Sub-Guide to Rarely Branched (mostly acrocarpous) Mosses of the West Coast

Revised through 27 January 2010

***Reminder**: A dagger (†) indicates that not all of the species within the given genus have the character(s) defining that Group. Abbreviations for the **distribution** of taxa are found at the end of the Concordance. Abbreviations for the number of **stereid bands** in costa cross sections are found in the Introduction and at the end of this section.*

Group A1 – Shoots flat or angular, not round

Group A1

Shoots **flattened**; leaves **2-ranked** (lying in one plane).
- Leaves **distichous** (attached in two rows on opposite sides of the stem).
  - Leaves **cleft** at anterior edge and clasping posterior edge of next leaf; WS — *Fissidens*
  - Leaves **conduplicate**, crowded, and progressively larger; the "Sword" moss; WS* — *Bryoxiphium*
  - Leaves flat, **decurrent** and **confluent**; protonemata **luminous**; "Goblin Gold"; WS* — *Schistostega*
  - Leaves **needle-like**; a roughened subula from a sheathing, shiny-white base; WS — *Distichium*
- Leaves **complanate** (attached all around the stem, but twisted into one plane).
  - Leaves with a long, single **costa**; cells **smooth**.
    - Leaves **distant** on stoloniferous shoots and **bordered** by linear cells; WS — *Plagiomnium*
    - Leaves **crowded**, unbordered and ±**undulate**; capsules plicate (dry); E — *Aulacomnium*†

Shoots **triangular**; leaves **3-ranked**.
- Plants **minute** with **immersed** capsules; leaves **broadly** ovate with **recurved** apiculi; WS — *Acaulon*†
- Plants **larger** with **exserted** capsules; leaves ovate **lanceolate,** squarrose and **decurrent**.
  - Cells **short** and strongly **papillose**; plants on **dry** soils; CA — *Triquetrella*
  - Cells **intermediate** and **smooth**; in calcareous **wetlands**.
    - Capsules with well-defined **neck**; endostome **longer** than exostome; N — *Meesia*†
    - Capsules **short** & **black** (golf clubs); endostome **reduced** to lacking; N — *Catoscopium*

Shoots **angular**; leaves **4-5 ranked**.
- Stems densely **tomentose**; leaves **squarrose** recurved; in calcareous **wetlands**; N — *Paludella*
- Stems **smooth**; leaves crowded and **appressed**; on **soil** near rocks; A/A — *Conostomum*

Group A2 – Shoots julaceous when wet

Group A2

Stems **red**.
- Stems **freely** forked; plants **whitish**; capsule necks **extremely long**; A/A, W — *Plagiobryum*
- Stems **sparsely** forked; capsule necks mostly **short** to **moderate** in length.
  - Cells **long** (**~**8:1); N* — *Anomobryum*
  - Cells **intermediate** (~4:1).
    - Upper leaves **abruptly acuminate**; capsules **erect**; peristome **single**; NW — *Aongstroemia*
    - Upper leaves **apiculate**; capsules **pendent**; peristome **double**; WS — *Bryum*†

Stems **green**.
- Cells **unipapillose** and ±**stellate**; leaves concave-cucullate; A/A. — *Aulacomnium*†
- Cells ±**prorulose**; leaves **5-ranked** and serrate; plants bluish**-white**; A/A — *Conostomum*
- Cells **smooth**; leaves radially arranged.
  - Leaves **serrulate** and **unbordered**; **immersed** capsules: E — *Pleuridium*†
  - Leaves **entire** and **bordered** with **longer** cells; **exserted** capsules; WS — *Bryum*†

Group A3 – Stems distinctly tomentose

Group A3

Stems covered with **pigmented** (reddish to brownish) rhizoidal tomentum to near apex.
- Leaves **squarrose-recurved** and heart shaped; fens; N — *Paludella*
- Leaves **ovate** to broadly elliptical.
  - Rhizoidal initials in **longitudinal rows**; endostome fused into a **dome**; N — *Cinclidium*
  - Rhizoidal initials **not** in rows; endostome segments **free**; N* — *Rhizomnium*†
- Leaves **oblong-**lanceolate to oblong-lingulate.
  - Cells **pleuripapillose**; terminal cell long and **smooth**; brood bodies **axillary**; N* — *Zygodon*†
  - Cells **unipapillose**; terminal cell **papillose**; brood bodies **terminal**; WS — *Aulacomnium*†
- Leaves **narrowly lanceolate** from an **ovate, plicate** base; WC, NW — *Anacolia*
- Leaves **lanceolate** to **subulate**-**setaceous**; WS — *Dicranum*

Stems covered with **white-wooly** tomentum.
- Leaves with green sheets (**lamellae)** on their surface; bogs; N* — *Polytrichum*†
- Leaves **lacking** lamellae; WS — *Dicranum*

Group A4 – Stems red

Group A4

Plants **julaceous**.
- Stems freely **forked**; leaves with distinct, ±reflexed **point**; cells in **oblique** rows; A/A, W — *Plagiobryum*
- Stems **occasionally** forked; leaves ovate to ovate-lanceolate and concave.
  - Leaves **broadly** obtuse to acute; costa ending **subpercurrent**; cells **~8:1**; N* — *Anomobryum*
  - Leaves **abruptly acuminate**; costa **percurrent**; cells ~**4:1**; NW — *Aongstroemia*
  - Leaves obtuse to **acute**; costa percurrent to **excurrent**; cells ~**4:1**; WS — *Bryum*†

Plants with stems covered with **pigmented** (reddish to brownish) **tomentum**.
- Leaf cells **>3:1**; WS — *Bryum*†
- Leaf cells **<2:1**.
  - Leaves **setaceous**, **serrate** above & **recurved** below; WC, NW — *Anacolia*
  - Leaves **neither** setaceous, serrate **nor** recurved.
    - Rhizoidal initials in **longitudinal rows**; endostome **fused** into a dome; N — *Cinclidium*
    - Rhizoidal initials **not** in rows; endostome segments **free**; N* — *Rhizomnium*

Plants **neither** julaceous **nor** tomentose.
- Leaves **bordered** by elongated cells.
  - Leaves distinctly **toothed**.
    - Cells **smooth**, cells up to 50μ; leaves **plane**; WS — *Mnium*†
  - Leaves **entire**.
    - Leaves ±**dimorphic** (±**distichous** lateral leaves and smaller **dorsal** leaves); WC — *Epipterygium*
    - Leaves of **one** kind; WS — *Bryum*†
- Leaves **not** bordered.
  - Leaves serrulate ±**throughout**; cells **prorulose**; WS — *Philonotis*†
  - Leaves ±serrulate near the **apex**; cells **smooth**.
    - Leaves **subulate**; alar cells **inflated**, **thick**-walled and **reddish**; N* — *Blindia*
    - Leaves **not** subulate; alar cells ±**undifferentiated**; WS — *Pohlia*†

Group A5 – Leaves squarrose-recurved

Group A5

Leaves squarrose-recurved when **dry** (**or wet**).
- Leaves **5-ranked** and folded to appear **heart shaped**; stems densely **tomentose**; fens; N — *Paludella*

Leaves squarrose-recurved **only** when **wet** (±appressed when dry).
- Leaves **3-ranked**, long-**decurrent** and with papillose-**crenulate** margins; CA — *Triquetrella*
- Leaves **subulate**-**setaceous** from a **sheathing** base; disturbed soil; N — *Trichodon*
- Leaves **lacking** the above unique characteristics.
  - Cell walls irregularly **thickened**; cell lumens **stellate**; A/A — *Geheebia*
  - Cell walls of **uniform** width; cell lumens ±**rounded**.
    - Cells **intermediate** in length; WS — *Dicranella*†
    - Cells **short**.
      - Leaves ±**bordered** by **longer**, or **shorter** and **thick**-walled cells; **1***; WS — *Tortula*†
      - Leaves **unbordered**; **2***; WS — *Barbula*†

Group A6 –Leaves falcate-secund

Group A6

Plants **blackish**; leaves **multistratose**; capsules **valvate**; on rocks; NW — *Andreaeobryum*

Plants **grayish**; costa **>1/2** leaf breadth with **3**(4) cell layers; green **striations** on leaves; N* — *Paraleucobryum*†

Plants **green**; leaves unistratose and **lacking** striations; costa usually **<1/5** leaf breadth.
- Alar cells clearly **differentiated**; plants **large**, mostly >1cm.
  - Alar cells **pigmented**; capsules **rarely** strumose; **various** habitats; **2***; WS — *Dicranum*†
  - Alar cells **pale**; capsules **strumose**; on **alpine rocks**; **0***; A/A — *Kiaeria*†
- Alar cells ±**undifferentiated**; plants **small**, mostly <1cm; WS — *Dicranella*†

Group A7 – Leaves subulate / setaceous (8:1 or greater)

Group A7

Plants small to **minute** (mostly <5 mm high) with **±immersed** capsules growing on bare **soil**, usually as winter **annuals**; the "**pygmy ephemerals**" as defined here.
- Setae **straight**; capsules **immersed** and **cleistocarpous**.
  - Capsules **pyriform** with a conspicuous, **stomatose** neck; spores **small**; WS — *Bruchia*†
  - Capsules **globose** to **ovoid**, **lacking** a distinct neck.
    - Calyptrae mitrate or **cucullate**; spores numerous and **small**; WS — *Pleuridium*†
    - Calyptrae **rudimentary**; spores few and **large** (>100μ); E, CA — *Archidium*†

Plants **larger** with **exserted** capsules growing on **various** substrates.
- Leaves **squarrose**-**recurved** (wet); subula **roughened** throughout by cell ends; N — *Trichodon*
- Leaves with bases distinctly **incurved** to **expanded** and **clasping**.
  - Cells **intermediate** in length and **prorulose/papillose**; upper cells **±bistratose**; WS — *Bartramia*†
  - Cells **intermediate** in length and **smooth**.
    - Capsules with **distinct**, very long **necks**; WS — *Trematodon*†
    - Capsules **lacking** a distinct neck.
      - Plants **larger**; peristome **single** with **forked** teeth.
        - Teeth divided to **base**, **round** and **papillose**; WS — *Ditrichum*†
        - Teeth divided to **mid**-**point**, **flat** and **pitted**-**striolate**; WS — *Dicranella*†
  - Cells **short** and **smooth**.
    - Upper cells **±bistratose**; capsules **inclined**, **asymmetric** and **strumose**; WS — *Oncophorus*†
- Leaves with a **broad**, **single** costa (>1/3 the leaf width).
  - Alar cells **inflated** and **hyaline** or **colored** (brownish to reddish).
    - Costa **3**(4) cell **layers** thick (middle & dorsal layers **green** & "**striped**"); N* — *Paraleucobryum*
    - Costa **lacking** the above unique characters.
      - Inner basal cells **pale**, **enlarged** and extending up along the costa; N* — *Dicranodontium*
      - Inner basal cells **little** differentiated; WS — *Campylopus*†
  - Alar cells **±undifferentiated**; capsules **pyriform**; WS — *Leptobryum*
- Leaves **lacking** the above unique characteristics.
  - Alar cells distinctly **differentiated**.
    - Capsules **curved** and **strumose** (goiter-like swellings); on **rocks**; A/A — *Kiaeria*
    - Capsules **obovoid** to **pyriform**; on **rocks**.
      - Capsules **ribbed** (dry); peristome teeth wide-**flaring**, **±split** and **striolate**; N — *Arctoa*
      - Capsules **smooth** (dry); peristome teeth **erect**, **±entire** and **papillose**; N* — *Blindia*
    - Capsules **lacking** any of the above unique characters; substrates **various**.
      - Cells with **cuticular ridges**; peristome teeth **±entire** and **papillose**; N* — *Dicranoweisia*
      - Cells **smooth**; peristome teeth **forked** and pitted-**striolate** below; WS — *Dicranum*†
  - Alar cells **±undifferentiated**.
    - Stems **tomentose** & **red**; leaves **serrate** above & **recurved** below; WC, NW — *Anacolia*
    - Stems **lacking** tomentum & **green**.
      - Cells **intermediate** to long; peristome **teeth** usually present.
        - Plants **small** (<2mm); leaves **little** altered (dry); on **rocks**; WS — *Seligeria*†
        - Plants **larger** (>5mm); leaves **twisted** (dry); on **wood**; SA, WC — *Orthodontium*†
      - Cells **short**; annulus **compound**; peristome teeth mere **stubs**; WS* — *Brachydontium*

Group A8 – Leaves dimorphic

Group A8

Leaves **costate**, 4-ranked and **bordered**; **dorsal** leaves smaller; stems **red**; cells **smooth**; WC — *Epipterygium*

Group A9 – Leaves with hair-points or awns

Group A9

Plants **minute** (mostly <5 mm high) with ±**immersed** capsules growing on bare **soil**, usually as winter **annuals**; the "**pygmy ephemerals**" as defined here.

- Leaves with **lamellae** on the upper end of the costa; WS — *Pterygoneurum*
- Leaves with **filaments** on the upper end of the costa.
  - Leaves "**fleshy**" with **inrolled** margins; filaments on very **broad** costa; WC — *Aloina*†
  - Leaves thin with **reflexed** to revolute margins; filaments on **narrow** costa; W — *Crossidium*
- Leaves **lacking** lamellae or filaments.
  - Leaves with a **revolute** margin; cells **pleuripapillose**; WS — *Phascum*
  - Leaves with **reflexed** tips; cells with **single** blunt papillae; WS* — *Acaulon*†
  - Leaves with **plane** margins and tips; cells **smooth**.
    - Capsules **exserted** & **peristomate**; calyptrae **cucullate**; NW — *Stegonia*†
    - Capsules ±**emergent** & **operculate**; calyptrae **persistent**, **4-angled** & **split**; E, CA — *Pyramidula*

Plants growing on **dung**, animal remains, or other highly nitrogenous materials; the "**dung mosses**".

- Hypophysis greatly **differentiated** and **colored**; peristome teeth **chambered**; N, CP, SA — *Splachnum*†
- Hypophysis narrowly **pyriform** and ±urn-colored; peristome teeth **not** chambered; N — *Tetraplodon*†

Plants **lacking** any of the above unique characteristics.

- Leaves "fleshy" from crowded **lamellae** covering a very broad costa; WS — *Polytrichum*†
- Leaves with a **broad** (1/3 – 1/2 leaf width) single **costa**; WS — *Campylopus*†
- Leaves with distinct **border**.
  - Cells **short** (±isodiametric); pleuripapillose or smooth; WS — *Desmatodon*†
  - Cells **intermediate** in length; smooth.
    - Capsules **pendent** and **pyriform**; WS — *Bryum*†
- Leaves with large, lax and **hyaline** basal cells contrasting with dense upper cells.
  - Basal cells pale with **brown**, **thickened** cross walls; calyptrae **campanulate**; WS — *Encalypta*†
  - Basal cells **thin**-**walled** and **non-pigmented** throughout; calyptrae **cucullate**.
    - Peristome of 32 **twisted** teeth on a **high** basal membrane; WS — *Tortula*†
    - Peristome of 32 ±**erect** teeth on a **low** basal membrane; WS — *Desmatodon*†
- Leaves **lacking** the above unique characteristics.

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Continued from Group A9 above

Leaf cells distinctly **papillose**; marginal cells **greener**; on **mountain** rocks and soil; WC, SW — *Pseudocrossidium*†
Leaf cells **smooth** or indistinctly ornamented.
- Plants in **tufts** on **tree** trunks and branches (rarely on rocks); **diplolepideous**.
  - Leaves **crisped** when dry; basal cells **yellow**, **thick**-walled and in **diagonal** rows; WC — *Ulota*†
  - Leaves **not** crisped when dry; basal cells **undifferentiated**; WS* — *Orthotrichum*†
- Plants in tufts, **cushions** and mats on **rocks**; **haplolepideous**.
  - Calyptrae large, **campanulate**, plicate and lacerate at base.
    - Leaves **ovate** to obovate; WS (W) — *Jaffueliobryum*
    - Leaves ovate-**lanceolate** and **biplicate**; N* — *Coscinodon*
  - Calyptrae small, **cucullate** or **mitrate**.
    - Capsules **systylious**; calyptrae **short**; in **wetter** habitats; WS — *Schistidium*†
    - Capsules **not** systylious; calyptrae **reaching** operculum; in **dryer** habitats; WS — *Grimmia*†
- Plants on **soil** primarily.
  - Cells **intermediate** in length; capsules **pendent** and **pyriform**; WS — *Bryum*†
  - Cells **short** (±isodiametric); capsules mostly **erect** and **cylindrical**; WS — *Desmatodon*†

Group A10 – Leaves with lamellae, ridges, or filaments

Group A10

Leaves with **green**, sheet-like **lamellae**.
- Leaves with a very **broad costa** covered by **>20** lamellae.
  - Leaves mostly **unistratose**; peristome **present**.
    - Lamellar apical cells **papillose**; capsules ±**terete**.
      - Leaves **subtubulose**; lamellar apical cells elliptic-**pyriform**; WS — *Polytrichastrum*
      - Leaves oblong **lanceolate**; lamellar apical cells ±**rounded**; WS — *Pogonatum*
    - Lamellar apical cells **smooth** or ridged; capsules sharply **4-5 angled**; WS — *Polytrichum*
- Leaves with a **narrow costa** having **<20** lamellae.
  - Lamellae on **both** surfaces of leaves; leaves unbordered; 5-15 lamina; WC, NW — *Oligotrichum*
  - Lamellae restricted to the **upper** surface of leaves.
    - Leaves with **awns**; 2-4 lamellae; plants ±**bulbiform**; WS — *Pterygoneurum*
    - Leaves with **cilia** at leaf shoulder; 5-15 lamellae; WA, BC, AK — *Bartramiopsis*
    - Leaves bordered by **hyaline**, **elongate** cells; 2-8 lamellae; WS — *Atrichum*

Leaves with **ridge**-like lamellae on the **back** (dorsal side) of the costa.
- Stems **tomentose** (wooly; white to rusty brown); alar cells **hyaline** and **yellow**-brown; WS — *Dicranum*†
- Stems **smooth**; alar cells **not** pigmented.
  - Costa **broad** (>1/3 leaf width); ridges **weak** (1-2 cells); cells short-**rectangular**; WS — *Campylopus*†
  - Costa **narrow** (<1/3 leaf width); ridges **strong** (>6 cells); cells rounded-**oblate**; N — *Dryptodon*

Leaves with **green**, branched **filaments**.
- Leaves "**fleshy**": filaments on **lamina** and costa, but covered by **inrolled** leaf margins; WS* — *Aloina*
- Leaves **thin**; filaments on **costa** only; leaf margins **reflexed** to revolute; W — *Crossidium*

Leaves with fine, **white**, threadlike **filaments** in a tangled, cobwebby **weft**; N* — *Saelania*

Group A11 – Leaves undulate

Group A11

Leaves **complanate** (attached all around the stem but twisted into one plane); E — *Aulacomnium*†

Leaves with **lamellae** on the costa; WS — *Atrichum*†

Leaves **lacking** any of the above unique characteristics; N — *Dicranum*†

Group A12 – Leaves involute

Group A12

Leaf margins involute **wet** or dry.

- Leaf margins **infolded/inflexed** over **photosynthetic** lamellae or filaments.
  - Leaves with green, sheet-like **lamellae**; WS — *Polytrichum*†
  - Leaves with green, branched **filaments**; WS* — *Aloina*
- Leaf margins **inrolled** over laminae **lacking** lamellae or filaments.
  - Leaf cells **papillose**.
    - Capsules **exserted** and **operculate**; WS — *Weissia*
    - Capsules **immersed** to emergent, **cleistocarpous**; E — *Astomum*

Group A13 – Leaves ±all costa

Group A13

No relevant genera on the West Coast.

Group A14 – Leaves with a broad, single costa

Group A14

Leaves **bristle-like** (setaceous) or with distinct hair-points.

- Leaves with costa of **3**(4) cell **layers** (middle & dorsal layers **green** & "**striped**"); N* — *Paraleucobryum*
- Leaves **crowded** at stem tips; reddish, axillary **hairs** common; WS — *Leptobryum*
- Leaves **lacking** the above unique characteristics.
  - Leaves with **strongly differentiated** alar cells (inflated and hyaline).
    - Inner basal cells **pale**, **enlarged** and **extending** up along the costa; N* — *Dicranodontium*
    - Inner basal cells **little** differentiated; WS — *Campylopus*
  - Leaves with alar cells **little** differentiated.
    - Leaves **<3mm**; upper cells rectangular to **linear**.
      - Costa **lacking** median row; brood leaves **lacking**; WS — *Dicranella*†

Leaves **oblong-lanceolate**; capsules elongate, curved and with a conspicuous neck.

- Upper leaf cells pale, **lax**, thin-walled and **oblong-hexagonal**; N — *Amblyodon*
- Upper leaf cells short **rectangular**, but **not** lax; N — *Meesia*†

***Reminder**: The costa in Groups A15 through A19 is long and single.*

Group A15 – Leaves with bases distinctly incurved to expanded and clasping

Group A15

Leaves **squarrose-recurved**.
- Leaves **subulate / setaceous**; subula **roughened** throughout by cell ends; N — *Trichodon*

Leaves **subulate / setaceous** (needle or bristle-like).
- Cells **intermediate** in length and **prorulose/papillose**; upper cells ±**bistratose**; WS — *Bartramia*†
- Cells **intermediate** in length and **smooth**.
  - Capsules with **distinct**, very long **necks**; WS — *Trematodon*
  - Capsules **lacking** a distinct neck.
    - Plants **larger**; peristome **single** with **forked** teeth.
      - Teeth divided to **base**, **round** and **papillose**; WS — *Ditrichum*†
      - Teeth divided to **mid-point**, **flat** and **pitted-striolate**; WS — *Dicranella*†
- Cells **short** and **smooth**.
  - Upper cells ±**bistratose**; capsules **inclined**, **asymmetric** and **strumose**; WS — *Oncophorus*†

Leaves with **lamellae** or **ridges** on their laminae or costa.
- Leaves with a very **broad costa** covered by **>20** lamellae.
  - Leaves mostly **unistratose**; peristome **present**.
    - Lamellar apical cells **papillose**; capsules ±**terete**.
      - Leaves **subtubulose**; lamellar apical cells elliptic-**pyriform**; WS — *Polytrichastrum*
      - Leaves oblong **lanceolate**; lamellar apical cells ±**rounded**; WS — *Pogonatum*
    - Lamellar apical cells **smooth** or ridged; capsules sharply **4-5 angled**; WS — *Polytrichum*
- Leaves with a **narrow costa** having **5-15** lamellae.
  - Lamellae on **both** surfaces of leaves; leaves **unbordered**; WC, NW — *Oligotrichum*†
  - Lamellae on **upper** surface of leaves only; **cilia** at leaf shoulder; WA, BC, AK — *Bartramiopsis*

Leaves **lacking** any of the above unique characteristics; cells strongly **bulging** on upper surface; endostome of 64 papillose **filaments**; WS — *Timmia*

Group A16 – Leaves with long decurrencies

Group A16

Shoots **angular** in cross-section; leaves **squarrose** recurved; cells **short** and **papillose**.
- Leaves **3-ranked**; stems **smooth**; CA — *Triquetrella*
- Leaves **5-ranked**; stems densely **tomentose**; calcareous **wetlands**; N — *Paludella*

Shoots **terete** (round in cross-section); capsules **pyriform** or **pendulous**.
- Leaves distinctly **toothed** ±throughout.
  - Marginal teeth **paired**; sterile stems ±**erect** and **round**; WS — *Mnium*
  - Marginal teeth **single**; sterile stems **prostrate** and **complanate**; WS — *Plagiomnium*
- Leaves **entire** to ±serrulate or ±toothed at apex.
  - Leaves predominantly **broader** near the **middle**; capsules **pendent**.
    - Leaves commonly **bordered**; median cells **<4:1**; WS — *Bryum*†
    - Leaves **not bordered**; median cells **>4:1**; WS — *Pohlia*†
  - Leaves predominantly **broader** at the **base**; setae very **long**; capsules ±**inclined**; N — *Meesia*†

Group A17 – Leaves with a distinct group of hyaline cells

Group A17

Note: hyaline cells may not be clearly distinct in very old leaves that have lost their chlorophyll.

Hyaline cells at **apex** of leaves; plants **whitish**.
- Stems often **forked** or branched, especially at stem apices.
  - Cells **papillose** (simple and forked); capsules **immersed**; peristome **lacking**; WS — *Hedwigia*
  - Cells **smooth**; capsules **exserted** with **extremely long** necks; **peristomate**; A/A, W — *Plagiobryum*†
- Stems **rarely** branched; leaves **apiculate**; capsules **pendent**; cells **smooth**; WS — *Bryum*†

Hyaline cells as **marginal wedges** broadest at the base of leaves.
- Leaves **spreading** and crenulate to **entire**.
  - Leaves **acute** to acuminate; upper cells **pleuripapillose**; WS — *Tortella*

Hyaline cells in **abruptly differentiated**, ±oval "**windows**" (cancellinae) in the lower 1/3 of leaves.
- Leaves **lacking** linear, intramarginal cells; calyptrae **deciduous** and cucullate.
  - Leaf margins **revolute**; peristome of **32 twisted** teeth; **1***; WS — *Tortula*† (*Syntrichia*)

Hyaline, **inflated** and **thin-walled** cells across the **lower 1/3** of leaves.#
- Leaves abruptly **serrate** at the **shoulder** and **whorled** at branch points; **2***; WS — *Eucladium*
- Leaves **toothed** above; **2***
  - Older leaves **brick-red**; stems **lacking** a hyalodermis; WS — *Bryoerythrophyllum*
  - Older leaves **brownish-green**; stems with a **hyalodermis**; BC — *Paraleptodontium*
- Leaves with erect, **bistratose** margins; **1***; WC, AZ — *Trichostomopsis*
- Leaves **revolute** at least below; **1***.
  - Leaves ±**rounded** with short to **long** awns; cells **10-13**μ; **peristome** present.
    - Peristome of 32 **twisted** teeth on a **high** basal membrane; WS — *Tortula*†
    - Peristome of 32 ±**erect** teeth on a **low** basal membrane; WS — *Desmatodon*†
  - Leaves **±acute**; cells **15-20**μ; peristome **none** or **rudimentary**; WS — *Pottia*† (*Microbryum*)
- Leaves **lacking** any of the above unique characteristics.
  - Cross walls of basal cells **thick** and **brown**; calyptrae long **campanulate**; **1***; WS — *Encalypta*†
  - Cross walls of **normal** thickness; calyptrae **cucullate**.
    - Stems with a **hyalodermis**; papillae usually **bifid**; **2***.
      - Stems with a **central** strand (small cells); NW, WC, GC — *Trichostomum*
      - Stems **lacking** a central strand; WS — *Oxystegus*
    - Stems **lacking** a hyalodermis; papillae usually **C-shaped**; **1***.
      - Peristome of 32 **twisted** teeth on a **high** basal membrane; WS — *Tortula*†
      - Peristome of 32 ±**erect** teeth on a **low** basal membrane; WS — *Desmatodon*†

#: *Note: Many taxa with short, papillose, medial cells possess basal cells that are somewhat differentiated, i.e., pale (translucent), less papillose, somewhat elongated and/or colored, especially near the insertion. The taxa in this Group A17 represent the extreme, strongly differentiated condition of a gradient while those taxa with the less differentiated basal cells are found in Group A25.*

Group A18 – Leaves with a distinct marginal border

Group A18

Leaves **ciliate** at the margins.
- Plants primarily **protonemata**; capsules inclined, ovoid and **ventricose**; WS* — *Buxbaumia*
- Plants **leafy**; capsules not differentiated as above.
  - Leaves with 4-9 **lamellae** on costa; cilia at leaf **shoulder**; WA, BC, AK — *Bartramiopsis*
  - Leaves **lacking** lamellae; cilia at leaf **base**; WA, AK — *Oedipodium*

Leaves with a border of **elongate** cells contrasting with **shorter** medial cells.
- Plants strongly **flattened**; leaves twisted into one plane (**complanate**); WS — *Plagiomnium*
- Plants with **red stems**.
  - Stems **tomentose**.
    - Rhizoidal initials in **longitudinal rows**; endostome fused into a **dome**; N — *Cinclidium*
    - Rhizoidal initials **not** in rows; endostome segments **free**; N* — *Rhizomnium*
  - Stems **smooth**.
    - Leaves **4**-ranked and **dimorphic** (dorsal leaves smaller); WC — *Epipterygium*
- Plants **lacking** the above unique characteristics.
  - Leaves with **lamellae** on the costa; WS — *Atrichum*
  - Leaves with **paired teeth** on margins; WS — *Mnium*†
  - Leaves with distinct **single teeth** or serrulations on margins.
    - Leaf cells >**3:1**.
      - Leaves **rounded-obtuse** and apiculate; upper cells in **oblique** rows; N* — *Pseudobryum*
      - Leaves **acute** to awned; cells **not** in oblique rows.
        - Capsules **pendent** and **pyriform**; WS — *Bryum*†
        - Capsules **erect** and ±**cylindric**; GC, SW, SA — *Brachymenium*†
    - Leaf cells <**2:1**; WS — *Plagiomnium*
  - Leaves with **entire** margins.
    - Leaf cells >**3:1**.
      - Capsules **pendent** and **pyriform**; WS — *Bryum*†
      - Capsules **erect**.
        - Leaves **rounded-obtuse**; upper cells in **oblique** rows; N* — *Pseudobryum*
        - Leaves broadly **acute**; cells **not** in oblique rows; WS — *Entosthodon*†

Leaves with margins differing in **color** and/or **opacity** from the medial laminae.
- Margin **darker** because **3-5** cell layers thick; plants **blackish**; on **rocks** in rivers; WC, NW — *Scouleria*
- Margin **paler** and **yellowish** due to **thick**-walled, **less** papillose cells.
  - Leaves distinctly **toothed** above; basal membrane **lacking**; **2***; SE — *Leptodontium*†
  - Leaves **entire**; basal **membrane** present; **1***.
    - Peristome (32) **spirally** twisted above a **high** basal membrane; WS — *Tortula*†
    - Peristome (16) **obliquely** slanted above a **low** basal membrane; WS — *Desmatodon*†
- Margin **greener** (cells **thin**-walled & **less** papillose) and **spirally** revolute; **1***; WC, SW — *Pseudocrossidium*†

Leaves with an **intramarginal** "border", i.e., differentiated cells just inside short marginal cells.

Leaves with an **intramarginal** "border", i.e., differentiated cells just inside short marginal cells.
- "Border" of **long**, **narrow**, **pellucid** cells along leaf bases.
  - Basal cancellinae **lacking**; plants **blackish**; on **rocks** in rivers; WC, NW — *Scouleria*
- "Border" of **enlarged**, ±**isodiametric**, **yellow** to orange, **thick**-walled cells; **1***; W — *Crumia*

Group A19 – Leaves with distinct alar cells

Group A19

Stems **tomentose**; alar cells **inflated**, **hyaline** and ±**yellow-brown** towards the margin; WS — *Dicranum*

Stems **not** or indistinctly tomentose; alar cells **not** as above.

- Costa **broad**, **>1/3** leaf width; alar cells **inflated**, and hyaline to brownish to **reddish**.
  - Costa **3**(4) cell **layers** thick (middle & dorsal layers **green** & "**striped**); N* — *Paraleucobryum*
  - Costa **lacking** the above unique characters.
    - Inner basal cells **pale**, **enlarged** and extending up along the costa; N* — *Dicranodontium*
    - Inner basal cells **little** differentiated; WS — *Campylopus*
- Costa **narrow**, **<1/3** leaf width.
  - Alar cells enlarged to **inflated** and **yellowish** to **brownish**.
    - Capsules **curved** and **strumose** (goiter-like swellings); on **rocks**; A/A — *Kiaeria*
    - Capsules **obovoid** to **pyriform**; on **rocks**.
      - Capsules **ribbed** (dry); peristome teeth wide-**flaring**, ±split and **striolate**; N — *Arctoa*
      - Capsules **smooth** (dry); peristome teeth **erect**, ±entire and **papillose**; N* — *Blindia*
    - Capsules **cylindrical**; substrates **various**.
      - Cells with **cuticular ridges**; peristome teeth ±**entire** and **papillose**; N* — *Dicranoweisia*
      - Cells **smooth**; peristome teeth **forked** and pitted-**striolate** below; WS — *Dicranum*
  - Alar cells **sub-quadrate** and **pale**; cells ±**thick**-walled and often **nodulose**; WS — *Grimmia*†

Group A20 – Leaves with costa extremely reduced to lacking

Group A20

Leaves in **clusters** of **branches** around a central stem and a **network** of green and hyaline cells; WS — *Sphagnum*

Leaves **distichous**, **decurrent** and **confluent**; protonemata **luminous**; "Goblin Gold"; WS* — *Schistostega*

Leaves **spinose** serrate; protonemata **persistent**; cells **smooth**; pygmy **ephemerals**; WS — *Ephemerum*†

Leaves **lacking** the above unique characters.

- Cells **papillose**; capsules **exserted** and **valvate** (4x); plants reddish-**black**; on **rocks**; N* — *Andreaea*†
- Cells **smooth**.
  - Capsules **exserted** with **4 prominent teeth**; on undersides of **rock overhangs**; N — *Tetrodontium*†
  - Capsules **sessile** and **gymnostomous**; pygmy **ephemerals**; on **soil**; WS — *Micromitrium*

***Reminder**: Definitions for cell length to breadth ratios are found in the Introduction and the Overview in addition to below. Abbreviations for the number of stereid bands in costa cross sections are found in the Introduction in addition to below. An expanded explanation of the difference between "Distinct" and "Indistinct" surface ornamentation is found in the Introduction.*

Cells = medial, laminal cells; cells ~2/3 of the way from insertion to apex, midway between the costa and the margin.

Length to breadth **ratios** of medial, laminal cells:

Long cells: >5:1; commonly termed linear.
Intermediate cells: 2-5:1; commonly termed elongated, rectangular, hexagonal, or rhomboidal.
Short cells: <2:1; commonly termed isodiametric, quadrate, rounded-quadrate, or sub-quadrate.

Number of **stereid bands** evident in costa cross-sections:

2* = costa with two stereid bands
1* = costa with one stereid band
0* = costa lacking stereid bands, i.e., ±homogeneous

Group A21 – Cells long (>5:1) and smooth

	Group A21
Leaves **flexuose-twisted** (dry); cell walls ±**thickened**; capsules mostly **erect**; SA, CA	*Orthodontium*†
Leaves **little** altered (dry); cell walls **not** thickened; capsules inclined to **pendulous**; WS	*Pohlia*†

Group A22 – Cells intermediate (2-5:1) and distinctly papillose

	Group A22
Leaves **ovate** and abruptly narrowed to a **short** acumen; papillae **simple**; W, VT	*Philonotis*†
Leaves linear-lanceolate to **subulate** from an **erect** base; papillae **simple**; WS	*Bartramia*†

Group A23 – Cells intermediate (2-5:1) and distinctly prorulose

	Group A23
Leaves **julaceous** and **5-ranked**; peristome teeth **fused** at tip; A/A	*Conostomum*
Leaves and peristome teeth **otherwise**.	
Setae **flexuose**; capsules **symmetric** and **rugulose**; peristome **reduced**; NC, TN	*Bartramidula*
Setae **straight**; capsules **asymmetric** and **furrowed**; peristome teeth **lanceolate**.	
Leaves with **bistratose** margins and/or lamina; **mesic** habitats; WS	*Bartramia*†
Leaves **unistratose**; **hydric** habitats; WS	*Philonotis*†
Setae **short**, capsules **immersed**	
Leaves ±linear-**lanceolate** and ±**spinulose** above; protonemata **persistent**; WS	*Ephemerum*†
Leaves ±**subulate** and **serrulate** above; protonemata **ephemeral**; WS	*Bruchia*†

Group A24 – Cells intermediate and smooth (or indistinctly ornamented[#])

Group A24

Leaves predominantly **broader near** or **above** the middle (±oblong or obovate).
- Plants **small**, **winter annuals** on soil.
  - Capsules clearly **exserted**.
    - Costa **strong**; protonemata **ephemeral**; peristome **lacking**; WS — *Physcomitrium*
    - Costa **weak**; protonemata **persistent**; peristome **present**; WS* — *Discelium*
  - Capsules ±**immersed** and ±**pyriform**.
    - Leaves ±concave-**obovate** and **serrulate**; capsules **operculate**; WS — *Physcomitrium*
    - Leaves ±concave-**ovate** and **entire**; capsules **cleistocarpous**; WS — *Bruchia*†
- Plants **otherwise**.
  - Leaves commonly bordered by **linear** cells; capsules pyriform and **pendent**; WS — *Bryum*
  - Leaves **unbordered**.
    - Medial cells **smooth** and **>5:1** (linear rhomboidal); capsules **pendent**; WS — *Pohlia*†
    - Medial cells **smooth** and **<4:1**; capsules inclined to **erect**.
      - Peristome of **4** massive teeth; plants **bud-like**; costa **weak**; on **rocks**; N — *Tetrodontium*
      - Peristome of **16** teeth; costa **strong**; on **soil**.
        - Capsules with well-**differentiated** necks; calyptrae **mitrate**; N* — *Tayloria*
        - Capsules **lacking** a distinctive neck; calyptrae inflated **cucullate**.
          - Capsules **inclined** and **asymmetric**; WS — *Funaria*
          - Capsules **erect** and **symmetric**; WS — *Entosthodon*
      - Peristome **lacking**; capsules **erect** and **symmetric**; calyptrae **mitrate**; WS — *Physcomitrium*

Leaves predominantly **broader** near the **base** (±lanceolate).
- Plants **small**, **winter annuals** on soil; capsules ±**immersed** and **cleistocarpous**; WS — *Bruchia*†
- Plants **otherwise**; capsules **exserted** and **peristomate**.
  - Leaves ±**subulate** / **setaceous**.
    - Capsules **ovoid**; plants minute to very **small**; on **calcareous** rocks; WS (N) — *Seligeria*†
    - Capsules long **cylindric**; peristome teeth **round**, fully **split** and **papillose**; WS — *Ditrichum*
    - Capsules ±**oblong**, often **curved**; peristome teeth **flat**, **split** 1/2 and **pitted**; WS — *Dicranella*
  - Leaves flexuose-**twisted** (dry); cells ±**thick**-walled; SA, WC — *Orthodontium*†
  - Leaves with expanded, **sheathing** leaf bases; WS — *Dicranella*
  - Leaves **lacking** any of the above unique characteristics.
    - Leaves **>**1mm; capsules **terminal**.
      - Costa **percurrent**; capsules **erect**; peristome **single**.
        - Upper cells ±**linear**; peristome teeth **long** & **split**; WS — *Ditrichum*
        - Upper cells **broad**; peristome teeth **short** & **irregular**; N — *Catoscopium*
      - Costa **subpercurrent**; capsules ±**pendant**; peristome **double**; WS — *Pohlia*†
    - Leaves **<**1mm; capsules **lateral**; peristome **single**; on **Cu** or **S** rich soils; N* — *Mielichhoferia*

[#] Cells bulging, mammillose (cells both bulging and papillose), or with low papillae or projections.

Group A25 – Cells short (<2:1) and distinctly papillose

Group A25

Leaves with **expanded**, **sheathing** bases; cells strongly **bulging** on upper surface; WS — *Timmia*†
Leaves distinctly **toothed** in the upper half.
- Cells **pleuripapillose**; leaves ±**squarrose**-recurved; **2***.
  - Leaf lamina **unistratose**; stem hyalodermis **lacking**; **peristome** present; SE — *Leptodontium*
- Cells **unipapillose** or mammillose; ventral stereid band **weak** or **lacking**.
  - Leaves ±**broad**; cells **mammillose**; capsules **smooth**; WS — *Dichodontium*
  - Leaves ±**narrow**; cells **coarsely** papillose; capsules **furrowed**; N — *Cynodontium*†

Leaves with large, curved, **projecting papillae** at extreme apex; cells **mammillose**: NW — *Dichodontium*
Leaves with **revolute** margins and **smoother**, **greener** marginal cells; **1***; WC, SW — *Pseudocrossidium*
Leaves **lacking** the above unique characteristics.
- Cells **collenchymatous** and **stellate**; **2***.
  - Leaves **squarrose**-**recurved** (wet); cells **pleuripapillose**; A/A — *Geheebia*
  - Leaves ±**erect** (wet); cells **unipapillose**; A/A — *Aulacomnium*†
- Cells **pleuripapillose**; but neither collenchymatous nor stellate.
  - Papillae **forked**; basal cells with **brown** cross-walls; calyptrae long-**cylindric**; WS — *Encalypta*
  - Papillae **C-shaped**.
    - Basal cells with **brown** cross-walls; calyptrae long-**cylindric**; **1***; WS — *Encalypta*
    - Basal cell walls **uncolored**; calyptrae **cucullate**.
      - Peristome teeth **long** and **twisted**; **2***; WS — *Barbula*†
      - Peristome teeth **short** and **erect**; **1***; WS — *Desmatodon*†
  - Papillae **conical**.
    - Cells with **4-7** papillae; peristome reduced to **lacking**.
      - Stems **repeatedly** forked; capsules elongate and **urn-shaped**; **2***; WS — *Amphidium*
      - Stems **sparsely** forked; capsules ±**pyriform**; **1*** or lacking; WS* — *Zygodon*
    - Cells with **1-4** papillae.
      - Costa with **two** stereid bands.
        - Leaf margins **revolute** on **both** sides; **peristome** present.
          - Papillae **crowded**; basal cells **hyaline**; peristome **twisted**; WS — *Barbula*†
          - Papillae **scattered**; basal cells **green**; peristome ±**oblique**; WS — *Didymodon*†
        - Leaf margins **revolute** on **one** side only; peristome **lacking**; WS — *Hymenostylium*
        - Leaf margins **plane**; peristome **lacking**.
          - Leaves **<2 mm**; sporophytes **terminal**; WS — *Gymnostomum*
      - Costa with **one** stereid band; peristome **lacking**.
        - Sporophytes **lateral**; stem rounded-**triangular**; WS — *Anoectangium*
        - Sporophytes **terminal**; stem **round**; WS — *Gymnostomum*
      - Costa **lacking** stereid bands; peristome **present**.
        - Basal marginal cells with **thickened** cross-walls; WS — *Ulota*†
        - Basal marginal cells ±**undifferentiated**; WS — *Orthotrichum*†
- Cells **unipapillose**; but neither collenchymatous nor stellate.
  - Leaves **serrulate** at apex; stems **tomentose**; **gemmae** on stem extensions; WS — *Aulacomnium*†
  - Leaves **entire**.
    - Capsules **exserted**; peristome of **32 twisted teeth**; plants on **soil** and rocks; **2***; WS — *Barbula*†
    - Capsules ±**emergent** and **valvate** (4x); **blackish** plants on **rocks**; **0***; N* — *Andreaea*†
    - Capsules ±**immersed** with **16** ±**reflexed** teeth; plants on **trees** and rocks; **0***.
      - Basal marginal cells with **thickened** cross-walls; WS — *Ulota*†
      - Basal marginal cells +**undifferentiated**; WS — *Orthotrichum*†

Group A26 – Cells short (<2:1) and smooth (or indistinctly ornamented#)

Group A26

Leaves ±oblong-**spathulate** (broad in the middle and even broader above).
- Leaf margins usually **revolute**, at least in part; cells **flat**.
  - Leaves ±**bordered** with **longer** cells; peristome teeth **short** and **erect**; **1***; WS — *Desmatodon*†
  - Leaves ±**bordered** with **shorter** cells; peristome teeth **long** and **twisted**; **1***; WS — *Tortula*†
  - Leaves with **intra**-**marginal** border of enlarged, **thick**-**walled**, **orange** cells; **1***; W — *Crumia*
  - Leaves **unbordered**.
    - Propagula **axillary**; peristome of **32** spirally **twisted teeth**; **2***; WS — *Barbula*†
- Leaf margins **plane**; cells **flat** and **large** (**>**15μ); peristome **none** or rudimentary; **1***; WS — *Pottia*†

Leaves ±oblong-**lingulate** (tongue-shaped)or oblong-**ligulate** (strap-shaped).
- Leaves ±**lingulate**; cells **2(3)stratose**; **awns** on perichaetial leaves; capsules **sessile**; E, BC — *Diphyscium*

Leaves ±**ovate** (broadest in lower third; egg-shaped) and **revolute**; peristome of **32** teeth; **2***; WS — *Barbula*†

Leaves ovate-lanceolate to **lanceolate** (broadest near the base; lance-shaped).
- Leaves **3-ranked**; setae very **long**; plants of **calcareous** wetlands; N — *Meesia*
- Leaves **falcate**-**secund**; capsules **valvate**; plants **saxicolous** and **blackish**; NW — *Andreaeobryum*
- Leaves with expanded, **sheathing** leaf bases.
  - Cells **bulging** on upper surface; capsules **symmetric** and **oblong**-**ovoid**; WS — *Timmia*
  - Cells **smooth**; capsules **asymmetric** and **strumose** (goiter-like swelling); WS — *Oncophorus*
- Leaves with **paired teeth** on **bistratose** margins.
  - Margins **revolute** below; cells with cuticular **ridges**; perichaetia **terminal**; N* — *Plagiopus*
- Leaves with an **intramarginal band** of long, narrow cells at base; WC and NW — *Scouleria*
- Leaves **bistratose**, at least in part.
  - Leaves **subtubulose** (dry); cells **bulging** on upper surface; **2***; WC, SW, TX — *Timmiella*
  - Leaves **curved** to **crisped** (dry); cells bulging or flat.
    - Calyptrae **mitrate**, **lobed** and **plicate**; **2***; WS — *Ptychomitrium*
    - Calyptrae **cucullate**, **entire** and **smooth**; **1***; WC, AZ — *Trichostomopsis*†
- Leaves **lacking** any of the above unique characters.

Continued below at left margin

Continued from Group A26 above

Leaves **lacking** the above unique characteristics.

Capsules split along **4 sutures**; plants **saxicolous** and **blackish**; N* *Andreaea*†
Capsules with **4**, **massive** teeth; leaves **pellucid**; terminal gemmae **cups**; WS *Tetraphis*
Capsules with 8, **16** or 32 **lanceolate** teeth.
Plants in **tufts** on **tree** trunks (rarely on rocks); **diplolepideous**.
Leaves **crisped** when dry; basal cells **yellow**, **thick**-walled; WC *Ulota*†
Leaves **not** crisped when dry; basal cells ±**undifferentiated**; WS* *Orthotrichum*†
Plants in **tufts**, **cushions** or mats on **rocks**.
Peristomes **diplolepideous** (double).
Basal cells **very thick**-walled, **yellow** and **radiating** from costa; WS *Ulota*†
Basal cells ±**thick**-walled, **neither** yellow and **nor** radiating; WS *Orthotrichum*†
Peristomes **haplolepideous** (single).
Plants very **small** (**<2** mm); setae **cygneous** (wet); N *Seligeria*†
Plants **larger** (**>2** mm).
Capsules **systylious**; calyptrae **short**; in **wetter** habitats; WS *Schistidium*†
Capsules **not** systylious; calyptrae **longer**; in **dryer** habitats; WS *Grimmia*†
Plants on **soil** primarily.
Setae **cygneous**.
Capsules yellow-orange with **red ribs**; calyptrae **cucullate**; A/A *Oreas*
Capsules yellowish and **smooth**; calyptrae **mitrate**; N* *Campylostelium*
Setae **bent** at capsule base; capsules strumose and **purple-red**; leaves **revolute** throughout and **serrate** apically; upper cells ±**square**; WS *Ceratodon*
Setae **straight**.
Capsules **ribbed**; in **crevices** of cliffs and boulders.
Peristome teeth **divided** to half their length; N *Cynodontium*†
Peristome teeth **undivided**; E *Rhabdoweisia*
Capsules **smooth** (or wrinkled when dry).
Setae very **long**; capsules **inclined**; peristome **double**; in **fens**; N *Meesia*
Setae **shorter**; capsules **erect**; peristome **single**; on mineral **soils**.
Basal cells **hyaline**; peristome teeth **twisted**; WS *Barbula*†
Basal cells **green**; peristome teeth ±**oblique**; WS *Didymodon*†

Cells bulging, mammillose (cells both bulging and papillose), or with low papillae.

End.