# *Guide to Freely Branched (mostly pleurocarpous) Mosses of the West Coast*

*Revised through 30 April 2010*

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***Reminder**: A dagger (†) indicates that not all of the species within a given genus, or the genus containing a species listed, have the character(s) defining that Group. Abbreviations for the **distribution** of taxa are found at the end of the Concordance.*

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## *Group P1 - Shoots strongly flattened (complanate) or angular*

**Group P1**

Shoots **angular** with leaves folded (**conduplicate**); plants **aquatic**, submerged part of year.

Leaves **ecostate** (costa lacking); leaves keeled or flat; WS — *Fontinalis*†

Shoots **complanate**.

Leaves with a **narrow**, **single** costa.

Plants **without both** large and small leaves.

Leaf tip **rounded-obtuse**, leaves **asymmetric**, upper leaf cells >5:1; WS* — *Homalia trichomanoides*

Leaf tip **obtuse**, leaves **undulate**, asymmetric; leaf cells 4-7:1; W — *Metaneckera menziesii*

Leaf tips **acuminate** to **acute**.

Leaf margins **coarsely serrate** above; leaf tip **not** twisted; W — *Porotrichum*

Leaf margins **distinctly serrulate**, leaf tip **twisted** at apex; E, WA — *Steerecleus serrulatus*

Leaf margins **entire**, leaf tip **not** twisted, in wet swampy places; WS — *Leptodictyum riparium*†

Leaves with a **short** & **double** costa, or none.

Leaf cells **large, lax, hexagonal**, often rhizoids and papillose gemmae on leaf tips; E, N, CA — *Hookeria*

Leaf cells firm- to thick-walled, **rounded to linear**.

Leaves slenderly **long** decurrent; leaf margins **entire**, or serrulate at tip; WS — *Plagiothecium*†

Leaves **shortly** decurrent, undulate or not; on vertical substrates; WS* — *Neckera*

Leaves **not** decurrent.

Leaves **secund**; very **shiny** plants; margins sharply **serrulate** above; WS — *Brotherella recurvans*

Leaves **straight** or slightly secund at tips.

Rhizoids **axillary** and **papillose**; stem **hyalodermis** well or moderately developed.

Leaves ±**serrate** throughout; alar cells **quadrate**; WS* — *Herzogiella turfacea*†

Leaves ±**entire**; alar cells ±**undifferentiated**; WS* — *Isopterygiopsis muelleriana*†

Rhizoids **below** leaf insertions and **smooth**; stem hyalodermis **lacking**.

Leaf apical cells **long**.

Alar cells **quadrate**, but **neither** particularly enlarged **nor** thick-walled.

Leaves **acuminate**; pseudoparaphyllia **filamentous**; E, CA — *Isopterygium tenerum*

Alar cells ±**undifferentiated**; pseudoparaphyllia **lacking**; WS — *Pseudotaxiphyllum*

Leaf apical cells **short**; pseudoparaphyllia **foliose**; E, SW — *Taxiphyllum*†

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## *Group P2 – Shoots julaceous (especially when dry) – shoots smoothly cylindric with crowded, overlapping and appressed leaves*

**Group P2**

Leaves with a **narrow**, **single** costa.

- Leaf margins **serrate** and strongly **revolute** to near apex; alar cells **differentiated**; W — *Antitrichia californica*†
- Leaf margins **entire** or slightly serrulate apically; paraphyllia **lacking**.
  - Median leaf cells **long**.
    - Branching ±**pinnate** and in one **plane**; lawns and disturbed areas; WC, NY — *Pseudoscleropodium purum*
    - Branching **irregular**; wet soil and rocks; W — *Scleropodium*†
  - Median leaf cells **intermediate**; stems **red**; main stems **not** julaceous; A/A, W — *Plagiobryum*

Leaves with a **short**, **double** costa or none.

- Leaves **serrulate** to **dentate**; cells **prorulose**.
  - Leaves **acute** to acuminate; alar cells **numerous** & **strongly** differentiated; WC — *Pterogonium*
  - Leaves **rounded**-**obtuse**; alar cells **indistinctly** subquadrate; WS(N) — *Myurella*†
- Leaves spinulose-**serrate** to serrulate at the **apex**.
  - Leaves spinulose-**serrate** & **hyaline** above; shoots **julaceous**; cells **papillose**; WS — *Hedwigia*
- Leaves **entire**; plants in very wet places, e.g., shallow water; alar cells **short** and **wide**; WS* — *Scorpidium*

## *Group P3 – Leaves spreading at right angles (squarrose) or squarrose-recurved; leaf tips often channeled*

**Group P3**

Stems **red**; plants ±**robust** and loosely **ascending**; costa **double** (long or short) or lacking; WS* — *Rhytidiadelphus*

Stems **green**; plants ±**slender** and **creeping**; costa long and **single**, short and **double**, or lacking; WS* — *Campylium*

## *Group P4– Plants with erect branches from a creeping stem*

**Group P4**

Costa **long** and **single**.; alar cells **quadrate** to **oblate**.

- Branching pinnate to **bipinnate** (frondose); costa **toothed** at back; CA — *Bestia longipes*

## *Group P5– Plants with leaves sickle-shaped and turned to one side (falcate-secund)*

**Group P5**

Costa **long**, **single** and **narrow**.
- Paraphyllia **abundant** and **filamentous**; stem leaves deeply plicate, not complanate; WS — *Palustriella*
- Paraphyllia **lacking**.
  - Leaf cells **prorulose**; leaves plicate and **rugose**; WS* — *Rhytidium rugosum*
  - Leaf cells **smooth**.
    - Stems with a **hyalodermis** (thin-walled, hyaline cells on stem surface).
      - Leaves **plicate** and **denticulate** in upper portion; WS* — *Sanionia*
      - Leaves **striolate** (finely ridged) to **plane**, and **entire** to slightly denticulate.
        - Alar cells **inflated**; plants occurring in **streams** on rocks or wet places; WS — *Hygrohypnum*†
        - Alar cells **little** differentiated; plants in rich **fens**; N — *Limprichtia*
    - Stems **lacking** a hyalodermis (thick-walled cells on stem surface).
      - Plants of **upland** habitats, leaves **plicate**; WS — *Brachythecium*†
      - Plants of **wet** habitats, leaves **not** plicate.
        - Leaves **keeled**, **3-ranked**; WS* — *Dichelyma*
        - Leaves **neither** keeled **nor** 3-ranked.
          - Costa **excurrent**; alar cells abruptly inflated or undifferentiated; WS* — *Drepanocladus*†
          - Costa **subpercurrent**; plants in **fens** and **seeps**.
            - Leaf margins finely **denticulate**; WS* — *Warnstorfia*
            - Leaf margins **entire**.
              - Central **strand** (small cells) in stem; WS* — *Drepanocladus*†
              - Central strand **lacking**; N — *Hamatocaulis*

Costa **short** and **double**, or none.
- Arms of double costa **meeting** at the base, or **none**.
  - Shoots in **flat**, evenly **pinnate**, **feather**-like, **fronds**; plants **large**; WS* — *Ptilium crista-castrensis*
  - Shoots **loosely complanate**; plants **very shiny**; leaves **very serrulate** above; E, NW — *Brotherella recurvans*
  - Shoots **julaceous**; found in wet places (often submerged); WS* — *Scorpidium scorpioides*
  - Shoots **falcate-secund** when **dry**, erect when moist; on trees; WS* — *Pylaisiella*
  - Shoots with many **brood bodies** at tips; usually on trees; WS* — *Platygyrium*
  - Shoots **lacking** the above unique characters.
    - Leaves **rugose**; stems with **paraphyllia**; NW — *Rhytidiopsis robusta*
    - Leaves **plane**.
      - Leaf cells **prorulose**; leaves crowded & **spreading**; alar cells **subquadrate**; E, AK, BC — *Ctenidium*
      - Leaf cells **smooth**.
        - Alar cells abruptly inflated as "**bubble**" cells; leaves <u>+</u>**homomallous**; E, CA — *Sematophyllum*
        - Alar cells in **triangular** patches; leaves <u>+</u>**entire**.
          - Plants on **wet rocks** in mountain streams; branching <u>+</u>**irregular**; WS — *Hygrohypnum*†
          - Plants of **mesic** to wet habitats; branching regularly **pinnate**; WS — *Hypnum*

## *Group P6 – Plants with paraphyllia or tomentum on stem.*

**Group P6**

Stems with **tomentum,** calciphile in fens, swamps; WS* *Tomentypnum*

Stems with **paraphyllia**.

- Leaves with a **short**, **double** costa or none; plants irregularly pinnate.
  - Leaves **rugose** and **falcate-secund**; NW, WA, OR *Rhytidiopsis robusta*
  - Leaves **smooth**, straight and **imbricate** when dry; WC *Alsia californica*
- Leaves with a **long**, **double** costa.
  - Plants **2-3**-pinnate with **stepwise** flat fronds; upper leaf cells **prorulose**; WS* *Hylocomium splendens*
  - Plants **irregularly** to **1-2**-pinnate; cells smooth or prorulose.
    - Leaves **spinulose**-serrate all around; NE, N *Hylocomiastrum umbratum*
- Leaves with a **long**, **narrow** costa.
  - Plants **dendroid**; upper leaf cells **short** (2-5:1).
    - Plants **little** altered dry; leaf margins strongly serrate in **upper half**; on rich soil; WS *Climacium*
    - Plants **curled** dry, leaf margins serrate at **tip**; on trees primarily; NW, ID *Dendroalsia abietina*
  - Plants **irregular pinnate**; cells **linear** (> 8:1); margins **spinulose**; NE, N *Hylocomiastrum pyrenaicum*
  - Plants **complanate**; stem leaves **undulate**; W *Metaneckera menziesii*
  - Plants **lacking** the above unique characters.
    - Alar cells **inflated** in well marked groups.
      - Stem leaves deeply **plicate**; paraphyllia **filamentous** and abundant; soil and rocks; WS *Palustriella*
      - Stem leaves **plane**; paraphyllia **foliose** and few to many; wet areas; WS* *Cratoneuron*
    - Alar cells mostly **not** differentiated, if so, **not** inflated.

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Paraphyllia **papillose**.

- Plants **large**; stem leaves **1-1.9mm**; branch leaf cells mostly **unipapillose**.
  - Plants **2-3-pinnate**, mostly spreading and softer; E, NW *Thuidium*

Paraphyllia **smooth**.

- Leaf cells either **prorulose** or with **short** and **simple** papillae; leaves ±**lanceolate**.
  - Stem and branch leaves **uniform**.
    - Leaf cells **elongate**, **oblong-rhombic** to oblong-linear.
      - Paraphyllia linear**-lanceolate** and numerous.
        - Capsules **inclined**, **asymmetric**; W *Pseudoleskea*
        - Capsules **erect**, **symmetric**; W, CO *Lescuraea*
      - Paraphyllia **filiform** and abundant; capsules inclined to horizontal and curved; WS* *Helodium*
    - Leaf cells **short** (isodiametric or nearly so, hexagonal to short-rhombic); W *Pseudoleskea*

## *Group P7 – Plants with red stems*

**Group P7**

Costa **long** and **double**.
- Stems with **paraphyllia**.
  - Plants **dendroid** (tree-like) on soil in wet, shady places; WS — *Climacium*
  - Plants **2-3**-pinnate with **stepwise** flat fronds; upper leaf cells **prorulose**; WS* — *Hylocomium splendens*
- Stems **without** paraphyllia and irregularly branched; WS* — *Rhytidiadelphus*

Costa **long** and **single**.
- Leaf margins ±**revolute** throughout; alar cells **oval** to transversely **elongate**; W, NL — *Antitrichia*
- Leaf margins **plane**; alar cells ±**undifferentiated**; A/A, W — *Plagiobryum*

Costa **short** & **double**, or none.
- Leaves distinctly **falcate**-**secund**; WS — *Hypnum*†
- Leaves squarrose to **squarrose**-**recurved**; WS* — *Rhytidiadelphus*
- Leaves **straight**.
  - Leaves with a **hyaline** tip; shoots **whitish** and ±**julaceous** when dry; cells **papillose**; WS — *Hedwigia ciliata*
  - Leaves with a **green** tip; leaf cells **smooth**.
    - Alar cells **inflated**, **hyaline** and **thin**-walled in distinct **auricles**; WS (N) — *Calliergonella cuspidata*
    - Alar cells **short**-oblong with **thick orange** walls; WS — *Pleurozium schreberi*

## *Group P8 – Plants with shoots flat on top and appearing "braided"*

**Group P8**

Costa **single** and **narrow**; pseudoparaphyllia present.
- Cells **prorulose** on leaf back; regularly 1-pinnate; leaves serrulate **all around**; E, AK, BC — *Ctenidium*
- Cells **smooth**; closely 1-pinnate in **feather**-**like** fronds; leaf **tips** serrulate; WS* — *Ptilium crista-castrensis*

Costa **short** and **double**, or none; pseudoparaphyllia usually present.
- Alar cells in **transverse rows** and inflated; leaves **sharply serrulate** above; E, BC, WA — *Brotherella*
- Alar cells in **triangular areas**, inflated or not; leaves entire to serrulate; WS — *Hypnum*†

## *Group P9 – Leaves undulate or rugose (irregular undulations)*

**Group P9**

Leaves with a **double** costa of **intermediate** length; leaves **plicate** below, **rugose** above; NW — *Rhytidiopsis robusta*

Leaves with a **narrow**, **single** costa.
- Leaves **undulate** and **asymmetric**; shoots **complanate**; **paraphyllia** on stems; W — *Metaneckera menziesii*
- Leaves **rugose**; shoots **round**; paraphyllia **lacking**.
  - Leaf cells **prorulose**; WS* — *Rhytidium rugosum*

Leaves with a **short** & **double** costa ,or none.
- Plants **julaceous** and growing in wet (submerged) areas; WS — *Scorpidium scorpioides*
- Plants **not** julaceous; leaves **complanate** & **undulate**; on rocks or trees; WS* — *Neckera*†

## *Group P10 – Leaves dimorphic (two forms on the same axis)*

**Group P10**

Smaller leaves (amphigastria) on the **ventral** (lower) side of stem in a **single** row; FL, BC, AK — *Hypopterygium*

## *Group P11 – Leaves with awns, hair-points or hyaline apices*

**Group P11**

Leaves with a **narrow**, **single** costa.

- Leaf cells **papillose**; creeping on tree bark or rock; W, AK — *Claopodium*†
- Leaf cells **smooth**.
  - Cell walls **nodulose** (wavy) throughout; WS — *Racomitrium*†
  - Cell walls **straight**.
    - Leaf apex **flat**, **filiform** and **serrate**; leaves **abruptly** acuminate; N* (S to NC) — *Cirriphyllum*

Leaves with a **short**, **double** costa or none; apex **hyaline** or abruptly contracted to long **setaceous** point.

- Leaf cells **papillose**; leaf apex **hyaline**.
  - Leaf cells **unipapillose** on both sides; WC — *Pseudobraunia californica*
  - Leaf cells with **1** or **more**, simple to **forked** papillae; WS — *Hedwigia ciliata*
- Leaf cells **smooth**, leaf apex hyaline or yellow.
  - Leaf apex **yellow**; alar cells **inflated** and **hyaline**; BC — *Wijkia carlottae*
  - Leaf apex **hyaline**; alar cells **undifferentiated**; leaves appressed, NW, OR — *Iwatsukiella leucotricha*

## *Group P12 – Plants thread-like (leaves <1mm)*

**Group P12**

Leaves to **1 mm**; costa **variable**; cells **rounded**-**elliptic**; pseudoparaphyllia **lanceolate**; N,W — *Pseudoleskeella*

Leaves **0.15-0.5 mm**; costa none or **short** and **double**; cells **rhombic**; paraphyllia **none**; WS — *Platydictya*

## *Group P13 – Costa double and more than 1/3 leaf length*

**Group P13**

*Note: see Group 20 also for several of these mosses where costa form is variable within a single plant.*

Costa **1/3-2/3** the leaf length with branches of ±equal length.

- Leaf cells **prorulose**.
  - Stems **red**.
    - Plants **regularly 2-3**-pinnate with **stepwise** flat fronds; WS* — *Hylocomium splendens*
    - Plants **irregularly** branched; leaves **plicate** with broad flat tip; WS* — *Rhytidiadelphus triquetrus*†
  - Stems **green**; plants **loosely** pinnate; leaves **decurrent**; costa **variable**; WS(N) — *Heterocladium dimorphum*†
- Leaf cells **smooth**.
  - Paraphyllia often **few** and **inconspicuous**; leaves **decurrent** and **dimorphic**; W — *Heterocladium procurrens*†
  - Paraphyllia **lacking.**
    - Leaves **spinulose**-**serrate** all around and **decurrent**; NE, N — *Hylocomiastrum umbratum*†
    - Leaves **entire** to somewhat serrulate; costa often **variable**.
      - Leaves slenderly long **decurrent**; costa branches often **unequal**; WS — *Plagiothecium*†
      - Leaves **not** distinctly decurrent.
        - Alar cells **subquadrate** and slightly **porose**; in rich, open **fens**; N — *Pseudocalliergon turgescens*
        - Alar cells **quadrate** or **inflated**; on rocks in **mountain streams**; WS — *Hygrohypnum*†
        - Alar cells **thick walled, porose**; plants **irregularly** branched; AK — *Rhytidiadelphus japonicus*†

## *Group P14 – Costa single and narrow; leaves with distinct decurrencies*

**Group P14**

Leaf cells **pleuripapillose**; decurrencies broad to **auriculate**.

Costa to **mid**-leaf (forked/shorter); leaf margins **serrulate**; leaves **dimorphic**; W,SE *Heterocladium macounii*†

Leaf cells **smooth** or indistinctly ornamented.

Plants large and **dendroid**; leaf tips **rounded** and sometimes apiculate; NW *Pleuroziopsis ruthenica*

Plants **arching** and ±regularly **pinnate**; leaf apical cells **shorter** than medial cells; W *Eurhynchium*†

Plants **neither** dendroid, arching-pinnate, **nor** complanate; apical cells **similar** in size to medial cells.

Leaves **smooth** with plane **or** twisted apices; cells mostly >**4:1**; WS *Brachythecium*†

## *Group P15 – Costa single and narrow; leaves with a distinct marginal border*

**Group P15**

Leaves bordered with **cilia** at leaf **base only**; paraphyllia **filiform** and abundant; WS* *Helodium* †

Leaves bordered with **linear** cells; leaf margins **serrulate** to **serrate**.

Leaf margins **serrulate** to **serrate**.

Shoots **round**; leaves **plane** with **multistratose** borders.

Leaves ±**lanceolate** and acuminate with **serrate**, **unistratose** marginal cells; OR *Limbella fryei*

Leaf margins **entire**; on rocks and tree trunks.

Border extends to near leaf **apex**; cells **intermediate** in length; BC, CA *Daltonia splachnoides*

## *Group P16 – Costa single and narrow; leaves with distinct alar cells*

**Group P16**

Alar cells **inflated** and **hyaline**, or **yellow**.
- Paraphyllia **present**.
  - Stem leaves **plicate**; paraphyllia **filamentous** and **abundant**; WS — *Palustriella*
  - Stem leaves **plane**; paraphyllia **foliose** and either abundant or few; WS* — *Cratoneuron*
- Paraphyllia **lacking**; leaves broadly **rounded** at tip.
  - Leaves with an **apiculus**; plants **reddish**; A/A — *Sarmenthypnum sarmentosum*
  - Leaves **without** an apiculus; alar cells thin-walled; in fens and swamps; N — *Calliergon*
- Leaves **acuminate** or bluntly **acute**, **falcate-second**.
  - In **fens** or other nutrient rich waters.
    - Alar cells **numerous** in **large** conspicuous groups; WS* — *Drepanocladus*
  - On **rocks** in or along **streams**; alar cells **subquadrate** to **oblong**; WS — *Hygrohypnum*
- Leaves **straight**.
  - Leaves narrowed to long, **channeled acumen**; WS* — *Campylium polygamum*
  - Leaves ovate-lanceolate and **narrowed** to an **acumen**; WS* — *Drepanocladus aduncus* var. *kneiffii*
  - Leaves **acuminate**; alar cells often in broad **decurrencies**; WS — *Brachythecium*†

Alar cells **small** and **subquadrate**.
- Leaves ±broadly **oblong-ovate**.
  - Shoots ±**julaceous**.
    - Leaves abruptly **apiculate**; plants **erect**; in **lawns** and gardens; WC, NY — *Pseudoscleropodium purum*
    - Leaves **rounded** to acute; plants **prostrate**; on **rocks** in or along **streams**; WS — *Hygrohypnum*
- Leaves **ovate** to **ovate-lanceolate**.
  - Leaf margins **serrate** above.
    - Branching pinnate to **bipinnate** (frondose); medial cells **<2:1** (±isodiametric); CA — *Bestia longipes*
    - Branching **irregular** to sub-pinnate; medial cells >**2:1**; WS(WC & SA) — *Isothecium*
  - Leaf margins **entire** to serrulate.
- Leaves ±**lanceolate**; shoots **not** julaceous; plants **prostrate**.
  - Leaves narrowed to long, **channeled acumen** and ±**squarrose-recurved**; WS* — *Campylium*†
  - Leaves and cells **lacking** any of the above unique characters.
    - Alar cells **symmetrically** arranged; WS — *Brachythecium*†

## *Group P17 – Costa short and double, or none; leaves with distinct decurrencies*

**Group P17**

Leaf cells 1-4 **papillose**; costa **variable**, usually single/forked; leaves **dimorphic**; W, SE — *Heterocladium macounii*†

Leaf cells **smooth**; costa short and double, or about 1/2 leaf length
- Leaf margins serrulate to **serrate** all around; alar cells abruptly **inflated**; WS* — *Herzogiella striatella*†
- Leaf margins **entire** or with serrulate tips.
  - Alar cells abruptly **inflated**; AK — *Herzogiella adscendens*†
  - Alar cells **poorly** differentiated; WS — *Plagiothecium*

## *Group P18 – Costa short and double, or none; leaves bordered*

**Group P18**

**No** relevant genera on the West Coast.

## *Group P19 – Costa short and double, or none; leaves with distinct alar cells*

**Group P19**

Alar cells **inflated,** and **hyaline** or **yellow**.
- Leaves distinctly **falcate-secund**.
  - Plants **regularly** pinnate, feather like; **flat** oblong, **triangular** fronds; WS* — *Ptilium crista-castrensis*
  - Plants **irregularly** pinnate to unbranched.
    - Plants in **calcareous** wet areas; leaves concave and apiculate; WS* — *Scorpidium scorpioides*
    - Plants **on rocks** in mountain **streams** or wet places; leaves ovate and concave; WS — *Hygrohypnum*
    - Plants in **other** habitats.
      - Stems with a **hyalodermis**; alar cells in large, almost decurrent areas; WS — *Hypnum*
      - Stems **lacking** a hyalodermis; leaf apices serrate to serrulate.
        - Alar cells **subquadrate** and in ±**triangular** group; apices **serrate**; SE — *Heterophyllium*
        - Alar cells **oblong** and in ±**triangular** group; apices **serrulate**; E, NW — *Brotherella*
        - Alar cells **few** with short-oblong cells above; apices **serrulate**; WS — *Hypnum*
- Leaves **homomallous**; alar cells abruptly and strongly inflated as "**bubble**" cells; E, CA — *Sematophyllum*
- Leaves **neither** falcate-secund **nor** homomallous.
  - Stem leaves contracted to a long, yellow, **setaceous point**; BC — *Wijkia carlottae*
  - Stem leaves **without** a setaceous point, acute, acuminate or apiculate.
    - Leaves **squarrose-recurved**; alar cells oblong and ±inflated; WS* — *Rhytidiadelphus squarrosus*†
    - Leaves **erect** to **spreading**; alar cells hyaline.
      - Plants **erect**; stems with a **hyalodermis**; alar cells in **auricles**; WS — *Calliergonella cuspidata*
      - Plants **prostrate**; alar cells **not** in auricles.
        - Cells at leaf insertion **enlarged** in 1 or 2 **distinctive rows**.
          - Alar cells **not** rounded to the insertion.
            - Alar cells **strongly** inflated as "**bubble**" cells; setae ~3 **cm**; E — *Sematophyllum*
        - Cells at leaf insertion **not** in a distinctive row; leaves **>1mm**.
          - Leaves **serrulate** throughout and **decurrent**; alar cells **thin**-walled; WS* — *Herzogiella*

Alar cells **quadrate** to **short** oblong.

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**P19** ***Continued from above***

Alar cells **quadrate** to **short** oblong.
- Leaves distinctly **secund** or **falcate-secund**; leaf cells **smooth**.
  - Plants with clusters of axillary **brood branchlets** at tips of erect branches; WS* — *Platygyrium*
  - Plants **without** brood bodies.
    - Leaves **ovate** and **concave**; plants of wet places and in mountain streams; WS — *Hygrohypnum*
    - Leaves **lacking** any of the above unique characters.
      - Costa **shorter** with branches **joining** at the base; pseudoparaphyllia common; WS — *Hypnum*
- Leaves **straight** or indistinctly falcate-secund.
  - Leaves **wide-spreading** to squarrose-recurved and with a long, **channeled acumen**; WS* — *Campylium*†
  - Leaves **flattened** into one plane, i.e., shoots **complanate**.
    - Leaves serrulate **throughout**; stem **hyalodermis** present; WS* — *Herzogiella turfacea*
    - Leaves serrulate in **upper half**; stem hyalodermis **lacking**; E, CA — *Isopterygium tenerum*
  - Leaves ±**concave** and **imbricate**, i.e., shoots ±**julaceous**.
    - Stems **red**; leaf apical cells **undifferentiated**; alar cell walls **thick** and **orange**; WS — *Pleurozium schreberi*
    - Stems **green**; leaf apical cells **short**; alar cell walls **thin** and **colorless**; SE — *Taxiphyllum cuspidifolium*†
  - Leaves **lacking** any of the above unique characters.
    - Branches strongly **curved** when dry; straight when moist.
      - Leaf cells **>5:1**; **5-20** quadrate alar cells at the **basal angles**; WS* — *Pylaisiella*
    - Branches **loosely curved** when dry.
      - Plants with clusters of axillary **brood branchlets** at tips of erect branches; WS* — *Platygyrium*
      - Plants **lacking** brood branchlets; stems with numerous **paraphyllia**; WC — *Alsia californica*
    - Branches ±**straight** when dry.
      - Stems with numerous **paraphyllia**; WC — *Alsia californica*
      - Stems **without paraphyllia**.
        - Leaves **<1 mm**; minutely **pleuripapillose**; CO, AK, CA — *Leptopterigynandrum austro-alpinum*
        - Leaves **>1 mm**.
          - Leaf cells **prorulose**; alar cells **transversely** elongate; WC — *Pterogonium gracile*
          - Leaf cells **smooth**.
            - Alar cells extending up the margins for **<1/6** of leaf length.
              - Leaves **acuminate**.
                - Stem leaves **serrulate** throughout; WS* — *Herzogiella seligeri*
                - Stem leaves **entire** and somewhat decurrent; WC — *Tripterocladium*

## *Group P20 – Costa of uncommon or variable form*

**Group P20**

Costa of **uncommon** form.
- Costa **single** with several minor basal, **supplementary** costae; stems **red**; W, NL — *Antitrichia*
- Costa **single** with a **forked** tip (Y-shaped); CO, AK, CA — *Leptopterigynandrum austro-alpinum*

Costa **variable** on **same plant** (single or double or variations of these in different leaves).
- Costa **usually variable** (double, double with a long branch, Y-shaped, single, forked or short and double).
  - Found on **rocks** or **wet** places in **mountain** streams; WS — *Hygrohypnum*
  - Found on **trees** near coast; plants with many paraphyllia; WC — *Alsia californica*
- Costa **mostly double** (1/3-2/3 leaf length), but sometimes single or short and double.
  - Stems loosely **pinnate**; leaves **dimorphic** and **decurrent**; on soil, rock and trees; WS(N) — *Heterocladium*
  - Stems **scarcely** branched; leaves **neither** dimorphic **nor** decurrent; fens; N — *Pseudocalliergon turgescens*
- Costa **mostly single** within the genus or the given species.
  - Costa rarely to often **forked** (with or without a spine), Y-shaped or with lateral **spurs**.
    - Plants **large** and ±robust; stem leaves typically **>2** mm.
      - Leaves **serrulate** to near base with **short** and **broad** apical cells; WS — *Platyhypnidium riparioides*†
      - Leaves **entire**, broad, concave and with apical cells **similar** to medial cells.
        - Leaves abruptly **apiculate** (**reflexed**); **weedy** habitats; WC, NY — *Pseudoscleropodium purum*
        - Leaves **rounded** to bluntly acute; plants of **fens** and **swamps**; N — *Calliergon*
    - Plants **medium** in size; stem leaves typically **1-2** mm.
      - Leaf margins strongly **serrate**; alar cells distinct and **quadrate**; E, WC — *Isothecium*
      - Leaf margins **entire**; costa occasionally Y-shaped; in bogs; WS* — *Drepanocladus simplicissimus*†
    - Plants **small** and **slender**; stem leaves **<1** mm; W, SE — *Heterocladium macounii*
  - Costa occasionally to frequently **short** and **double**.
    - Leaf margins **serrulate**; leaves **decurrent**; W, SE — *Heterocladium macounii*
- Costa **mostly short** and **double** within the genus or the given species.
  - Costa often **double** with **one** or **both** branches to 1/2 leaf length.
    - Leaves **decurrent**; leaf margins mostly entire; WS — *Plagiothecium*
    - Leaves **not decurrent**.
      - Leaf margins **serrulate** to **dentate**; branches **terete** (round); E — *Myurella siberica*†
  - Costa occasionally to often **single**.
    - Plants **thread-like**; leaves to 1 mm; N, W — *Pseudoleskeella tectorum*†

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***Note**: Only the genera in **normal** type (NOT in brackets) in the Skeleton to Freely Branched Mosses are included in the following Groups.*

***Reminder**: Definitions for cell length to breadth ratios are found in the Introduction, the Overview and at the end of this section. An expanded explanation of the difference between "Distinct" and "Indistinct" surface ornamentation is found in the Introduction.*

## *Group P21 – Cells long (>8:1), distinctly papillose or prorulose*

**Group P21**

Leaf cells **prorulose**; WS* *Homalothecium*†

## *Group P22 – Cells long, smooth or indistinctly ornamented#; costa single (long and narrow)*

**Group P22**

Shoots **curved**-**ascending** when dry; leaves **plicate**; WS* *Homalothecium*†

Shoots **julaceous**; leaves obtuse or acute; plants in or near streams; W *Scleropodium*†

Shoots **complanate**.

Leaves **serrulate** throughout with **twisted** tips; in **mesic** habitats; WS* *Steerecleus serrulatus*

Leaves **entire** and wide **spreading**.

Leaves **distant**; alar cells **few** and short-to-long **rectangular**; WS *Leptodictyum riparium*†

Shoots **triangular**; leaves **keeled**, **3-ranked** and slenderly acuminate; in wet places; WS* *Dichelyma*

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

Plants **large** and ±**pinnately** branched; basal cells **porose**.

Shoots ±**erect**; leaves deeply **plicate**; W *Trachybryum megaptilum*

Shoots **prostrate** to arching; leaves **plane**; W *Eurhynchium*†

Plants with **irregular** branching; leaves spreading and lanceolate.

Cells at branch leaf apex much **shorter** than median cells; costa ending in **spine**.

Plants **aquatic** (on rocks in flowing water); branch leaves **1.2 mm** or longer; WS *Platyhypnidium*

Plants on moist humic **soil**; branch leaves **<1.2 mm**; WS *Eurhynchium*†

Cells at apex **similar** to medial cells; costal spine or tooth present or absent.

Costa **distinct**; brood bodies **lacking**; WS *Brachythecium*†

Costa **indistinct** at mid-leaf; **gemmae** or rhizoids often at back of costa; WS *Conardia compacta*

# Cells with low papillae or short projections.

## *Group P23 – Cells long, smooth or indistinctly ornamented#; costa double (long or short) or none*

**Group P23**

Leaves with a **short**, double costa or **none**.

Plants **aquatic**, submerged part of year; cells **not** porose; leaves keeled or flat; WS *Fontinalis*

Plants **not aquatic**.

Rhizoids **papillose**; stem **hyalodermis** well or moderately developed.

Alar cells **inflated** or **quadrate**; leaves ±**serrate** throughout; WS* *Herzogiella*

Alar cells ±**undifferentiated**; leaves **entire**; WS* *Isopterygiopsis*

Rhizoids **smooth**; stem hyalodermis **lacking**.

Leaf apical cells **shorter** than medial cells; pseudoparaphyllia **foliose**; E, SW *Taxiphyllum*

Leaf apical cells **similar** to medial cells in length..

Alar cells **quadrate**; pseudoparaphyllia **filamentous**; E, CA *Isopterygium*

Alar cells ±**undifferentiated**; pseudoparaphyllia **lacking**.

Leaves **complanate** and **serrate** above; brood bodies often present; WS *Pseudotaxiphyllum*

# Cells with low papillae or short projections.

## *Group P24 – Cells intermediate (3-8:1), distinctly papillose or prorulose*

**Group P24**

Leaf cells **prorulose**.

Costa **long** and **single;** paraphyllia **abundant**; on **rocks** in mountains; W, CO — *Lescuraea*†

Costa **short** and **double**; plants small and creeping.

Plants **dull**; axillary **brood bodies** present; cells **thick**-walled; WS* — *Pterigynandrum filiforme*

## *Group P25 – Cells intermediate, smooth or indistinctly ornamented#; costa single and narrow*

**Group P25**

Leaves **falcate-secund**.

Leaves **keeled**, **3-ranked**, slenderly acuminate; plants periodically **submerged**; WS* — *Dichelyma*

Leaves **plicate**; capsules short and asymmetric; plants of **upland** habitats; WS — *Brachythecium*†

Leaves **straight**.

Plants on **tree trunks;** plants **small** to very small.

Leaves with **serrulate** margins and long-**acuminate** apices; branches ±**julaceous**; WS — *Fabronia*

Plants on **soil** in mesic to wet habitats.

Plants with **julaceous** shoots; leaves broadly ovate and concave.

Stems **red**; main stems **not** julaceous; leaf margins ±**revolute** throughout; W, NL — *Antitrichia*

Stems **green**; leaf margins **plane** or recurved below; median leaf cells **<8:1**; W — *Scleropodium*

Plants n**ot** julaceous.

Leaves broadly **oblong** to ovate, **concave** and with **rounded** to cucullate apices.

Plants **reddish**; stem tips **cuspidate**; leaf tips often **apiculate**; A/A — *Sarmenthypnum sarmentosum*

Plants **green**; stems ±**julaceous**; costa often with **spines**; W — *Scleropodium*

Leaves ovate **lanceolate**, ±**plane** and with mostly **acuminate** apices.

Apical cells much **shorter** than median cells; costa ending in a **spine**; WS — *Eurhynchium*†

Apical cells **similar** to medial cells in length.

Costa **percurrent** to excurrent.

Costa very **wide** (75-140$\mu$); leaf margins ±**entire**; WS — *Hygroamblystegium*†

Costa **narrow** (<35$\mu$); leaf margins serrulate to **serrate** above; WS — *Brachythecium*†

Costa **1/2** to **3/4** leaf length.

Leaf margins **serrulate** above to throughout.

Cells **3-5:1**; capsules ±**cylindric** and **yellowish**; WS — *Amblystegium serpens*†

Cells **>5:1**; capsules ±oblong-**ovoid** and **reddish**; WS — *Brachythecium*†

Leaf margins ±**entire**.

Leaves ±wide-**spreading**; capsules ±**cylindric** and **yellowish**; WS — *Leptodictyum*†

Leaves ±**erect**; capsules ±oblong-**ovoid** and **reddish**; WS — *Brachythecium*†

Plants ±**erect** on forest **litter**, **large** and **pinnately** branched; leaves deeply **plicate**; W — *Trachybryum megaptilum*

# Cells with low papillae or short projections.

## *Group P26 – Cells intermediate (3-8:1), smooth or indistinctly ornamented[#] costa short and double or none*

**Group P26**

Plants growing in **aquatic** habitats.
- Plants **trailing** from a single attachment point in flowing water; leaves keeled or flat; WS — *Fontinalis*
- Plants **not** trailing from a single attachment point.
  - Plants **large** and **sparsely** branched; foliose **pseudoparaphyllia**; in fens; N — *Pseudocalliergon turgescens*
  - Plants **medium** & **freely** branched; cells lax, **translucent** & **empty** looking; FL, CA — *Vesicularia vesicularis*

Plants growing in **terrestrial** habitats; plants small to medium in size.
- Leaves **dimorphic** (stem vs. branch) and **decurrent**; costa **1/3**-1/2 leaf length; W — *Heterocladium procurrens*†
- Leaves of stem **straight**, with a long **setaceous** point; on trees; AK, BC — *Iwatsukiella leucotricha*

## *Group P27 – Cells short (<3:1) and distinctly papillose or prorulose*

**Group P27**

Leaf cells **pleuripapillose** (1-5 papillae per cell).
- Cells **nodulose** (wavy) throughout the leaf; WS — *Racomitrium*
- Cells **neither** nodulose **nor** porose.
  - Leaf margins **entire** to **serrulate** throughout; basal, interior cells **not** pellucid.
    - Stems **papillose**; costa **variable**; W, SE — *Heterocladium macounii*†
    - Stems **smooth**; costa **not** variable; W, AK — *Claopodium*

Leaf cells strictly **unipapillose**.
- Costa **long** and **single**.
  - Leaf margins **serrulate** to **serrate** throughout; costa **pellucid**; W, AK — *Claopodium*
  - Leaf margins **entire** to subserrulate above; costa **opaque** and often **flexuose** above; E, OR — *Leskea*†
- Costa **short** and **double** or none; leaf margins dentate to **spinulose-dentate**; E — *Myurella*†

Leaf cells **prorulose** at back, especially at upper ends of leaves.
- Leaves strongly **dimorphic** (stem and branch leaves dissimilar); WS(N) — *Heterocladium dimorphum*†
- Leaves **not** dimorphic; costa **short** and **double** or **none**.
  - Branches **julaceous**; leaves **rounded-ovate** and **obtuse**; WS(N) — *Myurella julacea*†

## *Group P28 – Cells short (<3:1) and smooth or indistinctly ornamented*[#]

**Group P28**

Costa long and **single**.
- Shoots usually with dense **clusters** of axillary brood **branchlets**; often on bark; WS — *Leskeella nervosa*
- Shoots **lacking** brood branchlets.
  - Leaf apices **acute** to **acuminate**.
    - Leaf cell walls **sinuose** to **nodulose** (wavy edges); WS — *Racomitrium*
    - Leaf cell walls **straight**.
      - Upper leaf cells >**2:1**; basal cells at insertion usually **enlarged** and **yellowish**.
        - Costa >**35*μ*** at base; yellowish cells usually in **2-3** rows; WS — *Hygroamblystegium tenax*†
        - Costa <**35*μ*** at base; yellowish cells usually in a **single** row; WS — *Amblystegium varium*†
      - Upper leaf cells **1-2:1**.
        - Costa **subpercurrent** (>2/3 the leaf length).
          - Costa stout & **toothed** at back; leaves **serrate** above; shoots ±**bipinnate**; CA — *Bestia longipes*
          - Costa ±**straight**; leaves ±**entire**; cells **obscurely** papillose; E, OR — *Leskea*†
        - Costa **shorter** (1/3 – 2/3 the leaf length).
          - Leaf apex **obliquely asymmetric**; periodically **flooded** bark; NW, NB — *Myrinia pulvinata*

Costa **short** and **double** or none.
- Shoot ±**julaceous**; leaves **ovate** with an **apiculus**; arctic-alpine; NW — *Myurella tenerrima*†
- Shoots usually ±**complanate**; leaves ±**acuminate**; cells **lax** and **translucent**; FL, CA — *Vesicularia vesicularis*
- Shoots **neither** julaceous **nor** complanate; stem leaves with a **setaceous** point; NW — *Iwatsukiella leucotricha*

[#] Cells with low papillae or short projections.

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**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: >8:1; commonly termed linear or linear-flexuose.
- **Intermediate** cells: 3-8:1; commonly termed elongated, oblong-rhomboidal, fusiform., or elliptical.
- **Short** cells: <3:1; commonly termed isodiametric, quadrate, rounded-quadrate, or rhombic.

End.