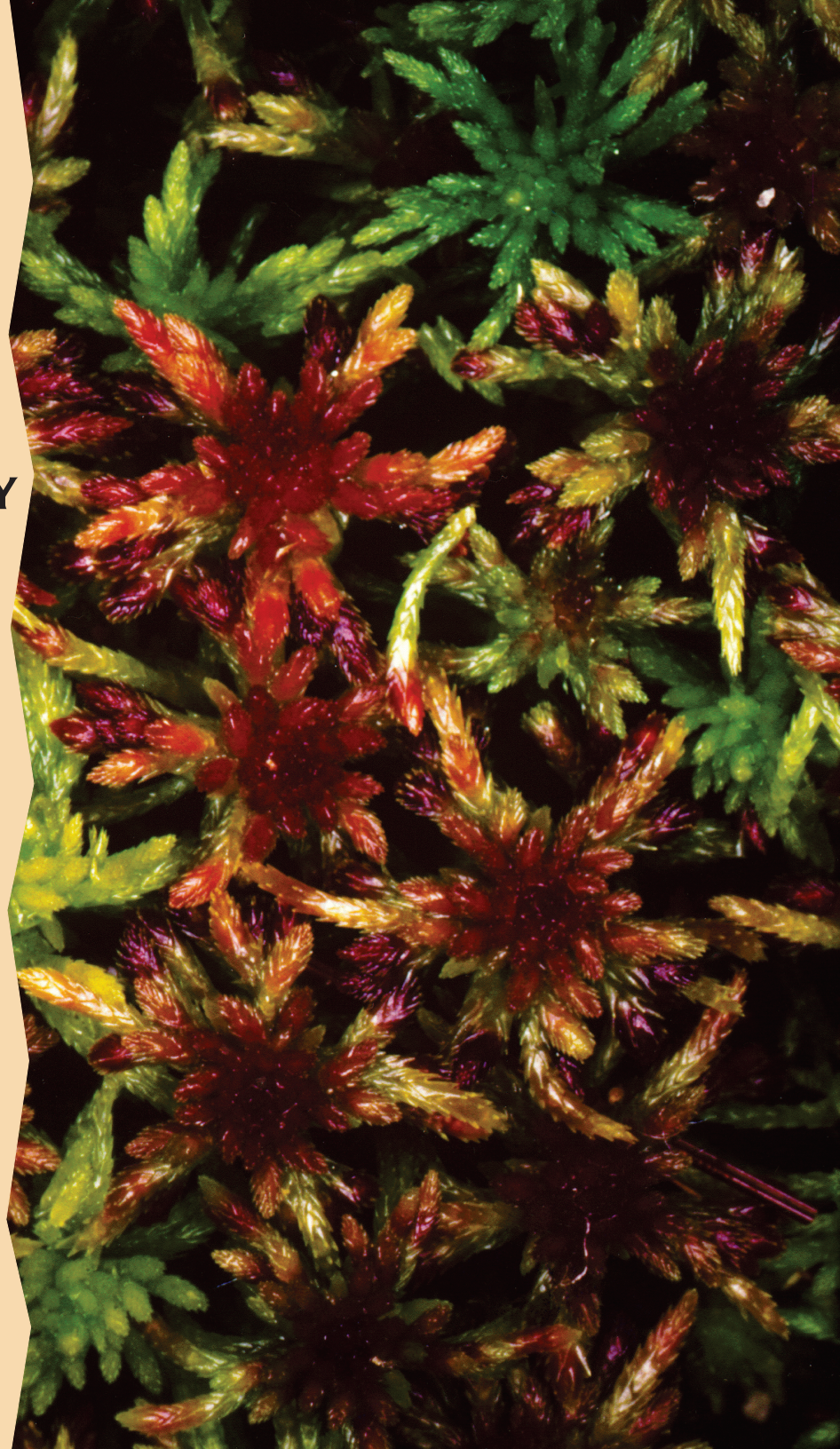
GEOLOGICAL SURVEY OF CANADA
MISCELLANEOUS REPORT 61

MACROSCOPIC IDENTIFICATION KEY OF 36 *SPHAGNUM* SPECIES IN EASTERN CANADA

D-F. Bastien and M. Garneau

1997



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Michelle Garneau

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Catalogue No. M41-8/61E
ISBN 0-660-16988-6

Available in Canada from
Geological Survey of Canada offices:

601 Booth Street
Ottawa, Ontario K1A 0E8

3303-33rd Street N.W.,
Calgary, Alberta T2L 2A7

or from

Canadian Government Publishing
Public Works and Government Services Canada
Ottawa, Ontario K1A 0S9

A deposit coy of this publication is also available for reference
in selected public libraries across Canada

Cette publication est aussi disponible en français

Price subject to change without notice

Cover illustration

Sphagnum species: *Sphagnum russowii*

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Original manuscript submitted: 1996-06
Final version approved for publication: 1996-07

Preface

It is not always easy to identify mosses, even with the help of a microscope and identification keys. While certain species can be identified directly in the field, others can easily be misidentified, despite the aid of precision instruments, because of the large number of shared characteristics. In addition, the task is often made more difficult since many specialists disagree about taxonomic criteria. The purpose of this guide is to synthesize published information about the morphological characteristics of *Sphagnum* species and their habitats (Haavisto, 1974; Vitt et al., 1988; McQueen, 1990; Hill, 1992; Flatberg, 1994; Sims and Baldwin, 1996) in order to provide field scientists with macroscopic identification keys.

Marc Denis Everell
Assistant Deputy Minister
Earth Sciences Sector
Natural Resources Canada

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MACROSCOPIC IDENTIFICATION KEY OF 36 *SPHAGNUM* SPECIES IN EASTERN CANADA

Abstract

An illustrated guide for the macroscopic identification of 36 Sphagnum species found in eastern Canada was produced as part of the Geological Survey of Canada project "Surficial Geology and Environmental Processes in Peatlands".

Sphagnum is a genus of mosses encountered in peatlands of eastern Canada. It is hard to find Sphagnum identification books that do not require the use of sophisticated tools such as a microscope. Two identification keys were produced to help the user identify, often directly in the field (using a hand lens), most of the species described in this guide. Descriptions and comments provide additional information about each of the species (distinctive characteristics, distribution, habitat, etc.). So that the user does not have to search through the text each time a species characteristic is mentioned, all figures and photographs are presented at the end of the guide. These illustrations will help in the identification process.

Résumé

Un guide illustré portant sur l'identification macroscopique de 36 espèces du genre Sphagnum de l'est du Canada a été produit dans le cadre d'un projet portant sur la géologie de surface et les processus environnementaux des tourbières de la Commission géologique du Canada.

Les sphaignes sont des mousses que l'on rencontre dans les tourbières de l'est du Canada. Rares sont les ouvrages qui permettent de s'initier aux sphaignes sans l'aide d'instruments complexes tels que le microscope. Deux clés d'identification ont été produites afin d'aider l'utilisateur à identifier, le plus souvent directement sur le terrain (avec une loupe simple), la plupart des espèces décrites dans ce guide. Outre ces deux clés d'identification, une description et des commentaires fournissent des renseignements additionnels (caractéristiques, répartition, habitat, etc.) sur chacune des espèces. Les figures facilitent l'identification des espèces. Toutes les figures et photographies sont regroupées à la fin du guide afin que l'utilisateur ne soit pas obligé de chercher inutilement dans le texte les illustrations mentionnées dans la description de chaque espèce.

INTRODUCTION

Uses of Sphagnum peat moss

In recent years, producers of peat moss and people involved in the pharmaceutical industry, research, and other fields have shown a growing interest in *Sphagnum* mosses. New products utilizing undecomposed *Sphagnum* from peat bogs have recently been developed. Sanitary napkins, biofilters for heavy industry, and inoculated horticultural media are just a few examples of new and innovative products that use *Sphagnum* mosses. In many cases, this recent diversification of *Sphagnum*-based products requires the harvesting of particular *Sphagnum* species or groups of species, since each species possesses different characteristics such as absorption and retention capacity, growth rate, plant colour, etc. Thus, by providing a means of identifying *Sphagnum* species or groups of species, this key will help guide harvesting for specific industrial uses.

Target clientele and geographical area covered by the guide

Although the best way of identifying *Sphagnum* species is with the aid of a microscope, this guide shows that it is possible to recognize several common species, sometimes directly in the field, using much less sophisticated tools. This identification guide is intended for various stakeholders in the peat sector. It is based mainly on macroscopic characteristics, and will help the user to become acquainted with 36 species of *Sphagnum* found in eastern Canada. The area covered extends from Ontario to Newfoundland, and includes Quebec, New Brunswick, Prince Edward Island, and Nova Scotia.

Contents

The first part of the guide (“Methodology”) contains a brief description of the material and methodology used to study *Sphagnum* in the field or laboratory (Haavisto, 1974). It also explains the use of the keys.

The second part (“Habitat characteristics”) focuses on the description of *Sphagnum* habitats. Since each species has particular requirements regarding its habitat, it is important to provide as precise details as possible about the location where each was collected. The peatlands associated with particular *Sphagnum* species are described and the plants commonly associated with these habitats are listed. Finally, a description of the microtopography (biotope) encountered completes the elements used in this guide to characterize the different habitats encountered.

The third and most important section of this guide (“Identification keys”) is a description of two identification keys that will allow the user to identify the *Sphagnum* specimens collected. The final part (“Species descriptions”) is a more detailed description (distinctive characteristics, distribution, habitat, etc.) of the 36 *Sphagnum* species given in the two identification keys. In addition to the 36 species described in this guide, 23 additional species are mentioned and an information source is provided. These species are either too rare, too localized, or beyond the scope of this guide to be included in the guide.

A glossary and list of cited and relevant publications are also included. All figures have been grouped thematically and are presented at the end of the guide. Figures 1, 2, and 3 show general *Sphagnum* organization (plant morphology, branch leaf arrangement, etc.). Figures 4, 5, and 6 show detailed views of capitula and plant sizes. Figure 7 illustrates branch leaf morphology while Figure 8 shows variations in stem leaf shapes. Figures 9 to 13 show various *Sphagnum* habitats and figures 14 to 46 present *Sphagnum* individuals or groups of plants in the field or in the laboratory. Finally, Figure 47 is a sketch of the most frequently observed biotopes in peatlands.

All drawings were made by Denis-F. Bastien (principal author of this guide). His sketches (Fig. 3A, B, C, E, 7) were inspired by Crum (1984). Unless otherwise indicated, all species descriptions given in the text are based on the personal field experience of Mr. Bastien.

Acknowledgments

Many people contributed to this publication and we thank them sincerely. Dr. Robert Gauthier, at the Louis-Marie Herbarium (QFA), Laval University, Quebec, loaned slides and many specimens that were photographed by Denis-R. Bastien. Lise Bastien and Inez Kettles worked on the English version of the manuscript. Pierre Buteau, Pierre Grondin, and Norman Dignard from Quebec's ministère des Ressources naturelles provided helpful comments which improved the manuscript. Dr. Dennis Gignac of the University of Alberta carried out a scientific review of both the English and French versions. We also thank Dr. Richard E. Andrus, Binghamton University, and Dr. Line Rochefort, Laval University, for their suggestions.

METHODOLOGY

Equipment

A magnifying hand lens with a minimum 10X magnification is indispensable in the field while a stereoscopic microscope with at least 20X magnification is the ideal tool for observing macroscopic details in the laboratory. One of the essential features for species identification is the stem leaf (Fig. 1B). To observe it in the laboratory, the following material is required: 1) a pair of very fine tweezers; 2) glass slides and cover glass; and 3) dyes (e.g. methylene blue). This material can be obtained at hobby shops specializing in science.

Procedures

In the field

1. Begin by closely examining the morphology of the selected specimen, noting its size (Fig. 6) and colour, the shape of the capitulum (Fig. 4), etc. Next, observe the site where the specimen was collected, paying particular attention to the characteristics listed under “Habitat characteristics”.

2. With thumb and index finger, carefully remove the capitulum and several fascicles of branches beneath the capitulum (Fig. 1A), leaving a stripped stem that is long enough (1-4 cm) so that several stem leaves (Fig. 1B) can be examined.

3. Identify the species using one or both identification keys in the guide, using all the characteristics of the specimen and its habitat. Advice on choosing the most appropriate key is given below.

In the laboratory

For laboratory observation, follow the steps described in the previous section, taking care to moisten the specimens sufficiently before beginning step 1. *Sphagnum* plants are less fragile and more pliable when moist. To observe stem leaf details (step 2 above), use tweezers to remove several leaves then soak the leaves in dye. Place the dyed stem leaf in a small drop of water on a glass slide and cover with a coverslip. You should be able to observe, with more precision than in the field, anatomical details of the stem leaf while it is lying flat. Use a ruler to measure stem leaf length.

Using the keys

Two different types of identification keys are defined in this guide. The first, a multiple access key, allows the user to identify a species without following a predetermined progression. The user selects

characteristics (morphology, biotope, etc.) until the collected specimen can be identified. The second key is a dichotomous key where at each step, the user must choose one of two statements that describe species morphology or habitat. The greater the number of details that are noted concerning the *Sphagnum* plant and its habitat, the better are the chances of correctly identifying the plant. Once the species has been identified, the user is referred to the section "Species descriptions". Comments in this part of the guide help confirm the species identification based on macroscopic keys.

HABITAT CHARACTERISTICS

Habitat characteristics are most important when identifying *Sphagnum* species using only macroscopic characteristics. By determining the trophic regime (water supply) described below, and noting the precise habitat of the specimen within the peatland (biotope), most species can be identified without the aid of a microscope.

The characterization of species habitat involves two steps.

Step 1: The **nutrient status** of the peatland must first be determined. A peatland nourished by ground water that has been in contact with mineral soil is minerotrophic and is called a "fen". When the peatland is nourished primarily by rainwater and the peat is built up to the point where surface vegetation is above the water table, the peatland is ombrotrophic and is called a "bog" (Couillard and Grondin, 1986; National Wetlands Working Group, 1988; Buteau et al., 1994). The physicochemical characteristics of peatland water are usually expressed by the surface vegetation; this allows us to distinguish bogs from fens without the need for sophisticated chemical analyses. The use of a pocket pH meter is recommended, especially when the user is not familiar with the vegetation.

In general, the upper strata of bogs are dominated by black spruce (*Picea mariana*) and ericaceous shrubs and the moss strata, by the *Sphagnum* genus with or without lichens (Fig. 9, 10, 11). The pH of the surface water is commonly between 3.5 and 4.6 (Gorham and Janssens, 1992). Fens are subdivided into poor, transitional (moderate-rich), and rich categories (rich and extreme-rich fens), depending upon the availability of nutritional elements. The upper strata of poor and transitional (moderate-rich) fens are dominated by larch (*Larix laricina*) and ericaceous shrubs and the moss strata, by *Sphagnum* (Fig. 13). The surface water of these fens is usually less acidic with pH values between 4.6 and 5.8. Rich and extreme-rich fens have a higher pH (5.8-8.5) than poor and transitional (moderate-rich) fens and their moss layer is characterized by the so-called "brown mosses" of the genera *Drepanocladus*, *Campylium* and *Scorpidium* (Gorham and Janssens, 1992).

The following is a list of the more common species encountered in minerotrophic and ombrotrophic environments. Some of them are easy to identify using unsophisticated methods.

Ombrotrophic peatlands (bogs)

Trees and shrubs: *Picea mariana* (black spruce), *Kalmia angustifolia* (sheep laurel), *K. polifolia* (bog laurel), *Ledum groenlandicum* (Labrador tea), *Andromeda glaucophylla* (glaucous bog rosemary), *Chamaedaphne calyculata*, (leather leaf), *Gaylussacia spp.* (huckleberry), *Empetrum nigrum* (black crowberry), *Vaccinium oxycoccos* (small cranberry).

Herbs: *Rubus chamaemorus* (cloudberry), *Carex oligosperma* (sedge), *C. limosa*, *C. paupercula*, *C. trisperma*, *Drosera rotundifolia* (round-leaf sundew), *Eriophorum spissum* (cotton grass), *E. virginicum*, *Rhynchospora alba*, *Scheuchzeria palustris*.

Mosses and lichens: *Aulacomnium palustre*, *Dicranum spp.*, *Polytrichum strictum*, *Cladina spp.* (reindeer lichens), *Cladonia spp.* (cup lichens).

For *Sphagnum* species, see the multiple access key.

Poor, transitional (moderate-rich), or rich minerotrophic peatlands (fens)

Trees and shrubs: *Larix laricina* (larch), *Thuja occidentalis* (white cedar), *Juniperus sp.* (juniper), *Betula glandulosa* (glandular birch), *B. pumila* (dwarf birch), *Alnus rugosa* (rough alder), *Myrica gale* (sweet gale), *Salix spp.* (willow), *Potentilla fruticosa* (shrubby cinquefoil).

Herbs: *Solidago spp.* (goldenrod), *Aster spp.* (aster), *Carex exilis* (sedge), *C. lasiocarpa*, *C. brunnescens*, *C. aquatilis*, *C. rostrata*, *Equisetum spp.* (horsetails), *Eriophorum viridi-carinatum*, *Menyanthes trifoliata* (buckbean), *Potentilla palustris* (marsh cinquefoil), *Habenaria spp.* (orchis), *Iris versicolor* (larger blue-flag), *Scirpus hudsonianus*, *Triglochin maritima*, *Viola spp.* (violet), *Selaginella selaginoides*.

Mosses and lichens: *Drepanocladus vernicosus*, *D. revolvens*, *D. aduncus*, *D. exannulatus*, *Calliergon giganteum*, *C. cordifolium*, *Campylium stellatum*, *Paludella squarrosa*, *Scorpidium scorpioides*, *Meesia triquetra*, *Mnium sp.*, *Helodium blandowii*.

For *Sphagnum* species, see the multiple access key.

Step 2: Special attention must be paid to the **biotope** (Fig. 47), or microtopography of the peatland where the species to be identified were collected. The main biotopes include depressions, lawns, carpets, strings, hummocks, and ponds, all of which are defined in the glossary.

IDENTIFICATION KEYS

Multiple access key

The multiple access key given below uses the principal characteristics of the species or its habitat. Species are referred to using an abbreviation made up of the first four letters of the species name.

The following is a table of abbreviations used for each species:

ange	=	*S. angermanicum*	angu	=	*S. angustifolium*
aust	=	*S. austinii*	balt	=	*S. balticum*
capi	=	*S. capillifolium*	cent	=	*S. centrale*
comp	=	*S. compactum*	cusp	=	*S. cuspidatum*
fall	=	*S. fallax*	fimb	=	*S. fimbriatum*
flav	=	*S. flavicomans*	flex	=	*S. flexuosum*
fusc	=	*S. fuscum*	girg	=	*S. girgensohnii*
jens	=	*S. jensenii*	lene	=	*S. lenense*
lind	=	*S. lindbergii*	mage	=	*S. magellanicum*
maju	=	*S. majus*	obtu	=	*S. obtusum*
papi	=	*S. papillosum*	plat	=	*S. platyphyllum*
pulc	=	*S. pulchrum*	pyla	=	*S. pylaesii*
quin	=	*S. quinquefarium*	ripa	=	*S. riparium*
rube	=	*S. rubellum*	russ	=	*S. russowii*
squa	=	*S. squarrosum*	subf	=	*S. subfulvum*
subs	=	*S. subsecundum*	tene	=	*S. tenellum*
tere	=	*S. teres*	torr	=	*S. torreyanum*
warn	=	*S. warnstorfii*	wulf	=	*S. wulfianum*

Characteristics

Colour of *Sphagnum* (growing in full sun)
Brown to black: aust, balt, flav, fusc, jens, lene, lind, maju, papi, plat, pyla, subf, subs, tere, wulf
Pink, red, violet: capi, comp, mage, rube, russ, warn
Yellow, green: ange, angu, cent, cusp, fall, fimb, flex, girg, obtu, pulc, quin, ripa, rube, squa, tene, torr

Stem colour
Dark (reddish brown to black): aust, cent, comp, flav, fusc, lene, lind, mage, papi, plat, squa, subf, subs, tere, wulf
Light (pink, green, yellow): all other species

Found in open habitat
Rare: cent, girg, quin, russ, squa, wulf
Common: all other species

Biotope
Pond: cusp, torr
Pond margin: cusp, fall, jens, lind, maju, papi, plat, pulc, ripa
Depression: balt, cusp, fall, maju, obtu, pyla, tene
Plateau, hummock: angu, aust, capi, flav, fusc, lene, mage, papi
Carpet and lawn: ange, capi, comp, cusp, fall, fimb, flex, lind, maju, rube, subs, tere
String: papi, plat, pulc, subf, subs, warn
Forest and bush: cent, girg, quin, russ, squa, wulf

Trophic regime
Minerotrophic (fen): ange, capi, cent, comp, fall, fimb, flex, girg, jens, lind, obtu, papi, plat, pulc, pyla, quin, ripa, rube, russ, squa, subf, subs, tere, warn, wulf
Ombrotrophic (bog): angu, aust, balt, capi, cusp, fall, flav, fusc, girg, lene, lind, mage, maju, pyla, russ, tene, torr, wulf

Distribution
Maritime: ange, aust, flav, pyla, tene, torr
Boreal to arctic: balt, lene, lind, obtu, subf, tene
Widespread: angu, capi, cent, comp, cusp, fall, fimb, flex, fusc, girg, jens, mage, maju, papi, plat, pulc, ripa, rube, russ, squa, subs, tere, warn
Temperate to boreal: quin, wulf

Number of spreading branches

Three or more (Fig. 3D): quin, wulf
Two or less (Fig. 1A): all other species

Branch leaves

Squarrose (Fig. 7J, K): comp, girg, squa, tere
Not squarrose (Fig. 7E): all other species
Wavy when dry (Fig. 7B, C, D): angu, balt, cusp, fall, flex, jens, lind, maju, obtu, pulc, ripa, torr
Not wavy when dry (Fig. 7E): all other species

Apical bud

Prominent (Fig. 4B): ange, fimb, girg, lind, plat, pyla, ripa, squa, tere
Visible (Fig. 4A, C, E): ange, aust, cent, cusp, fall, flex, girg, jens, lind, mage, maju, obtu, papi, pulc, quin, rube, russ, subs, tene, torr
Not visible or barely visible (Fig. 4D): angu, balt, capi, comp, cusp, fall, flav, flex, fusc, lene, obtu, russ, subf, subs, warn, wulf

Capitulum width

Small (<1 cm; Fig. 6A): angu, capi, fimb, fusc, lene, pyla, quin, rube, subs, tene, warn
Medium (1-2 cm; Fig. 6B): ange, balt, capi, comp, cusp, fall, flav, flex, girg, jens, maju, obtu, plat, pulc, russ, subf, tere, wulf
Large (>2 cm; Fig. 6C): aust, cent, lind, mage, papi, ripa, squa, torr

Tip of the stem leaf

Attenuate and/or sharp (Fig. 8K, W, BB, FF): balt, capi, cusp, fall, flav, jens, maju, pulc, quin, subf, torr
Round to truncated (Fig. 8M, O, P, EE): aust, balt, cent, comp, fusc, girg, mage, papi, plat, pyla, rube, russ, squa, subs, tene, tere, warn, wulf
Attenuate and slightly eroded (Fig. 8I, J, V, DD): ange, angu, flex, obtu
Cleft (Fig. 8E, F): lene, ripa
Fringed (Fig. 8C, D): fimb, lind

Stem leaf position

Hanging (Fig. 2C): angu, aust, comp, cusp, fall, flex, jens, lene, mage, maju, obtu, papi, pulc, ripa, squa, subs, tere, torr, wulf
Erect (Fig. 2B): ange, aust, capi, fimb, flav, fusc, girg, mage, papi, quin, rube, russ, squa, subf, tere, warn, wulf
Spreading (Fig. 2A): aust, balt, mage, papi, plat, pyla, squa, tene, tere, wulf

Dichotomous key

1.	Robust species (Fig. 29, 32) with cucullate, obtuse branch leaves (Fig. 7A).	**Group A**
1.	Species that do not match the description above.	**2**
2.	Stem leaves spatulate, as wide as long, broadly lacerate at the top and along the sides (Fig. 8C, D), apical bud visible, often prominent (Fig. 4B).	**3**
2.	Stem leaves not spatulate or if spatulate, longer than wide, sometimes lacerate at the top but never on the sides; apical bud visible or not.	**4**
3.	Robust species, usually brown (Fig. 28); stem dark (at least in its lower part).	***Sphagnum lindbergii***
3.	Delicate yellow or green species (Fig. 22); light-coloured stem.	***Sphagnum fimbriatum***
4.	Fascicles usually with three or more spreading branches (Fig. 3D); forest species.	**5**
4.	Fascicles usually with two or less spreading branches (Fig. 1A); species not confined to forests.	**6**
5.	Six to twelve branches per fascicle; stem dark, stem leaf obtuse (Fig. 8U).	***Sphagnum wulfianum***
5.	Five branches per fascicle, three of which are spreading; stem light coloured with acuminate stem leaf (Fig. 8W).	***Sphagnum quinquefarium***
6.	Stem leaf with a triangular cleft at its upper end (Fig. 8E, F).	**7**
6.	Stem leaf with no triangular cleft at its upper end.	**8**
7.	Large-sized green species with prominent apical bud (Fig. 4B); widely distributed.	***Sphagnum riparium***
7.	Small-sized brownish species with barely visible apical bud (Fig. 4D); nordic distribution.	***Sphagnum lenense***
8.	Branch leaves squarrose (Fig. 7J, K).	**Group B**
8.	Branch leaves not squarrose (Fig. 7E).	**9**

9. Stem leaves mostly hanging (Fig. 2C), triangular, often acuminate (Fig. 8AA); branch leaves wavy when dry (Fig. 3C); green, yellow, or brown species. **Group C**

9. Stem leaves mostly erect (Fig. 2B) or spreading (Fig. 2A; usually hanging in *S. subsecundum*), obtuse; branch leaves not wavy when dry (Fig. 3A); colour variable. **10**

10. Stem leaves oval or elliptical, similar to but larger than branch leaves (Fig. 7I); capitulum and stem usually with few branches (Fig. 3E). **11**

10. Stem leaves of various shapes that are different from the shapes of the branch leaves; capitulum and stem with well developed branches (Fig. 1A). **12**

11. Medium-sized (Fig. 6B) species with spreading branches >5 mm long; rich-fen species with widespread distribution. ***Sphagnum platyphyllum***

11. Small-sized (Fig. 6A) species with spreading branches <5 mm long; bog or poor-fen species with coastal distribution. ***Sphagnum pylaesii***

12. Stem leaves mostly erect (Fig. 2B; usually hanging in *S. subsecundum*); branch leaves not wavy when dry (Fig. 3A, B); green, brown, red, or violet species. **Group D**

12. Stem leaves spreading (Fig. 2A); branch leaves wavy when dry (Fig. 3C); green, yellow, or light brown species, never red tinged; wet habitats. **13**

13. Small-sized (Fig. 6A) species with oblong stem leaf (Fig. 8Z); apical bud visible among the secondary branches of the capitula (Fig. 4E). ***Sphagnum tenellum***

13. Medium-sized (Fig. 6B) species with roughly triangular stem leaf (Fig. 8AA); apical bud not visible among the dense branches of the capitulum (Fig. 4D). ***Sphagnum balticum***

Group A

*Note: Species of this group that are entirely green require examination with a microscope to confirm their identification.

1. Stem leaf <0.75 mm. ***Sphagnum compactum***

1. Stem leaf >1.0 mm. **2**

2.	Specimens growing in sunlight always with red tinge.	***Sphagnum magellanicum***
2.	Specimens growing in sunlight never red, sometimes orange.	**3**
3.	Usually a single branch of the fascicle is hanging (Fig. 1A), ochre-brown to dark brown, forming tall, compact hummocks (Fig. 16) in open maritime bogs (Fig. 10).	***Sphagnum austinii***
3.	Two or three hanging branches, green to light brown, forming low, mostly loose cushions just above the water table in fens in eastern Canada; widespread distribution.	**4**
4.	Yellow to light brown (Fig. 32) species of low and wet sections of open peatlands (Fig. 10).	***Sphagnum papillosum***
4.	Green species of brook and lake margins, found mainly in shaded habitats.	***Sphagnum centrale***

Group B

1.	Robust (Fig. 40) or large-sized (Fig. 6C) species.	**2**
1.	Slender (Fig. 44) medium-sized (Fig. 6B) species.	**3**
2.	Stem leaves 1.5-2 mm long, apical bud very large and prominent (Fig. 4B).	***Sphagnum squarrosum***
2.	Stem leaves 0.5-0.75 mm long, apical bud not visible or barely visible (Fig. 4D).	***Sphagnum compactum***
3.	Stem dark (at least in the lower part); stem leaves 1.25-1.75 mm long.	***Sphagnum teres***
3.	Stem light coloured; stem leaves 1.0 mm long.	***Sphagnum girgensohnii***

Group C

1.	Stem leaves roughly flat, slightly to distinctly eroded at the apex (Fig. 8I, J, DD; examine several leaves).	**2**
1.	Stem leaves concave, sharp or sharp looking at the tip (Fig. 8BB, CC; examine several leaves).	**5**
2.	Stem dark (at least in the lower part); branch leaves curved (Fig. 7H)	***Sphagnum subsecundum***
2.	Stem light coloured; branch leaves straight (Fig. 7E).	**3**

3.	Stem leaves <0.75 mm long; capitulum dense, not stellate (Fig. 15); species of usually fairly dry bog habitats.	***Sphagnum angustifolium***
3.	Stem leaves >0.75 to 1.25 mm long; capitulum stellate (Fig. 5D) or not (Fig. 5A); species of wet fens.	**4**
4.	Capitulum not stellate (Fig. 5A); very rare species of herbaceous fens in northern Ontario and along the east coast of Hudson Bay.	***Sphagnum obtusum***
4.	Capitulum clearly stellate (Fig. 5D); uncommon species of *Sphagnum*-dominated peatlands in eastern Canada.	***Sphagnum flexuosum***
5.	Capitulum 3-5 cm wide; aquatic (submerged) bog species with coastal distribution.	***Sphagnum torreyanum***
5.	Capitulum <3 cm wide; species of wet to very wet but not submerged habitats (rarely *S. cuspidatum*).	**6**
6.	Spreading branches soft and weak, stick together when wet so as to resemble an artist's paintbrush (Fig. 3F); yellow to green species of very wet bog habitats (pond margins, depressions).	***Sphagnum cuspidatum***
6.	Spreading branches stiffer, do not stick together like those of *S. cuspidatum*; yellow, green, or brown species of various habitats.	**7**
7.	Spreading branch leaves in five distinct rows when wet (Fig. 3B), abruptly acuminate (Fig. 7D); capitulum not stellate (Fig. 34); apical bud large and highly visible among the young curved branches of the capitulum (Fig. 4C, 34); robust greenish species found mainly in very wet parts of fens, more rarely in bogs.	***Sphagnum pulchrum***
7.	Spreading branch leaves sometimes forming five or so rows when wet, gradually acuminate (Fig. 7C, G); capitulum more stellate (Fig. 21, 30); apical bud visible or not; bog or fen species.	**8**
8.	Branches of the capitulum and branch leaves curved (Fig. 5C, 7G, 30); species brown when growing in sunlight; found in very wet bog habitats (pond margins, depressions).	***Sphagnum majus***
8.	Branches of the capitulum and branch leaves straight (Fig. 5A, 7E, 21); green or brown species of various habitats (bogs and fens).	**9**

9. Species green or yellow, sometimes brown at the tip when growing in sunlight (Fig. 24), apical bud rarely visible (Fig. 4D); very common and widespread bog or poor-fen species. ***Sphagnum fallax***

9. Species brown when growing in sunlight, apical bud visible (Fig. 4C); uncommon fen species. ***Sphagnum jensenii***

Group D

1. Brown species, rarely green; stem dark, at least in the lower part. **2**

1. Species green or variously tinged with pink, red, or purple; stem light coloured. **6**

2. Apical bud prominent (Fig. 4B); fen species. ***Sphagnum teres***

2. Apical bud sometimes visible but not prominent (Fig. 4A); bog or fen species. **3**

3. Stem leaves 1 mm long or less and mostly hanging; capitulum branches and branch leaves curved (Fig. 5C, 7H, 42). ***Sphagnum subsecundum***

3. Stem leaves >1 mm long and mostly erect; capitulum branches and branch leaves straight (Fig. 5A, 7E, F, 25). **4**

4. Stem leaves with broad tips (Fig. 8N); small-sized (Fig. 6A), very common bog species with widespread distribution. ***Sphagnum fuscum***

4. Stem leaves with acuminate tips (Fig. 8L, FF); medium-sized species (Fig. 6B) with localized distribution in bogs or fens. **5**

5. Stem leaves 1.5-2 mm long; common species of bogs in the Maritimes. ***Sphagnum flavicomans***

5. Stem leaves 1.0-1.5 mm long; fen species of boreal to arctic peatlands. ***Sphagnum subfulvum***

6. Stem leaves 1.5-2.5 mm long, spatulate (Fig. 8X); apical bud highly visible (Fig. 4B); young branches are flattened near the inner capitulum (Fig. 5B); rare species with maritime distribution. ***Sphagnum angermanicum***

6. Stem leaves 1.5 mm long, not spatulate; apical bud visible or not; young branches of the capitulum are not flattened (Fig. 5A); widespread distribution. **7**

7.	Branch leaves in five distinct rows, wet or dry (Fig. 3B; examine several branches); species of fen habitats, tinged with pink, red, or purple in full sunlight.	***Sphagnum warnstorfii***
7.	Branch leaves in roughly five rows when wet but never when dry (Fig. 3A); species of various habitats and colours.	**8**
8.	Stem leaves with acuminate tips (Fig. 8K); species commonly red in full sunlight.	***Sphagnum capillifolium***
8.	Stem leaves with broad tips (Fig. 8O, P, 55)	**9**
9.	Stem leaves eroded over least one quarter of their width (Fig. 8O, P); apical bud usually visible (Fig. 4A) to prominent (Fig. 4B); medium-sized (Fig. 6B) species. Mostly confined to shaded habitats (forest, high bush, etc.).	**10**
9.	Stem leaves not eroded at the tip (Fig. 8EE); apical buds visible (Fig. 4A) or not (Fig. 4D); small-sized (Fig. 6A) species not confined to shaded habitats.	**11**
10.	Stem leaves eroded at the tip over more than half their width (Fig. 8O); species never tinged with red.	***Sphagnum girgensohnii***
10.	Stem leaves eroded over one quarter of their width (Fig. 8P); species varies from green in heavily shaded habitats to red in partly sunny habitats.	***Sphagnum russowii***
11.	Stem leaves lingulate (Fig. 8EE); apical bud visible and slightly higher than the surrounding young branches (Fig. 4A); uncommon species, at least in large open bogs.	***Sphagnum rubellum***
11.	Stem leaves oblong (Fig. 8K); apical bud not or barely visible among the young branches of the capitulum (Fig. 4D); very common species widely distributed in forests as well as in different peatland habitats.	***Sphagnum capillifolium s.l.****

*According to Cronberg (1995), these specimens possess characteristics intermediate between those of *Sphagnum rubellum* and *S. capillifolium*, and genetic studies are required to identify them. Because these techniques are highly specialized, for practical purposes, these intermediate species are grouped under the name *Sphagnum capillifolium s.l.* (*s.l. = sensu lato* = in a broad sense). The group *Sphagnum capillifolium s.l.* includes a number of closely related species, including *Sphagnum rubellum*.

SPECIES DESCRIPTIONS

This section presents all the information that characterizes each species that is described in the preceding sections of the guide. This information included species morphology and distinguishing characteristics, species habitat, and additional comments, including information about other species with which the relevant species may be confused. The species are presented alphabetically, for the most part following the nomenclature of Anderson (1990).

Sphagnum angermanicum Melin

Distinctive characteristics and habitat: Medium-sized (Fig. 6B) plant, green (Fig. 14), sometimes tinged with pink. The apical bud protrudes (Fig. 4B) and is surrounded by flattened young branches (Fig. 5B; use a hand lens). The stem leaves are about 1.5-2.5 mm long, lingulate to spatulate (Fig. 8X), and usually truncated at the tip. *Sphagnum angermanicum* is found in moderately wet parts of poor fens, often near brooks or ponds, and is mostly confined to maritime areas.

Comments: This rare species is almost always confined to coastal regions of eastern Canada. *Sphagnum molle*, a much rarer species also found in coastal regions, closely resembles *S. angermanicum*. *S. molle* is characterized by a shorter (± 2.0 mm), lingulate stem leaf and more concave branch leaves; it forms lower, more compact cushions than *S. angermanicum* (Ireland, 1982; Crum, 1984). For more information about this species, see Dignard and Bastien (1990) and Lavoie and Gauthier (1983).

Sphagnum angustifolium (C. Jens *ex* Russ.) C. Jens in Tolf
Sphagnum recurvum var. *tenue* Klinggr.

Distinctive characteristics and habitat: Small- to medium-sized (Fig. 6A, B) green to yellow plant. The capitulum is not stellate (Fig. 15). The branch leaves are usually wavy when dry (Fig. 3C). The stem leaves are 0.5-0.75 mm long, flat, triangular, with eroded tips, and as wide as they are long (Fig. 8I). This species is commonly found on the side and tops of hummocks (Fig. 47) in ericaceous bogs (Fig. 9), generally well above the water table. It also occurs in open, black spruce bogs (Fig. 11).

Comments: *Sphagnum angustifolium* is a fairly common species in bogs of eastern Canada. It is nearly always found at the edge of clumps of black spruce. When the capitulum and stem leaves are typical, as described above (Fig. 8I, 15), it is easy to identify. However, it can be mistaken for *Sphagnum fallax*, which is characterized by mucronate stem leaves (Fig. 8BB), a more stellate capitulum (Fig. 5D), and a larger size. In addition, *S. fallax* grows in wetter habitats than *S. angustifolium*. To distinguish *S. angustifolium* from *S. balticum*, a similar species, see the comments under *Sphagnum balticum*.

Sphagnum austinii Sull.

Distinctive characteristics and habitat: Large (Fig. 6C), robust plant, ochre or brown (Fig. 16), with cucullate branch leaves (Fig. 7A), and fascicles with usually only one branch of the fascicle is hanging (Fig. 1A; Flatberg, 1984). *Sphagnum austinii* is found in open bogs, mostly in maritime regions (Fig. 10). It forms very dense cushions that lie well above the water table (Fig. 47).

Comments: *Spagnum austinii* is the most common member of the *Sphagnum imbricatum* complex, which has recently been revised and includes four species, three of which can be found in eastern Canada: *S. austinii*, *S. affine* and *S. steerei*. *S. steerei* is found only in arctic and subarctic regions of northern Quebec, while *S. austinii* is very common in open bogs of maritime areas, and *S. affine* is more widely distributed on the mainland (Vitt and Gauthier, 1991). *S. affine* is distinguished from *S. austinii* by its two hanging branches, its green colour, and its less compact growth habit in fen peatlands (Andrus, 1987). *S. affine* is rarer than *S. austinii*. To distinguish *S. austinii* from *S. papillosum*, a similar species, see the comments under *Sphagnum papillosum*. For more information about *Sphagnum austinii*, see Flatberg (1984).

Sphagnum balticum (Russ.) C. Jens.

Distinctive characteristics and habitat: Medium-sized (Fig. 6B) plant, green to yellow or, more commonly, light brown (Fig. 17). The stem leaves are 1.0 mm long, oblong, elliptical, with rounded tips (Fig. 8AA), but commonly appear sharper because of their concavity. They are typically spreading (Fig. 2A). *Sphagnum balticum* is mostly a bog species found at pond margins or in moderately wet depressions (Fig. 47), in boreal, subarctic, or arctic regions (Mogensen, 1986).

Comments: *Sphagnum balticum* is difficult to characterize, even with the aid of a microscope. Probably the best way to identify it macroscopically is by examining the stem leaves. *S. angustifolium* is similar in appearance to *S. balticum* and can be mistaken for it. The stem leaves of *S. angustifolium* are flat, hanging (Fig. 2C), and have eroded tips (Fig. 8I) whereas those of *S. balticum* are concave, spreading (Fig. 2A), and have rounded tips (Fig. 8AA).

Sphagnum capillifolium (Ehrh.) Hedw.
Sphagnum nemoreum Scop.
Sphagnum capillaceum (Weiss) Schrank

Distinctive characteristics and habitat: Small (Fig. 6A) plant, green in shaded habitats to completely red when growing in sunlight (Fig. 18, 46). Specimens in very wet habitats have a flatter capitulum than those on drier sites. The apical bud is usually not visible among the young branches of the capitulum (Fig. 4D). The stem leaves are 1.25 to 1.5 mm long, oblong, and narrow gradually at the tip (Fig. 8K). *Sphagnum capillifolium* is a very common species that can be found in many kinds of habitats. In open bogs, it grows in very wet (pond margins, depressions, etc. [Fig. 47]) to fairly dry habitats (hummocks, etc.). It is commonly found growing with *S. fuscum*, *S. angustifolium*, and *S. magellanicum*.

Comments: *Sphagnum capillifolium* is probably the most common small-sized red species in eastern Canada, where it is especially plentiful in open bogs. In more shaded environments (forest, tall bushes, etc.), it can be confused with *S. russowii*, which is told from *S. capillifolium* by its stem leaf with rounded tip (Fig. 8P). *S. subtile* is a rare forest species similar to *S. capillifolium* (Andrus, 1979) except for its stem leaves, which are shorter and without fibrils (microscopic characteristics). *S. tenerum* is another similar species that is characterized by a very convex capitulum (Crum and Anderson, 1981) and by its stem leaves, which have many pores in each hyalocyst (microscopic characteristics). For more information about these species, see the comments under *Sphagnum rubellum*. To distinguish between *S. capillifolium*, *S. quinquefarium*, *S. warnstorfii*, and *S. rubellum*, all species that resemble each other, see the comments given for each of these species.

Sphagnum centrale C. Jens. *ex* H. Arnell & C. Jens.

Distinctive characteristics and habitat: Large (Fig. 6C), robust plant, green in shady habitats to light brown when growing in sunlight. The branch leaves are cucullate (Fig. 7A). *Sphagnum centrale* is found in forested fens and rarely in open, exposed habitats.

Comments: When the following green species with cucullate branch leaves are found in shady habitats, it is almost impossible to tell them apart: *Sphagnum centrale*, *S. papillosum*, *S. magellanicum*, *S. austinii*. They can only be identified with the help of a microscope. *S. palustre*, a very rare species in eastern Canada, is also found in shaded habitats. Microscopic observation of details on a transverse cut of the branch leaves is needed to distinguish *S. palustre* from *S. centrale*.

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

Distinctive characteristics and habitat: Robust, medium-sized (Fig. 6B) species, green in shaded habitats to yellow (Fig. 19), brown, or reddish when growing in sunlight. The branch leaves are elliptical, commonly squarrose (Fig. 7J), and have truncated tips. The stem leaves are 0.5-0.75 mm long, lingulate, triangular, with eroded tips (Fig. 8V). The stem is dark. *Sphagnum compactum* is often found on sandy or rocky soil, at peatland margins. It is also found in disturbed soils, drainage ditches, and herbaceous fens. It is never encountered in large, open bogs.

Comments: Since *Sphagnum compactum* has few specific habitats, it is always a surprise to discover it. In the field, it looks like other species with cucullate branch leaves: *S. centrale* and *S. magellanicum*. On close examination, the stem leaves of *S. compactum* are much shorter, which helps to identify it. *S. strictum*, a rare species, is similar to *S. compactum* and is characterized by its lighter-coloured stem, its more uniformly squarrose branch leaves, and its green colour. *S. strictum* is found in coastal regions of eastern Canada (Ireland, 1982).

Sphagnum cuspidatum Ehrh. *ex* Hoffm.

Distinctive characteristics and habitat: Medium-sized (Fig. 6B) species, usually green to yellow, sometimes tinged with brown at the tip of its branches (Fig. 20). The stem leaves are triangular and 1.0-1.5 mm long. The spreading branches are soft and usually stick together when wet, resembling an artist's paintbrush (Fig. 3F, 20). *S. cuspidatum* is a bog species and can be found in very wet depressions, at pond margins, and sometimes submerged in ponds (Fig. 47).

Comments: When it is moistened in the field or in the laboratory, *Sphagnum cuspidatum* can always be recognized by the distinctive arrangement of its branches. The specimen must first be moistened, then shaken lightly to remove excess water. Some of its fascicles will show the characteristic arrangement of the branch leaves (Fig. 3F). *S. cuspidatum* can be mistaken for certain other *Sphagnum* species. It often grows with *S. majus* and *S. fallax*. *S. majus* is brown throughout in full-sun habitats. Wet branches of *S. fallax*, like those of *S. majus*, do not emulate the artist paintbrush form typical of *S. cuspidatum*. *S. viride*, a new species described by Flatberg (1988a) in Europe, may be present in eastern Canada. To distinguish *S. cuspidatum* from *S. torreyanum* and *S. tenellum*, see the comments under *Sphagnum torreyanum* and *Sphagnum tenellum*.

Sphagnum fallax (Klinggr.) Klinggr.
Sphagnum recurvum var. *brevifolium* (Lindb. *ex* Braithw.) Warnst.

Distinctive characteristics and habitat: Medium-sized (Fig. 6B) species, green to yellow, sometimes brownish at the tip of its branches (Fig. 24). The stem leaves are 0.75-1.25 mm long, triangular, concave, and often mucronate (Fig. 8BB). The capitulum is usually stellate when seen from above (Fig. 21). *Sphagnum fallax* grows in fairly wet habitats, such as depressions, pond margins, lawns, carpets, and drainage ditches (Fig. 47). This very common species occurs in bogs and poor fens.

Comments: *Sphagnum fallax* is a very common and variable species that can be mistaken for many others. *S. majus*, which grows in wetter habitats (very wet depressions, pond margins, etc.) is brown throughout compared to *S. fallax*. When seen from above, the capitulum branches are curved (Fig. 5C) in *S. majus* and straight (Fig. 5A) in *S. fallax*. *S. flexuosum*, a fen species, has stem leaves that are eroded at the tip (Fig. 8J). Moreover, the young, densely clustered branches of the inner capitulum pass more sharply to the radiating outer branches in *S. flexuosum* (Fig. 5D) than in *S. fallax* (Fig. 5A). *S. flexuosum* is much less common than *S. fallax*. *S. obtusum*, a very rare species in eastern Canada (mainly found in northern Ontario and on the east coast of Hudson Bay), has truncated stem leaves (Fig. 8DD). Flatberg (1991, 1992) has described two species from Europe that resemble *S. fallax*: *S. brevifolium* and *S. isoviitae*. The presence of these species has not yet been confirmed in eastern Canada. *S. splendens*, known from a single locality in central Quebec (Crum, 1979), is distinguished from *S. fallax* by the absence of fibrils in the branch leaves (a microscopic characteristic). To tell *S. fallax* from *S. angustifolium*, see the comments under *Sphagnum angustifolium*.

Sphagnum fimbriatum Wils. in Wils. & Hook. f.

Distinctive characteristics and habitat: Small (Fig. 6A), usually green plant (Fig. 22) with a prominent apical bud (Fig. 4B). The stem leaves are 1.0-1.25 mm long, fan shaped, and nearly completely fringed (Fig. 8D). The stem is light coloured. *Sphagnum fimbriatum* is a common fen species often occurring in such unstable habitats as brook margins where it often acts as a pioneer.

Comments: *Sphagnum teres* resembles *S. fimbriatum* except that its stem leaves are not fan shaped and its stem is always dark, at least near the base. *S. arcticum*, a medium-sized species recently described by Flatberg and Frisvoll (1984), is found in arctic Europe; its stem leaves are narrower and longer (1.25-1.5 mm) than those of *S. fimbriatum*. No occurrence of *S. arcticum* has yet been recorded in eastern Canada. To distinguish between *S. fimbriatum* and *S. lindbergii*, two species with fan-shaped stems leaves, see the comments under *Sphagnum lindbergii*.

Sphagnum flavicomans (Card.) Warnst.

Distinctive characteristics and habitat: Medium-sized (Fig. 6B) species, light brown to coffee cream in colour (Fig. 23), with a dark stem. The stem leaves are 1.5-2 mm long, oblong, and narrow gradually at the tip (Fig. 8FF). *Sphagnum flavicomans* is a bog species common in coastal regions of eastern Canada (Ireland, 1982). It is found in fairly wet to dry habitats, in completely open (Fig. 10) to moderately wooded peatlands (Fig. 11).

Comments: In partly wooded, dry habitats such as open, black spruce bogs (Fig. 11), *Sphagnum flavicomans* is medium sized and its stem leaves can reach 2 mm in length. In wetter, treeless habitats (Fig. 10), *S. flavicomans* is small and its stem leaves barely reach 1.5 mm in length. In this case, it can be mistaken for *S. subfulvum*. *S. subfulvum* is a fen species associated with high-pH environments, whereas *S. flavicomans* is a bog species associated with low-pH (clearly acidic) environments. A close look at the vascular vegetation combined with the use of a pH meter can help distinguish between the two species. *S. flavicomans* can also be confused with *S. fuscum*, a small-sized species with which it often grows. The stem leaves of *S. fuscum*, broadly round at the tip (Fig. 8N), can be used to distinguish between the two species.

Sphagnum flexuosum Dozy & Molk.
Sphagnum recurvum var. *amblyphyllum* (Russ.) Warnst.
Sphagnum recurvum P.-Beauv. var. *recurvum*

Distinctive characteristics and habitat: Medium-sized (Fig. 6B) species, yellow to green, sometimes tinged with brown at the tip of its branches (Fig. 24). The stem leaves are 0.75-1.25 mm long, flat, longer than than they are broad, and eroded at their apex (Fig. 8J). The apical bud is often visible when viewed from above but it is somewhat hidden by the young branches of the capitulum (Fig. 4C). There is a sharp transition from dense young branches of the inner capitulum to radiating branches (Fig. 5D). *Sphagnum flexuosum* is found in fen habitats and often grows with *S. fallax*. It is found in low lawns, a few centimetres above the water table (Fig. 47), in *Sphagnum*-dominated transitional (moderate-rich) fens. *S. flexuosum* is an uncommon species with a widespread distribution.

Comments: *Sphagnum angustifolium*, with its stem leaves eroded at the apex, is similar to *S. flexuosum*. *S. angustifolium* is a bog species found in drier habitats than *S. flexuosum*. The stem leaves of *S. angustifolium* are as long as they are broad (Fig. 8I), while those of *S. flexuosum* are longer than they are broad (Fig. 8J). *S. obtusum*, a very rare species, also has stem leaves that are eroded at the tip (Fig. 8DD), but its capitulum is not stellate (Fig. 31) and it is found in herbaceous fens. *S. flexuosum*, a poorly known and very confusing species, is well illustrated in Ireland (1982), Lange (1982), and Mogensen (1986).

Sphagnum fuscum (Schimp.) Klinggr.

Distinctive characteristics and habitat: Small-sized (Fig. 6A) species, completely brown in full sun (Fig. 25) to greenish in shaded habitats. The stem is always dark, even in shade. The stem leaves are 1.0-1.25 mm long with broadly rounded tips (Fig. 8N). In bogs, *Sphagnum fuscum* forms dense hummocks well above the water table (Fig. 47). In wetter places, it forms looser cushions. This species is very common in eastern Canada.

Comments: *Sphagnum fuscum* is a very common species and is usually easy to identify. To distinguish *S. fuscum* from *S. flavicomans* and *S. subfulvum*, see the comments under *Sphagnum flavicomans* and *Sphagnum subfulvum*.

Sphagnum girgensohnii Russ.

Distinctive characteristics and habitat: Medium-sized (Fig. 6B) species, completely green, never tinged with red (Fig. 26). The apical bud is usually highly visible (Fig. 4A) and prominent (Fig. 4B). The stem leaves are 1.0 mm long, broadly rounded, and eroded at the tip over half to three quarters of their width (Fig. 8O). *Sphagnum girgensohnii* is a species of heavy shade habitats, at least in temperate eastern Canada. It grows on moist forest soils, along the margins of brooks, or in logging road ditches. In subarctic to arctic regions, it is more commonly found in open habitats.

Comments: *Sphagnum teres* can sometimes be mistaken for *S. girgensohnii*; however, the dark stem of *S. teres* is enough to tell the two species apart. *S. rubiginosum*, a newly described species, is present in western Canada (Flatberg, 1993) but has not yet been reported in the east. *S. rubiginosum* is told from *S. girgensohnii* by its red tinge, its three divergent branches and its stem leaves, which range from 1.2 to 1.3 mm in length. To distinguish *S. girgensohnii* from *S. russowii*, another species with which it can be confused, see the comments under *Sphagnum russowii*.

Sphagnum jensenii Lindb. f.
Sphagnum annulatum var. *porosum* (Schlieph. & Warnst. *ex* Warnst.) Maass & Isov. *ex* Maass

Distinctive characteristics and habitat: Medium-sized (Fig. 6B) species, dark brown to black in full sun to green in shaded habitats. The apical bud is usually highly visible through the young branches of the stellate capitulum (Fig. 4C). The stem leaves are 1.0-1.5 mm long, concave, triangular, and pointed (similar to Figure 8CC). *Sphagnum jensenii* occurs in herbaceous fens. It grows in very wet habitats such as pond margins or depressions (Fig. 47); it is found in small, loose patches and rarely covers a large area.

Comments: *Sphagnum jensenii* can be mistaken for *S. majus*, although the two species are almost never found together. *S. jensenii* is found in fen habitats whereas *S. majus* is mostly associated with bogs. In addition, the branches and branch leaves of *S. majus* are curved (Fig. 5C, 7G, 30) while those of *S. jensenii* are straight. However, in some cases (intermediate habitats), a microscope is needed to tell the two apart. For more information about *S. jensenii* and another close species (*S. annulatum*), see Flatberg (1988b).

Sphagnum lenense Lindb. f. *ex* Pohle

Distinctive characteristics and habitat: Small-sized (Fig. 6A) species, brown (Fig. 27), sometimes orange tinged, with a dark stem. The stem leaves are 0.5-0.8 mm long and have a triangular notch at the tip (Fig. 8F). *Sphagnum lenense* is a nordic species, occasionally found further south in alpine tundra (Gauthier, 1985). It grows along pond margins (Fig. 47), under shrub cover, over bedrock, or at the tops of palsas (a thin cover of peat over an ice core) where it forms hummocks (Gauthier, 1985).

Comments: *Sphagnum lenense* is a small replica of *S. lindbergii*. The shorter stem leaves of *S. lenense* are not spatulate like those of *S. lindbergii* (Fig. 8C). *S. lenense* is similar in shape and colour to *S. fuscum.* However, the two species can readily be told apart by the shape of their stem leaves. For more information about the distribution of *S. lenense* in eastern Canada, see Gauthier (1985).

Sphagnum lindbergii Schimp. *ex* Lindb.

Distinctive characteristics and habitat: Large-sized (Fig. 6C) species, typically brown when growing in sunlight (Fig. 28) to green in shade. The stem is always dark (at least near the base) and the apical bud is large and usually prominent (Fig. 4B). The stem leaves are 1.25-1.75 mm long, fan shaped, as wide as they are long, and their upper part is fringed (Fig. 8C). *Sphagnum lindbergii* is found in bogs and poor fens. It grows in wet depressions (Fig. 47), along pond margins or, less commonly, at the center of clumps of black spruce. It is rare in temperate eastern Canada but more common at nordic latitudes and in alpine habitats.

Comments: *Sphagnum lindbergii* could be mistaken for *S. fimbriatum* because of its fan-shaped stem leaves (Fig. 8D). However, *S. fimbriatum* is smaller, light coloured, and has a light-coloured stem

instead of a dark one. *S. riparium* can occasionally be confused with green specimens of *S. lindbergii*; however, the latter species has a dark stem and its stem leaves are shaped differently.

Sphagnum magellanicum Brid.

Distinctive characteristics and habitat: Large (Fig. 6C), robust species with cucullate branch leaves (Fig. 7A), typically red when growing in sunlight (Fig. 29) to completely green in deeply shaded habitats. The stem leaves are 1.5-2.0 mm long, oblong, lingulate (Fig. 8Q), and flat. *Sphagnum magellanicum* occurs in various acidic habitats, mainly in bogs but also in poor fens. In open peatlands, it is found in habitats ranging from those near the water level to much drier ones such as hummocks (Fig. 47) or near clumps of black spruce. It is also common in coniferous or mixed forests where only a tinge of red can make its macroscopic identification certain.

Comments: *Sphagnum magellanicum* is the most common species having cucullate branch leaves. In open peatlands, it is completely red, unlike other species with cucullate branch leaves (*S. austinii*, *S. centrale*, and *S. papillosum*). It grows in dry habitats with *S. fuscum* to very wet habitats with *S. fallax*.

Sphagnum majus (Russ.) C. Jens.

Distinctive characteristics and habitat: Medium-sized (Fig. 6B) species, typically brown when growing in sunlight (Fig. 30) to green in shade. Branches when seen from above and branch leaves are usually curved (Fig. 5C, 7G, 30). The stem leaves are 1-1.75 mm long, triangular, and concave (Fig. 8CC). *Sphagnum majus* is found in very wet parts of bogs. It forms carpets or fills depressions where the water level is close to the surface (Fig. 47).

Comments: This very common species, characteristic of wet bog habitats, can be mistaken for a few other species. *Sphagnum fallax* resembles *S. majus* but is green or is brown only at the tip of its branches (Fig. 24). Moreover, the branches and branch leaves of *S. fallax* are straight instead of curved as in *S. majus*. A subspecies of *S. majus* (ssp. *norvegicum*) has been described by Flatberg (1987) in Europe and probably occurs in eastern Canada. To distinguish *S. majus* from *S. jensenii*, a similar species, see the comments under *Sphagnum jensenii*.

Sphagnum obtusum Warnst.

Distinctive characteristics and habitat: Medium-sized (Fig. 6B) yellow to green species (Fig. 31) with branches of the inner capitulum dense and stiffly erect. The capitulum is not stellate when seen from above (Fig. 5A). The stem leaves are 1.0-1.25 mm long and their tips are clearly eroded (Fig. 8DD). *Sphagnum obtusum* is a rare species with subarctic and arctic distributions and is found in herbaceous fens. In eastern Canada, it has been found only in northern Ontario and along the east coast of Hudson Bay (Mogensen, 1986).

Comments: *Sphagnum obtusum* is an extremely rare species that can be mistaken for more common species such as *S. fallax* and *S. flexuosum*. To differentiate between *S. obtusum* and these two latter species, see the comments under *Sphagnum fallax* and *Sphagnum flexuosum*. For more information about *S. obtusum*, see Vitt and Andrus (1977).

Sphagnum papillosum Lindb.

Distinctive characteristics and habitat: Large-sized (Fig. 6C) species, light brown in full sun (Fig. 32) to green in shade. The branch leaves are cucullate (Fig. 7A). The stem leaves are 1.5-1.75 mm long, flat, lingulate, with rounded tips (Fig. 8R). *Sphagnum papillosum* is mostly a fen species. It is found in wet places such as pond margins and depressions where it forms carpets or lawns (Fig. 47). It is occasionally found in bogs, particularly in coastal areas.

Comments: In open peatlands, *Sphagnum papillosum* is the commonest non-red species with cucullate branch leaves. It is often found in poor fens with *Larix laricina*, *Sphagnum pulchrum*, and *S. fallax*. In the Maritimes, it can be confused with *S. austinii* (Fig. 16), which forms very compact cushions in dry parts of bogs. *S. aongstroemii*, a very rare nordic species that looks like a species with cucullate branch leaves, has only been collected a few times in

northern Quebec. The light-coloured stem and truncated branch-leaf tip distinguishes *S. aongstroemii* from true cucullate branch leaf species. For more information about *S. aongstroemii*, see Gauthier and Ducruc (1984).

Sphagnum platyphyllum (Lindb. *ex* Braithw.) Sull. *ex* Warnst.
Sphagnum subsecundum var. *platyphyllum* (Lindb. *ex* Braithw.) Card.

Distinctive characteristics and habitat: Medium-sized (Fig. 6B) species, typically brown (Fig. 33) to black in full sun to green in shade. The capitulum consists of scattered branches (Fig. 3E), which make the apical bud highly visible and prominent (Fig. 4B). The fascicles consist of a small number (one to three) of branches, all more or less spreading. The stem leaves are 1.5-2.5 mm long, elliptical (Fig. 8H), and similar in shape to, but longer than, the branch leaves (Fig. 7I). *Sphagnum platyphyllum* grows in minerotrophic peatlands (Fig. 12, 13), in very wet habitats such as pond margins or depressions where it forms small cushions on carpets or in depressions (Fig. 47). It is an uncommon but widely distributed species in eastern Canada.

Comments: In its typical form, *Sphagnum platyphyllum* is easy to identify and difficult to confuse with other species. It is an uncommon species with a wide distribution *S. auriculatum*, a rare species, also has large spreading stem leaves similar to those of *S. platyphyllum*, but its capitulum is well developed as in *S. subsecundum*. The *Sphagnum* group that includes *S. subsecundum*, *S. contortum*, *S. platyphyllum*, *S. lescurii*, *S. inundatum*, and *S. auriculatum* is very difficult to classify taxonomically and needs further study (Institute of Terrestrial Ecology, 1990). To distinguish *S. platyphyllum* from *S. pylaesii*, see the comments under *Sphagnum pylaesii*.

Sphagnum pulchrum (Lindb. *ex* Braithw.) Warnst.

Distinctive characteristics and habitat: Robust, medium-sized (Fig. 6C) species, green to yellowish (Fig. 34), with speading branch leaves aligned in five distinct rows when wet (Fig. 3B). The branch leaves are abruptly pointed (Fig. 7D), compared to those of most species (Fig. 7C). The apical bud is large, visible, but somewhat protected by the young branches of the inner capitulum (Fig. 4C). The stem leaves are 1.0-1.25 mm long, triangular, and concave (similar to Figure 8BB). *Sphagnum pulchrum* is a confined mostly to fens. It is found in very wet habitats, such as pond margins and depressions, where it forms carpets or lawns (Fig. 47). It is sometimes found in bogs, particularly in coastal areas, and is common in eastern Canada.

Comments: *Sphagnum pulchrum* can be confused with other species, such as *S. fallax* and *S. majus*. However, when all the characteristics listed above are observed, it is usually easy to identify.

Sphagnum pylaesii Brid.

Distinctive characteristics and habitat: Small-sized (Fig. 6A) species, red-brown to black (Fig. 35), rarely green, with very few or sometimes no branches (Fig. 3E). The apical bud is prominent (Fig. 4B) and commonly alone at the top of the stem. The stem is dark. The stem leaves (Fig. 8G), which are usually 1.5 mm long, are similar in shape to the branch leaves but longer (Fig. 7I). *Sphagnum pylaesii* is found in bogs or poor fens, in wet habitats such as depressions and pond margins (Fig. 47) (Lavoie and Gauthier, 1983). It is confined to coastal regions in eastern Canada (Lavoie and Gauthier, 1983).

Comments: In the field, *Sphagnum pylaesii*, with its small number of branches, does not look like a *Sphagnum* species. Its structure is somewhat similar to that of *S. platyphyllum* except that the latter is larger and always grows in fens. Moreover, the spreading branches of *S. pylaesii* are rarely over 5 mm long, whereas those of *S. platyphyllum* are nearly always longer (Ireland, 1982). For more information about *Sphagnum cyclophyllum*, a species found in Nova Scotia and whose shape is close to that of *S. pylaesii*, see Crum (1984).

Sphagnum quinquefarium (Lindb. *ex* Braithw.) Warnst.

Distinctive characteristics and habitat: Small-sized (Fig. 6A) green species (Fig. 36) with typically three spreading branches per fascicle (Fig. 3D). The stem leaves are 1.0-1.25 mm long, triangular, and pointed (Fig. 8W). The apical bud is usually visible and slightly elevated above the surrounding young branches (Fig. 4A). When dry, the spreading branch leaves are aligned in five distinct rows (Fig. 3B).

Sphagnum quinquefarium is a forest species growing in coniferous to mixed forests. It is found in small patches on the forest floor, often with *S. girgensohnii*, *S. russowii*, *S. capillifolium*, or *S. wulfianum*. It is confined to temperate and boreal regions.

Comments: *Sphagnum quinquefarium* is most likely to be found in forested habitats. The macroscopic characteristics mentioned above are sufficient to identify the species. It can be mistaken for a green *S. capillifolium*, although the two spreading branches per fascicle in the latter species are usually enough to tell them apart. To distinguish *S. quinquefarium* from *S. russowii* and *S. warnstorfii*, see the comments under *Sphagnum russowii* and *Sphagnum warnstorfii*.

Sphagnum riparium Aongstr.

Distinctive characteristics and habitat: Large-sized (Fig. 6C) green species (Fig. 37) with a large, prominent apical bud (Fig. 4B) and a green stem. The stem leaves are 1.5-1.75 mm long and have triangular notches at their tips (Fig. 8E). *Sphagnum riparium* is found in poor fens, in very wet habitats such as pond (Fig. 47) or brook margins, and also in roadside or old ditches. It is occasionally found with *S. lindbergii* in very wet depressions at the centers of clumps of black spruce, in bog habitats.

Comments: *Sphagnum riparium* is sometimes found in natural, undisturbed peatlands, but is more common in old ditches. To distinguish *S. riparium* from *S. lindbergii*, see the comments under *Sphagnum lindbergii*.

Sphagnum rubellum Wils.
Sphagnum capillifolium var. *tenellum* (Schimp.) Crum
Sphagnum capillaceum var. *tenellum* (Schimp.) Andr.

Distinctive characteristics and habitat: Small-sized (Fig. 6A) green (Fig. 46), pink, or red (Fig. 38) species, occasionally copper coloured. The apical bud visible and slightly more elevated than the surrounding inner branches of the capitulum (Fig. 4A, 38). The stem leaves are lingulate (Fig. 8EE) and 1.0-1.25 mm long. The hyalocysts of the stem leaves are nearly as wide as they are long and, in most cases, without fibrils (these last two characteristics are best observed with a microscope). *Sphagnum rubellum* is mostly a poor-fen species associated with *S. fallax*, *S. flexuosum*, or *S. pulchrum*. It is found less commonly in bogs, generally with *S. capillifolium* (Fig. 46).

Comments: *Sphagnum capillifolium* and *S. rubellum* are two similar species that are sometimes very difficult to tell apart (Nylholm, 1954-1969; McQueen, 1989). Cronberg (1995) studied the genetic characteristics of both species and found that both are easily identified when their own distinctive morphological characteristics are evident. However, genetic intermediates are commonly encountered in the field and their shape characteristics make identification impossible based only on morphological details. Further genetic analyses are necessary to confirm their identification. At the time of publication, no such study of the genetic makeup of the *Sphagnum capillifolium* complex and related species such as *S. rubellum*, *S. andersonianum*, *S. subtile*, and *S. tenerum* has been undertaken in eastern Canada. The *Sphagnum rubellum* species described in this guide includes *S. andersonianum* from Andrus (1980) in synonymy.

S. rubellum sometimes occupies an important part of the moss strata in peatlands in eastern Canada. It is then generally associated with *S. capillifolium* and, when both are typical, they can easily be told apart by the shape of the stem leaf and by the visible apical bud. When they grow together, *S. capillifolium* is usually deeper red that *S. rubellum* (Fig. 46). However, typical *S. rubellum*, with clearly lingulate stem leaves (Fig. 8EE), is much less common than typical *S. capillifolium*, with oblong and gradually tapered stem leaves (Fig. 8K). To distinguish between *S. rubellum* and *S. warnstorfii*, see the comments under *Sphagnum warnstorfii*.

Sphagnum russowii Warnst.
Sphagnum robustum (Warnst.) Röll

Distinctive characteristics and habitat: Small- to medium-sized (Fig. 6B) species, red in sunny habitats (Fig. 39) to completely green in heavily shaded habitats. The capitulum is somewhat flat with a generally visible apical bud (Fig. 4A). The stem leaves are 1.0-1.25 mm long, broadly rounded at the apex, and their tips are eroded

over one quarter of their width (Fig. 8P). *Sphagnum russowii* is encountered almost exclusively in heavily shaded habitats (on the forest floor or under dense, shrub thickets) in temperate eastern Canada. In subarctic or arctic regions, it is much more common in open areas.

Comments: *Sphagnum russowii* is difficult to characterize. In shaded habitats, it can be mistaken for *S. capillifolium*, which has tapered stem leaves (Fig. 8K) in contrast to the broadly rounded ones of *S. russowii* (Fig. 8P). In addition, the capitulum of *S. capillifolium* is usually more convex than that of *S. russowii*. *S. girgensohnii* also closely resembles *S. russowii* except that it is never red, its apical bud is often prominent, and the tips of the stem leaves are more broadly lacerate. *S. warnstorfii* is similar to *S. russowii* and also grows in shady places, but it can be recognized by its spreading branch leaves that are aligned in five rows when wet or dry (Fig. 3B). *S. quinquefarium*, another forest species, is told from *S. russowii* by its three spreading branches, instead of two in *S. russowii*, and by its pointed stem leaves (Fig. 8W). *S. russowii* is often associated with *S. girgensohnii*.

Sphagnum squarrosum Crome

Distinctive characteristics and habitat: Large-sized (Fig. 6C) green to yellow species with typically squarrose branch leaves (Fig. 7K). The stem is dark, and the apical bud is very large and prominent (Fig. 4B, 40). The stem leaves are 1.5-2.0 mm long, oblong, with broadly rounded tips (Fig. 8A). *Sphagnum squarrosum* is a fen species more commonly found in shaded habitats, at least in temperate eastern Canada. It is very common in the wettest part of the forest floor, especially along brook margins. It is occasionally found in open, herbaceous fens. In the subarctic to arctic regions of eastern Canada, it is more commonly encountered in open, treeless places.

Comments: In its typical form, *Sphagnum squarrosum* is one of the easiest *Sphagnum* species to identify. However, when it is found with *S. teres*, it may be difficult to distinguish (see the comments under *Sphagnum teres*).

Sphagnum subfulvum Sjörs
Sphagnum nitidum Warnst.

Distinctive characteristics and habitat: Medium-sized (Fig. 6B) species, generally orange-brown or brown in full sun (Fig. 41) to completely green in shaded habitats. The stem is dark and the branch leaves are commonly shiny when dry (use a hand lens). The stem leaves are 1.0-1.5 mm long, oblong, with gradually narrowed tips (Fig. 8L). *Sphagnum subfulvum* is a fen species and is commonly found on the strings (Fig. 47) of patterned fens (Fig. 12) or along the margins of brooks, often in herbaceous fens. It is most common in boreal, subarctic, and arctic areas of eastern Canada (Mogensen, 1986).

Comments: In boreal, subarctic, and Arctic regions, *Sphagnum subfulvum* is omnipresent in herbaceous fens, often growing with *S. warnstorfii*, *S. platyphyllum*, *S. subsecundum*, and *S. jensenii*. It can be mistaken for *S. fuscum*, a smaller species with broadly rounded stem leaf tips (Fig. 8N). In addition, *S. fuscum* is a bog species rarely encountered in fens. *S. subnitens*, a common species in Europe, is extremely rare in eastern Canada (Ireland et al., 1987). It is distinguished microscopically from *S. subfulvum* by its different stem leaves and macroscopically by its red to purple colouration when found in sunny habitats. To distinguish *S. subfulvum* from *S. flavicomans*, see the comments under *Sphagnum flavicomans*. For more information about *S. subfulvum*, consult Sjörs (1944).

Sphagnum subsecundum Nees *ex* Sturm var. ***subsecundum***

Distinctive characteristics and habitat: Small-sized (Fig. 6A) species ranging from light brown to black in full sun (Fig. 42) to green in shaded habitats. The stem is always dark, at least near the base. The stem leaves are 0.75-1.0 mm long, triangular, with rounded tips (Fig. 8Y). The branch leaves and, when seen from above, the capitulum branches (Fig. 5C, 42) are both curved (Fig. 7H). *Sphagnum subsecundum* is a fen species and is found in wet, unstable habitats such as brook margins or on floating mats or lawns (Fig. 47). In open herbaceous fens, it can form small, isolated cushions. It is a common, widely distributed species in eastern Canada.

Comments: *Sphagnum subsecundum* is not easy to characterize. In the field, it often forms scattered cushions with other fen species such as *S. teres*, *S. warnstorfii*, *S. papillosum*, and in boreal regions, *S. subfulvum*. *S. contortum* is similar to *S. subsecundum* and is characterized by a stem cortex with three layers (a microscopic characteristic) and richer habitats. *S. contortum* is widely distributed in eastern Canada but is much rarer than *S. subsecundum*. *S. orientale*, also similar to *S. subsecundum*, is a nordic species found only in the eastern part of northern Ontario, near James Bay (Mogensen, 1986). A microscopic examination is required to tell the two species apart with certainty.

Sphagnum tenellum (Brid.) Pers. *ex* Brid.

Distinctive characteristics and habitat: Small-sized (Fig. 6A) species, yellow (Fig. 43) to green, sometimes brownish at the tip of its branches. The apical bud is visible among the sparse branches of the inner capitulum (Fig. 4E). The branch and stem leaves are similar in shape and size, the branch leaves being short with abruptly acuminate tips (similar to Fig. 7D). The stem leaves are 1.0-1.5 mm long, elliptical (Fig. 8Z), concave, and typically spreading on the stem (Fig. 2A). *Sphagnum tenellum* is a bog species and is found in very wet depressions or along pond margins where it forms loose carpets or lawns (Fig. 47). It is very common in boreal to arctic regions and in coastal areas (Mogensen, 1986).

Comments: Macroscopically, *Sphagnum tenellum* is difficult to characterize. In the field, its occurrence in loose yellowish lawns attracts attention. It can be mistaken for *S. cuspidatum*, a yellowish species that grows in the same type of habitat. The branch leaves of *S. tenellum* are elliptical (similar to Fig. 7D), while those of *S. cuspidatum* are gradually tapered (Fig. 7G).

Sphagnum teres (Schimp.) Aongstr. *ex* C. Hartm.

Distinctive characteristics and habitat: Medium-sized (Fig. 6B) species, brownish (Fig. 44) in full sun to completely green in shaded areas. The apical bud is prominent (Fig. 4B) and the stem is always dark, at least near the base. The branch leaves are sometimes squarrose (Fig. 7K). The stem leaves are 1.25-1.75 mm long, lingulate, flat, with broadly rounded tips (Fig. 8B). *Sphagnum teres* is a fen species that forms small cushions or sometime lawns or carpets, in fairly wet habitats. It is often associated with *S. warnstorfii*, *S. fimbriatum*, *S. subsecundum*, or other fen species.

Comments: *Sphagnum teres* is fairly easy to identify in the field when the characteristics described above are observed. However, certain other species can resemble *S. teres*. *S. fimbriatum* is more delicate than *S. teres*, its stem leaves are fan shaped (Fig. 8D) rather than lingulate, and its stem is always light coloured. Large specimens of *S. teres* with squarrose branch leaves can be mistaken for small specimens of *S. squarrosum*. Even with a microscope, it is difficult to distinguish between specimens that are intermediate in size. To tell *S. teres* from *S. girgensohnii*, see the comments under *Sphagnum girgensohnii*.

Sphagnum torreyanum Sull.

Distinctive characteristics and habitat: Very large-sized (Fig. 6C) species, yellowish, sometimes with a brown tinge at the tip of its branches. The capitulum is 3-5 cm in diameter. The apical bud is large and visible between the young branches of the inner capitulum (Fig. 4C). The branch leaves are long (4-6 mm) and spreading when the specimen is submerged. The branches are grouped in fascicles of four and the stem leaves have acuminate tips. *Sphagnum torreyanum* is an aquatic species confined to coastal bogs in eastern Canada. It grows completely submerged in ponds (Fig. 47), often near pond margins where the water is 30 to 60 cm deep.

Comments: *Sphagnum torreyanum* is a large-scale replica of *S. cuspidatum* and the two species can be mistaken for one another. When wet, the more rigid branches of *S. torreyanum* do not resemble an artist's paintbrush, unlike those of *S. cuspidatum* (see the comments under *Sphagnum cuspidatum*). *S. macrophyllum* is another species that grows under water in coastal areas. It is distinguished from *S. torreyanum* by its branches in groups of two and by its stem leaf with rounded tip (Crum, 1984). *S. torreyanum* is an uncommon species that should be protected as a rare species.

Sphagnum warnstorfii Russ.

Distinctive characteristics and habitat: Small-sized (Fig. 6A) species, generally pink, red, or purple in full sun to green in shaded habitats. The spreading branch leaves are typically aligned in five rows when wet or dry (Fig. 3B; examine several branches using a hand lens). The stem leaves are 1.0-1.25 mm long, oblong to lingulate, with broadly rounded tips (Fig. 8M). *Sphagnum warnstorfii* is a rich-fen species. It grows in rich forests under cedar or black ash or with larches in more open peatlands, and is a widely distributed species in eastern Canada.

Comments: *Sphagnum warnstorfii* can be mistaken for many other small-sized species. *S. russowii* is nearly always found in shade and usually has a visible apical bud (Fig. 4B), whereas *S. warnstorfii* does not have a visible apical bud (Fig. 4D). *S. capillifolium* has stem leaves that gradually narrow at the tip (Fig. 8K); it is found in poorer habitats than *S. warnstorfii*. *S. rubellum* has lingulate stem leaves (Fig. 8EE) while *S. quinquefarium*, a forest species, has pointed stem leaves (Fig. 8W). *S. fuscum* has a dark stem that is never tinged with red. In addition, none of these species has stem leaves in five distinct rows when wet or dry. *S. warnstorfii* is often associated with *S. teres*, *S. squarrosum*, *S. subsecundum*, *S. platyphyllum*, and in boreal, subarctic, and arctic regions, with *S. subfulvum*.

Sphagnum wulfianum Girg.

Distinctive characteristics and habitat: Medium-sized (Fig. 6B) species, green (Fig. 45) or rarely light brown when growing in full sunlight. The capitulum is dense and varies from slightly convex to hemispherical. The stem is very rigid and dark. The branches are grouped in fascicles of six to twelve, at least three of which are spreading (Fig. 3D). The stem leaves are oblong-triangular (Fig. 8U) and 0.75-1.0 mm long. *Sphagnum wulfianum* is found in wet areas in coniferous or mixed forests. It is very rarely found in open peatlands where it prefers drier habitats such as stumps. It grows directly on the ground or over fallen tree trunks and usually forms small isolated cushions. It is most common in temperate areas of eastern Canada.

Comments: Once *Sphagnum wulfianum* has been identified for the first time, it is easily recognized in the field from its distinctive characteristics described above.

GLOSSARY

Acuminate: Slender and gradually tapered (Fig. 7F, 8FF).

Apical bud: Central bud found in the centre of the capitulum at the top of the stem (Fig. 4).

Biotope: Microhabitat characterized by microtopography and specific ecological conditions (Fig. 47).

Branch leaf: Leaf attached to a branch (Fig. 3A, B, C, 7).

Capitulum: Concentration of young branches at the top of a stem (Fig. 1A, 4, 5).

Carpet: Flat, floating, and poorly consolidated biotope standing just above the water level.

Cucullate: Hood shaped (Fig. 7A).

Depression: Concave, circular to elongate area where the water table is near the surface.

Eroded: Referring to the tips of the stem leaves, irregularly torn or notched (Fig. 8I, O, P, DD).

Fascicle: Group of branches originating from a common point on a stem (Fig. 1, 3D, E).

Fibril: Microscopic, delicate, fiber-like structure found in *Sphagnum* leaves.

Floating mat: Very wet and unstable biotope floating at the margins of ponds.

Hanging branch: Fascicle branch roughly parallel to the stem (Fig. 1).

Hummock: Vegetated mound formed 15 to 50 cm above the water level in peatlands (Fig. 9, 10).

Hyalocyst: Empty water-storage cells enclosed by chlorocyst cells.

Lacerate: Irregularly torn (Fig. 8C, D).

Lawn: Flat, usually well-consolidated biotope standing just above the water level (Fig. 47).

Lingulate: Tongue shaped (Fig. 8EE).

Mucronate: Ending abruptly in a short point (Fig. 8BB).

Oblong: Longer than wide, with more or less parallel sides (Fig. 8M, N).

Obtuse: Rounded at the tip (Fig. 8N, EE).

Pond: Place with persistent open water (Fig. 10, 12, 13).

Robust: Fat and thick (Fig. 28, 32, 34).

Spatulate: Similar to lingulate but narrower at the base (Fig. 8X).

Spreading branch: Fascicle branch that makes a roughly 90° angle with the stem (Fig. 1).

Squarrose: Spreading away from the center (Fig. 7J, K).

Stellate: Shaped like a star with five points (Fig. 5D, 21, 26).

Stem: Central axis of a plant (Fig. 1).

Stem leaf: Leaf attached to the stem (Fig. 1, 8).

String: Long narrow band of vegetation between ponds (Fig. 12).

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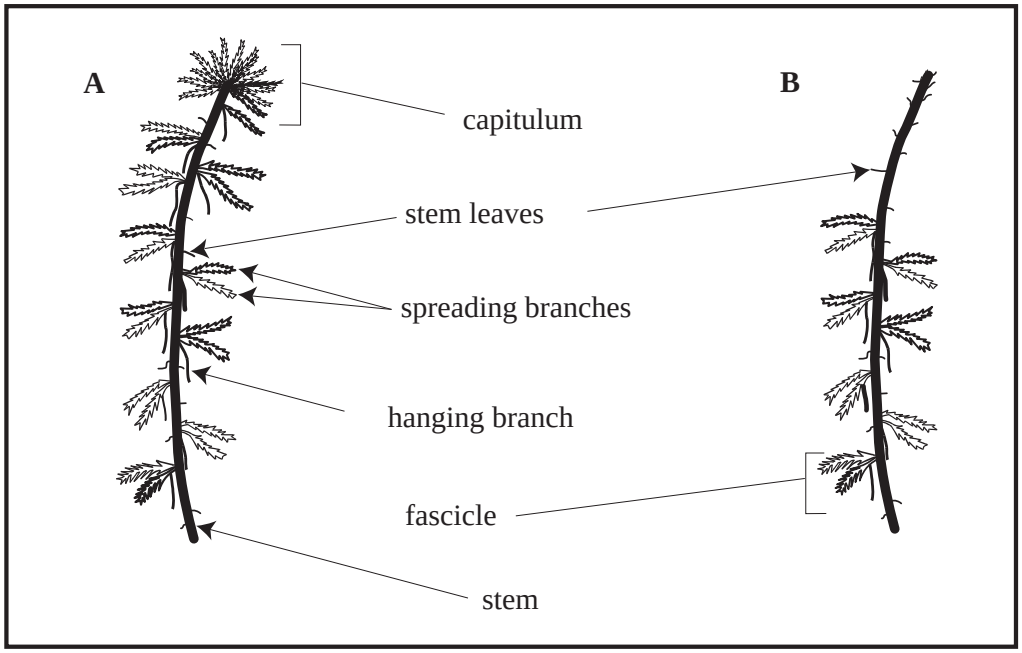

Figure 1.

Important morphological features of *Sphagnum* plants. Note the absence of capitulum and upper fascicles in Fig. 1B.

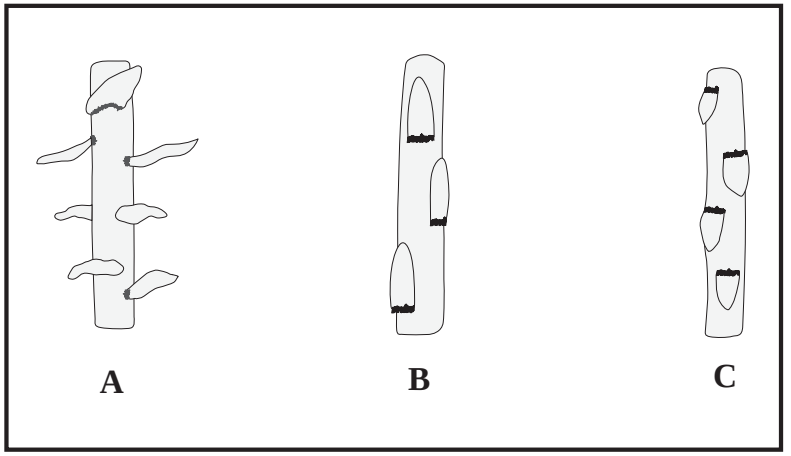

Figure 2.

Stem leaf positions. **A)** Spreading stem leaves. **B)** Erect stem leaves. **C)** Hanging stem leaves.

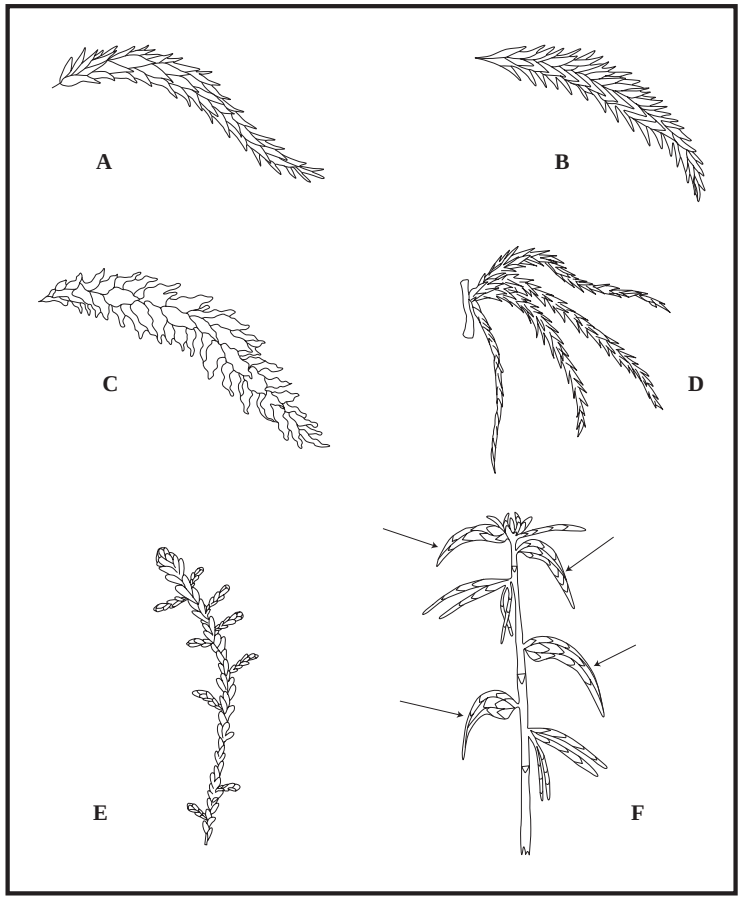

Figure 3. Details of *Sphagnum* branches. **A)** Branch leaves not in five rows. **B)** Branch leaves in five rows. **C)** Wavy branch leaves. **D)** Fascicle with three spreading branches **(***S. quinquefarium*). **E)** Sparse branches **(***S. pylaesii*). **F)** Branches in groups resembling an artist's paintbrush (*S. cuspidatum*).

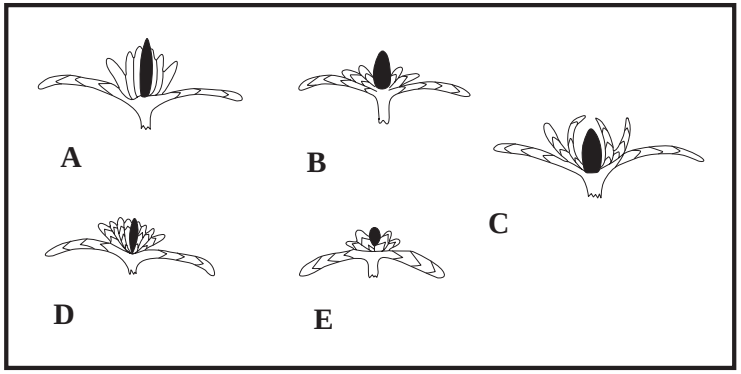

Figure 4. Transverse cuts of the capitulum showing the apical bud (black).

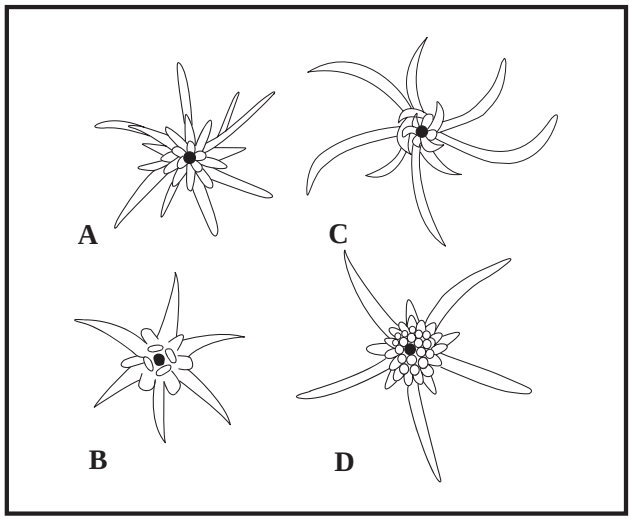

Figure 5. Capitulum as seen from above.

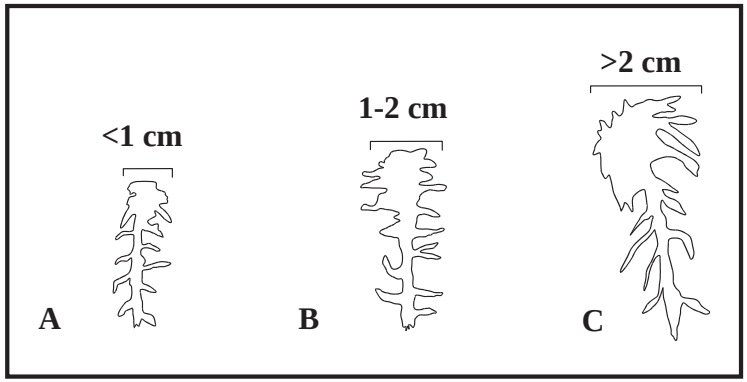

Figure 6.

Sizes of *Sphagnum* species, in centimetres. **A)** Small. **B)** Medium. **C)** Large**.**

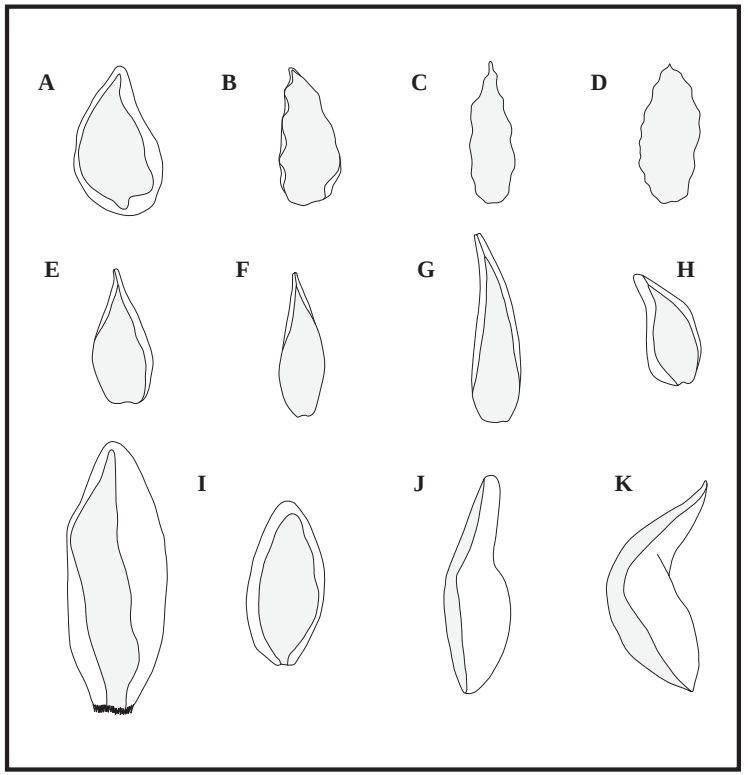

Figure 7.

Branch leaf shapes. **A)** Cucullate. **B)** Wavy. **C)** Wavy. **D)** Wavy (*S. pulchrum*). **E)** Straight. **F)** Straight. **G)** Curved. **H)** Curved. **I)** Stem leaf (large) and branch leaf (small) with similar shapes. **J)** Squarrose. **K)** Squarrose.

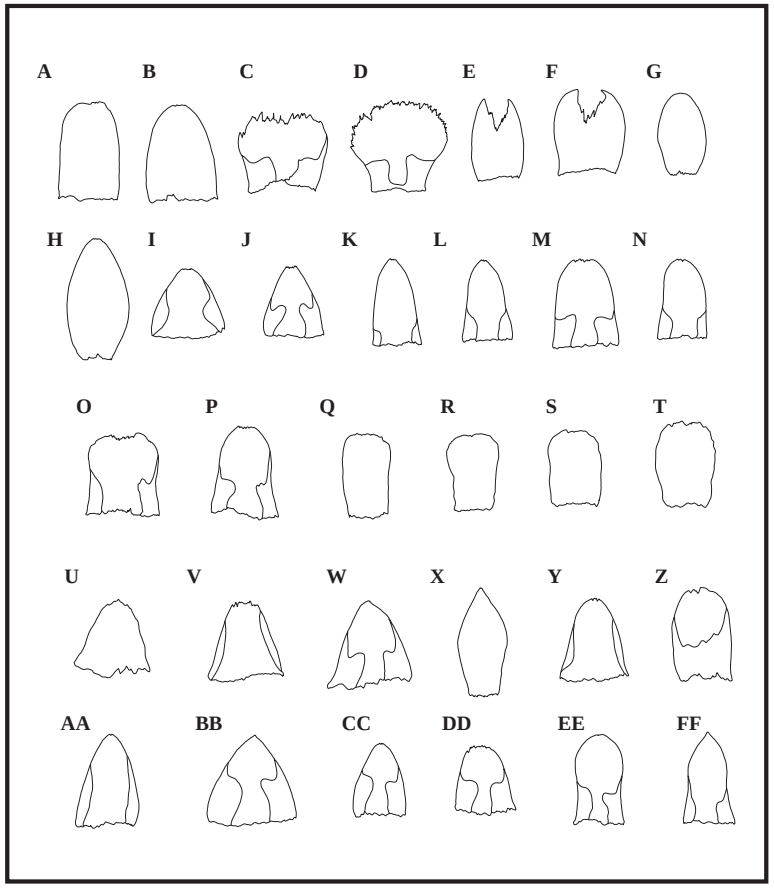

Figure 8. Stem leaf shapes (not to scale; for true sizes, see species descriptions). **A)** *S. squarrosum*. **B)** *S. teres*. **C)** *S. lindbergii*. **D)** *S. fimbriatum*. **E)** *S. riparium*. **F)** *S. lenense*. **G)** *S. pylaesii*. **H)** *S. platyphyllum*. **I)** *S. angustifolium*. **J)** *S. flexuosum*. **K)** *S. capillifolium*. **L)** *S. subfulvum*. **M)** *S. warnstorfii*. **N)** *S. fuscum*. **O)** *S. girgensohnii*. **P)** *S. russowi*. **Q)** *S. magellanicum*. **R)** *S. papillosum*. **S)** *S. austinii*. **T)** *S. centrale*. **U)** *S. wulfianum*. **V)** *S. compactum*. **W)** *S. quinquefarium*. **X)** *S. angermanicum*. **Y)** *S. subsecundum*. **Z)** *S. tenellum*. **AA)** *S. balticum*. **BB)** *S. fallax*. **CC)** *S. majus*. **DD)** *S. obtusum*. **EE)** *S. rubellum*. **FF)** *S. flavicomans*.

Figure 9. Ericaceous bog. (Photo courtesy of Denis-F. Bastien)

Figure 10. Bog with ponds. (Photo courtesy of Denis-F. Bastien)

Figure 11. Open bog (sparse trees). (Photo courtesy of Denis-F. Bastien)

Figure 13. Herbaceous fen with ponds. (Photo courtesy of Denis-F. Bastien)

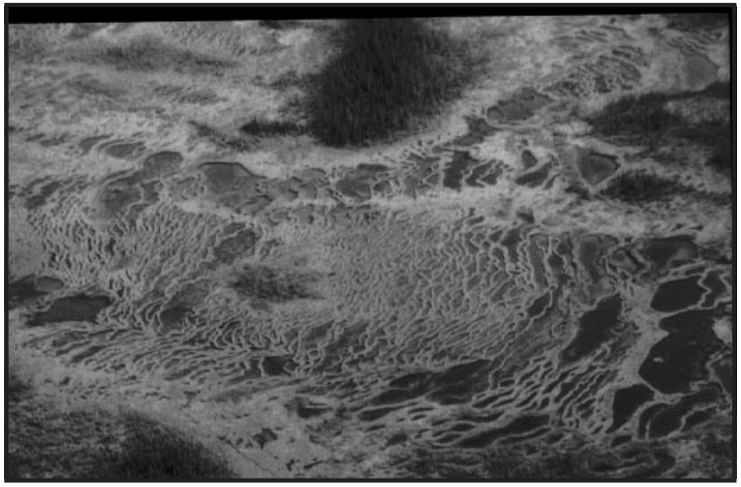

Figure 12. Patterned fen. (Photo courtesy of Pierre Buteau)

Figure 14. *Sphagnum angermanicum*. (Photo courtesy of Denis-F. Bastien)

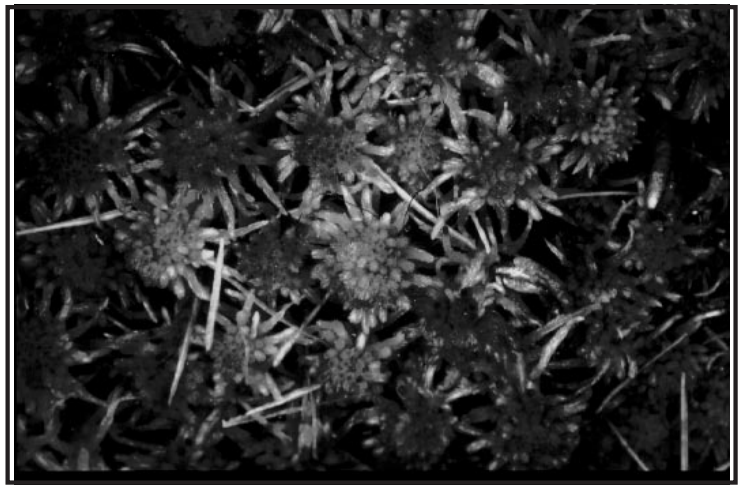

Figure 15. *Sphagnum angustifolium*. (Photo courtesy of Denis-R. Bastien)

Figure 17. *Sphagnum balticum*. (Photo courtesy of Robert Gauthier)

Figure 16. *Sphagnum austinii*. (Photo courtesy of Denis-F. Bastien)

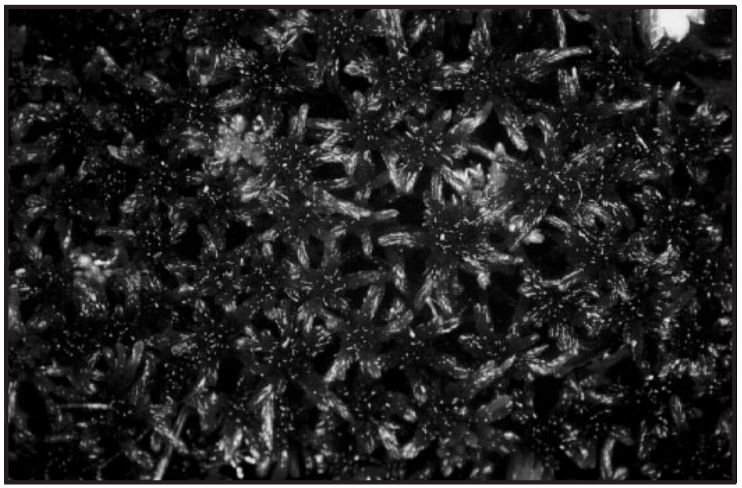

Figure 18. *Sphagnum capillifolium*. (Photo courtesy of Denis-F. Bastien)

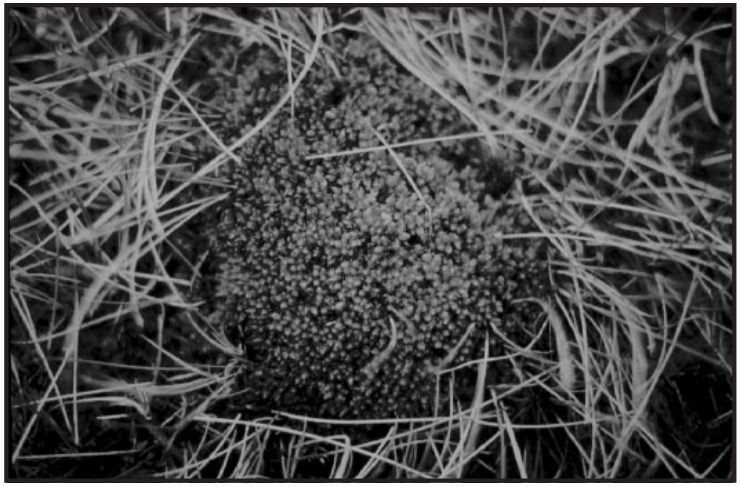

Figure 19. *Sphagnum compactum*. (Photo courtesy of Robert Gauthier)

Figure 21. *Sphagnum fallax*. (Photo courtesy of Denis-F. Bastien)

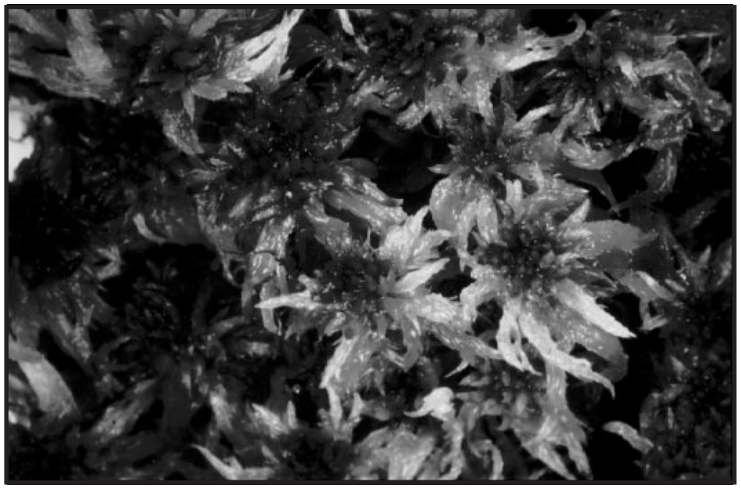

Figure 20. *Sphagnum cuspidatum*. (Photo courtesy of Denis-R. Bastien)

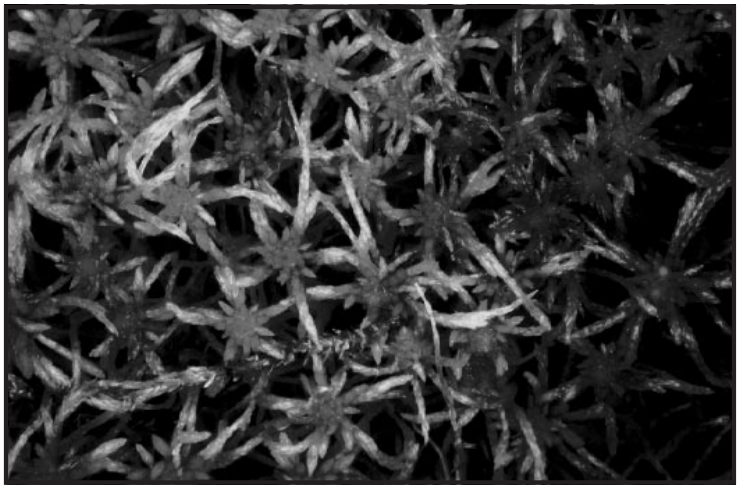

Figure 22. *Sphagnum fimbriatum*. (Photo courtesy of Denis-R. Bastien)

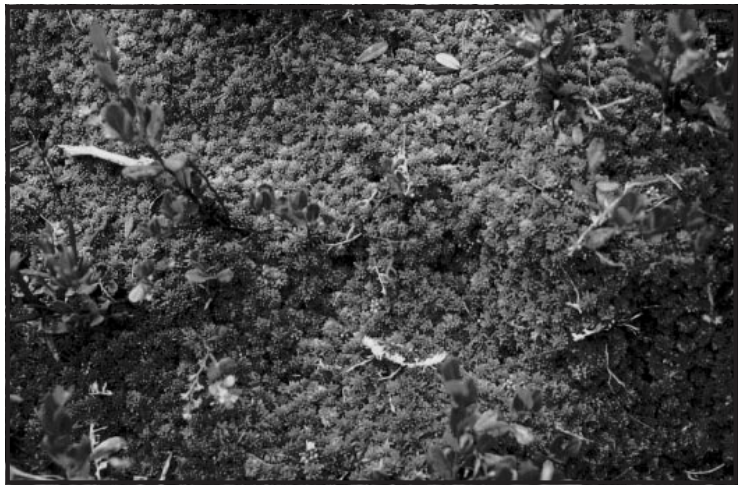

Figure 23. *Sphagnum flavicomans*. (Photo courtesy of Denis-F. Bastien)

Figure 24. *Sphagnum fallax* (dark) and *S. flexuosum* (light). (Photo courtesy of Denis-R. Bastien)

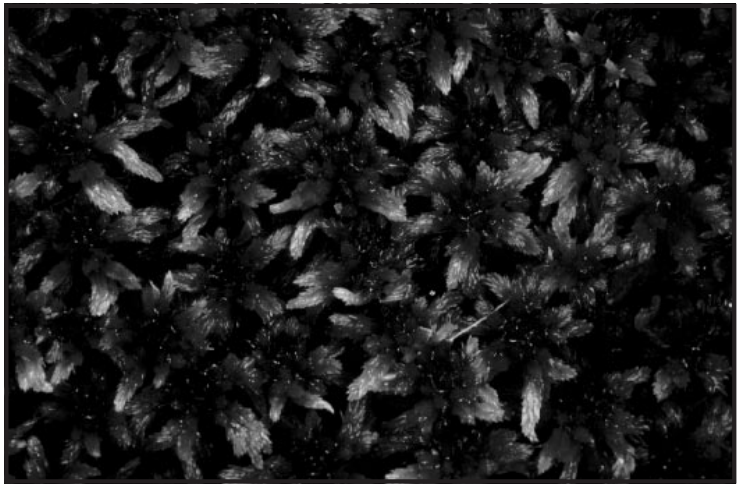

Figure 25. *Sphagnum fuscum*. (Photo courtesy of Denis-R. Bastien)

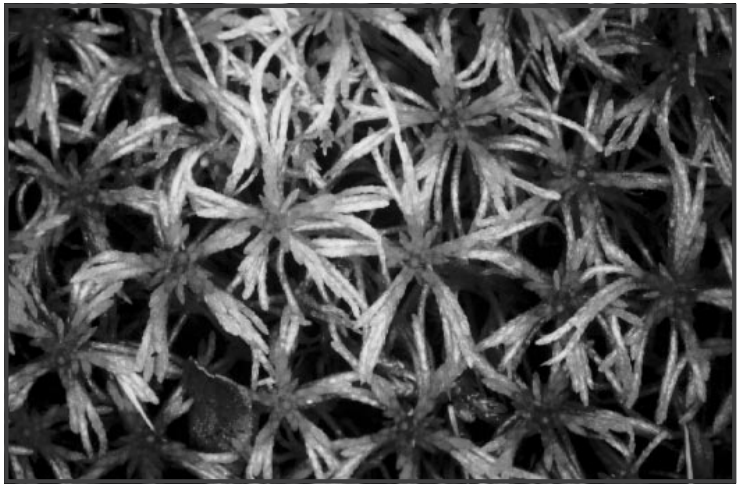

Figure 26. *Sphagnum girgensohnii*. (Photo courtesy of Denis-R. Bastien)

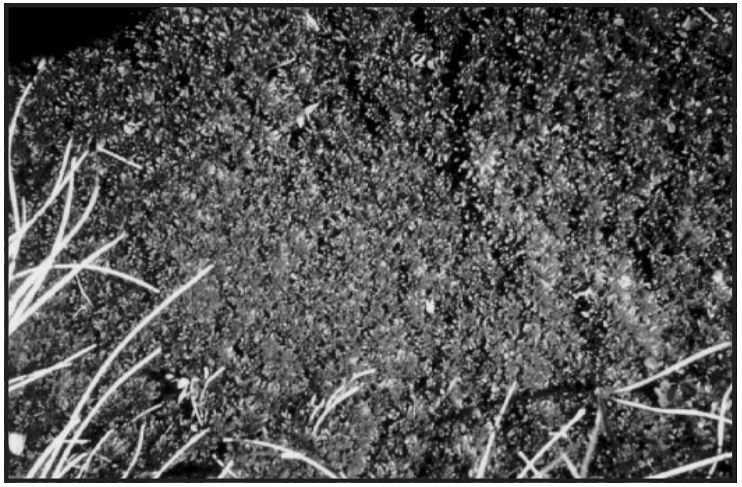

Figure 27. *Sphagnum lenense*. (Photo courtesy of Robert Gauthier)

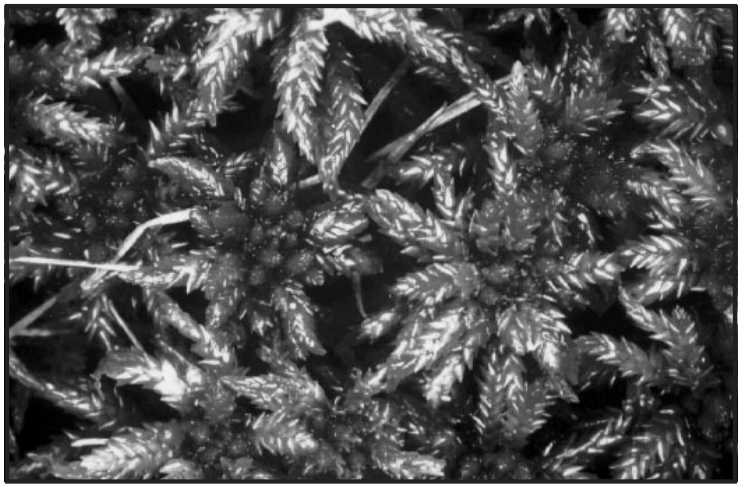

Figure 29. *Sphagnum magellanicum.* (Photo courtesy of Denis-R. Bastien)

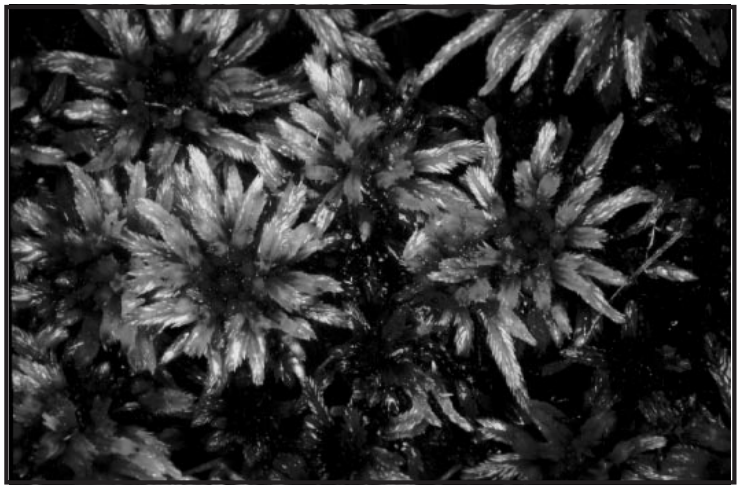

Figure 28. *Sphagnum lindbergii*. (Photo courtesy of Denis-R. Bastien)

Figure 30. *Sphagnum majus*. (Photo courtesy of Denis-R. Bastien)

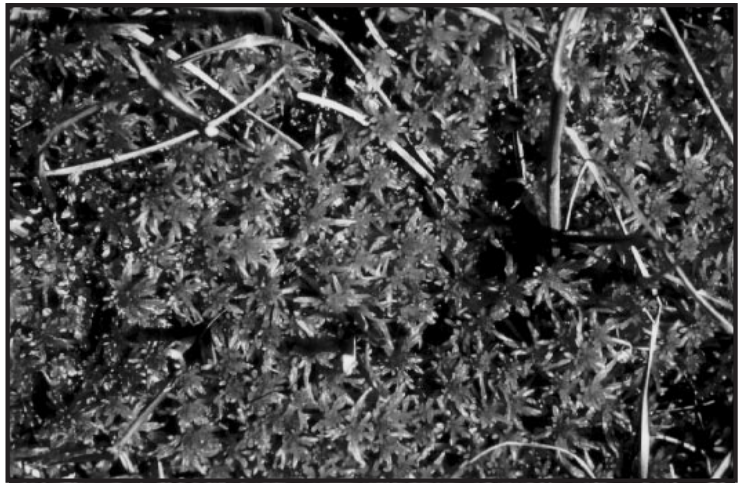

Figure 31. *Sphagnum obtusum*. (Photo courtesy of Robert Gauthier)

Figure 33. *Sphagnum platyphyllum*. (Photo courtesy of Denis-F. Bastien)

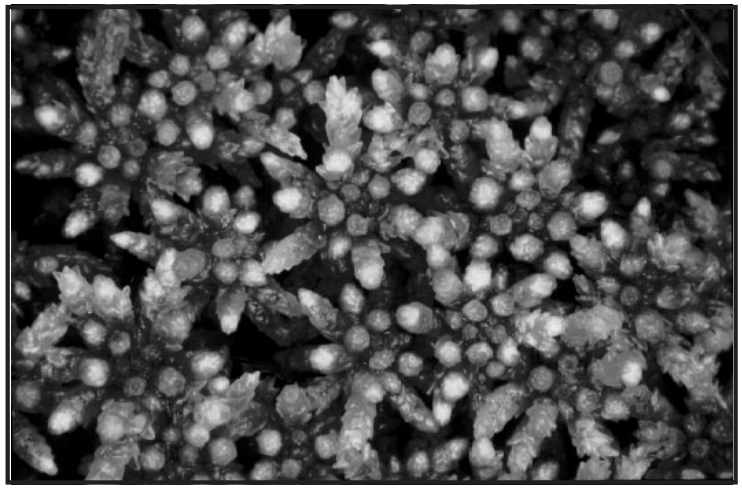

Figure 32. *Sphagnum papillosum*. (Photo courtesy of Denis-R. Bastien)

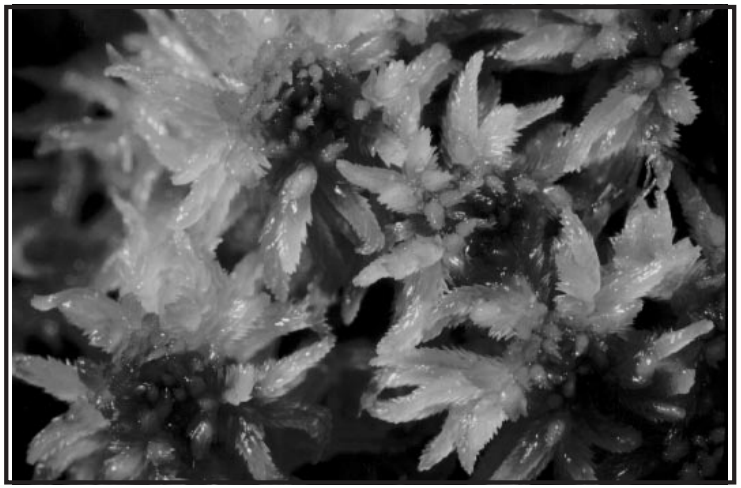

Figure 34. *Sphagnum pulchrum*. (Photo courtesy of Denis-R. Bastien)

Figure 35. *Sphagnum pylaesii*. (Photo courtesy of Denis-R. Bastien)

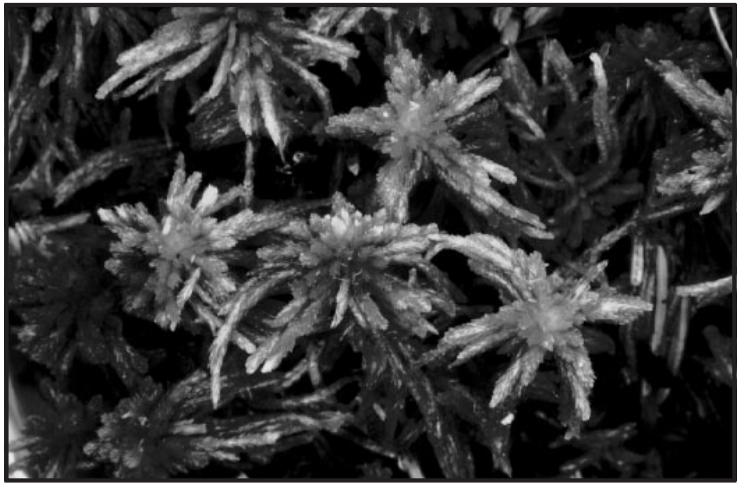

Figure 36. *Sphagnum quinquefarium*. (Photo courtesy of Denis-R. Bastien)

Figure 37. *Sphagnum riparium*. (Photo courtesy of Denis-R. Bastien)

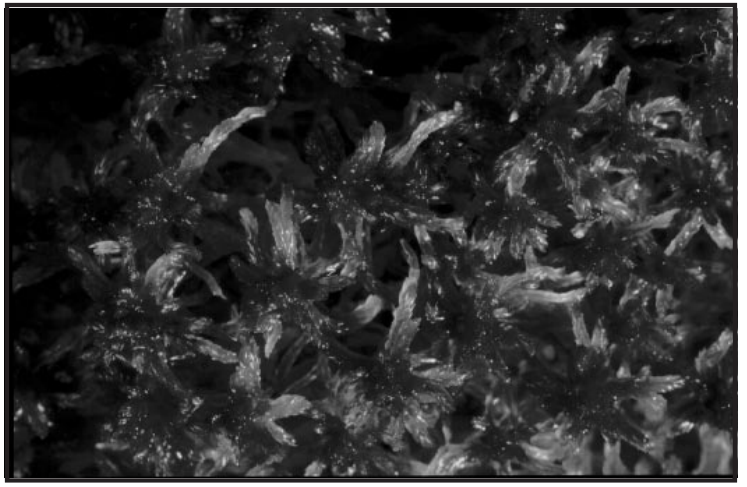

Figure 38. *Sphagnum rubellum*. (Photo courtesy of Denis-R. Bastien)

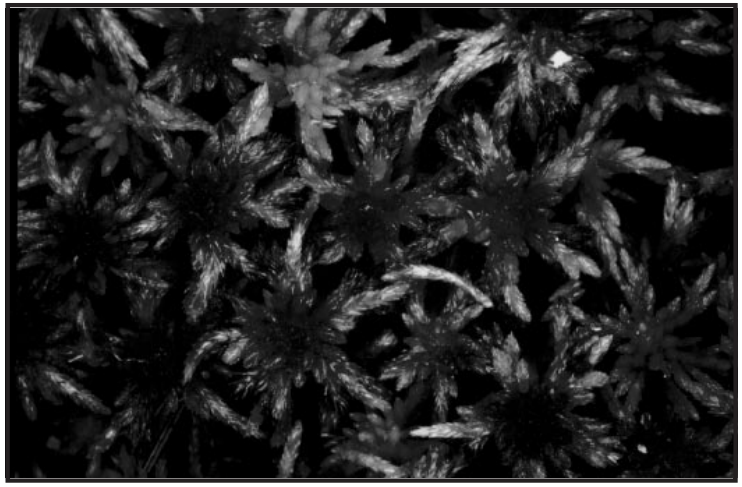

Figure 39. *Sphagnum russowii* (red). (Photo courtesy of Denis-R. Bastien)

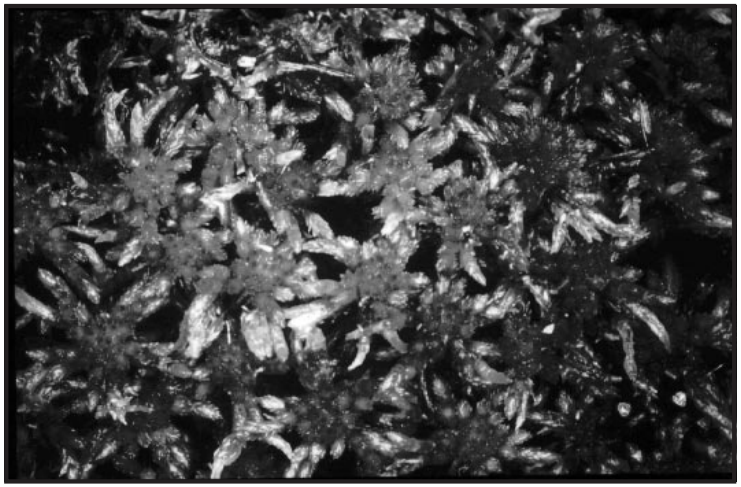

Figure 41. *Sphagnum subfulvum*. (Photo courtesy of Denis-R. Bastien)

Figure 40. *Sphagnum squarrosum*. (Photo courtesy of Denis-R. Bastien)

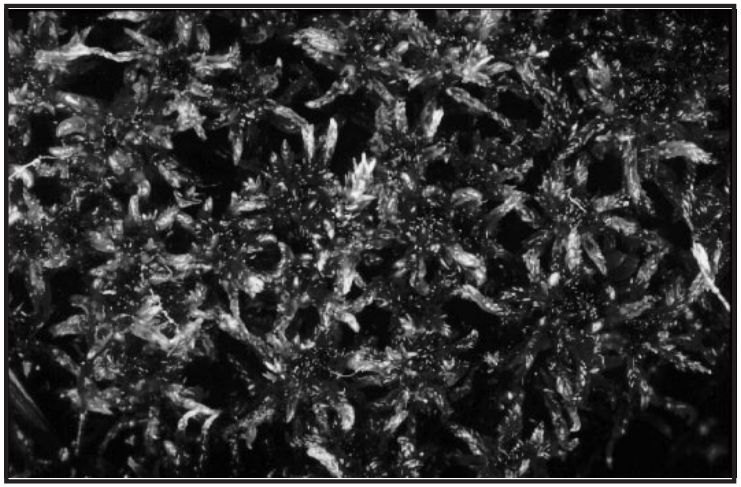

Figure 42. *Sphagnum subsecundum.* (Photo courtesy of Denis-R. Bastien)

Figure 43. *Sphagnum tenellum*. (Photo courtesy of Robert Gauthier)

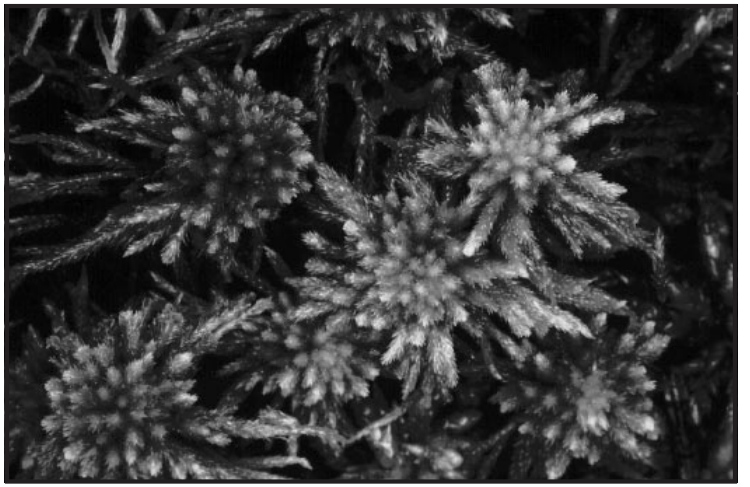

Figure 45. *Sphagnum wulfianum*. (Photo courtesy of Denis-R. Bastien)

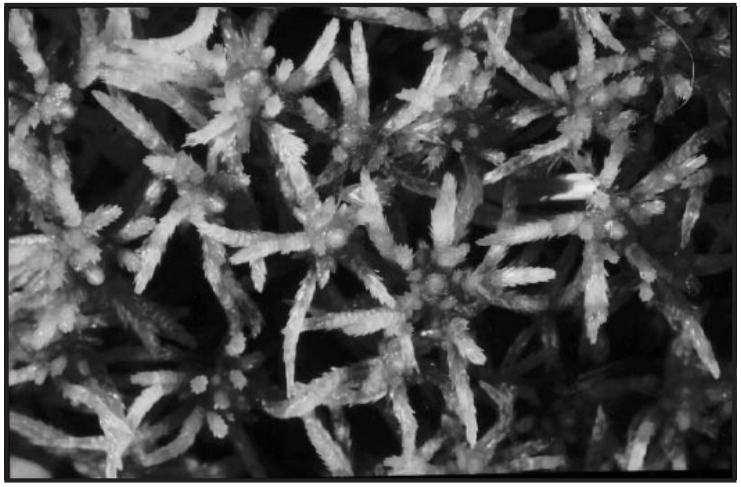

Figure 44. *Sphagnum teres*. (Photo courtesy of Denis-R. Bastien)

Figure 46. *Sphagnum rubellum* (green) and *S. capillifolium* (red). (Photo courtesy of Denis-F. Bastien)

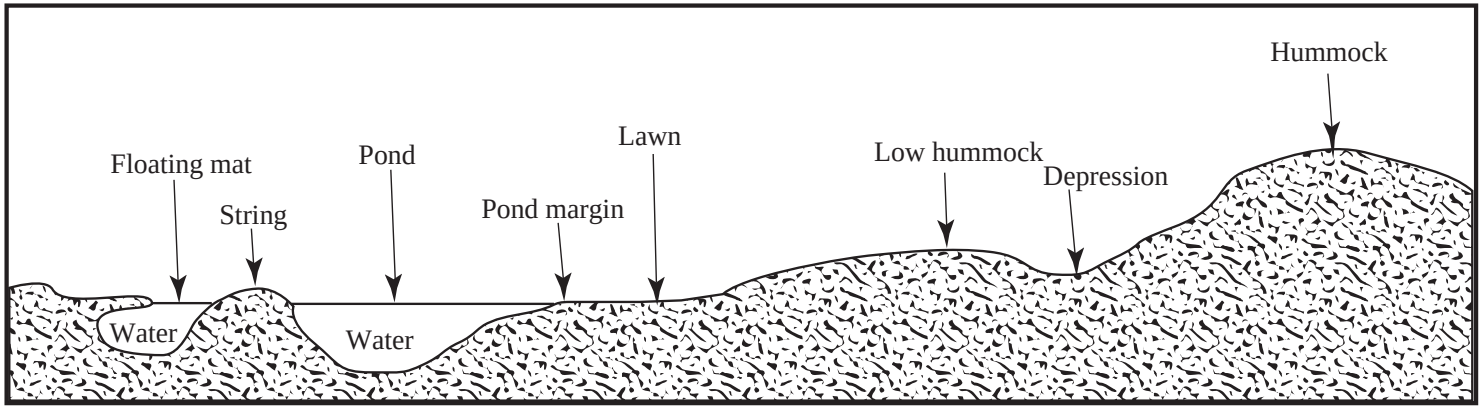

Figure 47. The most frequent biotopes observed in peatlands.