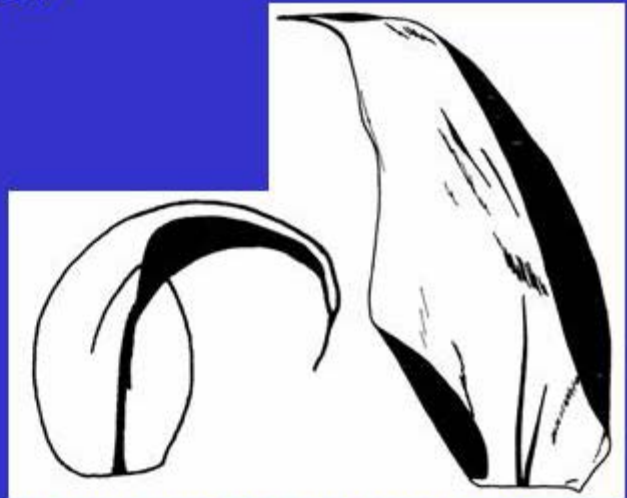


## SCORPIDIUM

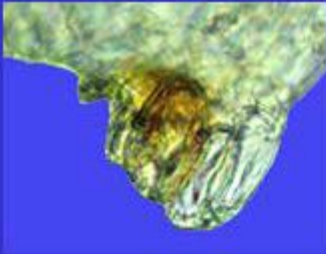


*Scorpidium  
cossonii*

*Warnstorfia  
exannulata*

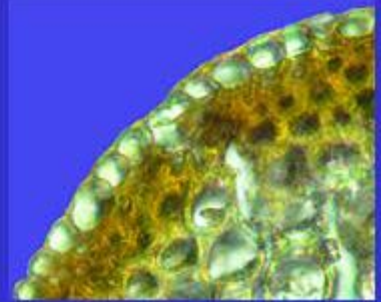


When curved, the leaves are  $\pm$  suddenly curved in their upper part; not plicate

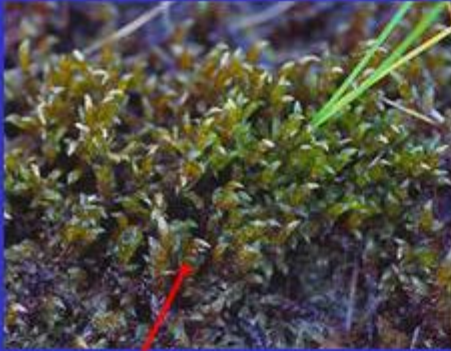


Alar groups small and consisting of a few inflated cells

Stem with hyalodermis and mostly a central strand



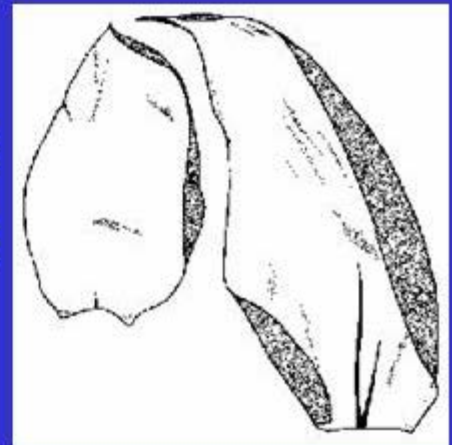
# *Scorpidium scorpioides*



**Shoot apex curved like a scorpion tail**



**Large  
Leaves broad and relatively shortly narrowed to apex; concave**



**Costa short, usually double**

pH 5.2-8.5  
EC 14-582 mS / m  
Ca 1.2-141.0 mg / l

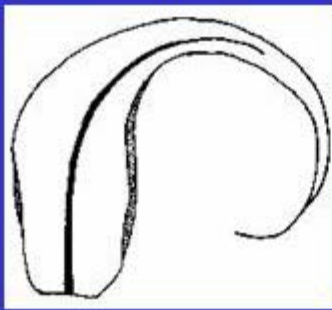
*Scorpidium revolvens*



Plants relatively large and relatively sparsely branched



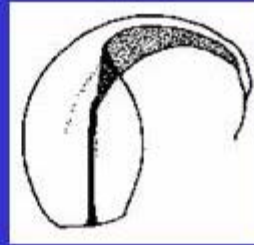
Leaves on the average more longly acuminate



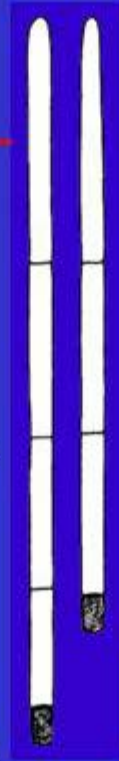
*Scorpidium cossonii*



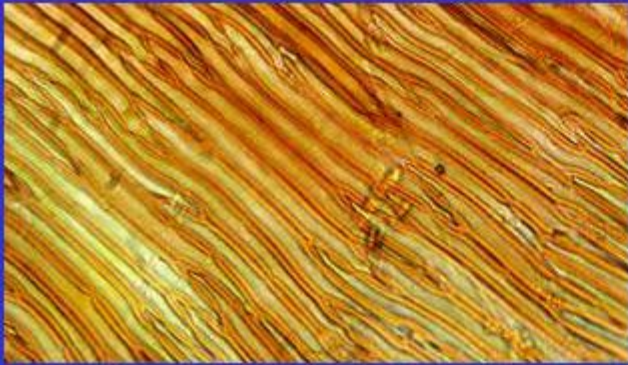
Plants relatively small and regularly branched



Leaves on the average more shortly acuminate



***Scorpidium revolvens***



**Leaf lamina cell ends  
longly tapering,  
cell length  
61-140(-178)  $\mu$ m**

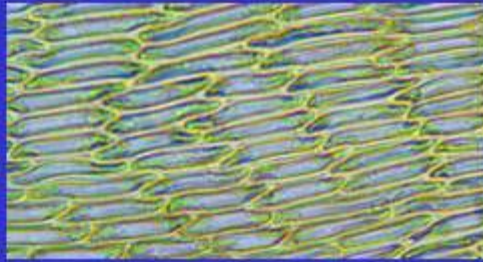
**Deep red colour  
characteristic**

**Autoicous**



pH 5.1-7.1  
EC 16-166 mS / m  
Ca 0.7-27.7 mg / l

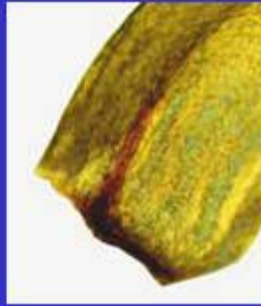
***Scorpidium cossonii***



**Leaf lamina cell  
ends shortly  
tapering, cell length  
14-95(-120)  $\mu$ m**

**Green/yellow-green  
colour with rusty red  
costa and leaf base  
characteristic**

**Dioicous**



pH 5.0-8.1  
EC 18-681 mS / m  
Ca 2.3-130.0 mg / l

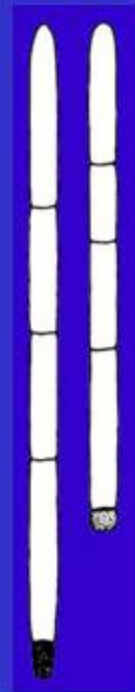
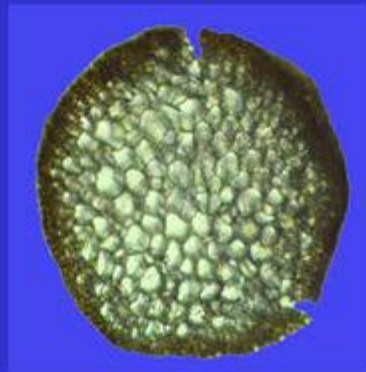
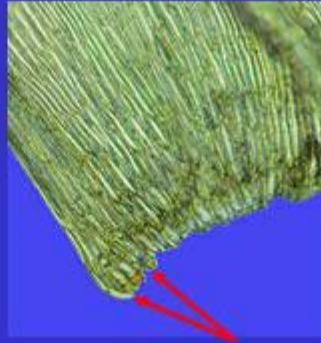
## HAMATOCAULIS

The leaves are  $\pm$  suddenly curved in their upper part;  $\pm$  plicate

Shoot apices hooked, or bent like the upper part of a walking stick

Alar cells not differentiated

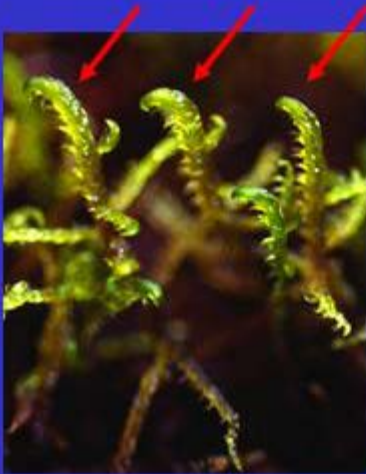
Stem without central strand; cortex thin and weakly differentiated



***Hamatocaulis vernicosus***



**Looser habit than  
*Scorpidium cossonii***



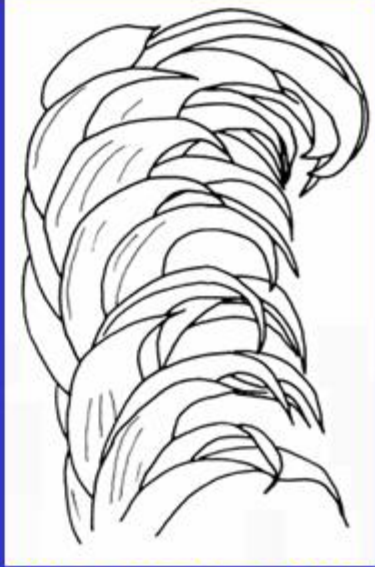
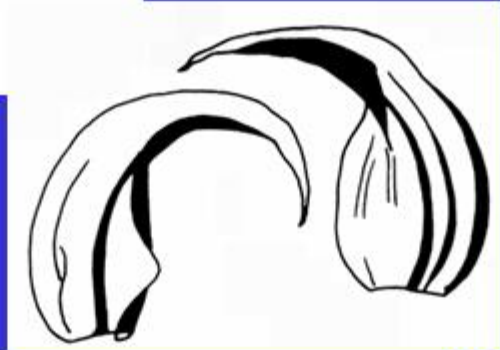
***Hamatocaulis lapponicus***



**As large as  
*Scorpidium scorpioides***

***Hamatocaulis vernicosus***

***Hamatocaulis lapponicus***



**Leaf base relatively erect**

**Leaf base erecto-patent**

pH 5.4-7.8  
EC 16-396 mS / m  
Ca 2.5-56.8 mg / l

**Leaves constricted towards insertion**



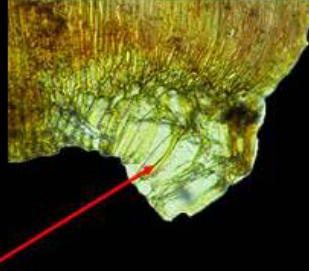
## **WARNSTORFIA**

**Leaves curved or straight**

**Red pigments common**

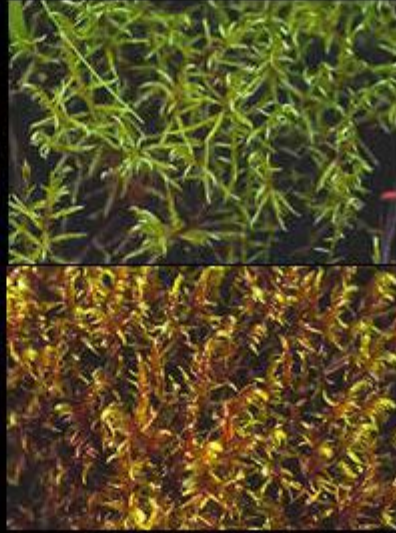
**Usually large, distinct alar groups, transversely triangular or almost quadrate**

**Alar cells when young (but mature)  $\pm$  inflated and thin-walled**



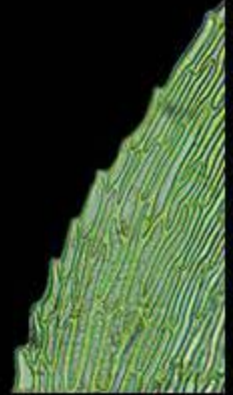
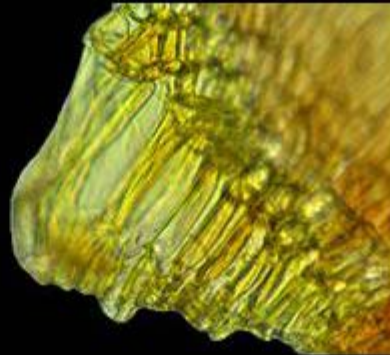


## *Warnstorfia exannulata*

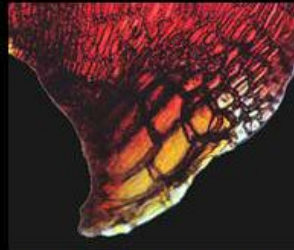
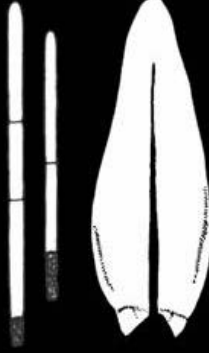


- Often with clear red colours
- Leaves mostly curved
- Transversely triangular alar groups
- Leaf margin denticulate
- Pseudoparaphyllia broad

pH 4.0-8.0  
EC 10-243 mS / m  
Ca 0.7-84.5 mg / l



***Warnstorfia sarmentosa***



- Often with clear red colours
- Leaves straight
- Leaves mostly apiculate

- ± Transversely triangular alar groups
- Leaf margin entire, sometimes very weakly denticulate near apex

pH 4.6-7.7  
EC 15-152 mS / m  
Ca 0.7-12.8 mg / l

***Warnstorfia fluitans***

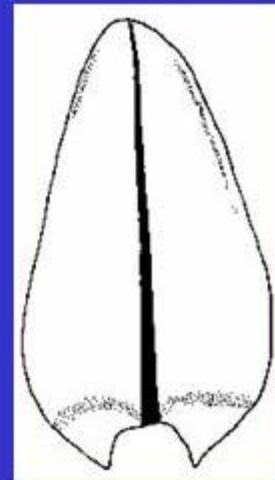
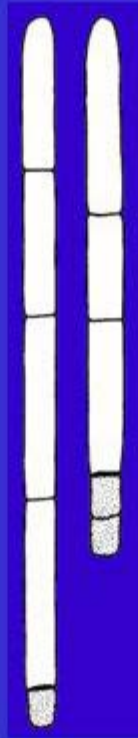


- Autoicous
- Rarely (brown-)red
- Leaves usually falcate
- Alar groups indistinct, transversely triangular
- Pseudoparaphyllia triangular or narrowly so

pH 3.2-6.3  
EC 0-84 mS / m  
Ca 0.2-5.4 mg / l

## CALLIERGON

- Plants large
- Stem leaves straight,  $\pm$  broadly ovate to broadly rounded-triangular
- Leaf apex rounded or obtuse
- Axillary hairs large and abundant
- All species tend to grow in at least somewhat nutrient-rich habitats



(*Calliergon cordifolium*)

***Calliergon cordifolium***



- ± Irregularly branched
- Green
- Mostly in nutrient-rich habitats; fens, shores, ditches, swampy forest

pH 3.8-8.2  
EC 23-324 mS / m  
Ca 1.4-57.8 mg / l

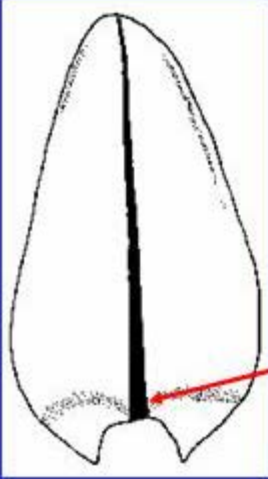
***Calliergon giganteum***



- Branched like a spruce tree
- Green or sometimes pale pinkish
- Mostly in mineral-rich habitats; fens, ditches, shores, floating or submerged in lakes

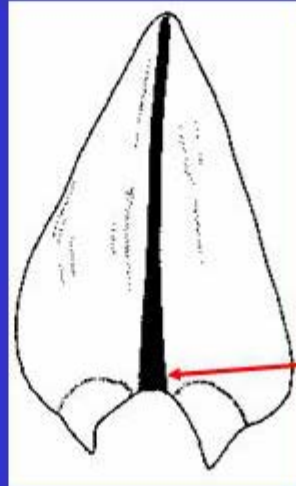
pH 5.2-8.5  
EC 35-499 mS / m  
Ca 1.6-65.8 mg / l

### *Calliergon cordifolium*

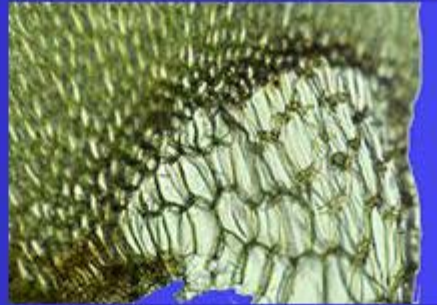
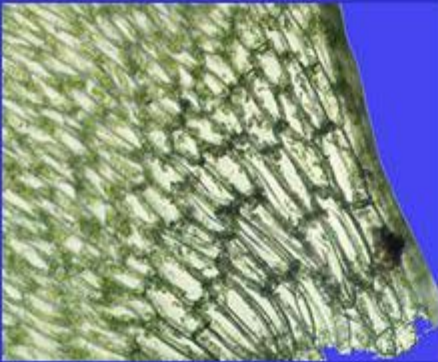


- Stem lvs  $\pm$  ovate
- Costa 54-117(132)  $\mu$ m
- Alar groups diffusely delimited

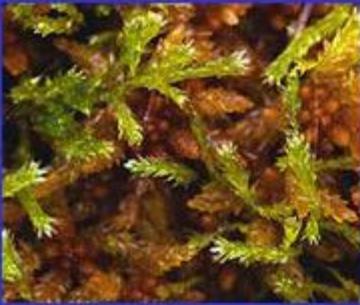
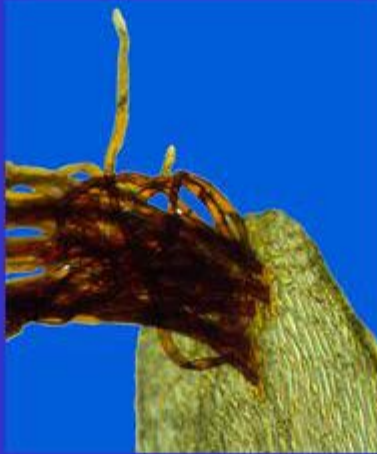
### *Calliergon giganteum*



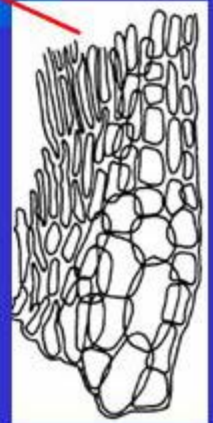
- Stem lvs  $\pm$  triangular
- Costa (88-)95-282  $\mu$ m
- Alar groups sharply delimited



## *Straminergon stramineum*



- Unbranched or weakly branched
- Pale or whitish- to yellow-green
- Stem leaves ovate or narrowly so
- Leaf apex rounded, often cucullate
- Alar groups ovate, along leaf margin
- Axillary hairs small and sparse
- Rhizoids commonly from upper leaf lamina



pH 3.2-7.3  
EC 7-264 mS / m  
Ca 0.7-28.7 mg / l

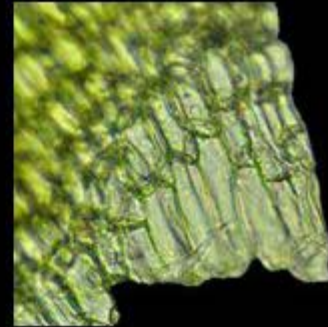
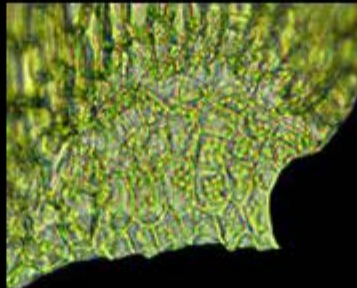
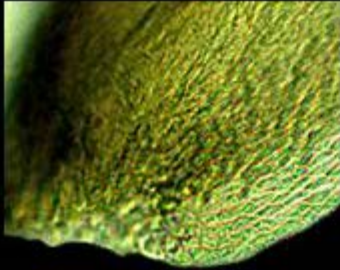
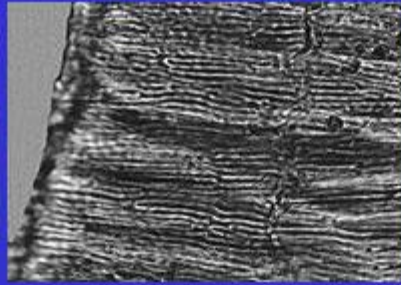


**Autoicous species more frequent than in the Calliergonaceae**

**Lower exostome outside cross-striolate**

**Red pigments absent**

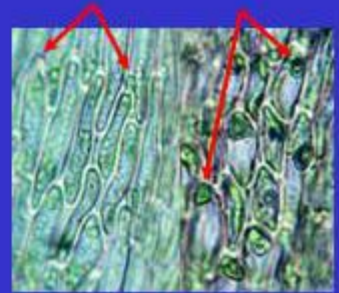
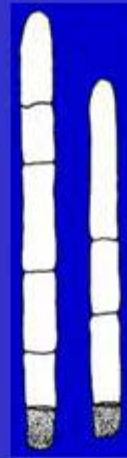
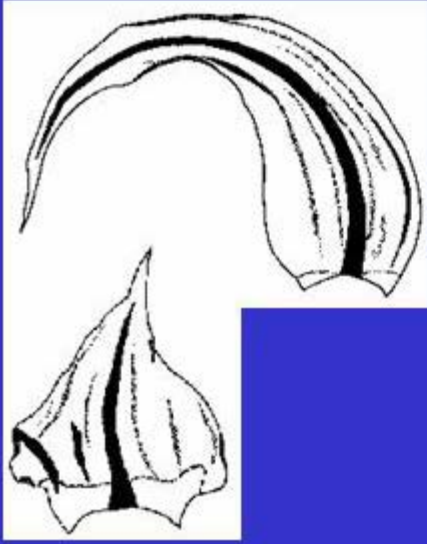
**Alar cell ontogeny of *Drepanocladus aduncus* type**



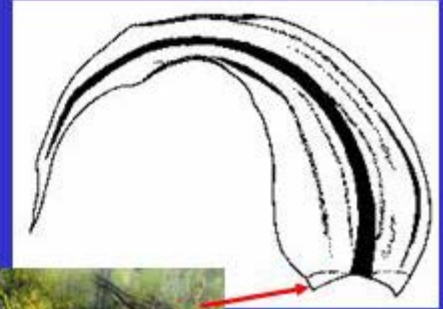


## PALUSTRIELLA

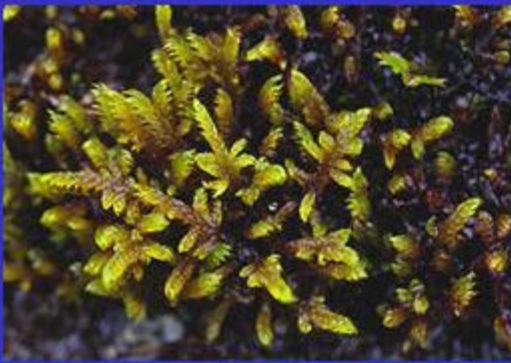
- Stem leaves plicate, costa strong, alar groups large and distinct
- Rhizoids branched, papillose when young
- Paraphyllia narrow
- Axillary hairs large, abundant
- Leaf lamina cells **prorate** or **mammillose**
- Calcareous habitats with high pH
- Springs or spring-influenced fens, brooks, wet rocks



## *Palustriella falcata*



- Relatively large and sparsely branched
- Leaf base ovate
- Alar groups not strongly widened near leaf margin



pH 5.0-8.4  
EC 53-706 mS / m  
Ca 6.4-121.0 mg / l



*P. commutata*

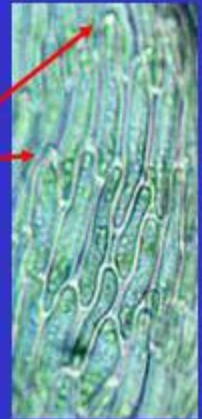
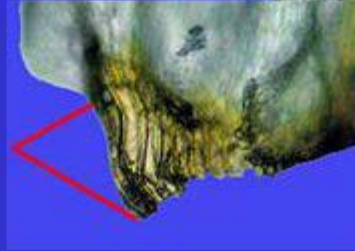
*P. falcata*

## *Palustriella commutata*

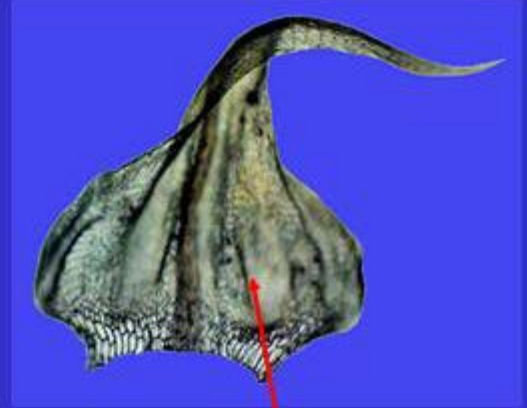


- Medium-sized and usually densely pinnate
- Leaf base cordate
- Alar groups strongly widened near leaf margin
- Many leaf lamina cells prorate, especially in lower leaf (cf. *P. decipiens*)

pH 4.9-8.1  
EC 280-538 mS / m  
Ca 48.6-103.5 mg / l

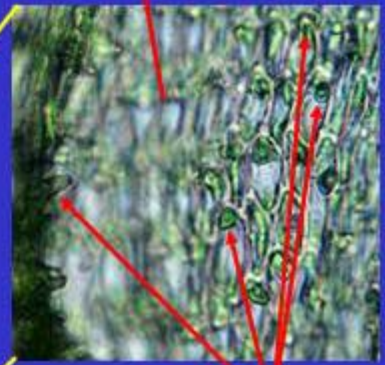
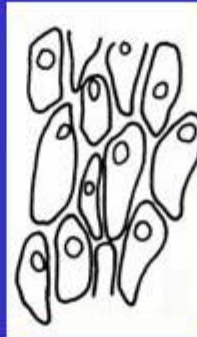


## *Palustriella decipiens*



- **Medium-sized and usually densely pinnate**
- **Leaf base cordate**
- **Alar groups strongly widened near leaf margin**
- **Many lower leaf lamina cells with mamillae, prorate cells also present**

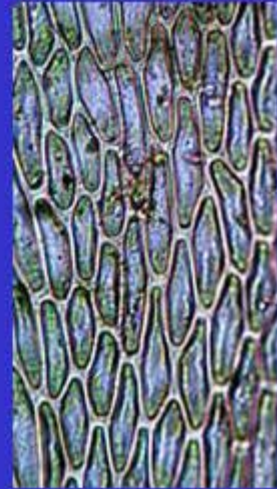
pH 5.8-8.0  
EC 80-538 mS / m  
Ca 4.2-87.8 mg / l



## CRATONEURON



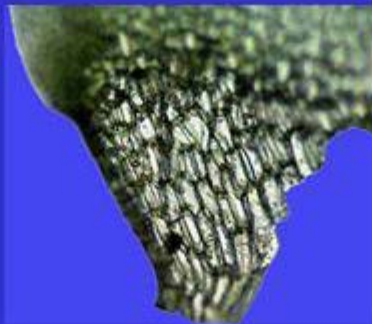
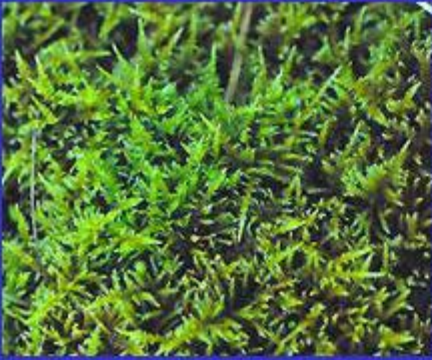
- Stem leaves smooth, costa strong, alar groups large and distinct
- Rhizoids branched, smooth
- Paraphyllia broad, leaf-like
- Axillary hairs small and rare
- Leaf lamina cells smooth
- Calcareous habitats with high pH
- Springs or spring-influenced fens, brooks, wet rocks, wet soil



## *Cratoneuron filicinum*

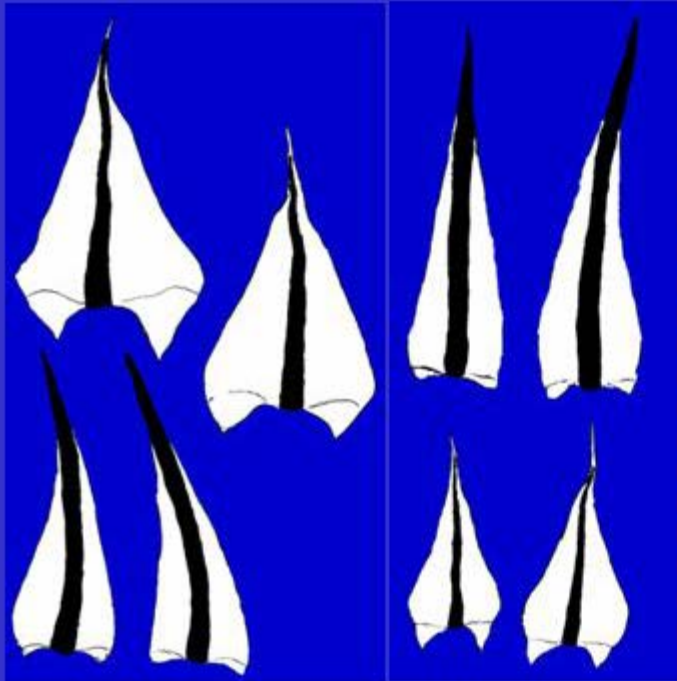


- Medium-sized, pinnate or irregularly so
- Leaf base mostly cordate
- Alar groups strongly widened near leaf margin
- Shoot apices often pale



pH 6.7-8.2  
EC 106-706 mS / m  
Ca 18.3-121.0 mg / l

***Cratoneuron filicinum***



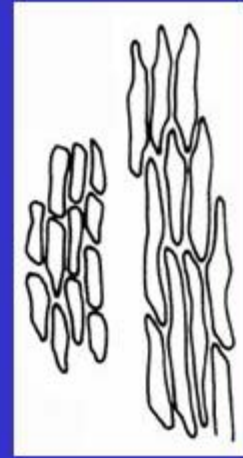
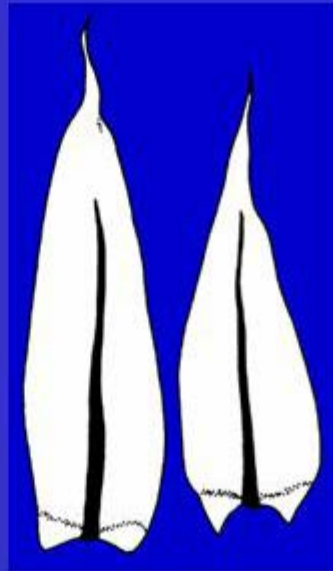
**Hungary**

**Two leaf types,  
three cm apart**

**Poland**

**New shoot above,  
old shoot below**

***Cratoneuron curvicaule***



- Stem leaves varying around ovate
- Median leaf lamina cells 21-80  $\mu\text{m}$  long (12-53  $\mu\text{m}$  in *C. filicinum*)
- Paraphyllia absent

## CAMPYLIIUM

## CAMPYLIADELPHUS

## CAMPYLOPHYLLUM

Upper leaf portion frequently set off from rest of leaf and furrowed  
(occurs also in some *Drepanocladus* species)

Alar groups  $\pm$  ovate, along basal leaf margin

Leaves frequently  $\pm$  spreading to squarrose

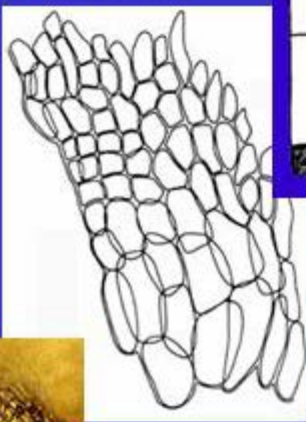
Costa short, double

Widest alar cells  
17.0-29.5  $\mu\text{m}$  wide

Lamina and costa  
cells smooth



*stellatum*



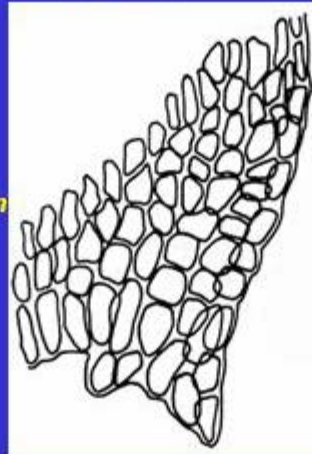
Costa mostly long, single

Widest alar cells 10.5-  
19.0(-21.0)  $\mu\text{m}$  wide

Lamina and costa  
cells smooth



*chrysophyllum*



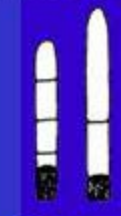
Costa short, double

Widest alar cells  
8.5-16.0  $\mu\text{m}$  wide

Lamina and costa  
cells partly prorate  
on back



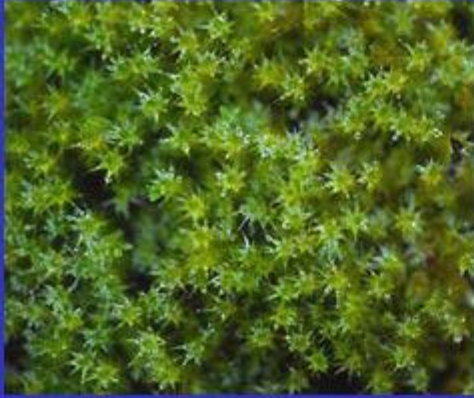
*sommerfeltii*



*halleri*



*Campylium stellatum*



*Campylium laxifolium*



*Campylium longicuspis*



*Campylium protensum*



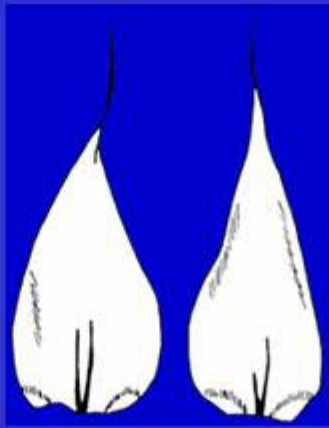
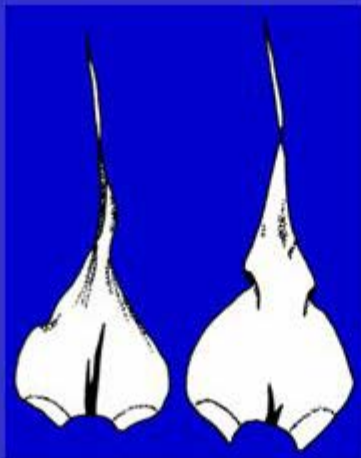
*Paraphyllia rare*

*Campylium protensum*

*Campylium longicuspis*

*Campylium stellatum*

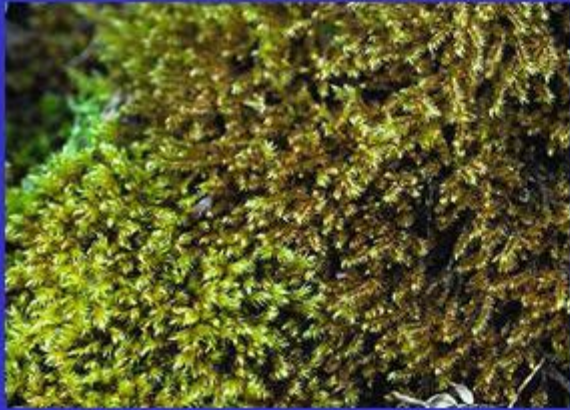
*Campylium laxifolium*



***Campyliadelphus chrysophyllus***



***Campyliadelphus elodes***



- Stem leaves triangular to ovate, 0.9-1.5(-1.8) x 0.4-0.7 mm, acumen  $\pm$  recurved in parts of shoots
- Margin entire to partly very weakly denticulate
- Costa ending (40-)50-80% way up leaf, occas. short and double
- Spores 8.5-14.5  $\mu$ m

pH 5.0-7.8  
EC ---  
Ca ---



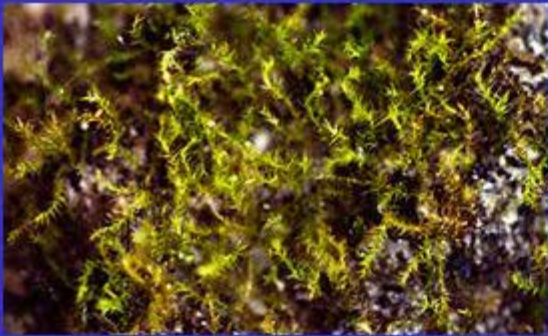
- Stem leaves triangular to lanceolate, 1.0-2.4 x 0.2-0.6 mm, sometimes curved, but acumen not recurved
- Margin partly or entirely denticulate to finely so, esp. above alar groups and near leaf apex
- Costa ending 50-100% way up leaf, somet. excurrent
- Spores 15.0-20.5  $\mu$ m

pH 6.4-8.1  
EC 220-622 mS / m  
Ca 40.6-72.2 mg / l

**(Campylophyllum)**



***C. halleri***



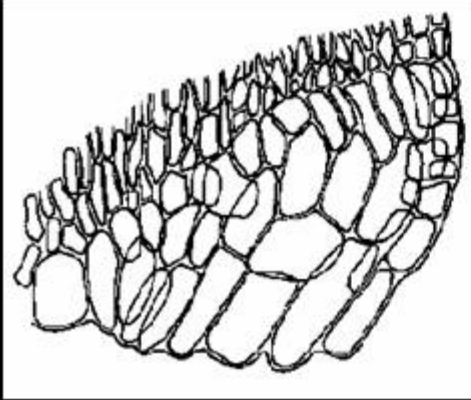
***C. calcareum***



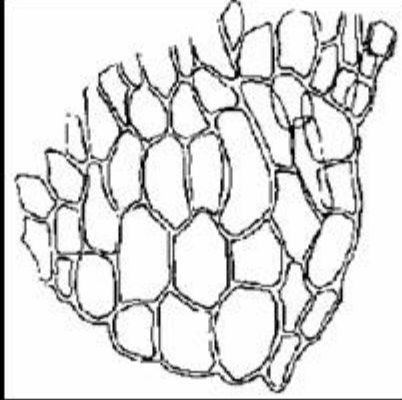
***C. sommerfeltii***



## DREPANOCLADUS



***D. aduncus***  
– transverse triangular  
group,  $\pm$  reaching costa



***D. sordidus***  
– quadrate or shortly  
transverse triangular  
group, not reaching costa

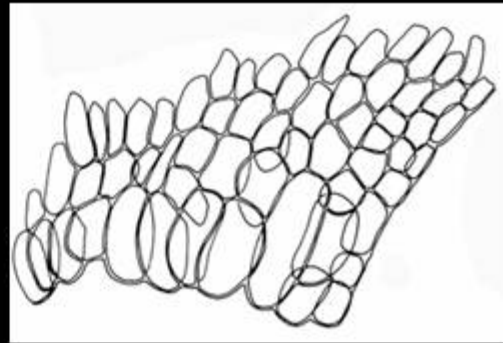
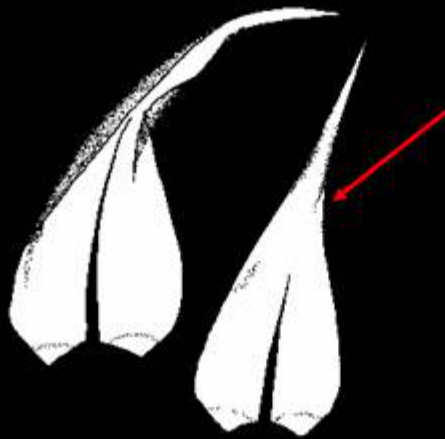


- Alar groups well delimited, of inflated and mostly thin-walled cells (two types of groups)
- Axillary hairs mostly with 1-2 upper cells, hyaline when young
- (Alar group ontogeny of *D. aduncus* type)
- (Leaf margin entire or sometimes finely denticulate)
- Usually in eutrophic habitats

## *Drepanocladus polygamus*

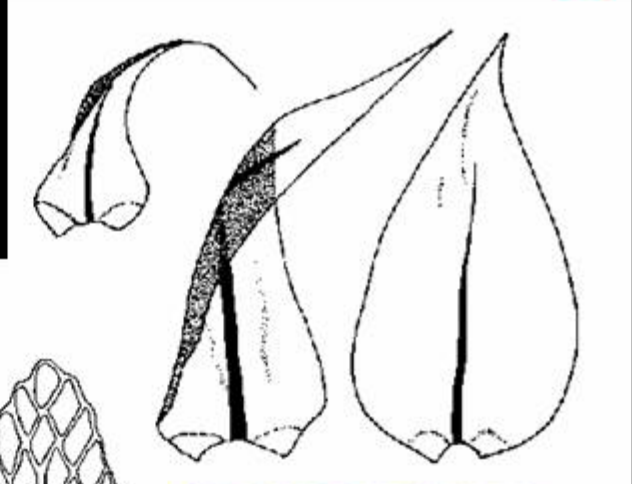
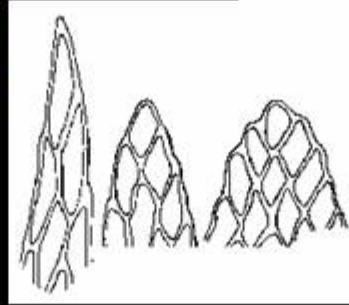


- Partly spreading or recurved leaves often give plants a *Campylium*-like appearance
- Many leaves often narrow  $\pm$  suddenly to acumen
- Acumen furrowed
- Alar groups transversely triangular
- Costa mostly long and single
- Autoicous (*C. stellatum* is dioicous)



pH 5.5-7.9  
EC 63-1600 mS / m  
Ca 1.1-175.0 mg / l

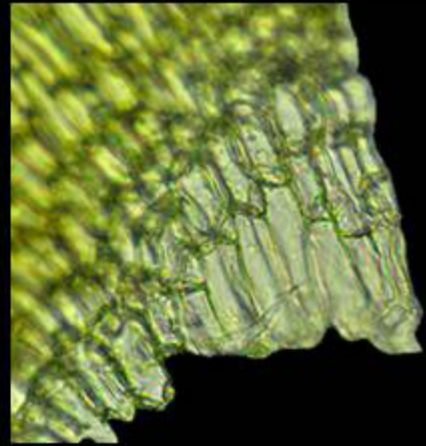
## *Drepanocladus aduncus*



- Leaves falcate-secund or sometimes straight and erect
- Leaf apex mostly acuminate, rarely acute or even obtuse
- Alar groups transversely triangular
- Costa single and ending above mid-leaf
- Dioicous

pH 4.3-9.6  
EC 38-1600 mS / m  
Ca 0.9-88.8 mg / l

- (Very variable in appearance;  
cf. *D. polycarpus*, *D. stagnatus*,  
*D. simplicissimus*)



***D. sendtneri***



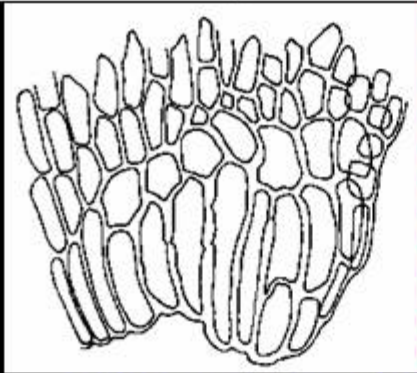
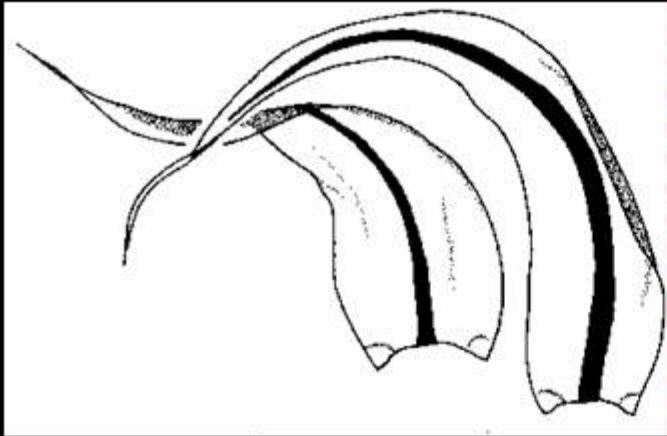
***D. sordidus***



- Leaves mostly falcate-secund
- Costa stronger than in *D. aduncus*

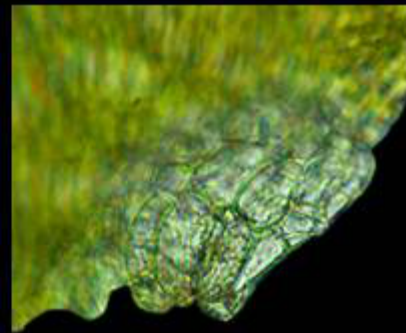
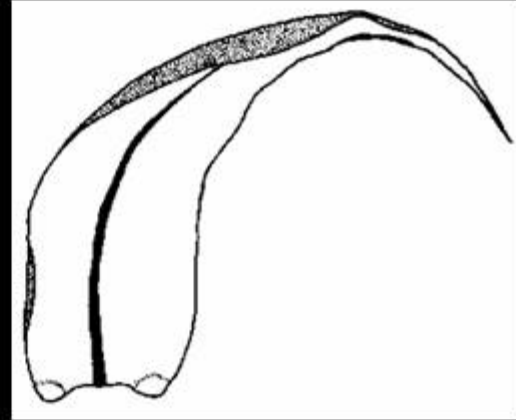


***D. sendtneri***



pH 5.9-7.8  
EC 140-960 mS / m  
Ca 22.7-219.0 mg / l

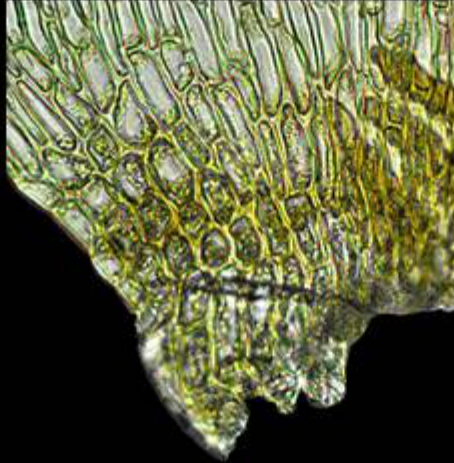
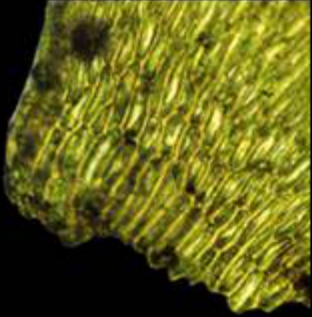
***D. sordidus***



pH 6.1-8.1  
EC 1-24 mS / m  
Ca 1.1-41.9 mg / l

**- Alar groups quadrate or shortly  
transversely triangular, not reaching costa**  
**- Differ in the ratio between length of  
median lamina cells and leaf length**

## **PSEUDOCALLIERGON**



- **Alar groups diffusely delimited, transversely triangular, of small or slightly inflated and mostly incrassate cells**
- **Axillary hairs mostly with 1-2 upper cells, early yellowish, apical cell often long**
- **Secondary pigments yellow or brownish yellow; dry plants often with golden metallic gloss in spots**
- **Leaf margin entire or sometimes finely denticulate**
- **Leaf shape and costa very variable within the genus**
- **Dioicous**
- **Mostly in mineral-rich to strongly calcareous habitats**

## *Pseudocalliergon lycopodioides*

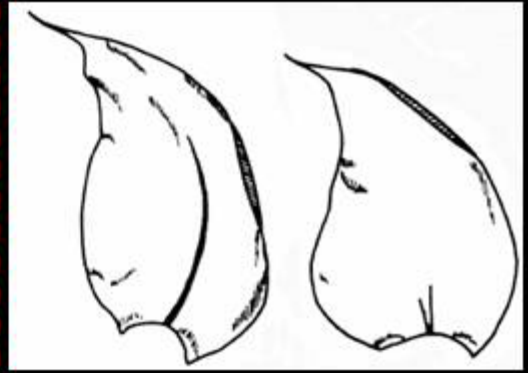


- Leaves broad, concave; plants turgid
- Leaves falcate-secund
- Leaf apex acuminate
- Costa single and long



pH 6.0-8.2  
EC 48-960 mS / m  
Ca 25.8-218.0 mg / l

## *Pseudocalliergon brevifolium*

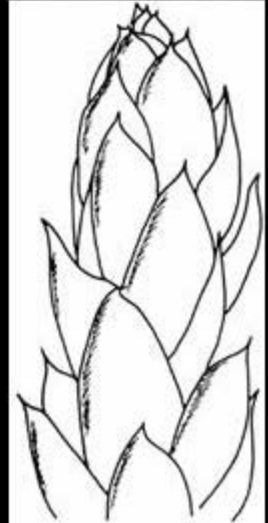
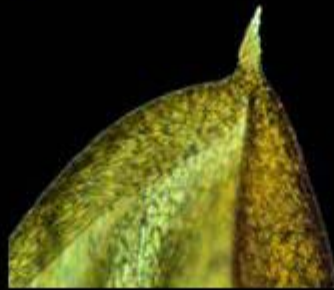


## *Pseudocalliergon turgescens*



- Plants only slightly branched
- Leaves broad, concave; plants turgid
- Leaves straight and  $\pm$  erect
- Leaves apiculate
- Costa short and double

pH 5.9-8.6  
EC 187-885 mS / m  
Ca 15.4-137.0 mg / l

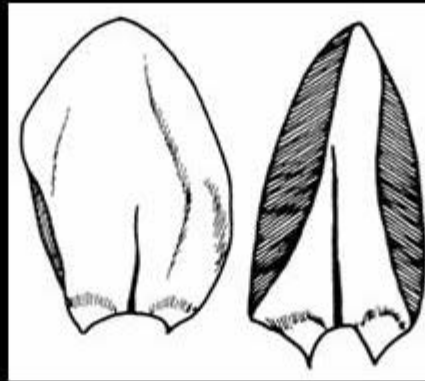


## *Pseudocalliergon trifarium*



- Plants weakly branched
- Leaves broad
- Leaves straight and erect
- Leaf apex rounded
- Costa single and  $\pm$  long

pH 5.6-8.1  
EC 27-555 mS / m  
Ca 4.2-75.8 mg / l



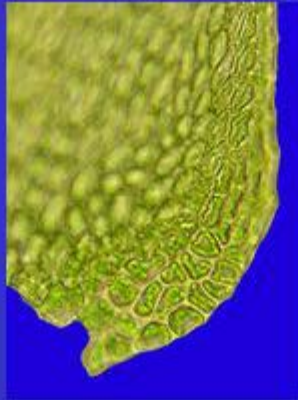
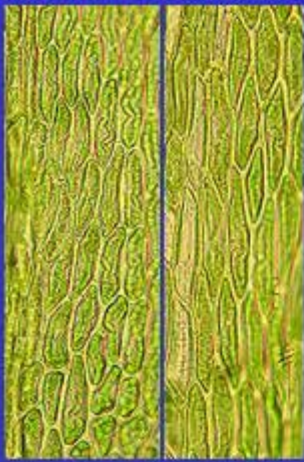
## AMBLYSTEGIUM



*A. serpens*



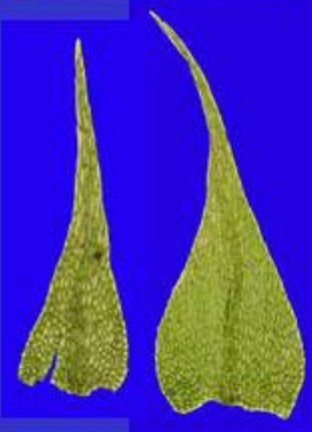
*A. confervoides*



- Small or minute plants
- Leaves gradually narrowed to acuminate or longly acuminate apex
- Leaf lamina cells short
- Alar cells small, in diffusely delimited group
- Axillary hairs small and sparse
- Usually in humid but not wet habitats



**A. serpens**



- Capsule horizontal, curved
- Costa long
- Leaf margin finely denticulate

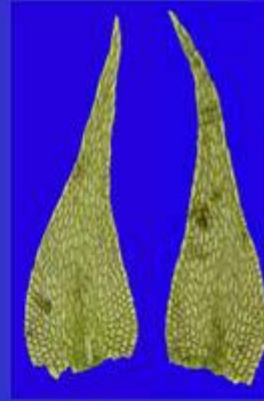


**A. confervoides**  
(*Serpoteskea c.*)



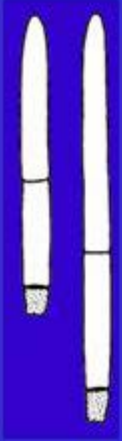
- Capsule horizontal, curved
- Costa short
- Leaf margin entire or almost so

**A. subtile**



- Capsule 'erect', ± straight
- Costa short
- Leaf margin entire or almost so

## *Amblystegium / Hygroamblystegium radicale*

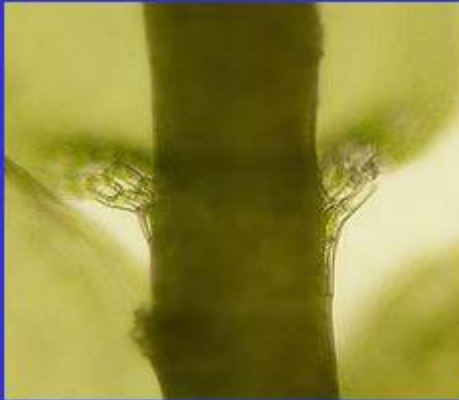


- Similar to *Amblystegium serpens* or some *Hygroamblystegium* species, but:

- Leaves decurrent

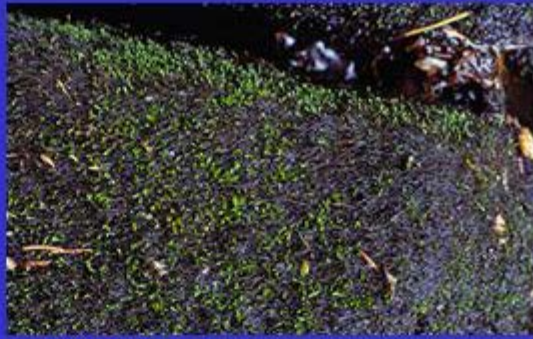
- Alar cells tend to be longer and slightly inflated

- Axillary hairs larger



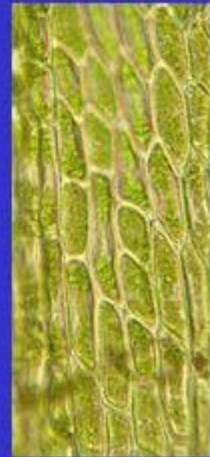
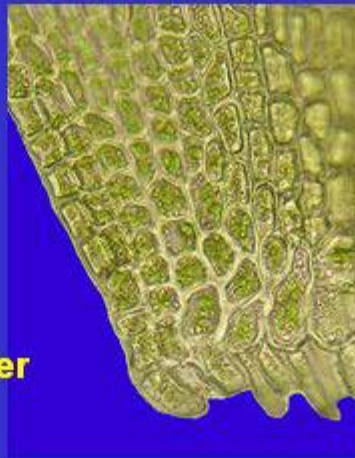


## HYGROAMBLYSTEGIUM



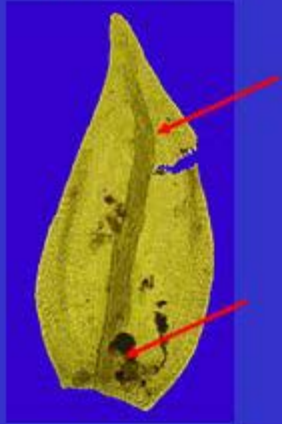
*H. fluviatile*

- Similar to *Amblystegium serpens*, but often slightly larger, and:
- Leaves more shortly narrowed upwards
- Leaf margin less distinctly denticulate or entire
- Usually associated with running water

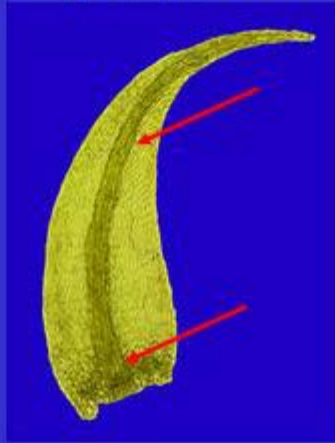




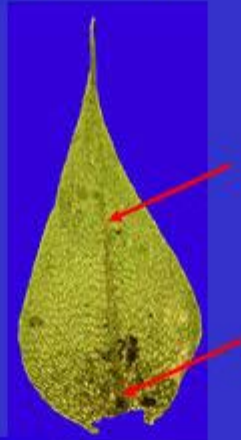
***H. fluviatile***



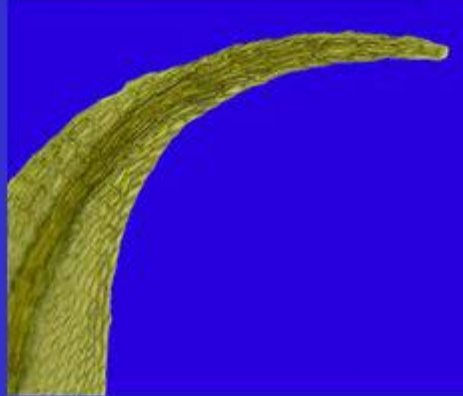
***H. tenax***



***H. humile***



***H. varium***



- Leaf apex
- Costa length
- Costa width
- Costa curvature

***H. fluviatile***



***H. tenax***



***H. humile***



***H. varium***



- Denticulation of upper leaf margin
- Length / width ratio of lamina cells

## ISSR (NJ tree)



### ***Hygroamblystegium varium***

syn.: *H. fluviatile*

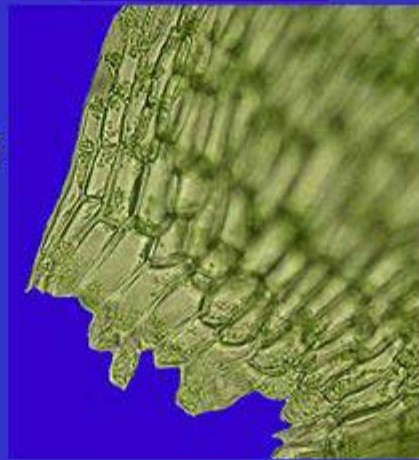
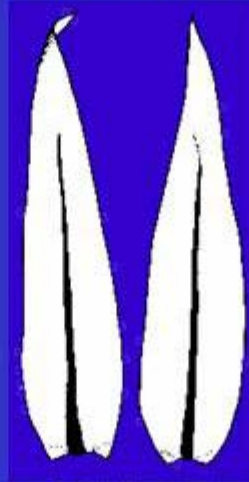
syn.: *H. humile*

syn.: *H. tenax*

(Vanderpoorten 2004)

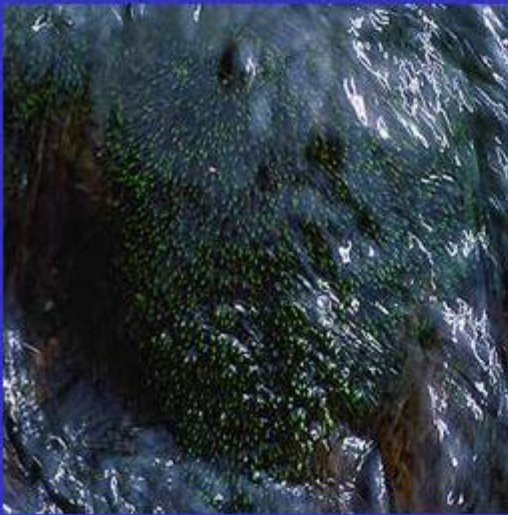
After Vanderpoorten  
& Jacquemart (2004)

## *Leptodictyum riparium*



- Larger than all other *Amblystegium* s.l. species
- Median leaf lamina cells long
- Alar groups poorly differentiated
- Axillary hairs long (2-7 upper cells) and abundant
- Branch leaves often clearly complanate
- (Sometimes confused with *Drepanocladus aduncus*)

## **HYGROHYPNUM**



***H. ochraceum***

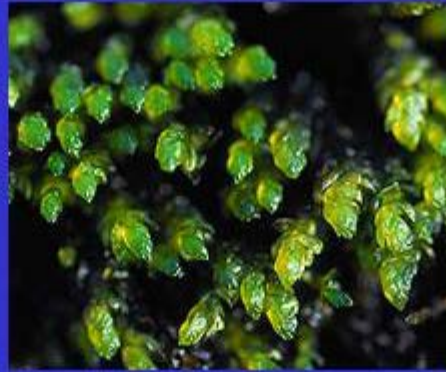


***H. eugyrium***

- In running or trickling water
- Habit and leaf characters very variable
- Sporophytes typical for the Amblystegiaceae

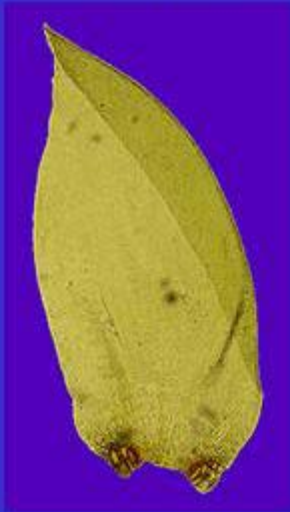
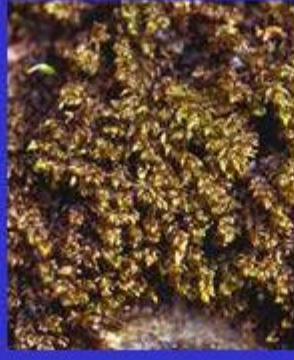
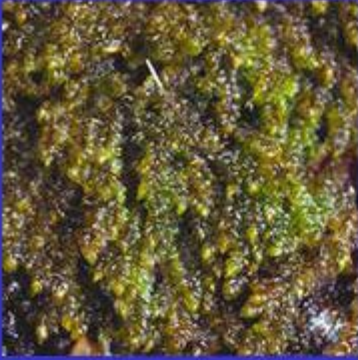


***H. alpinum***



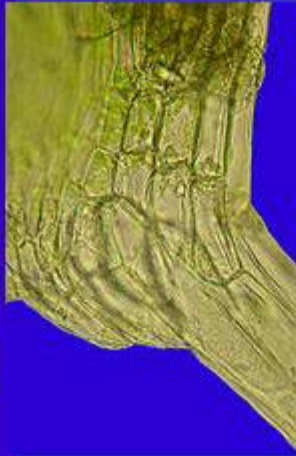
***H. alpestre***

## *Hygrohypnum eugyrium*



- Leaves loosely imbricate, erect-spreading or almost spreading, falcate or straight, concave
- Leaves ovate; above gradually narrowed to blunt point
- Costa short and double
- Alar cells forming well delimited groups of pale or brownish, inflated cells
- Hyalodermis differentiated, but somewhat indistinct

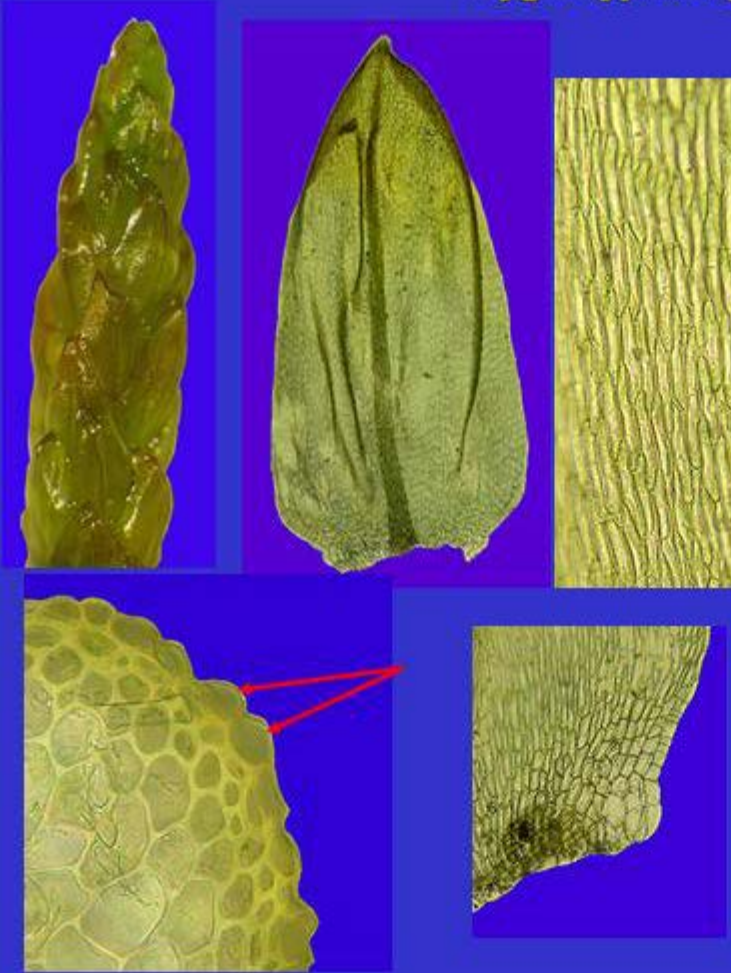
## *Hygrohypnum ochraceum*



- Leaves erect-spreading or spreading, falcate or straight, concave
- Leaves ovate; above gradually narrowed to obtuse or blunt point
- Costa mostly branched, mostly ending in mid-leaf
- Differentiated alar cells few,  $\pm$  rectangular, thin-walled and inflated
- Hyalodermis differentiated

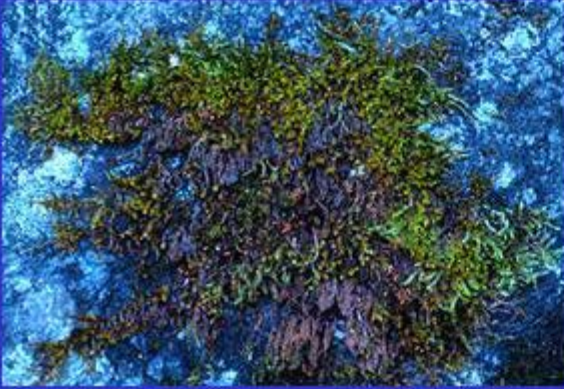


## *Hygrohypnum polare*



- Leaves erect-spreading, straight or slightly falcate
- Leaves ovate, strongly concave; above suddenly narrowed to obtuse or blunt point
- Costa single, percurrent or almost so
- Alar cells quadrate or rectangular, thin-walled or slightly incrassate
- Hyalodermis differentiated

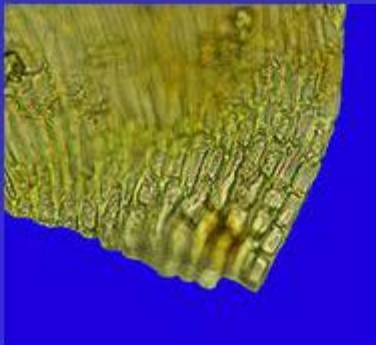
## *Hygrohypnum luridum*



- Leaves erect or erect-patent, straight or falcate, concave
- Leaves ovate or oblong-ovate; apex acuminate, acute, or sometimes obtuse
- Costa single, forked or branched, ending 25-80% way up leaf
- Alar cells rectangular, well differentiated
- No hyalodermis

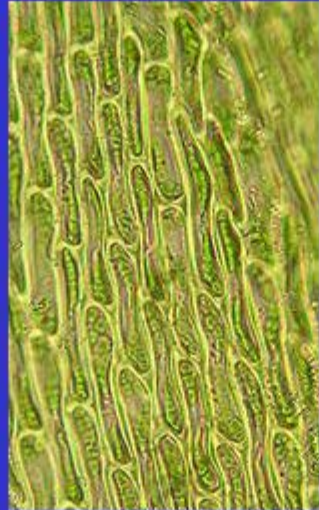
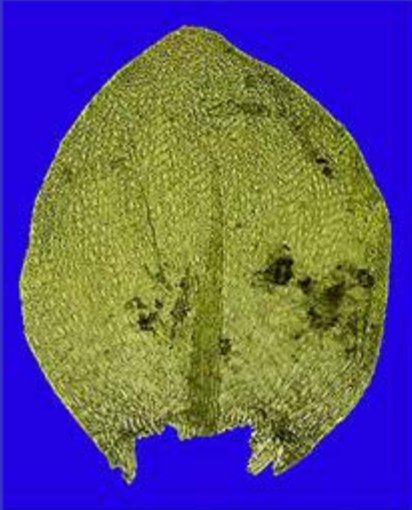
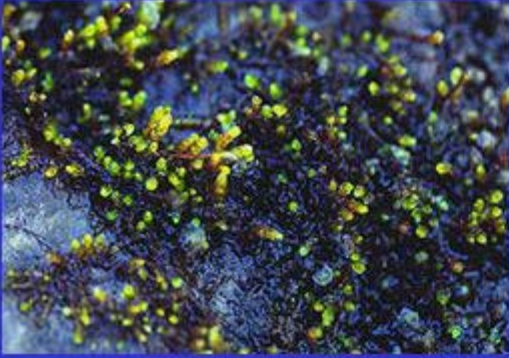


*Hygrohypnum styriacum*



- Leaves erect-spreading to almost spreading, straight or falcate, concave
- Leaves ovate; above suddenly narrowed to slightly elongate, mostly blunt point
- Costa weak, mostly branched, ending ca. half way up leaf
- Alar cells rectangular, hardly differentiated from other basal cells
- No hyalodermis

*Hygrohypnum smithii*



- Leaves erect-spreading to spreading, straight, slightly concave
- Leaves very broad; apex broadly obtuse to rounded
- Costa mostly single, stout
- Alar cells rectangular, indistinctly differentiated
- No hyalodermis

*Hygrohypnum molle*



*Hygrohypnum duriusculum*



- Leaves  $\pm$  plane

- No hyalodermis

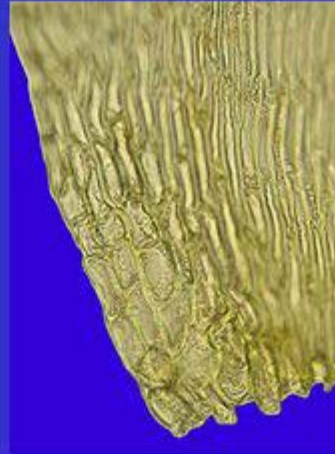
- Costa short and double

***Hygrohypnum molle***



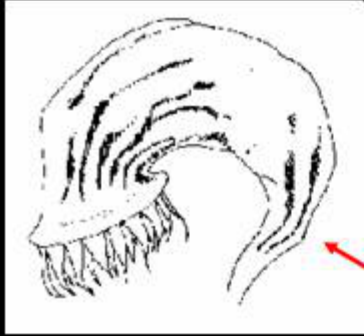
**- Alar groups indistinctly differentiated**

***Hygrohypnum duriusculum***



**- Alar groups distinct**

# CALLIERGONELLA

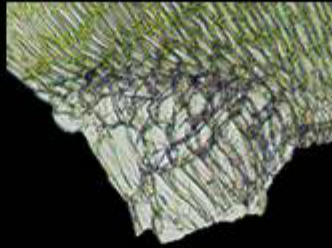


dry - moist

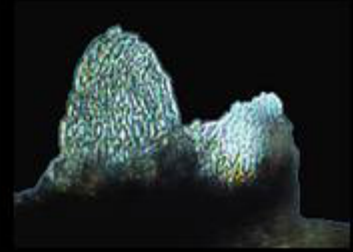
- Spore capsule thick, furrowed or sulcate when dry
- Hyalodermis differentiated
- Pseudoparaphyllia broad
- Alar groups large and well delimited, of inflated, thin-walled cells



*C. cuspidata*



*C. lindbergii*



*Calliergonella cuspidata*

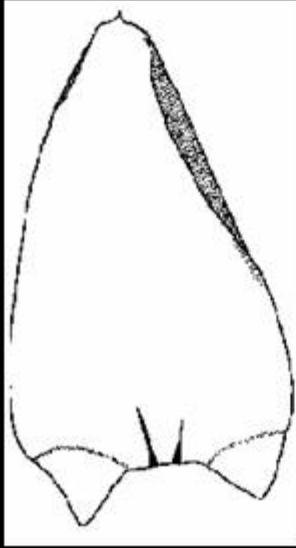


*Calliergonella lindbergii*

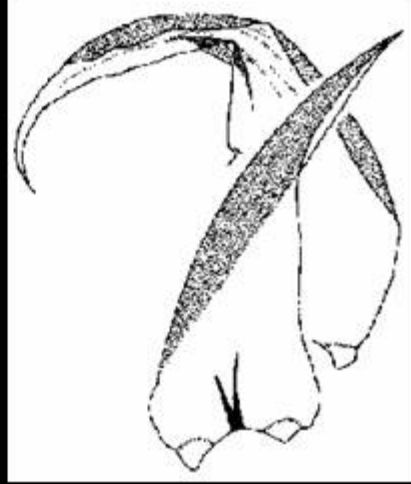




***Calliergonella cuspidata***



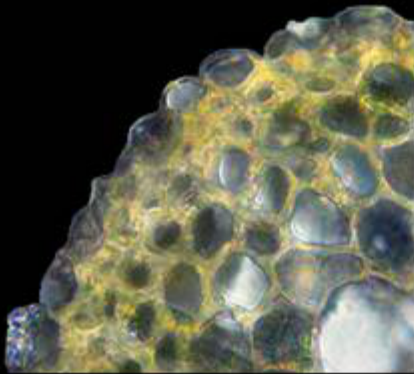
***Calliergonella lindbergii***



## **SANIONIA**



- **Mostly in humid, non-wetland habitats**
- **Leaves ± plicate**
- **Hyalodermis differentiated**
- **Alar groups well developed, alar cells thin-walled and inflated**
- **Autoicous**
- **Axillary hairs well developed**



*S. uncinata*



*S. orthothecioides*



*S. georgicouncinata*



*S. uncinata*



*S. orthothecioides*



*S. georgicouncinata*



*S. uncinata*



*S. orthothecioides*



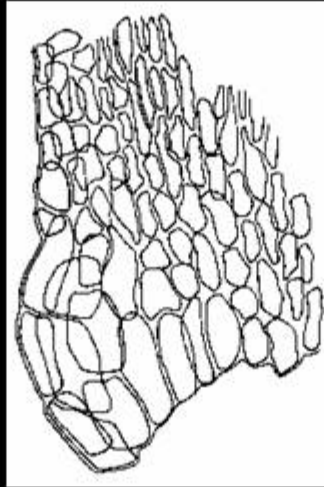
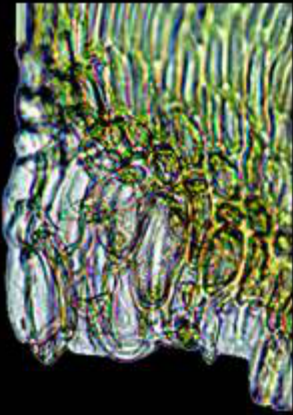
*S. georgicouncinata*



*S. uncinata*

*S. orthothecioides*

*S. georgicouncinata*



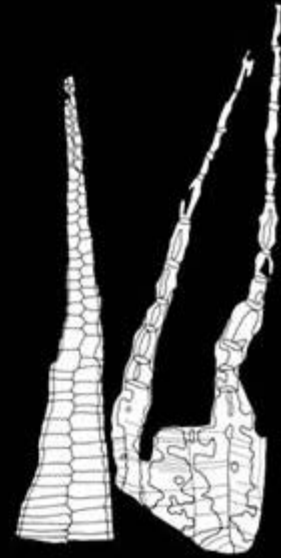
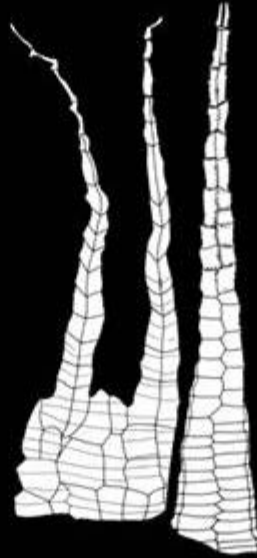
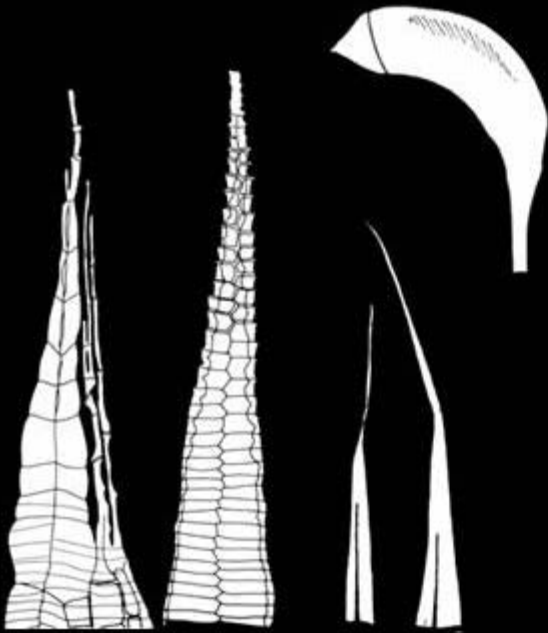
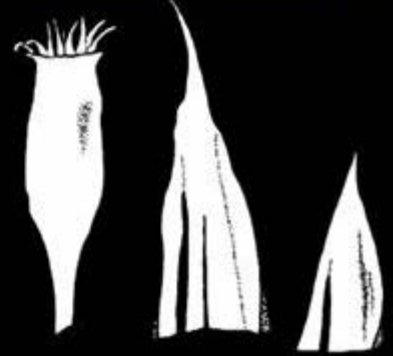
*S. uncinata*



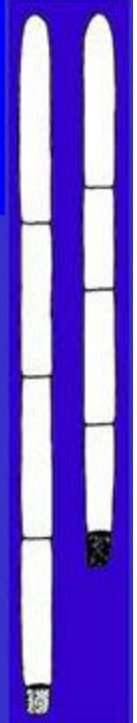
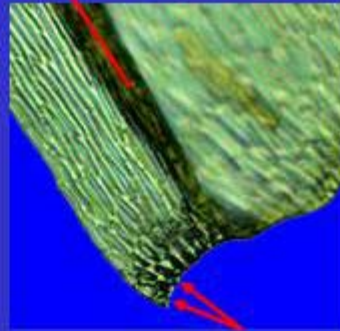
*S. orthothecioides*



*S. georgicouncinata*



## *Tomentypnum nitens*



- Golden yellow, often in high hummocks
- Leaves narrowly triangular and gradually narrowed upwards from far below
- Leaves longitudinally plicate
- Branched rhizoids usually present on lower back of costa in at least some leaves
- Alar cells not differentiated

- Exostome outside reticulate below

pH 5.7-8.0  
EC 24-509 mS / m  
Ca 2.1-73.7 mg / l



## *Conardia compacta*



- Small, *Amblystegium*-like plant
- Warty-papillose, often branched rhizoids usually present on lower back of costa in at least some leaves
- Axillary hairs broad, with 1-4 short upper cells
- Alar cells quadrate or rectangular, indistinctly delimited, but  $\pm$  reaching costa
- Exostome outside partly reticulate below

