

Sphagnum Species in Northwestern Ontario: A Field Guide to Their Identification

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ABSTRACT

Many species of *Sphagnum* are common and widespread as ground mosses, and they can be very specific in their habitat requirements. *Sphagnum* spp. are especially important elements of the biodiversity of wetland ecosystems in boreal environments. This report provides an overview of 20 *Sphagnum* species known to occur in northwestern Ontario. Included are two identification keys and additional descriptions that summarize each species' general appearance and habitat preferences. The resulting system for identifying *Sphagnum* spp. is intended for use as a field tool, and relies mainly upon easily observed macrofeatures and ecological/habitat characteristics associated with each species.

RÉSUMÉ

De nombreuses espèces de sphaignes communes et très répandues comme mousses au sol peuvent être très spécifiques en ce qui concerne l'habitat. Les sphaignes sont des éléments particulièrement importants de la biodiversité des écosystèmes des milieux humides boréaux. Le rapport passe en revue 20 espèces présentes dans le nord-ouest de l'Ontario. Il présente 2 clés d'identification et des descriptions additionnelles qui résument l'aspect général et les préférences en matière d'habitat de chaque espèce. Ce système d'identification, destiné à être utilisé sur le terrain, repose principalement sur les traits macroscopiques facilement reconnaissables et les caractéristiques écologiques ou particularités de l'habitat de chaque espèce.

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1.0 INTRODUCTION

The field identification of *Sphagnum*¹ species is a source of frustration for many botanists and field naturalists. Comprising one genus and about 150 recognizable species worldwide (Crum 1984, Schofield 1985), the bryophyte family *Sphagnaceae* has developed a (not wholly undeserved) reputation for being taxonomically difficult. Because of the problems these taxa pose for field biologists, it is not uncommon in North America to see *Sphagnum* species omitted from synecological studies or merely denoted as "*Sphagnum* spp."

In spite of this taxonomic dilemma, *Sphagnum* spp. are very important biological components of ecosystems, particularly in lowland boreal habitats where the genus is especially widespread in terms of both numbers of species and areal extent (Crum and Anderson 1981, Clymo and Hayward 1982, McQueen 1990). In many wetland and forested ecosystems, *Sphagnum* spp. are among the most ecologically important vegetation species, especially in terms of total biomass or carbon sequestration (Gorham 1991). They may exist as continuous or broken carpets; raised hummocky or rolling mounds; submerged or floating mats in pools, water-tracks, or lake margins; or isolated patches or individual stems among other bryophytes or ground covers (Figs. 1 to 3; Crum and Anderson 1981, Schofield 1985).

Many *Sphagnum* species are sensitive to certain chemical and physical habitat parameters, and consequently are useful indicators of lowland and boreal environmental conditions. Some species grow submerged or floating in pools of water; others are emergent or partially submerged through the growing season; still others grow only in relatively dry habitats (Jeglum et al. 1974, Vitt et al. 1975, Horton et al. 1979, Andrus et al. 1983, Vitt and Slack 1984, Rydin and McDonald 1985). Some *Sphagnum* spp. are indicators of groundwater nutrient levels, ranges of pH, or the presence of certain minerals, such as calcium (e.g., Heinselman 1963; Sjörs 1963; Clymo 1964; Vitt and Slack 1975, 1984; Euroala et al. 1984; Vitt and Bayley 1984; Glaser et al. 1990).

Sphagnum spp. are capable of exerting considerable influence on their surroundings. They can acidify and chemically modify their surroundings, often retarding decomposition, and imbibe and retain large quantities of water (Clymo 1964, Clymo and Hayward 1982). In northern lowland forests, *Sphagnum* cover may insulate the



Figure 1. *Sphagnum* spp. growing, as part of the ground layer vegetation, along the margins of an open shallow marsh.



Figure 2. Hummock-forming *S. nemoreum* under a black spruce canopy (NWO FEC V-type 34).



Figure 3. *S. wulfianum* growing on rotting wood in an overmature black spruce stand (V-type 35, black spruce-speckled alder-Sphagnum).

¹Nomenclature for *Sphagnum* spp. in this report follows Ireland et al. (1980).

subjacent mineral soil, depress subsurface soil temperatures, and increase soil moisture levels throughout the growing season (Heinselman 1963, Foster 1984, Schofield 1985). Through such properties, *Sphagnum* spp. can sufficiently alter their surroundings so as to control the presence or absence of other plants (Watson 1918, Heinselman 1963, Eurola et al. 1984). *Sphagnum* is a well-known paludifier in cool, humid areas; over time, *Sphagnum* dominated basin wetlands can, to a limited extent, encroach and expand onto adjacent lower slopes (see Crum 1984, Kershaw et al. 1994).

Peat deposits that accumulate from *Sphagnum* spp. over relatively long time frames, often thousands of years, are of considerable economic as well as ecological significance (see Graham 1979). *Sphagnum* dominated peat has been used for centuries as a fuel and energy source, and continues to be in high demand for a range of horticultural and other uses. *Sphagnum* peat also has potential application for the treatment of oil spills and water pollution. *Sphagnum*-rich peatlands are often valued for agricultural conversion although, in their natural state, ecosystems that support *Sphagnum* species provide important habitat for wildlife species as well as a wide range of insect and arthropod taxa (Schofield 1985, Crum 1988).

Given such considerations, it is imperative in any thorough botanical or ecological investigation of boreal sites that individuals accurately recognize and record *Sphagnum* species, along with other commonly occurring taxa. The purpose of this report is to provide some assistance with the field recognition of *Sphagnum* species occurring in northwestern Ontario.

In general, distinguishing among the approximately 20 *Sphagnum* species that occur in northwestern Ontario is not difficult if one looks for key characteristics on fresh material and generally assesses the local habitat where specimens are encountered. With these pieces of information in mind, provisional identifications can be made in the field. Such identifications should be verified later in the laboratory using standard microscopic techniques and more comprehensive morphologically based keys.

2.0 THE NORTHWESTERN ONTARIO STUDY AREA

2.1. General Background

The area of primary focus in this report is the predominantly forested portion of northwestern Ontario located to the north and west of Lake Superior. Geographically, the report area extends from Manitowadge and White River in the east to the Ontario–Manitoba border in the west, and from the Ontario–Minnesota border in the south to just

north of the physiographic limit of the Canadian Precambrian Shield (Figs. 4 and 5). A more detailed description of the area is provided by Sims et al. (1989).

In general, the climate of northwestern Ontario is microthermal (C'21 to C'22) and humid (B'1 to B'3–B'4) (Sanderson 1948). Two broad climatic gradients—temperature and humidity—generally stratify the area. Seasonal temperatures tend to increase with decreasing latitude and are moderated in proximity to Lake Superior (Chapman and Thomas 1968); mean annual temperatures range from 0°C in northern parts of the study area to over +3°C near the United States border in the southwestern corner of northwestern Ontario. Precipitation (and hence humidity) trends from drier conditions in the west to increased moisture in the east (Chapman and Thomas 1968); mean annual precipitation ranges from less than 550 mm in the west to over 800 mm in the east.

The forests of northwestern Ontario consist predominantly of elements of the Boreal Forest Region (Rowe 1972). These include pure or mixed stands of jack pine (*Pinus banksiana* Lamb.), trembling aspen (*Populus tremuloides* Michx.), white birch (*Betula papyrifera* Marsh.), balsam fir (*Abies balsamea* [L.] Mill.), white spruce (*Picea glauca* [Moench] Voss), and black spruce (*Picea mariana* [Mill.] B.S.P.). To the west of Lake Superior, in a zone that extends north of the United States border and into Manitoba, the forests belong to part of the Great Lakes–St. Lawrence Forest Region (Rowe 1972). Here, mixedwood stands are more extensive, scattered stands of red pine (*Pinus resinosa* Ait.) and eastern white pine (*Pinus strobus* L.) occur, and a variety of other tree species that are not found in the Boreal Forest Region to the north are encountered.

With the exception of a zone of strongly broken topography along the Lake Superior coast, northwestern Ontario is characterized by an undulating, bedrock dominated terrain. Surficial landform features generally reflect the effects of four major glaciations, the last ending approximately 10 000 to 8 000 years ago (Zoltai 1965, 1967; Sims and Baldwin 1991). The most commonly occurring glacial deposit is a shallow, bouldery, sandy or coarse loamy till (Sado and Carswell 1987), which typically reveals the topographic character of the underlying Shield bedrock. A finer-textured till, derived from the carbonate bedrock of the Hudson Bay Lowland and spread southward onto the Shield by moving ice, occurs within discrete dispersion trains and locally thin smears. Ice-contact and outwash glaciofluvial deposits, consisting of sorted sands and gravels, are found throughout the area. These deposits, including features such as eskers, kames, kame moraines and deltas, are among the most prominent landforms in northwestern Ontario. Numerous glacial lakes (including

Lake Agassiz), which historically inundated much of northwestern Ontario, deposited a range of materials including beach and near-shore sand deposits as well as deeper basin silts and clays. These glaciolacustrine deposits are frequently in close proximity to glaciofluvial landforms. Aeolian deposits occur throughout northwestern Ontario, although with restricted spatial distribution. Typically sandy in nature, these materials tend to be associated with both glaciofluvial and glaciolacustrine landforms.

2.2. *Sphagnum* spp. Habitats in Northwestern Ontario

In northwestern Ontario, *Sphagnum* spp. are most commonly encountered in low lying wetland ecosystems, often on organic deposits. Organic deposits range considerably in their extent, depth, general physiognomy, and soil/site associations in northwestern Ontario. Generally, organic deposits occur as fens, bogs, marshes, or swamps (Table 1; following wetland definitions provided by Jeglum et al. 1974), but are usually of limited areal extent. Peatlands, characterized by a peat accumulation of at least 40 cm (Canada Soil Survey Committee 1978), occupy

poorly drained bedrock depressions and lower landscape positions or, less frequently, they overlie fine-textured (silt and clay), low relief glaciolacustrine basins. The areal extent of wetlands in the report area has not been determined with any degree of precision, but is estimated to be between 5 percent and 25 percent of the total area (Environment Canada 1981, Zoltai et al. 1988).

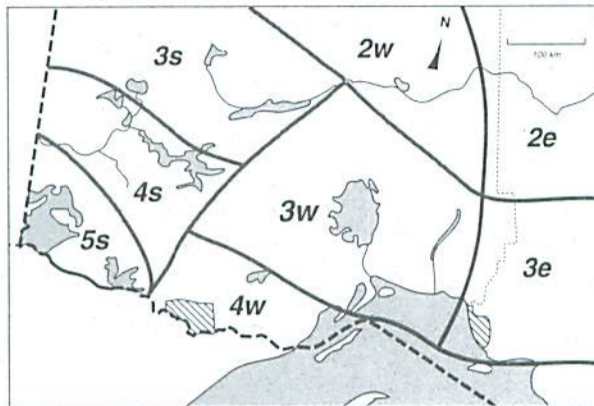


Figure 4. Map of the northwestern Ontario report area showing site regions (after Hills 1961).

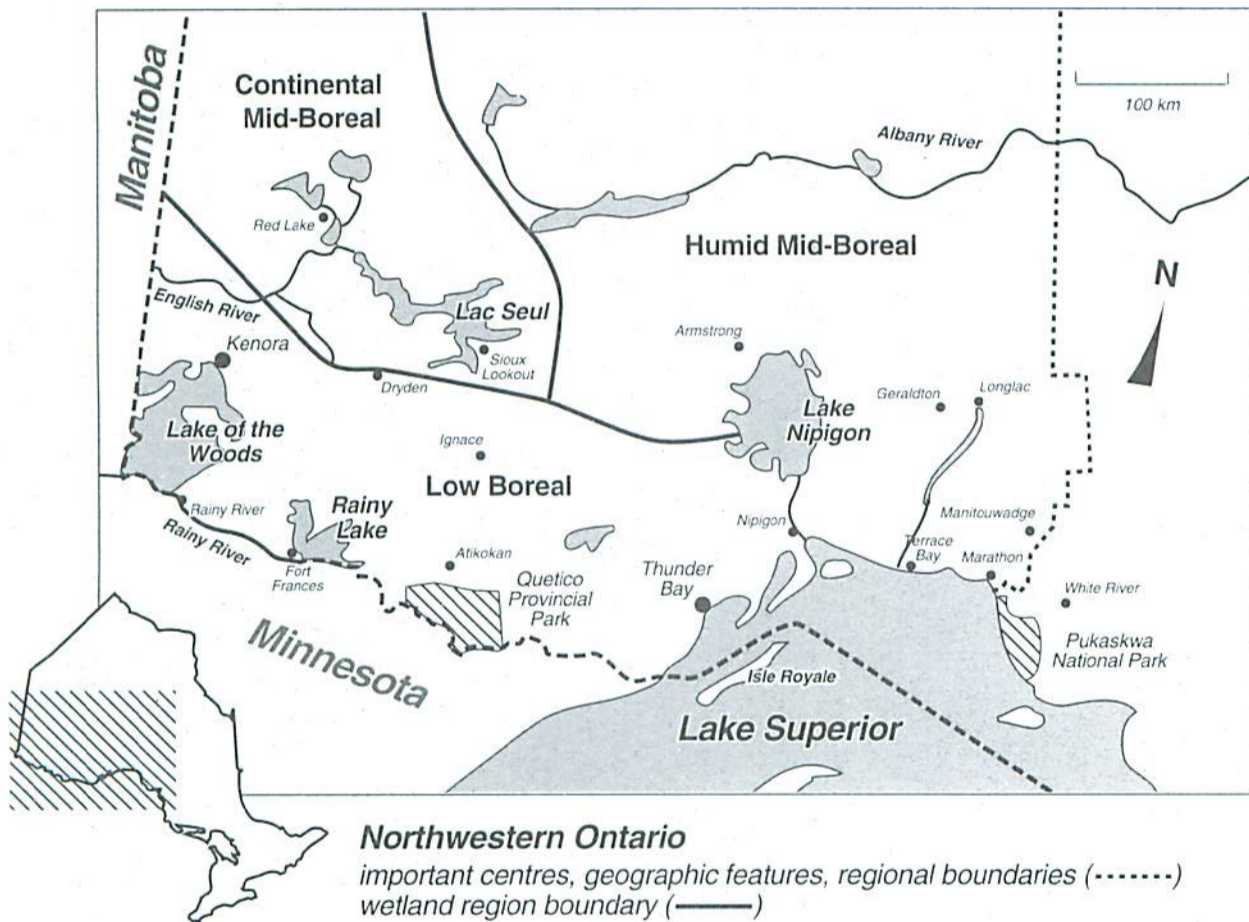


Figure 5. Map of the northwestern Ontario report area showing important centers, geographic features, political and administrative boundaries (.....), and wetland regions (——) (after Environment Canada 1981).

Table 1. Distinguishing characteristics among four main wetland classes in Ontario (after Jeglum et al. 1974, Environment Canada 1981).

	Bog	Fen	Marsh	Swamp
Peatland vs mineral soil wetland	Peatland	Peatland	Mineral soil wetland	Mineral soil wetland or peatland
Water table	At or near the surface	At or above the surface	Periodic inundation by standing or slowly moving waters	Standing or very gently flowing waters occurring in pools or channels
Nutrient and acid/base status	Poor, acidic, ombrotrophic	Poor to rich, acidic to basic, minerotrophic	Generally intermediate to very rich, often circumneutral to basic, minerotrophic	Generally intermediate to very rich, acidic to basic, minerotrophic
Terrain surface appearance	Level, gently sloping or domed, and often with raised-surface <i>Sphagnum</i> spp. hummocks and damp or wet hollows	Flat or sloping, and frequently patterned (e.g., ribbed)	Flat, sloping or dissected ground surface, often with a mosaic of pools/channels, and frequently submerged	Generally flat or sloping, sometimes hummocky
Typical peat depths	Variable thickness, but ≥ 40 cm deep peats, and frequently much deeper (e.g., > 1.5 m)	Variable thickness, but ≥ 40 cm deep peats, and sometimes much deeper (e.g., > 1.5 m)	Mineral soils, but occasionally with thin peat accumulations (≤ 40 cm)	Mineral soils, but often with thin peat accumulations (≤ 40 cm)
Commonly associated soils ¹	Mainly Fibrisols, Mesisols, or Organic Cryosols	Mainly Mesisols, Humisols, or Organic Cryosols	Mainly Gleysols, and sometimes Humisols and Mesisols	Mainly Mesisols, Humisols, and Gleysols
Commonly associated vegetation	Treed or treeless, usually covered with <i>Sphagnum</i> spp. and ericaceous shrubs	Dominantly sedges, grasses, reeds, and brown mosses, with some shrub cover and, at times, a sparse tree layer	A mosaic of emergent sedges, grasses, rushes, and reeds (lower locations), bordering grassy meadows and peripheral bands of shrubs and/or trees (raised locations)	Dense tree or shrub cover of deciduous or coniferous species, herbs, and some mosses

¹Naming conventions after the Canada Soil Survey Committee (1978).

Vegetation communities associated with *Sphagnum* spp. include virtually all treed and non-treed wetland communities as well as upland forest associations and, occasionally, aquatic vegetation communities. *Sphagnum* spp. occur commonly in association with such woody species as black spruce, eastern white cedar (*Thuja occidentalis* L.), larch (*Larix laricina* [Du Roi] K. Koch), speckled alder (*Alnus rugosa* [Du Roi] Spreng.), leather leaf (*Chamaedaphne calyculata* [L.] Moench), Labrador tea (*Ledum groenlandicum* Oeder), swamp birch (*Betula pumila* L.), *Salix* spp., and small cranberry (*Oxycoccus microcarpus* Turcz.). Graminoid genera, such as *Carex*, *Eriophorum*, *Scirpus*, *Calamagrostis*, *Glyceria*, and *Juncus*, are well represented in the flora of northwestern Ontario wetlands. Other bryophyte species, such as ribbed bog moss (*Aulacomnium palustre* [Hedw.] Schwaegr.), broom moss (*Dicranum polysetum* Sw.), Schreber's moss (*Pleurozium schreberi* [Brid.] Mitt.), *Mnium* spp., fern moss (*Thuidium delicatulum* [Hedw.] B.S.G.), *Polytrichum* spp., and shaggy moss (*Rhytidiadelphus triquetrus* [Hedw.] Warnst.), are common associates of *Sphagnum* spp. in northwestern Ontario.

Northwestern Ontario belongs, except in the far north, to the Low Boreal Wetland Region (Fig. 5, Environment Canada 1981), which is characterized by bowl bogs. These are treed and often surrounded by peat margin swamps, and by fen, swamp, and shallow or deep marsh wetlands that tend to have shallow to moderately deep peat accumulations. The northern portions of the report area belong to the Continental Mid-Boreal Wetland Region (Environment Canada 1981), which is characterized by an increasing occurrence, relative to the Low Boreal Wetland Region, of more extensive flat and basin bogs along with horizontal and ribbed fens, but still with shallow to intermediate peat depths. A more comprehensive and detailed inventory and classification of wetland types in northwestern Ontario, including a quantitative treatment of vegetational and soil/site features, is provided by Harris et al. 1996.

2.3. Forest Operations and *Sphagnum* spp. in Northwestern Ontario

The effects of forest harvesting operations on *Sphagnum* spp. within northwestern Ontario may be quite variable from location to location. Removal of the tree canopy in *Sphagnum*-dominated peatlands invariably results in an altered water budget. Often the surface layer (of the forest floor) dries, potentially leading to high *Sphagnum* mortality, particularly for those species that require partial or full shade. However, surface soil moisture may sometimes increase due to compaction effects or a raised or impounded water table, and this may serve to accelerate the expansion or invasion of certain *Sphagnum* spp. (Jeglum 1984, Jeglum and Kennington 1993, Kershaw et al. 1994).

Harvesting operations frequently result in significant quantities of residual slash and litter on a site. This can substantially reduce *Sphagnum* cover and, consequently, the amount of seedbed that may be available for black spruce. In general, conifer reproduction and survival on *Sphagnum* is greater than that on drier seedbeds composed of feathermoss and other organic materials (Vincent 1965, Jeglum 1979, Kershaw et al. 1994).

Artificial reforestation of *Sphagnum*-dominated sites is a common practice within the report area. Planting and aerial seeding of black spruce, and preservation of advance regeneration by careful logging, are frequently employed techniques. Some *Sphagnum* spp. provide a favorable medium for black spruce germination because of their ability to retain moisture after overstory removal (Haavisto 1979). Some faster-growing *Sphagnum* spp. may smother young tree seedlings and cause mortality. The low nutrient status of sites supporting most *Sphagnum* spp. may serve to impede seedling growth over the medium to long term (Jeglum 1981, 1984). Nonetheless, *Sphagnum* spp., especially compact mat-forming species, are generally considered to create good seedbeds for black spruce regeneration (Jeglum 1984, Jeglum and Kennington 1993). Extensive *Sphagnum* cover in black spruce lowland sites in northwestern Ontario encourages the development of layering and adventitious root development (Wickware et al. 1990, Sims and Walsh 1995). The regeneration practice of winter shearblading is sometimes recommended in more extensive, rich wetlands where speckled alder is abundant and the *Sphagnum* is loose and fast growing (Jeglum et al. 1983, Jeglum and Kennington 1993). The technique provides better seedbeds (exposed flat *Sphagnum* moss surfaces) for black spruce and lowers competition for new seedlings, but it also destroys any black spruce advance growth that may be present on a site.

Although not an intentional objective of reforestation efforts in northwestern Ontario, ensuring rapid black spruce seedling growth immediately following harvesting may in fact serve to minimize the deterioration of a *Sphagnum* ground cover (Jeglum 1984, Jeglum and Kennington 1993). Postlogging succession on black spruce peatlands often results in *Sphagnum* spp. becoming reestablished relatively quickly, especially where the underlying decomposed peat layer is thin (Vincent 1965, Kershaw et al. 1994). Small cushions appear first in wet depressions and, within about 2 years, larger areas may be colonized, often competing with black spruce seedlings (Vincent 1965). Prescribed burns on harvested sites may remove slash and kill fast-growing *Sphagnum* spp.; mortality is related directly to burn intensity, season of burn, and certain microsite conditions. An early spring surface burn will not greatly reduce *Sphagnum* spp., but a hot summer burn may lead to high mortality (Haavisto and Jeglum

1978, Jeglum and Kennington 1993, Kershaw et al. 1994). Mechanical site preparation may greatly reduce the abundance and cover of *Sphagnum* spp.; in particular, wetting/drying cycles combined with surface weathering following scarification may lead to the formation of hard, crusty surfaces on exposed raw humus and mineral soil materials that are unfavorable for the establishment of *Sphagnum* spp. (Haavisto 1979, Jeglum and Kennington 1993). Within northwestern Ontario, herbicide treatments are uncommon on *Sphagnum*-dominated sites (Kershaw et al. 1994).

3.0 SPHAGNUM SPP. MOSSES IN NORTHWESTERN ONTARIO

3.1. General

Of the 25 *Sphagnum* species reported to occur in Ontario by Ireland and Cain (1975), 20 are present within the northwestern Ontario report area, according to herbaria distribution records. The 20 species listed for northwestern Ontario have broad distributional tendencies; all have been collected elsewhere in Ontario (Ireland and Cain 1975) and are known to occur in northern Michigan (Crum 1983). Most are recorded from the Maritime provinces (Ireland 1982, Ireland et al. 1987) and the west coast of Canada (Vitt and Andrus 1977, Ireland et al. 1987). General habitats and sociabilities of these 20 species are summarized, along with other information, in Table 2.

Many individuals feel more comfortable using common names for species. While this practice is discouraged by scientists because common names tend to proliferate and change, a list of "suitable" common names for the 20 *Sphagnum* spp. considered in this report has been provided (see Section 6). Some of these common names are literal translations from Finnish names for the same species. Nomenclatural authorities and some of the most commonly encountered synonyms are also provided as part of the individual species' descriptions (Sections 6.1 to 6.20).

Throughout this report, an attempt has been made to minimize the use of specialized taxonomic and other scientific terms. In spite of this effort, it has been necessary to employ a number of scientific terms that are commonly used when describing the appearances, structures/features, habitats, growth forms, and site conditions associated with *Sphagnum* spp. A glossary of these commonly used terms is provided in Section 8.

While the treatment here is limited to these 20 species, the field botanist should always be on the lookout for others that may occur in the region, especially given that several species have general geographic ranges that include parts of northwestern Ontario. One such taxon is *S. papillosum* Lindb., and both Crum (1983) and Ireland et al. (1987)

indicate that this distinctive species (because it has small papillae [bumps] on the branch leaves) may be encountered within bogs and fens in the Great Lakes Region of Ontario. The current field keys should be relatively easy to use and will invariably get the practitioner to an endpoint, but new taxa—those not included in the key—that don't quite fit could get passed over, so beware.

3.2. *Sphagnum* spp. in the Context of the Northwestern Ontario Forest Ecosystem Classification (NWO FEC)

The Northwestern Ontario Forest Ecosystem Classification (NWO FEC) (Sims et al. 1989) is a site classification system that incorporates information about understory and overstory vegetation into definitions of 38 vegetation types (Table 3). The NWO FEC was developed using site data collected and analyzed from over 2 100 forest stands throughout northwestern Ontario. One of the ancillary benefits of this extensive sampling effort has been the availability of detailed autecological information about numerous plant species in northwestern Ontario, including the most common forest-dwelling *Sphagnum* spp. Only stands that were representative of mature forest conditions were selected for inclusion in the NWO FEC sample, so *Sphagnum* spp. were recorded only in mature, forested habitats; species of non-treed, wetland habitats (where *Sphagnum* spp. are often found in abundance) are not represented in this dataset.

According to the NWO FEC dataset, northwestern Ontario forest habitats where *Sphagnum* species frequently occur in abundance include treed fens and bogs (V23, V36, V37, V38); cedar (V22), black ash (*Fraxinus nigra* Marsh., V2), and black spruce (V35) swamps; and toe-slope locations of upland forest types (V4, V19, V20, V31, V32, V33, V34). The most commonly encountered *Sphagnum* species in the NWO FEC dataset were: *S. nemoreum*, *S. girgensohnii*, *S. magellanicum*, *S. angustifolium*, *S. wulfianum*, *S. fuscum*, *S. russowii*, and *S. warnstorffii*. For these species, selected habitat information from the NWO FEC is summarized in Table 4 and Figure 6.

The NWO FEC vegetation type ordination diagram (Sims et al. 1989) is overlain with the percent frequency occurrence for these common *Sphagnum* spp. in Figure 6. The ordination diagram incorporates abundance information for all vegetation species recorded in NWO FEC field plots. Each of the 38 plotted points (V1–V38) in the ordination diagram represents an average vegetational composition for a V-type, such that V-types that are close together (e.g., V20 and V33) are more similar in terms of their vegetational characteristics than are those which are farther apart (e.g., V27 and V2). The ordination diagram effectively relates V-types according to general patterns

of soil moisture (vertical axis) and nutrient status (horizontal axis). Information about the percentage occurrence of individual *Sphagnum* species is overlain onto the ordination diagram (see Fig. 6a to 6h) according to methods described by Baldwin and Sims (1989) and Kershaw et al. (1994). Hatched areas on each habitat diagram show the V-types where a given species occurred in at least 10 percent of the NWO FEC samples. (Note, however, that the diagrams in Figure 6 do not provide information on levels of abundance.)

4.0 MORPHOLOGICAL CHARACTERISTICS OF *SPHAGNUM* SPP.

A typical *Sphagnum* spp. plant consists of an erect or ascending stem with leafy, lateral branches and a terminal growing point. An "individual plant" includes both growing and decadent portions of the stem with all attached branches, the terminal head, and any attached reproductive structures. Sometimes an individual plant will vegetatively divide into two or more stems, each of which supports branches and a terminal head.

The stem comprises compact central tissue (small thin-walled cells) surrounded by thick-walled cortical cells (the "sclerodermis" or stem wood cylinder). The cortex is coated by a layer of hyaline tissue known as the stem "hyalodermis", which in most *Sphagnum* species (e.g., *S. palustre*) is easily removed.

Stem growth is from a central terminal bud or buds that may or may not be prominent or distinguishable when viewed from above. The terminal bud(s), along with numerous maturing branches grouped tightly together at the apex of the stem, forms the characteristic *Sphagnum* head or "capitulum" of the plant (Figs. 7 to 10). In some species the head is large, well developed, and almost spherical in shape (e.g., *S. wulfianum*); in other species (e.g., *S. russowii*) it is flat-topped and small.

Stem leaves and branches are borne along the stem (see Figs. 7 to 10). The stems of *Sphagnum* spp. are capable of indefinite growth and frequently split and grow dichotomously. The branches are of limited growth and originate several together on the stem in groups called "fascicles" (see Figs. 7 to 10). As stem elongation takes place, fascicles of branches are progressively separated. Each fascicle typically consists of two to four (occasionally up to eight) spreading branches and one to three (sometimes up to four) hanging or pendent branches. Branches support branch leaves that are almost always different in form from the stem leaves.

Sphagnum spp. are either dioecious or monoecious, with male and female structures always developing on separate branches. Spores are explosively discharged from mature capsules borne on elongated fruiting branches. Sporophyte production is not uncommon in some species (e.g., *S. fimbriatum*); however, *Sphagnum* reproduction in northern habitats occurs overwhelmingly by vegetative processes (Lane 1977, Lange 1982).

For detailed treatments of the morphological features of *Sphagnum* spp. and their taxonomic significance, the reader is referred to Vitt and Andrus (1977), Ireland (1982), Crum (1983, 1984), and Schofield (1985).

5.0 *SPHAGNUM* SPP. IDENTIFICATION KEYS

5.1. General

Many keys and lists of descriptive features have been published to aid in differentiating the various species of *Sphagnum*. Valuable treatments are provided in a number of recent moss floras (see Conard 1956; Nyholm 1969; Crum and Anderson 1981; Ireland 1982; Crum 1983, 1984, 1988; Ireland and Bellolio-Trucco 1987).

Many *Sphagnum* species have broad ranges of expression within certain morphological features, often as a result of environmental influences. Plant color, for example, in many *Sphagnum* species is affected by the degree of shading at a site, or by other environmental conditions. Fearnside's (1938) noted that while a broad range of colors, ranging from white to dark purple, is exhibited by the genus, green specimens of almost every *Sphagnum* spp. are known. Hence, while color can be a useful criterion for generally separating taxa, it must be used very carefully because of the variability of this character throughout the genus. Characteristics of sporangia or sexual organs are best avoided in most *Sphagnum* keys because sterile specimens are so common.

Often, *Sphagnum* taxonomic keys require the preparation of stained stem and/or leaf sections and the use of a medium-powered (150X) compound microscope to observe fine details of leaf cells (shapes of alar cell walls, presence of fibrils or pores, etc.) and other microstructures (Andrews 1913; Fearnside's 1938; Proctor 1955; Abramova et al. 1961; Duncan 1965; Andrus 1980, 1986). Lange (1982) developed a dichotomous key to the boreal and arctic species of *Sphagnum* in which she mainly used macrofeatures of the stem leaves, primarily leaf shape and size. However, there are still some requirements for microscopic examination of leaf cells in several parts of the key. Sjörs², who prepared a similar key for northern

² Sjörs, H. 1966. A key to the northern *Sphagna*. Unpublished report. 14 p.

Table 2. Habitat and sociability of *Sphagnum* spp. found in northwestern Ontario. Sociability of *Sphagnum* spp. is based mostly on field observations by the authors.

Species	Distribution ⁴	Trophy ¹				Water table ²			Light ³		
		1	2	3	4	Hummock	Intermediate	Flark	Light	Moderate shade	Much shade
<i>S. angustifolium</i>	CB	x	x	(x)		x	x		x	x	
<i>S. centrale</i>	CP			x	x	(x)	x			(x)	x
<i>S. compactum</i>	CP	(x)	x				x				
<i>S. cuspidatum</i>	CP	x	(x)					x	x	(x)	
<i>S. fimbriatum</i>	CP	(x)	x	(x)		(x)	x		x	x	
<i>S. fuscum</i>	CP	x	x			x					
<i>S. girgensohnii</i>	CP			x		x	x				
<i>S. magellanicum</i>	CP	x	x			x	x		x	x	(x)
<i>S. nemoreum</i>	CP	x	x			x			x	x	x
<i>S. palustre</i>	CP	x	x				x	x		x	x
<i>S. quinquefarium</i>	CB		x	x		x	x				
<i>S. rubellum</i>	CB	x	x			x	x				
<i>S. russowii</i>	CB	x	x			x					
<i>S. squarrosum</i>	CP			x			x			x	x
<i>S. subnitens</i>	CP		x	x			x		x	x	(x)
<i>S. subsecundum</i>	CB			x	x		x	x	x	(x)	
<i>S. tenerum</i>	east NA		x	(x)		x	x		x	x	
<i>S. teres</i>	CP			x	x		x		x	x	x
<i>S. warnstorffii</i>	CP			(x)	x		x		x	x	
<i>S. wulfianum</i>	CB			x		x	x			x	x

¹ Levels of trophic (nutrient status) correspond to those of the Finnish mire classification system (Eurola et al. 1984): 1 - ombrotrophic (nutrient poor), 2 - oligotrophic (intermediate), 3 - mesotrophic (rich), 4 - entrophic (very rich). Parentheses (e.g., (x)) indicate a less preferred condition.

² Typical locations of the species with respect to prevailing water table (after Eurola et al. 1984).

³ Normal ranges of light tolerance for the species.

Other sources: Nyholm (1969), Vitt and Andrus (1977), Horton et al. (1979), Crum and Anderson (1981), Ireland (1982), Lange (1982), Euroala et al. (1984), Vitt and Slack (1984).

Typical moisture status of habitat	Acid/base preferences ⁵	Common <i>Sphagna</i> associates	Typical habitats ⁶
Moist to wet	Moderately acidic	<i>russowii</i> , <i>magellanicum</i> , <i>teres</i> , <i>girgensohnii</i>	Fens, especially fens; around pools, lakes, streams black spruce peatlands
Moist to wet	Moderately acidic to basic	<i>magellanicum</i> , <i>palustre</i> , <i>nemoreum</i>	Rich fens, cedar swamps, shaded margins of rich peatlands or moist conifer forests, ditches, depressions
Moist to wet	Acidic	<i>fuscum</i> , <i>nemoreum</i> , <i>subsecundum</i>	Open fens; wet drainage ditches; especially on sandy, wet soil; occasionally in damp, rocky crevices
Wet	Moderately acidic	<i>angustifolium</i> , <i>magellanicum</i>	Submerged in pools and depressions in bogs and poor fens, and along margins of (acid) lakes
Moist	Acidic	<i>russowii</i> , <i>palustre</i>	Open fens; wet drainage ditches; especially on sandy, wet soil; occasionally in damp, rocky crevices
Dry to moist	Acidic	<i>magellanicum</i> , <i>rubellum</i> , <i>nemoreum</i> , <i>angustifolium</i> , <i>compactum</i>	Open and semi-shaded bogs; black spruce peatlands
Moist to wet	Basic to moderately acidic	<i>russowii</i> , <i>angustifolium</i> , <i>squarrosum</i> , <i>warnstorffii</i> , <i>teres</i> , <i>quinquefarium</i>	Shaded coniferous woods, cedar swamps; wet depressions in woods; lake and river margins
Moist to wet	Acidic	<i>fuscum</i> , <i>rubellum</i> , <i>angustifolium</i>	Open and wooded peatlands, especially bogs; sometimes a pioneer species in wet habitats (e.g., swamp margins)
Dry to moist	Acidic	<i>angustifolium</i> , <i>fuscum</i> , <i>russowii</i> , <i>compactum</i> , <i>quinquefarium</i>	Bogs and fens; wet depressions; on humus and wet rocks in shaded coniferous woods; black spruce peatlands
Moist to wet	Moderately acidic to acidic	<i>squarrosum</i> , <i>nemoreum</i>	Margins of bogs and fens, usually in the shade; swamps and shaded coniferous woods
Dry to moist	Moderately acidic	<i>nemoreum</i> , <i>russowii</i> , <i>girgensohnii</i>	Coniferous woods on humus or peat; moist rock crevices or sloping ground in forests
Moist to wet	Moderately acidic to acidic	<i>fuscum</i> , <i>magellanicum</i>	Open peatlands, especially bogs; wet depressions in coniferous woods
Moist to wet	Acidic	<i>girgensohnii</i> , <i>angustifolium</i> , <i>magellanicum</i>	Coniferous woods on humus; bogs, fens, and swamps especially in ecotonal or marginal areas
Moist to wet	Basic to moderately acidic	<i>girgensohnii</i> , <i>teres</i> , <i>palustre</i>	Less acidic, coniferous woods in wet depressions, especially in areas seasonally or occasionally flooded; cedar swamps; stream margins
Moist to wet	Moderately acidic	<i>warnstorffii</i> , <i>nemoreum</i> , <i>teres</i>	Open and treed fens, alder thickets, and conifer-dominated moist to wet forests
Wet	Moderately acidic	<i>teres</i> , <i>warnstorffii</i> , <i>angustifolium</i>	Open fens and wet sedge meadows; along (circumneutral) lakes and drainageways; alder thickets; an early successional species in open wetlands
Moist to wet	Moderately acidic	<i>nemoreum</i> , <i>girgensohnii</i>	Open or shaded poor fens, treed peatlands, margins of ponds or drainageways, also, roadside ditches, wet sand, and bedrock slopes
Wet	Basic to moderately acidic	<i>warnstorffii</i> , <i>squarrosum</i> , <i>girgensohnii</i>	Wooded or open rich fens; willow or alder thickets; lake margins; cedar swamps
Moist to wet	Basic	<i>teres</i> , <i>fuscum</i> , <i>subsecundum</i> , <i>girgensohnii</i>	Open or wooded rich fens; cedar and other conifer swamps
Dry to moist	Moderately acidic	<i>girgensohnii</i> , <i>russowii</i> , <i>nemoreum</i>	On humus in shaded coniferous woods especially on mounds or ridges corresponding to stumps or logs in advanced decay; along bog margins; cedar swamps

⁴ CB - circumboreal, CP - circumpolar.

⁵ Only general pH ranges can be assigned: basic - pH 7.0, moderately acidic - pH 5.0–7.0, acidic - pH 5.0.

⁶ Wetland terminology follows Jeglum et al. (1974). 'Coniferous woods' refers to sites overlying mineral soils; coniferous woods supporting *Sphagnum* species are relatively moist to wet sites with perhaps some peat accumulations.

Table 3. Vegetation types of the Northwestern Ontario Forest Ecosystem Classification (NWO FEC) (after Sims et al. 1989).

V1	Balsam Poplar Hardwood and Mixedwood
V2	Black Ash Hardwood and Mixedwood
V3	Other Hardwoods and Mixedwoods
V4	White Birch Hardwood and Mixedwood
V5	Aspen Hardwood
V6	Trembling Aspen (White Birch)–Balsam Fir/Mountain Maple
V7	Trembling Aspen–Balsam Fir/Balsam Fir Shrub
V8	Trembling Aspen (White Birch)/Mountain Maple
V9	Trembling Aspen Mixedwood
V10	Trembling Aspen–Black Spruce–Jack Pine/Low Shrub
V11	Trembling Aspen–Conifer/Blueberry/Feathermoss
V12	White Pine Mixedwood
V13	Red Pine Mixedwood
V14	Balsam Fir Mixedwood
V15	White Spruce Mixedwood
V16	Balsam Fir–White Spruce Mixedwood/Feathermoss
V17	Jack Pine Mixedwood/Shrub Rich
V18	Jack Pine Mixedwood/Feathermoss
V19	Black Spruce Mixedwood/Herb Rich
V20	Black Spruce Mixedwood/Feathermoss
V21	Cedar (including Mixedwood)/Mountain Maple
V22	Cedar (including Mixedwood)/Speckled Alder/ <i>Sphagnum</i>
V23	Tamarack (Black Spruce)/Speckled Alder/Labrador Tea
V24	White Spruce–Balsam Fir/Shrub Rich
V25	White Spruce–Balsam Fir/Feathermoss
V26	White Pine Conifer
V27	Red Pine Conifer
V28	Jack Pine/Low Shrub
V29	Jack Pine/Ericaceous Shrub/Feathermoss
V30	Jack Pine–Black Spruce/Blueberry/Lichen
V31	Black Spruce–Jack Pine/Tall Shrub/Feathermoss
V32	Jack Pine–Black Spruce/Ericaceous Shrub/Feathermoss
V33	Black Spruce/Feathermoss
V34	Black Spruce/Labrador Tea/Feathermoss (<i>Sphagnum</i>)
V35	Black Spruce/Speckled Alder/ <i>Sphagnum</i>
V36	Black Spruce/Bunchberry/ <i>Sphagnum</i> (Feathermoss)
V37	Black Spruce/Ericaceous Shrub/ <i>Sphagnum</i>
V38	Black Spruce/Leatherleaf/ <i>Sphagnum</i>



Table 4. Summaries of NWO FEC vegetation types, soil types, and soil/site features according to eight common forest-dwelling *Sphagnum* species in northwestern Ontario. For each feature, commonly associated conditions are listed in decreasing order of percent frequency (percent of total occurrence) for each of the *Sphagnum* species. Superscript numbers are percent frequency classes where 1 = 10–15 percent, 2 = 16–25 percent, 3 = 26–35 percent, etc.

<i>Sphagnum</i> species	Percent frequency of total NWO FEC sample ^a	NWO FEC vegetation types ^b	NWO FEC soil types ^b	Forest humus forms ^c	Soil moisture regime/soil drainage classes ^c	Organic (O) or thickness ranges (cm) of LFH layer	Slope position classes ^c
<i>Sphagnum angustifolium</i>	6.0	V37 ³ , V34 ² , V36 ¹ , V35 ¹ , other ³	S12S ⁵ , S12F ¹ , other ³	fpmor ⁵ , fmor ² , mpmor ¹ , other ²	W ⁶ , M ² , F-D ² /VP ⁶ , P ² , W-R ²	O ⁶ , 16–25 ¹ , 6–15 ¹ , other ²	level ⁵ , depr ² , toe ¹ , other ²
<i>Sphagnum fuscum</i>	4.5	V37 ² , V38 ² , V36 ² , V34 ¹ , V35 ¹ , other ²	S12S ⁶ , other ⁴	fpmor ⁷ , other ³	W ⁶ , M ³ , F-D ¹ /VP ⁷ , P ² , W-R ¹	O ⁶ , 6–15 ¹ , other ³	level ⁶ , depr ³ , other ¹
<i>Sphagnum girgensohnii</i>	14.0	V34 ² , V37 ¹ , V36 ¹ , V35 ¹ , other ³	S12S ⁴ , S12F ² , other ⁴	fpmor ⁵ , fmor ² , other ³	W ⁴ , M ⁴ , F-D ² /VP ⁵ , P ³ , W-R ²	O ⁵ , 16–25 ¹ , other ⁴	level ⁵ , depr ² , other ³
<i>Sphagnum magellanicum</i>	8.5	V37 ² , V36 ² , V35 ¹ , V34 ¹ , other ⁴	S12S ⁵ , S12F ² , other ³	fpmor ⁶ , mpmor ² , other ²	W ⁶ , M ³ , F-D ¹ /VP ⁷ , P ² , W-R ¹	O ⁷ , 6–15 ¹ , other ²	level ⁶ , depr ³ , other ¹
<i>Sphagnum nemoreum</i>	17.5	V34 ² , V37 ¹ , V33 ¹ , V36 ¹ , other ³	S12S ³ , S12F ² , other ⁵	fpmor ⁴ , fmor ² , hfemor ¹ , other ³	M ⁴ , W ⁴ , F-D ² /VP ⁴ , P ³ , W-R ¹	O ⁴ , 6–15 ² , 16–25 ² , 26–39 ¹ , other ¹	level ⁵ , depr ² , mid ¹ , other ²
<i>Sphagnum russowii</i>	3.1	V34 ² , V37 ² , V35 ¹ , other ⁵	S12S ³ , S12F ² , S8 ¹ , other ⁴	fpmor ⁵ , fmor ² , hfemor ¹ , mpmor ¹ , other ¹	M ⁵ , W ³ , F-D ² /VP ⁵ , P ³ , W-R ¹	O ⁵ , 16–25 ² , 6–15 ² , 26–40 ¹	level ⁵ , depr ² , mid ¹ , other ²
<i>Sphagnum warnstorffii</i>	2.5	V34 ² , V36 ¹ , V20 ¹ , V33 ¹ , other ³	S12S ² , S12F ² , S8 ¹ , other ⁵	fpmor ³ , hfemor ³ , mpmor ² , fmor ¹ , other ¹	M ⁵ , W ³ , F-D ¹ /VP ⁴ , P ⁴ , W-R ¹	O ⁵ , 6–15 ³ , 16–25 ¹ , 26–39 ¹	level ⁶ , mid ² , other ²
<i>Sphagnum wulfianum</i>	5.5	V34 ² , V36 ² , V35 ² , V37 ² , other ²	S12S ³ , S12F ² , S8 ¹ , other ⁴	fpmor ⁵ , fmor ² , hfemor ¹ , other ²	M ⁴ , W ⁴ , F-D ¹ /VP ⁵ , P ⁴ , W-R ¹	O ⁵ , 6–15 ³ , 16–25 ¹ , other ¹	level ⁵ , depr ² , toe ¹ , other ²

^a Based upon a total of 2 167 NWO FEC (10-m X 10-m) plots established in mature forest stands throughout northwestern Ontario during 1983–1989.

^b Refer to Table 3 for naming conventions of NWO FEC vegetation types; **Soil types:** S12S - Wet organic [*Sphagnum*] soil, S12F - Wet organic [Feathermoss] soil, S8 - Moist/coarse loamy deep mineral soil.

^c Conventions and classes for soil and site variables follow Sims et al. (1989). Abbreviations included in the table are: **forest humus forms:** fmor - fibrimor, hfemor - humifibrimor, fpmor - fibric peatymor, mpmor - mesic peatymor; **soil moisture regime class:** W - wet, M - moist, F-D - fresh to dry; **soil drainage class:** VP - very poor, P - poor, W-R - well to rapid; **slope position class:** level - flat surface, depr - depression, mid - middle slope, toe - toe slope.

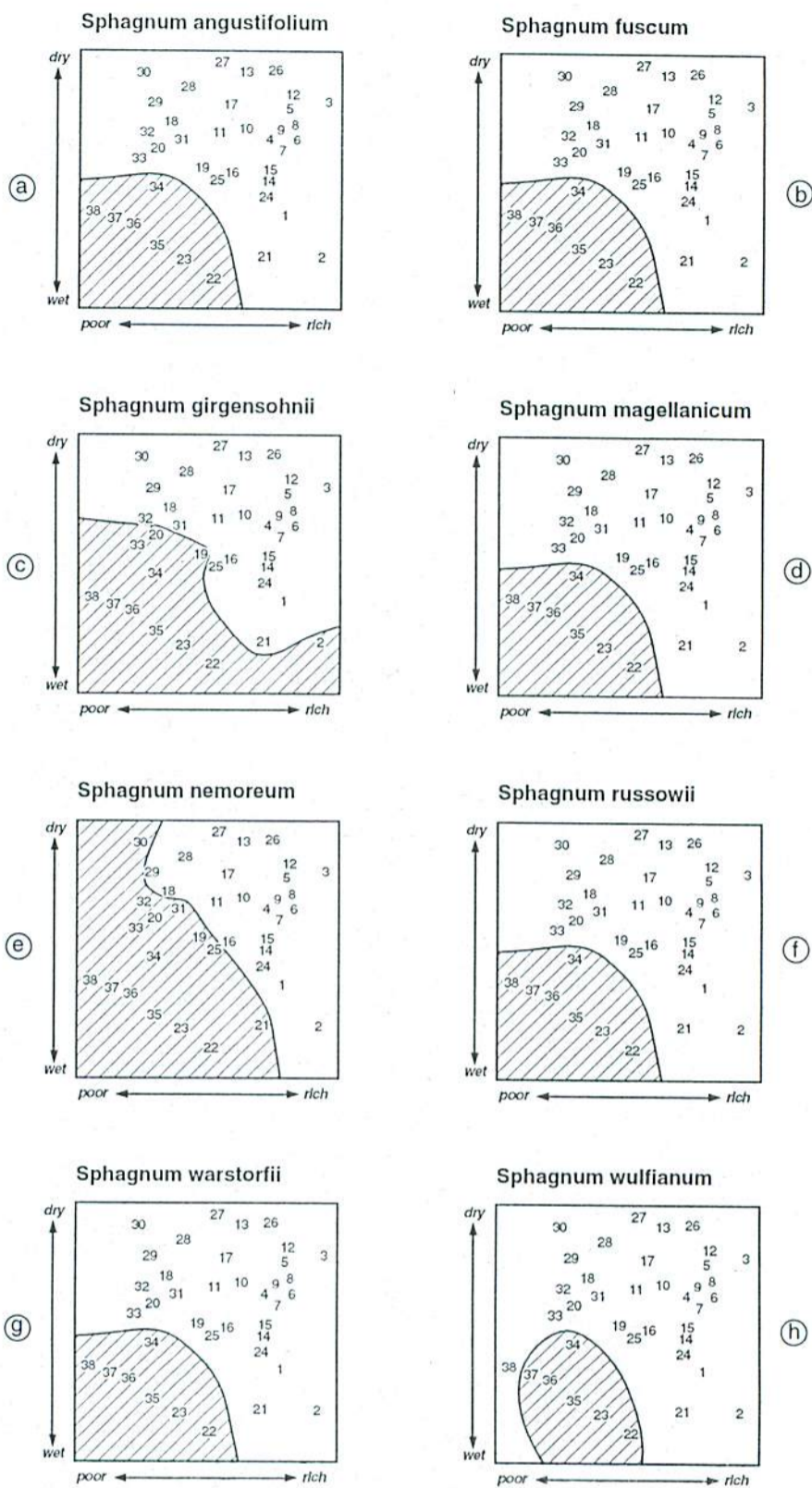


Figure 6. NWO FEC ordinations of the 38 vegetation types and habitat overlays for eight common *Sphagnum* spp.: a) *S. angustifolium*, b) *S. fuscum*, c) *S. girgensohnii*, d) *S. magellanicum*, e) *S. nemoreum*, f) *S. russowii*, g) *S. warnstorffii*, and h) *S. wulfianum*.

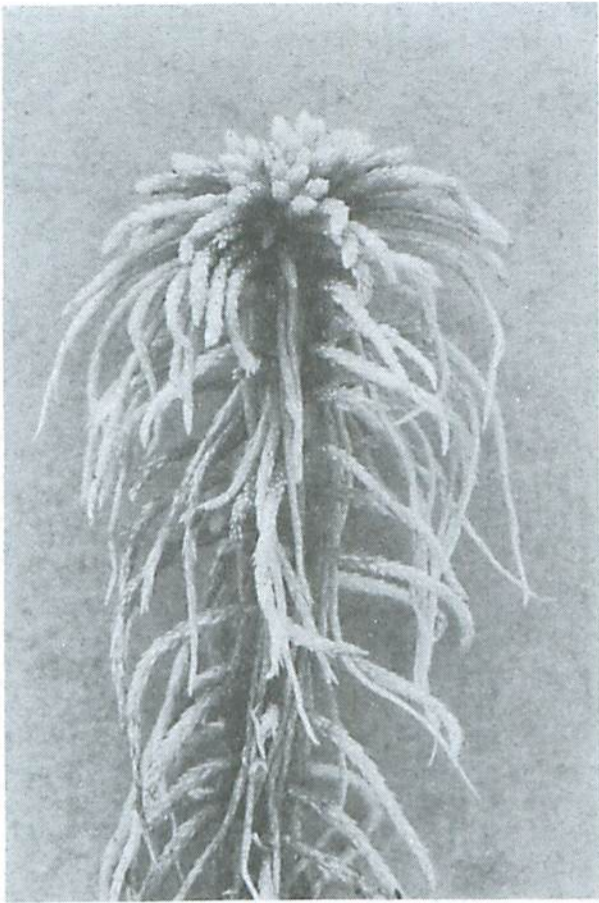


Figure 7. Photograph of *S. girgensohnii*, showing the prominent head.

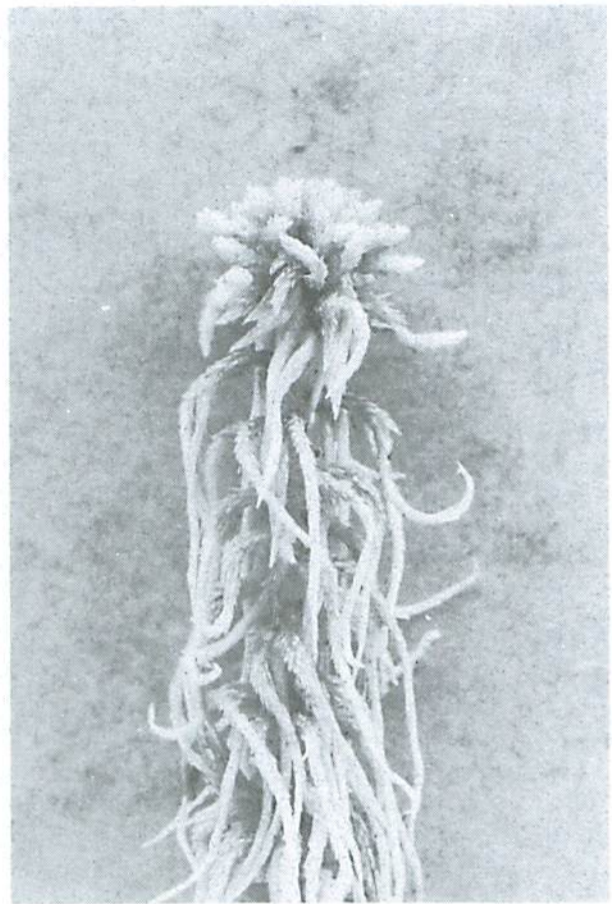


Figure 8. Long, trailing branches (i.e., 'ladies' tresses), in profile, are characteristic of *S. nemoreum* as compared with appressed lateral branches of *S. angustifolium*.

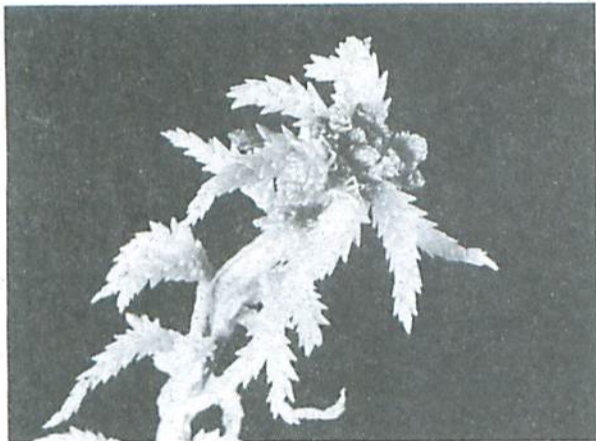


Figure 9. Inflated, tumid, large branch leaves are characteristic of *S. magellanicum*. Like several others (e.g., *S. nemoreum* and *S. wulfianum*), this species has a well developed head.

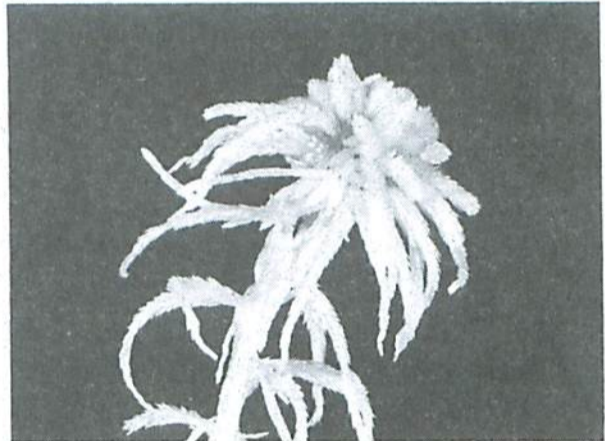


Figure 10. Branch buds of *S. angustifolium* often grow in distinct pairs. To recognize this feature in the field, look just beneath the head in the axils of the spreading branches.

Europe, relied primarily on stem and branch leaf characteristics. He also provided, directly in the key, a concise and helpful description of distribution and habitat for each species. Sjörs' key also requires some referral to microscopic material for proper identification of a number of species. In fact, the use of a microscope is probably mandatory in the determination of some species and in the development of precise taxonomic descriptions of certain groupings within the genus.

Nonetheless, for some groupings of *Sphagnum* spp., a few authors have been successful in developing identification keys that only utilize characteristics that can be observed with the eye or with the aid of a low-powered (e.g., 2.5X to 5X) hand-lens (Tuomikoski 1946, Haavisto 1974). These keys have been particularly useful for the casual field botanist and lay-person, and have provided an impetus for development of the present field keys for northwestern Ontario.

Two cross-referenced and complementary *Sphagnum* spp. keys are provided in the current report; the first (Fig. 11) is a dichotomous field key with habitat descriptions (Haavisto 1974), and the second (Fig. 12) is a multiple access field key (Tuomikoski 1946). Both keys have their own strengths, and the practitioner may find it helpful to use both in combination, in order to arrive at a reliable provisional identification in the field.

- The dichotomous key (Fig. 11) presents "pairs" of questions (down the left side of each page). Occasional use of a low-powered lens is required as the practitioner works through the pairs to eventually arrive at a species name. On the right side of the page there are habitat descriptions for all of the species, for comparison with the field location of the specimen.
- The multiple access key (Fig. 12) provides greater flexibility in choosing which characteristics to employ in the key-out process; a total of 66 characteristics are listed in the key, organized according to seven categories. The practitioner works through the key and eliminates possible taxa until only one or a few choices remain.

5.2. Dichotomous Field Key for *Sphagnum* spp. of Northwestern Ontario

A dichotomous field key, based mainly on macrofeatures, was prepared by Haavisto (1974) for the determination of 23 *Sphagnum* species and one variety occurring in Ontario. This key was based on a number of characteristics, such as the size and shape of branch and stem leaves, the color of the stem wood cylinder and the entire plant, and the number and orientation of branches in the fascicles (Haavisto 1974).

The dichotomous key presented in this report (Fig. 11) provides some improvements over the earlier key provided by Haavisto (1974). First, it is specific to northwestern Ontario, comparatively a much smaller area, and consequently deals with fewer taxa. As well, wherever possible, scientific terms have been avoided. Perhaps the most notable difference, however, is that ecological considerations have been integrated into the key and individual *Sphagnum* species descriptions.

The dichotomous *Sphagnum* spp. key (Fig. 11) was developed in a preliminary form for use by field workers during data gathering for the Northwestern Ontario Forest Ecosystem Classification (NWO FEC) program (Baldwin and Sims 1989, Racey et al. 1989, Sims et al. 1989). One goal of the data gathering phase of the NWO FEC was to accurately record and describe representative forest understorey vegetation across a range of site conditions. The *Sphagnum* spp. key was initially constructed using information compiled from a variety of sources: keys prepared by other authors, published descriptions of typical habitats for many of the species, and the authors' experiences (together with those of their colleagues) with field recognition of many of the taxa. The most useful published sources in developing the current field key system were Haavisto (1974), Vitt and Andrus (1977), Lange (1982), and Crum (1983). The current dichotomous key (Fig. 11) was developed following a series of successive approximations and revisions over the five summers (1985 to 1989) that the authors and others informally field-tested it.

5.3. Multiple Access Field Key for *Sphagnum* spp. of Northwestern Ontario

Because of the inherent variability of macrofeatures within this genus, difficulties are often encountered in using dichotomous keys, especially when identification is being based solely upon these less-than-precise macroscopic features. Multiple access keys provide a useful alternative method for identifying *Sphagnum* spp., and such keys have been introduced by several authors (Vitt and Andrus 1977, Andrus 1980, McQueen 1990).

Vitt and Andrus (1977) provided a multiple access key to the 21 *Sphagnum* species known to Alberta. This key incorporated many macrofeatures of the plants, including the number of branches per fascicle, stem leaf shape and size, plant color, and habit of the branch leaves. McQueen (1990) provided a key employing a similar format for a number of boreal *Sphagnum* spp. in northeastern North America. Most Ontario *Sphagnum* spp. can be identified using a multiple access key and without resorting to a microscope.

The multiple access key to the northwestern Ontario species of *Sphagnum* (Fig. 12) permits the practitioner to

select any characteristics, in any order, to undertake identification using a "process of elimination". The key consists of 63 characteristics grouped into seven subject areas, and each species is represented by a number (1 through 20). Note that this is the same species numbering sequence used in the dichotomous key (Fig. 11). The list of numbers following each characteristic names those species that do not exhibit that particular feature.

To properly apply the multiple access key to an unknown specimen of *Sphagnum*, six steps must be followed:

1. On a blank piece of paper prepare a list of numbers, 1 to 20. (See Appendix A for a template that could be photocopied and used for this purpose.)
2. Select any characteristic from the multiple access key (Fig. 12), and then examine the unknown specimen to determine if it displays that characteristic. If it does, then simply cross out on your list all of the numbers that are named after that characteristic; this removes from your list all of those species that do not exhibit that characteristic.
3. Continue this procedure with other characteristics from the key until one or only a few numbers are left on your list.
4. Match the remaining number(s) with the species code number(s) (Fig. 12) to determine the names of the remaining species. At this point, it may also be useful to cross-check your provisional identification by working through the dichotomous key (Fig. 11).
5. Consult the "Species Descriptions" provided in Section 6 of this report, as well as detailed taxonomic descriptions provided by other authors (e.g., Andrus 1980, Ireland 1982, Crum 1983), to determine whether the full description provides a suitable match to your unknown specimen.
6. Compare the provisional identification obtained using the multiple access key to the provisional identification using the dichotomous key. Attempt to resolve any discrepancies using deductive reasoning and by reviewing the decisions made using both key-out systems. If a suitable resolution cannot be attained, be sure to collect, label, record, and properly process the specimen so that a lab-based examination can be undertaken at a later date.

Examples:

- According to the multiple access key (see Fig. 12; Key Item 1.7), if an unknown specimen has six or more branches per fascicle, Species 1 to 5 and 7 to 20 are eliminated; this means the specimen must be Species 6.6, *S. wulfianum*.

- If a specimen is "red", according to the multiple access key (Key Item 2.1), this characteristic eliminates all numbers except 1, 14, 15, 16, and 19. If, upon further examination, the specimen is found to have a rounded head (Key Item 1.3), numbers 15 and 16 are eliminated and, if the specimen has only two spreading branches per fascicle (Key Item 1.5), 14 is also eliminated. This leaves only two candidate species, numbers 1 and 19. These species can be readily distinguished on the basis of branch leaf characters in either the multiple access or dichotomous keys (swollen, cucullate leaves), and suggest a provisional identification of 6.1, *S. magellanicum*.

5.4. Recommendations Regarding Use of the Keys

Both keys should be considered as first approximations that require further evaluation and improvement with time. Certain areas of the dichotomous key are prone to be misleading; these need to be more clearly identified with use, and revised as possible. The habitat descriptions are useful; however, only the most commonly associated habitats are provided. Some taxa, in particular, have wider and more robust ecological tolerances than others, and so may be encountered in habitats other than those described. With the recent publication of an accurate and comprehensive classification of wetlands for northwestern Ontario (Harris et al. 1996), many of the habitat descriptions presented here can now be extended or framed more broadly in terms of the wetland ecosystem classes.

Although an attempt has been made to utilize the most stable morphological features in the key, some structural characters are inherently more variable than others. Some species of *Sphagnum* exhibit a very wide range of morphological variation, and this broad variation may not be fully or always adequately represented by the characteristics employed in the two keys presented here. The lists of morphological characteristics used in both keys are not exhaustive and, as noted earlier, only macroscopic features were used; a reliable identification for some difficult specimens of *Sphagnum* will demand closer examination of microscopic features. To this end, practitioners should diligently and systematically collect and label any *Sphagnum* spp. specimens that are clearly not easily "keyable" in the field.

Although it is acknowledged by the authors that these keys and identification aids have a number of shortcomings, they should still be useful in assisting practitioners to arrive at a provisional identification for unknown *Sphagnum* specimens. Ultimately, it is only with continued use and experience that practitioners will encounter and become familiar with the weaknesses anticipated in these first approximation keys.

Figure 11. Dichotomous identification key for 20 *Sphagnum* spp. mosses in northwestern Ontario, based mainly on field observable morphological characters and habitat preferences.

1. Plants stout and tumid, appearing water-filled and thick-leaved. Branch leaves very broad (1/3 to 1/2 of length), and often cucullate-concave. 2.
2. Branch leaves spreading and strongly cucullate at the apex [use hands lens]. 3.
3. Plants red (rarely green), especially when dry. Stem wood cylinder red to red-brown. Often forming well developed hummocks. **6.1. *S. magellanicum***

S. magellanicum. Circumpolar; common throughout northwestern Ontario. Forming small to medium-sized hummocks, low cushions, extensive loose carpets, or rarely, floating mats; also commonly growing in mixtures with other *Sphagnum* spp. on the sides and crests of large hummocks. Usually occurring in the open, but less commonly in partially or fully shaded wet or moderately wet locations. *S. magellanicum* is an ombrotrophic to moderately minerotrophic species found in bogs, poor to medium (occasionally rich) fens, swamps, black spruce peatlands, and moist to wet conifer-dominated forests.

3. Plants pale green, yellow, or pale brown, but never red. Wood cylinder brown. Often growing in loose, uncompacted tufts. Occasionally forming hummocks. 4.
4. Wood cylinder green or pale brown. **6.2. *S. centrale***

S. centrale. Usually forming small hummocks, low cushions, or dense carpets; only occupying fully shaded, wet to moderately wet locations. *S. centrale* is a moderately to strongly minerotrophic and calciphilic species, and is most commonly found in cedar swamps, medium to rich treed fens (often occurring along the margins of open, rich fens), black spruce peatlands (often beneath alders and other shrubs), and moist to wet conifer-dominated forests. Also found in wet, shaded ditches and depressions where there is some seasonal fluctuation of the water level.

4. Wood cylinder brown to black. **6.3. *S. palustre***

S. palustre. Usually exhibiting a lax growth habit and forming extensive loose carpets or low cushions, occasionally somewhat compact and forming small to medium-sized hummocks; mainly in fully shaded, wet locations. *S. palustre* is a moderately to strongly minerotrophic species and is most commonly found in the shrub zones bordering open medium to rich fens and open water pools. Occasionally it is found growing in shaded depressions in cedar swamps, black spruce peatlands, and moist to wet conifer-dominated forests.

2. Branch leaves appressed (not spreading), not or only very weakly cucullate. Plants green, yellow, or brown, not red. 5.
5. Plants robust, green (sometimes brown on exposed sites). Pendent branches longer than spreading branches and very dissimilar in appearance. **6.4. *S. compactum***

S. compactum. Circumpolar; occasional throughout northwestern Ontario. Usually occurring as small, compact cushions or dense carpets, sometimes in floating mats; in open or partially shaded, wet to very wet locations. Occupying ombrotrophic to weakly minerotrophic habitats, *S. compactum* is a pioneer species over poorly drained sand (e.g., on the shorelines of shallow lakes), shallow peat surfaces (especially previously burned-over peatlands), and bedrock slopes or cliff faces supplied by abundant seepage water. Occasionally it is also found among alder thickets, at the margins of bog or poor fen pools, or at the edges of flarks in patterned fens.

5. Plants small, slender and often wiry, frail, usually brown or orange. Pendent and spreading branches the same length, and similar in appearance. **6.5. *S. subsecundum***

S. subsecundum. Circumboreal; occasional throughout northwestern Ontario. Forming small hummocks, extensive loose carpets or floating mats; occupying very wet (occasionally submerged), open or partially shaded locations. Found in weakly to moderately minerotrophic habitats, *S. subsecundum* is an early successional species of very wet locations, and is typically found along streams, in pools and drainage channels, and in open sedge-dominated marshes or open, poor to medium (sometimes rich) fens.

1. Plants not stout and tumid. Branch leaves narrower (less than 1/3 of length) and not cucullate. 6.
6. Stems black or red-brown, upright, stiff and springy, brittle so that they break with a snap. The large, rounded head resembles a head of clover. Six or more branches per fascicle give plants a "woolly" appearance. **6.6. *S. wulfianum***

S. wulfianum. *Circumboreal; common throughout northwestern Ontario. Forming extensive loose carpets, low cushions, small hummocks, and frequently growing in small, loose patches along fallen, decaying logs or in mixtures with other Sphagnum spp. in medium to large hummocks; occurring in partially to fully shaded, moderately wet to dry locations. Found in weakly to strongly minerotrophic habitats, in cedar swamps, black spruce peatlands, and moist to wet conifer-dominated forests, and on moist humus or rotting logs in fresh to wet upland conifer-dominated forests. Also, occasionally found in alder thickets, or along the margins of medium to rich fens.*

6. Stems soft and more or less flexible. Fewer than six branches per fascicle. 7.
7. Individual or pairs of large terminal buds visible and conspicuous. 8.
8. Branch leaves usually squarrose (bent backward 90° from midway up leaf) giving plants a ragged, fluffy, or spiny appearance. 9.
9. Plants large, robust and green (ranging from pale green to yellow-brown). Branch leaves often greater than 1 mm wide. **6.7. *S. squarrosus***

S. squarrosus. *Circumpolar; infrequent throughout northwestern Ontario. Forming loose carpets, never hummocks, in partially or fully shaded, moderately wet locations. Found in less acidic, weakly to strongly minerotrophic, moist to wet habitats, but seldom directly adjacent to the water level, and occurring in black spruce peatlands, cedar swamps, among willows and alders in medium to rich fens, and at the shaded margins of streams.*

9. Plants medium-sized, frail, slender, and often yellow or yellow-green. Branch leaves usually less than 1 mm wide. Not always distinctly squarrose. **6.8. *S. teres***

S. teres. *Circumpolar; infrequent to occasional throughout northwestern Ontario. Typically growing as floating mats, extensive loose carpets, or low cushions in open or partially shaded, very wet locations. S. teres is a moderately to strongly minerotrophic and calciphilic species, and is often found in open, medium to rich fens, sedge- or cattail-dominated marshes (often along lake margins), and also sometimes in cedar swamps, alder thickets, and medium to rich treed fens.*

8. Branch leaves not squarrose, but appressed for most of their length. 10.
10. Stem leaves large (more than 1 mm long), lingulate, and with a strongly fringed apex [use hand lens]. The large terminal bud of this slender plant is often grayish-cobwebby because of the strongly fringed leaves enveloping it. Commonly fruiting. **6.9. *S. fimbriatum***

S. fimbriatum. *Circumpolar; infrequent throughout northwestern Ontario. Forming small hummocks or dense carpets above the water level in open or occasionally partially shaded locations. S. fimbriatum is a weakly to moderately minerotrophic species found on mineral soil substrates at the margins of ombrotrophic bogs and poor to medium fens, in relatively dry parts of open bogs, or in the wet, shrubby transition zones between open bog and forested wetland.*

10. Stem leaves not strongly fringed, but slightly fringed or notched [use hand lens], and lingulate or triangular shaped. Plants growing in a loose clump with a distinctive star-shaped appearance when viewed from above. Seldom fruiting. 11.
11. Single, very prominent terminal buds. Stem leaves large (more than 1 mm long), lingulate shaped and slightly fringed or notched at the apex [use hand lens]. 12.
12. Plants green, never red. Stem leaf apex irregularly slit as if torn [use hand lens]. Stem wood cylinder pale brown to pale green. **6.10. *S. girgensohnii***

S. girgensohnii. Circumpolar; common throughout northwestern Ontario. Forming dense carpets or low cushions, but not hummocks, in wet, open, or shaded locations. A weakly to strongly minerotrophic species, *S. girgensohnii* is found on damp humus or bare peat in poor to rich, moist to wet conifer-dominated forests, especially in lower landscape positions and wet depressions, as well as cedar swamps, black spruce peatlands, poor to rich treed or open fens, and bordering drainage channels and seepageways on slopes.

- 12. Plants pink or strongly red-tinged (occasionally green). Stem leaves stiff with slightly notched apex [use hand lens]. Wood cylinder usually green. Terminal buds smaller, often with one to several short branch tips standing alongside. 6.11. *S. russowii*

S. russowii. Circumpolar; common throughout northwestern Ontario. Forming low cushions, loose carpets, or small hummocks, or occurring in mixtures with other *Sphagnum* spp. on medium-sized to large hummocks, in wet, shaded, or open locations. *S. russowii* is a weakly to strongly minerotrophic species found in moist to wet conifer-dominated forests, black spruce peatlands, cedar swamps, and in the more acidic parts of open or treed bogs or poor to rich open or treed fens. *S. russowii* occurs in a variety of wetland habitats and is frequently associated with other *Sphagnum* spp. in hummock-hollow complexes.

- 11. Pairs of buds side-by-side between the bases of sets of branches, the head with a very dense, star-shaped appearance. Stem leaves small (less than 1 mm), triangular shaped, and with a blunt or rounded apex [use hand lens]. 6.12. *S. angustifolium*

S. angustifolium. Circumpolar; common throughout northwestern Ontario. Typically forming extensive loose carpets or low cushions, or growing in mixtures with other *Sphagnum* spp., sometimes on the bases or sides of medium-sized to large hummocks, in wet, shaded, or open locations. *S. angustifolium* is an ombrotrophic to moderately minerotrophic species occurring in open or treed bogs; poor, medium, or less frequently, rich open or treed fens; black spruce peatlands; cedar swamps; and alder thickets.

- 7. Individual or pairs of large terminal buds not visible and conspicuous. 13.

- 13. Branch leaves becoming wavy when plants are squeezed and air dried. Stem leaves small (less than 1 mm), triangular shaped, and with a blunt apex [use hand lens]. 14.

- 14. Branch leaves large (1.5 - 3 mm) with apex not recurved. Wood cylinder yellow-green, yellow-brown, or brown. Plants usually light green, large but delicate. 6.13. *S. cuspidatum*

S. cuspidatum. Amphiatlantic; occasional throughout northwestern Ontario. Growing as scattered individual plants, loose carpets or floating mats (often submerged in shallow water) in open or partially shaded locations, right at the water level. *S. cuspidatum* is an ombrotrophic to weakly minerotrophic species and is found in the wetter depressions, pools, or drainage channels of open peatlands, sometimes becoming emergent in mid- to late summer, but normally growing directly in water. Sometimes occurring in wet pools in alder thickets, on wet peat, among sedges in fens, or growing in mixtures with other *Sphagnum* spp., including *S. angustifolium*, *S. nemoreum*, and *S. rubellum*, but always located in the wetter, low-lying positions.

- 14. Branch leaves small (1.2 mm) and with a recurved apex. Wood cylinder nearly white to yellow-green. Plants variable in color, usually robust with a very dense head. Bud pairs between branches. 6.12. *S. angustifolium*

S. angustifolium. Circumpolar; common throughout northwestern Ontario. Typically forming extensive loose carpets or low cushions, or growing in mixtures with other *Sphagnum* spp., sometimes on the bases or sides of medium-sized to large hummocks, in wet, shaded, or open locations. *S. angustifolium* is an ombrotrophic to moderately minerotrophic species occurring in open or treed bogs; poor, medium, or less frequently, rich open or treed fens; black spruce peatlands; cedar swamps; and alder thickets.

- 13. Branch leaves not becoming wavy when squeezed and air dried. Stem leaves large (greater than 1 mm) [use hand lens]. 15.

15. Branch leaves five-ranked, so that they appear to be in five distinct, sometimes spiralling, rows. Because of spreading branch leaves, branches are widest at the distal end, giving them a club-shaped appearance. 16.

16. Wood cylinder pale green, yellow to brown, but not red. Plants green, grayish-green, or variegated green and rose. Leaves dull in appearance when squeezed and air dried. Three spreading branches per fascicle. 6.14. *S. quinquefarium*

S. quinquefarium. Circumboreal; infrequent to occasional throughout northwestern Ontario. Forming compact small hummocks, low cushions, or dense carpets and preferring partially or fully shaded, wet to moderately wet locations. *S. quinquefarium* is a weakly to moderately minerotrophic species found on wet peat, humus, or mineral soil substrates in black spruce peatlands, cedar swamps, moist to wet conifer-dominated forests, or on bedrock slopes and rocky cliffs where there is continuous, slow water seepage.

16. Wood cylinder red. Two divergent branches per fascicle. 17.

17. Plants somewhat stiff and usually red. Leaves dull in appearance when squeezed and air dried. Branch leaves curved and somewhat secund, and appressed to stem. 6.15. *S. rubellum*

S. rubellum. Circumpolar; occasional throughout northwestern Ontario. Forming small to medium-sized hummocks, low cushions, extensive loose carpets, or occasionally, floating mats, in open or partially shaded, wet or very wet locations. An ombrotrophic to weakly minerotrophic species found in open bogs and poor fens, usually in distinctly acidic habitats, and also frequently growing in mixtures with other *Sphagnum* spp., especially *S. fuscum*, *S. angustifolium*, and *S. magellanicum*, and occupying intermediate or low-lying positions.

17. Plants lax and often red-tinged, or less frequently, red, yellow, or completely green. Leaves with a metallic sheen when squeezed and air dried. Branch leaves straight, small, and triangular. 6.16. *S. warnstorffii*

S. warnstorffii. Circumpolar; common throughout northwestern Ontario. Occurring as individual plants or forming extensive, loose carpets or small cushions, and preferring partially or fully shaded, wet locations. *S. warnstorffii* is a moderately to strongly minerotrophic and calciphilic species found in medium to rich treed fens, black spruce peatlands, cedar swamps, and moist to wet conifer-dominated forests. It typically grows in small depressions where water levels remain close to the ground surface, or may form extensive, loose carpets, particularly in large, treed fens.

15. Branch leaves not five-ranked. 18.

18. Plants dull, compact, brown, not green except sometimes at the top. Wood cylinder brown to black. Thread-like, wiry branches become interwoven inside hummocks with a very distinctive appearance. 6.17. *S. fuscum*

S. fuscum. Circumpolar; common throughout northwestern Ontario. Forming medium-sized to large, compact hummocks in open or shaded, moderately wet to dry locations. *S. fuscum* is an ombrotrophic to weakly minerotrophic species found in acidic open or treed bogs; poor to rich, open or treed fens; and poor black spruce peatlands. Typically forming well developed, dense, brown or brownish-green hummocks, or topping older, drier hummocks that may have been initially created by other *Sphagnum* spp.

18. Plants not dull, compact, and brown. Wood cylinder pale to red-brown, but not brown. 19.

19. Plants robust and yellow-green to pink. Branches thick and turgid. 6.18. *S. tenerum*

S. tenerum. Endemic to eastern North America; infrequent to occasional throughout northwestern Ontario. Forming compact, small to medium-sized hummocks or low cushions, in open or shaded, wet locations. A weakly minerotrophic species that occurs in black spruce peatlands; open or treed bogs and poor fens; along the margins of ponds, drainage channels, and roadside ditches on wet sand and thin humus; and on wet bedrock slopes.

19. Plants slender and red, green, or green tinged with red or blue, but never brown. Branches generally soft and slender. 20.

20. Plants somewhat stiff, red and often with a flattened head.
 Branch leaves curved and somewhat secund, and appressed to stem.
 Stem leaves obtuse and broadly rounded. Wood cylinder red. . **6.15. *S. rubellum***

S. rubellum. Circumpolar; occasional throughout northwestern Ontario. Forming small to medium-sized hummocks, low cushions, extensive loose carpets, or occasionally, floating mats, in open or partially shaded, wet or very wet locations. An ombrotrophic to weakly minerotrophic species found in open bogs and poor fens, usually in distinctly acidic habitats, and also frequently growing in mixtures with other *Sphagnum* spp., especially *S. fuscum*, *S. angustifolium*, and *S. magellanicum*, and occupying intermediate or low-lying positions.

20. Plants lax, green, often with some red tinges, and often with a large, well-rounded head. Branch leaves straight, not tightly appressed to the stem. Stem leaves oblong-triangular to acute.
 Wood cylinder pale, red or red-brown. 21.

21. Plants not shiny when squeezed and air dried. Branches slender, delicate, and long trailing, often curving upwards at the end (lady's tresses). Wood cylinder pale green or red. **6.19. *S. nemoreum***

S. nemoreum. Circumpolar; common throughout northwestern Ontario. Forming small, medium-sized, or large compact hummocks, or occasionally low cushions, in open or shaded, moderately wet to dry locations. An ombrotrophic to moderately minerotrophic species, *S. nemoreum* is found in a wide variety of habitats, including open or treed bogs; poor, medium or rich, open or treed fens; cedar swamps; black spruce peatlands; or on humus or wet rocks in moist to wet conifer-dominated forests. Often forming small to medium-sized hummocks or occurring on the tops and sides of large hummocks in association with other *Sphagnum* spp., especially *S. fuscum*, *S. russowii*, and *S. magellanicum*.

21. Plants with a distinctive metallic lustre and blue tinges; lustre only visible when plant is squeezed and air dried. Branches not longtrailing.
 Wood cylinder red-brown. **6.20. *S. subnitens***

S. subnitens. Circumpolar; infrequent to occasional throughout northwestern Ontario. Occurring as individual plants or forming low cushions or loose carpets in open or shaded, wet to moderately wet locations. *S. subnitens* is a weakly to moderately minerotrophic and perhaps somewhat calciphilic species, and is found in open or treed bogs; poor to medium, open or treed fens; alder thickets; and small, wet depressions or on wet rocks in moist to wet conifer-dominated forests.

To assist the practitioner, the following recommendations are made regarding the use of the keys:

(i) It is recommended that both the dichotomous key and the multiple access key be used in the field, and that results be cross-referenced. Individuals will get a more accurate appreciation for the species, their morphological macrofeatures of taxonomic importance, and their typical habitats by first keying out a specimen using one approach, and then using the second key to provide a confirmation. Use these keys and species descriptions to help develop familiarity, over time, about the various taxa, their general morphology, growth form, and ecological/site preferences. The glossary of scientific terms used in this report (Section 8) should also be consulted as required.

(ii) To help corroborate provisional determinations, consult species descriptions provided in this report as well as taxonomic descriptions provided by other authors. To positively identify some *Sphagnum* specimens from northwestern Ontario, there is a need to examine plant structures with a microscope. As already noted, there is an inherent variability of macrofeatures within many *Sphagnum* species. Some taxa, especially those common ones that grow across a range of ecological conditions, are particularly variable (e.g., *S. angustifolium*, *S. nemoreum*, and *S. girgensohnii*). Because of the wide variation in growth form and habitat of such taxa, the keys provided here will not be infallible.

(iii) Collect and label unknowns for laboratory examinations. Difficult specimens and perhaps species new to the area will be encountered. These should be collected, labeled, and dried as herbarium voucher collections. Later, these should either be identified in the laboratory with the

aid of a microscope and additional taxonomic references, or submitted to taxonomic authorities for their expert examination. Schofield (1985) provides full instructions on collecting and preparing bryophytes as herbarium specimens. It is also useful for individuals to compile and maintain their own small field voucher collection of dried, packaged, and correctly named *Sphagnum* spp. to check specimens against in the field.

(iv) To assist identifications, correlate individual taxa with the habitats in which they are encountered. Summarized information on habitats and common associates for taxa (e.g., Table 2, and "Species Descriptions" in Section 6) will help to validate provisional identifications reached using the keys in this report. For eight forest-dwelling northwestern Ontario *Sphagnum* species, additional habitat information, derived from the NWO FEC database, is also provided (see Fig. 6 and Table 4).

(v) Refer to other published taxonomic references, and pay particular attention to illustrations of structural features. Excellent scientific line drawings of habit and diagnostic features for the *Sphagnum* taxa considered in this report are provided by Nyholm (1969), Andrus (1980), Ireland (1982), Ireland and Bellolio-Trucco (1987), and Crum (1983, 1984, 1988). Diagrams illustrating useful field characters for several of the taxa are given by Haavisto (1974), Jones et al. (1983), and Baldwin and Sims (1989). Vitt et al. (1988), Klinka et al. (1989), McQueen (1990), and MacKinnon et al. (1992) provide some excellent color photos of many of the common *Sphagnum* spp. that occur in northwestern Ontario. As well, Figures 13 to 32 in this report illustrate many of the field characters that should be examined during the identification of *Sphagnum* spp. in northwestern Ontario.

Figure 12. Multiple access identification key (based mainly on field-observable characters) for *Sphagnum* spp. mosses in northwestern Ontario.

Species Code Numbers for Multiple Access Key:

1. <i>S. magellanicum</i>	8. <i>S. teres</i>	15. <i>S. rubellum</i>
2. <i>S. centrale</i>	9. <i>S. fimbriatum</i>	16. <i>S. warnstorffii</i>
3. <i>S. palustre</i>	10. <i>S. girgensohnii</i>	17. <i>S. fuscum</i>
4. <i>S. compactum</i>	11. <i>S. russowii</i>	18. <i>S. tenerum</i>
5. <i>S. subsecundum</i>	12. <i>S. angustifolium</i>	19. <i>S. nemoreum</i>
6. <i>S. wulfianum</i>	13. <i>S. cuspidatum</i>	20. <i>S. subnitens</i>
7. <i>S. squarrosum</i>	14. <i>S. quinquefarium</i>	

Characteristics NOT Present in Species:

1. General growth habit

1.1 large, robust plants	4, 5, 8, 9, 12-17
1.2 star-shaped head	1-7, 9, 12-14, 17, 18, 20
1.3 rounded head	4, 5, 7-11, 13, 15-17, 20
1.4 large terminal bud(s)	1-6, 13-20
1.5 two spreading branches per fascicle	6, 8, 14
1.6 three to five spreading branches per fascicle	2-4, 7, 9-13, 15-20
1.7 six or more branches per fascicle	1-5, 7-20

2. Plant color (all species may be green)

2.1 red throughout	2-13, 17, 18, 20
2.2 green tinged with red	2-5, 7-10, 17, 18, 20
2.3 green tinged with blue	1-19
2.4 pink	2, 3, 5-13, 15-17, 20
2.5 brown	1-3, 6, 7, 9-11, 13-16, 18-20
2.6 red-brown	1-3, 5-16, 18-20
2.7 brown-green	1, 4, 5, 9-15, 18-20
2.8 pale green	1, 5, 11, 15-17, 19, 20
2.9 yellow-green	1, 3, 4, 6, 7, 9-11, 13-17, 19, 20
2.10 yellow	1, 3, 6, 11, 12, 14, 15, 17, 19, 20
2.11 yellow-orange	1-6, 8-20
2.12 yellow-brown	1-6, 8, 10, 11, 13-19
2.13 orange	1-4, 6-20

3. Color of stem wood cylinder (all species may be green)

3.1 red	2-14, 17, 20
3.2 black	1, 2, 5, 7-16, 18-20
3.3 brown	1, 6, 7, 9-12, 14, 15, 18-20
3.4 red-brown	2-5, 9-15, 17-19
3.5 pale brown	1, 3, 4, 6-9, 11, 12, 14-20
3.6 pale green	1-8, 13, 15-17, 20
3.7 yellow-green	1-10, 15-20
3.8 yellow-brown	1-12, 14-20

4. Branch leaves

4.1 five-ranked pattern	1-5, 7-11, 13, 17-20
4.2 shape cucullate	6-20
4.3 shape secund	1-4, 6-14, 17-20
4.4 shape squarrose	1-3, 5, 6, 9-20

4.5	shape recurved	1-11, 13-15, 17-19
4.6	margins involute	1-3, 12, 14, 15
4.7	undulate when dry	1-11, 14-20
5. Stem leaves		
5.1	size larger than 1 mm	6, 7, 12-14, 16, 17
5.2	shape short triangular	1-4, 7-11, 15-20
5.3	shape triangular-lingulate	1-3, 5, 7-13, 17-19
5.4	shape lingulate	2, 4-6, 8, 9, 12-14, 18-20
5.5	shape rectangular	2-20
5.6	shape ovate	1, 3-7, 9-12, 14-17, 20
5.7	shape spatulate	1-8, 11-20
5.8	margins involute	1-5, 7-17, 20
5.9	apex blunt	1-3, 6-11, 14-17, 19, 20
5.10	apex rounded	4-10, 13, 14, 18-20
5.11	apex acute	1-5, 7-13, 15-19
5.12	apex slightly or strongly fringed	1-6, 11-20
6. Location		
6.1	on hummocks	3-5, 7, 8, 10, 13, 14, 16, 20
6.2	in carpets or mats	5, 7, 8, 11, 13, 15, 17
6.3	in wet hollows	6, 8, 9, 11, 13-20
6.4	submerged or at water level	2-4, 6, 7, 9-12, 14-20
6.5	exposed, unshaded	2, 3, 6, 7, 10, 13, 14, 16, 18, 19
7. Ecology		
7.1	ombrotrophic bogs	2, 5-8, 10, 14, 16
7.2	poor fens	2, 6-8, 10, 14, 16-18
7.3	medium fens	2, 6, 9, 10, 14-18, 20
7.4	rich fens	3, 4, 6, 9, 11-15, 17-20
7.5	alder thickets	2, 6, 9-11, 14, 16, 17, 20
7.6	swamps and wet woodlands	3-5, 8, 9, 13, 15, 17, 20
7.7	cedar swamps	4, 9, 13, 15, 17, 18, 20
7.8	black spruce peatlands	4, 5, 8, 13, 20
7.9	moist to wet conifer-dominated forests	4, 6-9, 13, 15, 17, 18, 20
7.10	bare sand or rock surfaces	1-3, 5-18, 20
7.11	wet cliffs/seeps	1-3, 5-13, 15-20

6.0 SPHAGNUM SPP. DESCRIPTIONS

Descriptions for *Sphagnum* species presented in Sections 6.1 to 6.20 emphasize general appearances, habitat relations, and field-observable features. Each description includes the following:

- a short general description of the plant;
- a brief summary of its geographic distribution and common habitat relations;
- miscellaneous comments regarding other similar taxa, or common associates in some habitats;
- a list of common names and taxonomic synonyms³ that might be used by other floras or publications that may be consulted during the identification process; and,
- line illustrations of important taxonomic features referred to in the keys.

³ In the descriptions, names denoted with asterisks (*) are literal translations of Finnish common names for those species (Jeglum, pers. comm.). Some of the most commonly encountered synonyms are given for a number of the species; for more complete listings of taxonomic synonyms the reader is referred to Ireland and Cain (1975), Andrus (1980), Ireland (1982), Crum (1983), and Ireland et al. (1980, 1987).

6.1. *Sphagnum magellanicum* Brid.

*Red Fat-leaved Sphagnum

General Description (Figure 13)

Usually large, turgid, and robust plants; plant color is typically red throughout, but, when found in shade, plants may be green, green tinged with red, or pink; the color of the stem wood cylinder is red or red-brown; the somewhat rounded head (composed mainly of short, stout branches) and branches have a thick, swollen appearance; there are two spreading branches in each fascicle of four (sometimes five) branches, with the longer pendent branches more or less covering the stem; branch leaves are large, imbricate to spreading, cucullate, broadly ovate, with a rounded, finely toothed apex; stem leaves are large, rectangular, with a broadly rounded, entire or finely fringed apex.

Distribution and Habitat

Circumpolar; common throughout northwestern Ontario. Forming small to medium-sized hummocks, low cushions, extensive loose carpets, or rarely, floating mats; also commonly growing in mixtures with other *Sphagnum* spp. on the sides and crests of large hummocks. Usually occurring in the open, but less commonly in partially or fully shaded wet or moderately wet locations. *S. magellanicum* is an ombrotrophic to moderately minerotrophic species found in bogs, poor to medium (occasionally rich) fens, swamps, black spruce peatlands, and moist to wet conifer-dominated forests.

Comments

Although this species is often encountered in wet locations throughout northwestern Ontario, locally it is usually not abundant enough to be a significant peat former. In relatively acid habitats, it often forms medium-sized hummocks, or occurs on the sides or crests of large hummocks with *S. fuscum*, *S. angustifolium*, and other *Sphagnum* spp. Normally, it can be distinguished from *S. centrale* and *S. palustre*, two closely related species also with cucullate leaves and a turgid appearance, by its red coloration and long rectangular stem leaves with nearly parallel sides. However, with some shade forms of *S. magellanicum*, or open-growing forms of the other two species, microscopic features must be examined in order to make an accurate separation.

Synonyms: *S. medium* Limpr.

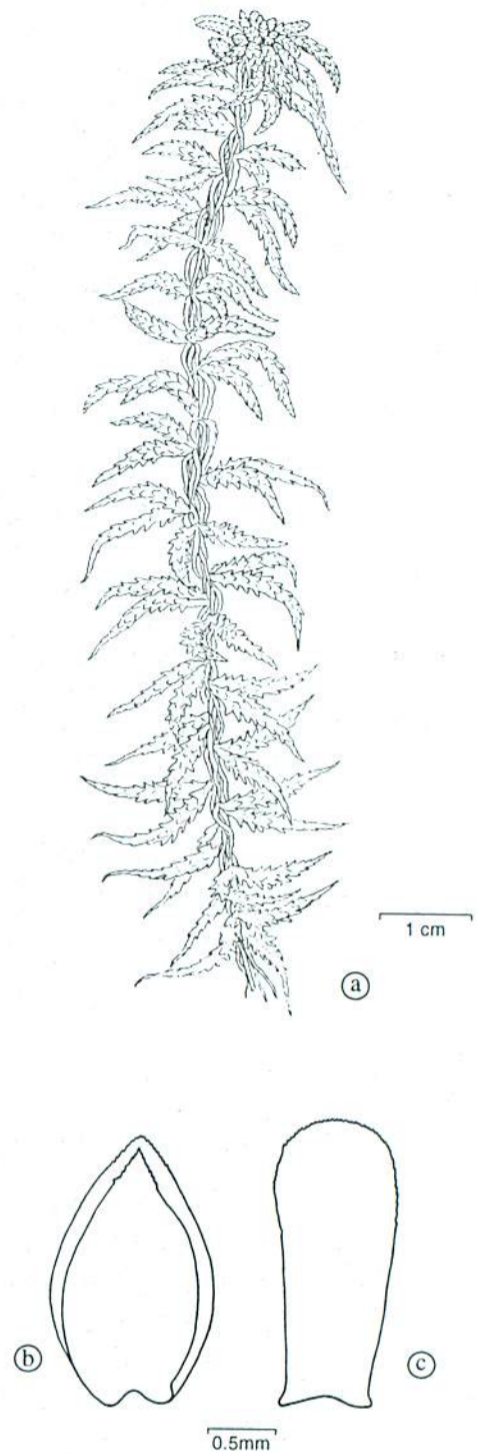


Figure 13. *S. magellanicum* Brid.: a) general habit, b) cucullate branch leaf, and c) long, rectangular stem leaf.

General Description (Figure 14)

Medium-sized to large, turgid, robust plants; plant is usually shiny and color is pale green (sometimes white), or less frequently, yellow, yellow-green, or brown-green, but never red; the color of the stem wood cylinder is green, pale brown or, rarely, brown; the somewhat-rounded head is composed of short, stout branches and has a swollen appearance; there are two spreading branches in each fascicle of four or five thick branches, with pendent branches more or less covering the stem; branch leaves are large, imbricate to spreading, cucullate, broadly ovate, with a rounded, finely toothed apex; stem leaves are large, broadly ovate, widest above the middle, with a broadly rounded, finely fringed apex.

Distribution and Habitat

Circumpolar; infrequent to occasional throughout north-western Ontario. Usually forming small hummocks, low cushions, or dense carpets; only occupying fully shaded, wet to moderately wet locations. *S. centrale* is a moderately to strongly minerotrophic and calciphilic species, and is most commonly found in cedar swamps, medium to rich treed fens (often occurring along the margins of open, rich fens), black spruce peatlands (often beneath alders and other shrubs), and moist to wet conifer-dominated forests. Also found in wet, shaded ditches and depressions where there is some seasonal fluctuation of the water level.

Comments

Usually a whitish-green (never red) species of wet, shaded locations, it generally resembles the more common *S. magellanicum*. The two species are often found growing together; *S. magellanicum* is a much better hummock-forming species and has a stem wood cylinder that is colored red to red-brown. *S. palustre* is also similar in general appearance to *S. centrale*, but has a darker (i.e., brown to black) stem wood cylinder. *S. centrale* may also be separated from *S. palustre* by its generally shorter (<1 cm) lateral branches (cf. Haavisto 1974). Crum (1983) noted that *S. centrale* is a taxonomically difficult species and even examination of microstructures does not always permit clear identification.

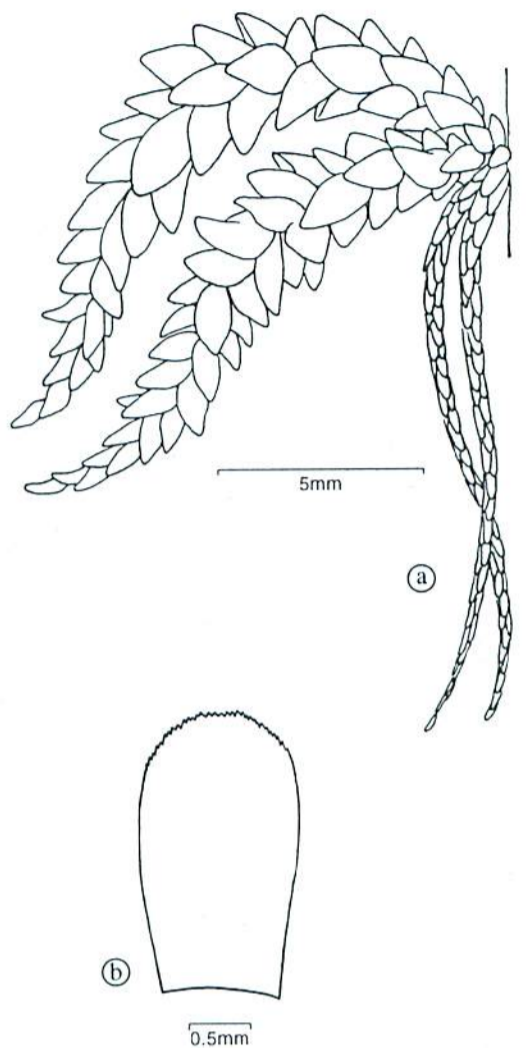


Figure 14. *S. centrale* C. Jens. ex H. Arnell & C. Jens.: a) fascicle of branches, and b) broadly ovate stem leaf.

General Description (Figure 15)

Medium-sized to large, turgid, robust plants; plant color is usually green, sometimes tinged with brown, but never red; the color of the stem wood cylinder is brown or black; the somewhat rounded head (composed of short, stout branches) and branches have a thick, swollen appearance; there are two spreading branches in each fascicle of four or five branches, and the pendent branches more or less cover the stem; branch leaves are large, imbricate to spreading, cucullate, broadly ovate, with a rounded, finely toothed apex; stem leaves are large, lingulate, with a rounded, slightly fringed apex.

Distribution and Habitat

Circumpolar; infrequent throughout northwestern Ontario. Usually exhibiting a lax growth habit forming extensive, loose carpets or low cushions, occasionally somewhat compact and forming small to medium-sized hummocks; mainly in fully shaded, wet locations. *S. palustre* is a moderately to strongly minerotrophic species and is most commonly found in the shrub zones bordering open medium to rich fens and open water pools. Occasionally it is found growing in shaded depressions in cedar swamps, black spruce peatlands, and moist to wet conifer-dominated forests.

Comments

Although widely distributed, this species is seldom abundant where found and is probably relatively uncommon in northwestern Ontario. It tolerates a wide range of acid conditions. *S. palustre* is a green to brown-green (never red) species of shrubby borders of moderately to strongly minerotrophic peatlands and wetland pools. It resembles *S. magellanicum*, a much more common species that is red or red-tinged and forms large, well-developed hummocks. *S. centrale*, also similar in general appearance, has a lighter colored (green or pale brown) stem wood cylinder; sometimes, reliable separation of these species requires the examination of microscopic features. Also, specimens of *S. papillosum* Lindb. may key out to *S. palustre*; although very similar to *S. palustre* in terms of general appearance and growth form, and frequenting the same habitats, plants of *S. papillosum* may have a distinctive brownish tinge, and stem leaves that are often covered by small papillae (bumps).

Synonyms: *S. subbicolor* Hampe

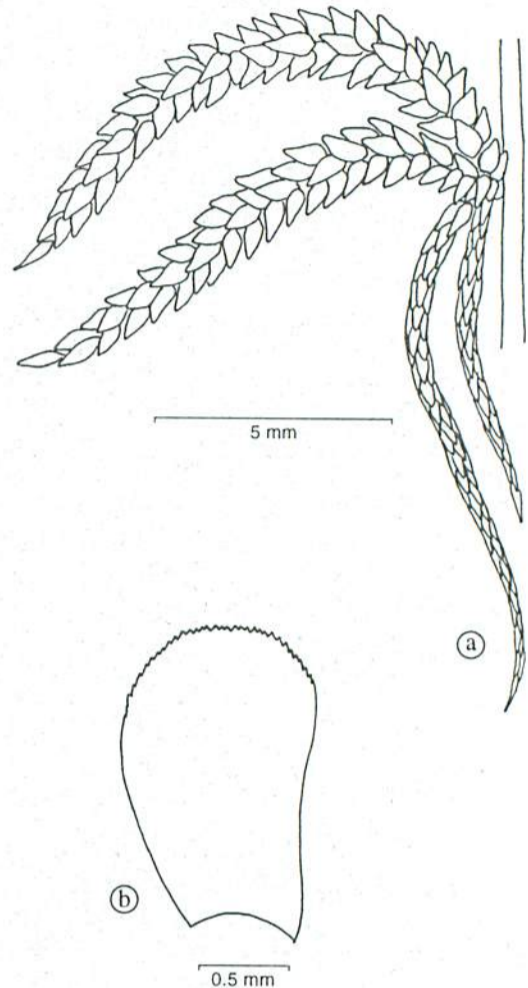


Figure 15. *S. palustre* L.: a) fascicle of branches, and b) broadly lingulate stem leaf.

General Description (Figure 16)

Typically short, compact plants, but occasionally medium sized, with a lax growth habit; plant color is usually green, brown, brown-green to pale green, yellow, red-brown or pink, but not red; the color of the stem wood cylinder is brown or black; the somewhat rounded head is irregular and poorly developed, often with short, stout branches pointing upward and having no discernible terminal bud; the two stiffly spreading branches per four- or five-branch fascicle are shorter and very dissimilar in appearance to the closely appressed pendent branches; branch leaves are large, ovate, appressed or sometimes squarrose (especially when growing in shade), and weakly cucullate, with an involute margin and a broad, truncate, finely toothed apex; stem leaves are small, concave, triangular-lingulate, with a blunt, often slightly fringed apex.

Distribution and Habitat

Circumpolar; occasional throughout northwestern Ontario. Usually occurring as small, compact cushions or dense carpets, sometimes in floating mats; in open or partially shaded, wet to very wet locations. Occupying ombrotrophic to weakly minerotrophic habitats, *S. compactum* is a pioneer species over poorly drained sand (e.g., on the shorelines of shallow lakes), shallow peat surfaces (especially previously burned-over peatlands), and bedrock slopes or cliff faces supplied by abundant seepage water. Occasionally, it is also found among alder thickets, at the margins of pools in bogs or poor fens, or at the edges of flarks in patterned fens.

Comments

S. compactum is important locally as a pioneer species over wet sand, thin peat, or rock. In shaded locations, plants may develop squarrose branch leaves, but should still be distinguishable from *S. squarrosum* by their small, triangular-lingulate stem leaves. The small stem leaves can also be used to help separate this species from *S. centrale*, *S. palustre*, and green forms of *S. magellanicum*.

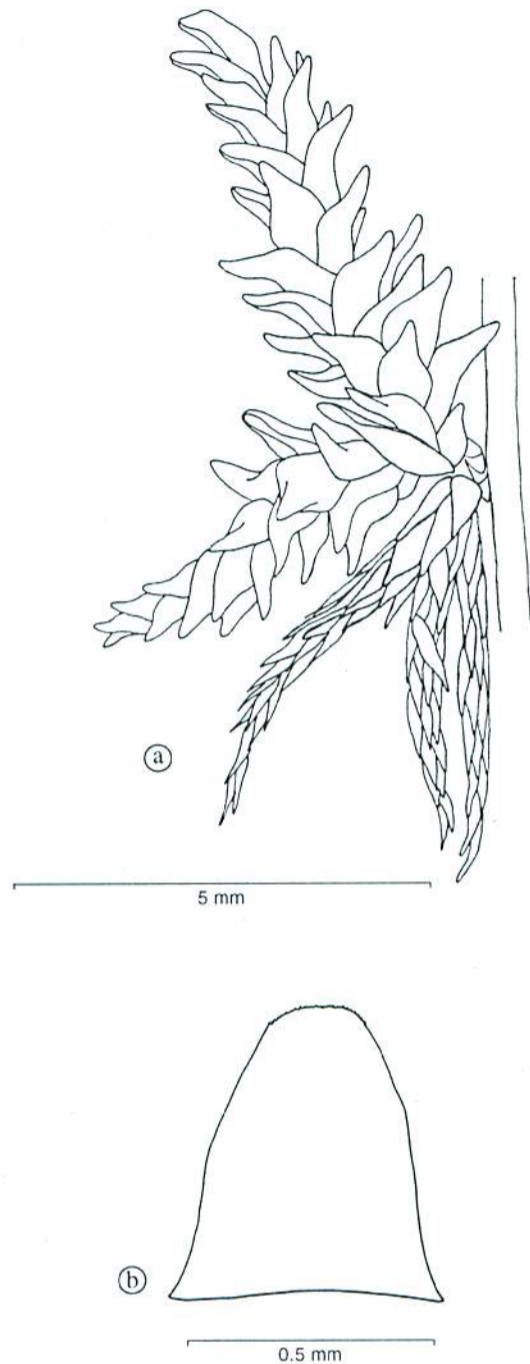


Figure 16. *S. compactum* DC. ex Lam. DC.: a) fascicle of branches, and b) small, triangular stem leaf.

6.5. *Sphagnum subsecundum* Nees ex Sturm

*Fist-topped Sphagnum

General Description (Figure 17)

Small to medium-sized, wiry, and slender plants; plant is usually shiny when dry, and the color is often distinctive, usually orange, yellow, or brown, but sometimes yellow-green or green; the color of the stem wood cylinder is brown, but may be light brown to green in the most recent growth; the somewhat rounded, irregular head is composed of small curled branches, with a very small, usually scarcely discernible, terminal bud; there are usually two or three spreading branches per five- or six-branch fascicle, with spreading branches often curved but otherwise similar in length and general appearance to pendent branches; branch leaves are small, usually curved to one side and somewhat secund, not undulate, ovate to lanceolate in shape, involute along the margins and finely toothed at the apex; stem leaves are small, short-triangular, with a blunt and cucullate apex.

Distribution and Habitat

Circumboreal; occasional throughout northwestern Ontario. Forming small hummocks, extensive loose carpets or floating mats; occupying very wet (occasionally submerged), open or partially shaded locations. Found in weakly to moderately minerotrophic habitats, *S. subsecundum* is an early successional species of very wet locations, and is typically found along streams, in pools and drainage channels, and in open sedge-dominated marshes or open, poor to medium (sometimes rich) fens.

Comments

This species is relatively easy to recognize in the field if one can observe the following characters: the distinctive orange, yellow, or brown coloration; brown stem wood cylinder; curved branches in the head; subsecund branch leaves; and a very wet, mineral-rich habitat. Plants are shiny when dry.

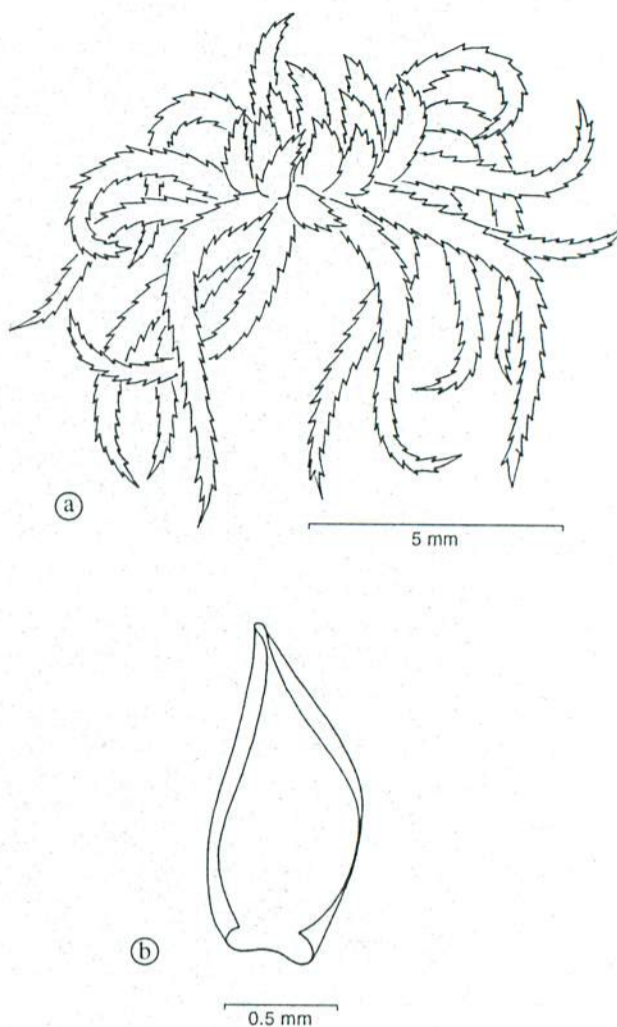


Figure 17. *S. subsecundum* Nees ex Sturm: a) irregular head with curled, short branches, and b) subsecund branch leaf.

General Description (Figure 18)

Plants are rather large, robust, stiff-stemmed and loosely tufted; plant color is dark green to brown-green, sometimes with tinges of light red in the upper portions; the color of the stem wood cylinder is red-brown or black; the very large, rounded head is packed with densely crowded branches so that it appears shaggy and resembles a flowering head of clover, and there is no conspicuous terminal bud; individual fascicles are crowded with six to 12 branches, of which three or more are spreading; pendent branches are mostly longer and thinner than spreading branches; the stem is dark, wiry, brittle, and relatively thick and can be easily broken between the fingers with an audible snap; branch leaves are small, five-ranked, ovate-lanceolate, involute, tapering to a long, pointed apex and conspicuously spreading at the apex when dry, giving the branches a somewhat fuzzy appearance; stem leaves are small, short-triangular or triangular-lingulate, involute, with an acute apex.

Distribution and Habitat

Circumboreal; common throughout northwestern Ontario. Forming extensive loose carpets, low cushions, small hummocks, and frequently growing in small, loose patches along fallen, decaying logs or in mixtures with other *Sphagnum* spp. in medium to large hummocks; occurring in partially to fully shaded, moderately wet to dry locations. Found in weakly to strongly minerotrophic habitats, in cedar swamps, black spruce peatlands, and moist to wet conifer-dominated forests and on moist humus or rotting logs in fresh to wet, upland, conifer-dominated forests. Also, occasionally found in alder thickets, or along the margins of medium to rich fens.

Comments

S. wulfianum is the most xerophytic *Sphagnum* species growing in northwestern Ontario and the only one with six or more branches per fascicle; it is rarely found in the open and occupies relatively acid niches, especially stumps or logs in advanced decay. It is perhaps northwestern Ontario's most easily recognized *Sphagnum* species; although some forms of *S. warnstorffii*, *S. quinquefarium*, and *S. angustifolium* may sometimes look similar, these species all have five or fewer branches per fascicle, and may be readily separated from *S. wulfianum* based on other field characters as well.

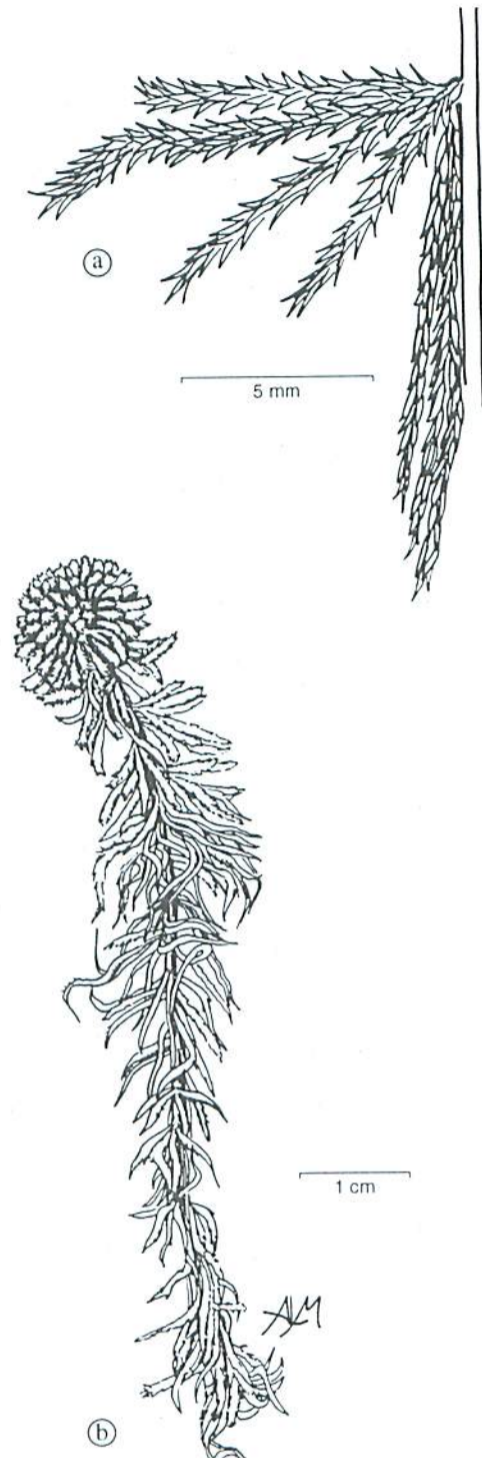


Figure 18. *S. wulfianum* Girg.: a) fascicle with more than six branches, and b) general habit and head.

6.7. *Sphagnum squarrosum* Crome

Prickly Sphagnum
Shaggy Sphagnum

General Description (Figure 19)

Medium-sized to large, stiff, robust plants; plant color is usually bright green, but occasionally may be pale green or yellow-green, or infrequently, yellow-orange, yellow-brown, yellow or brown-green; color of the stem wood cylinder is red-brown; the head has a single large, conical terminal bud surrounded by very short, loosely packed branches; there are two spreading branches per five-branch fascicle; pendent branches closely cover the stem; branch leaves are >1 mm wide, not five-ranked, strongly squarrose (giving the branches of plants a prickly or fuzzy appearance, especially when dry), ovate and tapering to an involute, acute, finely toothed apex; stem leaves are large, long, lingulate, and concave, with a slightly fringed apex.

Distribution and Habitat

Circumpolar; infrequent throughout northwestern Ontario. Forming loose carpets, never hummocks, in partially or fully shaded, moderately wet locations. Found in less acidic, weakly to strongly minerotrophic, moist to wet habitats, but seldom directly adjacent to the water level; occurring in black spruce peatlands, cedar swamps, among willows and alders in medium to rich fens, and at the shaded margins of streams.

Comments

S. squarrosum is easily recognized in the field by its strongly squarrose branch leaves and bright green color. Some forms of *S. palustre*, *S. compactum*, and *S. teres* may sometimes resemble *S. squarrosum*; however, *S. palustre* has cucullate branch leaves, *S. compactum* has small, triangular stem leaves, and *S. teres* has mainly three spreading branches per fascicle and is not common in shaded habitats. *S. squarrosum* is frequently covered by abundant sporophytes.

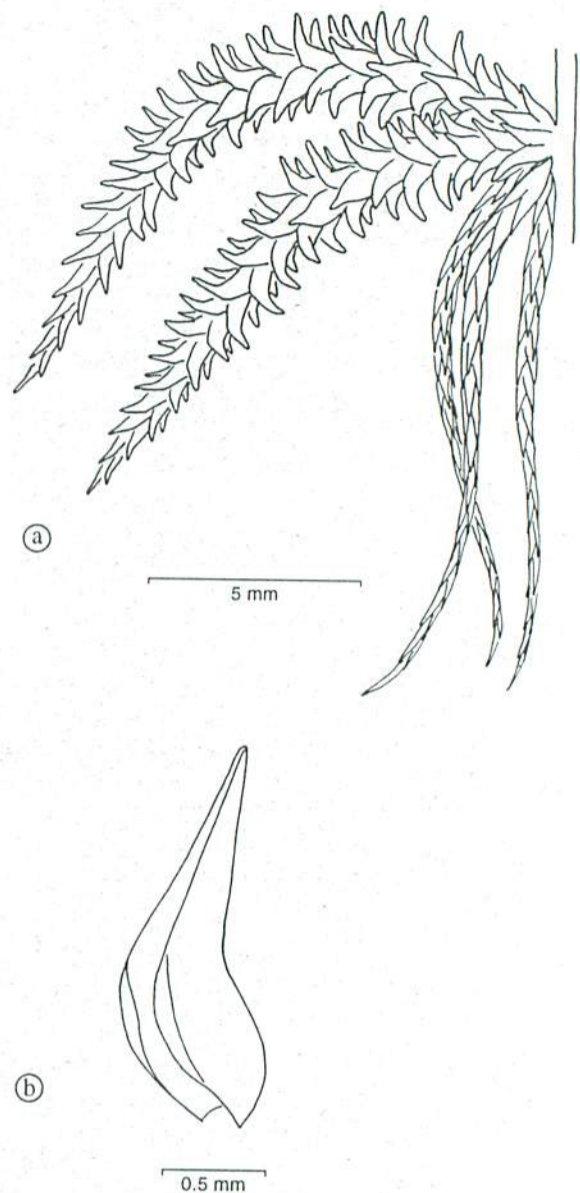


Figure 19. *S. squarrosum* Crome: a) branch with fuzzy appearance, and b) squarrose branch leaf.

General Description (Figure 20)

Slender but somewhat rigid, small to medium-sized plants; plant color is brown–green or yellow, less commonly brown, yellow–green, or pale green; color of the stem wood cylinder is brown or red–brown; the head is small, flattened, and sometimes star-shaped, with a single, large and conical terminal bud; branches occur in fascicles of five, with three (sometimes two) spreading; branch leaves are >1 mm wide, loosely appressed, not five-ranked, ovate to lingulate-lanceolate, somewhat spreading and squarrose (especially when dry), with an involute margin toward the finely toothed apex; stem leaves are large, ovate to elliptic, flat and slightly fringed at the broadly rounded apex.

Distribution and Habitat

Circumpolar; infrequent to occasional throughout northwestern Ontario. Typically growing as floating mats; extensive, loose carpets; or low cushions in open or partially shaded, very wet locations. *S. teres* is a moderately to strongly minerotrophic and calciphilic species, and is often found in open, medium to rich fens, sedge- or cattail-dominated marshes (often along lake margins), and also sometimes in cedar swamps, alder thickets, and medium to rich treed fens.

Comments

The rather rigid branches are nearly perpendicular to the stem, and the branch leaves are not five-ranked. Leaf tips of plants growing in shade tend to spread more than those of open-grown plants. Robust individuals, especially when they are dry, may be difficult to distinguish from *S. squarrosum*, which is typically stouter, bright green, and often covered by abundant sporophytes. Green forms of *S. teres* may also resemble *S. girgensohnii*, but the latter has only two spreading branches per fascicle, a green-colored stem wood cylinder, and is more frequently found in fully shaded locations.

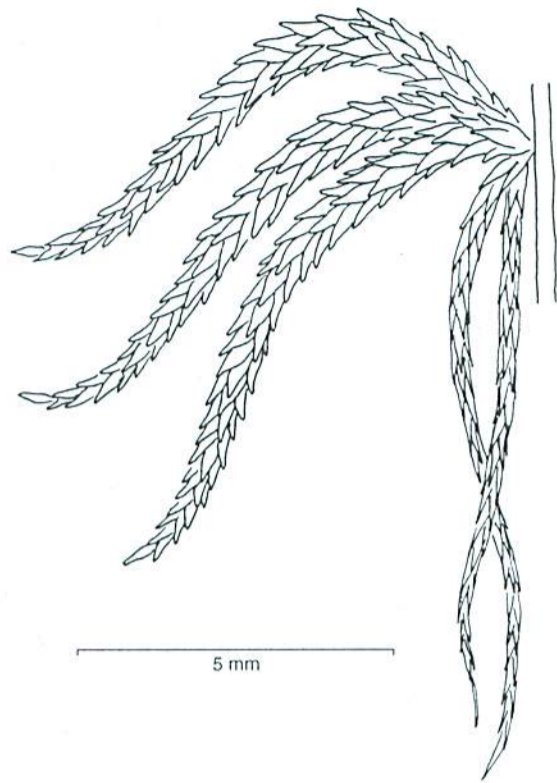


Figure 20. *S. teres* (Schimp.) Angstr. ex C. Hartm.: fascicle of branches.

General Description (Figure 21)

Slender and flexuous, small to medium-sized plants; plant color is pale green or green, occasionally (pale) yellow or yellow-brown; the color of the stem wood cylinder is pale green or green; the head is generally small and has a single, very large, cone-shaped terminal bud; the stem is thin and lax; there are typically two (sometimes three) spreading branches per five-branch fascicle; branch leaves are small, not five-ranked, imbricate, narrowly ovate and involute, with a finely toothed apex; stem leaves are large, lingulate, and distinctively and strongly fringed or lacerated along the sides and across the broad apex.

Distribution and Habitat

Circumpolar; infrequent throughout northwestern Ontario. Forming small hummocks or dense carpets above the water level in open or occasionally partially shaded locations. *S. fimbriatum* is a weakly to moderately minerotrophic species found on mineral soil substrates at the margins of ombrotrophic bogs and poor to medium fens, in relatively dry parts of open bogs, or in the wet, shrubby transition zones between open bog and forested wetland.

Comments

Slender and typically bright green when moist, plants become gray when dry; in particular, the terminal bud develops a distinctive gray-cobwebby appearance (cf. Crum 1983) because of the strongly fringed or lacerated leaves that enclose it. *S. fimbriatum* commonly produces abundant sporophytes that arise on short, erect stalks from the head and appear as small, dark brown or black, globular capsules; no other *Sphagnum* species found in northwestern Ontario fruits as freely. Larger plants of *S. fimbriatum* may resemble *S. teres*, which has a brown or red-brown stem wood cylinder and smaller, less fringed stem leaves. *S. fimbriatum* is also very similar in appearance to *S. girgensohnii*, but can be distinguished on the basis of its small and frail habit, stem leaves that are conspicuously fringed-lacerated at both the sides and tip, and a clearly visible terminal bud. *S. fimbriatum* occurs in the same habitats as *S. russowii* and *S. palustre* (e.g., mineral soil edges of bogs and poor fens).

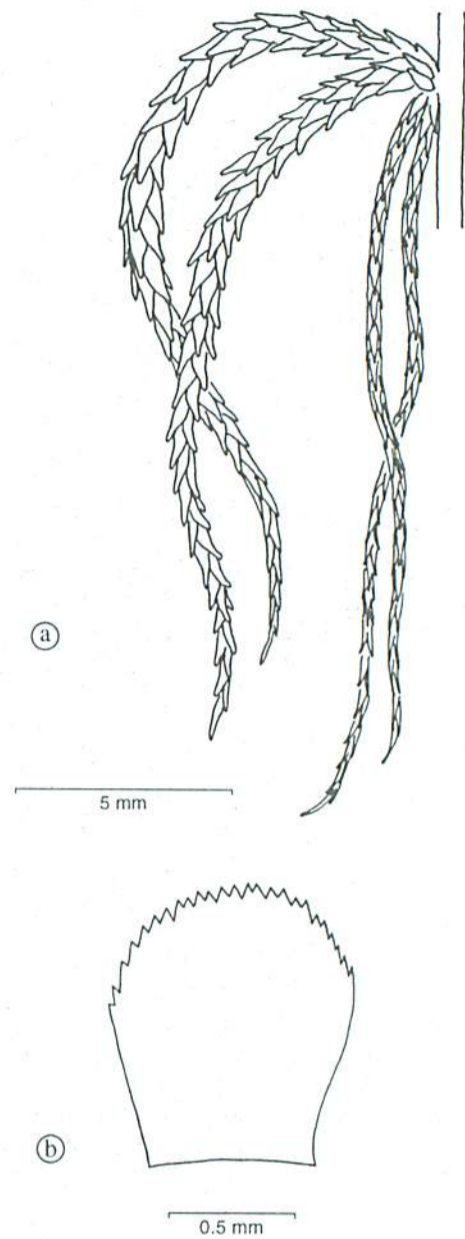


Figure 21. *S. fimbriatum* Wils. ex J.D. Hook. f.: a) fascicle of branches, and b) lingulate, lacerate stem leaf.

6.10. *Sphagnum girgensohnii* Russ.

Spruce Swamp Sphagnum
Common Green Sphagnum

General Description (Figure 22)

Medium-sized to large, stiff, wiry plants; plant color is bright green (never red or red-tinged); color of the stem wood cylinder is pale green, green, or pale brown; the head is distinctly star-shaped with five radiating points, somewhat flattened, with a large, glossy, terminal bud protruding from the center; the stem is stiff and breaks crisply when snapped in two; the two spreading branches per four- or five-branch fascicle are long and drooping in five rows, and the pendent branches more or less cover the stem; branch leaves are small, never five-ranked, imbricate, ovate-lanceolate, with strongly involute margins near the pointed apex; stem leaves are large, broadly lingulate, with a slightly fringed or lacerated, blunt apex.

Distribution and Habitat

Circumpolar; common throughout northwestern Ontario. Forming dense carpets or low cushions, but not hummocks, in wet, open, or shaded locations. A weakly to strongly minerotrophic species, *S. girgensohnii* is found on damp humus or bare peat in poor to rich, moist to wet conifer-dominated forests, especially in lower landscape positions and wet depressions, as well as cedar swamps, black spruce peatlands, poor to rich treed or open fens, and bordering drainage channels and seepage ways on slopes.

Comments

In northwestern Ontario, *S. girgensohnii* may generally be less extensive than *S. russowii*, which it resembles; these two *Sphagnum* spp. often grow together in mixtures, but are easily distinguished on the basis of color, since *S. russowii* is usually tinged with red whereas *S. girgensohnii* lacks any red pigment. *S. teres* may sometimes be confused with *S. girgensohnii*, but can be separated by its darker (i.e., brown or red-brown) stem wood cylinder.

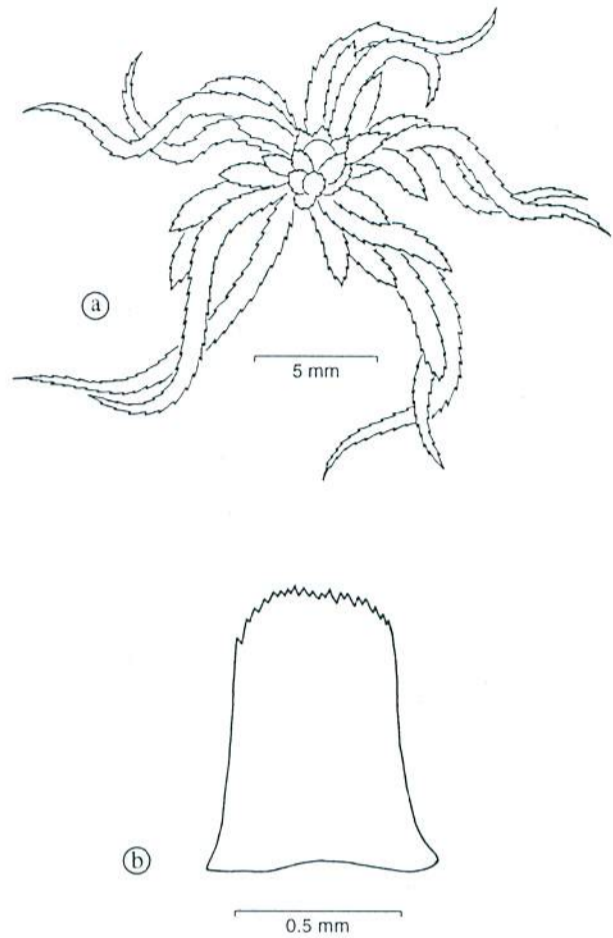


Figure 22. *S. girgensohnii* Russ.: a) stellate head with large terminal bud, and b) slightly fringed stem leaf.

General Description (Figure 23)

Slender, usually medium-sized but sometimes large plants; plant is usually multicolored, typically green tinged with various shades of red, and very rarely (and only in plants growing in full shade) entirely green; color of the stem wood cylinder is green, pale green, or sometimes yellow-green, and often is tinged with red; the head is distinctly star-shaped with five radiating points, somewhat flattened, with an often conspicuous, small to large, glossy terminal bud protruding from the center; the stem is somewhat lax and usually does not break crisply when bent in two; branches occur in fascicles of four or five, with two long-spreading and drooping, and two to three pendent branches more or less covering the stem; branch leaves are small, ovate-lanceolate, with involute margins towards the apex; stem leaves are large, lingulate, and have a small notch (and are not fringed or lacerated) at the rounded apex.

Distribution and Habitat

Circumpolar; common throughout northwestern Ontario. Forming low cushions, loose carpets, or small hummocks, or occurring in mixtures with other *Sphagnum* spp. on medium-sized to large hummocks, in wet, shaded, or open locations. *S. russowii* is a weakly to strongly minerotrophic species found in moist to wet conifer-dominated forests, black spruce peatlands, cedar swamps, and in the more acidic parts of open or treed bogs, or poor to rich open or treed fens. *S. russowii* occurs in a variety of wetland habitats and is frequently associated with other *Sphagnum* spp. in hummock/hollow complexes.

Comments

Although found throughout northwestern Ontario, *S. russowii* is usually not very abundant locally, growing as scattered plants or in small patches, and usually occurring in mixtures with other *Sphagnum* spp. Plants growing in the shade may be confused with *S. girgensohnii*, but even green forms of *S. russowii* have red tinges on the stem near the head, and plants are not stiff and wiry, so that the stem does not usually break with an audible snap. Accurately separating some forms of *S. russowii* and *S. nemoreum* is problematic, and sometimes microscopic features must be examined; in general, the stem leaves of *S. russowii* are not as square as those of *S. nemoreum* and have a small notch at the apex.

Synonyms: *S. robustum* (Warnst.) Röll

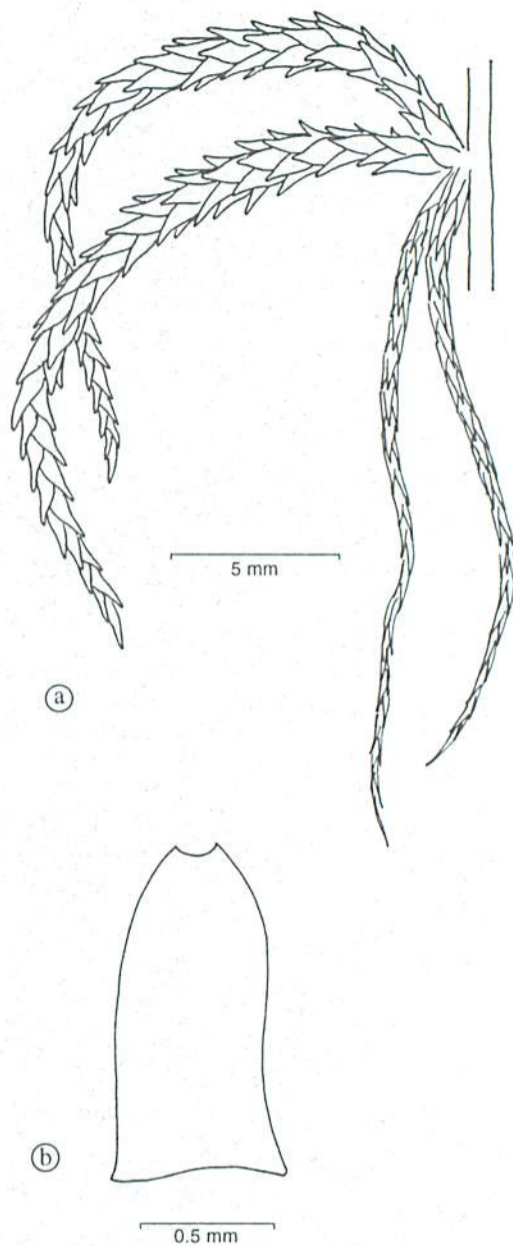


Figure 23. *S. russowii* Warnst.: a) fascicle of branches, and b) notched stem leaf.

General Description (Figure 24)

Slender, small to medium-sized plants; color of plant is pale green, green, green tinged with red, or, less frequently, yellow-green, yellow-brown, or brown; color of the stem wood cylinder is nearly white, pale green, green, or yellow-green, often tinged with pink; the head is flattened or somewhat rounded, not star-shaped, and often (but not always) with one or two prominent terminal buds protruding near the center; on the side of the head there are conspicuous sets of young, paired buds that radiate from between spreading branches; branches occur in fascicles of four (sometimes five), with the two spreading branches easily differentiated from the longer, thread-like, usually paler pendent branches that loosely cover the stem; branch leaves are small, five-ranked, ovate-lanceolate, recurved, and somewhat undulate when dry; stem leaves are small, short-triangular, with a blunt or rounded, sometimes finely toothed, apex.

Distribution and Habitat

Circumpolar; common throughout northwestern Ontario. Typically forming extensive, loose carpets or low cushions, or growing in mixtures with other *Sphagnum* spp., sometimes on the bases or sides of medium-sized to large hummocks, in wet, shaded, or open locations. *S. angustifolium* is an ombrotrophic to moderately minerotrophic species occurring in open or treed bogs; poor, medium, or less frequently, rich open or treed fens; black spruce peatlands; cedar swamps; and alder thickets.

Comments

S. angustifolium may be replaced in more calcareous habitats by *S. warnstorffii*. It is typically located in low-lying positions, in wet depressions, or in drainage channels at or just above the water level. Often it is found growing in mixtures with other *Sphagnum* spp., most commonly *S. magellanicum*, *S. nemoreum*, and *S. fuscum*.

Synonyms: *S. recurvum* var. *tenue* Klinggr., *S. fallax* var. *angustifolium* (C. Jens. ex Russ.) Nyh., *S. parvifolium* (Warnst.) Warnst.

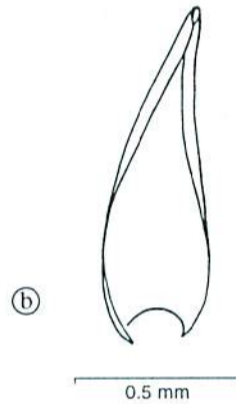
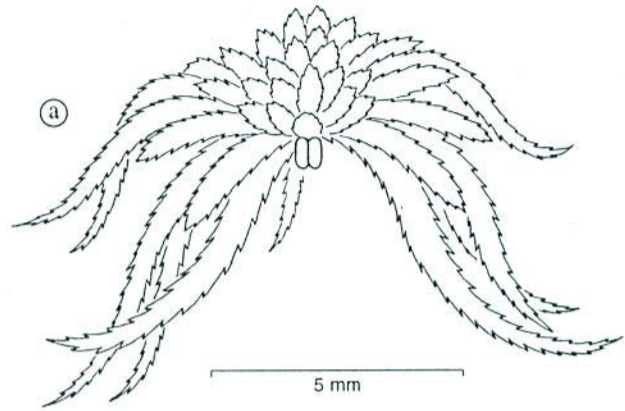


Figure 24. *S. angustifolium* (C. Jens. ex Russ.) C. Jens.: a) pair of buds on the head, and b) recurved branch leaf.

General Description (Figure 25)

Weak, limp when wet, slender, small to medium-sized plants; plant color is pale green, green, green tinged with red, or yellow; color of the stem wood cylinder is yellow-green, yellow-brown, brown, pale brown, or sometimes green; the head is often small and poorly developed, flattened, tinged with red, not star-shaped, with a small, inconspicuous terminal bud; the stem is weak, thin, flexible and often very long; branches occur in fascicles of four, with the two spreading branches often not well differentiated from the pendent branches; branch leaves are large, not five-ranked, narrow, long-lanceolate, curved and undulate when dry, involute, with a finely toothed apex; stem leaves are small, short-triangular and concave, with a bluntly pointed, finely toothed apex.

Distribution and Habitat

Amphiatlantic; occasional throughout northwestern Ontario. Growing as scattered individual plants, loose carpets or floating mats (often submerged in shallow water) in open or partially shaded locations, right at the water level. *S. cuspidatum* is an ombrotrophic to weakly minerotrophic species and is found in the wetter depressions, pools, or drainage channels of open peatlands, sometimes becoming emergent in mid- to late summer, but normally growing directly in water. Sometimes occurring in wet pools in alder thickets, on wet peat, among sedges in fens, or growing in mixtures with other *Sphagnum* spp., including *S. angustifolium*, *S. nemoreum*, and *S. rubellum*, but always located in the wetter, low-lying positions.

Comments

The most hydrophytic *Sphagnum* species in northwestern Ontario, it can be readily identified by its habitat preference and wet feathery appearance; it sometimes grows in tangled masses. The growth form may be more compact and stout when *S. cuspidatum* is growing as an emergent plant, and in these forms in particular, separation of this species from *S. angustifolium* may require the examination of microscopic features.

Synonyms: *S. laxifolium* C. Mull.

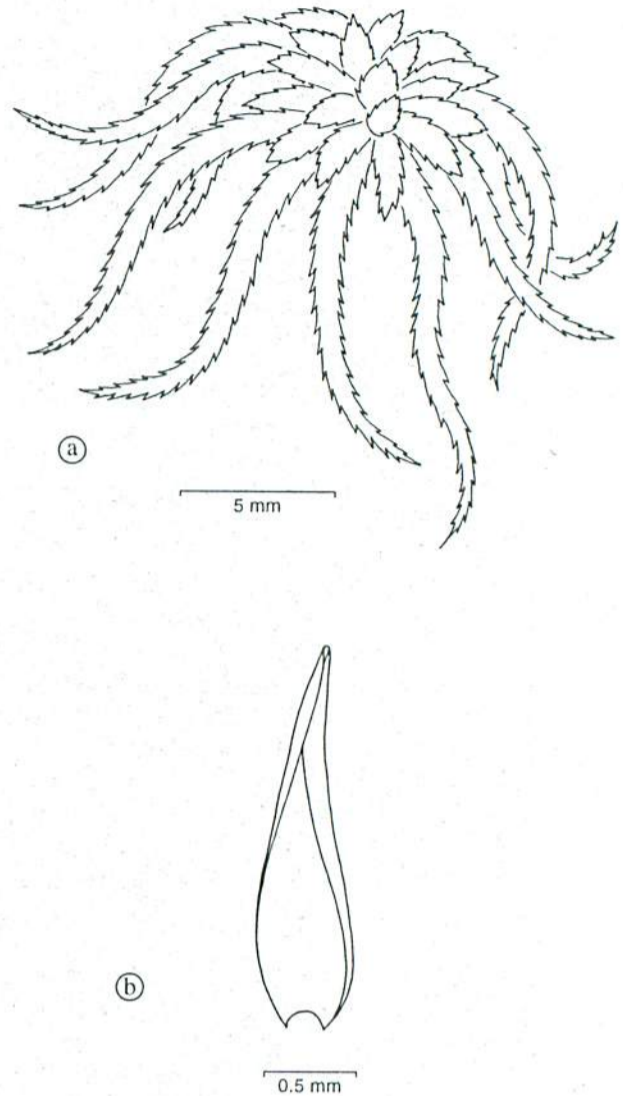


Figure 25. *S. cuspidatum* Ehrh. ex Hoffm.: a) loose, lax head and branches, and b) branch leaf (not recurved).

General Description (Figure 26)

Stiff, compact, small to medium-sized plants; color of the plant is red, pink, green tinged with red, green, or pale green, with a dull, somewhat metallic lustre when dry; the color of the stem wood cylinder is pale green to yellow-green; the rounded to hemispherical head is densely branched and lacks a prominent terminal bud; branches are in fascicles of four or five, mostly with three spreading branches per fascicle; spreading branches gracefully curve and appear somewhat bushy when dry, while pendent branches loosely cover the stem; branch leaves are small, strongly five-ranked, ovate to ovate-lanceolate, straight, spreading and involute near the pointed apex; stem leaves are small, short-triangular to triangular-lanceolate, somewhat involute, with an acute apex.

Distribution and Habitat

Circumboreal; infrequent to occasional throughout northwestern Ontario. Forming compact small hummocks, low cushions, or dense carpets and preferring partially or fully shaded, wet to moderately wet locations. *S. quinquefarium* is a weakly to moderately minerotrophic species found on wet peat, humus, or mineral soil substrates in black spruce peatlands, cedar swamps, moist to wet conifer-dominated forests, or on bedrock slopes and rocky cliffs where there is continuous, slow water seepage.

Comments

S. quinquefarium has sharply five-ranked branch leaves, especially when dry, and most fascicles have three spreading branches, a condition that gives the head a dense, hemispherical shape, and the plant a distinctively bushy aspect. It may sometimes be confused with *S. rubellum*, which has somewhat secund branch leaves, or with *S. warnstorffii* or *S. russowii*, both of which have mainly two spreading branches per fascicle.

Synonyms: *S. acutifolium* var. *quinquefarium* Lindb. ex Braithw.

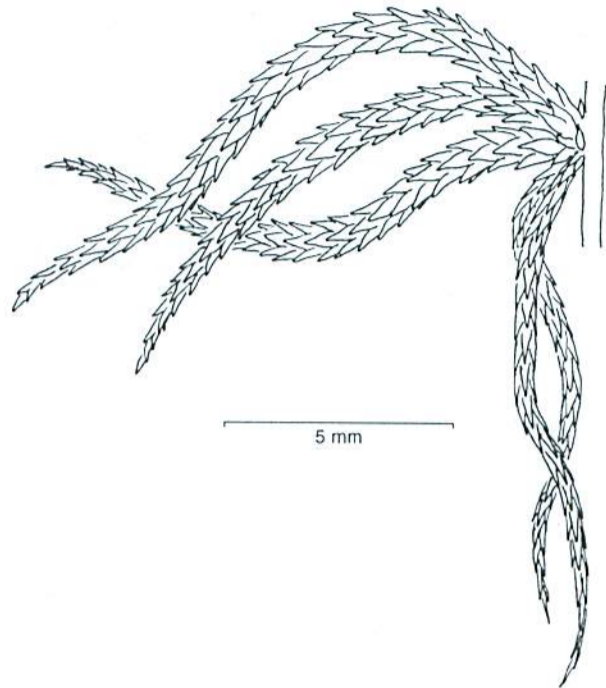


Figure 26. *S. quinquefarium* (Lindb. ex Braithw.) Warnst.: fascicle of branches (five-ranked branch leaf pattern and three spreading branches per fascicle).

General Description (Figure 27)

Slender, stiff, small to medium-sized plants; plant color is red, pink or green tinged with red, or less commonly, green or pale green; color of the stem wood cylinder is red (sometimes green in the upper portions of the plant); the head is typically flattened or somewhat rounded (especially when growing in hummocks), not or sometimes indistinctly star-shaped, and without prominent terminal buds; branches are in fascicles of mostly three or four, with two widespreading branches, and pendent branches closely appressed to the stem; branch leaves are small, strongly five-ranked (most noticeable on dry branches), ovate to ovate-lanceolate, slightly curved and somewhat secund, and involute at the apex; stem leaves are large, lingulate to triangular-lingulate, with a broadly rounded apex.

Distribution and Habitat

Circumpolar; occasional throughout northwestern Ontario. Forming small to medium-sized hummocks, low cushions, extensive loose carpets, or occasionally, floating mats, in open or partially shaded, wet or very wet locations. An ombrotrophic to weakly minerotrophic species found in open bogs and poor fens, usually in distinctly acidic habitats, and also frequently growing in mixtures with other *Sphagnum* spp., especially *S. fuscum*, *S. angustifolium*, and *S. magellanicum*, and occupying intermediate or low-lying positions.

Comments

S. rubellum may be distinguished from *S. nemoreum* and *S. russowii*, two species which may sometimes be closely similar in appearance, by its strongly five-ranked and somewhat secund branch leaves. *S. rubellum* is most frequently encountered in open locations where it exhibits a brilliant and characteristic red coloration. It frequently forms small hummocks or occurs on the bases and sides of medium-sized to large hummocks dominated by *S. fuscum*.

Synonyms: *S. capillaceum* var. *tenellum* (Schimp.) Andrews, *S. capillifolium* var. *tenellum* (Schimp.) Crum

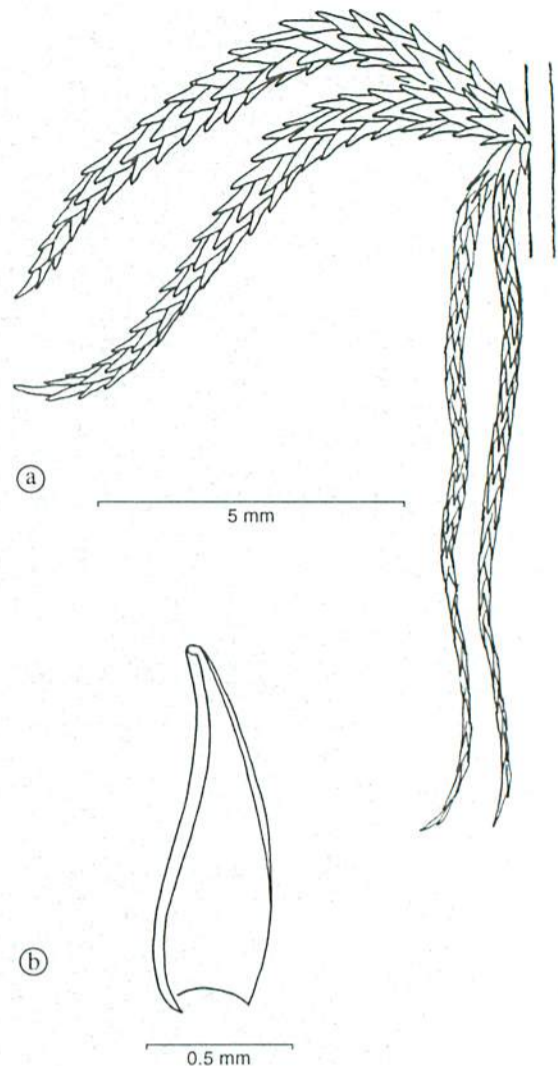


Figure 27. *S. rubellum* Wils.: a) fascicle of branches (five-ranked branch leaf pattern, with two spreading branches per fascicle), and b) curved, secund branch leaf.

General Description (Figure 28)

Rather slender, delicate, small to medium-sized plants; plant color ranges from red to green, but rarely entirely green (usually, there are some red tinges evident), and occasionally, brown-green or yellow; color of the stem wood cylinder is usually green (upper portions) to red, brown, or red-brown (lower portions); the head is distinctly star-shaped and flattened, and does not have a prominent terminal bud; branches are in fascicles of three to five, with two slender spreading branches strongly diverging from the stem, and one to three pendent branches loosely covering the stem; branch leaves are small, strongly five-ranked (often spirally arranged in five distinct rows), ovate to ovate-lanceolate, spreading to recurved (especially when dry), with an involute, pointed apex; stem leaves are small, oblong to triangular-lingulate or lingulate, with a blunt, notched apex.

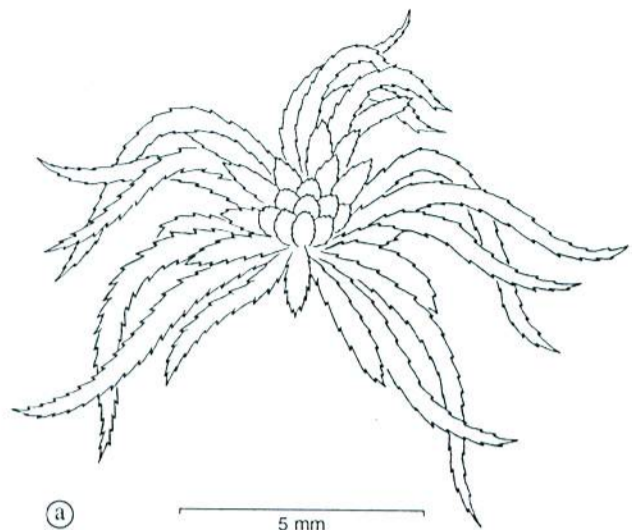
Distribution and Habitat

Circumpolar; common throughout northwestern Ontario. Occurring as individual plants or forming extensive, loose carpets or small cushions, and preferring partially or fully shaded, wet locations. *S. warnstorffii* is a moderately to strongly minerotrophic and calciphilic species found in medium to rich treed fens, black spruce peatlands, cedar swamps, and moist to wet conifer-dominated forests. It typically grows in small depressions where water levels remain close to the ground surface, or may form extensive, loose carpets, particularly in large, treed fens.

Comments

Plants are typically colored dark red or even purple, but may be dark green when growing in full shade. It is possible to separate this species from most others that might be confused with it in northwestern Ontario (e.g., *S. girgensohnii*, *S. russowii*, and *S. nemoreum*) by recognizing its habitat preferences; the coloration of both plant and stem wood cylinder; and the small, straight, spreading, and distinctly five-ranked branch leaves. It is often found growing in mixtures with other moderately to strongly minerotrophic *Sphagnum* spp., such as *S. teres*, *S. squarrosum*, and occasionally, *S. centrale*.

Synonyms: *S. warnstorffianum* DuReitz



(a)

5 mm



(b)

0.5 mm

Figure 28. *S. warnstorffii* Russ.: a) stellate head, with no prominent terminal bud, and b) small, straight, spreading branch leaf.

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

Brown Bog Sphagnum
Common Brown Sphagnum

General Description (Figure 29)

Small, slender, compact and wiry plants; color of the plant is typically brown or red-brown, but in shade may be brown-green or occasionally green; color of the stem wood cylinder is brown to black; the head is small, very compact, flat and somewhat star-shaped, or rounded, and there is no distinct, easily discernible, terminal bud; the stem is stiff and wiry; branches, growing in fascicles of three to five, are slender and thread-like, with two shorter spreading branches, and pendent branches thinner, about twice as long, and tightly appressed to the stem; branch leaves are small, usually not five-ranked, ovate-lanceolate, imbricate, with margins finely toothed and involute at the narrow apex; stem leaves are small to large, lingulate, with a broadly rounded apex.

Distribution and Habitat

Circumpolar; common throughout northwestern Ontario. Forming medium-sized to large, compact hummocks in open or shaded, moderately wet to dry locations. *S. fuscum* is an ombrotrophic to weakly minerotrophic species found in acidic open or treed bogs; poor to rich, open or treed fens; and poor black spruce peatlands. Typically forming well-developed, dense, brown or brownish-green hummocks, or topping older, drier hummocks that may have been initially created by other *Sphagnum* spp.

Comments

S. fuscum is a major peat-forming species in the boreal wetlands of northwestern Ontario, growing at the top of larger hummocks in the drier parts of very acidic peatlands. It develops into large hummocks above *S. angustifolium*, *S. magellanicum*, *S. nemoreum*, and *S. rubellum* (in drier, more acidic, ombrotrophic or weakly minerotrophic habitats) or *S. warnstorffii* and other *Sphagnum* spp. (in wetter, calcareous and moderately to strongly minerotrophic habitats). Useful aids for recognizing *S. fuscum* in the field are the dark brown color of plants and stem wood cylinder; the compact growth form within hummocks; and the characteristic disorganized and wiry appearance of interwoven thread-like branches, visible when a clump of plants is examined in profile. In open locations, plants of *S. angustifolium*, *S. teres*, *S. subsecundum*, *S. fimbriatum*, and *S. subnitens* may also sometimes be brown in color, and may superficially resemble *S. fuscum*.

Synonyms: *S. acutifolium* var. *fuscum* Schimp.



Figure 29. *S. fuscum* (Schimp.) Klinggr.: fascicle of branches.

General Description (Figure 30)

Weak-stemmed, medium-sized to large, robust plants; plant color is pink, green, pale green, yellow-green or yellow, not shiny when dry; color of the stem wood cylinder is red, pale green or green; the head is well-rounded, often hemispherical, densely crowded with short, blunt, swollen branches, and there is usually no distinct, easily discernible, terminal bud; there are two spreading branches per three- to five-branch fascicle; branch leaves are large, not five-ranked, ovate to ovate-lanceolate, and involute near the pointed apex; stem leaves are large, elongate, and ovate with a concave, blunt apex.

Distribution and Habitat

Endemic to eastern North America; infrequent to occasional throughout northwestern Ontario. Forming compact, small to medium-sized hummocks or low cushions, in open or shaded, wet locations. A weakly minerotrophic species that occurs in black spruce peatlands; open or treed bogs and poor fens; along the margins of ponds, drainage channels, and roadside ditches on wet sand and thin humus; as well as on wet bedrock slopes.

Comments

Distinguishing this species from *S. nemoreum* is problematic and the use of a microscope to examine stem and branch leaf cell structure is often required (see Andrus 1980). In general, *S. tenerum* is more robust in general aspect; has stem leaves that are more elongate; and branches that appear swollen, not slender, especially in the head of the plant. *S. russowii* may also be difficult to separate from *S. tenerum*, but it too is less robust and lacks swollen branches.

Synonyms: *S. capillifolium* var. *tenerum* Sull. & Lesq., *S. capillaceum* var. *tenerum* (Sull. & Lesq.) Crum

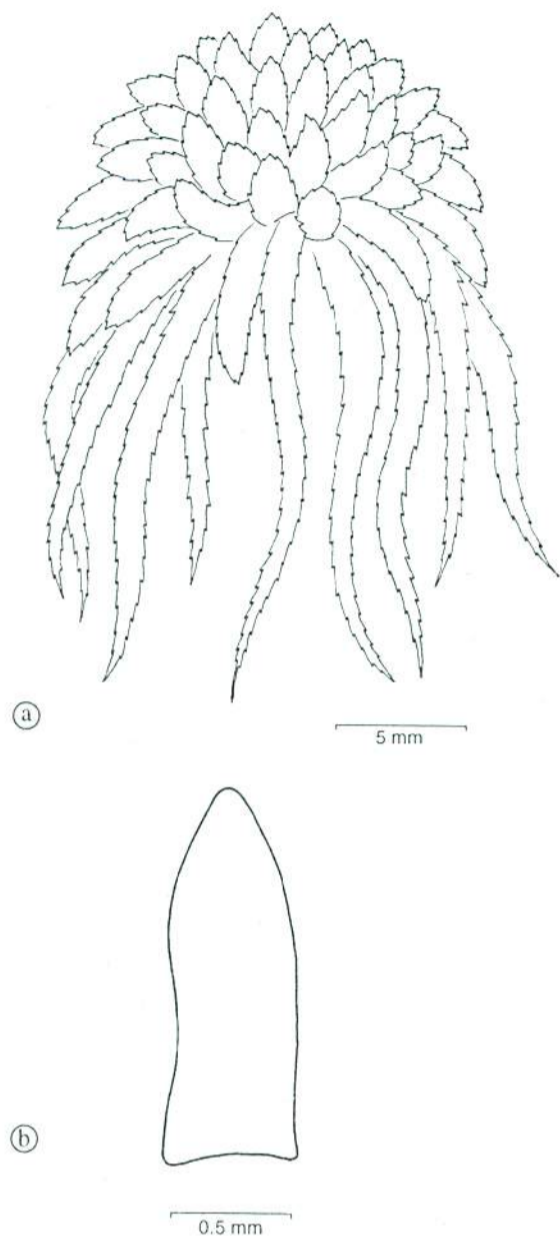


Figure 30. *S. tenerum* Sull. & Lesq.: a) generally "swollen" head (compare with *S. nemoreum*), and b) stem leaf.

6.19. *Sphagnum nemoreum* Scop.

“Ladies Tresses” Sphagnum
Common Red Sphagnum

General Description (Figure 31)

Rather slender, medium-sized to large plants; plant color ranges from green to red, often green tinged with red; color of the stem wood cylinder is usually red, but may be green or pale green, especially in upper portions of the stem; the head is typically small, rounded to hemispherical, compact, often double, and there is usually no distinct, easily discernible, terminal bud; branches occur in fascicles of three to five, with normally two spreading; the spreading branches are long, sweeping, curving outwards at the ends like “ladies tresses”, and often tangled with one another; the pendent branches are very slender and tightly appressed to the stem, more or less concealing it; branch leaves are small, not five-ranked, imbricate, straight (not subsecund), lanceolate, with involute margins near the pointed apex; stem leaves are large, lingulate to triangular-lingulate, involute, and tapering to a truncate, concave apex.

Distribution and Habitat

Circumpolar; common throughout northwestern Ontario. Forming small, medium-sized or large compact hummocks, or occasionally low cushions, in open or shaded, moderately wet to dry locations. An ombrotrophic to moderately minerotrophic species, *S. nemoreum* is found in a wide variety of habitats, including open or treed bogs; poor, medium or rich, open or treed fens; cedar swamps; black spruce peatlands; or on humus or wet rocks in moist to wet conifer-dominated forests. Often forming small to medium-sized hummocks or occurring on the tops and sides of large hummocks in association with other *Sphagnum* spp., especially *S. fuscum*, *S. russowii*, and *S. magellanicum*.

Comments

With the notable exception of *S. fuscum*, *S. nemoreum* is tolerant of more acidic conditions than any other *Sphagnum* spp. found in northwestern Ontario. Taxonomically, this species is problematic, and some forms of *S. tenerum*, *S. russowii*, *S. quinquefarium*, and *S. rubellum* may be difficult to separate from *S. nemoreum*, requiring the examination of microscopic features. In general, *S. tenerum* is more robust and has branches that appear swollen, *S. rubellum* has broadly rounded (not truncate) stem leaves and somewhat secund (not straight) branch leaves, *S. quinquefarium* has mainly three (not two) spreading branches per fascicle, and *S. russowii* has stem leaves that are rounded and notched (not involute and blunt) at the apex.

Synonyms: *S. capillaceum* (Weiss) Schrank, *S. capillifolium* (Ehrh.) Hedw., *S. acutifolium* Schrad.

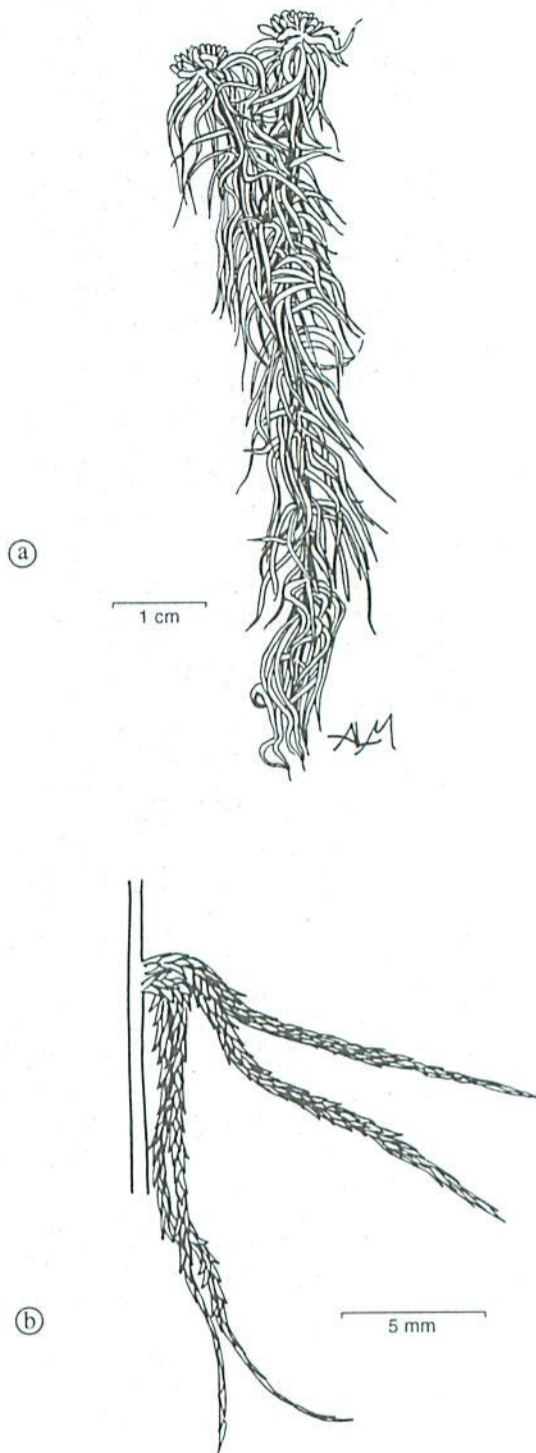


Figure 31. *S. nemoreum* Scop.: a) general habit, and b) fascicle of branches.

General Description (Figure 32)

Soft, lax, medium-sized to large, sometimes robust, plants; plant color is green tinged with blue and red, or occasionally yellow-brown on open sites, and developing a characteristic shiny, metallic lustre when dry; color of the stem wood cylinder is red-brown, or less commonly, green; the head is flattened or somewhat rounded, and there is usually no distinct, easily discernible, terminal bud; branches occur in fascicles of three to five, with the two spreading branches not noticeably differentiated from the pendent branches; branch leaves are large, lanceolate, recurved (especially when dry), involute, and tapering to a pointed apex; stem leaves are large, short-triangular to triangular-lingulate, and tapering to a short, pointed apex.

Distribution and Habitat

Circumpolar; infrequent to occasional throughout northwestern Ontario. Occurring as individual plants or forming low cushions or loose carpets in open or shaded, wet to moderately wet locations. *S. subnitens* is a weakly to moderately minerotrophic, and perhaps somewhat calciphilic species. It is found in open or treed bogs; poor to medium, open or treed fens; alder thickets; and in small, wet depressions or on wet rocks in moist to wet conifer-dominated forests.

Comments

When dry, plants develop a characteristic shiny, metallic lustre, which highlights the blue and red tinges. *S. subnitens* may sometimes be difficult to separate from *S. nemoreum*, possibly requiring the examination of microscopic features. *S. subnitens* has a dark brown stem wood cylinder and, in a dry state, branch leaves with a distinctive metallic lustre; the branch leaves of *S. nemoreum* are dull when dry. Typical habitats for *S. subnitens*, which appears to be relatively rare throughout its range in North America, are mineral-rich treed fens or conifer swamps. In the field, *S. subnitens* may be found growing in association with *S. warnstorffii*, *S. nemoreum*, and *S. teres*.

Synonyms: *S. plumulosum* Röll

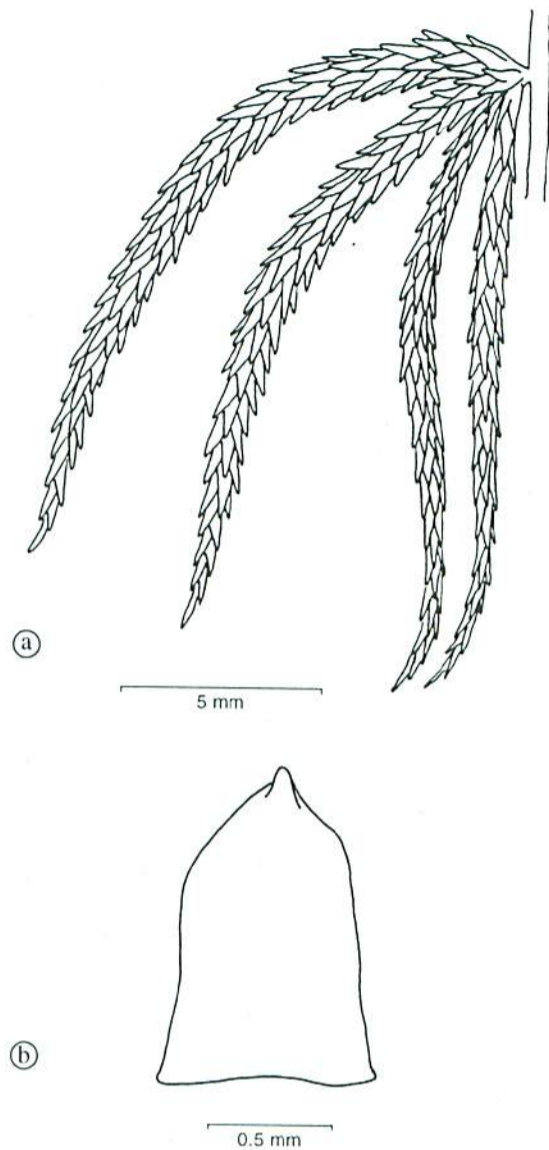


Figure 32. *S. subnitens* Russ. & Warnst. ex Warnst.: a) fascicle of (not widespreading) branches, and b) stem leaf.

7.0 SUMMARY AND RECOMMENDATIONS

This report is intended to provide assistance with the field recognition of 20 *Sphagnum* species known to occur in northwestern Ontario. The reader is cautioned that under field conditions many *Sphagnum* species are difficult to identify with accuracy, but it is often possible to obtain a provisional identification that can be confirmed later with laboratory study. The reader is also warned that there may be other species encountered in northwestern Ontario that are not dealt with here. Some characters may vary considerably from the "norm" when a species occurs at the edge of its regular ecological range (i.e., it is "off-site") or where it may have been affected by an altered environmental state, either through natural effects (e.g., beaver dam change to local patterns of water movement and soil moisture) or human disturbance (e.g., forest harvesting and reforestation).

The *Sphagnum* spp. described in this report collectively occur over a wide range of soil conditions, although they are most commonly encountered on those parts of the landscape where drainage is impeded and nutrient status is generally poor. Wetland scientists have long known and reported on the importance of using *Sphagnum* spp. as indicators of wetland moisture, light, and nutrient status. In northwestern Ontario, different species often exhibit affinities to different environmental conditions; for example, in association with a nutrient gradient, *S. warnstorffii* grows mainly in nutrient-rich sites (e.g., mainly swamps and moist upland forests), *S. magellanicum* occurs regularly in association with intermediate nutrient regimes (e.g., swamps and fens), while *S. angustifolium* and *S. fuscum* are most frequently encountered in association with weakly minerotrophic and ombrotrophic conditions (e.g., poor fens and bogs) (Kershaw et al. 1994).

The *Sphagnum* spp. keys and identification system presented here should be considered as a "first approximation" that should be improved and updated at some point in the future. A required step will be the incorporation of better site descriptions according to the recently published wetland classification system for northwestern Ontario (Harris et al. 1996). With some additional work, the system presented here could also be expanded to cover other geographic parts of the province, and/or could be used as a prototype for completing an Ontario-wide version. At this point, the reader is cautioned to be very careful in using the current system in geographic areas that are outside of the defined report area. For example, species may be encountered that are not covered by these keys, or some of the species reported here may be found in association with different habitats or a wider range of habitats.

In identifying *Sphagnum* species, the authors recommend that other taxonomic aids and publications also be consulted regularly, and that the steps and cautions raised here

be kept in mind. *Be aware that there will still be a regular requirement for lab-based identifications and the use of herbaria materials to confirm identifications.*

This report has provided an introduction to and overview of the identification of commonly occurring *Sphagnum* species in northwestern Ontario, including the presentation of field-based identification aids. The intent is that *Sphagnum* spp. will ultimately become better represented in ecological field surveys and scientific investigations, as well as in decision making for operational resource management. The latter notion is especially important because *Sphagnum* species represent a distinct group of taxa that are well known as accurate and useful local site indicators of average water level, soil moisture or groundwater nutrient regimes, and general acid/base status. A better knowledge of this genus by lay botanists, professional biologists, and resource management specialists alike will lead to better bases for studying and describing biodiversity and ecosystem processes, and the effects of changes to these systems by both natural and anthropogenic forces.

8.0 GLOSSARY OF SELECTED TERMS

Acidic - a habitat or substratum that is dominated by hydrogen ions; a condition which may be neutralized by alkalis [bases].

Acute - sharply pointed (less than 90° angle).

Alternate - attached singly along a stem or axis; not opposite or whorled.

Appressed - lying close together or closely applied to the stem.

Axil - the upper angle between leaf and stem.

Basic - a habitat or substratum that is dominated by ammonium or hydroxyl ions; a condition which may be combined with an acid to form a salt (e.g., calcium-rich substrata).

Biodiversity - the variety of life in all its forms, including consideration of genetic, species, community, and landscape levels of biological diversity.

Bog - an open or sparsely treed wetland habitat that is poor in mineral nutrients because water is supplied exclusively by precipitation; characteristically highly acidic and nutrient poor peatland dominated by *Sphagnum* and ericaceous shrubs. Many variations exist: including, basin, blanket, raised, and domed bogs.

Calciphile - an organism adapted to calcareous environments, which are characterized by soil water containing high concentrations of calcium ions, usually derived from weathered limestone or dolomite rock.

Capitulum - the often rounded and compact head of an individual *Sphagnum* plant, formed from a dense cluster of branches surrounding a terminal growing point.

Cortex - a woody cylinder of cells (*see also sclerodermis*) that composes most of the stem (and branch) tissue in a *Sphagnum* plant.

Cucullate - hooded or hood shaped; cucullate leaves are concave at the apex in a hood-like manner.

Dichotomous - equally forked, with paired branches.

Dioecious - bearing the male and female sex organs on separate plants; opposite of monoecious.

Distal - away from the center of body or point of attachment (opposite of proximal).

Elliptic - broadest in the middle and tapering equally toward both ends.

Entire - margins without teeth, lobes, or divisions.

Erect-spreading - spreading at an angle of about 45°.

Ericaceous - referring to a member of the *Ericaceae* (heath) family, which includes bog rosemary (*Andromeda glaucophylla* Link) and Labrador tea (*Ledum groenlandicum* Oeder).

Fascicles - the small bundle or cluster of lateral branches arranged in spirals on the main stem of *Sphagnum* plants.

Feathermoss - a group of mosses generally with a prostrate growth habit and pinnately branched stems, in particular including Schreber's moss (*Pleurozium schreberi* [Brid.] Mitt.), stair-step moss (*Hylocomium splendens* (Hedw.) B.S.G.), and plume moss (*Ptilium crista-castrensis* [Hedw.] De Not).

Fen - an open or sparsely treed wetland habitat that is more mineral rich than a **bog** due to groundwater input; ranging from acidic to alkaline, and nutrient poor to moderately rich (sometimes very nutrient rich).

Fibric peat - scarcely decomposed peat, consisting mainly of *Sphagnum* moss (or other organic materials).

Flarks - the alternating pools, hollows, or depressions of a patterned peatland that has developed on a slight slope.

Floating mat - a peatland that is largely underlain by water or unconsolidated peat, so that it "quakes" and yields underfoot.

Fruiting - forming a **sporophyte** (seta and capsule); in *Sphagnum* plants the capsule, when it occurs, is a distinct structure that remains attached to the **gametophyte**.

Gametophyte - the dominant, sexual generation of a plant that bears the sex organs; the green, leafy, or thalloid plant.

Humic peat - greasy, soft peat material resulting from advanced decomposition, usually with few or no discernable plant parts remaining intact.

Hummock - a rounded mound of *Sphagnum*, often supporting other plants such as **Ericaceous** species, and surrounded by a generally wetter and lower ground surface.

Hollow - wet depressions or pools, usually among hummocks; together, hummocks and hollows make up the general ground surface in a wetland.

Hyalodermis - large, empty, and colorless cells that create an outer layer of tissue on a *Sphagnum* plant's main stem that covers the cortex (**sclerodermis**); in most *Sphagnum* spp. the hyalodermis is easily removed.

Hydrophyte - a plant adapted to very wet environments.

Imbricate - appressed and overlapping.

Involute - inrolled, especially in reference to leaves that appear to be rolled along the margins.

Lacerate - deeply and irregularly slashed and torn.

Lanceolate - shaped like a lance head; much longer than wide, tapering towards the apex from below the middle and attached at the wide end (narrower than **ovate**).

Lateral - at the side (as opposed to **terminal**).

Lax - soft or loose (not upright and erect).

Lingulate - tongue shaped, oblong with a broadened apex.

Marsh - a grassy or shrubby wetland developed on mainly mineral soil in areas standing under water for at least part of the year; well aerated with **minerotrophic** conditions; includes vegetational and other variants, including riparian, deep, shallow, and meadow marsh.

Mesic peat - peat of intermediate decomposition, with some plant parts still intact, but exhibiting decompositional changes to structure, color, and appearance.

Mesotrophic - of a habitat: moderately rich or productive, and more or less neutral in reaction, as opposed to richer (basic) or poorer (acidic).

Minerotrophic - receiving nutrients from the groundwater and therefore rich in minerals as compared to an **ombrotrophic** condition where mineral nutrition is solely from atmospheric inputs; used in particular to describe areas where runoff or groundwater has an effect on vegetation.

Monoecious - bearing both male and female sex organs on the same plant; opposite of **dioecious**.

Niche - the specific habitat occupied by an organism.

Nutrients - ions dissolved in soil water solution, and taken up for use by plants.

Oblong - longer than broad with parallel sides.

Obovate - egg shaped (see above) but attached at the narrow end with the broader portion near the apex.

Obtuse - broadly pointed (more than 90° angle), sometimes used to mean blunt or rounded at the end.

Ombrotrophic - with water derived solely from precipitation and therefore poor in nutrients, such as in a bog; opposite of **minerotrophic**.

Ovate - broadly elliptical; broader at one end than the other, like the longitudinal section of an egg, and attached at the wide end.

Ovate-lanceolate - broadly elliptical but extending to a long, lance shaped, and narrowly tapered end.

Paludification - a dynamic process of peatland expansion involving a gradual rise in the water table as peat accumulation exceeds drainage and *Sphagnum* spp. ground cover continues to grow and expand.

Peatland - terrain that is underlain by organic (peat) soils; peat results when organic matter (originating from plant materials, and often primarily derived from *Sphagnum* spp.) is deposited under water-soaked and anaerobic conditions, such that, over time, the rate of accumulation exceeds the rate of decomposition; **fens**, **bogs**, and some **swamps** with deeper organic accumulations are often collectively referred to as "peatlands".

Pendent - drooping downward.

Ranking - forming distinct "rows"; in *Sphagnum* plants this term is frequently used to describe the pattern of insertion of leaves on the stems or branches.

Recurved - curved away; used to describe leaf margins or teeth that curve downward and/or backward, away from the stem apex.

Revolute - strongly **recurved**.

Sclerodermis - thick-walled cells that form the woody cylinder of *Sphagnum* spp. stems and branches; the sclerodermis surrounds a compact central tissue (small thin-walled cells) and is coated by a thin layer of **hyalodermis**; the color of this tissue is often a diagnostic aid in *Sphagnum* spp. identification.

Scythe-shaped - strongly curved to one side, shaped like a scythe; also referred to as **circinate** or **falcate**.

Secund - conspicuously turned to one side; used to describe leaves in which the apices all point in one lateral direction.

Spatulate - tapered from a broad, rounded apex, similar to **lingulate**, but more abruptly narrowed to more noticeable basal portion.

Sporophyte - literally, the spore-bearing plant; all plants have a diploid sporophyte generation, but where this occurs in *Sphagnum* spp., the sporophyte is a short, cylindrical capsule attached usually to the gametophyte's **capitulum**; colloquially referred to as a "fruiting body".

Spreading - bent backward (reflexed) at an angle of 45° or more (widespreading means near 90° and **squarrose** means at 90°).

Squarrose - spreading at right angles (90°).

Stellate - star shaped.

Sub- - a prefix meaning nearly, almost, or somewhat, as in subsecund, subacute, etc..

Swamp - usually a forested or treed wetland, flooded during part of the year or with moving groundwater, well aerated, rich in minerals, and often storing little or no peat; includes varieties such as thicket or conifer, the latter often transitional to treed **fen**.

Terminal - at the apex or end of an organ (as opposed to **lateral**).

Thicket - a condition characterized by dense tall shrub cover (e.g., thicket swamp), especially alder, willow, or other deciduous species.

Toothed - irregularities or projections along a leaf margin.

Truncate - abruptly cut off or squared off at the apex.

Tumid - swollen, inflated.

Undulate - wavy.

Water table - the top of the zone of saturation where all the pore spaces are filled with water, in contrast to the aerated upper zone of peat or soil.

Xerophyte - a plant adapted to dry environments.

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