



## MOSS LESSON 5: SPHAGNUMS IN THE FIELD

Jerry Jenkins ♦ THE NORTHERN FOREST ATLAS PROJECT ♦ June 2020



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ABOVE, wet bog mats at Branch Pond, Sunderland, Vermont: *Sphagnum magellanicum*, *majus*, *recurvum*, *papillosum*. Below, wet ledges in the Notch, White Creek, New York: *Sphagnum girgensohnii*, *Scapania nemorea*.



## INTRODUCTION

THIS IS THE FIFTH of eight moss lessons I am preparing for the on-line moss class, May-June 2020. It introduces the genus *Sphagnum* and explains how I parse it for field identification. I first outline the names and groups I use, then take you into the woods to meet five common *Sphagnum*s, and then explain the ten field groups in more detail.

The lessons are meant to accompany our photographic guide, the *Mosses of the Northern Forest* (Cornell University Press, 2020).

First an appreciation. *Sphagnum*s are wonderful plants: big, vivid, varied, informative, important. If you love moss, and especially if you can never get enough moss, you are in for a treat.

With, of course, a few challenges. There are a lot of *Sphagnum* species—I treat 29 in the northern forest—and at first they tend to look alike. But the differences are there, and you can learn to see them. There are also a lot of additional names that denote microscopic differences. If, for example, you want the world to know that you have found a plant of *Sphagnum imbricatum* with distinct fibrils in the walls of the inner stem cortical cells, you may call it *affine*. But the additional names are optional, and you can name everything you see without using them.

There are two different approaches to learning *Sphagnum* in the field: the first uses distinctive characters, the second distinctive groups. Our photo guide explains the first, this lesson introduces the second. I recommend using both. When you are just starting, the distinctive characters work best. If you have a plant with a purple-red plant with strongly 5-rowed leaves on a hummock in a rich fen, you can look it up in the quick guides and moss maps in my photographic guide. They will point like an arrow to *warnstorffii*. You look it up in the species accounts, and it fits. If you have a microscope, you stain some branch leaves, look at the tips, see the tiniest ringed pores you can imagine, and pour yourself a drink to celebrate.

Once you know the common *Sphagnum*s, the field groups described in this lesson will help you remember the species you have seen and close in on unknowns quickly. If you have a moss with long slender inrolled leaves from a pool in a bog, you know immediately that it has to be one of the three long-leaved *Cuspidata* in Group 5. You lift it out of the water and it collapses like sea lettuce. It is *cuspidatum*, and you are done. And may drink to that, too.

Both approaches work and will teach you a lot. Try them and see.



A hemlock swamp in the Taconics, about 1,700' elevation, Grafton, New York. Low mucky flats, flooded in winter and spring, dominated by *Rhizomnium appalachianum*. Raised hummocks and islands, connected by roots and rotted logs, with *Sphagnum capillifolium*, *girgensohnii*, *palustre*, *rubellum*, and *squarrosum*.

1 *SPHAGNUM* is a large and unusual moss genus, differing from other mosses in architecture and cytology. Sphagnums have moss spores and a moss life cycle, but every part of them differs from the corresponding parts of ordinary mosses. Their spores germinate to form a flat protonema; their branches occur in clusters, aggregated into a head at the top of the stem; their leaves contain a meshwork of slender green cells surrounding large hollow ones; their capsules are two chambered and elevated on an extension of the stem rather than a seta; their spores are dispersed explosively by a charge of compressed air.

2 The Sphagnums have been separate from other mosses for at least 300 million years. They are found world-wide, excepting Antarctica, with a preference for cool moist climates. They are the dominant plants in boreal peatlands. Worldwide, about 40% of soil carbon—550 GT—is stored in peat. The majority of this is *Sphagnum* peat.

3 Excepting the minimalist *pylaesii*, our sphagnums are generally similar. They have an upright stem with stem leaves, a terminal bud at the tip of the stem, and branches in clusters from the axils of stem leaves. The young branches form a head at the top of the stem. The older branches spread horizontally or bend down and sheath the stem. The leaves are composed of large water-holding cells—clear cells—surrounded by a meshwork of slender photosynthetic ones. The clear cells have pores to let water in and out and reinforcing thickenings that keep them from collapsing when they dry. The shapes and cellular details of the leaves are critical for identification.

4 *Sphagnum* species have strong ecological preferences. They have preferred pHs, mineral-nutrient levels, and heights above the water table. They also, because they store water, sequester nutrients, release acids, and decay to form peat, have impressive abilities to alter topography and water chemistry. In our area they mostly fill basins and generate microtopography. Farther north, they cover and shape whole landscapes.

5 Because of their preferences and skills, Sphagnums are ecologically predictable. If you understand the hydrology and general vegetation of a wetland, you can usually predict, often quite accurately, what the dominant Sphagnums will be. This is a great help in the field. It means that when I go into a wetland and see a *Sphagnum*, there are usually only a few species it might be.

6 The *Sphagnum* taxonomists I have known were, uniformly, individualists and adventurers. Their treatments reflect. Over the last century, estimates of the *Sphagnum* flora of North America have ranged from a minimum of

39 species and 5 varieties (44 named taxa) to 91 species and 38 varieties (129 named taxa). More recent estimates are 50 species and 5 varieties (65 taxa, Howard Crum, 1984) to 92 species and no varieties (92 taxa, Dick Andrus, 2006).

7 This is not as scary as it sounds. Howard liked to group related and variable plants as varieties within species complexes. Dick told me that he never used varieties because no one would pay any attention to them. Either way, the differences between their treatments are mostly in the attention they paid to the microscopic details of a relatively few variable species.

8 This, of course, is what makes taxonomy fun. In Section *Cuspidata*, for example, *majus*, *pulchrum*, and *tenellum* are dull species that everyone accepts. *Cuspidatum* and *recurvum* are loose balls in play; some of us see two species, others see nine. We all acknowledge the variability. Where we differ, as we should, is on what it means.

9 To the field biologist, microscopic detail is unimportant unless it has ecological meaning. *Sphagnum warnstorffii* and *rubellum* differ, most convincingly, in the size and the ringing of the pores on the outer side of the branch leaves, near their tips. *Warnstorffii* seems to be restricted to hummocks in rich fens; *rubellum* can occur in many kinds of wetlands and is probably most dominant in low wet lawns in raised bogs. The ecology correlates well with the microscopy, and as an ecologist, I need both species to describe what I see.

10 For teaching and use in the field, I prefer broad species with good ecology. Over the years, I have gotten to study and talk sphagnum with Blank Aguero, Dick Andrus, Howard Crum, Cyrus McQueen, and Jon Shaw and Nancy Slack. All influenced my thinking. Howard's approach seemed, and still seems to me, the one that works best for me. I recognize 7 sections and 29 widely distributed species and species groups in the Northern Forest Region. At least five other species occur rarely in the NFR. I have only seen a few of them, and don't treat them here.

11 Recent treatments split 7 of the 29 species, adding another 18 species. I have looked at the *capillifolium* and *recurvum* groups repeatedly and can't make them work for me. The others I have not tested. The table on page 5 shows my basic set and the more recent segregates.

12 Because the seven large sections are hard to recognize in the field, I divide them a bit farther, getting eleven groups that I can recognize them in the field. These field groups are the basis for this lesson; I lay them out on page 6 and treat them in detail from page 25 on.



## THE SECTIONS AND WIDESPREAD SPECIES OF THE NORTHERN FOREST REGION

### ACUTIFOLIA

angermanicum (c)  
capillifolium\* (andersonianum, subtile)  
fimbriatum\*  
flavicomans (c)  
fuscum\*  
girgensohnii\*  
quinquefarium (R)  
russowii\*  
rubellum\*  
subfulvum (R)  
warnstorffii\*

### CUSPIDATA

cuspidatum\* (viride, mcqueenii)  
majus\*  
pulchrum (c)  
recurvum\* (angustifolium, brevifolium, fallax, flexuosum, isovittae)  
riparium  
tenellum (c)  
torreyanum (c) (atlanticum)

### POLYCLADA

wulfianum (R)

### RIGIDA

compactum (C, R)

### SPHAGNUM

centrale\*  
imbricatum (c) (affine, austenii)  
magellanicum\* (divinum, medium)  
palustre\*  
papillosum\*

### SQUARROSA

squarrosum\*  
teres\*

### SUBSECUNDA

pylaesii (C, R)  
subsecundum\* (contortum, innundatum, lescurii, platyphyllum)



SECTION ACUTIFOLIA



SECTION CUSPIDATA



SECTION SPHAGNUM

THE TAXONOMY I use in the photographic guide and these lessons is close to that used by Crum and Anderson in the *Mosses of Eastern North America*, 1981. Segregates recognized in the *Flora of North America* (McQueen and Andrus, 2006) and subsequent works are in parentheses. Cyrus died in 1999; Dick described many of the new species, including *mcqueenii*, after Cyrus died. Both were inspired madmen and are missed. I discuss 29 Northern Forest region Species here. Several rare species (*annulatum*, *balticum*, *bartlettianum*, *jensenii*, *lindbergii*, *tenerum* ...) that I have not be able to study are not included. I have promoted *rubellum* to species rank—Howard liked it as a variety of *capillifolium*—because it is often recognizable ecologically. Intermediates are common; I have trained myself not to look. I can't define either *russowii* or *subfulvum* but keep running into plants that don't fit anywhere else and need somewhere to put them.



1 SECTION SPHAGNUM (p. 25)

magellanicum\*  
centrale\*, imbricatum (c), palustre\*, papillosum\* (not separable in field)

2 COLORED ACUTIFOLIA (p. 26)

capillifolium\*  
flavicomans (c, close to fuscum)  
fuscum\*  
rubellum\*, russowii\* (a hybrid series, not separable in field, barely separable in the lab)  
warnstorffii\*

3 GREEN OR PALE ACUTIFOLIA (p. 27)

angermanicum (c)  
fimbriatum\*  
girgensohnii\*  
quinquefarium (r?)

4 RECURVUM GROUP (CUSPIDATA) (p. 28)

recurvum\*

5 LONG-LEAVED CUSPIDATA (p. 29)

cuspidatum\*  
majus\*  
torreyanum (c)

6 DISTINCTIVE CUSPIDATA (p. 30)

pulchrum (c)  
riparium (r)  
tenellum (c)

7 SPHAGNUM WULFIANUM (POLYCLADA) (p. 31)

wulfianum\* (r, locally common in cedar swamps)

8 SPHAGNUM COMPACTUM (RIGIDA) (p. 32)

compactum (r, c)

9 SPHAGNUM PYLAESII (SUBSECUNDA) (p. 33)

pylaesii\* (r, locally common in alpine zone)

10 SQUARROSE WOODLAND MINEROTROPHS (p. 34)

squarrosum\*  
palustre\*

11 BROWN-STEMMED FENNSIES (SUBSECUNDA) (p. 36)

subfulvum (r)  
subsecundum group\* (3-4 species or forms, perhaps separable in field)  
teres\*



SECTION *Sphagnum*



COLORED *ACUTIFOLIA*



RECURVUM GROUP



LONG-LEAVED *CUSPIDATA*



DISTINCTIVE *CUSPIDATA*

THE ELEVEN GROUPS I use for the rapid field identification of the northern forest Sphagnums. The species on separate lines are identifiable, at least on good days, in the field. As always, wise souls check with the microscope. The groups are illustrated for wooded swamps on pages 8 to 24, and then explained in more detail from page 25 on.



## MUST-KNOW SPECIES, INLAND NEW YORK AND NEW ENGLAND

### 1 SECTION SPHAGNUM



MAGELLANICUM



ALL THE OTHERS\*

### 2 COLORED ACUTIFOLIA



CAPILLIFOLIUM\*



FUSCUM



RUSSOWII



RUBELLUM\*



WARNSTORFII

### 3 GREEN OR PALE ACUTIFOLIA



FIMBRIATUM



GIRGENSOHNII\*

### 4 RECURVUM GROUP



RECURVUM

### 5 LONG-LEAVED CUSPIDATA



CUSPIDATA



MAJUS

### 7 SWAMP LOLLIPOPS



WULFIANUM

### 9 DARK AND STRINGY



PYLAESII

### 9 SQUARROSE WOODLAND MINEROTROPHS



PALUSTRE\*



SQUARROSUM\*

### 11 BROWN-STEMMED FENNERS



SUBSECUNDUM



TERES

IF YOU WORK IN INTERIOR NEW ENGLAND OR NEW YORK, here are 17 Sphagnums that you need to know. There are 18 pictures, but *palustre* occurs in both Group 1 and Group 9. Fifteen are widespread species that you will see everywhere in wetlands. The other two, *pylaesii* (alpine seeps) and *wulfianum* (cedar swamps) are local but can be quite conspicuous when you are in the right places. Sixteen can be identified with reasonable confidence in the field. *Russowii*, known to the pros as “that semi-isphyllous s.o.b.,” is difficult, indoors or out. You may, if you like, ignore it or regard it as a bin into which you put things that make you nervous. Bin or species, you are going to run into things that look like *russowii* and will have to do something with them. And, interestingly, before you can ignore something you have to know it is there.

That finishes the preliminaries. Next we go into the woods, and meet the five species that are starred above.



## MUCKY PLACES IN THE WOODS: *SPHAGNUM PALUSTRE*



WE START WITH *SPHAGNUM PALUSTRE*, one of the commonest and most widely distributed Sphagnums in our flora. To find it, go to a shaded mucky pool where there are frogs in April and violets and *Rhizomnium* in May. Look around the edges or on hummocks for mottled green cushions. These are *Sphagnum palustre*. The ones above are in the Notch, White Creek, about two miles from my house. These plants have squarrose leaf tips that stick out, from the branches, like teeth or cogs. Many, but not all, of our *palustre* are squarrose. The squarrose tips and fondness for seeps and pools place it in Group 10, the Squarrose Woodland Minerotrophs, page 34. The relatively thick branches and deeply concave leaves also place it in Group 1, Section *Sphagnum*, page 25.



# MUCKY PLACES IN THE WOODS: *SPHAGNUM PALUSTRE*



spreading  
branches

descending  
branches

head

young  
branches

branch  
leaves



*SPHAGNUM PALUSTRE*, with *Dicranum scoparium*, on soft rotted logs, again in Grafton, elevation 1,700'. The swamp has *Sphagnum* on the hummocks, logs, and raised islands, and *Rhizomnium* and *Bryhnia* on the exposed muck in the pools. *Sphagnum* doesn't mind submersion, but doesn't like being frozen when the pools ice. No one really does; the other mosses in the pools collapse into a wet mat in the fall, and then sprout and make new stems and leaves in the spring. This is not a *Sphagnum* option: they don't do collapse and die. Note the classic *Sphagnum* features: spreading branches covered with overlapping, concave leaves; a central stem, surrounded by descending branches; a terminal head, made up of young spreading branches.



# MUCKY PLACES IN THE WOODS: *SPHAGNUM PALUSTRE*



*TO LEARN SPHAGNUM*, you have to look at the parts. Get a big one, remove the head of branches and the branch clusters from the stem. Stain the stem leaves with crystal violet or ink or a pen or marker. Look at the branch clusters, the spreading and descending branches, the branch and stem leaves; pull the head apart and find the terminal bud; put the leaves under a microscope or lens and admire their construction. Draw everything, visualize how the parts connect and how the plant grows. A quick summary: Sphagnums have terminal bud made up of the stem tip and the youngest leaves. The branches develop in the axils of these leaves. The spreading branches elongate and form the head. The descending branches develop near the bottom of the head, flex downwards and sheath the stem. The stem elongates, the branch clusters become visible below the head. The descending branches grow down the stem; spreading branches may grow horizontally or curve downwards.





with slightly squarrose leaves



with strongly squarrose leaves

*SPHAGNUM PALUSTRE* belongs to Section *Sphagnum* (page 25), which is recognized in the field by the deeply concave leaves with rounded bodies and hooded tips. Well developed plants are big, and the branches look fat. When the leaves are only slightly angled out, it looks quite similar to the other green members of Section *Sphagnum*, and must be separated microscopically by the leaf cross sections. The habitat helps—*palustre* loves shaded seepage wetlands—but is not decisive because other species of Section *Sphagnum* can occur there too. When the leaves are angled out—strongly squarrose, right pictures—it can be identified in the field, as long as you take care not to confuse it with *Sphagnum squarrosum* (page 34). Even then, this is a variable group and a microscope check is wise.





OUR SECOND *SPHAGNUM*, *squarrosum*, is found on low hummocks and rotted logs in minerotrophic (groundwater-fed) swamps. The picture are from the swamp in Grafton, New York, shown on pages 3 and 8. Look for a *Sphagnum* that stands up on its own and makes open groves, with branch leaves abruptly narrowed to spreading tips. It needs swamps of medium fertility with groundwater influence. Hemlock, or hemlock-fir swamps will do nicely. Spruce-fir swamps, with a continuous understory of *Sphagnum*, are usually too poor; black-spruce and tamarack are beyond the pall. It is common but not abundant, often growing in small groves of a dozen stems or so. I place it in Field Group 10, the Squarrose Woodland Minerotrophs, on page 34.





*SQUARROSUM* is distinctive, but only when looked at closely. Other *Sphagnum*s, particularly *palustre*, can have squarrose leaves. Note that the *squarrosum*'s leaves have clasping bases that narrow and bend out abruptly to a sharp tip. The bases of *palustre* are more concave, the tips less abrupt and sharp. The terminal bud of *squarrosum* is conspicuous, that of *palustre* harder to see.



SPHAGNUM CAPILLIFOLIUM, ROUND HEADS, PACKED TOGETHER ON HUMMOCKS



LIKE MANY WOODED SWAMPS, the hemlock swamp in Grafton has moss-covered hummocks, often built around rotted stumps and logs. Some have upland species like *Dicranum* and *Bazzania*. Others, especially those that near wet hollows, have *Sphagnum*. The lower hummocks often have *palustre*; the higher ones, circled here, typically have two smaller species that are red, pink or green, *capillifolium* and *rubellum*. *Capillifolium* has rounded heads that are often tightly packed; *rubellum* has flat five-parted and grows more loosely. There are only four small reddish *Sphagnum*s with red color; all belong to Field Group 2, the colored *Acutifolia* (page 26).



*SPHAGNUM CAPILLIFOLIUM*, ROUND HEADS, PACKED TOGETHER ON HUMMOCKS



New and old growth: everything in this mat is *capillifolium*.



*SPHAGNUM CAPILLIFOLIUM* is a small species with rounded head and a mop of older branches that surround the stem. It may be red, green, or, especially when the new growth is coming out, mottled. The stem and at least the base of the older branches are usually red, even in green forms. Near the forest floor, as in the left picture, it often grows spread out. On the tops of hummock, it is often tightly packed together, with the heads touching and the branches hidden.



*SPHAGNUM CAPILLIFOLIUM*, ROUND HEADS, PACKED TOGETHER ON HUMMOCKS



*CAPILLIFOLIUM* COMES IN RED AND GREEN, and grows either loosely or tightly backed. It is very common on hummocks in open bogs and conifer swamps, and also on boreal forest floors, wet ledges, and rocks and soil in the alpine zone. It is a classic ombrotroph (rain-fed) species, growing in acid bogs and swamps and in raised mounds out of contact with groundwater.



SPHAGNUM CAPILLIFOLIUM, ROUND HEADS, PACKED TOGETHER ON HUMMOCKS



new growth  
is green

rounded head,  
branch leaves  
not in five rows

some red  
color

loose mop  
of branches

stems are red



branch leaves  
slender, tapering  
to long points



stem leave long  
triangular, pointed,  
often slightly  
inrolled at tips

STANDARD-ISSUE *CAPILLIFOLIUM* is red or pink and has rounded heads with down-curved branches making a mop around the stem. Branch leaves are slender, inrolled, and long pointed, typical of *Acutifolia*. Stem leaves are long, with rounded points, often slightly inrolled or concave near the tips. Shade forms are nearly all green, but usually have some red or pink on branches or stem. Hummock plants are usually tightly packed; plants on ledges and the forest floor may form loose groves. Forms with flat or five-parted heads are common. They are often called *Sphagnum subtile*. I find them mixed with and grading into normal *capillifolium*, and don't think they deserve their own name. More about this on the next page.





A small *Acutifolia* with 5-parted heads, from shaded hummocks in boreal forest, Dyer Point, Maine.

THE SHADE FORMS OF *CAPILLIFOLIUM* that grow hummock tops, typically have round heads and are often pale green with a little pink on the stems and branches. Similar plants with flatter, five-parted heads are common in boreal forest and mid-elevation forests and in conifer swamps. We often find them on the lower part of hummocks with ordinary *capillifolium* at the top. Crum and Anderson called them called them *capillifolium*; Anderson and Shaw and Shaw (*Peat Mosses of the Southeastern United States*, 2009) called them *Sphagnum subtile* but noted that DNA sequence data said that *subtile* was nested within *capillifolium*. Dick Andrus, who was not interested in molecules, treats them as *subtile*. I call them *capillifolium*; I see round, five-parted, and in-between forms on single hummocks, and have no idea where one ends and the other begins.



SPHAGNUM RUBELLUM, LOOSE AND FIVE PARTED



ONE OF THE DRAMATIC FEATURES of northern peatlands are the extensive, blood-red carpets of a small, five-parted *Sphagnum* with the leaf characters of the *Acutifolia*. It falls in Field Group 2, the colored *Acutifolia* (page 26). It also grows on low hummocks in wooded swamps and can be mottled red and green. This was *capillifolium* var. *tenellum* to Crum and Anderson, and is *Sphagnum rubellum* in most books today. I accept the species because it grows lower and makes looser mats than *capillifolium*, though often see individual plants that are transitional between the two. Section *Acutifolia* is full of transitional plants. The picture in the lower right-hand corner, with Labrador tea and orange plants of *Sphagnum recurvum*, is from a large bog in the Adirondacks where it makes extensive carpets. The other three are from the hemlock swamp in Grafton.



SPHAGNUM RUBELLUM, LOOSE AND FIVE PARTED



CLASSICAL *RUBELLUM* is deep red in the sun and has five-parted heads which are flat topped. The branches are slender and do not hang down and form a mop like *Capillifolium*. The branch leaves are often in five spiralling rows, but this character varies. The stem leaves are said to be more rounded and less inrolled at the tip than *capillifolium*. I see this, but not consistently either. Stem leaves in the *Acutifolia* are nice, and I like them as well as anyone. But after looking at them for years, I find them as often confusing as clarifying.



*SPHAGNUM RUBELLUM*, LOOSE AND FIVE PARTED



DRY *RUBELLUM* TURNS A SHINY PINK, and the leaf arrangements stand out clearly. Note that the new growth is going to be green, and that some branches, and some parts of branches, have strongly five-rowed leaves and others don't. There is actually a reason for this. The leaves are spirally arranged in both cases. The rows are secondary features, depending on the coincidence of leaves in different turns of the spiral. Mathematicians studying phyllotaxy call *visible parastichies*. They are very sensitive to slight changes in the geometry of the fundamental spiral. A slightly lengthening or twisting of the branch—ordinary growth, that is—can make them appear or disappear.





THE LAST OF OUR FIVE WOODED-SWAMP SPHAGNUMS is *girgensohnii*. It is tall and slender, with flat, five-parted heads and a stiff spreading branches. The leaf shape and cross-section place it in Section *Acutifolia*. There is never any red or brown color, so it goes in Group 3, the Green *Acutifolia* (page 28). The young descending branches, visible between the rays of the head, are in a single vertical row. This rules out the *Recurvum* group, Field Group 4 (page 29), which can look similar.





*SPHAGNUM GIRGENSOHNII* is a circumboreal species, transcontinental in northern North America. It is abundant on the floors of conifer swamps, in low spots in boreal forests, and in the shrubby parts of bogs. In spruce-fir and spruce-tamarack swamps it makes continuous carpets. In mixed swamps with pools like the Grafton swamp, it grows on the lower parts of islands, below *rubellum* and *capillifolium*, just above the pools. The plants are often nicely spaced with their branches just touching. Pentagons can't, of course, tile the plane without dislocations, and the mats are a fascinating study in broken symmetry. I asked them how they did it and they said "It took us a while to figure it out. The violets helped." *Sphagnum recurvum* often makes similar mats in similar places and does excellent *girgensohnii* imitations.. Always check for the single row of descending branches before you call something *girgensohnii*.



SWAMP FLOORS: *SPHAGNUM GIRGENSOHNII*



flat, five-parted heads



young descending branches in one row (box)

slender, stiffly spreading branches

no red at all

slender, long-tapering branch leaves



broad stem leaves, fringed across the tip

*GIRGENSOHNII* is a well-marked species. The stiff slender branches, lack of any red color, young descending branches in a single row, and broad stem leaves with ragged, squared-off tips will get it every time. But you have to remember to check with a lens. There are things out there that look like *girgensohnii* from above but aren't when you get close.



FIELD GROUP 1, SECTION *SPHAGNUM*: BRANCH LEAVES DEEPLY CONCAVE AND HOODED; BRANCHES OFTEN THICK



*SPHAGNUM CENTRALE*  
fens, fertile conifer swamps



*SPHAGNUM IMBRICATUM*  
sedge fens, shrub swamps,  
poor fens, commonest near the  
coast



*SPHAGNUM PALUSTRE*  
deciduous and mixed  
swamps, woodland pools



*SPHAGNUM MAGELLANICUM*  
bogs, poor fens, spruce-tamarack  
swamps



*SPHAGNUM PAPILLOSUM*  
bogs, poor fens, open wet float-  
ing mats



branch leaves,  
whole group

WE NOW LOOK AT THE ELEVEN FIELD GROUPS in more detail. Group 1 is Section *Sphagnum*, the only section that can be identified as a whole in the field. The critical characters are the blunt, deeply concave stem leaves with closed (hooded) tips, and, in well developed plants, the relatively short thick branches. Compare *Sphagnum compactum*, page 32, and the *subsecundum* group, page 36, which also have deeply concave leaves but with more differentiated tips. While the group is easy to identify in the field, the species are largely impossible. A red or pink species is always *magellanicum*, but *magellanicum* is not always red. A green, yellow, or brown species may be any of the five. A species with strongly squarrose leaf tips is usually *palustre* and falls in Group 10 as well. See pages 34 and 35 for pictures. But *palustre* is not always squarrose, and when it isn't, it can't be identified in the field. Recent treatments recognize two additional species each in *Sphagnum imbricatum* and *magellanicum*, based on microscopic characters. The segregates of *imbricatum* (*affine* and *austenii*) overlap geographically but are said to differ in ecology. The segregates of *magellanicum* (*divinum* and *medium*) are said to overlap ecologically and even grow together. Their geography is poorly known.



FIELD GROUP 2, COLORED ACUTIFOLIA: LEAVES AND STEMS PINK, RED, PURPLE, OR RICH BROWN



*SPHAGNUM CAPILLIFOLIUM*  
open bogs, boreal forest,  
wooded swamps; hummocks,  
ledges, alpine tundra



*SPHAGNUM FLAVICOMANS*  
hummocks in coastal bogs



*SPHAGNUM FUSCUM*  
hummock tops in bogs  
and fens



WARNING: ALL THE RED SPECIES CAN BE GREEN WHEN  
THEY WANT.



*SPHAGNUM RUSSOWII*,  
shores, marshes, intermittently  
submerged



*SPHAGNUM RUBELLUM*,  
bogs, fens, wooded swamps;  
lawns and low hummocks



*SPHAGNUM WARNSTORFFII*  
hummocks in rich fens



GROUP 2 includes the species with narrow, long taped leaves and intense shades of red, pink, purple or brown. They are all members of Section *Acutifolia*, the only group that produces intense reds and browns. All can be recognized in the field, but not always correctly. Note the round heads and mop of branches in *capillifolium*; the deep brown color and stems (lighter than natural in the photos) of *flavicomans* and *fuscum*; the flat tops and variegated color of *russowii*; the flat tops, five-parted heads, typically deep color, and sometimes 5-rowed branch leaves of *rubellum*; and the purple-red color and strongly five-rowed branches of *warnstorffii*. *Rubellum* can give trouble in the field. *Flavicomans* and *russowii* can give trouble everywhere. Many books separate them by the shape of the stem leaves. I find this gives trouble too. This is a hard group; the species have distinct tendencies, but not distinct boundaries.

All of the produce new green branches in the spring; all-green forms of the red species are common in the shade. Often you can find some hints of color on the stem or old branches that place them in this group. When you can't, you have a microscope problem, of at least two-glasses difficulty.

The *Flora of North America* splits *capillifolium* into three species. The one you hear about most often is *subtile*; see page 18 for some pictures.



FIELD GROUP 3, GREEN *ACUTIFOLIA*: SLENDER LONG-TAPERED LEAVES, YOUNG DESCENDING BRANCHES IN 1 ROW



*SPHAGNUM ANGERMANICUM*,  
wet mats in coast bogs; young branches  
flattened, large oval stem leaves



*SPHAGNUM FIMBRIATUM*  
boggy shores, wet bog mats, alder  
swamps; flaring fringed stem leaves  
that make a collar around the stem



*SPHAGNUM GIRGENSOHNII*  
conifer swamps, wet boreal  
forest; broad stem leaves with  
ragged squared-off tips



*SPHAGNUM QUINQUEFARIUM*  
dirty ledges, boreal forest floor, in mountains;  
three spreading branches per cluster; round heads  
crammed full of branches; may have red color

GROUP 3 includes four distinctive species with green heads. (*Quinquefarium* may have some pink, but it is usually mostly green so I put it here.) They have the slender long-tipped leaves shared by the *Acutifolia* and *Cuspidata*. They lack the special *cuspidata* features of Groups 4, 5, and 6, so they are in *Acutifolia* and fall here. None of them jump out at you in the field, but if you use your lens and take the time to look for the distinctive stem leaves or the extra spreading branches in *quinquefarium*, you will get them easily.



FIELD GROUP 4, *RECURVUM* GROUP (*CUSPIDATA*): YOUNG DESCENDING BRANCHES PAIRED



*SPHAGNUM RECURVUM* GROUP

open bogs, fens, wet boreal forests; leaves slender, long tapering, often recurved when dry; young descending branches in pairs (boxes); stem leaves rounded triangular, small, round or pointed at the tip, often pointing down the stem.

THE *SPHAGNUM RECURVUM* GROUP dominates the lawns of many open wet bogs, and is also found in fens and in boreal forests. It is variously treated as a single variable species or as a complex of loosely related species. I am solid for complex. It is recognized by a combination of slender, long tapering leaves; five-parted heads with the young descending branches paired; and small rounded triangular stem leaves. The plants are variously green, brown, or golden, and the branch leaves often flatten out and recurve in an interesting way when dry.

The *Flora of North America* divides it into six species (*angustifolium*, *brevifolium*, *fallax*, *flexuosum*, *isovittae*, *recurvum*) based on details of the stem and branch leaves. I can see the differences but have never been able to get them to correlate with ecology or each other. I tried again last week and still couldn't. To me the plants I see, which do not represent the whole diversity of the group, are members of a single variable species.



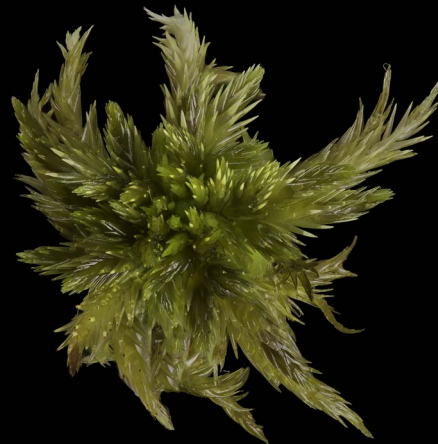
FIELD GROUP 5, LONG-LEAVED *CUSPIDATA*: AQUATIC OR SEMI-AQUATIC WITH LONG INROLLED LEAVES



*SPHAGNUM CUSPIDATUM*  
aquatic, in pools in bogs and fens; yellow green,  
collapses when removed from water



*SPHAGNUM MAJUS*  
low wet bogs and fens; plants brown to almost  
black, growing erect in wet bog lawns



*SPHAGNUM TORREYANUM*  
semi-aquatic, wet coastal fens, bog pools: plants large, with long leaves,  
often almost black, growing in pools in coastal fens; heads look bristly

THREE DISTINCTIVE SPECIES, recognized by the long, curved, inrolled branch leaves and the aquatic or semiaquatic habit. They are fairly easy to separate in the field. *Cuspidatum* is small, yellow-green, and limp when growing submerged. *Torreyanum* is large dark and coastal, with a bristly look, often floating just below the surface of fen pools. *Majus*, a common species of floating mats and wet bog and poor fens, is black or brown and usually grows erect in wet mats. All three vary a lot in color and size; if you are uncertain, look at the leaf pores with the scope. The *Flora of North America* divides *cuspidatum* into three species and *Torreyanum* into two. I haven't tried to use them.



FIELD GROUP 6, DISTINCTIVE COASTAL *CUSPIDATA*: SAW-TOOTHED BRANCHES OR SPOON-SHAPED LEAVES



*SPHAGNUM PULCHRUM*

hummocks in coastal bogs, lower than *fuscum*; branch leaves  
in strong rows, the branches looking like Ryoba saws



*SPHAGNUM TENELLUM*

aquatic, in pools in coastal bogs and fens; small soft plants  
with concave oval leaves; stem and branch leaves similar

TWO DISTINCTIVE SPECIES, commonest near the coast. *Pulchrum* is a dominant in wet fens, making floating lawns that are hard to walk across. The strongly ranked leaves, rich golden color in summer, and saw-toothed look identify it. *Tenellum* is a small limp light-colored species of wet depressions in coastal bogs. The large stem leaves and spoon-shaped branch leaves identify it.



FIELD GROUP 7, *SPHAGNUM WULFIANUM* (POLYCLADA): ERECT, BIG HEADED, SIX OR MORE BRANCHES PER CLUSTER



*SPHAGNUM WULFIANUM*  
cedar swamps: big erect plants  
forming groves or mounds;  
heads round, leaves strongly  
recurved when dry, 6 or more  
branches per cluster.

*WULFIANUM* is everyone's favorite cedar-swamp species, recognized by the upland habitat and big heads standing up from the forest floor; confirmed by the clusters with 6 or more branches.



FIELD GROUP 8, *SPHAGNUM COMPACTUM* (*RIGIDA*): DEEPLY CONCAVE LEAVES WITH LONG TIPS IN DENSE HEADS



*SPHAGNUM COMPACTUM*

wet ledges, wet places in rocky or sandy barrens;  
leaves with a rounded, concave base that extends  
into a long tip

A SINGLE DISTINCTIVE SPECIES. The plants are light colored and grow in wet pools or in seepage on acid rocks or sand. They make mounds, sometimes densely squashed together like plants of *Leucobryum*. The leaves have a deep concave base which extends into a channeled tip. They resemble the leaves of Section *Sphagnum* (Group 1) at their bases but the tips are longer than anything in that group and not closed at their ends. The leaves recurve and look wild and pointed when dry.





*SPHAGNUM PYLAESII*

wet ledges, seeps, pools in rocky and sandy barrens, mostly coast and mountains; plants dark brown or black, in wet mats in pools or seeps; heads indistinct, branches not clustered, stem leaves similar to branch leaves

A UNIQUE SPECIES, locally common in pools and seeps along the north coast and in the alpine zone. Once you know that it is a *Sphagnum*, which is not obvious, there is nothing else it can be.





*SPHAGNUM PALUSTRE* (SECTION *SPHAGNUM*, SQUARROSE FORM)  
deciduous and mixed swamps, mucky pools in forests: leaves deeply concave  
at base gradually tapering to a closed (hooded) tip. Terminal bud small



*SPHAGNUM SQUARROSUM* (SECTION *SQUARROSUM*)  
low hummocks, rotted logs in deciduous and mixed swamps; leaves clasping the  
stem at base, abruptly tapering to a sharp channeled tip. Terminal bud conspicuous.

TWO UNRELATED SPECIES of shaded seepage wetlands, both with squarrose branch leaves. The details of the leaves and the larger terminal buds of *squarrosum* will separate them. *Squarrosum* is always squarrose; *palustre* has nonsquarrose forms, which will be found with the rest of Section *Sphagnum* in Group 1.



FIELD GROUP 10, THE SQUARROSE WOODLAND MINEROTROPHS



*PALUSTRE* AND *SQUARROSUM* are not closely related, but they look similar and grow in the same sort of shaded medium-fertility swamps. They are often found together and can be intermingled. I give them a field group of their own. *Palustre* is also a member of Section *Sphagnum*, which is Group 1 (p. 24); the squarrose plants are distinctive, the nonsquarrose ones look like the other Group 1 species and must be separated microscopically. When compared side by side, *squarrosus* has sharper leaf tips, slenderer branches, and a larger terminal bud; *palustre* has leaves that are deeply concave at the base, like a gravy boat.

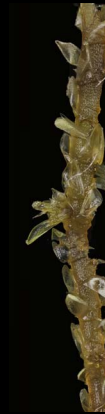




*SPHAGNUM SUBFULVUM* (SECTION *ACUTIFOLIA*)  
hummocks in fens; hard to define, something like a flatter paler *fuscum*.



*SPHAGNUM TERES* (SECTION *SQUARROSUM*)  
hummocks in fens: brown stem, often brown or golden, prominent terminal bud, slender branch leaves, large oblong stem leaves.



*SPHAGNUM SUBSECUNDUM* group (SECTION *SUBSECUNDUM*)  
hummocks in fens, pond shores, polls in fens, may be intermittently submerged: dark stems, rounded oblong stem leaves; branch leaves deeply concave at base, similar to Section *Sphagnum* but more pointed; young branches may curl over head

THREE UNRELATED SPECIES of minerotrophic peatlands, grouped here by their brown stems. *Subfulvum* is troublesome; I use it for the pale brown plants with rounded stem leaves that are in the *Acutifolia* and don't exactly look like anything else. It is supposed to be separable from *fuscum* and others by small differences in stem leaves, which I haven't been able to use. *Teres*, on the other hand, is a distinctive species, sharply defined microscopically. In the field it is a small yellow-brown species on hummocks in fens which can resemble *recurvum* or *subsecundum*. Under the lens, the combination of brown stem, prominent terminal bud, and oblong stem leaves is distinctive. The *subsecundum* group, now considered to include at least five species in our area, is distinguished easily microscopically—cute strings of little oval pores—but is hard for me in the field. I look for plants with deeply concave leaves that are a bit too pointed to go into Section *Sphagnum*, plus brown stems and often short branches curving over the head. Sometimes they are what I am left with after I eliminate everything else.



## A SHORT SUMMARY:

1 The Sphagnums are wonderful plants: wonderful colors, neat leaves, crazy cells, exquisite ecological taste, and Machiavellian competitive abilities. Learn them and their biology and you won't be sorry.

2 Sphagnums can be daunting at first. They all have the same general structure and can vary a lot. In their favor, they are ecologically predictable and have a lot of good hand-lens details. Focus on ecology and details, learn the 10 groups described here, and they will get in line. They are just plants, and nice ones at that.

3 For use in field 10, I recommend a basic set of 29 species, divided into 10 Field Groups. I don't use the sections much in field 10 because four important ones—*Acutifolia*, *Cuspidata*, *Squarrosa*, and *Subsecunda*—don't have group characters that work in the field.

4 My set of 29 names is utilitarian in a particular sense: it is, in my experience, the minimum number of names that will still allow you to name almost everything you see. You may, of course, use more. But if you want to be efficient and stay away from the microscope, these will do.

5 I learned *Sphagnum* from Howard Crum's books, and, later, from Howard himself. My list of framework species comes from him. He was a deeply thoughtful biologist and very alert ecologically. His books have worked for me for forty years, and I recommend them to you.

6 Seventeen of these species I consider must-knows: widespread in our area, reasonably easy to identify, encountered day after day. Learn them first, and you will have good reference points for learn the rest.

7 Larger species sets are available. Seven of the moist variable species were split into 18 others in the *Flora of North America*. I am unconvinced by two splits—of *capillifolium* and *recurvum*—that I have looked; think that splitting *subsecundum* is necessary but haven't tested it; and am neutral to the others.

8 As a matter of intellectual clarity, before you use the newer names, you should understand what they mean. *Sphagnum affine* is not just a new way of saying *Sphagnum imbricatum*. It is an assertion that (a) your plant has fibrils in the walls of both the inner and outer stem cortical cells; and (b) that you believe that this gives it a unique biological identity. If you aren't sure of (a) or don't believe in (b), you should probably just call it *imbricatum*.

8 To introduce the Sphagnums, I made two trips to swampy woods and photographed five species, which I present here. To review, they are:

*Sphagnum palustre*, Section *Sphagnum*, Group 1

*Sphagnum capillifolium*, Section *Acutifolia*, Group 2

*Sphagnum rubellum*, Section *Acutifolia*, Group 2

*Sphagnum girgensohnii*, Section *Acutifolia*, Group 2

*Sphagnum squarrosum*, Section *Squarrosa*, Group 10

They are nice plants, and a great place to start. Can you find them near you?

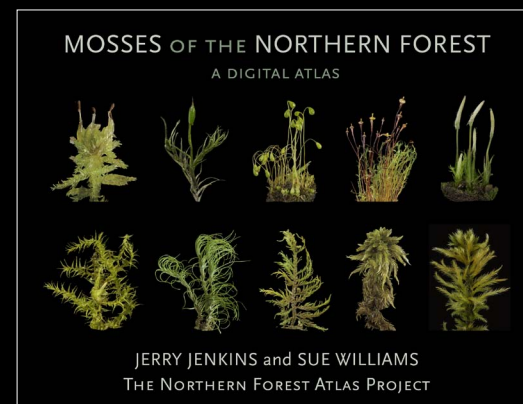
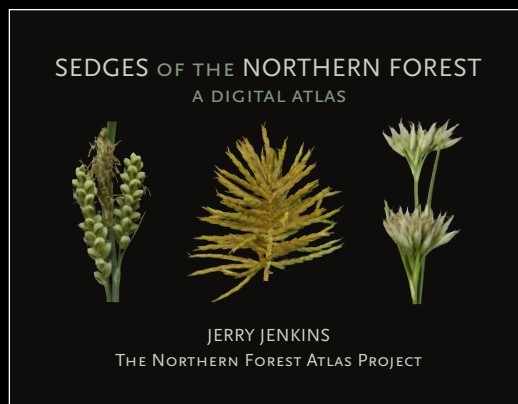
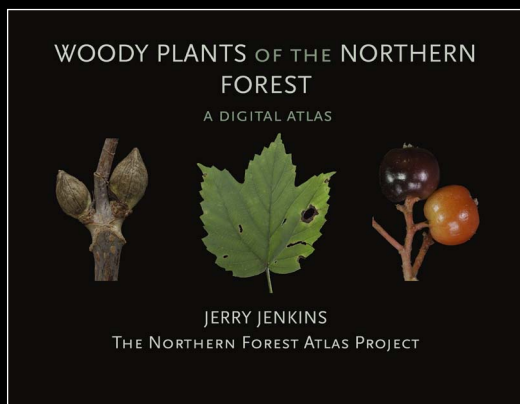


A wet sedge fen at Winter Harbor, Maine. *Sphagnum pulchrum* (Group 6) dominant, with *angermanicum* (Group 3) and *magellanicum* (Group 1). *Drosera intermedia* in the pool and the cottongrass *Eriophorum angustifolium* in fruit.

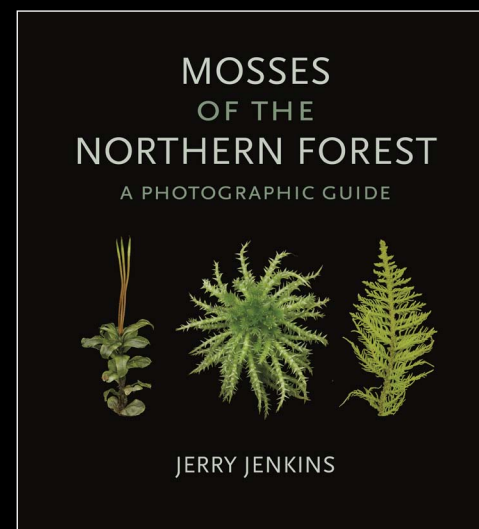
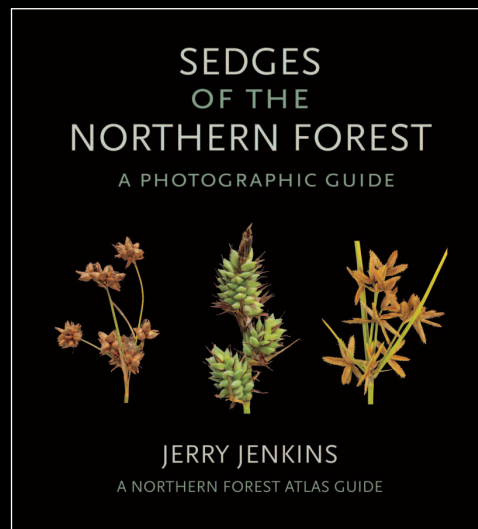
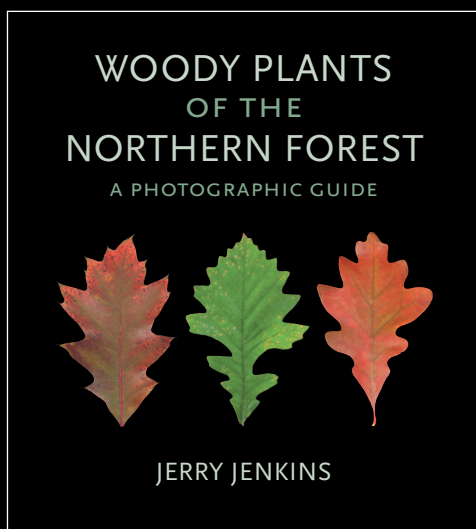


## PUBLICATIONS OF THE NORTHERN FOREST ATLAS PROJECT

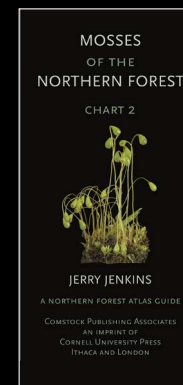
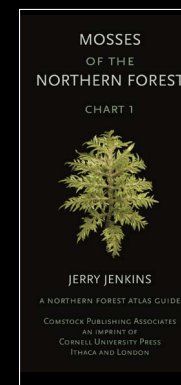
### DIGITAL ATLASES



### PHOTOGRAPHIC GUIDES



### WATERPROOF FOLDING CHARTS



As of Spring, 2020, the Atlas Project has produced digital atlases, paper photographic guides, and folding charts to woody plants, sedges, and mosses. The digital atlases are available for download from our website, [northernforestatlas.org](http://northernforestatlas.org); the photographic guides and charts from Cornell University Press, [cornellpress.cornell.edu](http://cornellpress.cornell.edu). Photographic guides to grasses, a digital atlas of grasses, and a book-length field guide to woody plants will be published in 2022.