MOSS/BRYOPHYTE GROWTH-FORMS: TURFS & CUSHIONS

I. Most shoots upright (orthotropic growth)

A. Upright shoots conspicuously branched – *Climacium, Sphagnum*

B. Upright shoots not conspicuously branched

1. Shoots densely packed into dome-shaped cushions: Cushion
2. Shoots packed into level-topped leafy turfs: Turf

Common Haircap, *Polytrichum commune*; often Tall Turf (> 2 cm)

Male Plants with Splash Cups

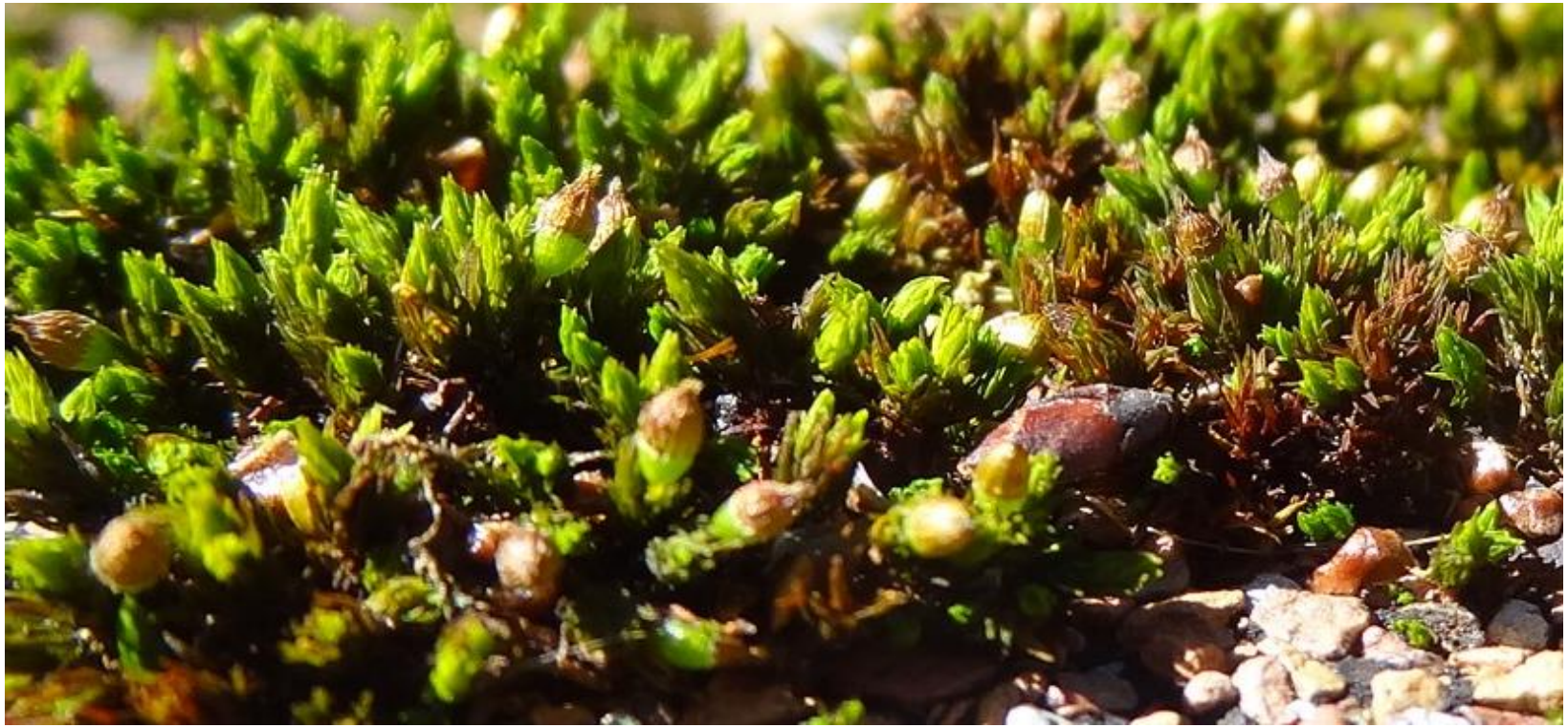
SMALL CUSHIONS: *ULOTA* (ORTHOTRICHACEAE)

Ulota crispula **on tree trunk in dry crisped condition.**

Ulota hutchinseae **with non-crisped leaves when dry, on acidic rock.**

How are these small cushions well-suited for windy dry microclimates?
What about the sporophytes – any xeric adaptations noted?

SHORT CUSHIONS OF ORTHOTRICHUM COALESCED INTO A TURF



- ***Orthotrichum ohioense*, a common epiphyte (usually on trees), growing on an asphalt roof of a garden shed.**

- ***How could you distinguish this species from U. hutchinseae & U. crispa?***

GREEN ROOF USING MOSS-LIKE TRACHEOPHYTES, USUALLY *SEDUM*, OFTEN COMBINED WITH MOSS

Any advantages to using moss-like plants rather than true mosses?

MOSS BALLS/SPHAEROIDS/POLTERS/VAGRANTS

Fig. 6.8 Polsters of *Drepanocladus berggrenii* on the ablating ice of Gilkey Glacier, Alaska. The polsters give the glacier the appearance of having a cobble strewn surfac (Heusser 1972).

http://newbotany.mihanblog.com/post/119

- ***How can cushions be converted to moss balls or vagrants?***
- ***Where are cushions and vagrants especially common?***
- ***Tradeoffs of the weak rhizoidal attachments of mosses (except for....)?***

LARGE CUSHION MOSS (> 2 CM DIAM):*LEUCOBRYUM GLAUCUM*

- Widespread in the Northern Hemisphere
- White when dry, green when wet
- Cactus-like in ability to hold water

LEUCOBRYUM GLAUCUM: UNIQUE CELL ARCHITECTURE

***Leucobryum* leaf cross-section:**

- **Mostly midrib; multicellular**
- **Middle layer is green**
- **Outer dead cells hold water or air**

- ***Leucobryum* is well-adapted to survive on windy ridges**
- ***Other suitable habitats?***
- ***Any other moss genus with both green & water-storage cells?***

https://www.britishbryologicalsociety.org.uk/learning/species-finder/leucobryum-glaucum/

LEUCOBRYUM GLAUCUM IN MOSS GARDENING

Berlin Botanic Garden

- ***Why screens over the colonies?***
- ***Why use concrete basins formerly for aquatic plants?***

LEUCOBRYUM ALBIDUM: SMALL COUSIN OF *L. GLAUCUM*

- Smaller cushions with more ovate leaf shape
- Young leaves of L. glaucum can look similar.
- Check older leaves lower in colony

- Cushions can coalesce into lumpy turfs as in L. glaucum
- Distribution is Eastern North America, extending into Mexico, Central America, West Indies; neotropical affinities

TURF GROWTH-FORM: *POLYTRICHUM*

Turfs resemble the pile on a carpet:

- ❖**Closely packed shoots**
- ❖**Even-topped Colony Surface**
- ❖**Little Branching of Shoots**

Why is a moss shoot more likely to survive within a turf than on its own?

POLYTRICHUM: BEAUTIFUL TURF ABOVE-GROUND, TOUGH RHIZOME BELOW

❖Tough buried rhizomes anchor Polytrichum firmly: unusual feature for a bryophyte!

❖Trampled Polytrichum regenerates readily from rhizomes as well as fragments, as shown by my Centre College (KY) students in the 1980'a.
(See Studlar, S.M. Trampling effects on bryophytes: Trail surveys and experiments. Bryologist.)

❖*What other features of Polytrichum make it unusually competitive with tracheophytes/vascular plants?*

TURFS AS ENVIRONMENTAL INDICATORS & DICRANELLA

❖Short turfs often occupy extreme vertical habitats as do Small Cushions.

❖Tall Turfs are often indicative of relatively moist conditions.

❖However, the physiological ecology of each species is different so generalizations must be qualified.

Dicranella heteromalla- Short Turf.
Fine Hair Moss
Extensive colonies on vertical surface of sandstone in the New River Gorge, WV

SHORT TURF (<2 CM): DICRANUM MONTANUM. Mountain Broom Moss.

- **Short turfs thrive on tree trunks, bare rocks, & steep slopes.**
- **Water is stored in capillary spaces between leaves & between shoots.**
- **Evaporating water from moss turfs can form mists or mini-clouds (*left above)***
- **Crispy Broom Moss, *Dicranum montanum*, has deciduous shootlets (*right)* that colonize hemlock bark crevices (*middle)*.**

TALL TURFS-*POLYTRICHUM & ATRICHUM*

Polytrichum commune **with hairy calyptrae protecting capsules**

Atrichum crispulum **with non-hairy slipper-like calyptrae on capsules.**

TALL TURF. ATRICHUM *CRISPULUM*, CRISPY STARBURST MOSS

- ❖Dry (*left*): Shut down
- ❖Wet (*right*): Active

Differences from Polytrichum wet/dry?
Other differences?

FROGS WITH REMARKABLE “RESURRECTION” LIFE STYLES!

❖Argentinian Horned Frog, estivates in pampas in hot dry season, emerges with the rain; reburies itself seasonally. (Studlar pet)

❖Similarities to bryophyte “resurrection life style”?

Estivation: 6 months

Emergence: May 23, 2019 (Reburial May 24)

Up & hungry. May-June through November for 25 years!

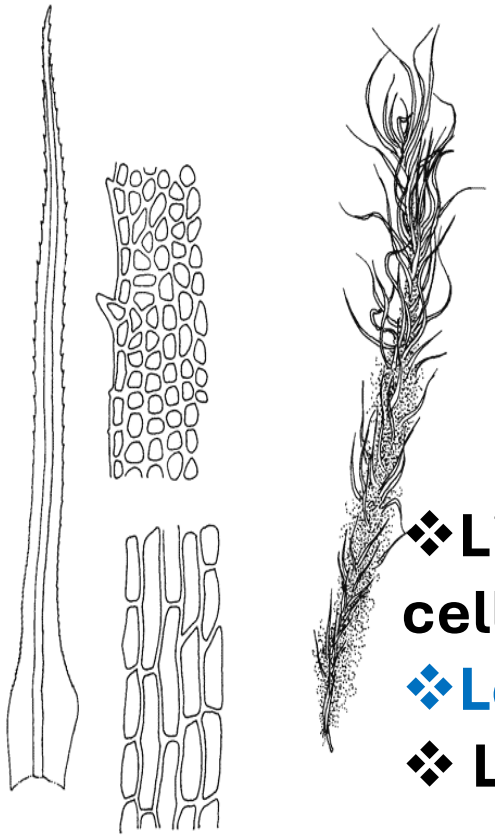
BARTRAMIA POMIFORMIS- APPLE MOSS
A WIDESPREAD TURF OR CUSHION MOSS OF SEEPY HABITATS

- ❖Genus- honors John Bartram, of PA who collected in the Carolinas in the 1760s.

- ❖Species name (specific epithet) describes abundant apple-like capsules; monoicous

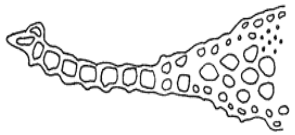
- ❖Often grows in trickling water over cliffs in shade.

BARTRAMIA POMIFORMIS- APPLE MOSS - CUSHIONS MAY COALESCE INTO TURFS.



Cushions on Cliffs, Laurel River Trail, Big Laurel Creek Gorge

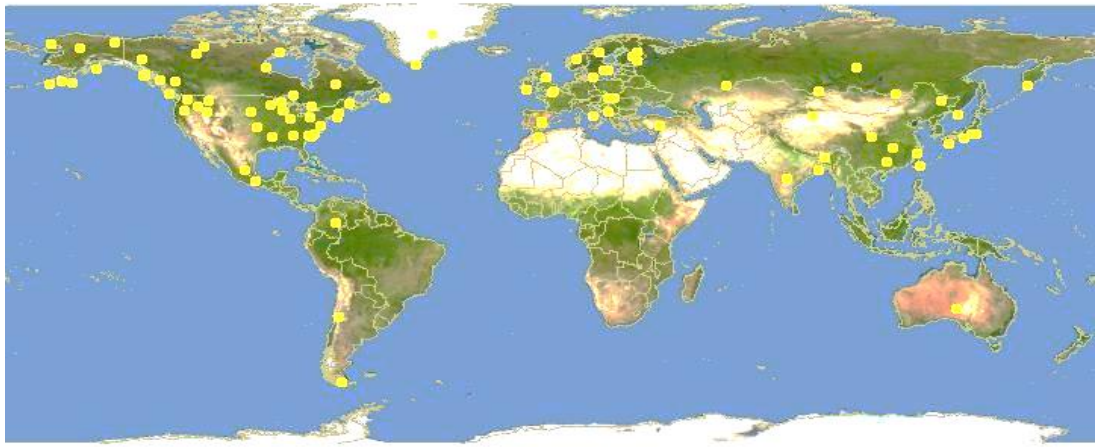
- Light yellow-green color is due to large papillae (bumps on cell wall, shown in leaf x-s)
- Leaves lanceolate, narrow above, with strong midrib
- Leaves crisped when dry, spreading when moist



- Well-adapted to periodically drying out (tomentose, crisped) – and to wet conditions - avoids water-logging.
- Papillae provide mini-drainage channels.

https://ucjeps.berkeley.edu/

BARTRAMIA POMIFORMIS- WIDESPREAD MOSS OF SEEPY SHADY HABITATS



https://www.discoverlife.org/mp/20q?search=Bartramia+pomiformis

❖**A common pattern among Appalachian bryophytes:** ***B. pomiformis*** **is widely distributed in the Northern Hemisphere, with outposts in the Southern Hemisphere.** ***Why?*** **Due to…**

- **Plate Tectonics (Vicariance): long proximity of northern hemisphere continents and isolation from southern hemisphere continents.**
- **Effective Dispersal (Dispersal + establishment in favorable niche) of spores, fragments, & specialized asexual propagules (e.g., gemmae)**

CUSHION OR TURF MOSS. *DICRANUM SCOPARIUM*
Windswept Broom Moss.

❖Little changed when dry, attractive & common species

Colony above is a Turf draped over a log.

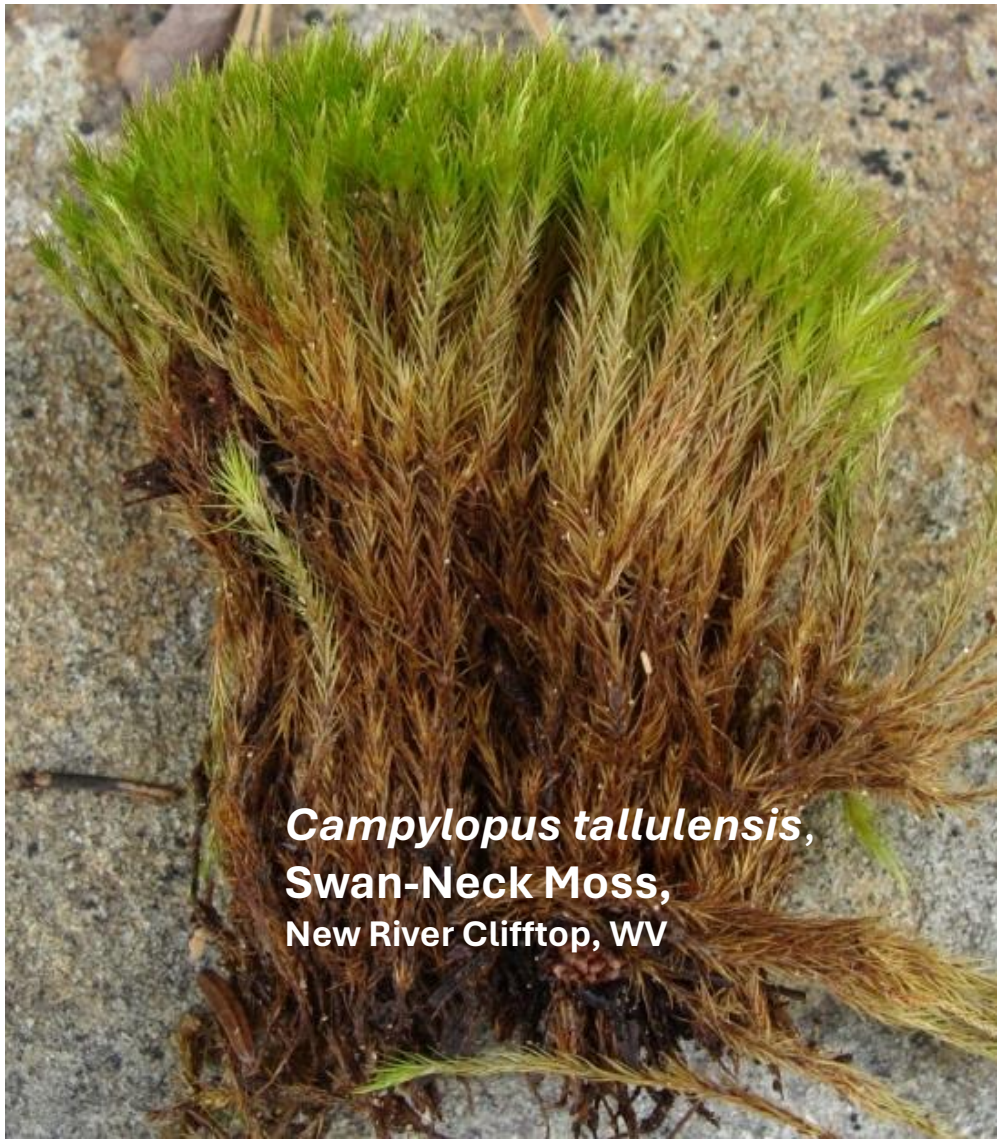
How this differ from a Cushion?

Dicranum polysetum: even showier; boreal-montane, esp. coniferous forests.

TALL TURF: *RHODOBRYUM ONTARIENSE*, ROSE MOSS

- Showy rosettes
- Spreads by horizontal stems or rhizomes – growing edge of colony is Open Turf (rosettes among other species).
- Chacteristic of moist, deeply habitats such as old growth forests or deeply shaded slopes. Eastern North America, Eurasia, disjunctive to mesic deciduous forests.

TALL TURF : *CAMPYLOPUS TALLULENSIS*



Densely packed shoots display red-brown tomentum.

Look blackish when dry. Look for on Sunset

Look for *Campylopus* on Sunset Rock!

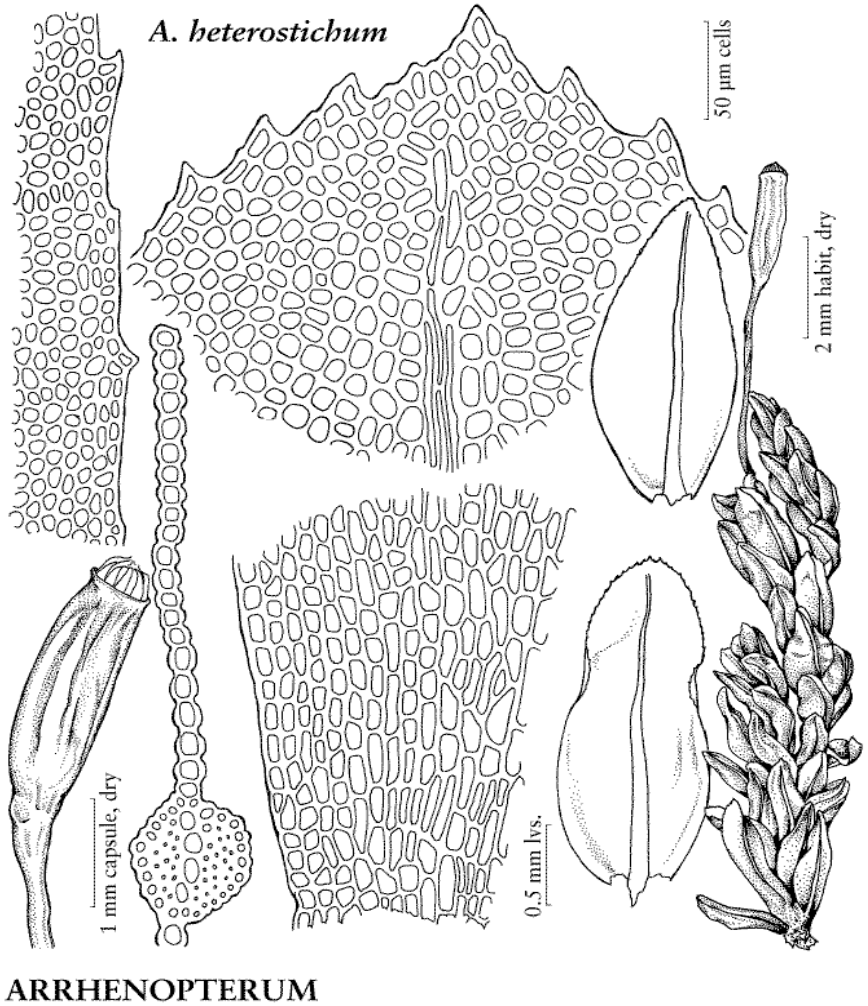
Disjunct distribution – SE North America & Mexico; reflects former continuous Tertiary distribution (c. 50 million years ago).

ARRHENOPTERUM (AULACOMNIUM) HETEROSTICHUM & DISJUNCT DISTRIBUTIONS

GOOSE EGG MOSS

- **Flattened (complanate)**
- ***How distinguish from a liverwort?***
- **Monoicous and often fertile.**

IDENTIFYING TRAITS OF *A. HETEROSTICHUM*, RIBBED BOG MOSS



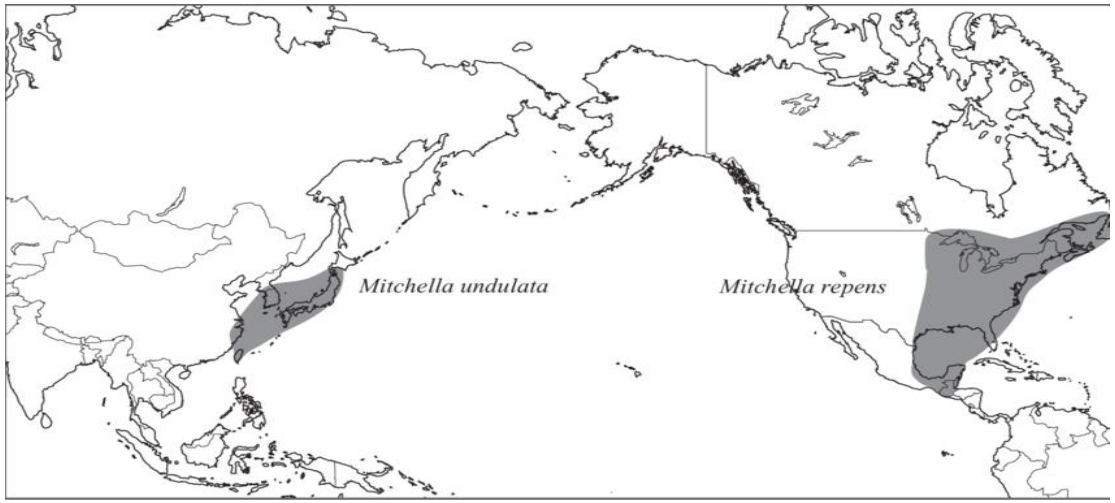
Flora North America

- ❖Coarse teeth
- ❖Obovate-ovate leaves
- ❖Strong, somewhat flexuose (bendy) midrib
- ❖Ribbed (furrowed) Capsule

Traits common to many mosses:

- ❖ Leaf blade 1-cell-thick
- ❖ Leaf midrib many cells thick
- ❖ Water-conducting cells (hydroids) in midrib

DISJUNCTIVE DISTRIBUTION OF *ARRHENOPTERUM HETEROSTICHUM*



- **Eastern North American – Eastern Asian Disjuncts have long fascinated geographers: e.g. for genera such as partridge berry (Mitchella), hickories (Carya), & tulip poplar *(Liriodendron)*.**

- **Bryophyte *species* of special interest display this same disjunction; a famous example is Arrhenopterum heterostichum. Most of our bryophytes are widely distributed in the northern hemisphere (circumboreal-montane)**

POSSIBLE CAUSES OF DISJUNCTIVE DISTRIBUTIONS

1- VICARIANCE EVENT

Continental glaciers in northern hemisphere could have eliminated intermediate populations.

Expected evidence: fossils in the gap.
Found! In Europe by Diana Horton: called the fossils *A. heterostichoides*

2- DISPERSAL EVENT

Could spores have dispersed from Japan to America or vice versa?

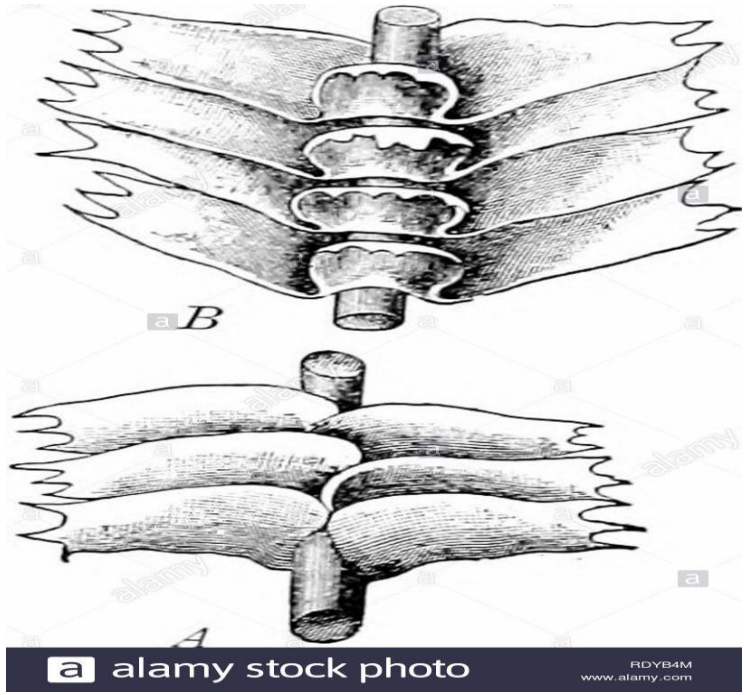
Expected molecular evidence?

LEAFY LIVERWORT THAT CAN GROW AS A TURF

BAZZANIA TRILOBATA, COMMON BAZZANIA

- ❖Robust, widely distributed in the northern hemisphere
- ❖2 Rows lateral Leaves, 1 row underleaves
- ❖Commonly grows on conifer trunks as a Smooth Mat
- ❖May grow as a turf under very favprab;e conditions. Note Y-shaped or dichotomous growth pattern.

BAZZANIA TRILOBATA, COMMON BAZZANIA or 3-LOBED BAZZANIA

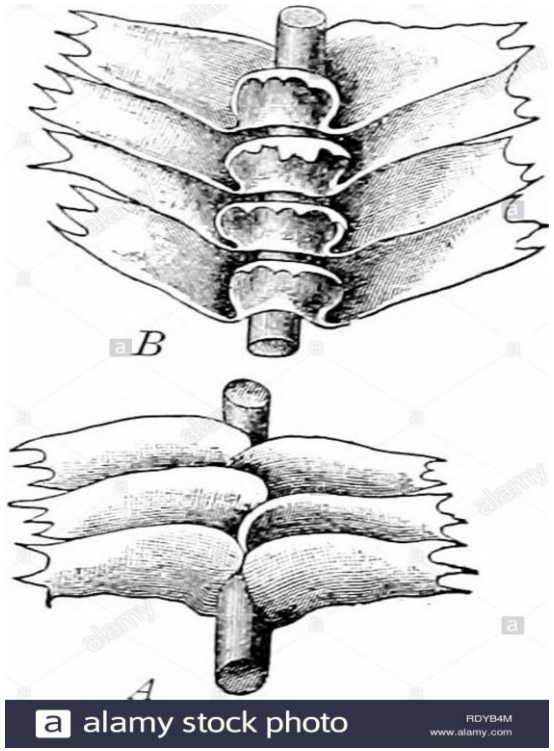


INCUBOUS LEAF ARRANGEMENT: Viewed from the *top* or dorsal side, each leaf hides the lower part of the next leaf above it (meaning closer to the growing tip). This favors water running in between the leaves hence *in*cubous. Some liverwort overlap like shingles: upper part of a leaf is hidden by the next leaf above it. Such leaves are called *succubous* (think alliteratively – succubous-shingles)

BAZZANIA TRILOBATA GROWING AS A TURF

- Lush turfs form on ground in cool moist coniferous forest
- Preferred habitat of Cheat Mountain Salamander, threatened species.

BAZZANIA TRILOBATA, COMMON BAZZANIA or 3-LOBED BAZZANIA



INCUBOUS LEAF ARRANGEMENT: Viewed from the *top* or dorsal side, each leaf hides the lower part of the next leaf above it (closer to the growing tip). This favors water running in between the leaves hence *in*cubous. Some liverwort overlap like shingles: upper part of a leaf is hidden by the next leaf above it. Such leaves are called *succubous* (think alliteratively – succubous-shingles)