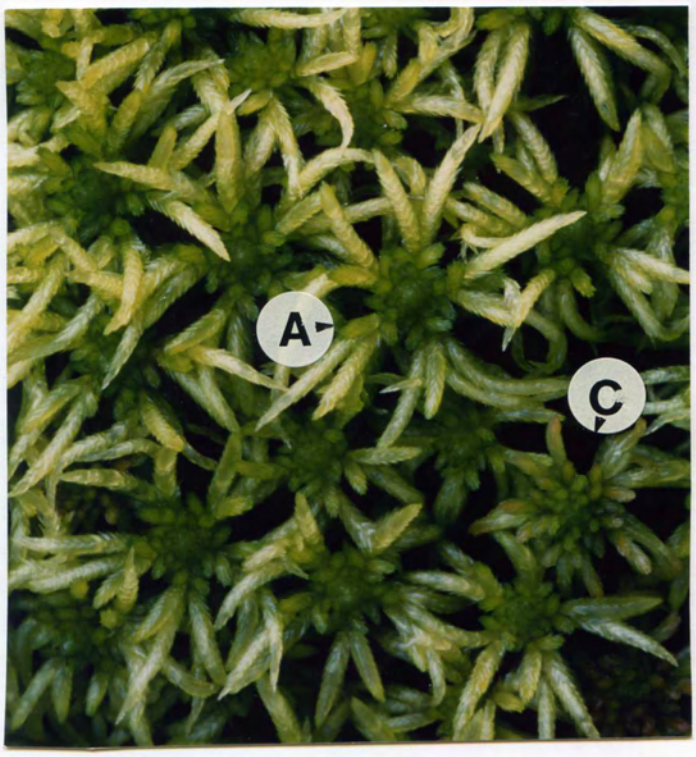

A: obtusum, boreal plant
B: teres

C: majus ssp. majus
D: obtusum, arctic plant

# Sphagnum riparium Ångstr.





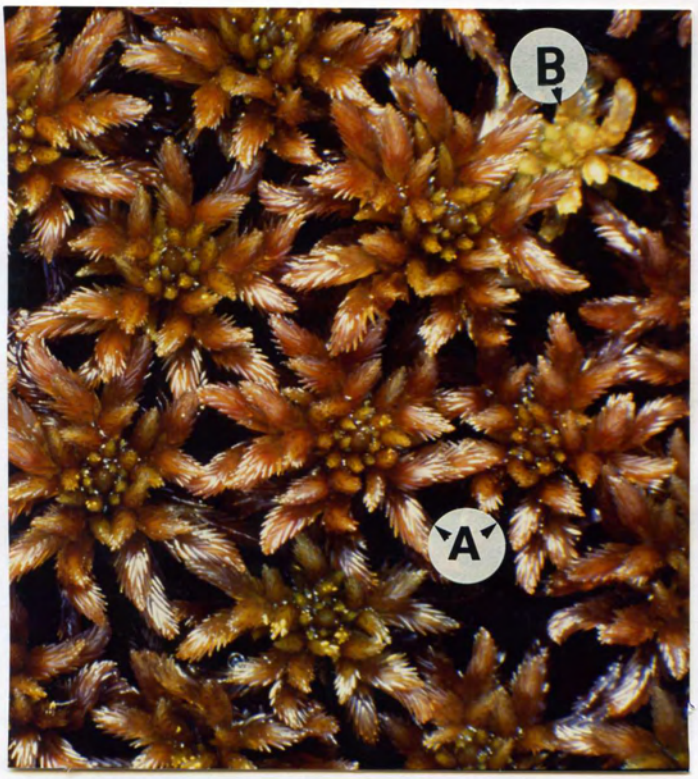



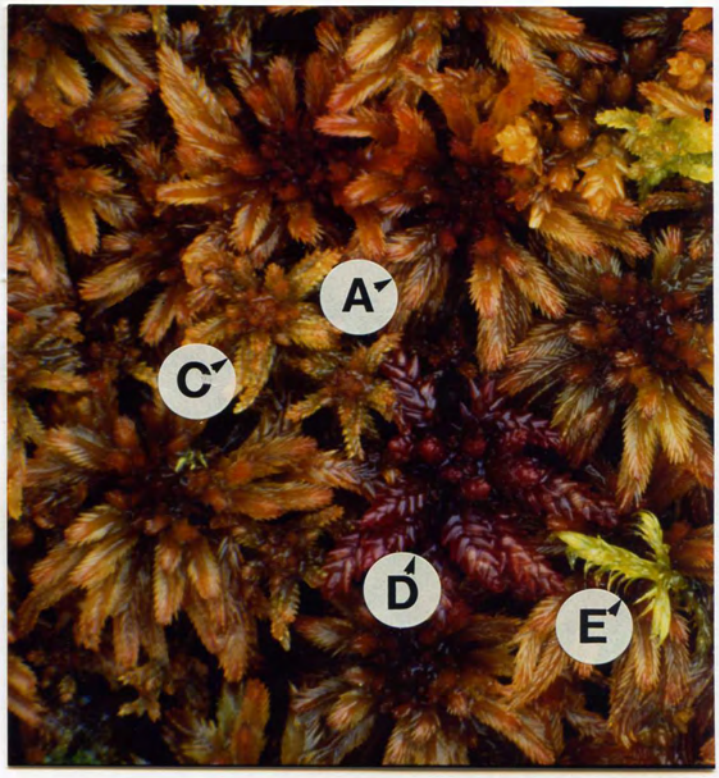
**A: riparium**
**B: angustifolium**

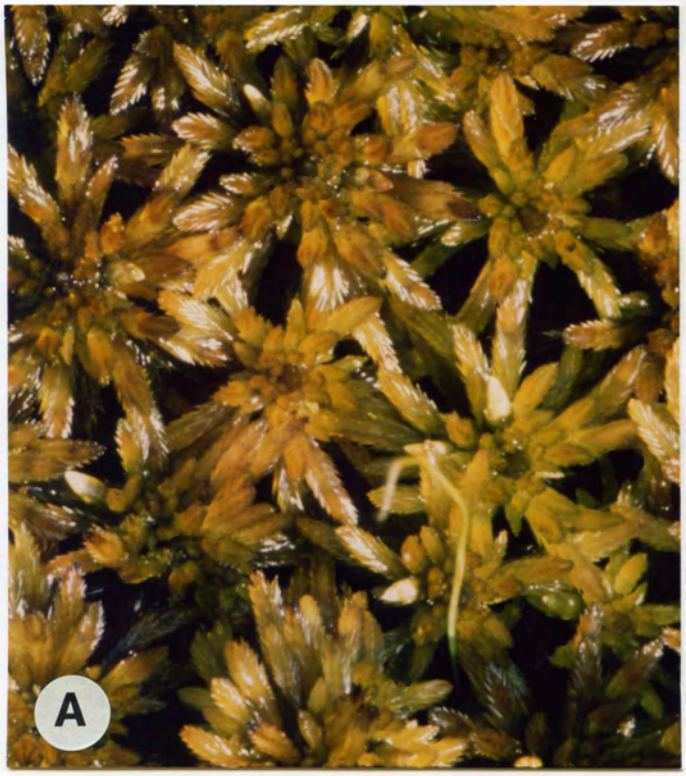
**C: fallax**

# Sphagnum lindbergii Lindb.





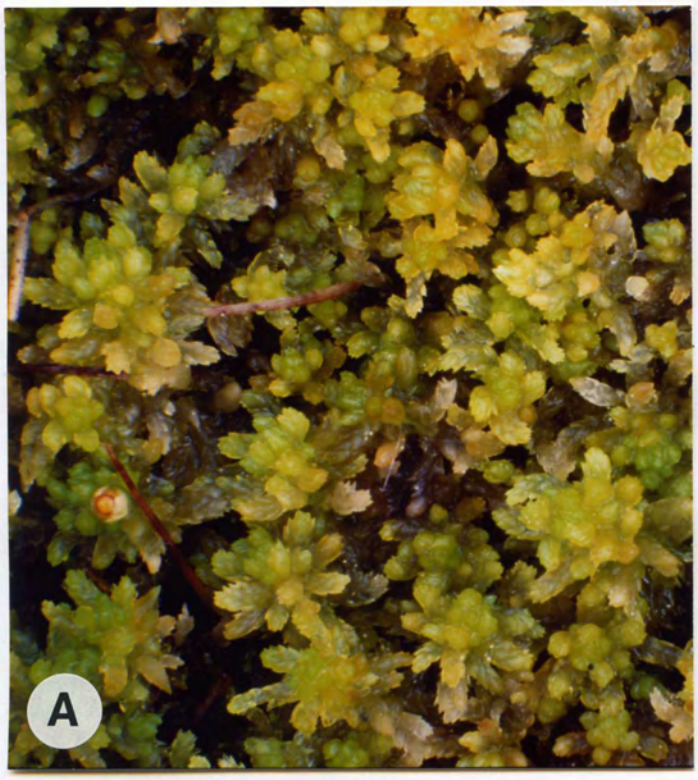



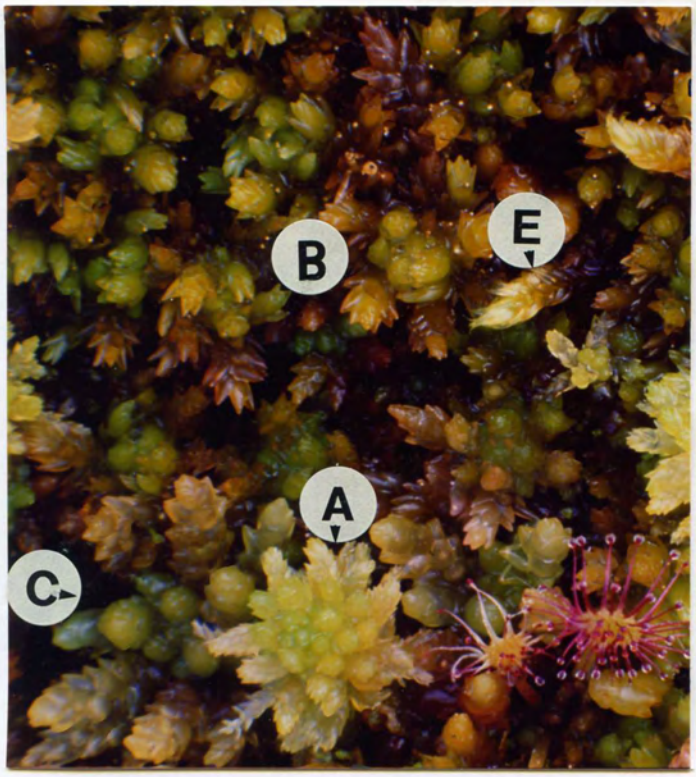
**A: lindbergii**
**B: subsecundum**
**C: tenellum**

**D: magellanicum**
**E: Warnstorfia fluitans**

# Sphagnum tenellum (Brid.) Brid.





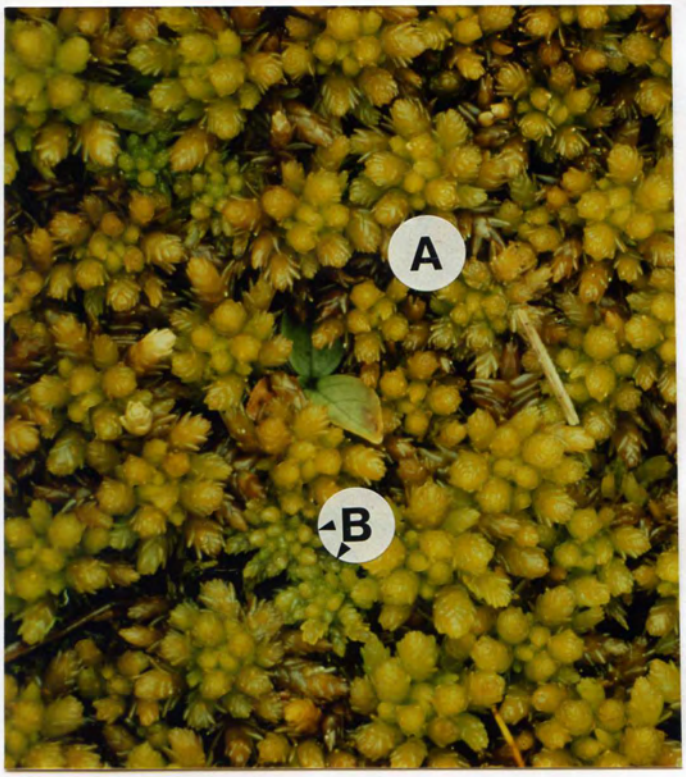


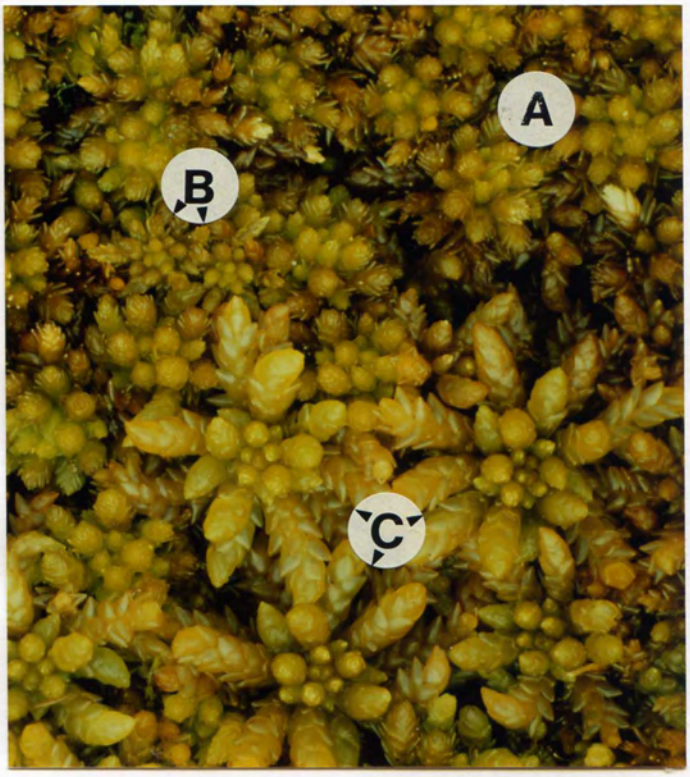
**A: tenellum**
**B: compactum**
**C: papillosum**

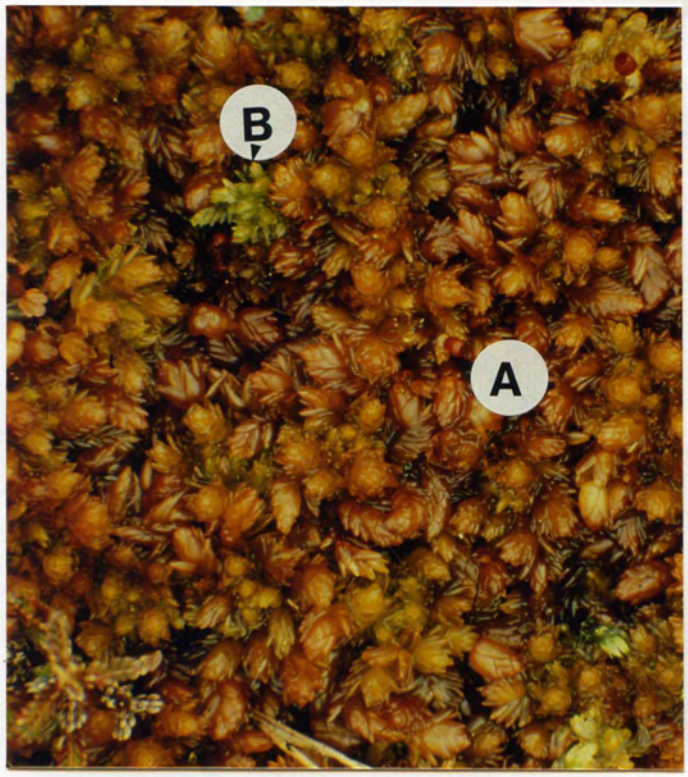
**D: isoviitae**
**E: Warnstorfia fluitans**

# Sphagnum compactum DC





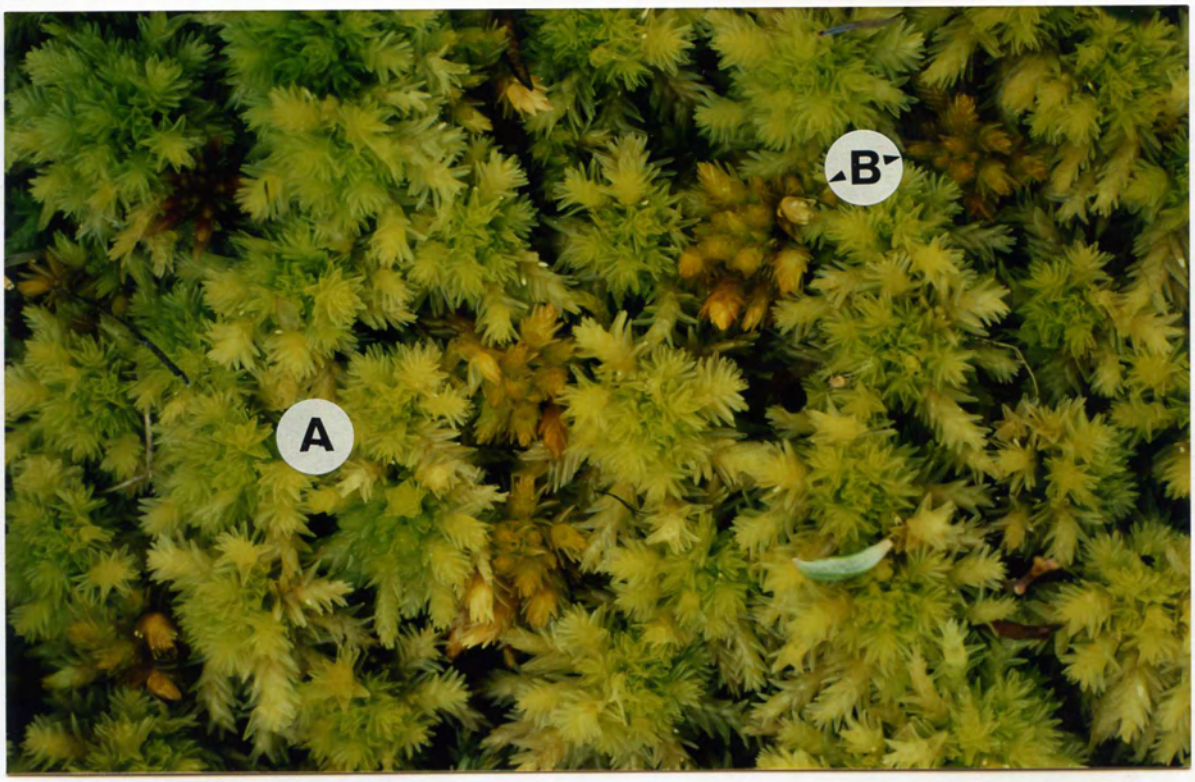



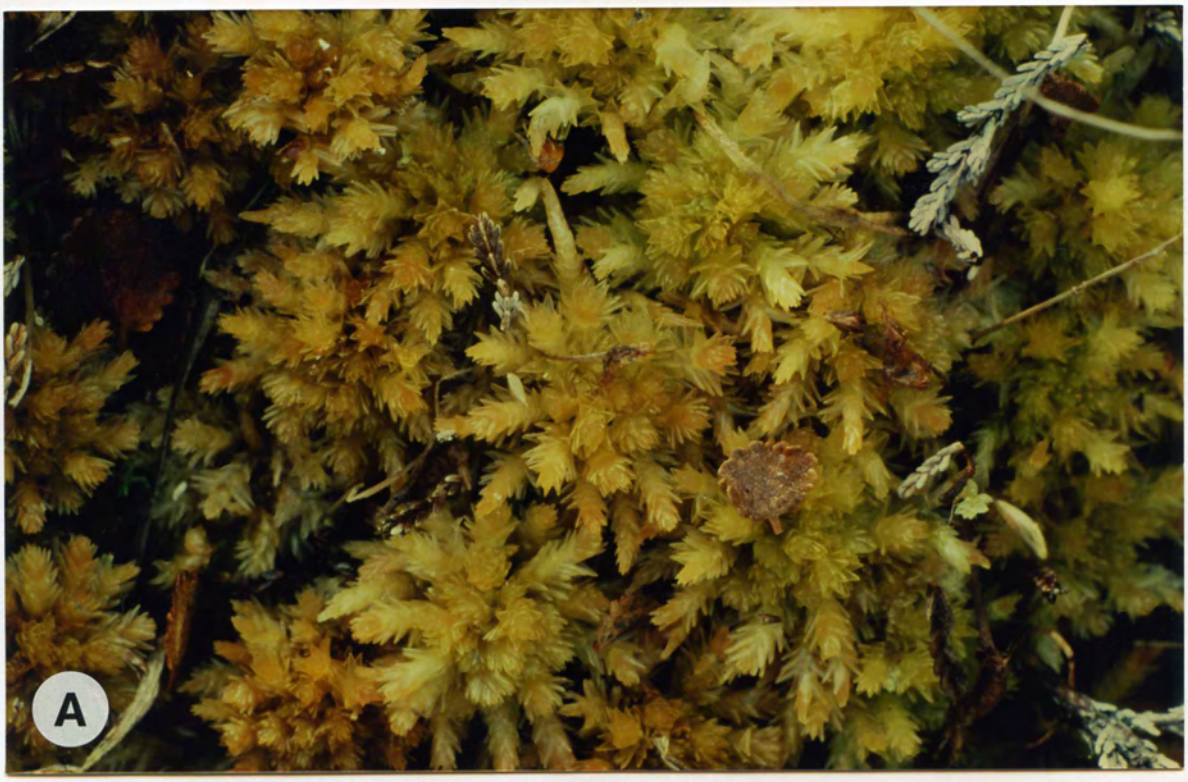
A: compactum
B: tenellum

C: papillosum
D: Polytrichum strictum

# Sphagnum strictum Sull.

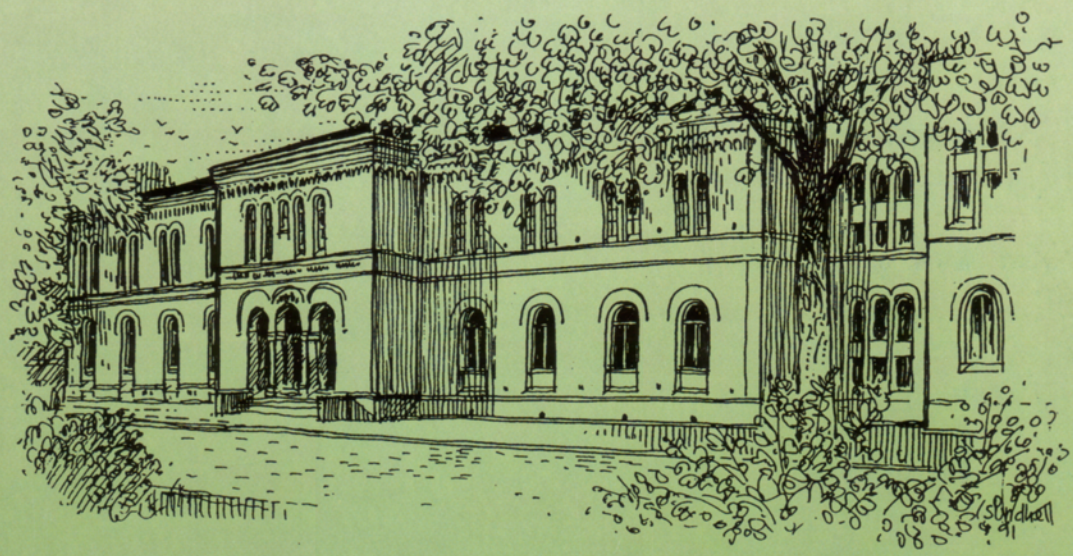





A: strictum

B: compactum



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