

# Key to the Lichen Genera of the Pacific Northwest

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This is a draft key that I am willing to share with you as long as you realize that it represents a slice in time in a rapidly evolving document. Almost every week I find new information from publications and from the field and lab work of my students and colleagues that needs to be incorporated. Some of these remain to be incorporated, e.g. changes in the Verrucariaceae and Teloschistaceae. Comments, corrections, or suggestions are appreciated.

This key attempts to include all lichenized fungi known from the Pacific Northwest or North America. This is the region from the Pacific Coast inland to the Continental Divide in Montana, extending north to include coastal southeast Alaska, and south to northern California. It includes most of British Columbia, Washington, Oregon, Idaho north of the Snake River Plain, and western Montana. Coverage for northern California is not comprehensive, but most of its species can be keyed here. Peripheral species not yet known from the Pacific Northwest, but likely to be found there, are given in parentheses (...). Most of these are from California, Alaska, and Colorado.

Genera of non-lichenized lichenicolous fungi are not included in the key, with few exceptions, such as genera traditionally treated by lichenologists rather than mycologists.

Colors are for dry specimens unless stated otherwise. "Spores" refers to ascospores unless stated otherwise. Crustose species that typically occur in sterile form are keyed separately. At endpoints in the keys, key characters are separated from supplemental characters by a period.

For now I have omitted most references, except the collection of general references in the back. A few not-so-obvious sources are mentioned in the text. I plan to incorporate complete references into the keys to species. These keys are slowly accumulating.

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Cover: *Hypogymnia enteromorpha* by Eric B. Peterson

## INTRODUCTORY KEY

- 1a Fungus a basidiomycete; fruiting structures mushroom-like or club-shaped ..... Key A, Page 4
- 1b Fungus an ascomycete; fruiting structures various but not mushroom-like or fruiting structures not apparent
  - 2a Thallus GELATINOUS, black to brown or gray, photobiont blue-green except in two intertidal species; thallus not filamentous ..... Key B, Page 4
  - 2b Thallus STRATIFIED (or too finely filamentous to tell), color various, photobiont blue-green and/or green
    - 3a CRUSTOSE lichens
      - 4a Thallus fertile
        - 5a Fruiting structure a MAZAEDIUM (spores in a loose powdery mass) and/or minute and on a very thin stalk ..... Key C, Page 7
        - 5b Fruiting structure apothecia, perithecia, or lirellae
          - 6a Fruiting structure elongate, narrow LIRELLAE, or ascocarps sometimes stellate, elliptical, or irregular ..... Key D, Page 9
          - 6b Fruiting structures roundish ascocarps
            - 7a Peritheciate: Ascocarps forming PERITHECIA, or perithecia-like; black, flask-shaped ..... Key E, Page 11
            - 7b Apotheciata: Ascocarps forming APOTHECIA, or apothecia-like; disc shaped
              - 8a Primary photobiont blue-green ..... Key F, Page 16
              - 8b Primary photobiont green (cephalodia with blue-green photobionts may be present) or thallus not apparent
                - 9a Apothecia lacking both thalline and proper margin, the hymenium extending to the edge of the apothecium ..... Key G, Page 18
                - 9b Apothecia with thalline margin and/or proper margin
                  - 10a Apothecia with a thalline margin (generally containing the photobiont and colored similarly to the thallus); sometimes with a pseudothalline margin (colored like the thallus rather than the disk, but not containing the photobiont); proper margin present or not ..... Key H, Page 24
                  - 10b Apothecia with a proper margin only
                    - 11a Spores nonseptate ..... Key I, Page 32
                    - 11b Spores septate ..... Key J, Page 38
    - 4b Thallus STERILE
      - 12a Thallus ORANGE, YELLOW, or yellow green ..... Key K, Page 38
      - 12b Thallus another color
        - 13a Photobiont blue-green (cyanobacteria); thallus bluish gray or brownish gray; STERILE CYANOLICHEN CRUSTS ..... Key L, Page 40
        - 13b Photobiont green; thallus gray, white, cream, brownish, olive, etc.
          - 14a Thallus wholly LEPROSE or completely ecorticate ..... Key M, Page 40
          - 14b Thallus CORTICATE, even when almost entirely sorediate at least some parts corticate (in a few cases forming a discontinuous leprose crust, the nonsorediate part of the thallus being endophloedal)
            - 15a On BARK OR WOOD or bryophytes over bark or wood ..... Key N, Page 42
            - 15b On ROCK or SOIL or bryophytes over rock or soil ..... Key O, Page 51
    - 3b MACROLICHENS (thallus squamulose, foliose, or fruticose, including minutely filamentous species)
      - 16a Thallus SQUAMULOSE ..... Key P, Page 56
      - 16b Thallus foliose or fruticose
        - 17a Thallus FOLIOSE, with dorsiventral lobes (if  $\pm$  crustose with marginal lobes, key as crustose or squamulose)
          - 18a Thallus UMBILICATE (with central holdfast), on rock ..... Key Q, Page 61
          - 18b Thallus not umbilicate, more broadly attached, or if centrally attached then not on rock
            - 19a Primary photobiont blue green (STRATIFIED CYANOLICHENS); upper surface usually

- some shade of dark gray, brown, or black ..... Key R, Page 61
- 19b Primary photobiont green (look for grass GREEN ALGAL layer); upper surface variously colored ..... Key S, Page 64
- 17b Thallus FRUTICOSE, only rarely with dorsiventral lobes
- 20a Thallus BLACKISH FILAMENTOUS, prostrate or erect, minute or large ..... Key T, Page 70
- 20b Thallus not of black filaments; color various
- 21a Thallus of HOLLOW STALKS (podetia) that are ± round and pointed or tipped with apothecia or cups ..... Key U, Page 73
- 21a Thallus not of hollow stalks (thallus either not stalked or not hollow); OTHER FRUTICOSE lichens ..... Key V, Page 73

## Key A: BASIDIOMYCETES

1a Fruiting body with stalk and cap (typical mushroom form), tan or brown, with thin decurrent gills; the lichenized portion is dark green to gray green and granular to small squamulose. — On rotten wood and peaty soil; widespread, common

*Lichenomphalia*  
*Omphalina, Botrydina*

1b Fruiting body short, clavate, pinkish brown, yellowish, tan, or whitish; thallus granular or membranous. — On soil and rotten wood; widespread, occasional

*Multiclavula*

## Key B: GELATINOUS, BLACKISH, NONFILAMENTOUS

Thallus gelatinous, non-stratified (homoiomorous); black to brown or gray, photobiont mostly blue-green (Also see Schultz & Büdel's key to the Lichinaceae (Lichenologist 34:39-62).)

1a Plants aquatic or in rocky intertidal areas

2a Plants in freshwater; photobiont blue green; ascocarps apothecia

3a Lobes 2-15 mm broad, loosely attached. — Lower surface veined; thallus foliose, with medium-sized lobes; locally common in Cascades, rare in RM, typically in small spring-fed streams having little fluctuation in water level

*Peltigera hydrothyria*  
*Hydrothyria venosa*

3b Lobes < 2 mm broad, coalescing and tightly attached in dark, thin rosettes that are very difficult to remove from rock. — In mountain streams

*Scytinium rivale*

2b Plants in the rocky intertidal; photobiont green; lower surface not veined; thallus foliose, taking the form of the algal partner; ascocarps perithecia

4a Spores elongate ellipsoid, 11-18 x 3-5  $\mu\text{m}$ ; gelatinous matrix enclosing asci in center of ascocarp; thallus with short thin lobes to 1 cm wide, shiny greenish gray. — Algal partner (*Prasiola borealis* Reed), algal cells often in regular groups, the groups separated by fungal mycelium; chloroplasts shallowly stellate; see photos in Brodo (1976); Aleutian Islands to s BC; also on coasts of Chile and Siberia

*Mastodia tessellata* Hook. f. & Harvey  
*Kohlmeyera complicatula* (Nyl.) S. Schatz  
*Turgidosculum complicatulum* (Nyl.) Kohlm. & Kohlm.  
*Guignardia alaskana* Reed

4b Spores ellipsoidal, 10-13 x 3.5-7  $\mu\text{m}$ ; gelatinous matrix filling only the ostiole; thallus of tubular to flattened lobes. — Algal partner *Blidingia minima* var. *vexata* (Setch. & Gardner) Norris; algal cells irregularly arranged in surface view; fungal hyphae layered between algae; chloroplasts single, parietal, not stellate; QCI to Monterey, California

*Turgidosculum ulvae* (Reed) Kohlm. & Kohlm.  
*Guignardia ulvae* Reed

1b Plants mostly not aquatic, although sometimes in persistently damp places; lower surface not veined or not easily inspected; thallus form various, minute to large

7a Thallus umbilicate, small (generally 1-2 (8) mm wide), often finely granular isidiate; spores nonseptate; on rock

8a Thallus monophyllous to polyphyllous, the upper surface divided by ridges

9a Apothecia "thallinocarps" (thallus colored with expanded disk-like surface); hymenium sometimes with inclusions of thalline tissue (seen in section under LM); photobiont sheaths yellow brown — Photobiont cells about 9-11  $\mu\text{m}$  diam

*Lichinella*

9b Apothecia sunken in the thallus or slightly swollen, with a pinhole opening; hymenium lacking thalline tissue; photobiont sheaths red brown. — Photobiont of the *Chroococcus* type, cells uniformly large (ca. 20-27  $\mu\text{m}$  diam), 1-2 cells per thick gelatinous sheath, the sheath 2-5  $\mu\text{m}$  thick, hyaline to

reddish); Thallus glossy, black; spores nonseptate, 7-11 x 4-5 µm; on occasionally wet siliceous rock; widespread, Alaska to Oregon mainly w Cascades

*Phylliscum demangeonii*

8b Thallus lobed to polyphyllous; photobiont of *Gloeocapsa* or *Xanthocapsa* type (sheaths red-brown or yellow-brown at the margins, cells in colonies of 2-8, often with many layers of sheaths, one inside the other); on dry limestone, soil, or soft rock

12a Apothecia with expanding disks; thallus small umbilicate to squamulose or crustose

13a Thallus blackish, umbilicate to squamulose, often shallowly lobed; on calcareous rock. — Spores nonseptate, hyaline, 8/ascus; photobiont *Xanthocapsa* type; thallus often pruinose; apothecia partly sunken or sessile with an open lecanorine disk; hymenium I+B; California; poorly known

*Anema*

13b Thallus red-brown, granular-crustose or granular-squamulose; on rock or alpine sod. — Widespread but mainly oceanic to suboceanic

*Euopsis*

[*Pyrenopsis* is similar but has punctiform disks.]

12b Apothecia with sunken disks with punctiform openings; thallus umbilicate, often deeply lobed

14a Spores > 8/ascus; lobes seldom pruinose. — Rosettes often crowded and turf-like; lobes to 3 mm wide, irregularly divided, the lobe ends shell-like; photobiont *Gloeocapsa*-like; surface often with small spherical granules or isidia; on calcareous rock or calcareous seeps; widespread in N Am

*Lichinella nigritella*

14b Spores 8/ascus; lobes usually bluish gray pruinose. — Thallus ecorticate, smooth, granular or isidiate; lobes sparsely branched to unbranched; apothecia immersed or semi-immersed; spores simple, ellipsoid to globose; on calcareous rock

*Thyrea confusa*

[See also *Digitothyrea* in Sonoran Flora I, which has lobes deeply divided, tongue-shaped; apothecia sessile to stipitate; thallus ecorticate, smooth or isidiate; spores simple, ellipsoidal to globose; on calcareous or siliceous rock]

7b Thallus not umbilicate, small or large, isidiate or not; spores septate or not; substrate various

18a Thallus granular, minutely squamulose, crustose, or minutely fruticose (note: small filamentous species are in Key T)

19a Thallus dwarf fruticose over a flattened thallus or squamulose-warty or umbilicate-polyphyllous; photobiont *Nostoc*; spores nonseptate. — On rock or moss or soil over rock; widespread, rarely collected

*Lempholemma*

19b Thallus granular to obscurely squamulose or dwarf fruticose; photobiont various; spores nonseptate or septate

20a Photobiont filamentous (*Calothrix* or *Nostoc* or *Stigonema*)

21a Photobiont *Stigonema*

See “blackish filamentous” key

21b Photobiont *Calothrix* or *Nostoc*

22a Photobiont filaments not distinctly beaded, *Calothrix*; on moist rock, often by streams or lakes; spores nonseptate

23a Epihymenium deep green. — Alaska and Colorado

*Thelignya lignyota*

23b Epihymenium brown or reddish brown. — Alaska and Colorado

*Porocyphus*

22b Photobiont distinctly beaded, *Nostoc*; substrate various; spores 1-septate to muriform

*Collema* s.l.

[including *Blennothallia*, *Enchylum*, *Lathagrium*, *Rostania*, and *Leptogium callopismum*]

20b Photobiont colonial or single-celled, nonfilamentous (*Gloeocapsa* or *Chroococcus* type); spores nonseptate

24a Spores very small, mostly < 6 µm long, about 4-5 x 2 µm, many per ascus; disk deeply sunken. — On moist noncalcareous rock; Arctic

*Pyrenopsis grumulifera*

24b Spores larger

25a Spores 3-4-septate, narrowly cylindrical. — Thallus membranous, with colonies of

*Gloeocystis* (similar to *Gloeocapsa* in general appearance but a green alga); apothecia initially immersed and closed, then opening to a deeply concave disk; disk yellow brown to reddish or rarely dark brown; thalline exciple lacking; spores 20-30 x 1.5-2 µm; Alaska, Michigan, and Europe

***Bryophagus gloeocapsa***

25b Spores nonseptate, mostly ellipsoidal

26a Photobiont *Chroococcus* type (cells in colonies of 2-4 with a clear, thin, uniform sheath); mostly on wet rock. — Reported from Colorado, but undoubtedly more widespread

***Pterygiopsis***

26b Photobiont *Gloeocapsa/Xanthocapsa* type (cells in colonies of 2-8 with thick sheaths, the sheaths at the margin yellow to yellow brown, red brown, orange brown, purplish, or dark violet; substrate and habitat various)

27a Photobiont sheaths at the upper surface reddish brown to purple to dark violet (when on more alkaline substrates), rarely yellowish brown; photobiont cells small, the interior cells with lumen ca. 3-6 µm diam and wall ca. 2-3 µm diam; hymenium IKI-; spores 16 or more per ascus. — Thallus of club-shaped terete lobes forming small cushions; widespread

***Synalissa***

27b Photobiont sheaths at the upper surface red brown, orange brown, or yellow brown; photobiont cells usually larger, interior cells with lumen usually > 5 µm; hymenium IKI+B (often fading to greenish yellow); spores 8/ascus

28a Thallus fruticose or lobate squamulose or with short club-shaped erect lobes. — Apothecia with thalline margin, lacking proper exciple; photobiont sheaths orangish brown

***Peccania***

28b Thallus squamulose or crustose

29a True proper exciple very thin or lacking; paraphyses not distinctly moniliform. — Photobiont sheaths yellowish brown; substrate mostly calcareous

***Psorotichia***

29b True proper exciple thin but distinct; paraphyses usually becoming moniliform (but apparently not in *P. furfurea*, the most common local species). — Disk narrowly exposed or expanded; on noncalcareous rock; widespread

***Pyrenopsis***

18b Thallus foliose or fruticose

33a Spores nonseptate; thallus tiny; upper cortex of interwoven hyphae

34a Apothecia lacking thalloid margin; thallus granulose to subfruticose

***Leciophysma***

34b Apothecia with thalloid margin; thallus of flat, interlaced lobes with fruiting warts, small knobby clusters, or fruticose with cylindrical branches. — Widespread, rare

***Lempholemma***

33b Spores septate; thallus tiny to large; upper cortex various

35a Thallus without a cortex, the upper surface of interwoven hyphae (whole-thallus mount viewed from above through compound microscope, but note, however, that the thalline exciple can be corticate); thallus often dull, black or olive-black. — Widespread, common

***Collema* s.l.**

(including *Blennothallia*, *Enchylum*, *Lathagrium*, *Rostania*)

35b Thallus with a cellular cortex, generally of ± isodiametric cells; thallus often faintly shiny, brown, gray or black

36a Upright hyaline hairs on very margin of thallus; spores 2-celled, 18-26 x 5-9 µm; on moss and soil or soil over rock; photobiont *Rhizonema*. — Widespread, fairly common in moist to arid environments

***Leptochidium albociliatum***

36b Hairs lacking on upper surface or if present then spores muriform; photobiont *Nostoc*

37a Spores 2-celled; thallus fruticose with terete branches, richly branched. — On various substrates, but common on moss over rock

*Polychidium*

37b Spores > 2-celled; thallus fruticose or foliose, habit various. — Thallus small or large, various in form; spores parallel septate or muriform; widely distributed and common

*Leptogium* and *Scytinium*

## Key C: CRUSTOSE, MAZAEDIA OR MINUTE WITH VERY THIN STALKS

1a Mazaedia sessile, immersed in thallus, or on short, broad stalks

2a Mazaedia sessile or immersed in the thallus

3a On soil or old animal dung; spores with a very thick cellular-appearing wall, obscuring the internal septation; on soil in dry, open habitats. — Mazaedium with a fine but distinct yellow-green edge (calycin); rare; Washington, Idaho, and Oregon to San Diego

*Texosporium sancti-jacobi*

3b On bark, wood, or rock; spores without a thick cellular covering; habitat otherwise

4a Mazaedia immersed in distinctly protruding areoles; lateral part of exciple very thin and hyaline; spores 0-1-septate. — On fenceposts and other bare wood (one species on rock), exposed sites; widespread

*Thelomma*

4b Mazaedia immersed in flat to bullate areoles; lateral part of exciple dark brown or black and well developed; spores 1-septate or submuriform. — On wood and bark, widespread, common

*Cyphelium*

2b Mazaedia on broad-based, short stalks or on short hollow podetia

5a Mazaedia on short hollow podetia. — Spores 1-septate; on twigs, mainly subalpine conifers but occasionally at lower elevations and occasional on angiosperms (e.g. *Betula*); uncommon w Cascades, NWT and Yukon s to n California, inland to e BC;

*Tholurna dissimilis*

5b Mazaedia on broad-based short stalks

6a Mature spores pale green-brown, 0- to 3-septate, cylindrical; thallus indistinct, not lichenized. — On conifer bark and wood; se Alaska to California

*Microcalicium disseminatum*

6b Mature spores dark brown, ellipsoidal to barrel shaped or ± cylindrical, 1-septate; thallus distinct, obviously lichenized. — On bark and wood; common and widespread

*Cyphelium*

1b Mazaedia or other fruiting bodies on slender stalks, or the length of stalk generally > width of mazaedium

9a Stalked bodies are pycnidia or synnemata (a group of erect and fused conidiophores or hyphophores)

10a Stalked bodies are pycnidia and contain long, slender, septate conidia. —Thallus clearly visible, thin, granulose, grayish yellow-green to olive brown; hyperoceanic areas from se Alaska to OP; on bark

*Szczawinskia tsugae*

10b Stalked bodies are synnema or hyphophores

11a On rock or soil

12a Stalk brown, only slightly longer than the head is broad; spores 12-13 µm diam. — Conidia spherical, coarsely knobby, 12-13 µm diam; conidial head ca. 150 µm wide, spherical; thallus not apparent; apparently nonlichenized but sometimes lichenicolous, on soil in seasonally damp sites

*Leightonimyces phillipsii* (Berk. & Leight.) D. Hawksw. & B. Sutton

*Doratomyces phillipsii* (Berk. & Leighton) F. J. Morton & G. Sm.

12b Stalk shiny black, about 2X as long as the head is broad; spores 6-8 µm diam. — Spore mass brown, appearing like a minute *Chaenotheca brunneola*; stalk about 0.12-0.20 mm long, 25-35 µm diam at base, 20-25 µm near head; conidial head 50-100 µm wide, spherical to slightly elongate or slightly flattened vertically; conidia spherical, brownish, papillose, about 6-8 µm diam; thallus thin or not apparent, membranous to slightly verrucose; possibly lichenized with chlorococcoid algae (examples: *McCune 25760*, in *Picea sitchensis* forest on Oregon coast; Cascade Range, *Rosso 891b*)



**unknown calicioid (*Leightonimyces* sp?)**

11b On moss, bark, or wood

13a Stalked bodies are hyphophores

*Gyalideopsis*

[Also consider *Gomphillus*, apparently unknown from w N Am.]

13b Stalked bodies are synnemata

14a On dried resin of conifers

unknown hyphomycetes (non lichenized)

14b On conifer twigs, branches, and trunks

15a On conifer twigs; lichenized. — Stalks 1-2 mm high and 60-145  $\mu\text{m}$  thick at the base and tapering to 24-40  $\mu\text{m}$  near the head; on conifer twigs in oceanic forests; se Alaska to Oregon



*Gyalideopsis epicorticis*

15b On Cupressaceae (e.g. *Calocedrus*, *Juniperus*); not lichenized. Forming thick felty mats of dark brown filaments; synnema short, thickish, dark brown; filaments short celled, beaded, variable in diameter (mostly 3-25  $\mu\text{m}$ )

*Metacapnodium*

[J. Rikkinen (2007, in litt.) conveyed the following. Many blackish fungi grow on resin and may be associated with resinicolous *Chaenothecopsis* species. These can include *Metacapnodium* species and other sooty moulds, but often the most conspicuous one is the synnematosus fungus that has been called *Pycnostysanus resinae* or *Sorocybe resinae* (apparently the latter is the correct name). The synnemata resemble those of *Pycnostysanus azaleae*, which is common on old fruits of *Rhododendron* in PNW forests. Information on several other genera and species, including e.g. *Cladosporium resinae* (the ‘kerosene fungus’) and *Strigopodia resinae*, can be found in various papers by Stanley Hughes and others.]

9b Stalked bodies are apothecia

18a Spores simple

19a Spores spherical

20a Mazaedium brown; spores brown. — Widespread and common

*Chaenotheca*

20b Mazaedium pale; spores pale

21a Stalk pale, often light yellow; thallus endophloedal; photobiont *Trentepohlia*. — Widespread, infrequently collected

*Sclerophora*

21b Stalk black or greenish yellow; thallus various; photobiont not *Trentepohlia*

22a Stalk greenish yellow; on soil in sheltered sites (beneath undercut banks, on tip-ups). — Widespread and common

*Chaenotheca furfuracea*

22b Stalk black. — Widespread, occasional

*Coniocybe*

19b Spores ellipsoidal or cylindrical

23a Spores cylindrical, appearing nonseptate or more usually with 1(-3) indistinct septa

24a Mazaedium dark, greenish tinged. — Over green algae and leprose lichens on overhanging, shaded cliffs or sheltered rootlets; rare

*Microcalicium arenarium*

24b Mazaedium brown; exciple generally yellowish pruinose — Widespread

*Chaenotheca laevigata*

23b Spores ellipsoidal or spherical, nonseptate

25a Ascocarp shaped like a bowling pin, cylindrical but with a submedian swelling containing the hymenium; thallus not lichenized. — Ascocarps black; spores extruded from the tip in a mazaedium; on bark, especially *Populus*

*Caliciopsis calicioides* (Ell. & Ev.) Fitzp.

25b Ascocarp swollen at the head like a typical pin lichen, the stalk without a swollen lower or middle section; thallus lichenized or not

26a Apothecia extruding a brownish spore mass (mazaedium)

27a Thallus lichenized or not; asci cylindrical; ascus wall thin and disintegrating early in development; spores various in shape; substrate various

*Chaenotheca*

27b Thallus not lichenized; asci clavate; ascus wall thick and persisting until spores are nearly mature; spores ellipsoidal; substrate conifer resin

*Bruceomyces*

26b Apothecia black, not forming a thick spore mass

29a Stalks whitish; hypothecium and stalk K+ green (LM)

*Chaenothecopsis viridialba*

29b Stalks black; hypothecium and stalk K-; thallus mostly endoxylic, not apparent, probably not lichenized. — Widespread and common on bare wood in sheltered microsites, especially snags and old wood buildings

*Mycocalicium subtile*

18b Spores septate

34a Apothecia without a well-developed mazaedium, the spores mostly retained in asci and not forming a powdery mass on the surface

35a Mature spores < 10 µm long; asci 35-45 µm long

*Chaenothecopsis*

35b Mature spores > 10 µm long; asci 70-100 µm long

36a Spores 1-septate or nonseptate, rarely 3-septate

*Phaeocalicium*

36b Spores 3-or more septate, rarely 1-septate

*Stenocybe*

34b Apothecia with a well-developed mazaedium

38a Mazaedium black; mature spores dark brown, ellipsoidal, 1-septate, the septum distinct

39a Stalks unbranched, very fine, < 0.5 mm diam; mainly on bark and wood, rarely on rock

*Calicium*

39b Stalks branched, erect, 0.5-2 mm diam and 2-20 mm tall; on rocks and wood, mainly wood in N Am. — Widespread but rare; sw BC to n Cascades, disjunct to Mexico, also in Asia and s hemisphere

*Acroscyphus sphaerophoroides*

38b Mazaedium dark or brown; spores with 1-3 indistinct septa, ellipsoidal-cylindrical

40a Spores light brown; exciple yellow pruinose

*Chaenotheca laevigata*

40b Spores pale, with a greenish tinge; exciple not yellow pruinose

*Microcalicium arenarium*

[See also *M. ahlneri*, with shorter stalks and mazaedium with sclerotized hyphae.]

## Key D: CRUSTOSE, APOTHECIA LIRELLAE OR IRREGULAR

1a Spores simple

2a Exciple dark brown to black throughout

3a On rock; thallus areolate, whitish to pale gray-brown. — Apothecia black, almost rounded or short lirellate, simple, straight to slightly curved; disk slit-like, not opening; medulla K+R (norstictic acid); Bering Strait to BC

*Lithographa tesserrata*

3b On wood; thallus mainly within the substrate

4a Apothecia persistently narrow and elongate; spores 8.5-13 x 4.5-6.5 µm; hymenium often with lengthwise partitions of dark sterile tissue. — On wood; w Cascades

*Ptychographa xylographoides*

4b Apothecia initially narrow, soon becoming triangular or quadrangular; spores 6-8 x 3-5 µm; hymenium simple or often irregularly partitioned as the exciple becomes gyrose. — Disk brown to black, with a shiny black margin; exciple black, even, incurved over the edges of the hymenium;

on wood; se Alaska, BC, Idaho, and Washington

*Elixia flexella*

2b Exciple light to dark brown at the edge, pale within; hymenium not partitioned

5a Epithecium brown, rarely olive brown, N-; exciple not pruinose; conidia slender, falcate. Apothecia elliptical to elongate, pale brown, brown, or dark brown; exciple hyaline or nearly so within; common on wood, widespread

*Xylographa*

5b Epithecium intensely greenish, N+ reddish; exciple pruinose; conidia bacilliform. — On wood of conifers, BC, Montana, and North Dakota s to Arizona

*Lignoscripta atroalba*

1b Spores septate

6a Spores muriform

7a Apothecia round to irregular. — Common on hardwoods; w Cascades

*Arthothelium (see Arthonia)*

7b Apothecia linear or elongate

8a Lirellae not typically curved; on wood; spores < 8 µm wide. — Thallus immersed, whitish; spores brown, 20-38 x 6-8 µm, 1(2) per ascus; BC

*Xyloschistes platytropa*

8b Lirellae elongate and often sinuose; on bark; spores > 8 µm wide. — Similar in external appearance to *Graphis scripta*, but apothecia often longer and/or broader, sometimes pruinose; spores ca 44 x 16-18 µm; on hardwoods; Coast Range

*Graphis pergracilis*

6b Spores only transversely-septate or 1-septate

9a Exciple lacking or weakly developed

*Arthonia*

9b Exciple present (carbonaceous, brown, or hyaline)

10a Spores 1-septate, constricted, colorless or finally darkening; on rock

11a On limestone; thallus ± thick (to 0.6 mm), chalky white to grayish, continuous to areolate; asci *Rhizocarpon* type, clavate; spores hyaline becoming violet black, remaining hyaline around the septum, 12-20 x 8-13 µm. — Apothecia angular to short-lirelliform; rare; RM in BC

*Poeltinula cerebrina*

11b On noncalcareous rock; thallus barely apparent, pale greenish gray to pale brownish; asci having an apical dome with a narrow ocular chamber; spores hyaline but old spores brown, unequally 1-septate, 17-23 x 9-12 µm. — Rare; sw Oregon

*Melaspilea interjecta*

10b Spores 3 or more septate, hyaline or darkening; substrate various (Note: some non-lichenized fungi with lirellae may also key here, such as *Hysterographium* and *Hysterium*)

12a Ascocarps visible as brownish black thalline cracks or slits; spores 3 septate

*Fissurina*

12b Ascocarps with well-developed labia bordering the slit or an exciple bordering the disk; spores 3- or more septate

13a Proper exciple thin, hyaline to brown, within a thalline margin. — Spores 5(7) septate, halonate; on *Picea* twigs and foliicolous on ericaceous shrubs and *Picea*; California to BC

*Enterographa oregonensis*

13b Proper exciple dark brown black, olive black, or carbonaceous, lacking a thalline margin

14a Mature spores brown. — On bark; coastal California to Oregon; apparently rare

*Phaeographis*

14a Mature spores hyaline

15a Spore walls thickened to form lenticular or rounded lumina, 7- or more septate; common w Cascades, more rarely inland, on bark of broad-leaved woody plants (especially conspicuous on *Alnus*)

*Graphis*

15b Spore walls not markedly thickened, with cylindrical lumina; 3 to 5 septate. — On hardwoods; w Cascades; a few species are known from rock; a number of species are non-lichenized

## Key E: CRUSTOSE, PERITHECIA

- 1a Photobiont blue-green (cyanobacteria) or a brown alga; on rock or barnacles (this can be very difficult to discern when the thallus is immersed in the substrate; in that case, the substrate is shell or soft calcareous rock.)
- 2a Seashore habitats; on rock or barnacles; ascocarps true perithecia
- 3a Photobiont a brown alga [*Petroderma maculiforme* (Wollny) Kuckuck]; ascospores 1-celled. — On rock, middle to upper intertidal, on rocky shores in central California
- Verrucaria tavaresiae*
- 3b Photobiont cyanobacteria; ascospores 1-2-celled. — Common
- Collemopsidium*
- 2b Other habitats; on rock; ascocarps true perithecia or not
- 5a Ascocarps perithecia; on rock in or by fresh water. — Widespread, but apparently not yet reported from the PNW
- Collemopsidium angermannicum*
- 5b Ascocarps actually perithecia-like apothecia; substrate various
- see *Pyrenopsis* and *Euopsis* below
- 1b Photobiont a green alga (but various in color, including reddish, yellowish, brownish, and green) or not apparent; substrate various
- 8a Spores simple
- 9a Spores small, 50-300/ascus; ascocarp an apothecium with narrow opening (perithecioid). — On decaying organic matter, rock, rotten wood, and lichens (especially *Peltigera*, *Solorina*, and *Baeomyces*)
- Thelocarpon*
- 9b Spores larger, 8 or fewer per ascus; ascocarp a true perithecium or not
- 10a Ascocarp with a pale or hyaline wall. — Spores large (mostly > 20 µm long) and thick-walled; ascocarp not a true perithecium but often with a narrow opening (perithecioid)
- Pertusaria*
- 10b Ascocarp with a brown, dark brown, or black wall
- 11a Paraphyses persistent, distinct; on soil or rock
- 12a On soil or rock. — Thallus dull greenish or soil colored, continuous, membranous; spores elongate ellipsoidal, 18-25 x 5-10 µm; rarely collected and inconspicuous but present in many open habitats, including the coast, steppe, and recently disturbed soil in forested areas
- Thrombium epigaeum*
- 12b On rock (calcareous). — Thallus endolithic; perithecia globose, with a fragile dark brown wall, semi-immersed or sessile; hymenial gelatin I-; paraphyses present in ostiole; asci broadly cylindrical to clavate; spores ellipsoid to narrowly ellipsoid, biseriate to irregularly arranged, elongate, 12-29 x 4.5-13 µm; photobiont chlorococcoid; Montana to Texas, e to Missouri
- Monoblastiopsis*
- 12b Paraphyses disintegrating; mostly on rock, a few species occur on bark
- 13a Thallus with black dots (other than perithecia) or columns of dark involucrellum like tissue, sometimes forming as narrow columns extending upward from the involucrellum; spores mostly < 18 µm long; thallus with a black basal layer. — Amphibious on siliceous rock; widespread
- Hydropunctaria*
- 13b Thallus lacking black dots other than perithecia or columns in the thallus; spores various; thallus with or without a black basal layer
- 14a Habitat rocks by the ocean; spores relatively short, usually < 12 µm long; medulla poorly differentiated or absent; thallus greenish or olive greenish. — Common in its restricted habitat
- Wahlenbergiella*
- 14b Habitat aquatic or terrestrial, but not exclusively marine; spores often > 12 µm long; medulla various; thallus color various. — Widespread and common
- Verrucaria*
- 8b Spores septate to muriform

- 17a Spores muriform; paraphyses or paraphysoids often disintegrating or lacking (but paraphyses often present)
- 18b Hymenial green algae present, included within the perithecium; spores brown
- 19a Thallus squamulose, on soil or rock. — Widespread, fairly common in arid areas and outcrops in RM
- Endocarpon*
- 19b Thallus crustose, on rock. — Fairly common in many habitats; widespread
- Staurothele*
- 18a Hymenial algae lacking; spores hyaline or brown
- 20a Thallus squamulose or minutely squamulose
- 21a Squamules slightly umbilicate, cortical cells not papillate (LM). — Thallus brown, dull or shiny; perithecia globose, black, ca. 0.25 mm diam, sparse and inconspicuous on the under surface of the squamules or on the stipe, sometimes on the upper surface; on HCl- rock; w Montana
- Henrica americana*
- 21b Squamules not umbilicate; cortical cells papillate (LM). — Thallus gray-green to brownish, with fine lobes to 1 mm long or smaller and granular to coralloid; perithecia rough, black, superficial; true exciple 3-layered, the outermost brown black, the inner two hyaline or light brown; on moss or soil over rock and on bark
- Agonimia*
- 20b Thallus crustose or poorly developed or not apparent
- 22a On bark, mossy bark, or rock
- 23a On calcareous and siliceous rock in many habitats, including alpine and shaded forest floor. — Spores hyaline or brown; rarely collected and inconspicuous
- Polyblastia* (including *Sporodictyon*)
- 23b On bark or mossy bark
- 24a Spores < 35 µm long. — Thallus smooth and continuous to uneven or granular, green when wet, dull green, brown, or gray green when dry; perithecia 0.15-0.35 mm diam; true exciple blackened; spores 27-35 x 10-16 µm, hyaline, muriform; on bark and wood of hardwoods
- Agonimia allobata*
- 24b Spores > 35 µm long
- 25a Spores 35-50 µm long. — Proper exciple visible from above as a broad, pale brownish ring around a brown pore, all of this surrounded by a greenish thalloid exciple; spores 35-50 x 14-19 µm, 4-8/ascus; on conifer twigs near the ocean
- Thelenella modesta*
- 25b Spores > 50 µm long, commonly to 100 µm. — Thallus inconspicuous, very thin, whitish; apothecia perithecioid, subglobose, < 0.5 mm diam, with dark gray, ± erose and fissured margin, with a small white-rimmed denticulate apical pore; spores 2/ascus, to 100 x 30 µm; on bark and mossy bark, coastal BC and OP
- Melanotopelia toensbergii* (
- 22b On mosses or lichens or soil, rarely rock; spores hyaline or pale greenish
- 26a Exposed portion of perithecium pale yellowish to orangish; spores 30-43 x 11-15 µm. — Paraphyses disappearing; hymenium I+B, then immediately wine red; spores I+ yellow orange; on soil and moribund mosses; arctic Alaska
- (Psoroglaena biatorella*
- 26b Exposed portion of perithecium black or dark brown; spores various
- 27a Ascus tip I-; photobiont chlorococcoid. — On lichens, mosses over tree bases, rock, and soil; steppe habitats and w Cascades
- Thelenella muscorum*
- 27b Ascus tip I+B; photobiont *Elliptochloris*. — Damp habitats in mountains to arctic-alpine; Washington and BC to Arctic
- Protothelenella*
- 18b Spores cross septate only, without lengthwise septa
- 32a Ascomata containing multiple chambers (locules)
- Tomasellia americana* (Willey) R. C. Harris

[Reported from BC, on *Sorbus* bark in Vancouver. See Harris (1975) for description. Apparently not a lichenized.]

32b Ascomata containing a single locule

33a Spores brown or dark brown

34a Spores 3-7 septate

35a Perithecia on greenish gray squamules; spores 7 septate

*Normandina pulchella*

35b Perithecia not associated with squamules; spores mostly 3-6-septate

36a Spore walls thickened, producing diamond-shaped or lens-shaped lumina. — Very common on hardwoods and shrubs, especially *Alnus rubra*; w Cascades

*Pyrenula*

36b Spore walls only slightly thickened, lumen ± cylindrical, not lens- or diamond-shaped

*Eopyrenula*

34b Spores 1-3-septate

37a Paraphysoids persistent, branched, anastomosing. — Apothecia perithecia-like or with a broader opening and lecidine in appearance; ascocarps immersed in larger areoles or forming hemispherical mound; lichenization of thallus questionable

*Lichenothelia*

37b Paraphysoids deliquescing or not developing, not apparent in mature perithecia

38a Spores 16-64 or more per ascus. — Spores < 10 µm long; parasitic fungus on many genera of crustose lichens; ascocarps perithecia, with one ostiole, sessile or immersed; periphyses present

*Muellerella*

38b Spores 8 per ascus. — Parasitic fungus on many genera of crustose lichens; ascocarps perithecia, with one ostiole, sessile or immersed

*Endococcus*

33b Spores hyaline or becoming brown when old

39a Spore walls conspicuously thickened to form diamond-shaped to rounded lumina, the end lumina close against the ends of the spore

*Pyrenula*

39b Spore walls not conspicuously thickened

40a Spores 5-septate or more, long and slender (>4X long as wide), > 25 µm long

41a Substrate moist calcareous rock, mostly semi-aquatic. — Thallus thin, smooth, continuous to cracked, deep gray green to green; perithecia sessile, simple to compound, to 0.5 mm wide; paraphyses persistent; spores hyaline, fusiform, (3)7(9)-septate, 25-32(45) x 5-7 µm; BC

*Pseudosagedia guentheri*

41b Substrate bark, moss, or soil

42a Spores not constricted, 28-38 x 4-6.5 µm, generally 5-septate; mature perithecia with flattened apex, becoming almost disk-like as the covering layer is shed. — Thallus gray-green; Colorado, Oregon

*Protothelenella pluriseptata*

42b Spores ± constricted at mid-septum, 25-35(50) x 5-8 µm, (4)6-7(9)-septate; mature perithecia about half immersed, partly covered by a thin layer of thallus. — Thallus thin, effuse, white to pale gray; perithecia to 0.4 mm broad; perithecial wall black, absent at the base; paraphyses simple to sparingly branched, about 1 µm wide, persistent; hymenium not interspersed with oil drops; photobiont *Trentepohlia*; on bark of hardwoods, mossy tree bases, or exposed tree roots; BC to s California

*Strigula stigmatella*

40b Spores 1-4 septate, relatively broad (usually ≤ 4X long as wide)

43a Paraphyses disintegrating, not recognizable in mature fruits

44a On bark

45a Thallus filamentous; spores 3-4(5)-septate. — On conifer bark

*Psoroglaena stigonemoides*

*Macentina stigonemoides* Orange

45b Thallus crustose and thin or not apparent; spores 1-3-septate

46a Spores > 25 µm long; paraphyses gelatinizing. — Spores 1-septate (sometimes 3-septate with age), slightly constricted at the septum, one cell shorter, broader, and more pointed than the other, 27-35 x 7.5-10.5 µm; frequent on *Alnus* and other hardwoods w Cascades

*Mycoporum antecellens*

46b Spores < 25 µm long; paraphyses gelatinizing or persistent. — Spores 14-21 x 4-6 µm, hyaline to sometimes browning with age, 1-septate, constricted at the septum or not, one cell broader than the other, with a gelatinous episporium; not lichenized; fairly frequent on *Alnus* and other hardwoods w Cascades

*Naetrocymbe punctiformis*

44b On rock or soil

49a Parasitic on rock- or soil-dwelling crustose lichens in various habitats, including steppe and alpine. — Perithecia raised, black, 90-120 µm diam; asci 31-50 x 12-15 µm I+ orange; perithecial wall dark brown; spores 1-septate (often not exactly equal-celled), 6-10(13) x 3-5.5 µm, 16-64 per ascus; not lichenized

*Muellerella pygmaea*

[Other species of *Muellerella* are likely as well, but poorly studied in our area.]

49b On rock

*Thelidium*

43b Paraphyses (or paraphysoids or pseudoparaphyses) persistent, not disintegrating

50a On soil, plant detritus, moss, moss over rock, or rock

51a Thallus parasitic on a yellow-green thallus (*Arthrorhaphis*); on soil. — Spores 1-septate or 3-septate; widespread

*Cercidospora*

[including *Neonorrinia trypethiliza* (Nyl.) H. Sydow reported from Colorado.

*Cercidospora* is a lichenicolous fungus that parasitizes many different genera.]

51b Thallus otherwise, on rock or plant detritus

52a Spores 3-septate

53a Thallus indistinct, the fungus apparently parasitizing green algal films

*Epigloea*

53b Thallus distinct, smooth to cracked areolate, glossy or dull, light grayish olive to deep olive brown, dark green, dark gray, or purplish gray.

54a Spores 20-30(40) x 5-8 µm. — Thallus pale ochre to deep brown or brownish green; perithecia to 0.5 mm diam, hemispherical, enveloped by a thalline exciple; Alaska and BC

*Segestria lectissima*

54b Spores 17.5-22(24) x (4)4.5-6.5 µm. — Thallus smooth to cracked areolate, glossy or dull, light grayish olive to deep olive brown, dark green, dark gray, or purplish gray; perithecia to 0.4 mm wide; paraphyses simple, coherent, persistent; on noncalcareous rock, fully exposed or deep shade, often in the supralittoral zone or ± permanently inundated; BC and Alaska

*Porina pacifica*

52b Spores 1-septate

55a Spores with a warted episporium; two cells of spore of equal size. — Spores uniseriate, with a thick septum; perithecia large (0.3-1.0 mm)

*Acrocordia*

55b Spores smooth, without a warted or granular episporium, two cells of spore equal or unequal in size

56a On algal films over lichens, bryophytes, rock, or plant detritus; spores < 15 µm long

*Epigloea*

56b On rock; spores > 15 µm long

57a Thallus brown to dark brown; paraphyses persistent and gelatinizing. — Thallus well developed, 150-300 µm thick, areolate; perithecia 0.2-0.3 µm diam, semi-immersed; exciple

dark brown, becoming hyaline at the base; involucrellum contiguous on the upper half to two thirds of the exciple, spreading below; spores hyaline, 1-septate, cells equal or one cell slightly wider, 16-22 x 4.7-6.2  $\mu\text{m}$ ; perispore thin, indistinct, not ornamented; photobiont *Trentepohlia*; known only from the type locality on coastal rock in San Luis Obispo Co., California

(*Naetrocymbe herrei*)

57b Thallus medium to dark gray; paraphyses gelatinizing. — Thallus very thin, rimose cracked to almost farinose; perithecia < 0.1 mm wide; spores hyaline to light brownish, 1-septate, with one cell slightly longer and narrower than the other, sometimes constricted at the septum, 16-18 x 6-7  $\mu\text{m}$

*Anisomeridium cf. carinthiacum*

50b On bark or wood

54a Perithecia orange to red brown, gray green, or dark pinkish gray; spores 16-23 x 3-5  $\mu\text{m}$ , 3(5)-septate

*Porina* (including *Segestria*)

54b Perithecia black; spores various in size, 1-3-septate

55a Spores typically 1-septate, but appearing 3-septate because of mid-lumina constrictions or wall thickenings; spores also constricted at the septum. — Pseudoparaphyses  $\pm$  simple, persistent; spores 2-6 celled, with thin septa, in more than one row; perithecia small (0.1-0.4 mm); on bark of conifers and hardwoods

*Arthopyrenia*

[Most species once placed in *Arthopyrenia* have been moved to various other genera. See also *Naetrocymbe punctiformis* (above) which can have paraphyses disappearing.]

55b Spores otherwise

56a Spores 3-septate

57a Spores > 25  $\mu\text{m}$  long

58a Spores about 32-37 x 10-12  $\mu\text{m}$ . — Perithecia black, single or sometimes in small groups, black but sometimes with a thin veil of bark cells at the base

*Anisomeridium macrocarpum*

58b Spores about 25-35 x 7-9  $\mu\text{m}$ . — Perithecia gregarious, large, brown black, becoming large; not lichenized; on bark

*Massarina corticola*

57b Spores < 25  $\mu\text{m}$  long

59a Spores asymmetrically septate, the part above the primary septum wider and about 2X as long as the lower; conical pycnidia usually present. — Perithecia to 0.25 mm diam, subconical to globose, immersed to  $\pm$  superficial; involucrellum scarcely differentiated; Spores 1-3 septate, 12-23 x (3)4.5-5(6)  $\mu\text{m}$ ; photobiont *Trentepohlia*; humid, shady bark, wood, polypores, and dead bryophytes

(*Anisomeridium polypori*)

59b Spores symmetrically septate or nearly so; conical pycnidia lacking. — Thallus thin, shiny, smooth to somewhat granular, pale brownish gray to pale greenish gray; spores 3-septate (sometimes septa obscure in water but clear in K), fusiform, hyaline; spores 16-24 x 3-5  $\mu\text{m}$ ; paraphyses simple to sparingly branched, coherent, persistent; on hardwoods and conifers; distribution poorly known but apparently widespread

*Pseudosagedia aenea*

[*Arthopyrenia cerasi* is also 3-septate and would key here.]

56b Spores 1-septate



60a Spores narrowly fusiform to acicular, 20-50 x 2-3  $\mu\text{m}$ . — Thallus not lichenized

*Leptorhaphis*

[*Leptorhaphis epidermidis* (Ach.) Th. Fr. occurs on *Betula* and has an I- hymenium. Other species in the genus have and I+ orangish or I+B hymenium.]

60b Spores broader (mostly > 3  $\mu\text{m}$ )

61a Spores with a warted epispore, the two cells of equal size. — Spores uniseriate, with a thick septum; perithecia large (0.3-1.0 mm)

*Acrocordia*

[*Acrocordia* includes both saxicolous and corticolous species. Several species are known from e N Am.]

61b Spores smooth, without a warted or granular epispore, the two cells usually unequal in size. — Spores 10-18 x 4-7  $\mu\text{m}$ ; paraphysoids long-celled and slender; usually on hardwoods; w Cascades, BC to California, widespread in temperate to subtropical areas

*Anisomeridium biforme*

## Key F: CRUSTOSE CYANOLICHENS WITH APOTHECIA

1a Spores septate; apothecia lecideine

2a Spores 4-15 celled, elongate; apothecia brown; on moss over rock, mossy bark, or tundra sod. — Arctic-alpine to s Oregon; rare

*Arctomia*

2b Spores 2-4 celled; apothecia black; substrate usually rock. — Widespread, occasional

*Placynthium*

1b Spores non-septate; apothecia lecanorine; growth form variable

3a Thallus blackish, gelatinous, nonstratified (homoiomorous), various in form

Key B, Page 3

3b Thallus olivaceous or brownish, stratified or not

4a Thallus olivaceous, stratified (heteromorous), rosetiform with very narrow elongate lobes; photobiont possibly *Rhizonema* (*Scytonema*-like; filamentous, with intercalary heterocysts and  $\pm$  paired false branches); on rock, often where moist or seepy. — Mainly in coastal states and provinces inland to Montana

*Vestergrenopsis*

4b Thallus reddish brown or dark brown, granular to minutely squamulose; photobiont *Gloeocapsa* with or without *Trebouxia* in the exciple; on dry rock or alpine sod. — Widespread but mainly oceanic to suboceanic

*Euopsis*

[*Pyrenopsis* is similar but has perithecia-like apothecia or somewhat expanded disks, a tendency to moniliform paraphyses in some spp, and clavate rather than cylindrical asci.]

## Key G CRUSTOSE, MARGINLESS

1a Spores muriform

*Arthothelium*

1b Spores simple to 1 or many septate

2a Spores thick-walled, often > 20  $\mu\text{m}$  long

3a Disk black; thallus gray to white. — Mainly on bark, rarely on rock; very common, especially w Cascades

*Mycoblastus*

3b Disk brown; thallus brown. — On bark; abundant w Cascades, uncommon in RM

*Japewia*

2b Spores thin-walled, usually < 20  $\mu\text{m}$  long, if thick walled then spores < 20  $\mu\text{m}$  long

4a Cephalodia present; apothecia dark brown to black; on rock. — Alaska s to BC

*Pilophorus dovrensis*

[Other species of *Pilophorus* may occasionally be found with sessile apothecia, but in *P. dovrensis* this is the typical condition.]

4b Cephalodia absent; apothecia and substrate various

5a Asci free standing among the paraphyses, not embedded in a hymenial gelatin

6a Asci I- or I+ reddish brown; thallus not apparent; spores simple, ellipsoid to pear shaped. — On bryophytes, especially *Cephaloziella turneri* and other leafy liverworts; apothecia whitish or blue green

***Mniaecia***

6b Asci I+B; thallus present but subtle; spores simple or septate. — Thallus developing below the cuticle of bryophytes, the cortex of lichens (e.g. *Peltigera*), or on other plant material, then rupturing the cuticle and forming soredia-like granules; spores generally 1-septate (occasionally more); apothecia stipitate or sessile

***Vezdaea***

5b Asci embedded in hymenial gelatin

7a Spores spherical — Thallus thin; apothecia convex to hemispherical, dark brown; spores 5-7 µm wide, 16 per ascus; on soil, rotten wood, and detritus; Colorado; probably widespread but very inconspicuous

***(Steinia geophana)***

7b Spores not spherical

8a Thallus with dull to bright fluorescent yellowish green UV+ soredia (rhizocarpic acid)

9a Spores simple; apothecia to 0.3 mm diam, yellow green to yellow orange. — On sheltered rock, soil, and roots; widespread but seldom collected

***Psilolechia lucida***

9b Spores (1-2)3-septate; apothecia to 1 mm diam, yellow green to brownish. — Nonsorediate parts of the thallus immersed and forming a pale gray stain in the substrate; on conifer trunks, Alaska and OP

***Chrysothrix chrysophthalma***

8b Thallus lacking yellowish green soredia

10a Spores septate with one cell enlarged; ascocarps orange brown, brown black, or black, often sessile, round to lobed or stellate. — Widespread, common, mostly on bark w Cascades or *Populus* e Cascades, but one species (*A. glebosa*) common on soil in steppe and alpine

***Arthonia***

10b Spores simple to septate and then with all cells of equal size; ascocarps pale yellow; bluish, gray to black or mottled, round to somewhat irregular in outline

11a On rock; thallus white to yellowish or yellowish brown, areolate on a black hypothallus. — Mostly on noncalcareous rock; common

***Calvitimela***

11b On various substrates but seldom on rock; thallus various but never areolate on a black hypothallus

12a Paraphyses branched. — Common, especially w Cascades

***Micarea***

12b Paraphyses simple or sparingly branched, though in some cases richly branched near the surface (epithecium)

13a On soil, moss, or humus; spores (8)10-14(16) x 3-5 µm; thallus P+O or R (pannarin and terpenoids). — Rare, arctic-alpine s to BC and Alaska

***Protomicarea limosa***

13b On rock (rarely on wood or rusted iron) and usually on shaded, sheltered, noncalcareous rock; spores 5.5-12 x 1.5-5 µm; thallus P- (no lichen substances). — Infrequent

***Brianaria***

## Key H: CRUSTOSE THALLINE MARGIN

### 1a Spores simple

2a Spores minute, generally  $< 5 \mu\text{m}$  long,  $> 32/\text{ascus}$

3a Thallus brown, olive, grayish, or whitish.

4a Thallus lacking a distinct cortex; asci with IKI+B tholus (but this dissolving at maturity). — On calcareous rock, grasslands to alpine

*Caeruleum heppii*

4b Thallus with a cortex clearly set off from the algal layer; asci lacking an IKI+B tholus. — On rock, less often on soil; widespread, common

*Acarospora*

3b Thallus fluorescent yellow-green

5a Asci with I- apical dome; hymenium usually  $> 100 \mu\text{m}$  tall. — Apothecia  $\pm$  immersed in the thallus; habitat mostly warm, low elevation sites to cold steppe; widespread, common

*Acarospora*

5b Asci with I+B and K/I+B apical dome; hymenium usually  $< 100 \mu\text{m}$  tall. — Apothecia  $\pm$  immersed in the thallus; habitat variable, but including montane, cold steppe, and alpine; widespread, common

*Pleopsidium*

[*Pleopsidium* is said to have an upper cortex that is prosoplectenchymatous in contrast to a paraplectenchymatous cortex of *Acarospora*. But the cortical cells in *Pleopsidium* are typically short, so that this difference can be difficult to see. Knudsen (2008) in the Sonoran Flora pointed out that the distinction also breaks down because some species of *Acarospora* have a prosoplectenchymatous upper cortex.]

2b Spores larger, generally  $> 5 \mu\text{m}$  long and  $\leq 32/\text{ascus}$

6a Spores thick-walled (wall usually  $> 1 \mu\text{m}$  thick, proportionately more like an orange peel than an avocado skin) at maturity, often very large

7a Cephalodia absent

8a Spores 1-8 per ascus, nonseptate, not fragmenting, medium-sized to large, generally thick walled

9a Apothecia urceolate; spores 8/ascus; epihymenium K-; thallus spot tests negative. — On bark and wood of conifers; BC, Idaho, and Montana

*Gyalectaria*

9b Apothecia without the above combination of characters. — On many substrates; a common, widespread genus with many species

*Pertusaria*

8b Spores 1 per ascus but fragmenting into two 1-celled spores, often difficult to find the two parts attached. — Medulla C+R, K-, KC+R, P-; spores huge (to  $200 \mu\text{m}$  long), very thick walled; usually on bark; widespread, infrequently collected

*Varicellaria rhodocarpa*

7b Cephalodia present. — On rocks and trees on the immediate coast; locally common

*Coccotrema*

5b Spores thin-walled (wall  $< 1 \mu\text{m}$  thick, proportionately more like an avocado skin than an orange peel), small or large

10a Apothecia  $\pm$  immersed or level with upper thallus surface

11a Apothecia *Pertusaria*-like, opening by a small pore; cephalodia present; on coastal trees and rocks; spores  $45\text{-}65 \times 23\text{-}39 \mu\text{m}$ , the spore wall  $2\text{-}3.5 \mu\text{m}$

*Coccotrema*

11b Apothecia with a  $\pm$  expanded opening; cephalodia present or absent; substrate and habitat various; spores small or large

12a Apothecial disk tan, yellowish, pale reddish, or pinkish; epithecium HCl-. — Common on streamside and lakeside rock, less frequent in other habitats

*Ionaspis*

12b Apothecial disk brown, black, or greenish-black; epithecium HCl+ green, purple, or HCl-

13a Spores  $30\text{-}45 \times 16\text{-}30 \mu\text{m}$

14a Cephalodia present; substrate rock. — Common in coastal BC and Alaska to rare in Oregon

- Amygdalaria*
- 14b Cephalodia lacking; substrate plant detritus, mosses, and tree trunks. — Common, widespread
- Megaspora*
- 13b Spores smaller; substrate various
- 15a Disk black or greenish black; epithecium HCl+ green or HCl-
- 16a Epithecium deep bluegreen. — Asci with I+B apical dome; spores 12-18 x 7-9  $\mu\text{m}$ ; hypothecium hyaline; thallus pale or darkening with the same pigment in the cortex as in the epithecium; on calcareous rock in stream beds
- Eiglera flavida*
- 16b Epithecium olive green, brownish green, dark brown, or black green
- 17a Epithecium dark brown, HNO<sub>3</sub>-, HCl-; paraphyses even, not moniliform. — Thallus brown to gray brown; apothecia immersed to raised, the margin colored like the thallus or whitish; spores 9-13 x 6.5-8  $\mu\text{m}$ ; coastal BC and Alaska
- Fuscidea intercincta*
- 17b Epithecium olive, greenish brown, black green, or bluish green, HNO<sub>3</sub> and HCl+ green or purple; paraphyses moniliform or not; spores various
- 18a Epithecium HNO<sub>3</sub>+ green and HCl+ green; paraphyses bead-like (moniliform); thallus some shade of white, olive, brown, or gray. — Asci with I- apical dome but with an I+B outer coat; common, mostly on rock and soil
- Aspicilia*
- [Two genera have recently been split from the large genus *Aspicilia*, *Circinaria* and *Sagedia*. Superficially similar in appearance, these are keyed together for the time being. *Sagedia* is nested within *Aspicilia*, so is unlikely to be maintained as a separate genus. *Circinaria* is also still in question. So far the split is partial: new combinations have not been made for all species in *Aspicilia* that will need been reassigned to these genera.]
- 18b Epithecium HNO<sub>3</sub>+ purple (and HCl+ purple?); paraphyses even, not moniliform; thallus brown. — Arctic-alpine on noncalcareous rock.
- Clauzadeana macula*
- 15b Disk some shade of brown, often reddish brown; epithecium HCl-
- 19a Thallus distinctly lobate
- Lobothallia*
- 19b Thallus areolate or verrucose
- 20a On mosses or detritus in late snow-lie habitats. — Apothecia with a pseudothalline exciple that initially bursts in a star-like pattern; thallus small warts to subsquamulose areoles; apothecia dark brown to chestnut brown, usually with a paler proper exciple; spores 18-24 x 5-7  $\mu\text{m}$ ; BC
- Ameliella andreaeicola*
- 20a On rock in various habitats
- 21a Medulla and ascus wall I+B; thallus areolate. — Fairly common on rock, mainly subalpine to alpine
- Bellemeria*
- 21b Medulla and ascus wall I-; thallus areolate, nearly flat or often developing into thick, warty protruberances ("isidia" in the literature) 0.3-0.7 mm diam. — Spores 17-30 x 9-15  $\mu\text{m}$ , with a thick perispore when young; spot tests negative or medulla C+R, KC+R (gyrophoric acid); on rock by water at low elevations to alpine; Alaska to Oregon, inland to e-central BC and Montana
- Koerberiella wimmeriana*
- [Sometimes parasitized by *Sagediopsis aquatica* (B. Stein) Triebel]
- 10b Apothecia adnate or bulging above thallus surface; widespread, common, on all substrates
- 22a Apothecia bright yellow. — On many substrates; widespread, common
- Candelariella*
- 22b Apothecia white, tan, green, brown, to black but not bright yellow
- 23a Spores large, > 30  $\mu\text{m}$  long; thallus typically white to cream or pinkish; hypothecium usually with a yellow layer in fresh material; thallus and or apothecia often C+R. — On many

substrates; widespread, common

*Ochrolechia*

23b Spores smaller, < 30 µm long; thallus color various; hypothecium rarely yellow; tissues C+ or C-

24a Exciple and hypothecium dark; thallus white; apothecia black, often with a white false-thalline margin; medulla I+B; thallus K-. — On rock; uncommon

*Porpidia speirea*

24b Exciple and hypothecium not both dark, or if so, apothecia and spot tests not as above

25a Thallus white, K+Y (atranorin); disk black or dark brown

26a Hymenium violet to violet brown, epihymenium dark violet brown to violet black; spores 9-15 x 5.5-8.0 µm; containing atranorin and alpha-collatolic, bourgeanic, and alectoronic acids in various combinations; on rock and bark. — Common, especially w Cascades

*Tephromela atra*

26b Hymenium pale or hyaline, epihymenium various; very common, especially on bark and wood, but also on rock, soil, and moss

*Lecanora*

25b Thallus white or another color, but if white then K- or disk not black

27a Thallus brown, reddish brown, dark gray brown, or olive brown

28a Thallus thin, membranous, never lobate; on mosses and detritus on acidic soils; exciple containing algae but externally often appearing lecideine; apothecia brown; spores usually nonseptate but occasionally 1-septate. — Widespread, subalpine to alpine, occasional in steppe

*Bryonora*

28b Thallus often fairly thick and ± marginally lobate; on rock or parasitic on rock lichens; apothecia black, brown, or reddish brown; spores nonseptate

29a Thallus of small granular, umbilicate areoles, red brown above and black below; apothecia small, to 0.3 mm diam, the disk red brown. — Spores 9-13 x 4-6 µm; on siliceous rock, mainly arctic-alpine s to Colorado and OP; apparently uncommon

*Euopsis granatina*

29b Thallus of larger areoles and lobes; apothecia usually larger, variously colored

30a Marginal lobes slight or lacking

31a Thallus with isidia or isidia-like structures, sometimes ± sorediate; thallus containing gyrophoric acid, C+R, KC+R. — Thallus some shade of brown; isidia 0.15-0.25 mm wide and to 0.5 mm tall, usually with paler tips, or developing small (to 0.5 mm diam) soralia; apothecia with swollen thalline margins, to 1.2 mm diam; spores 15-25(30) x 10-13(14) µm; disk initially punctiform, later broadening; on rock

*Rimularia gibbosa*

31b Thallus lacking isidia and soredia, C-, lacking gyrophoric acid, but K+R (norstictic acid) or K-, often UV+ (lobaric acid). — On rock and bark; fairly common and widespread

*Protoparmelia*

30b Marginal lobes distinct; not parasitic

32a Thallus K+Y to R, P+O; typically > 1 mm thick. — Thallus whitish gray to brown or blackish; apothecia sunken to sessile; disk brown to black; paraphyses moniliform; on rock and moss over rock; widespread, fairly common in dry exposed habitats

*Lobothallia*

32b Thallus K- (protolichesterinic acid), less often with pannarin (P+ orange) or psoromic acid (P+Y), typically > 1 mm thick. — Apothecia orange-brown, ± concolorous with the thallus; on rock; common, especially in dry areas e Cascades s through Great Basin

and Sierra Nevada

*Lecanora pseudomellea*

27b Thallus another color

33a Thallus KC+R, C+R

34a Thallus with prominent marginal lobes; cephalodia pinkish or brownish, conspicuous. — Apothecia with true thalline margin; common on rock w Cascades

*Placopsis*

34b Thallus without prominent marginal lobes; cephalodia lacking

35a Areoles growing on a bed of dark filamentous algae (*Stigonema*); apothecia with a thalline margin. — Thallus contains gyrophoric acid; spores 23-31 x 9-14 µm; on siliceous rocks near the coast, usually exposed; coastal BC and Alaska;

*Placopsis roseonigra*

35b Areoles not intimately associated with *Stigonema*; apothecia with a pseudothalline margin. — Common on rock w Cascades

*Trapelia*

33b Thallus KC- or KC+Y; apothecia with a thalline margin

36a Disk C+ strong Y, densely white pruinose; growing on rock. — Thallus generally thick, whitish; on siliceous rock, widespread and common

*Lecanora rupicola* and *L. bicincta*

36b Disk C- or if C+ strong Y then growing on bark or wood

37a Epithymenium K+ violet; spores often 1-septate; on rock or moss over rock; apothecial margin often lecideine; disk black. — Rare, Colorado to e Oregon

*Caloplaca oblongula*

37b Epithymenium K-; substrate and spores various; apothecial margin generally clearly lecanorine; disk color various

38a Medulla with chalky texture; lower cortex absent; ascus tips K/IKI+B throughout, without a K/IKI- axial mass; thallus slightly to distinctly lobate, on calcareous soil — Locally common in calcareous regions

*Squamarina*

38b Medulla with a loose or cartilaginous texture; lower cortex often present in part; ascus tips K/IKI+B with a K/IKI- axial mass; substrate various, thallus lobate or not, but the lobate species most common on rock. — Widespread and common

*Lecanora*

1b Spores septate

39a Spores dark brown or dark gray at maturity

40a Spores 1-septate

41a Thallus marginally lobate, yellow-green, brown, or gray. — Widespread and common, mainly in dry habitats

*Dimelaena*

41b Thallus not or only slightly lobate

*Rinodina*

[Several spp of saxicolous *Buellia* with a pale yellow green thallus, often C+O, KC+O, have a false thalline margin and will key here; e.g. *Buellia halonia* and *B. verruculosa*]

40b Spores multi-septate

42a Apothecia with a true thalline margin; spores multiseptate but not submuriform or muriform

*Rinodina*

42b Apothecia often with a false thalline margin; spores submuriform, with a few longitudinal hyphae. — Thallus white to gray, areolate; disk black, pruinose or not; on bark or rock

*Buellia alboatra*

39b Spores hyaline at maturity, sometimes pale brownish when overmature

43a Spores polarilocular. — Apothecia often yellow, orange or red, K+ purple or red; widespread and common on many substrates

*Caloplaca*

43b Spores not polarilocular

44a Spores with one to many transverse septa but no longitudinal septa

45a Spores 150-200  $\mu\text{m}$  long, 1 per ascus, fragmenting into two 1-celled spores. — Medulla C+R, K-, KC+R, P-; spores very thick walled; soredia often present; apothecia usually present, though often concealed by the soredia; on many substrates, but most often on acidic bark; widespread in PNW

*Varicellaria rhodocarpa*

45b Spores < 100  $\mu\text{m}$  long, not fragmenting

46a On rotten wood, mosses, or soil

47a On rotten wood or mosses

48a Thallus greenish; apothecia large, pinkish, often short stalked, the thalline margin prominent or disappearing; spores 1-3 septate, 15-25 x 4-6  $\mu\text{m}$ . — Thallus P+O, K+O, KC+O, C-, UV+ white (thamnolic and perlatolic acids); common in moist forests

*Icmadophila ericetorum*

48b Thallus whitish; apothecia minute (mostly 0.1-0.3 mm); thalline margin persistent; spores 1(3) septate, 11-21 x 4.5-7.5  $\mu\text{m}$ . — On bark, rotting wood, and litter; subalpine; Alaska s to Idaho and w Montana

*Anzina carneonivea*

47b On soil

49a Thallus restricted to small triangular lobes surrounding the apothecia and formed from the exciple; disk brown to black; spores 1-septate, 8-15 x 4-5  $\mu\text{m}$ . — Rare, dry areas in Alberta, BC, and Yukon

*Gyalidea asteriscus*

49b Thallus thin, membranous to granular, disk orange brown to paler and whitish; spores 3-septate, 12-24 x 5-9  $\mu\text{m}$ . — On soil; arctic alpine in RM

*Gyalecta foveolaris*

46b On bark, wood, or rock

50a Apothecia bright red. — Soredia lacking; thallus thick, yellowish, on siliceous rock; subalpine to mainly alpine, occasional

*Ophioparma*

50b Apothecia tan to brownish or pale grayish

51a On rock; spores 3-septate

52a Thalline exciple present; photobiont chlorococcoid

*Lecania nylanderiana* and perhaps other *Lecania* spp.

52b Thalline exciple lacking but the  $\pm$  immersed, concave apothecia may give the superficial appearance of a thalline exciple; photobiont *Trentepohlia* or *Leptosira*

53a Exciple black, carbonized; spores 25-31 x 4.5-5  $\mu\text{m}$ . — Photobiont *Trentepohlia*; so far known only on serpentinite from the type locality in n California

*Ramonia extensa*

53b Exciple not carbonized; spores 12-16 x 5-7  $\mu\text{m}$ . — Photobiont *Leptosira*-like; growing in damp shady places on siliceous rock; s BC

*Gyalidea hyalinescens*

51b On bark or wood; spore septation and habitat various

54a Thallus prominently isidiate, the isidia long and slender; spores becoming 3-5 septate, 35-50(65) x 5.5-7.5  $\mu\text{m}$ . — on bark and wood; common w Cascades

*Loxosporopsis corallifera*

54b Thallus lacking isidia; spores various

55a Hypothecium dark brown

56a Thallus thin and sometimes endosubstratal, containing calcium oxalate crystals; apothecia with poorly developed or thick thalline margin; containing roccellic acid

*Schismatomma*

56b Thallus episubstratal, not containing calcium oxalate crystals; apothecia

with well-developed thalline margin; containing psoromic acid; rare;  
immediate coast

*Sigridea californica*

55b Hypothecium hyaline to at most pale brown

57a Apothecia minute (0.1-0.3 mm diam), ± sunken in the thallus. — Thallus whitish, thin; apothecia reddish yellow, flat to convex, with whitish thalline margin; epithecium and hypothecium nearly hyaline; spores 1(3) septate, 11-21 x 4.5-7.5 µm; subalpine

*Anzina carneonivea*

57b Apothecia larger or not immersed or both

58a Apothecia ± immersed to erumpent from the thallus

59a Spores 3- to 7-septate, 15-35 x 3.5-5 µm apothecial margin with a distinct proper exciple and ± a thin thalline-like exciple. — Thallus thin and superficial to ± immersed; disk reddish brown to orange, gelatinous; photobiont *Trentepohlia*; on hardwoods; se Alaska

*Gyalecta fagicola*

59b Spores hyaline, (30)35-50(55) x 7-10 µm, with (7)9-11(12) transverse septa; apothecia with a torn, irregular margin. — Apothecia 0.4-0.8 mm diam; thallus spot tests negative; on smooth-barked hardwoods in sheltered, damp sites; coastal BC to Oregon

*Thelotrema petractoides*

58b Apothecia otherwise

60a Spores distinctly constricted at the septum; paraphyses with dark swollen tips, K+ reddish violet. — Example: on *Populus* bark in central Montana, *McCune 31518*



Unknown genus and species

60b Spores not distinctly constricted; paraphyses various

61a Conidia bacilliform. — Spores 1-septate, with thick swollen perispore in K; only one species known so far in PNW, *H. viridescens*, which has minute punctiform dark green soralia and sorediate apothecial margins and is P+R (argopsin); known from coastal Washington and Oregon on *Alnus rubra* and *Salix*

*Halecania*

61b Conidia sickle-shaped or curved filiform. — Spores (0)1-3(7) septate; most common on *Populus* and *Salix* bark; widespread but rarely collected

*Lecania*

43b Spores muriform or submuriform

62b Spores persistently hyaline or pale brownish, submuriform or muriform

63a On bark or wood

64a Apothecia with a persistent prominent margin which arches over the disk. — Spores with a thick episporium 18-22 µm wide; thallus K-; on bark and wood, w Cascades

*Thelotrema lepadinum*

64b Apothecia with indistinct or poorly developed margin, immersed in the thallus, in one species soon eroding into soredia. — Thallus K+ Y to R; spores 25-45 µm wide; on bark or wood, sometimes overgrowing mosses on those substrates, rarely on rock; widespread

*Phlyctis*

63b On rock, soil, or moss over rock or soil

66a Thallus thick, white, cream, or gray, C+R, KC+R; on rock, soil, or moss in dry habitats. — Common

*Diploschistes*

66b Thallus thin, dirty white, gray, or pinkish tan, C-, KC-; substrate various

67a Hymenium and asci I+B; photobiont *Cystococcus* or *Leptosira*-like; on damp, shaded, calcareous rock, often along creeks. — Coastal BC to nw Montana

*Gyalecta jenensis*



67b Hymenium and asci I- or orangish; photobiont *Trentepohlia*; substrate various. —  
Infrequent

*Gyalidea*

## Key I: CRUSTOSE LECIDEINE, NONSEPTATE SPORES

- 1a Spores thick-walled, medium-sized (> 12 µm long) to very large (> 40 µm long), hyaline or nearly so  
2a Spores very large, > 40 µm long. — Apothecia black; thallus white to gray; very common, especially w  
Cascades, mainly on bark, rarely on rock

*Mycoblastus*

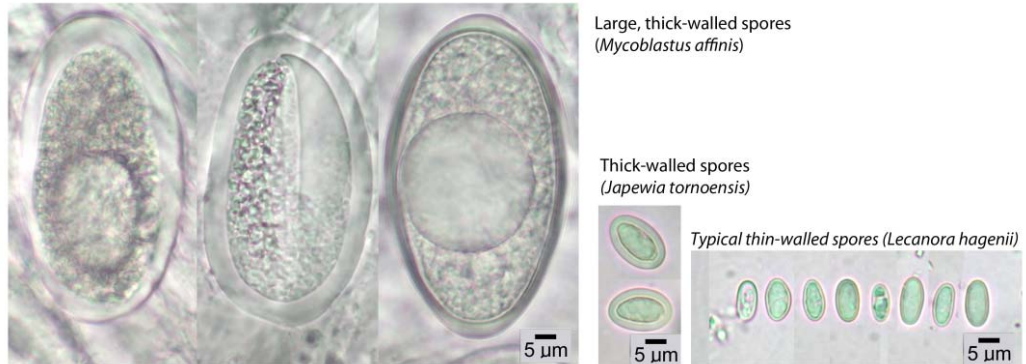
- 2b Spores medium-sized, < 30 µm long

3a Apothecia pale red brown to dark brown. — Thallus mid to dark brownish, more olive in deep shade;  
abundant on bark w Cascades, uncommon in RM

*Japewia*

- 3b Apothecia black. — Thallus pale grayish brown to pale olive brown, often with punctiform convex brown  
soralia; spores (10)13-16(20) x (8)9-12(14) µm

*Schaereria corticola*



- 1b Spores thin-walled, < 40 µm long, hyaline or dark  
4a Spores many more than 8 per ascus, minute (generally < 6 µm long)  
5a On bark or wood  
6a Spores 16-24 per ascus; apothecia black. — Uncommon

*Lecidea malmeana*

- 6b Spores >24 per ascus; apothecia variously colored

7a Spores fusiform. — Apothecia whitish to dark greenish brown; asci *Lecanora* type with a tholus  
with a broad cylindrical "masse axiale"; paraphyses branched and interconnected; exciple poorly  
developed, similar to *Scoliciosporum*; spores 6-8(10) x 2 µm; New England and se Alaska  
(Spribille 2010, on *Alnus*)

*Myrionora albidula*

[A monotypic genus, the species formerly treated in *Biatorrella* or *Scoliciosporum*. The species is  
similar in appearance to *Micarea peliocarpa*.]

- 7b Spores ± spherical

8a Exciple rudimentary, very thin to nearly absent; apothecia brown, black, or brightly colored. —  
Rarely collected

*Strangospora* and *Piccolia*

8b Exciple biatorine, poorly developed; apothecia pale yellowish or pinkish brown or whitish. —  
Infrequently collected; low elevation moist forests, especially on *Populus trichocarpa*

*Biatoridium delitescens*

- 5b On rock, soil, bryophytes, detritus, or decayed wood

9a Thallus areolate, distinct, dark to pale brown or gray; on rock. — Arctic-alpine to subalpine, very  
common

*Sporastatia*

- 9b Thallus thin or obscure; substrate various

- 10a Apothecia and thallus citrine yellow. — On gypsum rock or soil; not yet known in N Am n of New Mexico  
*(Biatorella clauzadeana)*
- 10b Apothecia and thallus not yellow
- 11a On soil, mosses, and decayed wood, apothecia pale brownish to light reddish brown; spores 6.5-8 x 2.5-3  $\mu\text{m}$
- 12a Apothecia with a narrow opening, perithecioid; exciple often yellow granular pruinose (LM)  
*Thelocarpon*
- 12b Apothecia with an expanded opening
- 13a Apothecia convex, 1-2 mm wide, reddish yellow to red brown; asci club-like, with a tholus. — On calcareous soils and mosses in rock cracks in sheltered habitats; apparently rare  
*Biatorella hemisphaerica*
- 13b Apothecia concave or plane, 0.1-0.3 (0.5) mm wide, pale orangish tan; ascus cylindrical thin-walled, without a tholus. — Widespread, rare, often on old fire sites; Montana, Oregon, e N Am  
*Sarcosagium campestre*
- 11b On rock; apothecia entirely black or dark brown with black margin; spores 3-6 x 1-2  $\mu\text{m}$ , larger (7-10  $\mu\text{m}$  long) in one species
- 14a Apothecia < 0.5 mm; exciple swollen and convoluted,  $\pm$  obscuring disc. — Widespread, occasional  
*Polysporina simplex*
- 14b Apothecia  $\geq$  0.5 mm wide; exciple hardly raised, thin, not covering disc, often excluded. — Widespread, occasional  
*Sarcogyne*
- 4b Spores usually 8 per ascus, always < 16 per ascus, generally > 6  $\mu\text{m}$  long
- 15a Spores dark, *Buellia*-like but non-septate or indistinctly 1-septate. — Thallus areolate; areoles blackish, shiny; spores 10-18 x 6-10  $\mu\text{m}$ ; epithecium brown, greenish brown, or green black; hypothecium brown, K+ violet; on noncalcareous rock; Arctic s to Oregon and New England  
*Orphniospora moriopsis*
- [See also *Rimularia*, with light brown spores when mature.]
- 15b Spores hyaline or pale (in a few cases light brown when mature or overmature)
- 16a Paraphyses free in water,  $\pm$  simple; AND tholus generally I+ blue (*Lecanora* type)
- 17a Asci free standing among the paraphyses, not embedded in a hymenial gelatin; thallus not lichenized; on decaying leafy liverworts. — Apothecia whitish or blue green.  
*Mniaecia*
- 17b Asci embedded in a somewhat coherent hymenium; thallus lichenized; substrate various, but rarely on leafy liverworts
- 18a Spores < 11  $\mu\text{m}$  long; on calcareous rock. — Thallus not apparent or chinky and white; apothecia to 0.8 mm diam, black, shining; epithecium blue-green; exciple interior reddish brown; paraphyses readily separating in water, simple or sparingly branched, with swollen tips; arctic-alpine calciphile s to Colorado  
*Cephalophysia leucospila*
- 18b Spores > 11  $\mu\text{m}$  long; substrate various. — Very common on both bark and rock, less often on mosses or alpine sod; widespread  
*Lecidella*
- [*Eiglera flavida* with aspicilioid apothecia may key here. The apothecia begin immersed but eventually form a raised, dark proper exciple. *Eiglera* has a bright bluegreen epithecium and proper exciple edge, largish spores, and occurs on calcareous rock along streams or in dry stream beds and other damp habitats.]
- 16b Paraphyses coherent in water, simple or branched; OR tholus mostly I-, occasionally I+ blue, or tholus lacking
- 22a Exciple dark brown or reddish brown to black throughout or nearly so
- 23a On bark, wood, litter, or organic-rich soil
- 24a Spores spherical or nearly so; thallus brown to olive brown. — Infrequent

- Schaereria dolodes*
- 24b Spores ellipsoid to subglobose; thallus color various
- 25a Thallus dark brown, granular, areolate, or isidiate. — Epithecium, hypothecium, and exciple brown; spores 9-14 x 5-6  $\mu\text{m}$ ; common on peaty soils, occasionally on bark or wood
- Placynthiella* (in part)
- 25b Thallus pale gray to yellowish brown, areolate
- 26a Spores > 12  $\mu\text{m}$  long; thallus pale grayish. — On conifer branches and cones; widespread, common on the immediate coast on Pinus, elsewhere infrequent
- Lambiella*
- 26b Spores < 12  $\mu\text{m}$  long; thallus various
- 27a Exciple K-. — Epithymenium and exciple carbonized; spores 7-12 x 4-5  $\mu\text{m}$ ; on wood of conifers, BC, NWT, and Washington (Spribille & Björk 2008)
- Lecidea scabridula*
- 27 b Exciple K+ violet. Thallus pale gray to yellowish brown, pale yellowish green, pale greenish white, or grayish white), K+Y, P+Y (alectorialic acid); hypothecium, lower hymenium, and exciple purplish brown to brown black, K+ violet; spores small (generally < 12  $\mu\text{m}$  long); on conifer bark or wood; most common e Cascades
- Pycnora*
- 23b On rock or mossy rock, rarely on bark
- 31a Thallus parasitic on *Lecanora rupicola* group; thallus dark brown-black
- Lambiella insularis*
- 31b Thallus not parasitic on *Lecanora rupicola* group; thallus color various
- 32a Cephalodia present; spores often almond-shaped. — Common in coastal Alaska and BC to rare in Oregon
- Amygdalaria*
- 32b Cephalodia absent; spores various
- 33a Apothecia concentrically fissured (gyrose) or with a central sterile button. — Exciple dark brown, thallus brownish to gray. containing stictic  $\pm$  norstictic acid or gyrophoric or psoromic acids or no lichen substances; widespread but infrequently collected
- Rimularia*
- 33b Apothecia not gyrose
- 34a Spores small (< 12 (14)  $\mu\text{m}$  long)
- 35a Exciple interior brown; spores subglobose to ellipsoid; exciple often contorted, gyrose, or umbonate; paraphyses branched and anastomosed
- Rimularia* and *Lambiella*; see key to *Rimularia*
- 35b Exciple interior pale brown to hyaline; spores ellipsoid or bean shaped; exciple edge circular to flexuose; paraphyses simple to sparingly branched. — Thallus some shade of brown, sometimes brownish-tinged white or gray; apothecia sessile or immersed; epithecium brown; exciple interior pale brown to hyaline; medulla mostly UV+, P- (divaricatic acid), less often UV-, P+R (fumarprotocetraric acid); on rock, except for one species on bark
- Fuscidea*
- 34b Spores medium to large (commonly > 12  $\mu\text{m}$  long), ellipsoidal; thallus white, tan, gray, gray-brown, greenish gray, or lacking; thalli not typically forming a mosaic
- 36a Thallus orange-brown, with blackening cracks and  $\pm$  immersed black apothecia. — Hypothecium brown; spores 9-16 x 5-9  $\mu\text{m}$ ; medulla K-, C-, KC-, P-; on noncalcareous iron-rich rock; widespread
- Tremolecia atrata*
- 36b Thallus otherwise
- 37a On various rocks in various habitats; exciple often dark but seldom carbonaceous
- 38a Apothecia minute, 0.1-0.2 mm diam, embedded in the thallus,

externally nearly concolorous with the thallus and thus superficially barely recognizable as apothecia. — On damp siliceous rocks

***Rimularia actinostoma***

38b Apothecia typically > 0.2 mm diam, embedded or sessile on the thallus, usually darker than the thallus. — Thallus white, gray, greenish gray, or not apparent; apothecia black or dark reddish brown, pruinose in some species; ascus with an I+B tip with darker staining tube surrounding an unstained channel; epithecium usually dingy green, olive green, or brown; widespread, common, one of the most common lecideoid crusts on rock in shady to partly exposed habitats

***Porpidia***

37b On calcareous rock or moss over rock, mostly subalpine and alpine; exciple dark, sometimes carbonaceous

40a On moss over rock. — Thallus granular, whitish to pale gray brown or ash gray; apothecia turbinate or substipitate; spores 10-17 x 3-4.5 µm, 0(-1) septate; outer exciple greenish, dark purplish brown within; hypothecium dark purplish brown; true exciple well developed in young apothecia but becoming excluded; arctic-alpine; Alaska

***Helocarpon crassipes***

[*Micarea incrassata* and *M. assimolata* area similar but they have an indistinct exciple and cephalodia are present.]

40b On calcareous rock

41a Thallus white, distinct. — Spores 18-27 x 9-14 µm; epithecium green to black green; medulla I+B

***Farnoldia micropsis***

41b Thallus a trace of whitish or ochre white or absent

42a Spores 10-15 x 5-7 µm; hymenium 55-70 µm high; apothecia often sunken in rock. — Alpine; Colorado

***(Melanolecia transitoria)***

42b Spores 13-30 x 7-14 µm; hymenium 70-130 µm; apothecia sessile. — Epithecium blue green to olive or brown black; hypothecium thick, dark brown, often intensely blue-greenish in upper part; exciple and hypothecium K+ purplish; medulla I- to I+B; widespread

***Farnoldia jurana***

22b Exciple light colored in thin section or if dark then hyaline to brownish or blue-greenish translucent internally, in some cases exciple highly reduced; on all substrates

47a Apothecia orange, yellow orange, red, or reddish brown, in some species K+ purple; spores narrowly ellipsoid

48a On calcareous rock or alpine sod; apothecia orange. — Widespread, fairly common

***Protoblastenia***

48b On bark and wood; apothecia orange-red to red, deep red, or brownish red

49a Spores < 14 µm long and < 8 µm wide, thin walled; epithecium K+R or K-

50a Thallus a whitish stain on hard decorticate wood, not lichenized. — Disk brownish red; epihymenium red brown, granular, POL+, K+ deep Y or orangish red diffusion; exciple brownish, POL+, K+ reddish; hypothecium hyaline; spores ellipsoidal, nonseptate, hyaline, 10-14 x 6-8 µm; common on hard snags in the Cascades, Coast Range, and near the coast

***Agyrium rufum***

50b Thallus thin or thick but lichenized

51a Epithecium K+R

***Ramboldia***

51a Epithecium K-

***Lecidea erythrophaea***

49b Spores 15-17 x 8-9 µm, thick walled; epithecium K- or brownish

(*Japewia carrollii*)

- 47b Apothecia usually brown, black, tan, beige, or whitish; spores commonly ellipsoid  
52a Parasitic on *Lecanora rupicola* and *L. bicincta*; thallus dark brown, generally < 1 cm broad. — Spores 6-12 x 4.5-7.5 µm, subglobose to broadly ellipsoid; very common e Cascades, less common w Cascades

*Lambiella insularis*

- 52b Not parasitic on *Lecanora rupicola* group; thallus various  
53a Thallus rust-brown, yellow-brown, dark brown or black  
54a Hypothecium hyaline to pale brownish or grayish  
56a Medulla I-, K+Y, P+O (miriquidic and stictic acids). — Thallus areolate, brown or dark brown, glossy, with a thick epinecral layer; apothecia dark brown black, to 2 mm diam; spores 12-17 x 4.5-6 µm; on siliceous rock; alpine, uncommon

*Miriquidica garovaglii*

- 56b Medullary spot tests otherwise

57a Thallus C+R, KC+R

- 58a Paraphyses delicate, branched, anastomosed (best seen in K); ascospores mostly > 15 µm long; ascus *Trapelia* type; apothecia with a thalloid veil in some spp. — Thallus variously colored, granular, areolate, verrucose, or squamulose; epithecium, hymenium, and hypothecium not all brown; exciple hyaline or pale brown; common and widespread on rock, soil, wood, moss, and plant detritus

*Trapeliopsis* and *Trapelia*

(*Trapeliopsis* is more or less squamulose and *Trapelia* is more strictly crustose. One common species of *Trapelia* on rock, *T. involuta* typically has a false thalline margin or thalline veil.)

- 58b Paraphyses simple or sparingly branched, anastomosed or not; spores mostly < 15 µm long (but larger in a few species); ascus *Lecidea* or *Porpidia* type; apothecia seldom with a thalloid veil

59a Spores 13-20(24) x (6)7-10(13) µm; asci *Porpidia* type (with an I+B tube in the tip)

*Immersaria athroocarpa*

- 59b Spores mostly < 13 µm long (to 17 µm long in one species); asci *Lecidea* type (outer coat I+B, apex thickened, apical dome I+ pale blue, with an I+B subapical ring)

*Lecidea*

57b Thallus C-

- 58a Exciple containing algae but externally appearing lecideine. Apothecia liver-brown, 1-3 mm diam; thallus red brown to dark gray brown, membranous; medulla K- or K+Y-R; spores 12-25 x 4.5-7 µm; on mosses and detritus on acidic soils; mainly subalpine to alpine, occasionally in steppe

*Bryonora*

58b Exciple lacking algae

- 59a Exciple turning under, becoming thin and reduced; asci *Bacidia* type. — Paraphyses simple or sparingly branched, their tips with a dark hood; epithecium blue-green-black, continuous with the thin blue-green exciple edge; thallus substances variable, often containing one or more of: atranorin, usnic acid, stictic acid, and bourgeanic acid; arctic-alpine

*Calvitimela*

- 59b Exciple usually well developed; asci *Lecidea* type. — Paraphyses simple or sparingly branched, often with a dark tip; widespread, common

*Lecidea* and related genera (*Fuscidea*, etc.)

54b Hypothecium some shade of brown

- 70a Exciple brown, the edge dark brown; thallus bullate-areolate, brown to black

brown. — Thallus K+Y or R (stictic and/or norstictic acids, rarely with gyrophoric acid); medulla I-; epithecium brownish; spores 5.5-10 x 4.5-6 µm; disk flat, black, to 0.5 mm; arctic-alpine

*Lambiella impavida*

70b Exciple hyaline to pale brown, the edge various, much reduced in a few spp; thallus various

71a Thallus yellow-brown, pale brown, or orange brown, thick, with a well developed black hypothallus; exciple much reduced or essentially absent. — Hypothecium pale brown; cortex K+Y or O, KC+R, C-, P+Y or R (alectorialic, protocetraric, and ± roccellic acid; the only lecideoid species containing alectorialic acid); a facultative parasite as a juvenile on *Sporastatia testudinea*; subalpine to alpine, on siliceous rock

*Calvitimela armeniaca*

71b Thallus brown, rust brown, or black-brown; thin or thick; hypothallus present or not; exciple usually distinct

72a Paraphyses and asci easily separating in K; asci without apical dome (tholus). — Uncommon

*Schaereria*

72b Paraphyses and asci coherent; asci often with apical dome. — Widespread and common

*Lecidea*

53b Thallus lacking or some shade of white, gray, olive-gray, cream, or greenish

73a Hypothecium orange, brown, or darker

74a On rock or on lichens on rock

75a Thallus forming whitish gall-like warts on *Lecidea* or *Porpidia* on rock. — Apothecia common, black, often with a central umbo or with irregularly thickened exciple; arctic-alpine s to Colorado

*Cecidonia*

75b Thallus and substrate otherwise

76a Exciple black, carbonized; hymenium or at least upper hymenium bright blue green or emerald green. — Widespread but not often collected

*Carbonea*

76b Exciple brown or hyaline, not carbonized; hymenium various

77a Spores (5)8-11(12) x (1.5)2-3(4) µm; epithecium black-green; thallus often lacking or dispersed areolate, gray; inner exciple I+B. — Common on siliceous rock, especially granite, mainly in continental climates; widespread

*Lecidea* (*L. auriculata*, *L. promiscens*, and related species)

77b Spores (6)7-9(10) x (2)3-4(5) µm; epithecium dark blue green or green brown; thallus continuous, rimose areolate, or dispersed areolate on rock or grayish to inconspicuous on wood; inner exciple I-. — Paraphyses basally branched; exciple persistent, thin, ± raised; thallus and apothecia K-, C-, KC-, P-, UV-; uncommon on rock and wood w Cascades

*Leimonis erratica*

74b On other substrates

78a On soil, detritus, rotten wood, tree bases or bryophytes on those substrates

79a Thallus UV+ white (perlatolic acid); apothecia with a thin pale rim. — On decaying wood, burnt wood, or tree bases

*Hertelidea botryosa*

79b Thallus UV- (perlatolic acid lacking); apothecia without a thin pale raised edge

80a Hymenium often with scattered dark blue-black or green-black granules that are K+ green and weakly POL+; apothecia with or without an apparent margin; asci otherwise. — Widespread

*Lecidea berengeriana* group  
(see also key to *Mycobilimbia*)

80b Hymenium lacking dark K+ green granules; apothecia lacking an apparent margin; asci *Psora*-like, with a K/I+ B tholus and darkly staining tube. — Arctic-alpine, rare

*Protomicarea limosa*

78b On trees and shrubs

81a Spores 13-16 x 6-7 µm; tips of paraphyses slightly clavate, olive brown pigmented. — On hardwood trees and shrubs, coastal BC s to Oregon

*Helocarpon lesdainii*

81b Spores 10-13 x 4-6 µm; tips of paraphyses not widened, hyaline. — Inner exciple and hypothecium brown to blackish brown. — On bark and wood; coastal states and provinces, rarely inland

*Lecidea albofuscescens*

[Weakly pigmented or moribund forms of *Lecidella elaeochroma* may be confused with this.]

74b Hypothecium hyaline, grayish granular, pale bluegreen, or pale brownish

82a Spores variously oblong or teardrop shaped and < 7 µm long; hymenium bluegreen; substrate sheltered soil, rock, roots, wood, or bark. — Widespread but seldom collected

*Psilolechia clavulifera*

82b Spores otherwise; hymenium various; substrate various

85a On bark, wood, humus, or other organic substrates

86a Thallus K+Y → R, white to gray, dirty-gray, or light tan. — Apothecia black, brown, tan, or mottled; spores 7-11 x 3-4 µm; thallus white to yellowish; occasional in moist forests e Cascades

*Lecanora cadubriae*

86b Thallus K-

87a Thallus distinct, C+R, KC+R, often sorediate, crustose to nearly squamulose; soredia when present often greenish or dark. — Widespread and common

*Trapeliopsis*

87b Thallus and spot tests various, but mostly C-; soredia sometimes present

88a Thallus yellowish and/or rim of apothecia yellowish, containing usnic acid. — Widespread

*Lecanora* sp, e.g. *L. luteovernalis* and *L. polytropa*

[A few species of *Lecanora* lacking algae in the exciple may key here.]

88b Thallus or rim of apothecia otherwise, not containing usnic acid

89a Apothecia brown, tan, pinkish tan, yellowish, or nearly colorless

90a Paraphyses branched and anastomosed; apothecia whitish; growing exclusively on the liverwort *Ptilidium*. — Spores 5.3-7.3 x 2.3-3.0 µm; PNW and Europe

*Puttea margaritella*

90b Paraphyses simple or sparingly branched; apothecia variously colored; substrate various

91a Excipular hyphae densely branched and entangled, with apical cells slightly thickened and brown; ascus *Micarea* type. — Widespread

*Myochroidea*

91b Excipular hyphae weakly branched and radiating, with apical cells not thickened, hyaline; ascus *Biatora* type. — Widespread and common

*Biatora*

89b Apothecia dark brown, greenish black, bluish black, or black

92a Spores minute, < 6 µm long; substrate conifer needles. — BC

and Montana

*Scoliciosporum abietinum*

92b Spores larger or substrate otherwise

93a Excipular hyphae densely branched and entangled, with apical cells slightly thickened and brown. — Ascus *Micarea* type; widespread

*Myochroidea*

93b Excipular hyphae weakly branched and radiating, with apical cells not thickened, hyaline

94a Ascus *Biatora* type. — Widespread and common

*Biatora* and *Lecidea*

94b Ascus *Porpidia* type. — Widespread

*Bryobilimbia*

85b On rock or soil, occasionally on moss over rock

95a Thallus K+Y → R, white to gray, dirty-gray, or light tan; on rock

96a Thallus white to gray. — Widespread, fairly common in RM

*Lecidea lactea*

96b Thallus light brown or tan. — Occasional in RM

*Lecidea syncarpa*

95b Thallus K+Y or K- or thallus lacking; on rock, soil, or moss over rock

97a Thallus distinct, C+R, KC+R, often sorediate. — Thallus crustose to nearly squamulose; soredia when present often greenish or dark; widespread and common

*Trapeliopsis*

97b Thallus and spot tests various, but mostly C-, sorediate or not

98a Thallus yellowish and/or rim of apothecia yellowish, containing usnic acid

*Lecanora* spp, e.g. *L. stenotropa* and *L. polytropa*

[A few species of *Lecanora* lacking algae in the exciple may key here.]

98b Thallus or rim of apothecia otherwise, not containing usnic acid

99a Thallus grayish, dark blue gray, blackish, or blackish brown; apothecia immersed and often having a false thalline margin (appearing like an *Aspicilia*), black; on rock. — Habitat subalpine to alpine; infrequent

*Schaereria fuscocinerea*

99b Thallus otherwise or if dark colored then apothecia otherwise; substrate various

100a Apothecia not completely black when moist (brown to purplish black); tholus amyloid (I+B); on calcareous rock. — Rare in PNW

*Clauzadea*

100b Apothecia generally black or very dark brown, wet or dry; tholus mostly not amyloid; substrate various

101a Epithymenium K+ violet; spores simple or occasionally 1-septate, oblong or narrowly ellipsoidal; on calcareous rock or *Grimmia* over rock. — Rare

*Caloplaca oblongula*

101b Epithymenium K- or K+ another color; spores simple, various in size and shape; substrate various

102a Exciple K+ magenta or red from yellow crystals in exciple interior. — Epithecium dark green to green black; exciple edge dark brown, pale within; hypothecium pale to dusky golden brown or dark



brown; spores 6-11 x 3-4.5 µm; apparently rare in PNW

*Adelolecia pilati*

102b Exciple K- or K+ brownish, greenish, purplish brown, or just slightly intensifying the coloration in water

103a Asci *Teloschistes*-type, with a thin, broad, I+B cap; apothecial and cortical pigments brown, N-, K- or K+ yellow brown; paraphyses mostly simple and ± free. — Common in coastal Alaska, decreasing s

*Fuscidea*

103b Asci usually otherwise; apothecial pigments often greenish, bluish, or purplish in water, K, or N; paraphyses often branched and coherent. — Widespread and common

*Lecidea*

## Key J: CRUSTOSE LECIDEINE, SEPTATE SPORES

1a Spores dark when mature (brown, dark greenish, greenish black, or olive brown), occasionally hyaline but then spores with a gelatinous halo and thallus saxicolous

2a Thallus yellowish, parasitic on *Baeomyces*. — Apothecia black; epithecium olive brown; exciple and hypothecium dark brown; spores 9-17 x 6-10 µm; thallus P+Y to O, UV+O; widespread

*Epilichen scabrosus*

2b Thallus otherwise or not apparent

3a Spores usually with haloes; paraphyses branched and coherent; saxicolous. — Widespread, common

*Rhizocarpon*

3b Spores without haloes; paraphyses ± simple; saxicolous or corticolous

4a Thallus not lichenized, saprophytic on wood, bark, lichens, fungi, or bryophytes, or perhaps parasitic on lichens; upper part of exciple differentiated from the basal part in cell structure and cell size

*Dactylospora*

[*Dactylospora* has about 20 lichenicolous species, about 37 species total. It has unitunicate asci with tips that have poorly developed I- caps and an outer I+ blue layer. Most species have transversely multiseptate spores, but some are 1-septate or submuriform. For keys, see *Lichenologist* 34:361-368 (2002) and *Bryologist* 107:357-362 (2004).]

4b Thallus lichenized or parasitic on lichens; exciple otherwise

5a Spores submuriform or muriform; widespread, common, especially on bark in moist forests

*Buellia* in part, or *Diplotomma* according to some authors

5b Spores 1-septate or 3-septate

6a Spore wall thin at the apices, otherwise unequally thickened such that the lumen of each locule appears ± pinched; on seashore driftwood and tree roots. — Thallus lacking to thick, gray, K+Y, P+ faint Y (diploicin and atranorin); apothecia dark brown to black, to 1.8 mm; spores 21-30 x 11-17 µm, often slightly curved; BC to Oregon

*Buellia fosteri*

6b Spores otherwise; habitat various. — Widespread and common

*Buellia* and *Tetramelas* (see *Buellia* key)

1b Spores hyaline, lacking haloes; corticolous or saxicolous

10a Spores polarilocular. — Thallus or apothecia K+ red or purple or, in species with a black disk, epithecium K+ purple or violet; widespread, common

*Caloplaca*

[In some species with brownish disks, e.g., *C. obscurella*, the epithecium is K-]

10b Spores thinly 1 septate, multiseptate, or muriform (but not polarilocular)

11a Spores 1 septate (sometimes oil drops give a false impression of >1 septa)

12a Spores unequally 2-celled, one end broader than the other

- 13a Thallus parasitic in the hymenium of lichens. — Distribution and abundance poorly known  
*Arthonia*
- 13b Thallus free living
- 14a Spores 10-15(17) x 3.5-7  $\mu\text{m}$ . — On conifer needles, small twigs, evergreen *Vaccinium* leaves, etc.; w Cascades in Oregon and n California  
*Fellhanera bouteillei*
- 14b Spores 8-10.5 x 4-4.5  $\mu\text{m}$ . — On lignum  
*Catillaria erysiboides*
- 12b Spores equally 2-celled or nearly so
- 15a Apothecia white, beige, pale yellowish, pinkish, or pale orangish, never blackening
- 16a Spores mostly < 4  $\mu\text{m}$  wide
- 17a Photobiont *Trentepohlia*. — On tree bases and mossy trunks, rarely on mossy rock; widespread, occasional in moist forests  
*Coenogonium*  
including *Dimerella*
- 17b Photobiont chlorococcoid. — 1-septate spp not yet reported from PNW  
*Absconditella*
- 16b Spores mostly > 4  $\mu\text{m}$  wide
- 21a Apothecia large, often > 2 mm diam, pinkish. — Widespread, common in oceanic to suboceanic climates  
*Icmadophila*
- 21b Apothecia smaller, < 2 mm diam, color various but not pink
- 22a On conifer needles and twigs; apothecia whitish, beige, or pale yellowish or pale orangish, hyaline in section; asci with amyloid dome with darker blue tubular ring structure; pycnidia inconspicuous, pale to brown. — Spores 1-septate, 9-15 x 3.5-6  $\mu\text{m}$ ; spot tests negative; thallus whitish, beige, pale gray green, or ochraceous; widespread  
*Fellhanera*
- 23b On bark and wood; apothecia pale or darkening; asci with I+B apical dome; pycnidia usually conspicuous and dark. — Moist forests, inland to w Montana  
*Cliostomum*
- 15b Apothecia brown to black; or sometimes pale but blackening in part
- 28a Paraphyses branched and anastomosed; substrate siliceous rock, mosses, or detritus
- 29a On mosses or detritus; hypothecium reddish brown, at least in part; apothecia black, convex. — Widespread, common  
*Micarea*
- 29b On siliceous rock; apothecia pale brown to blue black. — QCI, BC  
*Tylothallia biformigera*
- 28b Paraphyses mostly unbranched; substrate various
- 30a Thallus of convex areoles or squamules; apothecia black; on slightly to distinctly calcareous soil, rock, or other lichens, especially gelatinous cyanolichens. — Widespread, common  
*Tonia*  
(including *Kiliasia*)
- 30b Thallus various, but seldom of consistently convex areoles; apothecia brown, purplish black, or black; substrate various
- 31a Disk variously colored; apothecial section without bluegreen pigments; pycnidia often present. — Ascus tip with a completely amyloid tholus; paraphyses often with a strongly pigmented cap; on bark, wood or rock; widespread, occasional  
*Catillaria* s.l.  
(including *Catinaria*)
- 31b Disk purplish brown to black; epithecium or hypothecium or exciple green to blue green, K+ pure green, N+ purple red; pycnidia inconspicuous or lacking. — On bark, wood, or conifer needles, mainly in oceanic climates  
*Megalaria*
- 11b Spores more than 1 septate (multiseptate or muriform)
- 35a Spores muriform

- 36a Apothecia with pseudothalline margins, urceolate; photobiont *Trentepohlia*; on rock  
 37a Hymenium and asci I+B. — Arctic-alpine; rare  
*Gyalecta*
- 37b Hymenium and asci I- or I+ orangish or red. — BC, rare  
*Gyalidea*
- 36b Apothecia with only proper margin, urceolate or not; photobiont various; substrate various  
 38a On mosses and plant remains, usually on acid substrates  
 39a Spores 1(-2)/ascus, 50-140 x 20-50  $\mu\text{m}$   
 40a Apothecia black or dark brown, short stalked or sessile. — Arctic-alpine s to Alberta  
*Lopadium*
- 40b Apothecia golden yellow or tinged olive black, short stalked or sessile. — Coastal  
 Alaska s to BC  
*Brigantiaea fuscolutea*
- 39b Spores 2-8/ascus, 9-40  $\mu\text{m}$  long  
 41a Apothecia tan, orange, brown, orangish, or pinkish tan; spores 9-30  $\mu\text{m}$  long, submuriform to muriform; photobiont *Trentepohlia*. — Mostly arctic-alpine, uncommon  
*Gyalecta*
- 41b Apothecia black; spores 20-60  $\mu\text{m}$  long, muriform; photobiont chlorococcoid. — Arctic-alpine; Alaska, BC, Colorado, rare  
*Schadonia*
- 38b On bark, wood, or rock; spores 1 or 8/ascus  
 42a On rock. — Fairly common in coastal states and provinces  
hyaline-spored species of *Rhizocarpon*
- 42b On bark or wood  
 43a Spores small, < 20  $\mu\text{m}$  long. — Spores 8/ascus, hyaline; apothecia reddish(-black), < 1 mm wide; coastal states and provinces, rarely inland  
*Gyalideopsis*
- 43b Spores large, > 65  $\mu\text{m}$  long  
 44a Apothecia red. — Spores (30)50-80 x 20-35  $\mu\text{m}$ ; moist low-elevation conifer forests, inland BC s to Montana and Idaho, w to the Cascades  
*Brigantiaea praetermissa*
- 44b Apothecia black  
 45a Thallus superficial, distinct; on bark and wood; clearly lichenized with chlorococcoid algae. — Thallus pale greenish gray to olive or brownish; spores 1/ascus, hyaline or pale brown; apothecia black,  $\pm$  short-stalked; tips of paraphyses dark brown; exciple brown throughout, darker at edge; fairly common in moist conifer forests, especially w Cascades but also inland to w Montana  
*Lopadium disciforme*
- 45b Thallus immersed, indistinct; on wood of conifers and *Arbutus*; perhaps not lichenized or loosely associated with *Trentepohlia*. — Spores 90-140(170) x 22-40  $\mu\text{m}$ ; apothecia dark brown to black, initially closed, becoming urceolate, the edge entire to dentate; true exciple black; rare; so far known only from Scotland and Oregon  
*Xerotrema megalospora*
- 35b Spores only cross-septate, without lengthwise divisions  
 49a Spores 3-celled; asci subtly parasitic in the hymenium of *Lecidella* and some other saxicolous lichens. — Widespread  
*Arthonia intexta*
- 49b Spores otherwise, or if 3-celled then asci not parasitic on *Lecidella*  
 50a Asci often thick walled; paraphyses interwoven, netlike anastomosing; apothecia mostly black or with light-colored pruina; photobiont *Trentepohlia* (lecideoid Arthoniales)  
*Subgroup JI*
- 50b Asci seldom thick walled; paraphyses anastomosing or not; apothecia black or not, pruinose or not; photobiont usually chlorococcoid (*Trentepohlia* in a few)

51a Spores fusiform (cigar- or banana-shaped), mostly < 5(9)-septate, the ends often ± blunt or broadly acute or with one end pointed

**Subgroup J2**

51b Spores long and narrow, often needle-like, straight or curled, often > 4 septate with pointed ends

**Subgroup J3**

**Subgroup J1**

Cross-septate Lecideoid Arthoniales

1a Spores frequently and characteristically fragmenting into part-spores. — Apothecia black, round, irregular, or stellate; exciple dark, carbonaceous; mainly tropical, but in w N Am from coastal Alaska to California

**Bactrospora**

1b Spores intact or occasionally fragmenting, not routinely broken

2a Exciple thick, with deep radiate cracks or crenate. — Spores 3-septate, often with a thin perispore; paraphyses weakly branched; on calcareous rock or acidic litter; rare

**Sagiolechia**

2a Exciple thick or thin but not deeply cracked or crenate

3a Spores 11-17 µm long, somewhat thick walled, the locules ± rounded; pycnidia immersed to subimmersed; paraphysoids simple to sparingly branched, not or little anastomosed; thallus white or greenish, continuous and smooth or indistinct; subhymenium hyaline; hypothecium blackish. — Spores ovate to fusiform, often wider at one end, 3-septate; on bark or wood, conifers or hardwoods, ne N Am, California, and sporadic n along the coast

**Cresponea chloroconia**

3b Spores >17 µm long, thin walled, the locules rectangular; pycnidia in protruding warts; paraphysoids irregularly branched, ± anastomosed; hypothecium dusky or dark

4a Spores 17- 25 µm long, 3-septate. — On bark and wood; w Washington

**Lecanographa amylacea**

4b Spores > 25 µm long, 3- or more septate. — Mostly on bark or wood

**Lecanactis**

**Subgroup J2**

Multiseptate fusiform-spored crusts with proper exciple

1a Spores mostly non-septate. — Widespread and common

**Biatora**

1b Spores mostly septate

2a Spores < 3 µm wide

3a Spores 1.5-2 µm wide; disk yellow brown to dark brown; on bryophytes over soil. — Thallus membranous, weakly structured, with colonies of *Gloeocystis* (similar to *Gloeocapsa* in general appearance but a green alga); apothecia to 0.5 mm diam, initially immersed and closed, then opening to a deeply concave disk; disk yellow brown to reddish or rarely dark brown; spores 3-4 septate, 20-30 x 1.5-2 µm; Alaska, Michigan, and Europe

**Bryophagus gloeocapsa**

3b Spores 2-3 µm wide; disk black; on bark or wood. — Epithecium greenish black; spores 16-23 x 2.5 µm; thallus thin or disappearing

**Bacidia circumspecta**

2b Spores > 3 µm wide; apothecia black or otherwise

4a Proper exciple usually thin or reduced, poorly developed, or absent. — Paraphyses usually branched; photobiont green, often with paired cells ("micareoid"); apothecia white, gray, brown, bluish gray, or black; spores often variable in septation within a single apothecium; most often on wood, bark, or bryophytes; widespread and common

**Micarea**

[See *M. lignaria*, *M. peliocarpa*, *M. ternaria*, and *M. turfosa*]

4b Proper exciple usually distinct, though often turned under when apothecia are strongly convex

5a Spores mostly > 3-septate AND apothecia brown to black

6a Hypothecium dark brown or reddish brown

7a On noncalcareous rock; thallus some shade of brown. — Proper exciple concolorous with the disk; dark brown at edge, brown or mottled brown within; epithecium reddish brown to violet brown; hypothecium pale yellowish to red brown; spores transversely 5-7-septate, (17)35-48(50) x 4-7  $\mu\text{m}$ , often curved and often narrowly pointed at one end; thallus K-, C-, P-, UV-; on exposed steep rock faces; Arctic to se Alaska and New England

*Ropalospora lugubris*

7b On moss or soil; thallus some shade of gray or white. — Widespread, occasional

*Bilimbia sabuletorum*

6b Hypothecium pale or hyaline

8a Spores 3-5-septate, 11-18 x 3-5  $\mu\text{m}$ ; epithecium brownish, purplish, or greenish; hypothecium pale; thallus greenish or gray green; on *Populus* and *Salix*. — Great Plains and boreal

(*Arthrosporium populorum*)

8b Spores 3-8 septate, 20-35 x 3-5  $\mu\text{m}$ ; epithecium pale to dark brown or blue green tinged; hypothecium pale; thallus dark greenish to blackish, granular; on many kinds of bark and wood — widespread, especially common in urban and suburban environments

*Scoliciosporium chlorococcum*

5b Spores mostly  $\leq$  3-septate OR apothecia brown, tan, yellowish, pink, orangish, or hyaline

9a Apothecia dark brown to black; on exposed siliceous rock in subalpine or alpine. — Thallus unusual for *Stereocaulon* in being crustose and lacking cephalodia; thallus white or dirty white, warty areolate (field appearance similar to a *Lecidella* or *Buellia*); exciple and hypothecium dark brown; spores 3(5-7) septate, often slightly constricted at septa when fresh; se Alaska to Oregon Cascades

*Stereocaulon nivale*

9b Apothecia pale (tan, orangish, pink, yellow, brown, nearly hyaline) or black; substrate or habitat otherwise

10a On damp, shaded, rock, or moss over rock

11a Spores 12-16(-24) x 5-7  $\mu\text{m}$ , 3(4)-septate, occasionally with the middle cell divided lengthwise; apothecia pale tan to yellowish; with a pseudothalline margin; proper margin yellowish, becoming yellow brown or blackening; thallus gray, thin, membranous continuous to cracked and granular. — On damp siliceous rock; BC

*Gyalidea hyalinescens*

11b Spores 15-22 x 3-4.5  $\mu\text{m}$ , 3-septate; apothecia pale orange, broad; thallus thin, continuous to occasionally granulose. — On rock or mossy rock in damp, shaded overhangs; BC

*Gyalecta friesii*

10b Habitat otherwise; spores various; thallus usually thicker, membranous or granular or subareolate

12a Apothecia pink to orange, large, constricted at the base or short stalked; thalline margin often present; thallus greenish; on rotten wood. — Spores 13-27 x 4-6  $\mu\text{m}$ , 1-3-septate; widespread, common in moist conifer forests

*Icmadophila ericetorum*

12b Apothecia and thallus not as above; substrate various

13a Exciple composed of loosely tangled hyphae (visible at least in K), the surface sometimes tomentose. — Spores 3-septate, 12-18 x 3-5  $\mu\text{m}$ ; hypothecium dark brown; apothecia brownish to almost black, usually with a bluish tinge; exciple persistent and paler than the disk; n California to BC; on *Alnus rubra* and *Picea sitchensis*

*Byssoloma*

13b Exciple of radiating hyphae in a gelatinous matrix

14a Disk milky gray to dark gray or pure black. — Epithecium greenish or blue green, POL+; hypothecium hyaline; exciple thin, hyaline; spores mostly 3-septate, averaging 15-23 x 3-6  $\mu\text{m}$ ; fairly common in a wide range of habitats, w Cascades

*Micarea peliocarpa*

[*Micarea cinerea* is similar but has 7-septate spores. Both have epithecium and

exciple POL+ and C+ pink.]

14b Disk some shade of beige, brown, orangish, whitish, or yellowish

15a Disk minute (mostly < 0.25 mm diam), flat, urceolate, or concave

16a Ascus wall I+B and thin throughout, the tip not noticeably differentiated; spores  $\geq 16$  per ascus; apothecia minute to small; photobiont *Trentepohlia*. — On bark; rarely collected

*Gyalecta fagicola*

16b Ascus wall I- or rarely bluish, with an apical dome; spores 8 per ascus; apothecia minute to small; photobiont chlorococcoid. — On wood, rock, soil, or moribund mosses or lichens, sometimes where heavy metals have accumulated

*Absconditella*

15b Disk minute or larger, becoming convex

16a Apothecia arising as an appressed cushion of tissue, remaining appressed or eventually  $\pm$  constricted at the base. — Widespread, common

*Biatora*

16b Apothecia arising as a subspherical to spherical projection from the thallus, very soon constricted at the base to substipitate. — Widespread, common

*Mycobilimbia*

[See also *Waynea californica*: thallus squamulose, olive-green to brown green; spores 3-septate, 13-19 x 3-4  $\mu\text{m}$ ; soralia developing; on trees; California, rarely to BC.]

### ***Subgroup J3***

Multiseptate needle-spored crusts with proper exciple

1a Paraphyses anastomosing; spores curled, curved, or sigmoid; exciple reduced. — Apothecia light to dark brown or black; on bark, wood, rock, metal, etc.; widespread and common

*Scoliciosporum*

1b Paraphyses not anastomosing; spores straight, sigmoid, or spiraled; exciple usually well developed (LM)

2a Hypophores present, black, forming a flange with lateral projections; apothecia brown black to red brown, pale and translucent when wet, to 0.6 mm diam. — Spores 48-55 x 2-3  $\mu\text{m}$ , 15-20-septate; on mossy trunks or rocks in damp microsites, including the supralittoral zone; BC

*Gyalideopsis muscicola*

2b Hypophores lacking; apothecia various

3a On seacoast rocks

4a Spores 3-5 septate, 32-48 x 1.5-2  $\mu\text{m}$ ; thallus granulose isidiate; apothecia light brown to dark reddish brown, usually sparse or absent. — On shady coastal rocks, BC

*Bacidia scopulicola*

4b Spores 0-3-septate, 22-25(30) x 2.5-3(4.5)  $\mu\text{m}$ ; thallus cracked areolate; apothecia black, common. — Pycnidia common; se Alaska s to Oregon

*Herteliana alaskensis*

3b Substrate otherwise

5a Apothecia black or nearly so

6a Thallus yellow to yellowish green; on soil, mosses, and detritus. — Widespread; fairly common

*Arthrorhaphis*

6b Thallus white to gray or greenish, on bark or rock

7a Thallus whitish or some shade of gray; spores often > 35  $\mu\text{m}$  long, needle-like, straight to strongly spiraled; apothecia brown, tan, orange, or black; on bark, rock, or soil. — Widespread, common

*Bacidia*

7b Thallus usually dark green, gray, or gray green; spores < 35  $\mu\text{m}$  long, banana shaped or  $\pm$  straight; apothecia black to brownish; on bark or rock. — Widespread, common

*Scoliciosporum*

- 5b Apothecia brown, red, orange, pinkish, yellowish, or paler  
8a Spores extremely long, to 350 x 1-2.5 µm or even longer; apothecia deeply sunken, rough-edged craters containing a yellowish or brown disk. — Not lichenized

*Stictis*

- 8b Spores < 100 µm long; apothecia various but never deeply sunken in a rough-edged crater  
9a Apothecia deep red, with distinct, paler margin. — Thallus cream, pale yellowish, or yellowish green, of roundish corticate granules; epithecium K+ intense blue then violet; mainly on wood; uncommon in moist conifer forests

*Ophioparma rubricosa*

- 9b Apothecia tan, orange, brown, or darkening  
10a Spores 30-35(42) x 3-4.5 µm; paraphyses much branched and anastomosed. — Thallus pale greenish gray or gray, thin; exciple hyaline; epithecium red brown, K-; hypothecium brown, K-; commonly seen without apothecia but with groups of pycnidia, the pycnidia about 200 µm diam and to 300 µm tall, globose to elongate; conidia filiform, to 45(65) µm long; on bark or bryophytes or lichens over bark, especially on *Alnus rubra* at low elevations; Washington

*Fellhaneropsis vezdae*

- 10b Spores various; paraphyses simple or nearly so  
11a Apothecia tiny, pale, deeply concave; on bryophytes over soil. — se Alaska

*Bryophagus gloeocapsa*

- 11b Apothecia otherwise; substrate various. — Widespread, fairly common, especially w Cascades

*Bacidia* and *Bacidina*

Key K: CRUSTOSE, STERILE; ORANGE, YELLOW

- 1a Thallus K+ cinnamon brown, violet, violet blue, or purple-red; sorediate  
2a Thallus K+ cinnamon brown or orange brown. — Thallus dispersed to almost continuous, consisting of yellow heaped or branched granules, which sometimes develop into deeply concave soralia up to 1 mm broad and concolorous with the thallus, crater-like; lobes very short, rounded and lifting from the substrate; on soil, mosses, and loosely attached to noncalcareous rocks; apparently rare in RM and intermountain valleys  
*Lecanora reagens*
- 2b Thallus yellow to yellow-orange, K+ purple-red or violet blue  
3a On calcareous soil  
4a Soredia present on upraised thallus margins or laminal; thallus unlobed except in the largest specimens. — Widespread, common  
*Caloplaca erichansenii*
- 4b Thallus esorediate, becoming lobed. — Apothecia often present; spores one-celled; widespread and fairly common on soil; exposed habitats; w and Arctic N Am  
*Gyalolechia* (formerly in *Fulgensia*)
- 3b On another substrate  
5a Thallus wholly a leprose crust; on bark  
6a Thallus K+ purple or red, always completely leprose; apothecia never present. — Fairly common w Cascades  
*Caloplaca citrina*
- 6b Thallus K+ violet blue, areolate to completely leprose; apothecia fairly common, the margin sorediate. — On deciduous trees; widespread but rarely collected  
*Caloplaca chlorina*
- 5b Thallus corticate at least in part; substrate various  
7a Thallus minutely foliose or fruticose. — Widespread, common  
*Xanthoria*
- 7b Thallus crustose. — Widespread, common

1b Thallus K- or K+Y or O

9a Thallus vibrant lemon yellow to yellow green

10a Thallus UV-

11a Thallus P+O; soralia yellowish green. — On shaded, sheltered bark in humid sites, oceanic to suboceanic forests

*Cliostomum flavidulum*

11b Thallus P-; soralia bright yellow to yellow green or vivid green. — Soralia developing from and often replacing the grayish thallus; thallus P-, K±Y (atranorin, planaic acid, and usnic acid in soralia); on plant detritus, wood, and acid rock; few reports from the PNW

*Mycoblastus alpinus*

10b Thallus weakly to strongly longwave UV+ yellow, orange, or red brown

12a Thallus squamulose or areolate

13a On sheltered rock, areoles soon producing soredia

14a Areoles highly convex, the upper surface bursting into soralia; thallus containing epanorin, rhizocarpic acid, and zeorin. — On steep sheltered faces of iron-rich rock; widespread but rarely collected, probably overlooked

*Lecanora epanora*

14b Thallus leprose granular to granular areolate; thallus containing rhizocarpic acid. — Thallus often completely dissolving into soredia; apothecia uncommon, biatorine; disk pale yellowish or tan; on sheltered rock, soil, and roots; widespread

*Psilolechia lucida*

[Sterile *Arthrorhaphis citrinella* can be similar, but *P. lucida* is more diffuse and powdery overall, and more directly saxicolous, while *A. citrinella* forms small dense colonies, usually on moss over rock.]

13b On soil; areoles or squamules esorediate. — Apothecia frequent, lecanorine; disk brown; spores minute, many per ascus; widespread, fairly common

*Acarospora schleicheri*

12b Thallus granular or completely leprose; spores > 4 x 2 µm

15a Thallus usually in small patches

16a On bark or wood; thallus granular — On bark and wood; widespread, fairly common

*Chaenotheca chrysocephala*

16b On soil or moss over rock; thallus areolate or often dissolving into soredia. — Spores multiseptate, borne in black apothecia; widespread; fairly common

*Arthrorhaphis*

15b Thallus usually extensive, completely leprose

17a Thallus dull yellowish; substrate bark or wood. — Thallus UV+O

*Pyrrhospora querneae*

17b Thallus bright yellow or yellow green; substrate various

18a Thallus bright yellow or fluorescent yellow with a greenish tint; containing calycin, vulpinic, or pinastric acids; rhizocarpic acid lacking

19a Thallus containing vulpinic acid. — Producing tiny stalked mazaedia; widespread

*Chaenotheca chrysocephala*.

19b Thallus containing calycin or pinastric acid or calycin + vulpinic acid. — Widespread and common

*Chrysothrix*

18b Thallus vibrant yellow-green; containing rhizocarpic acid or vulpinic acid

20a Spores borne in a stalked mazaedium; thallus UV+ Y or pale O, containing vulpinic acid and pulvinic acid; spores nonseptate, 2.5-5 µm; photobiont *Stichococcus*. — On acidic soil and tree roots in sheltered microsites; widespread, common

*Chaenotheca furfuracea*

*Coniocybe furfuracea*

20b Spores borne in an apothecium, 4-6 x 2-2.5 µm; thallus UV+O or red-orange, containing rhizocarpic acid; photobiont usually *Trebouxia*-like, rarely *Stichococcus*. — On sheltered rock and soil; circumpolar s at least to Oregon, Idaho, and Montana

*Psilolechia lucida*



[Sometimes indistinguishable by eye from *Chaenotheca furfuracea* when sterile]

9b Thallus pale yellow, yellow, or deep yellow, long-wave UV-

27a On soil, plant detritus, or moss. — Widespread and common

*Candelariella*

27b On bark or wood (rarely rock)

28a Thallus granular isidiate to isidiate, pale yellow or greenish yellow

29a Propagules are gray green to yellow green coralloid granules; esorediate. — On deciduous trees with nutrient-rich bark; uncommon w Cascades

*Bacidia rubella*

29b Propagules are pale yellowish isidia on a continuous to rimose-cracked thallus. — On bark or rock, coastal Alaska s to Washington Cascades

*Pertusaria flavocorallina*

28b Thallus otherwise

30a Thallus yellow to deep yellow, generally corticate at least in part. — Widespread, common

*Candelariella*

30b Thallus pale yellow to yellow green, sorediate

31a Pycnidia present, black, irregular, 0.2-0.6 mm diameter. — Thallus pale yellowish, yellowish white, or pale greenish yellow, granular or scurfy; thallus K+Y, P+ pale Y, C- (atranorin and caperatic acid); apothecia pale yellowish to brownish; on conifer bark; coastal states and provinces inland to Montana

*Cliostomum leprosum*

31b Pycnidia lacking or inconspicuous

32a Thallus thin and chinky or becoming entirely sorediate, pale yellow gray to yellow-green; C+ orange (usnic and thiophanic acids, zeorin). — On smooth bark and wood, especially driftwood on the coast, also inland on fences and conifers

*Lecanora expallens*

32b Thallus entirely sorediate, C- or C+ orange

33a Thallus dull yellow, with a blackish delimiting prothallus; K+ orange-yellow or K+R in spots (incipient apothecia), P- or somewhat yellow (containing isoarthothelin and thiophanic acid), UV+ orange. — On bark and wood; California to BC, mainly near the coast, often in exposed sites

*Pyrrhospora querneae*

33b Thallus yellow green to sulfur yellow (usnic acid), with a white cottony prothallus, K+Y, P+Y (also containing atranorin, porphyritic acid, and zeorin). — On rock, walls, and bark; not yet reported from N Am

*(Haematomma ochroleucum* var. *ochroleucum)*

## Key L: CRUSTOSE, STERILE, CYANOLICHENS

1a Thallus with elongate fan-tipped lobes

See *Placynthium*, *Steineropsis*, and *Vestergrenopsis*, stratified cyanolichen key

1a Thallus squamulose or leprose, without elongate lobes

*Fuscopannaria*

## Key M: LEPROSE OR ECORTICATE CRUSTS, NOT YELLOW-ORANGE

Green photobiont; leprose or completely ecorticate thallus

Morphological difference among most of the species are so subtle that TLC is essential for confident identification.

1a Thallus with granules organized into weak to distinct marginal lobes. — Widespread and common

*Lepraria*

- 1b Thallus not at all lobate
- 2a Thallus producing white sporodochia with masses of conidia, otherwise thallus indistinct but containing chlorococcoid algae. — On bark, BC and se Alaska  
*Cheiromycina*
- 2b Thallus leprose, lacking sporodochia
- 3a Thallus P+O or R
- 4a Thallus K+Y or K+R
- 5a Thamnolic acid present; thallus K+ deep Y, P+ deep O
- 6a Thallus minutely fruticose, at least in some places, though the leprose granules are often confluent and not obviously differentiated into a stalk. — Thallus typically only a few mm tall, whitish, containing atranorin and thamnolic acid in the most common chemotype  
*Lepraria subalbicans*
- 6b Thallus truly leprose  
*Lepraria*
- 5b Thamnolic acid absent; thallus K+ weak or strong Y, P+O or R
- 7a Thallus containing oxypannaric acid (or 4-oxypannaric acid and 4-oxypannaric acid 2-methyl ester); C+Y or C-, K- to K+Y or O, P+ brownish red  
*Lepraria diffusa*
- 7b Thallus lacking oxypannaric acid; C-, K- or K+, P+O or P+R
- 8a Thallus yellowish green. — Thallus P+Y to R (fumarprotocetraric acid + atranorin); apothecia occasional yellowish or often darkening with gray mottles to nearly black; common on conifer trunks w Cascades  
*Cliostomum flavidulum*
- 8b Thallus whitish, grayish, or greenish gray  
*Lepraria*
- 3b Thallus K-
- 9a Thallus bluegreen or bluish gray, similar in color to *Fuscopannaria cyanolepra*. — On soil and soil over rock; California to s Oregon  
*Leprocaulon adhaerens* and *L. santamonicae*
- 9b Thallus some shade of white, cream, or gray
- 10a Thallus truly leprose; apothecia never found  
*Lepraria*
- 10b Thallus often with confluent soralia but not truly leprose; apothecia sometimes present
- 11a Thallus and soralia intense but pale green, forming small patches on conifer bark; common in mountains w Cascades — Thallus P+Y to R (fumarprotocetraric acid); on conifers  
*Cliostomum flavidulum*
- 11b Thallus and soralia dull greenish gray; common in large cities. — Apothecia with soreciate margins often present; thallus P+R (fumarprotocetraric acid); on bark, wood, rock, rubber, etc. in cities and polluted areas  
*Lecanora conizaeoides*
- 3b Thallus P- or P+Y
- 14a Thallus K+Y
- 15a Thallus P+ pale Y or P-, KC- (atranorin)
- 16a Thallus pale yellowish or yellowish gray. — Oceanic to suboceanic, occasional  
*Cliostomum leprosum s.l.*
- 16b Thallus some shade of white, greenish, grayish, or bluish gray. — Widespread and common  
*Lepraria*
- 15b Thallus P+Y, KC+ reddish orange (alectorialic acid) . — Widespread and common  
*Lepraria*
- 14b Thallus K-
- 17a Thallus UV+ bluish white or UV+O.
- 18a Thallus UV+ bluish white. — Thallus dull greenish gray, usually bluish tinged, rarely brownish orange; granules to 0.1 mm diam; thallus with divaricatic acid and zeorin, traces of nordivaricatic acid; P-, rarely K+ purple when an anthraquinone pigment is present, C± pink, KC+ pink; on shaded bark, rarely on noncalcareous rock; w N Am, primarily coastal states and provinces

- 18b Thallus UV+ orange or orange red. — Coastal  
*Lepraria pacifica*
- 17b Thallus UV-  
19a Thallus P+Y, containing psoromic acid . — Widespread and common  
chemotype of *Lepraria neglecta*
- 19b Thallus P-, psoromic acid lacking  
20a Thallus containing usnic acid (though yellowish tint often very subtle) — On rock;  
common w Cascades  
*Leprocaulon knudsenii*
- 20b Thallus lacking usnic acid  
21a Thallus C+ rose or violet-tinged pink (gyrophoric and/or 5-O-methylhiascic acid); on  
bark and wood  
*Biatora aureolepra, B. chrysantha, & B. chrysanthoides*  
[Also giving a C+R reaction, reported from Arizona (Tønsberg 2004) and California  
(Kocourkova et al. 2008) is *Lepraria lecanorica* Tønsberg. It contains lecanoric acid.]  
21b Thallus C-. — Thallus bluish green, changing to pale greenish gray in the herbarium;  
on rock and moss in sheltered sites; widespread  
*Botryolepraria lesdainii*

## Key N: OTHER STERILE CRUSTS ON BARK OR WOOD OR ON BRYOPHYTES OVER BARK OR WOOD

- 1a Pycnidia raised, black, barrel-shaped. — Pycnidia black or white pruinose, with extruding white pycnospores  
(like a frothy mug); pycnospores banana shaped or ellipsoidal, one or both ends often pointed, 12-16 x 2-3.5 µm;  
thallus thin, whitish gray; on sheltered bark of conifers; BC to Oregon, w Cascades  
*Lecanactis megaspora*
- [Many *Micarea* species also have prominent raised pycnidia, often with pale tips]
- 1b Pycnidia lacking or if present then ± immersed  
2a Thallus blackish brown or brown  
3a Thallus of minute, brown coralloid granules or isidia; esorediate. — Usually on wood, bark, or soil;  
widespread, common  
*Placynthiella*
- 3b Thallus ± areolate with discrete soralia  
4a Soralia orange-yellow when fresh, fading to cream in herbarium, punctiform; containing gyrophoric  
acid. — On *Alnus* near coast; Washington  
*Opegrapha sorediifera*
- 4b Soralia yellow, brown, or greenish, discrete or confluent; with or without gyrophoric acid  
5a Medulla UV+ bluish white (thallus usually greenish in shade but dark brown in exposed sites)  
6a Soralia whitish to brown. — Very common on hardwood trees and shrubs w Cascades  
*Rinodina disjuncta*
- 6b Soralia yellowish to brown. — On bark; see below  
lobaric acid chemotype of *Japewia subaurifera*
- 5b Medulla UV-  
7a Soralia often of mixed yellow-brown and brown granules; soralia almost discrete or sometimes  
becoming confluent; thallus often KC+ flash yellow or orange (secalonic acid and derivatives,  
eumitrin); otherwise spot tests negative. — Thallus brown, greenish brown, or greenish in deep  
shade, of discrete to somewhat fused areoles; fairly common in moist conifer forests, Coast  
Ranges inland to c Montana  
*Japewia subaurifera*
- 7b Soralia dark brown but abrading to green; soralia C+R, KC+R (gyrophoric, 5-O-methylhiascic  
and ± lecanoric acids). — Spores broadly ellipsoid to subglobose, 13-16 x 9-12 µm, with a  
gelatinous epispore; on *Alnus* and *Betula*; Alaska to California, BC and Montana

- Schaereria corticola*
- 2b Thallus some shade of gray, white, dirty white, greenish, yellowish, or olive gray or in some cases thallus not apparent (greenish brown thalli should be tried both here and the opposing lead)
- 9a Thallus isidiate
- 10a Isidia (thallus granules) roundish
- 11a Thallus yellowish to cream; thallus UV+. — On wood (usually) or bark; coastal states and provinces inland to Montana
- Ophioparma rubricosa*
- 11b Thallus dark to pale gray green, bluish gray, or gray brown; thallus UV-
- 12a Thallus P- or P+ pale Y, K- or K+ pale Y
- 13a Thallus K-, P-, KC- (thallus granules often K+ violet under LM, but appearing K- with usual method). — Thallus dark gray or bluish gray; most often on *Populus* bark, also on conifers and other trees and shrubs; widespread
- Rinodina colobina*
- 13b Thallus K+ pale Y or K-, P- or pale Y, KC- (atranorin, sometimes only a trace). — on hardwoods, less often on conifers; rare in PNW
- Bacidia rubella*
- 12b Thallus P+O or R, K- or K+R
- 14a Thallus K+R (norstictic acid). — On old wood and mossy rock in dry climates
- Sagedia mastrucata*
- 14b Thallus K-. — Thallus of separate to heaped corticate granules, the granules bursting or eroding to produce greenish soredia; thallus P+R (argopsin), KC+R (gyrophoric acid), K-, UV-; not yet known from PNW
- (Micarea leprosula)*
- 10b Isidia cylindrical; thallus white to gray or yellowish
- 15a Isidia very fine (< 0.2 mm diam) and long (up to 2 mm long). — Thallus K-, P-, C-, UV+ white (divaricatic acid); fairly common on bark mainly on the immediate coast, also in the Coast Range, Alaska to Oregon
- Loxosporopsis corallifera*
- 15b Isidia mostly > 0.2 mm diam, short or long; or isidia < 0.2 mm diam but short and granular
- Pertusaria, and Caloplaca*
- [Several isidiate species of *Caloplaca* may key here when sterile, including *C. chlorina* (on bark or rock, isidiate or lobulate to ± bluish sorediate) and *C. furfuracea* (on bark; isidia short, granular, gray).]
- 9b Thallus sorediate (or blastidiate)
- 17a Soralia elongate-linear or elliptical; thallus ± immersed within substrate
- 18a Thallus P- or P+ weak Y, containing gyrophoric or placodiolic acid
- 19a Thallus K-, P-, C+R, KC+R (gyrophoric acid). — Soralia elliptical or round; rare but locally abundant in humid coastal areas, mostly on *Alnus* but also on conifers and shrubs; BC and Washington
- Opegrapha fumosa*
- 19b Thallus K+Y, P- or weak Y, C-, KC- (atranorin and placodiolic acid). — Soralia discrete, rounded to ellipsoid, flat to crateriform, often distinctly bluish; on hard and smooth wood of conifers; w Montana and BC, infrequent
- Buellia arborea*
- 18b Thallus K-, K+Y, or K+R P+Y, O or R, C-, KC- (stictic, norstictic, or fumarprotocetraric acid)
- 20a Soralia pale cream gray to ash gray or dark bluish gray. — Thallus containing atranorin, norstictic acid, ± stictic acid group; soralia K+Y or K+R, sometimes weakly so, P+Y, O, or R; soralia pale yellowish when abraded (when strongly yellowish pigmented then C+O, UV+O); widespread but infrequently collected
- Buellia griseovirens*
- 20b Soralia cream, brown, pale greenish, or pale yellowish green. — Thallus containing fumarprotocetraric or stictic acid; soralia K-, K+Y, or K+ brownish, P+ deep Y, O, or R; widespread and common
- Xylographa*
- 17b Soralia ± roundish or diffuse; thallus conspicuous

22a Thallus grayish to dark gray or dark gray green; soredia C+R, KC+R

23a Soralia P+R (argopsin). — Not yet known from PNW

*(Micarea leprosula)*

23b Soralia P-. — Soralia cream, brownish, greenish, or dark gray green; on detritus, mosses, soil, rotten wood or on hard wood; widespread and common

*Trapeliopsis*

22b Thallus not dark gray, or if dark gray, then soredia C-; on bark or wood

25a Thallus KC+ instantly rose-violet, K- or dingy brownish, P±R (picrolichenic acid, with or without protocetraric acid), giving a distinctive bitter taste with a touch of the tongue (often with a delayed reaction of 15 seconds or more). — Common w Cascades, rare inland to w Montana

*Variolaria amara*

25b Thallus spot tests in some other combination; thallus without strong bitter taste

26a Thallus K+Y or K+R

*Group N1*

26b Thallus K- or faintly K+Y or K+ brownish

27a Thallus or soredia KC+R, C+R, P-

*Group N2*

27b Thallus and soredia KC- or KC+Y, C-

28a Thallus or soredia P+Y to O or R (fumarprotocetraric acid, protocetraric acid, argopsin, or pannarin)

*Group N3*

28b Thallus and soredia P- or faintly P+Y

29a Thallus or medulla UV+ blue white (perlatolic acid, sphaerophorin, alectoronic, or lobaric acid) or UV+ pink

*Group N4*

29b Thallus and medulla UV- or weak yellowish

*Group N5*

### *Group N1*

Thallus K+Y or K+R

1a Cephalodia to 1 mm diam, dark pink to gray, irregular or hemispherical, sometimes becoming constricted at base. — Thallus creamy to pale yellowish or greenish white; soredia cream to orangish or pinkish; soralia K+ deep Y to O (stictic acid), KC- or still Y, P+Y, UV- or UV+ weak whitish; common on conifers and hardwoods on the immediate coast

*Coccotrema*

1b Cephalodia absent

2a Thallus K+Y to O or R, P+Y or O (norstictic, stictic, or thamnolic acid)

3a On mossy bark or mossy rotten wood; thallus greenish with concolorous soredia, P+O, K+O, KC+O, C-, UV+ white (thamnolic and perlatolic acids). — Usually fertile but sometimes seen sterile; widespread, common in oceanic to suboceanic forests

*Icmadophila ericetorum*

3b On bark or wood; thallus another color or with contrasting soredia; thallus K+ deep Y to O or R (norstictic and/or stictic acid or thamnolic acid), P+Y or O, KC-, C-, UV-

4a Thallus indistinct to sparsely areolate, with discrete pale green to grayish or grayish blue soralia. — Thallus containing atranorin, chloroatranorin, zeorin, and stictic acids; on deciduous trees and shrubs at low elevations w Cascades

*Rinodina stictica*

[*Xylographa vitiligo* may key here if the soralia are not particularly elongate. It commonly develops blue-gray soralia from a barely apparent thallus and contains stictic acid.]

4b Thallus definite, white, cream, or gray; soralia large, scattered or confluent, granular or powdery, whitish, gray, or yellowish soredia

5a Thallus K+Y to R (norstictic acid)

6a Soralia dark bluish gray, contrasting with the whitish gray, pale greenish gray, or pale brownish gray thallus. — Prothallus indistinct or distinct and brownish or bluish; on bark and wood; widespread but infrequently collected

*Buellia griseovirens*

6b Soralia pale greenish white, pale yellowish white, or grayish, similar in color to the thallus  
7a Soredia powdery to granular; soralia pale greenish white to yellowish white. — Soralia roundish, elongate, or irregular; prothallus white, distinct; mainly on hardwood trees and shrubs; common

*Phlyctis argena*

7b Soredia coarsely granular; soralia grayish or whitish gray. — Although usually on moss over rock, rock, or plant detritus over rock, this species occasionally appears on wood in dry habitats; widespread

*Aspicilia mastrucata*

5b Thallus K+ deep Y to O (stictic or thamnolic acid)

8a Thallus K+ deep Y (thamnolic and elatinic acids); soralia forming powdery mounds or becoming confluent, very pale yellowish green, yellowish, or yellowish gray; cephalodia lacking. — Thallus thin and continuous or becoming warty, pale gray or whitish; se Alaska to Oregon; on bark

*Loxospora elatina*

8b Thallus K+Y to O (stictic or norstictic acids); soralia discrete; cephalodia normally present. — On bark and wood; coastal

*Coccotrema*

[See also *Xylographa vitiligo* (above), which may key here when the soralia are hardly elongate.]

2b Thallus K+Y, P-, P+ pale Y (atranorin), P+Y (alectorialic acid), or P+ orange-red (fumarprotocetraric acid)

9a Thallus P+ orange-red (fumarprotocetraric acid)

10a Thallus often indistinct but with large whitish to pale grayish or pale bluish gray soralia. — Thallus K+Y, KC-, P+R or P- (atranorin, zeorin, and usually fumarprotocetraric acid); usually on mossy bark, less often on mossy rock or soil; OP

*Megalaria pulverea*

10b Thallus distinct; soralia various

11a Thallus grayish or bluish gray, smooth to uneven, becoming granular sorediate, the soralia diffuse or well defined; containing atranorin and fumarprotocetraric acid (K- or K+ brownish). — On bark; se Alaska

*Violella fucata*

11b Thallus whitish, of small corticate granules or areoles, often with discrete soralia; containing atranorin and fumarprotocetraric acid (K+Y). — On bark and wood; widespread but infrequent in PNW

*Ramboldia cinnabarina*

9b Thallus P-, P+ pale Y, or P+Y (atranorin and/or stictic or alectorialic acid)

12a Thallus yellowish tinged (usnic acid present, KC+Y)

13a Thallus containing usnic acid and atranorin, ± trace of stictic acid; cortex and soralia K+ pale Y, KC+ still Y, C-, P+ pale Y, UV-. — Areoles flat to ± convex, contiguous when well developed, with punctiform yellowish soralia; on bark of shrubs, low elevations to (more often) subalpine; Alaska to Oregon

*Biatora flavopunctata*

13b Thallus containing thiophanic and usnic acids, zeorin, C+ deep Y, O, or R; K+Y, P-. — Thallus greenish to pale greenish yellow; on bark and wood; widespread

*Lecanora expallens*

12b Thallus not yellowish tinged from usnic acid

14a Thallus K+ strong Y, P+ strong Y (alectorialic acid)

15a Thallus pale brownish gray to brown; soralia pale greenish to cream colored, becoming confluent and brownish. — Usually on rock but occasionally on trees; distribution poorly known

*Fuscidea praeruptorum*

15b Thallus pale grayish white, pale greenish white, yellowish green, or pale yellowish brown,

with concolorous or paler soralia

16a Areoles yellowish green, to 0.6 mm diam, often completely dissolved into soredia. — On wood of conifers, rarely bark; Alaska to Manitoba, South Dakota and Colorado

*Pycnora sorophora*

16b Areoles grayish white to yellowish brown or pale greenish white, to 1 mm diam, usually not completely dissolved into soredia. — On bark; Alaska, BC, and Montana

*Toensbergia leucococca*

14b Thallus K- or K+Y, P- or P+ weak Y (atranorin), alectorialic acid lacking; thallus various but not incised-subsquamulose

17a Soralia initially linear, marginal on the areoles, sometimes beneath the slightly raised edges of the areoles. — Thallus light colored, gray white to gray green, containing atranorin and zeorin; soralia whitish; on both conifers and hardwoods, especially *Alnus*; ne US, se Canada, Great Lakes, rarely in PNW (BC)

*Rinodina degeliana*

17b Soralia roundish or broadly confluent

18a Soralia punctiform, usually < 0.2 mm diam, occasionally confluent into larger sorediate patches. — Containing atranorin and zeorin; on eutrophic bark of hardwoods, often in cities; lowlands w Cascades

*Rinodina griseosoralifera*

18b Soralia becoming larger

19a Thallus dissolving into soredia. — Thallus containing atranorin, zeorin and porphyritic acid; on bark or rock; BC, Washington, Colorado

*Haematomma ochroleucum* var. *porphyrium*

19b Thallus with yellowish sorediate patches

20a Soredia farinose, in flat to hemispherical mounds, usually discrete; apothecial margins generally not sorediate. — Thallus whitish to gray, thin, continuous to areolate or slightly warty; apothecia rare, disks pale greenish brown; thallus containing 2-O-methylsulphurellin and atranorin ± usnic acid; spot tests negative or K+ weak Y; BC to n California

*Lecanora jamesii*

[The sorediate form of *L. allophana* (f. *sorediata*) will also key here.]

20b Soredia granular, in excavate roundish patches coalescing into larger, continuous patches; apothecial margins becoming sorediate. — Thallus thin to thick, with yellowish sorediate patches; apothecia *allophana* type, rare; thallus K+Y, KC-, P- or pale Y, C-, containing atranorin only; widespread in more continental climates of N Am, fairly common in PNW

*Lecanora impudens*

## Group N2

Thallus or soredia K- or faintly K+Y, **KC+R**, **C+R**, P-

1a Thallus white or cream, pale greenish white, or pale grayish white

2a Thallus long-wave UV+ Y or O (xanthones)

3a Apothecia usually present, though often obscured by soredia; spores 2-celled in ascus but fragmenting into two 1-celled parts, each cell thick walled and large, resembling a *Pertusaria* spore; containing lecanoric acid. — Usually on bark; widespread, infrequently collected

*Varicellaria rhodocarpa*

3b Apothecia usually lacking; spores simple; containing gyrophoric and lecanoric acid. — Thallus thin; on bark; n temperate to boreal, mostly e N Am

*Ochrolechia arborea*

2b Thallus UV+ weak white or UV-

4a Soralia irregularly elongate, sometimes roundish but appearing in short rows; thallus thin, membranous. — On *Alnus*, conifers, and shrubs; rare but locally abundant in humid coastal areas, BC and Washington

*Opegrapha fumosa*

4b Soralia roundish; thallus thin or thick

5a Thallus membranous, with discrete soralia; thallus C-, only soredia C+R; apothecia commonly present, pruinose to pruinose-scabrous, margins C-; contains variolaric acid. — On bark and wood, mainly conifers; widespread in PNW

*Ochrolechia gowardii*

5b Thallus thin or thick and verrucose, C+R (even when thin); apothecia rare; margins C+R (cortex); lacking variolaric acid. — On many substrates; widespread, common

*Ochrolechia androgyna s.l.*

1b Thallus gray, olive, greenish, or brownish

6a Thallus gray, olive brown, or brownish

*Trapeliopsis*

[*Rinodina sheardii* may key here when the C+O substance is present in the soralia.]

6b Thallus greenish, continuous, granular, subareolate, or of small coalescing areoles; soralia paler than the thallus

7a Soredia UV+ orangish, C+ persistent orange. — Thallus granular, yellowish green to pale yellow green, often coalescing into a leprose crust; apothecia whitish to pale straw, margin soon disappearing; spores 9-14 x 3.5-4.5  $\mu\text{m}$ , (0)1(-3) septate; on bark, wood, and bryophytes, rarely on rock, in sheltered microsites; Alaska to Oregon, mainly near the coast

*Micarea xanthonica*

7b Soredia UV-

8a Soralia raised, punctiform, convex to almost spherical, (0.1-)0.2(-0.4) mm diam. — Thallus of inconspicuous greenish to greenish brown areoles; soralia punctiform, convex, pale buff to pale greenish buff; apothecia rare, pinkish brown, with nonseptate ascospores; soralia KC+R, C+R (gyrophoric acid); on shady rotten wood and bark and wood of acid-barked trees including *Alnus* and *Quercus*, also on bryophytes over roots, tree bases, and rotten wood; coastal BC to Oregon, occasional

*Trapelia corticola*

[*Micarea coppinsii* Tønsberg, known from se Alaska, would key here. It forms small roundish soralia developing from sparse, discrete, grayish or grayish green strongly convex areoles; soralia green of flecked with darker bluish green (N+R pigment under LM), to 0.3(0.5) mm diam; soredia fine, 12-25  $\mu\text{m}$  diam; thallus with 5-O-methylhiassic acid (major) and traces of lecanoric and gyrophoric acids, C+O or R, KC+O, K-, UV-, P-.]

8b Soralia irregular or initially punctiform but coalescing, 0.2-1.6 mm diam

9a Soralia irregular, pale green, to 0.2 mm diam. — Thallus appearing similar to nonlichenized granular green algae; when fertile with S-shaped, multiseptate ascospores; on hardwood bark in urban areas; thallus KC+R, C+R (gyrophoric acid, but usually in low concentrations so spot tests weak or failing); California to BC, w Cascades

*Scoliciosporum sarothamni*

9b Soralia greenish white, sometimes orange pigmented, initially convex and discrete, often 1 mm diam or more, then fusing. — On plant debris, mosses, and tree bases; scattered orangish spots that are K+ purple (an anthraquinone) are common in Europe, but infrequent in N Am; containing gyrophoric acid; on plant debris, mosses, rotting wood, bark, and tree bases; Alaska to Oregon, w Cas, rarely inland to Montana

*Trapeliopsis pseudogranulosa*

### Group N3

Thallus K-, KC- or KC+Y, C-, P+Y to O or R

1a Thallus P- but soralia P+ immediately rust red (argopsin). — Soralia greenish yellow (greener in shade), when well developed confluent into a thick leprose crusts; on *Alnus*, *Populus*, *Salix*, and conifers, less often on other hardwoods, sometimes spreading onto adjacent bryophytes; coastal Alaska to w Oregon

*Biatora efflorescens*

1b Thallus P+Y to O or R

2a Thallus of small areoles or granules; containing pannarin, argopsin, or fumarprotocetraric acid

3a Containing fumarprotocetraric acid; thallus coarsely or finely granular



4a Thallus yellowish green, becoming a leprose crust; soredia finely granular. — Apothecia occasional; disk yellowish or often darkening with gray mottles to nearly black; common on conifer trunks, occasionally on shrubs or hardwoods; w Cascades

*Cliostomum flavidulum*

4b Thallus greenish or greenish gray, corticate parts present; soredia medium to coarsely granular. — Apothecia occasional; disk tan to brown; on bark and wood and many other substrates in cities and other polluted areas; apothecia with sorediate margins are often present

*Lecanora conizaeoides*

3b Containing argopsin or pannarin; thallus of minute, often fragile areoles

5a Containing pannarin; areoles less fragile, 0.1-0.5 mm diam; soralia 0.1-0.4 mm diam. — Thallus of small brown-white to brown-gray or greenish tinged areoles; soralia scattered, often developing on the margins of the areoles (but not from the underside as in *Rinodina degeliana*), plane to convex and roundish, then becoming confluent, whitish to greenish or greenish yellow, often tinged brown; on bark; low elevations, coastal PNW

*Rinodina efflorescens*

5b Containing argopsin; areoles fragile (disintegrating when touched with a needle), 0.05-0.1 mm diam; soralia (0.1)0.2(-0.3) mm diam. — Apothecia with sorediate thalline margin; soralia dark green; on hardwoods and shrubs; near sea level in Washington and Oregon

*Halecania viridescens*

2b Thallus continuous or occasionally ± areolate; containing fumarprotocetraric and trace of protocetraric acid

6a Atranorin and chloroatranorin present, so normally K+Y. — On bark and wood; widespread but infrequent in PNW

*Ramboldia cinnabarina*.

6b Atranorin and chloroatranorin absent, K- or K+ brownish

7a Soralia brownish (gray brown to brownish green), ± diffuse. — On conifers and hardwoods but especially on *Alnus* and *Betula*; coastal Alaska

*Lecidea praetermissa*

7b Soralia pale green gray, bluish, yellowish, or white, discrete and convex

8a Usually on wood; soralia roundish to somewhat elongate; thallus containing fumarprotocetraric acid. Thallus endosubstratal to distinctly convex areolate; BC to Montana, s to Arizona

*Xylographa soralifera*

8b Usually on bark; soralia roundish

9a Thallus mostly immersed in the substrate in the non-sorediate parts; soralia concave to flat; thallus lacking succinprotocetraric acid. — On smooth bark, hardwoods and conifers, less often on wood; BC and Alaska inland to w Montana

*Pertusaria pupillaris*

9b Thallus superficial to occasionally immersed in the substrate in the non-sorediate parts; soralia ± convex; trace of succinprotocetraric acid present. — On conifers and hardwoods; circumpolar s to Oregon

*Pertusaria borealis*

### **Group N4**

Thallus K-, KC- or KC+Y, C-, P-, UV+ **blue white or pink**

1a Thallus of cream to yellowish corticate granules, not truly sorediate. — Mainly on wood; uncommon in moist conifer forests

*Ophioparma rubricosa*

1b Thallus variously colored but not entirely of corticate granules; with true soredia

2a Soralia yellow, yellow brown, pale brown, or greenish, discrete or fused or diffuse

3a Thallus UV+ pink (coronatin and unidentified xanthonines); pycnidia when present white pubescent. —

Thallus thin, rimose and finely granular, often appearing felty, pale bluish green or gray green; prothallus white, forming a distinct border; soralia irregular, effuse, yellowish green; on bark of conifers, hardwoods, and rock; OP

*Bacidia viridifarinoso*

- 3b Thallus UV+ white or bluish white; pycnidia when present not white pubescent
- 4a Soralia of mixed yellowish and brown granules, occasionally yellowish green. — Thallus areolate to continuous; thallus often KC+ flash Y or O, ± lobaric acid (UV+ with lobaric acid, otherwise UV-); on bark and wood; coastal states and provinces inland to w Montana
- Japewia subaurifera*
- 4b Soralia greenish, green tinged with brown, or yellowish green
- 5a Soralia granular or in consoredia (or blastidia) which effloresce into lighter soredia. — Thallus dull gray-greenish or brownish green or pale grayish green; areoles often ± constricted at the base; containing sphaerophorin and isosphaeric acid; usually on hardwoods; widely distributed in oceanic w N Am
- Rinodina disjuncta*
- 5b Soredia powdery, discrete or coalescing
- 6a Soralia discrete, persistently punctiform, mostly 0.1 mm diam, some to 0.3 mm diam; prothallus bluish or brownish, distinct; thallus containing sphaerophorin (usually major), ± isosphaeric acid. — Thallus thinly areolate or indistinct in the esorediate parts; soralia greenish or green tinged with brown, mostly discrete but occasionally coalescing; soredia fine, 20-30 µm diam; apothecia sometimes present, to 0.6 mm diam, bluish, brownish, or rarely blackish; on smooth bark and wood of conifers, shrubs, and hardwoods
- Frutidella pullata*
- 6b Soralia discrete or confluent but not persistently punctiform; prothallus whitish, brownish or indistinct; thallus containing perlatolic or lobaric acid
- 7a Soredia pale greenish to pale brownish, 20-40(50) µm diam; thallus containing lobaric acid. — Thallus brownish or greenish; soralia small and irregular at first, expanding and coalescing to form a nearly leprose crust; apothecia occasional, reddish brown, the margin lecideine; exciple brownish, pale brownish adjacent to the hymenium; hypothecium hyaline, interspersed with oil drops; epithecium brown, POL-, K+ olive brown; thallus K-, KC-, C-, P-, UV+ blue-white; widespread but infrequent
- Myochroidea porphyrospoda*
- 7b Soredia greenish or less often yellowish, about 20-30 µm in diameter; thallus containing perlatolic and hyperperlatolic acids. — Soralia discrete or confluent; thallus grayish green, of small convex areoles, but the areoles not constricted at the base; areoles greenish, discrete or contiguous; apothecia rare; on bark or wood of *Betula*, conifers, or other acidic-barked trees in damp sites; BC, Washington, and Montana
- Ropalospora viridis*
- 2b Soralia white to gray, pale greenish, or black, discrete or coalescing
- 9a Thallus C+Y, KC+Y, containing variolaric acid. — Thallus whitish with coarse granular soredia. — On wood, soil, and moss over rock; widespread
- Ochrolechia turneri*
- 9a Thallus C-, KC-, containing divaricatic, alectoronic, or perlatolic acid
- 10a Thallus containing alectoronic acid; cephalodia present. — So far known only from Kodiak Island, Alaska
- Coccotrema minutum*
- 10b Thallus containing divaricatic or perlatolic acid; cephalodia absent
- 11a Thallus containing divaricatic acid
- 12a Areoles and soralia pale bluish gray, whitish (shaded), gray, or gray brown, immediately dissolving into soredia and thus largely appearing leprose. — Apothecia uncommon, reddish brown, plane to convex; esorediate areoles when present bluish gray to tan-gray, but often indistinct or absent, soon bursting to form soredia; soralia bluish gray, greenish, or whitish (shaded), sometimes tinged with brown, discrete or coalescing into a leprose crust; soredia fine; thallus containing divaricatic acid (K-, C-, KC-, P-, UV+ white); spores globose, 5-7.5 µm diam; widespread
- Lecidea nylanderii*
- 12b Areoles grayish green to green, more persistent and thus bearing ± discrete soralia. — Coastal Alaska to s Washington Cascades and in e N Am
- Fuscidea pusilla*
- 11b Thallus containing perlatolic acid

13a On wood or bark of conifers; soralia soon coalescing into a thick leprose crust, beginning from coarse corticate granules that are covered with fine soredia. — Thallus pale greenish gray, gray, or brownish gray, occasionally strongly convex areolate, the areoles with a coarsely cracked whitish necrotic layer; prothallus not apparent; apothecia common, the disk flat, often arranged in dense botryose clusters; disk reddish brown, dark gray, or black, often with a thin pale whitish rim when young; spores 7-12(13) x 2.5-4 µm, 0(1)-septate; w Cascades inland to at least w Montana

*Hertelidea botryosa*

13b On smooth bark of hardwoods, less often on conifers; soralia discrete or ± fused, irregularly sized and spaced; prothallus bluish gray to bluish black, visible at the edge of the thallus and/or between areoles. — Thallus continuous to areolate or warty, gray to bluish gray; Alaska to n California

*Mycoblastus caesius*

### Group N5

Thallus K-, KC- or KC+Y, C-, P-, UV- or UV+ pale yellowish

1a Soralia yellow, yellow brown, pale brown, or greenish, discrete or fused or diffuse

2a Blastidia present, elongate to flattened, breaking into soredia. — Thallus thin, gray to gray brown, continuous or areolate, soon developing blastidia about 0.1 mm broad to 0.45 mm long; no lichen substances; on hardwoods, less often on conifers; low elevations w Cascades, sw BC to w Oregon

*Rinodina thomsonii*

2b Blastidia absent

3a Soralia yellow to yellow green or vivid green. — Thallus gray, thin to warty, often becoming consumed by the soralia; soralia containing atranorin, planic acid, and usnic acid; on plant detritus, wood, and noncalcareous rock; cool forests to alpine; few reports from the PNW

*Mycoblastus alpinus*

3b Soralia yellowish, yellow brown, pale yellowish green, pale brown, or greenish

4a Soralia whitish with pale yellowish to greenish tints; thallus containing a trace of gyrophoric acid by TLC but spot tests normally negative. — At least a few apothecia normally present; spores elongate, sigmoid-curved

*Scoliciosporum sarothamni*

4b Soralia more yellowish or yellow-brownish; thallus containing atranorin, secalonin acid A, thiomelin, and xanthonones (C- or C+O, KC-, but sometimes substances absent and all spot tests are negative). — Thallus very thin or endosubstratal, barely discoloring the bark or with very thin areoles; soralia discrete, plane to ± convex; spores *Physcia* type, 22-26 x 11.5-13.5; on *Alnus*; coastal Alaska

*Rinodina sheardii*

[*Rinodina flavosoralifera* is a similar species known from deciduous trees in coastal Alaska. It has yellowish areoles and brownish soralia, owing to the presence of xanthonones.]

1b Soralia white to gray, pale greenish, or black, discrete

5a Thallus of thick greenish gray bullate areoles tipped with blackish soralia. — Apothecia rare; spores 2-celled, 22-28 x 12-15 µm; on bird perches of old wood, especially fenceposts; common e Cascades, rarely w Cascades, BC to California inland to Montana and Idaho

*Thelomma ocellatum*

5b Thallus thin, whitish to gray or greenish gray; soralia white to gray or blue-gray

6a Soralia tiny (generally < 0.3 mm diam)

7a Soralia brownish or greenish, barrel-shaped, distinctly delimited by a white circular rim. — Soralia to 0.3 (0.5) mm diam; apothecia rare, rust red; containing roccellic acid; on shrubs (*Alnus*, *Salix*, *Sorbus*); subalpine to alpine; BC to Montana, s to Colorado

*Caloplaca sorocarpa*

7b Soralia variously colored but not surrounded by a white rim

8a Atranorin present (though usually K- or weakly K+Y). — Thallus areolate, dull greenish white to pale gray or grayish brown, with blue-gray, mostly discrete soralia that are plane to ± convex; apothecia very rare; spores brown, 24-29 x 12-17 µm; thallus also containing zeorin, P- or

P+ pale Y; on eutrophic bark of hardwoods, often in cities; common in lowlands w Cascades

*Rinodina griseosoralifera*

8b Atranorin lacking

9a Thallus of scattered areoles, the areoles very thin, developing into thin soralia mostly 0.1-0.2 mm broad and occupying the whole areole. — Thallus grayish yellow white, pale greenish, or pale yellowish green, containing gyrophoric acid; apothecia inconspicuous, immarginate, adnate, grayish to pale brown; spores simple or occasionally 1-septate, 9-10 x 2-4 µm; on shrubs; low elevations to more often subalpine

*Biatora vacciniicola*

9b Thallus thin and smooth or of contiguous to scattered areoles, the areoles becoming warty or irregularly verrucose and the warts bursting into crater-like soralia surrounded by a whitish or grayish cortex. — Apothecia uncommon; spores hyaline, 10-13 x 6-8 µm; on deciduous trees, often at the base; w Cascades

*Caloplaca obscurella*

6b Soralia > 0.5 mm diam

12a Thallus dark bluish gray. — Thallus becoming coarsely granular sorediate (blastidiate) to isidiate, the granules appearing corticate, K- under dissecting scope but often K+ violet under LM, diffuse rather than concentrated into soralia, sparse to abundant; apothecia black, fairly common, with thalline rim and septate spores; On bark, especially *Populus*; widespread but in PNW, most often e Cascades

*Rinodina colobina*

12b Thallus and granules not both dark bluish gray

13a On moss over bark, wood, or rock. — Thallus greenish gray or pale yellowish green; soralia diffuse; oceanic to suboceanic

*Mycobilimbia epixanthoides*

13b On bark or wood

14a Soralia irregular, forming a discontinuous leprose crust; thallus generally endophloedal; apothecia common. — Apothecia, black but bluish pruinose; thallus containing pseudoplacodiolic acid; on humid sheltered bark, associated with Caliciales and *Chrysothrix*; coastal Alaska and inland BC

*Lecidea leprarioides*

14b Soralia round, medium to large (0.5-1.2 mm diam), developing in fruiting warts; thallus generally thin to rather thick epiphloedal; apothecia common but obscured by the soredia

15a Warts of thallus small, to 1.2 mm diam; apothecial margins crenulate; disk black, commonly seen though often obscured by soredia. — Medulla with all spot tests negative; containing fatty acids by TLC; on conifers and hardwoods; widespread and common

*Variolaria ophthalmiza*

15b Warts of thallus large, to 4.5 mm diam; apothecial margins smooth; disk black but rarely seen. — On both hardwoods and conifers; mainly sw N Am; rare in PNW

*Pertusaria albescens*

## Key O: OTHER STERILE CRUSTS ON ROCK OR SOIL OR ON BRYOPHYTES OVER ROCK OR SOIL, PARTLY CORTICATE

1a Thallus isidiate or granular-isidiate, greenish or olive brown or dark brown

2a Thallus brown to dark brown; substrate various

3a Photobiont cells 6-12 µm diam; lichenicolous on rock or directly on rock. — Thallus minutely isidioid or granular; containing gyrophoric acid (K-, C+R, KC+R); widespread and fairly common

*Rimularia* and *Lambiella*; see key to *Rimularia*

[*Rinodina parasitica* can also form a dark brown granular crust over lichens on rock. Check carefully for apothecia. It contains no lichen substances.]

3b Photobiont cells 5-9 µm diam; on soil or detritus, rarely on rock. — Widespread and common

*Placynthiella*

2b Thallus greenish, olive, gray, or brownish gray; on rock

- 4a Thallus brownish gray; habitat shoreline noncalcareous rock; isidia coarse, 0.3-07 mm diam. — Alaska to Oregon, inland to e-central BC and Montana  
*Koerberiella wimmeriana*
- 4b Thallus greenish, olive, or olive brown; habitat various; isidia granular or finely cylindrical, < 0.3 mm diam
- 5a Thallus with elongate very narrow lobes, forming olivaceous rosettes; photobiont blue green. — On siliceous rock, in and w Cascades  
*Vestergrenopsis*, *Placynthium*, and *Steineropsis*-- see key to stratified cyanolichens
- 5b Thallus not lobate, greenish, granular isidiate; photobiont green. — Habitat shaded, maritime  
*Bacidia scopulicola*
- 1b Thallus sorediate or isidiate, but if isidiate then color otherwise
- 6a Thallus K+R (norstictic acid), white to gray; hypothallus dark gray to black, often distinct
- 8a Soralia and upper cortex whitish to cream, not at all gray. — Normally on bark or wood but occasionally on rock; widespread  
*Phlyctis argena*
- 8b Soralia and upper cortex predominantly gray or greenish gray
- 9a Thallus not sorediate, areolate to warty; substrate soil and moss. — Alaska.  
*(Baeomyces carneus)*
- 9b Thallus sorediate, areolate; substrate various
- 10a Soredia coarse, granular; soralia often poorly delimited. — On moss (especially *Grimmia*) over rock, rock, and old wood, usually in dry sites e Cascades  
*Sagedia mastrucata*
- 10b Soredia powdery; soralia often neatly delimited
- 11a Thallus yellowish white to pale gray; soralia black or white to pale yellow. — On rock  
cf. *Porpidia* sensu Gowan (1989)
- 11b Thallus gray or whitish gray; soralia dark gray. — Soralia roundish, discrete; medulla I+ violet or blue; Arctic s to at least the Canadian RM; on noncalcareous rock  
*Bellemerea subsorediza*
- 6b Thallus K- or K+Y, color various; hypothallus various
- 12a Thallus isidiate, papillate, with coarsely granular soredia or lacking soredia and areolate to warty
- 13a Thallus areolate to warty, esorediate; on soil and moss
- 14a Thallus P+Y to O, UV-. — Widespread, common  
*Baeomyce*
- 14b Thallus P+Y, UV+. — Arctic and northern  
*(Dibaeis baeomyces )*
- 13b Thallus papillose or coarsely granular sorediate
- 16a Thallus KC+R
- 17a Thallus thick, of swollen areoles. — Thallus containing gyrophoric acid (K-, C+R, KC+R); widespread, infrequent  
*Rimularia gibbosa*
- 17b Thallus thin, cracked areolate, when sterile often with whitish spots which are immature apothecia. — Common but often overlooked, especially in coastal states and provinces  
*Trapelia*
- 16b Thallus KC-
- 18a Thallus cracked areolate, granular, scurfy-isidiate to granular sorediate. — Thallus K-; mainly on supralittoral rocks; rarely reported  
*Circinaria leproscens*
- 18b Thallus entirely papillate. — Thallus pinkish-gray; on HCl- supralittoral rock; apparently uncommon in PNW (BC, Washington)  
*Lecania aipospila*
- 15b Thallus sorediate
- 19a Thallus with prominent pinkish to brown cephalodia; marginal lobes conspicuous. — Upper surface and medulla C+R, KC+R; abundant on rock w Cascades, rarely inland  
*Placopsis*
- 19b Thallus lacking cephalodia; margins not or slightly lobate
- 20a Thallus K+Y (atranorin, alectorialic, or stictic acid present), KC- or KC+ orange red or KC+

violet

21a Thallus with orange or yellow tints

22a Thallus gray, brownish gray, ochre, to rusty colored, with gray to blackish soralia. — On iron-rich rock, and often occurring with *Acarospora sinopica* and *Tremolecia atrata*; containing stictic acid; medulla I-; soralia crateriform to tubercular; prothallus gray or black; occasional in the coastal states but rarely reported

*Miriquidica atrofulva*

[See also *Porpidia tuberculosa*, which can appear similar but lacks stictic acid, containing instead confluent acid, and has an I+B medulla. *Porpidia soledizodes* also has stictic acid and an I- medulla, but is cream to gray with pale soralia.]

22b Thallus otherwise

23a Thallus creamy yellow orange to brownish orange, often with gray patches or margins. — Thallus continuous to finely cracked; medulla I-; soredia white or flecked gray, rarely darker; cortex K- (or Y from diffusion), medulla K+Y (stictic acid); on semi-inundated rocks; arctic-alpine s to Colorado

*Porpidia ochrolemma*

23b Thallus yellow-green. — Thallus areolate on a well-developed black prothallus; soralia developing on the edges of the areoles, coarsely granular, green black to yellow green, becoming convex; apothecia very rare; cortex K+Y, KC+Y (atranorin and usnic acid abundant), also containing rangiformic and norrangiformic acids; on siliceous rock, Arctic to s Appalachians, not yet known from PNW

(*Calvitimela talayana*)

21b Thallus white to gray, cream, brownish, or yellow-green

24a Thallus mostly ecorticate and sorediate. — White prothallus distinct; cortex K+Y, medulla K- (atranorin, zeorin, porphyritic acid); BC, Washington, Colorado

*Haematomma ochroleucum* var. *porphyrium*

24b Thallus usually with extensive cortex

25a Thallus KC+O, R, purple, or violet

26a Thallus P+ deep Y (alectorialic acid)

27a Thallus containing barbatolic acid?, dirty white, cream or pale tan. — On sheltered noncalcareous rock faces; n RM

Unknown species, not seen fertile; perhaps *Lecanora cavicola* which also keys here, although barbatolic acid is not reported from that. See the sorediate section of the *Lecanora* key for more detail.

27b Thallus lacking barbatolic acid, pale to mid brownish. — On sheltered rock and bark; apparently rare

*Fuscidea praeruptorum*

26b Thallus P- or pale Y (gyrophoric acid)

28a Thallus UV++ blue white (lobaric acid); areoles with darker centers contrasting with the margins, at least in part (i.e. as in *Stereocaulon vesuvianum*). — Alaska s to Oregon Cascades

*Stereocaulon leucophaeopsis*

28b Thallus UV+ weak whitish (gyrophoric acid); areoles more uniform in color, not having darker centers. — Soralia C+R, KC+R; thallus areolate, pale greenish gray; soralia greenish white, ± discrete, farinose, to about 0.5 mm wide; on exposed siliceous rock, near sea level

*Rinodina aspersa* (Borrer) Laundon

25b Thallus KC-

30a Stictic acid present; atranorin lacking

31a Soralia gray to blackish, forming craters or raised craters. — Occasional in the coastal states but rarely reported

*Miriquidica atrofulva*

31b Soralia white, greenish white, or grayish. — Medulla I-, K+Y (but often difficult to see clearly); thallus pale greenish white, dirty cream-gray to olive or brownish, subcontinuous to rimose or subareolate; soralia discrete, elevated in

warts, developing a distinct rim; prothallus black, often visible; apothecia rare, similar to *P. crustulata*; scattered localities in w N Am; on rock

*Porpidia soredizodes*

30b Stictic acid lacking; atranorin present; habitat steep sheltered faces of noncalcareous rock

32a Apothecia, when present, of the *Lecanora rupicola* type, with whitish disk. — Soralia in discrete (or coalescing), convex soralia; thallus thick and uneven, white to gray; cortex and medulla K+Y, C- (atranorin and rocellic acid); on siliceous rock, often beneath overhangs or in other sheltered microsites

*Lecanora rupicola* var. *efflorens*

32b Apothecia, when present, with brown to black disk

33a Apothecia, when present, with black disk (*Tephromela atra* type); thallus containing lichesterinic acid (with atranorin). — Soralia coalescing into a thick gray crust; n Europe, Scandinavia, Asia, not yet known from N Am

(*Tephromela grumosa*)

33b Apothecia, when present, with reddish brown to brown disk (*Lecanora subfusca* group)

34a Thallus containing terpenoids (with atranorin). — Widespread, uncommon

*Lecanora umbrosa*

34b Thallus containing fatty acids (with atranorin). — Widespread, rarely collected

*Lecanora caesiosora* and *L. pannonica*

20b Thallus K-

35a Thallus KC-, C-

36a Soralia P+R. — Thallus areolate to subcontinuous, pale brownish gray. Example: J. Davis 2788

Unknown sterile crust

36b Soralia P-

37a Thallus lobate, forming small tightly appressed rosettes. — Hypothallus indistinct or lacking; thallus K-, C-, KC-, P-, UV-; on sheltered siliceous rock; widespread in semiarid climates; fairly frequent throughout the PNW but often inconspicuous and difficult to collect

*Caloplaca demissa*

37b Thallus not lobate

38a Thallus UV+ yellow or orangish (xanthone). — Thallus of small whitish areoles with greenish powdery diffuse soredia coalescing into a leprose crust; spot tests negative; on sheltered basalt at low elevations (Example: Oregon, Clackamas Co., Clackamas River bluffs, 100 m, McCune 28606)

Unknown sterile crust

38b Thallus UV- or UV+ whitish

39a Thallus brownish, dark brown, or dark gray

40a Soralia punctiform, dark to lilac-mauve-white; habitat shaded noncalcareous rock. — Thallus containing confluent acid, 2'-*O*-methylmicrophyllinic and 2'-*O*-methylperlatolic acid; soralia UV ± blue white; apothecia black, conical, perithecia-like; on shaded, sheltered, noncalcareous rock (rarely on bark)

*Enterographa zonata*

40b Soralia marginal or extensive, often eventually covering the whole thallus

41a Thallus dark gray to blackish, containing miriquidic acid. — Thallus often parasitic on other lichens

*Miriquidica*

41b Thallus gray or brown, lacking lichen substances

43a Thallus grayish areolate with blackish soralia or becoming completely blackish sorediate. — Apparently rare in PNW

*Rinodina obnascens*

- 43b Thallus gray brown (shaded) or more often dark brown, granular to areolate — Widespread, occasional  
*Rinodina parasitica*
- 39b Thallus gray, whitish gray, olive gray, or greenish gray  
44a Thallus greenish gray or pale yellowish green; soralia diffuse; on mosses over bark, wood, or rock. — Oceanic to suboceanic  
*Mycobilimbia epixanthoides*
- 44b Thallus gray, whitish gray, or olive gray; soralia discrete; on rock  
45a Areoles with distinctly paler edges, at least in part; thallus containing atranorin and lobaric acid by TLC but giving negative spot tests when in low concentration. — Alaska to Oregon, infrequently collected  
*Stereocaulon leucophaeopsis*
- 45b Areoles more uniform in color; thallus substances various  
46a Soralia linear, blackish, excavate. — Soralia along the edges of the areoles or minute squamules; areoles dispersed; thallus lacking lichen substances, P-, K-, KC-, C-; on concrete  
*Acarospora moenium*
- 46b Soralia punctiform or roundish-convex, white to bluish gray or blackening  
47a Medulla I-; thallus containing 2'-*O*-methylsuperphyllinic and glaucophaeic acids; thallus of thick, white, convex areoles; soralia white or very pale greenish. — On noncalcareous rock; rare; coastal e Canada and sw Alaska  
*(Porpidia rugosa)*
- 47b Medulla I+B; thallus containing confluent and 2'-*O*-methylmicrophyllinic acids, rarely with stictic and/or norstictic acids; thallus moderately thick, medium gray, subareolate to areolate. — On noncalcareous rock  
*Porpidia tuberculosa*  
[A test for confluent acid: Mount section or fragment in water on microscope slide, apply coverslip, suffuse with K, after a few seconds, a stream of minute droplets (4-*O*-methylolivetonide) will come from the tissue, forming a dull halo.]
- 35b Thallus KC+O or R, C+R or C-  
48a Thallus brown to yellowish brown; soralia pinkish tinged; uncommon, with narrow habitat requirements. — Soralia numerous, punctiform; apothecia black, rounded, ± gyrose; spores 3-septate, 20-25(27) x 4-5 µm; thallus containing gyrophoric acid; on rocks on lakeshores and seashores; coastal BC and Atlantic coast  
*Opegrapha gyrocarpa*
- 48b Thallus white, cream, light gray or dark gray; soralia otherwise; common, widespread species  
49a Thallus C-, IK+ violet, containing picrolichenic acid. — Usually on bark or wood, rarely on porous rock, including supralittoral rock  
*Variolaria amara*
- 49a Thallus and/or soredia C+R, containing gyrophoric and/or lecanoric acid  
50a Thallus whitish  
*Ochrolechia*
- 50b Thallus pale gray or darker  
*Trapeliopsis, Trapelia*



## Key P: SQUAMULOSE

- 1a Squamules yellow, yellow-green, or orange
- 2a Squamules K+ purple
- 3a Lower surface corticate, occasionally rhizinate
- 4a Rhizines present; spermatia bacilliform; upper cortex and thalline margin with cell walls strongly glutinized. — Widespread, common
- Xanthomendoza*
- 4b Rhizines absent, the thallus attached by short hapters; upper cortex and thalline margin with cell walls little glutinized. — Widespread, common
- Xanthoria*
- 3b Lower surface ecorticate or too closely appressed to discern, lacking rhizines
- 5a Thallus pale to clear yellow; on calcareous soil; thallus squamulose, often marginally lobate. — Fairly common in cold or dry exposed sites
- Gyalolechia* (formerly in *Fulgensia*)
- 5b Thallus yellow to orange; substrate various; thallus more often foliose to dwarf fruticose. — Widespread, common
- Caloplaca*
- 2b Squamules K-
- 7a Thallus yellowish green, LW UV-.— Apothecia sessile; disk brown; spores > 6 µm long, 8/ascus; on calcareous soil; occasional in steppe and desert
- Squamarina*
- 7b Thallus vibrant yellow to yellow green, LW UV+ (rhizocarpic acid)
- 8a Apothecia immersed; disks brown to almost black; spores minute (< 6 µm long), 1-celled, hyaline, many/ascus. — On rock and soil; widespread, common
- Acarospora*
- 8b Apothecia sessile to ± stalked; disks black; spores 11-17 x 7-10 µm, 2-celled, dark, 8/ascus. — Thallus with marginal lobes to 1 cm long, areolate-squamulose in the interior, on soil and moss in rock crevices; arctic-alpine s to Colorado, rare
- Catolechia wahlenbergii*
- 1b Squamules another color
- 10a Thallus greenish, ear-shaped with a raised lip at the margin, the interior generally sorediate; always sterile; cortex and medulla K-, P-, C-, KC-.— Often on moss or other lichens; widespread; common w Cascades, rare (or overlooked) e Cascades
- Normandina pulchella*
- 10b Thallus variously shaped and colored but without a raised lip at the margin; often fertile; spot tests various
- 11a Ascocarps forming perithecia; usually fertile
- 12a Spores nonseptate, hyaline; hymenial algae absent
- 13a On bark
- 14a Upper cortex *Catapyrenium*-type, with thin-walled roundish cells and a gradual transition to the algal layer. — On *Quercus* bark; sw US and California to sw Oregon
- Catapyrenium psoromoides*
- 14b Upper cortex *Placidium*-type, with thick-walled cells near the surface, grading to thinner wals, then abruptly transitioning to the algal layer. — On *Quercus* bark; sw US to n California
- (Placidium fings)*
- 13b On rock or soil or detritus
- 15a Thallus thickly crustose areolate to subsquamulose, on rock
- 16a Thallus initially parasitizing *Staurothele areolata*, eventually free living, becoming a subsquamulose crust. — Widespread but infrequent, usually on calcareous rock
- Heteroplacidium zamenhofianum*
- 16b Thallus not parasitic on *Staurothele*
- 17a Lower or lateral cortex with cells arranged in vertical columns or prosoplectenchymatous
- 18a Lower or lateral cortex with cells arranged in vertical columns. — On

- noncalcareous rock; dry sites; Idaho to California
- Dermatocarpon leptophyllodes*
- 18b Lower or lateral cortex prosoplectenchymatous, of densely interwoven filamentous hyphae. — On calcareous rock; known only from type locality in Colorado  
(*Placopyrenium coloradoense*)
- 17b Lower cortex non-columnar paraplectenchymatous or lacking
- 19a Lower and lateral cortex paraplectenchymatous; areoles with a short stipe-like holdfast. — On rock; Columbia Plateau, rare
- Placopyrenium conforme*
- 19b Lower cortex lacking, areoles broadly attached. — Widespread and common as a genus but squamulose species infrequent
- Verrucaria*
- 15b Thallus squamulose, mostly on soil
- 20a Upper cortex of ± blocky cells arranged in vertical columns; squamules tinged gray, greenish, or whitish pruinose on a brownish background; rhizohyphae hyaline or brown. — Widespread; montane to mostly subalpine and alpine
- Catapyrenium*
- 20b Upper cortex of roundish cells not aligned into columns; squamules some shade of brown, epruinose; rhizohyphae hyaline. — Widespread; deserts to alpine
- Placidium*
- 24b Spores septate, hyaline or brown; hymenial algae present or absent
- 25a Spores hyaline, 1-septate (ours, sometimes septum obscure in water but obvious in K). — Hymenial algae lacking; widespread but rare
- Placidiopsis*
- 25b Spores muriform
- 26a Hymenial algae present; spores brown in almost all species. — On soil and rock; common in steppe and desert to alpine
- Endocarpon*
- 26b Hymenial algae absent; spores hyaline or brown
- 27a Squamules umbilicate; cortical cells not papillate; on rock. — Arctic-alpine and low elevations in w Montana, rare
- Henrica*
- 27b Squamules not umbilicate; cortical cells papillate; on moss, lichens, rock, or soil over rock or bark. — Widespread but infrequent in coastal states and provinces
- Agonimia*
- 11b Ascocarps forming apothecia or if sterile then often sorediate; thallus usually epruinose
- 28a Photobiont blue-green
- 29a Thallus umbilicate (peltate), with sorediate margins
- 30a Thallus 1-2 mm diam, thin (0.2-0.3 mm), dark olive green. — On rock; Mexico to n California and Nevada
- (Peltula bolanderi)*
- 30b Thallus to 10 mm or more diam; 0.2-0.5 mm thick, tan to olive. — Uncommon in PNW, more common in California
- Peltula euploca*
- 29b Thallus not umbilicate
- 31a Apothecia sunken in the thallus, the disk expanded and reddish
- 32a Spores 14-24 x 6-11 µm, 8 per ascus. — On soil; occasional in desert and steppe, usually where calcareous
- Heppia lutosa*
- 32b Spores < 10 µm long, > 100 per ascus. — On calcareous soil, or soil over rock, or rock; s California to ne Montana and s Saskatchewan
- Peltula patellata*
- 31b Apothecia sessile; corticolous or saxicolous or on moss over rock, rarely on soil
- 33a Spores warty, large (25-30 x 9-12 µm); apothecia with beaded thalline margin. — Thallus pale bluish gray to dark brown, fresh material dark bluish when wet; lower surface of apothecia margin lacking hairs; on shady soil, logs, tree bases, and mossy rocks;

widespread, common e Cascades

*Protopannaria pezizoides*

33b Spores uneven to smooth, mostly < 25 µm long; apothecia various

34a Apothecia lecanorine; isidia absent or, if present, then not dense and fingerlike. —  
Widespread, common

*Fuscopannaria*

34b Apothecia lecideine; isidia present or not

35a Thallus isidiate; apothecia often absent. — Widespread, occasional in coastal  
states and provinces

*Parmeliella*

35b Thallus of small squamules with incised margins; apothecia usually present. —  
Widespread, very common w Cascades, rare inland

*Fuscopannaria*

28b Photobiont green

40a Thallus sorediate or sterile; substrate various

41a Apothecia generally not borne directly on the squamules; squamules often with black, raised  
pycnidia and/or immature podetia. — Substrate various; widespread, common

*Cladonia*

41b Apothecia, if present, on or between the squamules; squamules lacking pycnidia and/or  
immature podetia

42a Thallus of microsquamules that become isidiate and granular sorediate, becoming  
delicately compound and suberect, to about 0.15 mm broad, greenish to grayish; spot tests  
negative except UV+; cortical cells with small papillae (LM). — on mosses, soil, or bark;  
widespread, rare

*Agonimia tristicula*

42b Thallus of appressed to ascending squamules, the color and spot tests various; cortical  
cells lacking papillae

43a On soil, moss, or rock

44a Thallus C-, KC-. — Squamules white, thickly pruinose, to 3 mm diam, appressed  
or with edges slightly raised, forming white to grayish brown soredia on the edges  
of the squamules; thallus K-, C-, KC-, P-, UV-; on calcareous silt in dry grassland,  
w side of Jasper Lake, Alberta, 1000 m

Unknown genus and species. P. Williston Site K15

44b Thallus C+R, KC+R. — Widespread, common

*Trapeliopsis*

43b On bark or wood; thallus spot tests various

45a Squamules bursting open to form a soredia-lined pocket; on bark. Thallus pale  
greenish gray, olive green, to brown green, of roundish to lobate squamules to about  
1 mm broad, the squamules typically developing one or two suberect to erect lobes  
with sorediate pockets; on trees; California to BC

*Waynea californica*

45b Squamules with marginal soredia; most common on charred wood but also on tree  
bases

46a Squamules K+Y or O, P+Y or O, C- (thamnolic acid with accessory alectorialic  
acid); squamule margins crenulate. — Arizona and California to s Oregon

*Fulgidea sierrae*

46b Squamules K-, P- or P+O, C- or C+R; squamule margins ± entire

47a Squamules C+R, KC+R (lecanoric acid), ascending, greenish or brownish  
green; apothecia uncommon, black, often pruinose; soredia present. —  
Widespread, common

*Hypocenomyce scalaris*

47b Squamules C-, KC-, adnate or ascending, grayish green, greenish brown, to  
rich brown; apothecia strongly convex, brown; soredia commonly present,  
though often sparse or lacking. — Widespread, occasional

*Carbonicola*

- 40b Thallus usually fertile, esorediate; on rock, moss, detritus, or soil  
 48a Asci polysporous; spores small,  $\leq 5 \mu\text{m}$  long; cortex often KC+R; thallus generally brown OR whitish pruinose. — Widespread, common  
*Acarospora*
- 48b Asci 8-spored; spores  $> 5 \mu\text{m}$  long; cortex KC+ or -; thallus color various  
 49a Apothecia with thalline margin, although the thalline margin may be lost with age  
 50a Saxicolous  
 51a Spores 1-3 septate. — Widespread, infrequently collected  
*Lecania*
- 51b Spores nonseptate. — Widespread, common  
*Lecanora*
- 50b Terricolous or muscicolous  
 52a Apothecial margin lobulate, persistent; spores hyaline, simple. — Widespread and very common  
*Psoroma hypnorum*
- 52b Apothecial margin not lobulate, often diminishing with age; spores brown, septate.  
 — Lower surface felty-black; upper surface pale brown, yellowish brown, or gray pruinose; common on soil and detritus; desert, steppe, and alpine  
*Phaeorrhiza*
- 49b Apothecia with proper margin or without a distinct margin  
 51a Spores simple  
 53a On bark or wood, commonly where charred  
 54a Apothecia brown. — Squamules with edges ascending, gray green, greenish brown, to rich brown; widespread, occasional  
*Carbonicola*
- 54b Apothecia plane, black, marginate  
 55a Thallus K+Y, KC+R (rarely KC-), C+R (rarely C-), P+R; containing alectorialic acid and usually thamnolic acid, rarely just thamnolic acid. — Widespread; infrequent  
*Fulgidea oligospora*
- 55b Thallus K-, KC-, C-, P-; containing friesiic acid. — Widespread, locally common  
*Xylopsora friesii*
- 53b On soil, thin soil over rock, rock, or detritus  
 56a Thallus pale yellowish green or yellowish tan  
 57a Epitecium K+R; medulla P-; spores 9-14 x 5-7  $\mu\text{m}$ ; thallus containing usnic and gyrophoric acids. — Arctic-alpine; rare  
*Psora rubiformis*
- 57b Epitecium K-; medulla P+Y; spores 10.5-12.5 x 6-7  $\mu\text{m}$ ; thallus containing alectorialic acid. — Alaska; rare  
*(Anamylopsora pulcherrima)*
- 56b Thallus brown, gray, cream, brownish green, or whitish  
 58a Thallus pale gray, creamy, or whitish above, C+R, KC+R. — On soil and mosses over rock; uncommon in PNW, common in California  
*Trapeliopsis glaucopholis*
- 58b Thallus tan, brown, brownish green, or dirty gray above; spot tests various  
 59a Squamules grayish to brown-gray, on a thick fibrous black hypothallus; apothecia brown, deeply set in a gray to brownish thallus. — Epitecium K-; spores 11-15 x 5-6  $\mu\text{m}$ ; no lichen substances; closely appressed to soil and detritus, widespread and common, especially subalpine to alpine  
*Lecidoma demissum*
- 59b Squamules brick red to brown or greenish brown although sometimes completely white pruinose; hypothallus inconspicuous or absent; apothecia brown to black, sessile or immersed

60a Ascocarp irregular in shape, lacking both proper and thalline exciple, eventually covering the entire squamule; ascocarp reddish brown. — Thallus olive brown; spores 13-17 x 7-9 µm; on gypsum soils, occurring with calciphiles, open habitats

*Gypsoplaca macrophylla*

61b Ascocarp generally circular in outline, delimited with a proper exciple; ascocarp reddish brown, brown, or black

62a Epithecium brown to orange brown, K+R (under compound microscope); hypothecium hyaline to pale brown, often with calcium oxalate crystals. — On soil or soil over rock in various habitats; widespread and common

*Psora*

62b Epithecium greenish, K-; hypothecium dark brown, lacking calcium oxalate crystals

63a Squamules convex; spores subspherical. — thallus warty-areolate to globose-squamulose or lobate squamulose, sometimes ± stalked, gray to dark brown or red brown; apothecia black, sessile; paraphyses free; epithecium clear blue green, discoloring to brown; spores about (6)7-9(10) µm diam, uniseriate; on siliceous rock; arctic-alpine s to Colorado, New England, and Oregon

*Schaereria cinereorufa*

63a Squamules concave, with raised edge; spores elliptical

64a Thallus squamulose; apothecia never lecanorine.

Overgrowing *Spilonema* on rock. — Widespread but rarely collected.

*Psorula rufonigra*

64b Thallus ± crustose, of peltate areoles; apothecia lecanorine when young; overgrowing a black hypothallus; thallus containing miriquidic acid; California, Alberta, and Saskatchewan

*Miriquidica scotophilis*

51b Spores 1- or several septate

65a Spores dark, 1- to several-septate. — Widespread, occasional

*Buellia badia*

[Crustose to subsquamulose species of *Buellia* are relatively common.]

65b Spores hyaline; thallus various

66a Spores unequally 1-septate, hyaline; paraphyses coherent, interwoven; thallus brown; apothecia black. — Hypothecium brown; epithecium greenish black and brown; on soil; common in dry or cold open habitats

*Arthonia glebosa*

66b Spores symmetrically septate, generally > 1-septate; thallus color various; apothecia dark or black

67a Thallus not delicate, whitish-edged squamules; spores 1-3 or more septate; hypothecium various. — Squamules pruinose or not; common on soil and rock in a wide variety of habitats

*Toninia*

67b Thallus of delicate, imbricate, whitish-edged squamules that are grayish, brownish, or olive gray; spores 3-septate, 13-24 x 4-6 µm; hypothecium red-brown. — Epithecium blue-green black or olive or mottled with both; common on soil and moss over calcareous rock; forested mountains and steppe

*Bilimbia lobulata*

## Key Q: UMBILICATE, FOLIOSE

1a Photobiont blue-green; thallus often  $\leq 1$  cm wide. — Margins sorediate; upper surface olive to brownish gray; on steep sheltered rock faces; widespread in w N Am but rare n of California

*Peltula euploca*

(*P. euploca* is the largest member of a mainly squamulose to crustose genus.)

1b Photobiont green; thallus generally  $> 1$  cm wide

2a Ascocarps forming perithecia (visible as black dots on the surface) or fruiting structures lacking

3a Perithecia present

*Dermatocarpon*

3b Perithecia lacking

4a Isidia or soredia present

*Umbilicaria*

4b Isidia and soredia lacking

5a Habitat usually semi-aquatic (streamside rocks, trickle lines on cliffs, seepy cracks in outcrops, etc.)

*Dermatocarpon*

5b Habitat various but seldom semi-aquatic

*Umbilicaria*

2b Ascocarps forming apothecia

6a Thallus white to gray, pruinose, appearing areolate, KC+R; apothecia brown, sunken in the thallus; spores minute, spherical, 2-4  $\mu\text{m}$  diameter, many per ascus. — On calcareous rock in continental climates

*Glypholecia scabra*

6b Thallus and apothecia otherwise; spores larger, 8/ascus

7a Thallus yellowish to greenish, occasionally whitish; apothecia lecanorine; widespread and common, mainly e Cascades

*Rhizoplaca*

7b Thallus brown to black, occasionally grayish or whitish; apothecia lecideine

8a Upper surface conspicuously blistered or warty, the warts typically 1-5 mm diameter and 1 mm or more high; rare disjuncts

*Lasallia*

8b Upper surface variously textured (often rugose) but not conspicuously warty; common

*Umbilicaria*

## Key R: STRATIFIED CYANOLICHENS

Foliose or placodioid crustose, lower surface sometimes veined

1a Thallus with veins on the lower surface (occasionally the veins  $\pm$  obscure); lower cortex absent (appearing dull and fibrous under lens)

2a Medulla white; lower surface never orange. — Common and widespread

*Peltigera*

2b Medulla orange; lower surface orange with brown veins. — On soil, subalpine to alpine, rarely at low elevations; widespread

*Solorina crocea*

1b Thallus without veins on the lower surface or too closely appressed to the substrate to tell; lower cortex present or not

3a Thallus minutely foliose or subfoliose; lobes  $\leq 2$  mm wide

4a On bark or wood or bryophytes or lichens over those substrates

5a Spores slender and  $\pm$  twisted, ca. 4.3 x 1.5-2  $\mu\text{m}$ . — Thallus of blackish-olive appressed lobes; isidia laminal, cylindrical, simple or branched; apothecia dark brown black with a brownish proper margin; California and sw US

(*Koerberia biformis*)

5b Spores ellipsoidal to somewhat elongate, broader than 5  $\mu\text{m}$

6a Spores septate; thallus brown

7a Spores 4-15 septate; thallus cortex of a single layer of cells. — Arctic-alpine to s Oregon; rare

*Arctomia*

7b Spores 1-3 septate; thallus cortex of several layers of cells. — Common in a wide range of climates and substrates, from treetops in old-growth rainforest to mosses on soil in steppe

*Massalongia carnosa*

6b Spores simple; thallus brown or more often some shade of gray

8a Cortex and/or medulla usually P+O; apothecia with thalline margin. — Coastal states and provinces, uncommon

*Pannaria* sens. str.

8b Cortex and medulla P-; apothecia various. — Widespread and common

*Fuscopannaria* and *Parmeliella*

4b On rock, or bryophytes or humus over rock

12a Lower surface thickly covered with a dark hypothallus that become distinctly bluish black

see *Degelia*, *Coccocarpia*, and *Placynthium* below

12b Lower surface otherwise

13a On mosses or humus over rock or bark; thallus brown; lobes never longitudinally ridged

14a Thallus brown or dark brown; lobes isidiate to lobulate; spores septate

15a Spores 4-15 septate; thallus cortex of a single layer of cells. — Arctic-alpine to s Oregon; rare

*Arctomia*

15b Spores 1-3 septate; thallus cortex of several layers of cells. — Common in a wide range of climates and substrates, from treetops in old-growth rainforest to mosses on soil in steppe

*Massalongia carnosa*

14b Thallus gray or brownish gray; lobes isidiate becoming sorediose; spores simple. — Widespread and common

*Fuscopannaria* and *Parmeliella*

13b On rock; thallus blackish, gray green, or olive colored; lobes often longitudinally ridged or striate

15a Lower surface dark, often with bluish black rhizohyphae. — Spores septate; widespread, occasional

*Placynthium*

15b Lower surface pale, without bluish rhizohyphae; thallus green-gray; without bluish black rhizohyphae

16a Thallus lacking isidia and lobules, usually fertile. — Thallus forming rosettes 2 cm diam or more; lobes flat, appressed, often minutely grooved, about 0.4-0.5 mm broad; apothecia to 1 mm diam, with thalline margin; disk brown or dark brown; on damp rock; rare in coastal states and provinces, s to Washington Cascades, more common n into Alaska

*Vestergrenopsis elaeina*

16b Thallus isidiate or lobulate, rarely fertile

17a Lobes laterally fused; lower cortex lacking but with the lower part of medulla densely prosoplectenchymatous; lobules globular to cylindrical, becoming flattened and constricted at the base, leaving pits as scars when detached. — Rare; coastal Alaska, subalpine to alpine

(*Steineropsis*)

17b Lobes contiguous or separate, but not laterally fused; lower cortex present, if rudimentary; isidia very slender and cylindrical but sometimes becoming lobulate, where detached not becoming regularly pitted-scarred. — Mainly in coastal states and provinces inland to Montana

*Vestergrenopsis*

3b Thallus medium to large foliose; lobes > 2 mm wide

20a Lower surface with white or yellow spots or pores (cyphellae or pseudocyphellae) < 2 mm diam

21a Lower surface with broad (generally 0.5-2 mm) whitish craters (cyphellae). — On bark, wood and less often rock; almost entirely w Cascades

*Sticta*

- 21b Lower surface with small (generally < 0.5 mm) white or yellow spots (pseudocyphellae or papillae)  
22a Spots on lower surface white or yellow, concave to slightly convex (pseudocyphellae); apothecia, if present, on the upper surface; upper surface dark brown, brown, gray, or greenish gray.  
xa Upper surface strongly reticulate-ridged, similar to *Lobaria pulmonaria*. — Common on bark and wood (rarely rock) w Cascades, uncommon e Cascades

*Lobaria anomala* and *L. anthraspis*

- xb Upper surface not or only weakly ridged. — Common on bark and wood (rarely rock) w Cascades, uncommon e Cascades

*Pseudocyphellaria*

- 22b Spots on lower surface white, raised (papillae); apothecia on the lower surface of the lobe tips; upper surface brown to gray brown. — Common on bark and wood at low elevations w Cascades, occasional inland to w Montana

*Nephroma resupinatum*

- 20b Lower surface lacking discrete white or yellow spots or pores, but in some spp with whitish patches > 2 mm diameter  
23a Lobes large, usually > 1 cm broad; lower surface with fine tomentum interrupted by naked, white patches; upper surface weakly undulating or with a network of prominent ridges. — On bark, wood, and rock; very common w Cascades, uncommon e Cascades to w Montana

*Lobaria*

- 23b Lobes smaller, usually < 1 cm broad; lower surface without naked, white patches or without tomentum; upper surface weakly or not at all ridged (sometimes strongly ridged in one rare species)  
24a Apothecia on lower surface of lobe tips; thallus brown to gray brown; soredia or lobules present or not. — On bark and wood; widespread, common w Cascades, most spp uncommon e Cascades

*Nephroma*

- 24b Apothecia absent or not on the lower surface; thallus gray, brownish gray, olive, greenish gray, or yellowish; soredia or lobules present

25a Lobules or apothecia present, soredia lacking

- 26a Lobules present, containing green algae, thallus otherwise with a blue-green photobiont; soredia absent. — Thallus to 2 cm diam; rare on conifer branches in old-growth forests w Cascades, BC to Oregon

*Lobaria oregana* (blue-green photomorph)

- 26b Lobules present or not, the whole thallus containing cyanobacteria; apothecia present,  
27a Spores dark and septate; lower surface lacking bluish or blue black rhizohyphae and tomentum. — On soil and moss, especially in calcareous areas, mostly subalpine and alpine

*Solorina*

- 27a Spores hyaline, nonseptate; lower surface often with bluish or blue black rhizohyphae and tomentum  
28a Lower surface thickly covered with a dark felty hypothallus and rhizines that becomes distinctly bluish black; thallus P-. — Arctic-alpine, Alaska and OP

*Coccocarpia erythroxyli*

- 28b Lower surface with whitish or bluish rhizohyphae; thallus P+O (eriodermin). — Alaska

*Erioderma pedicellatum*

[Also in this group, but not yet known from the PNW is *Degelia plumbea* (Lightf.) P. M. Jørg. & P. James. Lobes shallow, such that the thallus appears nearly monophyllous; apothecia, if present, with a prominent margin (proper and/or thalline exciple) in surface view. upper surface gray, brown, or black; thallus thick and rigid, forming roundish, lobate-margined patches to 10 cm diam; upper surface with longitudinal ridges and concentric, lateral, crescent-shaped curves; rare, on mossy rocks, soil, and trees; coastal Alaska, also in e N Am and n Europe]

25b Lobules absent, soredia present

- 31a Soredia mainly laminal; lower surface smooth and bare or faintly pubescent; upper surface yellowish tinged when dry, bluish gray when moist. — Old-growth forests w Cascades, BC to Oregon



*Nephroma occultum*  
31a Soredia mainly marginal; lower surface tomentose; upper surface grayish, not tinged with yellow

32a Upper surface glabrous or marginally scabrous; veins usually prominent although occasionally faint in some small specimens; widespread and common. — On bark, wood, and rock

*Peltigera collina*  
32b Upper surface with matted or erect tomentum; veins lacking; rare coastal species  
33a Upper surface with stiff prominent hairs; with lichen substances (P+O, eriodermin); upper cortex with ± irregular thick-walled cells. — On bark or moss over bark; rare, immediate coast

*Erioderma sorediatum*  
33b Upper surface arachnoid tomentose, never with stiff hairs; usually without lichen substances (P-); upper cortex paraplectenchymatous, with regular, thin-walled cells. — On bark or moss over bark; rare, immediate coast

*Leioderma sorediatum*

## Key S: OTHER GREEN-ALGAL FOLIOSE

Thallus stratified foliose, green-algal photobiont, non-umbilicate)

1a Thallus bright yellow or orange

2a Thallus K+ purple. — Widespread, common, on all substrates

*Xanthoria* and *Xanthomendoza*

2b Thallus K-

3a Lobes generally < 0.3 mm wide and < 2 mm long. — Thallus usually sterile, sorediate; spot tests negative (calycin); bright yellow, yellow green, to green; widespread, mainly on bark and wood

*Candelaria*

3b Lobes generally > 2 mm wide

*Vulpicida*

1b Thallus white, green, yellow-green (especially pale yellow-green) or brown

4a Lobes hollow, partially hollow, or solid but distinctly appearing inflated

5a Lobes solid but swollen and appearing inflated; medulla P-. — Generally on rock, occasionally on moss over rock; subalpine to alpine, fairly common

*Brodoa oroarctica*

[Uncommon forms of *Hypogymnia imshaugii* with solid lobes will key here.]

5b Lobes hollow; substrate and spot tests various

6a Upper surface perforate; thallus closely flattened to the substrate. — Frequent w Cascades, especially on *Alnus*

*Menegazzia*

6b Upper surface not perforate, but lobe tips often perforate; thallus appressed or loosely attached to the substrate

*Hypogymnia*

4b Lobes neither hollow nor appearing inflated

7a Lower surface with distinct or diffuse veins. — Cephalodia often present as superficial grayish warts on the upper surface

*Peltigera*

7b Lower surface not veined, though often variously textured (smooth, wrinkled, warty, etc.)

8a Lower surface mottled with pale to brownish tomentum and irregular bare patches; thallus usually large

*Lobaria*

8b Lower surface variously patterned or smooth but not mottled as above; thallus size various

9a Thallus yellow-green to greenish (containing usnic acid) when dry, but often darkening in exposed habitats. — Thallus medium to small; lobes medium to narrow

*Group S1*

9b Thallus white, gray, greenish gray, brown, or blackish (usnic acid lacking or not apparent)  
10a Lobes narrow,  $\leq 1.5$  mm wide; thallus small, generally  $< 3$  cm broad (Note: occasional narrow lobed forms can be found for most medium- to broad-lobed species; these should be keyed in Group 4)

11a Upper cortex K+Y or K+ dirty Y, light colored; lower surface generally white, occasionally brown or black; upper surface mostly white to gray

**Group S2**

11b Upper cortex K- or cortex too dark to see the K reaction; upper and lower surfaces various

**Group S3**

10b Lobes generally broader, generally  $\geq 1.5$  mm wide; thallus medium to large, often  $> 3$  cm

**Group S4**

### **Group S1**

Medium to small foliose, with faint yellowish tint (usnic acid)

1a Soredia present

2a Upper surface with whitish pores (pseudocyphellae); soredia laminal and marginal

**Flavopunctelia**

2b Upper surface lacking pores; sorediate or not

3a On rock

4a Medulla UV+ white, K-. Lobes often  $> 2$  mm wide; medulla KC+R (alectoronic acid); lower surface often purplish to black. — Arctic and boreal, rare in PNW

**Arctoparmelia**

4b Medulla UV-, K+Y to R; lobes narrow, to 0.5 mm wide; medulla KC-; lower surface black. — Soralia orbicular, capitate; rare

**Xanthoparmelia mougeotii**

3b On bark and wood

5a Lobes largely free of the substrate; thallus pale greenish or yellowish green above, whitish below

**Evernia prunastri**

5b Lobes  $\pm$  appressed to the substrate; thallus brown or black below or too tightly appressed to tell

6a Soredia marginal and/or terminal

7a Lobes narrow,  $< 2(3)$  mm broad; lower surface black; rhizines dichotomously branched and abundant; medulla C-, KC-; substrate various, usually deciduous spp. — Common w Cascades

**Hypotrachyna sinuosa**

7b Lobes medium,  $> 2$  mm broad; lower surface brown; rhizines generally simple, sparse; medulla C+R, KC+R; substrate various. — Mainly e Continental Divide

**Flavopunctelia soredica**

6b Soredia laminal

8a Lobes  $< 2$  mm broad, tightly appressed. — Lower surface so tightly appressed as to make it difficult to observe; soralia laminal, orbicular; widespread, common, especially e Cascades

**Parmeliopsis ambigua**

8b Lobes  $> 2$  mm broad, loosely appressed. — Lower surface black (brown at margins), sparsely rhizinate; upper surface greenish wet or dry; photobiont green; not yet known from our area but common east and s of PNW

**Flavoparmelia caperata**

1b Soredia lacking

9a On bark or wood

10a Thallus suberect, pale greenish; pycnidia mainly marginal and submarginal, black; at low elevations

**Cetraria pallidula**

10b Thallus closely appressed, pale greenish in shade to nearly black where exposed; pycnidia laminal, black; mainly subalpine. — Spores  $\pm$  spherical; apothecia typically present; on conifer branches; mainly subalpine

**Ahtiana sphaerosporella**

9b On soil or rock

11a Lobes broad (usually  $> 3$  mm wide). — Tundra to boreal forest

*Nephroma*

11b Lobes narrow to medium (usually < 3 mm wide). — Widespread

12a On rock, moss over rock, or occasionally soil; thallus erect or appressed; upper surface yellow green or greenish to blackish, lower surface pale tan, brown, or black but differing in color from the upper surface

*Xanthoparmelia*

12b On soil or alpine sod; thallus erect or suberect; upper and lower surfaces of lobes similar in color

*Cetraria nivalis* and *C. cucullata*.

**Group S2**

Narrow-lobed foliose, pale above, cortex K+Y, usnic acid lacking

1a On soil in semiarid sites; apothecial margin lecidine; thallus closely appressed to calcareous soil, upper surface K+ dirty Y. — Uncommon e Cascades

*Buellia elegans*

1b Not on soil; apothecial margin lecanorine; thallus and substrate various; upper surface K+Y

2a Isidia present; thallus closely appressed to bark. — Widespread but uncommon

*Imshaugia aleurites*

2b Isidia lacking; thallus and substrate various

3a Lower surface densely pock-marked with tiny pits (use lens). — Mainly w Cascades

*Hypogymnia*

*Cavernularia*

3b Lower surface not pitted or thallus too closely appressed to easily tell

4a Lower cortex partly or entirely lacking; thallus suberect or loosely attached or appressed; marginal cilia present

5a Cortex lacking only near the lobe tips; soredia, if present, only near the lobe tips

*Physcia*

5b Lower cortex completely to partially lacking; soredia various. — Soredia generally present; medulla K+Y to R (salazinic acid and zeorin); coastal BC to California, coastal, uncommon to rare in our area

*Heterodermia*

4b Lower cortex present or too closely appressed to tell; marginal cilia present or not

6a Soredia present

7a Soralia orbicular and laminal; thallus tightly appressed to bark; spores hyaline, nonseptate. — Thallus K+Y or K-, P-; widespread, common, on bark and wood

*Parmeliopsis hyperopta*

7b Soralia otherwise or, if orbicular and laminal, then growing on rock; spores brown, septate. — Medulla K+Y or K-; widespread and common on all substrates

*Physcia*

6b Soredia absent

8a Disk pale brown to medium brown; spores hyaline, nonseptate; medulla P+ deep Y (thamnolic acid). — e Montana to s RM

*(Imshaugia placorodia)*

8b Disk dark brown to black (or white pruinose); spores brown, septate; medulla P- or P+ pale Y

*Physcia*

**Group S3**

Narrow-lobed foliose; gray (or whitish pruinose), brown or black; cortex K-

1a Thallus brown or brownish black AND on rock

2a Pycnidia marginal, often protruding isidia-like; pseudocyphellae, if present, marginal; lobes often ascending; mostly subalpine to alpine

3a Thallus black below; medulla P+Y-O (often weak), UV-

*Melanelia hepaticon*

- 3b Thallus cream to tan below; medulla P-, UV+ *Cetraria commixta*
- 2b Pycnidia immersed, mainly laminal if present; pseudocyphellae, if present, laminal; lobes and habitat various
- 4a Lower surface lacking rhizines; lobes narrow and thick, often nodulose; pseudocyphellae lacking; mostly alpine *Allantoparmelia*
- 4b Lower surface rhizinate; lobes thin to moderately thick; pseudocyphellae present or not; widespread
- 5a Upper surface gray to brown, often with pale angular markings. — Widespread, common *Parmelia*
- [Dark forms of normally pale gray spp, e. g. *P. omphalodes* and *P. saxatilis*, will key here.]
- 5b Upper surface a rich brown to almost black, lacking angular markings or angular markings very subtle
- 6a Cortex N+ dark blue-green; thallus with globular isidia that often become sorediose; pseudocyphellae lacking. — Widespread, common *Neofuscelia*
- Xanthoparmelia* subg. *Neofusca*
- 6b Cortex N-; isidia present or not; pseudocyphellae present or not
- 7a Medulla C+R, KC+R
- 8a Pseudocyphellae abundant and conspicuous (though often dark) on the upper surface. — Widespread, fairly common *Montanelia*
- 8b Pseudocyphellae lacking or obscure on the upper surface. — Widespread and common *Melanelixia*
- 7b Medulla C-, KC-
- 9a On bark or wood. — Widespread and very common, often abundant *Melanohalea*
- 9a On rock
- 10a Isidia present, cylindrical. — Widespread and common *Melanohalea*
- 10b Isidia absent or present but sometimes becoming lobulate, spatulate, or inflated
- 11a Lobes usually distinctly convex, but sometimes flat or terete; isidia and soredia lacking. — Widespread, occasional in the mountains *Melanelia stygia*
- 11b Lobes ± flat; isidia sometimes present. — Widespread and common *Montanelia*
- 1b Thallus another color OR on another substrate
- 12a Lower surface white to pale brown
- 13a Soredia lacking
- 14a Thallus with few or no marginal rhizines. — Uncommon to rare; on calcareous rock, moss over rock, and alpine sod *Anaptychia*
- 14b Thallus with abundant long, pale marginal rhizines or cilia; on bark or rock
- 15a Lower cortex lacking; on bark. — A common boreal species in e N Am with disjuncts in Alaska and n BC and the immediate coast of w Oregon *Anaptychia crinalis*  
*Anaptychia setifera*
- 15b Lower cortex present; on rock or moss over rock. — Lobe tips lacking hyaline cortical hairs; algal layer ± continuous, the upper surface ± uniformly colored; uncommon e Cascades, most often in crevices in calcareous rock, subalpine to alpine *Phaeophyscia constipata*
- 13b Soredia present
- 16a Lobes very narrow and linear, generally < 0.3 mm broad, with sparse granular soredia or isidia on some lobe tips and margins; lower cortex paraplectenchymatous; occasional (generally overlooked) on bark and rock e Cascades *Phaeophyscia nigricans*
- 16b Lobes broader (mostly > 0.3 mm), with discrete laminal, marginal, or terminal soralia; mainly on *Populus* trunks e Cascades

- 17a Upper surface mostly white pruinose; substrate calcareous rock or thin soil or moss over calcareous rock  
*Anaptychia elbursiana*
- 17b Upper surface weakly or not at all pruinose; substrate usually bark or wood  
18a Lobe tips lacking pale cortical hairs; lower surface always pale below; lower cortex prosoplectenchymatous  
*Physciella*
- 18b Lobe tips with pale cortical hairs (inspect protected areas of the thallus -- the hairs are fragile and often rubbed off); lower surface pale or dark below; lower cortex paraplectenchymatous  
*Phaeophyscia hirsuta*
- 7b Lower surface brown to black or thallus too closely appressed to tell  
24a Lobes suberect or erect  
*Cetraria*
- 24b Lobes ± appressed  
25a Thallus firmly adnate to the substrate  
26a On rock; lower cortex and rhizines lacking but similar in appearance to a minute *Phaeophyscia*, but actually crustose  
*Caloplaca demissa*
- 26b On bark; lower cortex and rhizines almost lacking. Pycnoconidia filiform, generally > 15 µm long; Colorado, Great Plains, and California, at least as far n as Humboldt Co.  
*(Hyperphyscia)*
- 25b Thallus adnate to loose on the substrate but generally easy to separate from it; pycnoconidia otherwise; substrate various  
28a Rhizines squarrosely branched (one exception); upper cortex frequently heavily pruinose; apothecia lacking a corona of rhizines; pale cortical hairs lacking. — Widespread, common, on all substrates  
*Physconia*
- 28b Rhizines simple or sparsely dichotomously branched upper cortex occasionally pruinose; apothecia with a corona of dark rhizines; pale cortical hairs often present on lobe tips, exciple, or isidia. — Widespread, common, on all substrates  
*Phaeophyscia*

### **Group S4**

Medium- to broad-lobed foliose; not yellowish (usnic acid lacking)

- 1a Thallus brown, greenish brown, olive-brown, or brown-black  
2a Thallus erect or suberect, loosely or partially attached or ± free from substrate; rhizines not abundant  
3a Thallus free-living on arctic-alpine tundra, curled into balls when dry, opening when moist. — Lower surface with conspicuous grayish patches (pseudocyphellae); upper surface brown; barely reaching our area in n BC  
*Masonhalea richardsonii*
- 3b Thallus basally attached, prostrate to erect  
*Cetraria*
- 2b Thallus broadly attached to substrate; rhizines generally abundant  
4a Cortex N+ dark blue-green; isidia present, globular, often sorediose; pseudocyphellae lacking; on rock. — Common, particularly in dry exposed habitats  
*Neofuscelia*  
*Xanthoparmelia* subg. *Neofusca*
- 4b Cortex N-; isidia present or not; pseudocyphellae present or not; substrate various  
*Melanelia, Montanelia, Melanelixia, and Melanohalea*
- 1b Thallus gray, greenish gray, or bluish gray, sometimes with browned edges and lobe tips  
7a Thallus erect or suberect, loosely or partially attached or ± free from substrate; rhizines absent to moderately abundant  
8a Upper surface with pseudocyphellae OR lobe margins with black cilia; primarily w Cascades

9a Upper and lower surfaces lacking pseudocyphellae; marginal cilia generally present; lobes medium to broadly rounded, with short crescent-shaped to roundish marginal soralia. — Common near the coast, unknown e Cascades

*Parmotrema*

9b Upper and/or lower surface with small white pseudocyphellae; lobe margins lacking cilia

10a On bark or wood; upper surface gray to greenish gray;

11a Pseudocyphellae on lower surface, prominent; lower surface tan or whitish; lobes very broad (often > 2 cm), lobulate and/or isidiate. — Upper surface pale grayish often with a faint blue-green tinge; uncommon on bark in old growth conifer forests, w Cascades

*Pseudocyphellaria rainierensis*

11b Pseudocyphellae on both upper and lower surfaces, small, ± subtle; lower surface black with brown margins; lobes 0.5-1.5 cm broad, the ends broadly rounded and the edges sorediate. — Medulla K-, C-, KC- or KC+ pink (± perlatolic and imbricatic acids); cortex K+Y (atranorin); w Cascades, uncommon, mainly on riparian *Alnus*

*Cetrelia cetrarioides*

10b On rock, moss, and humus; upper surface yellowish tinged (usnic acid), mottled or edged with black. — Medulla K-, C-, KC+ pink (alectoronic ± alpha-collatolic acid); cortex K+Y (atranorin); arctic-alpine s to n BC

*Asahinea*

8b Upper surface lacking pseudocyphellae AND margins lacking cilia; common inland and on the coast

13a On boulders or humus in tundra; upper surface whitish to tan, black mottled, or mainly black isidiate. — Containing atranorin, alectoronic, and alpha-collatolic acids (medulla KC+ pink); arctic-alpine s to n BC

*Asahinea scholanderi*

13b On bark or wood, rarely on rock; upper surface white to gray or brownish in exposed sites, with or without marginal soredia or isidia

14a Lobes thick; thallus KC+R and/or P+O (physodic and/or physodalic acids); rhizines absent. — Lower surface black, brown near the edges

solid species of *Hypogymnia*

14b Lobes thin (like most foliose lichens); spot tests various but always KC- (physodic and physodalic acids lacking); rhizines sparse

15a Lower surface black (edges may be brown); marginal pycnidia abundant; lobes < 4 mm broad; apothecia or incipient apothecia commonly present; isidia and soredia lacking. — Common in moist forests e Cascades, less often in drier forests and treetops w Cascades

*Esslingeriana idahoensis*

15b Lower surface black, brown, or white, often mottled with those colors; marginal pycnidia apparent or not; lobes often > 4 mm broad; apothecia present or not; isidia or soredia present or not. — Widespread, common

*Platismatia*

7b Thallus broadly attached to substrate; rhizines generally abundant

16a Upper surface with pseudocyphellae or whitish angular markings

17a Lower surface pale brown or tan. — Upper surface with pores; medulla C+R, KC+R (lecanoric acid); uncommon w Cascades, more common in c RM and e N Am

*Punctelia*

17b Lower surface black (generally brown edged)

18a Upper surface with whitish angular markings (either conspicuous or subtle); isidiate, sorediate, or with neither; chemistry various. — Common and widespread

*Parmelia*

18b Upper surface with prominent roundish pseudocyphellae; soredia present; medulla C+R, KC+R (gyrophoric acid)

*Punctelia stictica* and *P. borrieri*

16b Upper surface lacking pseudocyphellae

21a Soredia and isidia lacking; margins sparsely to moderately ciliate; mainly on deciduous trees; California, to sw Oregon

*Parmelina coleae*

[*Parmelina yalungana*, which is morphologically essentially identical to *P. coleae*, is present in s-

- central Alaska.]
- 21b Soredia or isidia present
- 22a Soredia lacking, isidia present, the isidia becoming ciliate. — Medulla K+Y, C-, P+O (stictic acid); n California to BC, mainly near the coast, fairly common
- Parmotrema crinitum*
- 22b Soredia present, isidia lacking; lobes with marginal cilia or cilia lacking
- 23a Lobes typically > 3 mm wide; soredia generally powdery. — Lobe margins usually conspicuously ciliate; medulla K+Y or K+O and UV-(stictic or salazinic acid) or K- and KC+R (alectoronic if UV+ or lecanoric acid if UV-); common on bark, occasionally on rock, w Cascades, especially near the ocean
- Parmotrema*
- 23b Lobes typically < 3 mm wide; soredia pustulate or granular
- 24a Lobe margins sparsely ciliate; rhizines mostly simple. — Upper surface turning coarsely pustulate sorediate; on rock and soil; Colorado
- (Parmelinopsis swinscowii)*
- 24b Lobe margins lacking cilia, rhizines sparsely or densely dichotomously branched
- Hypotrachyna*

## Key T: BLACKISH FILAMENTOUS

- 1a Filaments or lobes > 2 cm long and > 0.1 mm in diameter; photobiont a single-celled green alga
- 2a Thallus forming black, richly branched, prostrate flat mats on siliceous rock
- Pseudephebe*
- [Narrowly divided forms of *Melanelia stygia* and *Allantoparmelia alpicola* may key here. The former has prominent pseudocyphellae which are absent on *Pseudephebe* and *Allantoparmelia*. *Allantoparmelia* has thickish (0.2-1 mm), often nodulose, branches.]
- 2b Thallus color various, sparsely branched, prostrate or erect; substrate various but most common on trees
- Bryoria*
- 1b Filaments or lobes < 2 cm long or less than 0.1 mm in diameter; photobiont blue-green or the filamentous green alga *Trentepohlia*, often filamentous (LM needed to proceed with confidence from this point)
- 3a Filaments very fine, main branches < 30  $\mu\text{m}$  (= 0.03 mm) diameter
- 4a Filaments 18-28  $\mu\text{m}$  diam, ca 2 mm long; photobiont a single *Scytonema* filament with a gelatinous sheath permeated by hyphae; branching is frequently one-sided; range of habitats uncertain. — On rock (both calcareous and siliceous), possibly overlooked; se Alaska
- Thermutis velutina*
- 4b Filaments ca 12-20  $\mu\text{m}$  diam, often > 2 mm long; photobiont a single *Trentepohlia* filament (no gelatinous sheath) enveloped by hyphae; on shaded, vertical or overhanging, moist noncalcareous rock
- 5a Fungal hyphae very irregular and bent, only partly coalescing. — Widespread, possibly fairly common but seldom collected
- Cystocoleus ebeneus*
- 5b Fungal hyphae parallel and straight to somewhat knobby, coalescing. — Washington, BC and n
- Racodium rupestre*
- 3b Filaments or lobes more coarse, main branches generally > 40  $\mu\text{m}$  diameter
- 7a Photobiont single-celled or colonial (*Gloeocapsa* or *Chroococcus*-like), not filamentous; thallus erect or cushion forming
- 8a Photobiont cells surrounded by reddish, K+ purple sheaths; thallus of club-shaped, terete lobes forming small cushions; asci with 16 or more spores. — Widespread
- Synalissa*.
- 8b Photobiont cells surrounded by yellowish brown sheaths, K-; lobes various; asci with 8, 16, or more spores
- 9a Lobes with a single or a few central strands in a fountain-like arrangement; apothecia concolorous with the thallus, blackish olive when wet; spored 16-32/ascus; hymenium lacking red blotches; conidia bacilliform. — Thallus cushion forming, upright, repeatedly bifurcate; on siliceous rock; Colorado and California n to Oregon

*Lichinella stipatula*

[*Paulia caespitosa* Treliach & Henssen, known from sw N Am, is similar but has dense branching forming a dense cushion and the branching is less clearly dichotomous than in *Lichinella stipatula*.]

- 9b Lobes with a distinct central strand of parallel hyphae; apothecia dark reddish or black when wet; spores 8/ascus; hymenium with red blotches; conidia filiform, sigmoid or sickle-shaped. — Mainly reported from calcareous substrates in sw deserts and Great Plains

*Peccania*

- 7b Photobiont filamentous (*Nostoc*, *Rhizonema*, *Stigonema*, or *Hyphomorpha*); thallus erect or decumbent

10a On rock, mosses over rock, soil, or moss over soil

- 11a Thallus a sprawling mat or cushion of fingerlike lobes about 0.1-0.2 mm thick and 1-2 mm long; photobiont *Nostoc*; branches often tipped with swellings (hormocystangia) producing vegetative propagules (hormocysts) with a few cyanobacterial cells and fungal hyphae. — On calcareous rock; Arizona, Montana

*Lempholemma cladodes*

- 11b Thallus a mat or cushion, the lobes either more slender or longer or both; photobiont various; branches without hormocystangia

12a Thallus mat forming; on rock

- 13a On calcareous rock where moist; spores generally 8-24/ascus; photobiont *Rhizonema* (*Scytonema*-like; single-rowed filaments, with ± paired, parallel branches with divergent tips, the tips not tapered); thallus threadlike, erect to decumbent, forming clumps or mats; hyphal cells ± angular, in rows; apothecia to 0.4 mm diam. — Rare, on calcareous rock

*Zahlbrucknerella*

- 13b On siliceous or calcareous rock, often where moist; spores 8-16/ascus; photobiont *Stigonema* (multiple-rowed filaments, with true branches not conspicuously paired and parallel); thallus in cushions or mats; hyphal cells and apothecia various

14a Blue-green rhizohyphae present (LM); thallus short-filamentous in cushions or mats 5-15 mm broad to 6 mm high; hyphae forming an irregular network overlaid on the much larger photobiont cells. — Spores nonseptate, about 10 µm long; on moist noncalcareous rock, both coastal and interior, commonly intermixed with the olive brown squamules of *Psorula rufonigra*; widespread

*Spilonema revertens*

[Other *Spilonema* spp, e.g. *S. paradoxum* Born. are mat forming]

- 14b Blue-green rhizohyphae absent; thallus in cushions or prostrate mats; hyphae with angular, rounded, or elongate cells arranged in rows or netlike patterns. — On moist calcareous or noncalcareous rock

*Ephebe*

- 12b Thallus cushion forming; substrate various

15a Photobiont *Stigonema*. — Widespread

*Spilonema*

15b Photobiont *Nostoc* or *Rhizonema* (*Scytonema*-like)

- 16a Spores brown, 2- to 4-celled; on soil and mosses; arctic-alpine to montane; cushion formed from branched cephalodia, the thallus highly reduced. — Widespread but rare

*Solorina spongiosa*

16b Spores hyaline, spores multicellular to muriform; on all substrates; cushion formed by the thallus, not the cephalodia

- 17a On mosses over rock; spores 2-celled; thallus densely cushion forming, richly branched, with glossy round branches; apothecia usually present. — Widespread and common

*Polychidium muscicola*

- 17b On various substrates including moss over rock; spores multicellular to muriform; thallus minutely fruticose or more often with fruticose projections from a dorsiventral thallus. — Widespread, fairly common

*Leptogium* and *Scytinium*

10b On bark

- 18a Hyaline hairs present on branch surfaces (LM); on bark. — Occasional, w Cascades



**“Dendriscocaulon”**

[“*Dendriscocaulon*” is catch-all name for fruticose blue-green photomorphs of multiple taxa, including a *Sticta* and *Lobaria*]

18b Hyaline hairs not present on branch surfaces; substrate various

19a Cortical cells in a jigsaw pattern. — Photobiont *Rhizonema* (*Scytonema*-like); coastal se Alaska to w Oregon; seldom collected

***Leptogidium contortum***

19b Cortical cells lacking or indistinct, irregular, or forming a mosaic, but not in a jigsaw pattern

20a Photobiont *Nostoc*, in short beaded chains

21a Thallus of minutely and richly dissected squamules, becoming isidioid or in part minutely fruticose, the lobes 60-120 µm wide, ecorticate or indistinctly corticate with two layers of cells; spores nonseptate; apothecia lacking photobiont in the exciple. — Rare; Alaska, BC, and Washington

***Santessoniella***

21b Thallus various, corticate with one layer of cells; spores muriform; apothecia usually with photobiont in the exciple. — Widespread, fairly common

***Leptogium* and *Scytinium***

20b Photobiont *Gloeocapsa*, *Hyphomorpha*, *Rhizonema*, or *Stigonema*, not forming distinctly beaded short chains

22a Photobiont colonial, *Gloeocapsa*-like. — Surface with hyaline knobs but not corticate; branches mostly short, ca. 35 µm diam, in minute fruticose clusters; on *Abies*, summit of coastal mountain (Example: Oregon, Clatsop Co., *McCune 26126*)

**unknown *Lichinodium*-like**

22b Photobiont filamentous, *Stigonema*, *Hyphomorpha*, or *Rhizonema* (*Scytonema*-like)

23a Branches ± flattened. — Branches 20-50 µm wide and to 0.2 mm long, forming tiny cushions to 3 mm across; photobiont *Rhizonema*, the cells 8-9.5 µm in diameter, surrounded by a fungal envelope of hyaline, angular, isodiametric cells 7-8 µm in diameter; rhizohyphae abundant, non-septate, threadlike; on bark with *Leptogidium contortum*; QCI

***Unknown species***

[Initially reported as *Dictyonema moorei* (Nyl.) Henssen by Brodo (1995, *Mycotaxon* 56:135-173), this specimen was later determined by Brodo to be an unknown, perhaps undescribed species (see Goward 1999, p. 293, treated as Unknown 2).]

23b Branches round

24a Photobiont *Hyphomorpha*; basal portions with rhizohyphae. — Surface cells short-elongate, length:width about 2:1 to 4:1; on conifer twigs in coastal forests; se Alaska and BC to OP of Washington

***Erinacellus dendroides***

24b Photobiont *Rhizonema* (filaments ± paired); basal portions lacking rhizohyphae

26a Branches often somewhat constricted at the base or elsewhere; branches covered by a monolayer cortex of small cells that are not at all elongate; exciple lacking. — On bark of conifers and *Betula*; coastal Alaska to Oregon, very rare

***Spilonema americana***

26b Branches filamentous without constrictions; exciple smooth or lacking

27a Thallus very small, < 3 mm diam, dull blackish. — Cortical cells irregularly angular; on conifer twigs, rock, and lichens; coastal Alaska to BC

***Lichinodium***

27b Thallus usually > 3 mm diam, ± shiny gray. — Distribution in PNW poorly known

***Polychidium***

## Key U: FRUTICOSE, HOLLOW STALKS

- 1a Stalks tipped with bright red apothecia. — Widespread, common  
*Cladonia*
- 1b Stalks tipped with brown apothecia or apothecia lacking
- 2a Stalks richly branched (generally branched more than 5 times over the length of a mature individual), the branch tips pointed. — Widespread, common  
*Cladonia*
- 2b Stalks simple to few-branched, pointed, blunt or tipped with cups
- 3a Thallus wholly of erect to prostrate stalks, lacking squamules; habitat mainly subalpine to alpine
- 4a Thallus yellowish brown to brownish, or yellowish green, occasionally purplish brown; stalks blunt
- 5a Thallus yellowish green; podetia branched. — Alpine, rare  
*Allocetraria*
- 5b Thallus yellowish to brownish; podetia branched or not. — Alpine, rare  
*Dactylina*
- 4b Thallus white to cream; stalks pointed or blunt
- 6a Stalks pointed; habitat cold, periodically dry. — Apothecia absent; suberect or prostrate on alpine sod and detritus; mainly at high elevations where it is fairly frequent  
*Thamnolia*
- 6b Stalks blunt; habitat wet sites in coastal bogs or damp coastal tundra. — Fairly common in coastal Alaska, rarer southward  
*Siphula ceratites*
- 3b Thallus differentiated into a basal, crustose to squamulose primary thallus and an erect secondary thallus (podetia); habitat various
- 7a Podetia unbranched, short (generally < 1.5 cm), mostly naked and ending in a brown to pinkish apothecium; primary thallus continuous, warty-squamulose. — Widespread, common  
*Baeomyces*
- 7b Podetia unbranched or branched, short or tall, often bearing squamules or soredia; primary thallus squamulose, generally persistent but sometimes disappearing. — Widespread, common  
*Cladonia*

## Key V: FRUTICOSE, NOT HOLLOW STALKED

- 1a Thallus yellow to orange
- 2a Thallus minute (gen < 2 cm long)
- 3a Soredia present
- 4a Thallus dwarf erect fruticose, generally < 5 mm high; not fibrillose. — On rock, bark, and wood; widespread  
*Xanthoria candelaria*
- 4b Thallus small, prostrate to suberect fruticose, generally > 5 mm diameter; lobes ± fibrillose. — On calcareous rock in sheltered crevices in cold dry habitats  
*Seiophora contortuplicata*
- 3b Soredia lacking
- 5a On seashore rocks in spray zone. — Occasional, Oregon s to Baja California  
*Caloplaca coralloides*
- 5b On woody plants
- 6a Thallus a knobby, short-branched, yellow to orange, typically forming compact globular clusters on twigs; apothecia generally present. — Abundant mainly in valleys, widespread  
*Xanthoria*
- 6b Thallus of short, branched, orange filaments, the filaments erect and forming a mat generally < 5 mm high; apothecia absent. — Common in many habitats  
*Trentepohlia* (an alga)
- 2b Thallus medium to large (gen > 2 cm diameter)
- 7a Thallus orange. — On conifers; rare, immediate coast, Oregon and California  
*Teloschistes flavicans*

7b Thallus bright yellow to fluorescent green. — On bark and wood; common, especially in drier conifer forests, savannas, and isolated trees

*Letharia*

1b Thallus another color

11a Thallus of compact, massed, stalked squamules, branches, or lobes, not filamentous

12a Thallus straw-colored, cream, or white

13a Stalks (actually long isidia) white, very slender (generally < 0.2 mm diam), unbranched or sparingly dichotomous branched, to about 2 mm long, closely set but not forming a continuous mass. — On bark and wood; common in Coast Range

*Loxosporopsis corallifera*

13b Stalks thicker than 0.2 mm, straw-colored, cream, or white, thickish, forming a continuous mass; substrate various

14a On inland rock, montane to alpine

*Lecanora argopholis* and *L. swartzii*

14b On seacoast rock

15a Thallus whitish; medulla tough, cartilaginous, algae present throughout, the inner parts green; apothecia terminal. — Thallus of short, thick, blunt, often branched stalks about 0.5-1 mm wide and mostly < 1 cm tall; surface usually thickly white pruinose; disk pinkish tan with whitish pruina; on rock; coastal California to Oregon

*Cladidium bolanderi*

[*Cladidium bolanderi* has the general appearance of an exuberant *Ochrolechia*, while the next species, *L. phryganitis*, looks macroscopically like a giant *Leprocaulon americanum*.]

15b Thallus pale yellowish green; medulla solid but rather soft, algae restricted to near the surface, the inner part white; apothecia lateral. — On steep rock faces and soil, coastal California

(*Lecanora phryganitis*)

12b Thallus brown, dark brown, or blackish green

16a Spores minute (< 6 µm long), many/ascus; thallus brown above, black below, of stalked, flat-topped squamules; cortex KC+R. — On rock; fairly common steppe to alpine

*Acarospora thamnina*

16b Spores larger, < 8/ascus; thallus and spot tests various

17a Spores hyaline, septate or nonseptate

18a Spores septate; on rock

*Lecania*

18b Spores nonseptate; on siliceous rock or moss over rock

19a On moss or detritus over rock; thallus light brown, gray, or dark gray. — Areoles swollen-verruculose to stalked, apothecia black ± grayish pruinose, convex; spores (11)15-19(26) x 5-7(9); medulla UV+ blue white; on cushion-forming bryophytes on rock; montane to subalpine or alpine; Alaska to Montana and Oregon

*Frutidella caesioatra*

19b On siliceous rock; thallus dark green, black, or dark brown

20a On sheltered siliceous rock, especially beneath overhangs; thallus dark greenish black to brown black; apothecia not obviously differentiated externally but blending smoothly with the contour and color of the lobe tips; medulla K+Y and/or P+Y. — Occasional, Cascades and RM

*Lecanora pringlei*

20b On exposed siliceous rock; thallus dark brown to black or olive black; apothecia readily recognizable in form but similar in color to the thallus; spot tests negative. — Occasional on ridges and mountaintops mainly in the Cascade Range

*Cornicularia normoerica*

17b Spores brown, septate; on rock or moss over rock

21a Spores 1-septate, in apothecia sessile on the thallus; thallus dark brown, of stalked areoles. — Apothecia black, sessile; widespread but only occasional

*Buellia badia*

21b Spores muriform, in perithecia embedded in the thallus; thallus brown to grayish brown, of massed lumpy and twisted fingerlike lobes. — Occasional in RM

*Endocarpon*

- 11b Thallus not of massed, stalked squamules
- 22a Thallus free-living (loose) on soil
- 23a Thallus gray, olive, or brown above (usnic acid lacking)
- 24a Branches dorsiventral but tightly rolled, gray or brown above, brown to black below; spores borne in perithecia but mostly sterile. — On thin soil over rock, especially basalt; nearly flat, exposed, poorly drained areas
- Dermatocarpon*
- 24b Branches round, not dorsiventral, olive, brown, greenish, or greenish gray; spores borne in apothecia but mostly sterile. — Thallus prostrate, branched, mat forming or spherical and erect; widespread in semiarid steppe and grasslands
- Aspicilia*  
[including *Circinaria* spp.]
- 23b Lobes pale greenish to yellow green (usnic acid present)
- 25a Lobes not dorsiventral, roundish in cross section. — Medulla K-, P-; rare on rocky calcareous flats at mid to high elevations, mainly in se Idaho and Wyoming
- Rhizoplaca haydenii*
- 25b Lobes dorsiventral, flat or rolled
- 26a Medulla K-; thallus of broad lobes that are somewhat divided and rolled under but not repeatedly branched; rhizines always lacking. — Widespread but uncommon in barren rocky habitats, mostly at mid to high elevations
- Rhizoplaca*
- 26b Medulla K+Y, O, or R, rarely K-; thallus of elongate lobes that are repeatedly branched; rhizines often present. — Widespread and common in semiarid areas e Cascades
- Xanthoparmelia*
- 22b Thallus attached, substrate various
- 30a Thallus brown to black, olive black, pale brown, or grayish brown
- 31a On bark or wood
- 32a Thallus reddish brown; soredia and isidia lacking
- 33a Thallus tufted and erect. — Widespread and common, especially e Cascades
- Nodobryoria abbreviata*
- 33b Thallus pendent
- 34a Pseudocyphellae present, small punctiform; medulla and pseudocyphellae C+R, KC+R (olivetic acid). — Coastal Alaska and BC
- Bryocaulon pseudosatoanum*
- 34b Pseudocyphellae absent; medulla with all spot tests negative. — BC to San Diego; common, especially Cascades and moist conifer forests e Cascades
- Nodobryoria oregana*
- 32b Thallus olive, brown, black, or grayish brown; soredia or isidia present or not
- 36a Thallus pendent or subpendent
- 37a Branches flattened and twisted, distinctly furrowed, dull brown to yellowish brown; isidia and soredia lacking; cortex K+Y (atranorin), P+ pale Y diffusing onto paper. — On well-lit trees at low elevations; OP (extirpated?) to n California; rare
- Sulcaria badia*
- 37b Branches and chemistry otherwise
- 38a Main branches with very long (often > 2 mm long), slender, pale pseudocyphellae. — Coastal, rare
- Sulcaria*
- 38b Main branches with long to short pseudocyphellae or lacking pseudocyphellae — Widespread, common
- Bryoria*
- 36b Thallus tufted
- 39a Thallus a delicate tuft, on trees or shrubs near the coast; thallus color pale to dark olive brownish or olive black. — Occasional in its restricted habitat
- Cetraria californica*
- 39b Thallus and habitat otherwise; color various. — Widespread and common
- Bryoria*

- 31b On soil, rock, or alpine sod  
 40a Thallus of erect, ± flattened lobes (though sometimes channeled or tubular). — Fairly common, mainly at mid to high elevations  
*Cetraria (islandica group)*
- 40b Thallus of branches that are ± round or angular in cross section  
 41a Thallus reddish brown  
 42a Pseudocyphellae absent; medulla C-, KC-; thallus decumbent. — Uncommon, alpine, RM and Cascades  
*Nodobryoria subdivergens*
- 42b Pseudocyphellae present; medulla C+R or C-, KC+R or KC-; thallus decumbent or erect  
 43a Medulla C+R, KC+R; thallus forming loose turfs or sprawling; mainly arctic  
*Bryocaulon divergens*
- 43b Medulla C-, KC-; thallus often forming ± compact turfs. — Common in arctic-alpine to exposed subalpine habitats  
*Cetraria aculeata* and related species
- 41b Thallus olive, brown, tan, or black  
 44a Thallus forming compact tufts of thick branches, dark brown to black or olive black; spot tests negative; attached firmly to subalpine or alpine rocks — Occasional on ridges and mountaintops mainly in the Cascade Range  
*Cornicularia normoerica*
- 44b Thallus of slender branches, color and spot tests various; on soil, alpine sod, or rock  
 45a Thallus generally black, pale brown or straw-colored at the base; cortex and medulla KC+R, P+ yellowish (alectorialic and barbatolic acids). — Rare in our area; arctic-alpine s to New Mexico and Washington  
*Gowardia (Alectoria) nigricans*
- 45b Thallus color various; spot tests otherwise. — Infrequent, mainly subalpine to alpine  
*Bryoria*
- 30b Thallus some shade of gray, green, yellow-green, or whitish (sometimes with dark mottles)  
 47a Cortex lacking; thallus whitish or pale yellowish green, of minute, delicate pseudopodetia forming a short, leprose-appearing turf  
 48a Thallus containing usnic acid, lacking atranorin. — Seldom collected; coastal rocks; reported inland to S Dak but inland records need to be confirmed  
*Leprocaulon americanum*
- 48b Thallus lacking usnic acid, containing atranorin. — Widespread, common  
*Lepraria*
- 47b Cortex present; thallus color various  
 49a Thallus white, gray, olive gray, or brownish white (usnic acid lacking)  
 50a Thallus of mostly unbranched stalks, generally < 2 cm long  
 51a Ascocarp a mazaedium produced at the tips of a short stalk.  
 52a Thallus white or pale yellowish white; stalks often > 1 mm diam; medulla deep yellow to orange. — On bark or wood, less often on rock; rare  
*Acroscyphus sphaerophoroides*
- 52b Thallus pale gray to greenish gray; stalks < 1 mm diam; medulla white. — Usually on conifer twigs in exposed subalpine habitats; infrequent; Alaska to Oregon  
*Tholurna dissimilis*
- 51b Ascocarp not forming a mazaedium or ascocarps not found  
 53a Stalks (actually long isidia) < 2 mm high and < 0.2 mm thick, white. — On bark or wood; Coast Range, rarely in Cascades; Alaska to n California  
*Loxosporopsis corallifera*
- 53b Stalks generally > 5 mm high or > 0.5 mm thick, grayish to greenish gray, sometimes brownish in exposed habitats; on rock, wood and soil  
 54a On rock (rarely wood); stalks commonly tipped with black apothecia. — Common w Cascades, uncommon to rare e Cascades, inland to n Idaho  
*Pilophorus*

54b On soil and organic mats; stalks never with apothecia. — Coastal bogs and wet tundra; BC, Alaska

*Siphula ceratites*

50b Thallus otherwise: branched, mostly > 2 cm long

55a Spores produced in apothecia; stalks lumpy and/or fuzzy, with minute cauliflower-like outgrowths and conspicuous or obscure cephalodia; mostly on rock or moss over rock. — Widespread, common

*Stereocaulon*

55b Spores produced in a mazaedium; stalks smooth and glossy, without cephalodia; mostly on trees

56a Stalks distinctly flattened in cross section. — Rare, Alaska s to OP near the coast

*Bunodophoron melanocarpum*

56b Stalks roundish to irregular or slightly flattened in cross section. — Common on conifers w Cascades, uncommon e Cascades to Idaho, where it is rare

*Sphaerophorus*

49b Thallus yellowish green to pale green (containing usnic acid)

60a Main branches with a tough central cord; most spp with numerous perpendicular branchlets. — Widespread, common

*Usnea*

60b Main branches without a central cord; most spp with few or no perpendicular branchlets

61a On alpine sod. — Branches soft, the cortex often cracked and eroding; RM

*Evernia divaricata*

61b On bark or wood, rarely on rock

62a Branches greenish above, whitish below, flat, dorsiventral. — Mainly on trees and shrubs; abundant at low elevations w Cascades, occasional e Cascades

*Evernia prunastri*

62b Branches not differentiated into an upper and lower surface

63a Branches becoming black spotted, relatively soft and flaccid even when dry. — Soredia present; on coastal trees, occasionally rock; rare

*Niebla cephalota*

63b Branches not black spotted, except when parasitized or diseased, ± tough and cartilaginous when dry

64a Thallus flat to irregular in cross section; isidia lacking

65a Main branches irregularly perforate into a ± hollow interior, slender, the tips often intricately divided; thallus generally < 4 cm long. — Common w Cascades, uncommon e Cascades in moist forests;

*Ramalina* (subg. *Fistulariella*)

65b Main branches not perforate into a ± hollow interior (although sometimes forming nets at the tips of the branches), narrow or broad, generally not intricately divided at tips; thallus generally 2-100 cm long. — Common on woody plants w Cascades, infrequent e Cascades to w Montana

*Ramalina*

64b Thallus roundish in cross section

66a Branch tips tightly curled into a tiny fiddlehead with minute terminal soralia; main branches generally < 1 mm, without prominent elongate pseudocyphellae. — Occasional, conifer forests near streams in mountains

*Ramalina thrausta*

66b Branch tips curved or straight but not curled; main branches becoming thick (often > 1 mm), with subtle to obvious elongate spiraling pseudocyphellae

*Alectoria*

[Some *Bryoria* species are occasionally pale enough to key here, including some forms of *B. trichodes* (K-, P+R, KC-) and *B. capillaris* (thallus K+ strong Y, P+Y, KC+ pale O)]

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## GLOSSARY

- acicular**: Long, very slender, and pointed, needle-like.
- adnate**: Closely appressed to a surface.
- amyloid**: Reacting positively (blue, violet, or black) to iodine solutions (IKI or Melzers) and therefore containing certain polysaccharides.
- anastomosing**: Fusing and interwoven hyphae, branches, or veins; making a network.
- anisotomic**: Applied to dichotomous branching with unequal-sized branches.
- apotheci(um)(a)**: A sexual reproductive structure of the fungus; usually a disk- or cup- shaped structure lined with, at maturity, an exposed spore producing surface.
- arachnoid**: Cobwebby.
- areolate**: Divided by cracks into small areas, often forming a mosaic.
- asci**: See ascus.
- ascocarp**: (= ascoma) The sexual reproductive body of an ascomycete, usually consisting of covering or supporting layers and the hymenium.
- ascomycete**: An organism in the Class Ascomycetes (or Subdivision Ascomycotina) producing spores in sacs (the asci).
- ascospore**: A spore produced in an ascus.
- ascus (asci)**: A sac-like structure, usually opening at the tip, in which sexually produced spores are borne.
- bacilliform**: Short rod-shaped, with rounded ends, like *Bacillus* bacteria.
- basidiomycete**: An organism in the Class Basidiomycetes (or Subdivision Basidiomycotina) producing spores at the tips of specialized, usually club-shaped cells, the basidia.
- biatorine**: an apothecium with a reduced true exciple when mature and generally pale colored and convex to strongly convex.
- bifurcate**: Dichotomously branched or forked.
- bitunicate**: (= fissitunicate) An ascus having two functional wall layers, the ascus discharging by extension of the inner wall layers which rupture the outer wall.
- blastidia**: Asexual propagules containing both the photobiont and fungus, rather like soredia, but relatively coarse, partly corticate, and budding like yeast.
- bullate**: Bulging upwards, usually applied to areoles that are thick and convex, or bubble-like.
- bysoid**: Cottony, made up of very fine threads.
- calcareous**: Substrates rich in calcium carbonate (lime), usually applied to rock, especially limestone (fizzes in 1 M HCl) and dolomite (fizzes in 6 M HCl).
- capitate**: An expanded head- or cap-like structure at the tip of a stalk or nearly sessile, usually applied to apothecia and soralia.
- carbonaceous**: Carbon- or charcoal-like: blackened and often easily broken.
- cephalodia**: Cyanobacteria-containing structures in otherwise algal-containing lichens, usually appearing as irregular warts or inclusions, occasionally squamulose or minutely fruticose.
- cilia**: Hair-like projections, usually applied to threadlike multicellular marginal hairs.
- clavate**: Club shaped.
- concolorous**: Having the same color.
- confluent**: Running together or merging.
- coralloid**: Coral-like, having dense, repeated branching of fine segments.
- cortex**: The outer "skin" of lichens, generally ± smooth, often glossy, composed of closely packed fungal hyphae.
- corticate**: Having a cortex.
- corticulous**: Growing on bark, or, more loosely applied to growing on bark or wood.
- crustose**: A crust-like growth form of lichens that is closely applied to the substrate, like paint, generally attached by all of the lower surface and lacking a lower cortex and rhizines.
- cyanobacteria**: prokaryotic photosynthetic organisms formerly known as "blue-green algae", generally having a blue-green tint and lacking chloroplasts.
- cyphellae**: Crater-like pores, usually in the lower surface of lichens, that open into the medulla and are lined with differentiated cells; characteristic of the genus *Sticta*.
- decorticate**: Lacking a cortex but formerly with one.
- decumbent**: Reclining, but not closely appressed to a surface, often with the ends upturned.
- decurrent**: Lamellae (gills) in basidiomycetes that taper gradually as they extend down the stipe.
- dichotomously branched**: Y-shaped branching.
- disk**: In surface view of an apothecium, the central part enclosed by, but not including, the margin. Anatomically the disk is the upper surface of the hymenium in apothecia.
- dorsiventral**: Having differentiated upper and lower surfaces.
- endolithic**: Growing immersed in rock, with only the fruiting structures protruding.
- endophloedal**: Growing within bark, with only the fruiting structures protruding. (Although the name implies growing within the phloem, the term is used more broadly.)
- epihymenium**: A layer on the surface of the hymenium,

sometimes applied strictly as a layer of branched and interwoven hyphae above the tips of the asci, but interpreted more broadly by most lichenologists to refer to any surface differentiation of the hymenium. Often used synonymously with "epithecium".

**epinecral:** A surface layer composed of dead cortical cells with indistinct lumina.

**epithecium:** The surface layer of the hymenium, sometimes applied strictly to the branched ends of paraphyses above the asci, but interpreted more broadly by most lichenologists to refer to any surface differentiation of the hymenium, usually consisting of the tips of the paraphyses embedded in a colored gelatinous substance. Often used synonymously with "epihymenium".

**epruinose:** Lacking pruina.

**exciple:** (= excipulum) The usually cup-shaped part of an apothecium or walls of a perithecium that contains the hymenium.

**excipuloid:** Like an exciple but not a true exciple.

**fibril(s)(lose):** A small fiber projecting from the thallus, roundish in cross section, usually produced at  $\pm$  right angles to the direction of growth, usually applied in *Usnea*.

**fissured:** Having fissures or vertical cracks.

**foliose:** A "leaf-like" growth form with dorsiventral lobes that is usually loosely to tightly appressed, 2-dimensional or weakly 3-D, and usually with a cortex on upper and lower surfaces.

**foveolate:** With delicately pits or shallow surface depressions

**fruticose:** A 3-dimensional growth form not differentiated into upper and lower surfaces, including pendulous and stringy, upright, or bushy, or with a 2-part thallus of primary squamules and upright stalks.

**fusiform:** Long, narrow, cigar-shaped or spindle-shaped, tapering toward the ends.

**glabrous:** Smooth and not hairy.

**gyrodisk:** An apothecial disk with numerous concentric fissures.

**halo:** see halonate.

**halonate:** Spores with a faint to prominent halo (transparent coating), external to the cell wall.

**hapters:** Short, peg-like attachments of the lower surface of lichens to the substrate.

**heterocysts:** In cyanobacteria the cells specialized for nitrogen fixation and usually clearly differentiated and bulging as compared to the surrounding cells.

**heteromerous:** A thallus that is distinctly layered, usually with a white layer, with the photobionts in a distinct band, as opposed to homoiomerous where the photobiont is spread throughout the cross-section of the thallus and a white medullary band is lacking.

**homoiomerous:** A thallus where the fungus and photobiont are not separated into distinct bands;

most of these have a dark, gelatinous texture.

**hyaline:** Transparent and colorless.

**hymenium:** The spore-bearing layer of fungal reproductive structures.

**hypha(e):** Fungal filaments.

**hyphophores:** small, erect, asexual, spore-producing bodies that may be peltate, fringed, top-shaped, or simple and awl shaped; commonly found in the genus *Gyalideopsis*.

**hypothallus:** (used here = prothallus) A thin, tightly appressed fungal layer differentiated below the main portion of the thallus. A more restrictive use refers to a spongy tissue on the underside of certain lichens, while the prothallus is the initial hyphal mat from which a lichen develops, and often visible as an appressed fringe along the edges of the thallus or areoles.

**hypothecium:** (= medullary excipulum) The fungal layer just below the subhymenium, but often applied more loosely to any tissues below the hymenium, including the subhymenium.

**intercalary:** Inserted between two cells.

**intermontane:** The region of valleys, plateaus, and hills occurring between the main masses of the Rocky Mountains and the Cascade Range.

**isidia:** Asexual reproductive structures that are minute and finger-like or globular, branched or not, covered with a cortex, and containing the photobiont.

**isodiametric:** Having approximately equal diameters in all directions.

**isotomic:** Applied to dichotomous branching with equal-sized branches.

**laminal:** Occurring on the lobe surface, as oppose to the lobe margins.

**lecanorine:** (= thalline) Apothecial margins that are colored like the thallus and usually unlike the disk and usually contain the photobiont.

**lecideine:** (= proper) Apothecial margins that are colored like the disk and unlike the thallus and usually lack the photobiont.

**lecideoid:** *Lecidea* like (sens. lat.).

**lenticular:** Lens-shaped (double convex).

**leprose:** A thallus that is entirely composed of granular or more often powdery soredia and without any cortex, even in young stages.

**lichenicolous:** Growing on lichens.

**lichenized:** A fungus that has an intimate mutualistic association with a photosynthetic partner.

**lignicolous:** Growing on lignum (bare wood).

**lirella(e):** An form of an ascocarp that is elongate and narrow, branched or not, rather than disk-like.

**lobate:** Having lobes.

**lobe:** A flattened branch or projection. Measure lobe width away from branch points, and away from lobe tips.

**locule:** Individual cells or cavities in septate fungal spores.

**lobulate:** Bearing lobules.

- lobule**: Tiny lobe-like, usually dorsiventral, asexual reproductive structures.
- lumen (lumina)**: The interior of a cell, contained by the cell wall.
- maculate**: Having small light-colored spots on the upper surface of a thallus, often caused by differences in the thickness of the cortex or clumping of algae beneath the cortex.
- marginal**: Situated on the margin of a lobe or apothecium or other structure.
- mazaedium**: A modification of the hymenium of ascomycetes whereby the asci quickly disintegrate, producing a loose powdery spore mass that is added to from below and sloughed off at the top.
- medulla**: The interior layer of most lichens, composed mainly of fungal hyphae.
- morph**: A form without any implied taxonomic rank.
- morphotype**: see morph.
- muriform**: Spores that have both internal crosswalls and longitudinal walls (= dictyospores).
- muscolous**: Growing on mosses.
- mycelium**: A mass or body of fungal hyphae.
- ocular chamber**: The "chambre oculare" in the ascus tip, consisting of a non-amyloid area embedded in the lower part of the tholus and above the spores, usually applied to bitunicate asci.
- orbicular**: Round.
- ostiole**: The pore or opening into a perithecium or pycnidium.
- palmately branched**: Several to many branches or lobes radiating from a single point.
- papilla(e)**: Minute, discrete, usually rounded bumps.
- paraphyses**: Sterile filaments (simple or branched) in the hymenium and usually surrounding the asci.
- paraplectenchyma**: A tissue type with compactly massed hyphae having  $\pm$  isodiametric lumina; essential the fungal equivalent of parenchyma. (Contrast with prosoplectenchyma)
- peltate**: Plate or shield-shaped and slightly raised, generally with a central stalk from the underside.
- peritheci(um)(a)**: A type of globose or flask-shaped ascocarp where the hymenium is completely enclosed by protective sterile tissue, except for a small opening at the tip, the ostiole.
- phialospore**: a type of conidia produced from a particular kind of conidiophore producing a basipetal succession of conidia that develop without an increase in length of the phialide (a cell developing the conidiogenous loci).
- photobiont**: The photosynthetic partner in a lichen, consisting of either green algae or cyanobacteria.
- podetia**: The upright, hollow stalk, that forms the secondary thallus in *Cladonia*-like lichens having a prostrate primary thallus and upright secondary thallus. (Actually an elongate apothecium in that the ascogonia are on the primary thallus.)
- polarilocular**: Septate spores in which the two locules (cells) are connected by a channel through a thick septum.
- proper margin**: (= proper exciple) The "excipulum proprium", a usually cup-shaped structure of just fungal tissues that surrounds the hymenium in an apothecium.
- prosoplectenchyma**: A tissue type with compactly massed hyphae with elongate lumina.
- pruina(ose)**: Superficial chemical deposits, usually whitish and usually formed from calcium oxalates, giving a frost-covered or floury appearance.
- pseudocyphellae**: A broad term referring to any differentiated breaks in the cortex of lichens but that lack specialized cells surrounding the opening: these may be round, irregular, angular, or a minuscule pore.
- pseudopodetia**: An upright generally solid stalk, similar in appearance to podetia, but the ascogonia arise on the stalk instead of giving rise to the stalk.
- punctiform**: Punctate; with small spots or hollows.
- pustular**: Usually applied to soredia that begin as a lump or small blister, then breaks down into (usually granular) soredia.
- pycnidi(um)(a)**: An asexual spore-producing structure of the fungus, usually embedded in the thallus and visible externally as a black dot, occasionally in a projecting bump from the thallus (as in *Cetraria*); anatomically a generally flask-shaped lined with conidiogenous cells and producing pycnospores (= pycnoconidia).
- pycnospores**: (= pycnoconidia, = pycniospores) Spores produced from pycnidia.
- reticulate**: A net-like pattern.
- rhizine(s)**: Root-like structures, mostly from the lower surface.
- rhizoid**: Root-like structures, similar in use to "rhizine" but sometimes applied to groups having a felty mass of root-like hairs that are often one or a few cells in diameter.
- saxicolous**: Growing on rock.
- scabrous**: (= scabrid) A roughened surface appearance.
- scale-like**: Of small flakes or squamules resembling fish scales.
- scurfy**: Minutely scaly.
- sessile**: Attached to a surface without a stalk but not immersed in the surface.
- sept(um)(a)**: A partitioning cell wall.
- siliceous**: Rocks with the primary anions being silica rather than carbonates. In practice, applied to rocks that are HCl- (no fizzing) in 6 M HCl.
- simple**: Unbranched; of spores, lacking septa.
- soralia**: The areas of a lichen where soredia are produced.
- soredia**: Asexual reproductive structures that are powdery to granular and not covered with a cortex, and contain both photobiont and mycobiont.
- spot tests**: Chemical tests for color reactions obtained by applying a liquid reagent to a lichen.
- squamul(e)(s)(ose)**: Small flakes or scales of lichen,

often rounded, ear-like, or lobed.

**squarrose**: Branching by many short perpendicular branches from a single main axis.

**stellate**: Star-shaped.

**steppe**: Semiarid shrublands or grasslands, usually with cold winters and hot summers and a continental climate.

**stratified**: Differentiated into layers; heteromerous.

**subhymenium**: The generative tissue below the hymenium and above the hypothecium, thus, sandwiched between the exciple and the hymenium. Sometimes applied more loosely as equivalent to the hypothecium.

**synnema**: a conidia-bearing structure formed by a ± compact group of erect ± fused conidiophores.

**terricolous**: Growing on the ground, including mineral soil, humus, litter, and organic sods.

**thalline margin**: (= thalline exciple, = excipulum thallinum) An apothecial margin similar in color and structure to the thallus and usually containing the photobiont.

**thalloconidia**: conidia arising from the surface of a thallus or prothallus; especially applied to the lower surface and rhizines of many *Umbilicaria* species that produce black powdery conidia.

**thallus**: The vegetative body of a lichen.

**tholus**: A structure in the tip of an ascus that fills the tip like a plug or dome and is usually amyloid (I+ blue).

**tomentose**: Faintly to distinctly felty or the surface with short, fine fuzz; having a tomentum.

**tomentum**: See tomentose.

**umbilicate**: Attached by a single holdfast, the umbilicus.

**unstratified**: Without separation of the photobiont and fungus into distinct layers; homoiomerous.

**veins**: Raised branching or anastomosing strands, applied to the lower surface of foliose lichens.

**verruca(e)(ose)**: Small bumps, warts, or projections.

**weft**: A loose filamentous mat.

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Including Mycobionts and Photobionts

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## ABBREVIATIONS

|          |                           |
|----------|---------------------------|
| BC       | British Columbia          |
| Cont Div | Continental Divide        |
| diam     | diameter                  |
| elev     | elevation(s)              |
| esp      | especially                |
| gen      | generally                 |
| occ      | occasional                |
| OP       | Olympic Peninsula         |
| RM       | Rocky Mountains           |
| µm       | micrometers               |
| Sask     | Saskatchewan              |
| w Cas    | west of the Cascade crest |
| <        | less than, fewer than     |
| >        | more than, longer than    |
| ±        | more or less              |

## SPOT TEST REAGENTS

|                  |   |
|------------------|---|
| C                | commercial chlorine bleach  |
| HNO <sub>3</sub> | 6 M aqueous solution  |
| I                | 0.25 g iodine in 100 ml aqueous<br>0.5% potassium iodide solution |
| K                | KOH, 10% aqueous solution   |
| KC               | treatment with K followed by C                                    |
| lw UV            | long wave ultraviolet light (366 nm)                              |
| P                | paraphenylenediamine (alcohol<br>solution)                        |
| sw UV            | short wave ultraviolet light                                      |
| UV               | ultraviolet light (long or short wave)                            |

## SPOT TEST COLORS

|   |        |
|---|--------|
| B | blue   |
| O | orange |
| R | red    |
| Y | yellow |