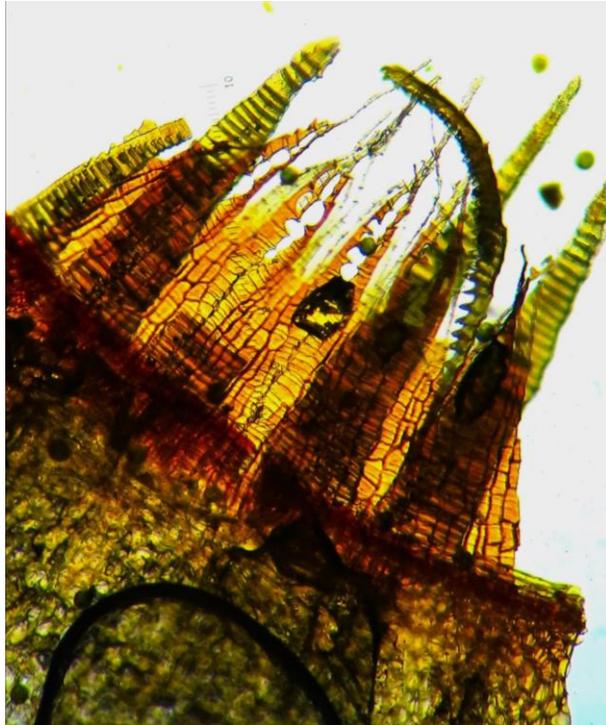


**PP #4 BRYOPHYTE GROWTH-FORMS, WITH  
EMPHASIS ON:**

**WEFTS, MATS, & MOVING ON TO NEW HABITATS**



**Moss Double Peristome –  
Outer Teeth flick out spores,  
Inner teeth serve as sieve.**

***Mnium hornum* (turf species)**

## GROWTH-FORMS: KEY

- I. Most shoots upright (orthotropic growth)..... Cushions & Turfs
  - A. Robust plants conspicuously branched.....Dendroids
  - B. Robust plants with heads & fascicles.....Sphagnum
  
- II. Most shoots or thalli (ribbons and sheets) creeping (plagiotropic growth)
  - A. No stems and leaves: Simple & Complex Thalloid Mats ....Thalloid Liverworts
  - B. Stems and leaves (shoots) are present
    - 1. Main stems arching upward; straggling, interwoven shoots....Wefts
    - 2. Main stems not arching; tighter branching.....Mats
      - A. Interwoven branches in one plane..... Smooth Mats
      - B. Branches ascending while main stem creeps.....Rough Mats

## Wefts: Mosses

- ❖ Loose mats with ascending branches –*foraging for?*
- ❖ Thrive in humid boreal & cool montane forests.
- ❖ Often begin as smooth mats.



**Delicate Fern Moss,**  
*Thuidium delicatulum*,  
log, WV



**Knight's Plume, *Ptilium***  
*crista-castrensis*, soil  
MD



**Brocade Moss,**  
*Hypnum imponens*  
MD

# WEFTS AS CLIMATE INDICATORS

## WEFTS

❖ Built for foraging for light, water, & nutrients in humid environments, become quite large and attractive, indicate high humidity /low moisture stress.

❖ Decline of boreal and montane wefts is likely with global warming, such as *Hylocomium splendens* (Splendid Stairstep Moss) & *Hylocomium brevirostre* (Pinched shaggy moss)

❖ Herbaria provide useful records of past and present distributions. Hence recent NSF funded project (Thematic Collections Network) to put bryophyte collections around the country into the Bryophyte Portal, where widely accessible.

## WEFTS USEFUL AS CLIMATE INDICATORS: EASILY RECOGNIZED



***Hylocomium splendens*, Splendid  
Stairstep Moss; High elevation Montane  
& Boreal Forests**



***Loeskeobryum brevirostre*, Pinched  
Shaggy Moss; Appalachian Cove-  
hardwood Forests.**

## WEFT- *THUIDIUM DELICATULUM* – DELICATE FERN MOSS

- ❖ Easy to recognize: 2X pinnate branching, & stems cloaked with *paraphyllia* (filamentous outgrowths of stem, in this case papillose).
- ❖ Photosynthesizes even encased in ice, like many temperate & boreal bryophytes; can acclimate to seasons.



Wikimedia Commons

- ❖ Wide global distribution: northern hemisphere to Mexico, Central & South America
- ❖ *What does it indicate about the climate at HBS?*

2-9-20,  
Laurel River Trail



## ROUGH MATS +/- INDICATORS OF MODERATE MOISTURE CONDITIONS



**Brachytheciaceae are Rough mats with midribs**

***Sciuro-hypnum (Brachythecium) plumosum*, Rusty Foxtail Moss.**

- ❖ **Very common at the edges of streams**
- ❖ **Leaves often bend in one direction (falcate)**
- ❖ **Dark capsules top papillose setae**
- ❖ **Very widely distributed in both hemispheres**

## ROUGH MAT: *BRYOANDERSONIA ILLECEBRA* WORM MOSS



- ❖ Recognized by concave leaves, midrib, twisted leaf tips, worm-like shoot appearance.
- ❖ Often grows on moist stream banks & trail banks.
- ❖ Endemic to Eastern North America.

❖ Concave boat-shaped leaves hold water; back of leaf is exposed to atmosphere & conducts gas exchange.



## ROUGH MAT *BRYOANDERSONIA ILLECEBRA*: DISTRIBUTION

- ❖ Endemic to Eastern North America

About 80% of ENA bryophytes are circumboreal-montane, & c. 20% endemic to Eastern North America.

- ❖ Reflects long isolation of ENA from Western North America, first by an inland (Cretaceous) sea, later by arid grasslands.
- ❖ ENA flora became separate from Eurasia with opening of Atlantic Ocean, gradual even starting c. 140 mybp.



Bryoandersonia on tree base

## ***ANOMODON ATTENUATUS* POODLE MOSS– ROUGH MAT,**



- ❖ **Drapes tree bases & steep rock faces, branches have tapering tips.**
- ❖ **Drooping branches & uneven aspect make growth-form a little difficult to classify.**
- ❖ **Spectacular thick mats on tree bases in old-growth forests give tree trunks a poodle-like aspect, as if covered in green fur.**

***ANOMODON ROSTRATUS*, ANOTHER ROUGH MAT CALCIPHILE;  
Lacks tapering branches of *A. attenuatus***

*For all our regional Anomodon species:*

❖ **Pale color is due to bumps (papillae) on cell walls that reflect light and dilute the green color. This may reduce solar damage**

❖ **Prefer nutrient or calcium-rich substrates; found on limestone or other nutrient-rich rocks such as the basaltic rocks of the Laurel River Trail cliffs.**



❖ **Also characteristic of nutrient-rich old tree bases in humid forests.**

❖ **Generally, lush *Anomodon* Rough Mats suggest a calcium-rich very humid habitat.**

**SMOOTH MATS: MAY INDICATE LESS MOIST CONDITIONS THAN  
ROUGH MATS, OFTEN GROW ON HARD SURFACES**



*Hypnum imponens*, Brocade Moss, grows as smooth mat or weft in very favorable conditions. Regular fern-like branching makes it a favorite for arts & crafts.

# MATS OF HYPNUM & OTHER SPECIES PROVIDE HOMES FOR INSECTS, SALAMANDERS, & OTHER SPECIES.

❖ **Peeling Back Moss Mat, exposing rotting log held together by moss**

Kumbrabow SF, WV

❖ **Insect larvae were under the moss mat; comprising base of the food chain.**

❖ **Hungry Bear tore Moss Mats off log.**

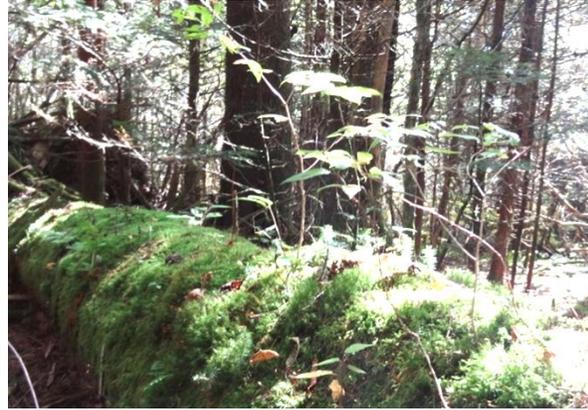
Cathedral SP, WV



## NURSE LOGS: OFTEN DOMINATED BY MATS OF *HYPNUM CURVIFOLIUM* & *H. IMPONENS*



Log with *H. imponens*,  
Blackwater Falls SP, WV



Nurse Log with yellow birch seedlings, & Spruce with Stilt Roots;  
Nature Trail near Clingman's Dome, TN

- ❖ Seedlings, like mosses, can be suffocated by litter.
- ❖ Mossy islands on Logs serve as Nurse Logs, allowing tree seedlings to get a start.
- ❖ When the log decays the tree may reveal its location by stilt roots that once embraced the log.
- ❖ Nurse logs play a major role in community dynamics in forests. In a hemlock forest, windfalls create a light gap, & nurse log seedlings take off.
- ❖ If the mat is too thick or too thin, seedlings may die (moisture & nutrients not suitable); a goldilocks phenomenon.



## MOSS MATS IN ARTS & CRAFTS



**Fairy Garden exhibit with elfin home,  
Santa Barbara Botanic Garden, CA**

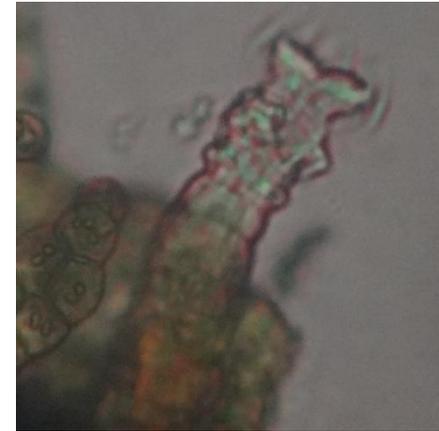
**Giant with *Hypnum imponens* Beard  
Coopers Rock SF, WV  
Artist: WVU student Benjamin Gazsi, 2012.**

## SMOOTH MAT : *FRULLANIA*: HOME FOR ROTIFERS

❖ Rotifers are “wheel animals”. Their beating cilia give the illusion of wheels as they create currents that channel edible organic debris into their mouths.

❖ Rotifers live in the lobules of *Frullania*. They are extremely tolerant of drying out, well-suited for life in *Frullania*, growing in xeric microhabitats, yet with temporary “ponds” for rotifers.

The relationship, known since the 1890’s, is now being investigated by University of Pittsburgh researchers.



## MOSS MATS FALL AWAY & LOGS & STUMPS ARE TEMPORARY.

- ❖ Gravity & weak rhiizoids mean moss mats fall from steep cliffs as well.
- ❖ Left behind: new surfaces suitable for colonization.



Stilt roots in Oregon, temperate rainforest



❖ Bryophyte Mats falling off Cliff, Laurel River



❖ Coniferous stumps are often covered with liverworts.

**Spores & Fragments & Gemmae = Means of Escape to a New Habitat; Survival of the Next Generation; the meaning of Life Cycles or “Life Spirals” .**

## MOVING ON – LOGS & STUMPS ARE TEMPORARY.

❖ **Even Steep Cliff faces are Temporary as Habitats.**

With only rhizoids as anchor, lush heavy mats fall away & leave behind bare rock ready for re-colonization – or colonization by other species.



Stilt roots in Oregon, temperate rainforest



❖ Bryophyte Mats falling off Cliff, Laurel River Trail (*Scapania*+)



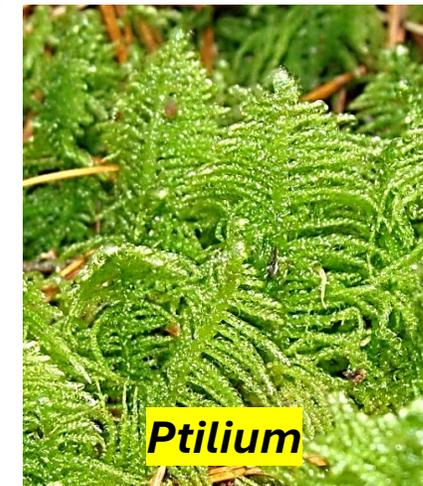
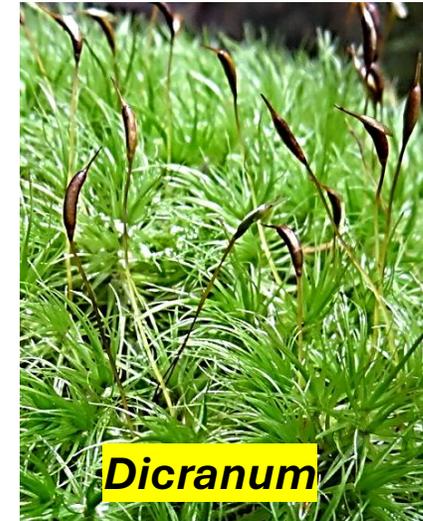
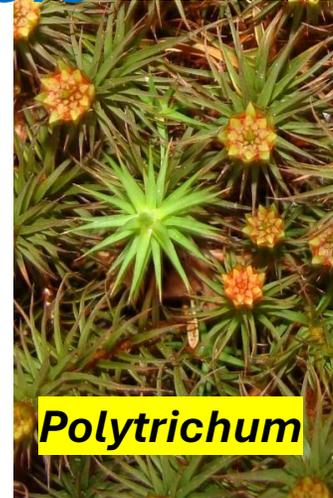
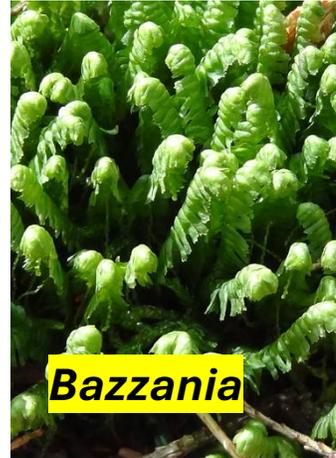
❖ Stumps of conifers are acidic & liverworts often prevail; hardwoods are often dominated by mosses.

**Spores & Fragments & Gemmae = Means of Escape to a New Habitat; Survival of the Next Generation; completion of Life Cycles or “Life Spirals” .**

# PERENNIAL TURF & DENDROID BRYOPHYTES OFTEN DOMINATE THE FLOOR OF BOREAL & MONTANE SPRUCE-FIR FORESTS

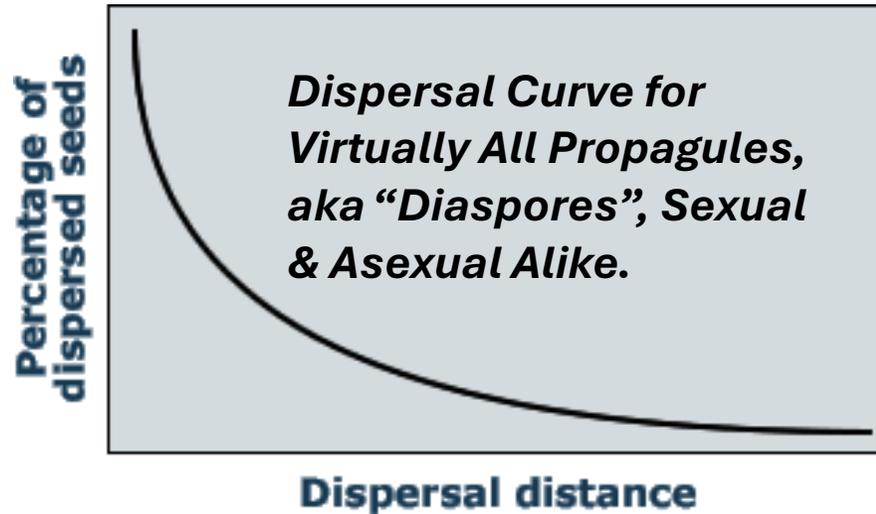
❖ It's easier to grow through needle-leaf litter than broadleaf-litter

❖ Minerals and water accumulate in Bryophyte Carpets in large amounts



e.g., \*See articles by Berg in *Forests* 2016, 7(9), 186; <https://doi.org/10.3390/f7090186>; & Rousk et al. 2013 in *Front. Microbiol.* 2013; 4: 150.

# DISPERSAL OF BRYOPHYTE PROPAGULES-Sexual & Asexual

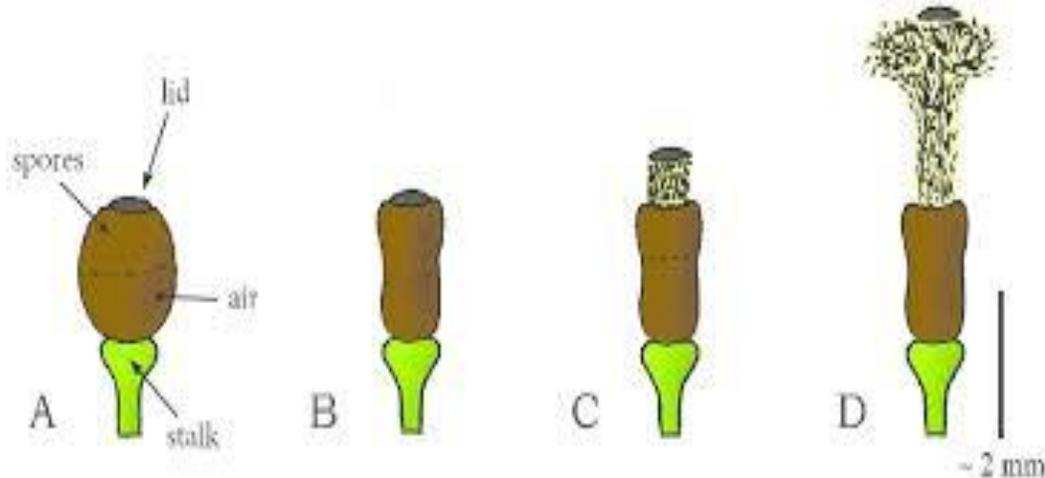


<https://www.geo.uzh.ch/microsite/alpecole/static/course/lessons/18/18r.htm>

❖ Most spores are deposited near the parent, as are seeds.

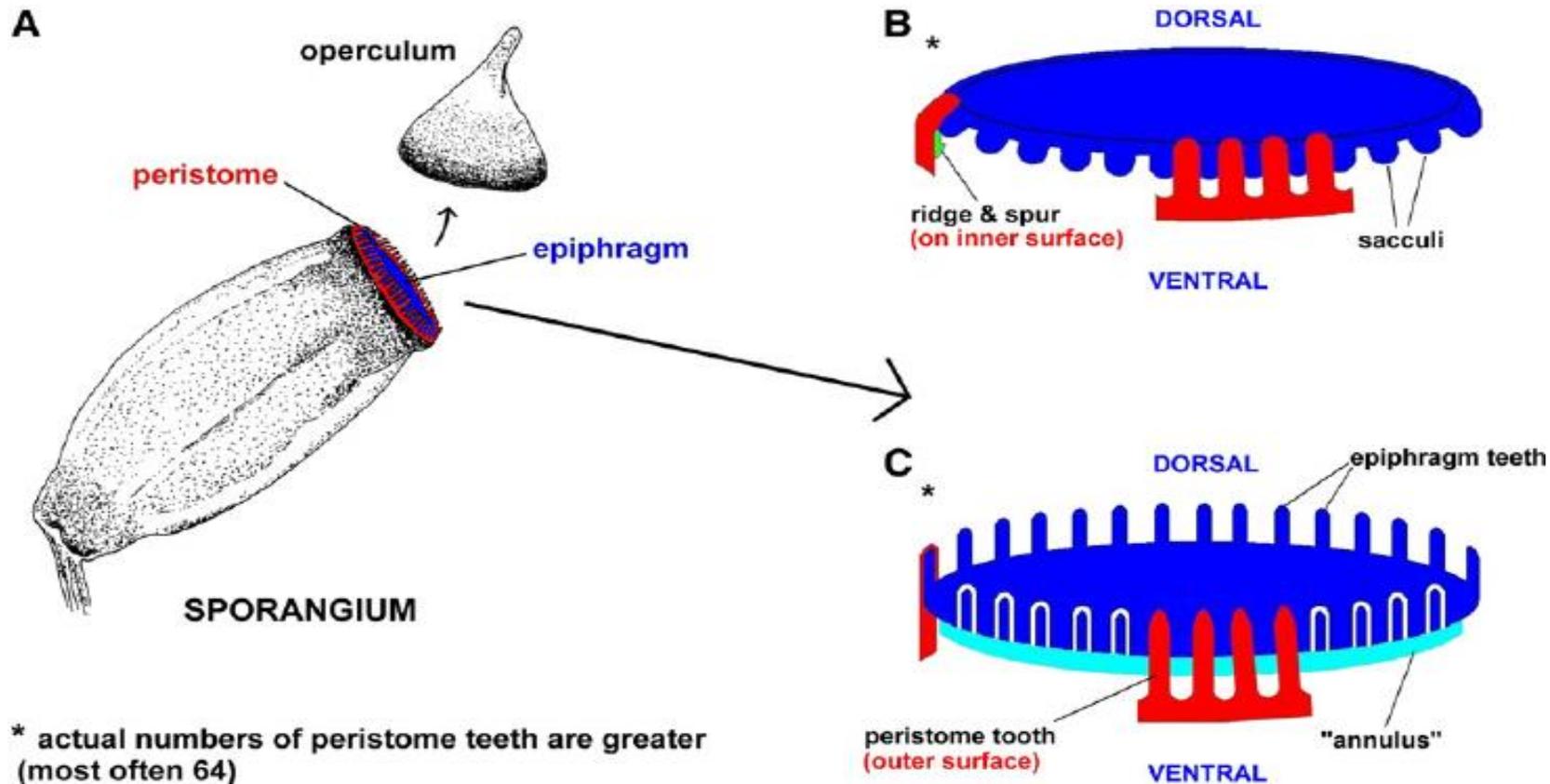
❖ A few may travel very long distances.

❖ Moss spores are **flicked out** by teeth (peristome), **shot out** under pressure (*Sphagnum*) or **fall out** as from a salt or pepper shaker (*Polytrichum* & *Atrichum*).



*Sphagnum* spore release

# ESCAPING TO A NEW HABITAT: POLYTRICHACEAE “SALT OR PEPPER SHAKER” MODE OF SPORE RELEASE



## DISPERSAL OF BRYOPHYTE FRAGMENTS BY ANIMALS, WATER, WIND



Nest box of wren filled with *Thuidium* (left); snail grazing on mosses (right)



❖ Snails & slugs feed on bryophytes and secrete sticky slime (mucopolysaccharides) to which fragments and spores adhere, resulting in dispersal. Also viable fragments may appear in feces.

❖ Many bird species transport bryophytes for use mosses in their nests – potential dispersal to new habitats.

## ASEXUAL PROPAGULES (from MITOSIS): VERY COMMON IN LIVERWORTS



<http://www.buildingthepride.com/faculty/pgdavison/i>

❖ ***Scapania undulata* (aquatic leafy liverwort) produces 2-celled gemmae from leaf margins. Dispersed by water**

❖ ***S. undulata* is exceptionally tolerant of acid mine drainage, as we found for WV & other researchers found for the UK and Japan!**

***SUNSET SLIDE for Bryophytes Course, Highlands 2024***

